Technical Documentation

Hand-held Analyzer Types 2250, 2250-L and 2270

with Microphone Type 4189

Instruction Manual

English BE 1712 – 21

Brüel & Kjær

Hand-held Analyzer
Types 2250, 2250-L and 2270

with
Microphone Type 4189

Type 2250, from Hardware Version 1.1
Type 2250-L, from Hardware Version 2.0
Type 2270, from Hardware Version 3.0

Instruction Manual

BE 1712–21

February 2015

Safety Considerations

This apparatus has been designed and tested in accordance with IEC 61010 – 1 and EN 61010 – 1 *Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use*. This manual contains information and warnings which must be followed to ensure safe operation and to retain the apparatus in safe condition. Special note should be made of the following:

Safety Symbols

The apparatus will be marked with this symbol when it is important that you refer to the associated warning statements given in the manual.

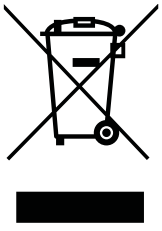
Protective Earth Terminal Hazardous Voltage

Explosion Hazard

The equipment is not designed to be used in potentially explosive environments. It should not be operated in the presence of flammable liquids or gases.

Warnings

- Switch off all power to equipment before connecting or disconnecting their digital interface. Failure to do so could damage the equipment.
- Whenever it is likely that the correct function or operating safety of the apparatus has been impaired, it must be made inoperative and be secured against unintended operation.
- Any adjustment, maintenance and repair of the open apparatus under voltage must be avoided as far as possible and, if unavoidable, must be carried out only by trained service personnel.



- Do not dispose of electronic equipment or batteries as unsorted municipal waste
- It is your responsibility to contribute to a clean and healthy environment by using the appropriate local return and collection systems
- Hazardous substances in electronic equipment or batteries may have detrimental effects on the environment and human health
- The symbol shown to the left indicates that separate collection systems must be used for any discarded equipment or batteries marked with that symbol
- Waste electrical and electronic equipment or batteries may be returned to your local Brüel & Kjær representative or to Brüel & Kjær Headquarters for disposal

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Table of Contents

Chapter 1

Introduction

1.1 About This Manual

Instruction Manual for Hand-held Analyzer Types 2250, 2250-L and 2270, together with the user manuals, has been created to fulfil the documentation requirements of the National and International Standards that the hand-held analyzers conform to. These standards are listed in section 4.2.

The user manuals provide all information necessary for operating Hand-held Analyzer Types 2250, 2250-L and 2270 and general advice on proper measurement practices.

This manual provides the remainder of the required documentation, including the full specifications required for conformance testing of the products when the hand-held analyzer is configured with Microphone Type 4189. For other microphone configurations, there are a number of supplements to this manual that give the relevant information for those configurations.

The specifications in this manual and the supplements cover Hand-held Analyzer Types 2250, 2250-L and 2270 and all the software modules that have sound level meter- or octave-based frequency analysis capabilities. The specific subset of specifications for a given hand-held analyzer configured with a given microphone and software configuration can be found from the descriptions in the user manuals. Not all possible configurations are supported.

The relevant user manuals are:

- BE 1713: *Hand-held Analyzer Types 2250 and 2270*
- BE 1766: *2250 Light*
- BE 1799: *Building Acoustics Software BZ-7228*

The user manuals also contain a summation of the most relevant technical specifications needed for the use of the instrument. In the event of any unintended inconsistency between the user manuals and the instruction manual, the instruction manual takes precedence.

Appendix B of this manual provides cross-references between specific paragraphs in the standards that require topics to be documented and the corresponding sections in this manual and the user manuals that conform to them.

1.2 System Overview

1.2.1 Analyzers

This manual covers:

- Hand-held Analyzer Type 2250: A single-channel general-purpose hand-held analyzer
- Hand-held Analyzer Type 2250-L, also called 2250 Light: A low-cost single-channel general-purpose hand-held analyzer
- Hand-held Analyzer Type 2270: A dual-channel high-end hand-held analyzer

Types 2250 and 2250-L can, with the appropriate software modules, be used as a single-channel, single-range sound level meter and frequency analyzer. The self-generated noise and level range specifications are found in Chapter 4's figures the tables under **Single range**.

Type 2270 hardware can be utilised in two ways:

1) As a single-channel, single-range sound level meter and frequency analyzer like Types 2250 and 2250-L. In this case only a single channel can be measured at a time. The input is selectable between the two physical channels in the user interface and the full level measuring range is covered in a single range without a level range control. In the specifications this range is called **Single range**.

2) As a dual-channel, multi-range sound level meter and frequency analyzer. In this case both channels can be measured simultaneously. The full level measuring range is covered in two ranges with a level range control. In the specifications theses ranges are called **High range** for the least sensitive range, and **Low range** for the most sensitive range.

Information on how the individual software modules use the hardware, the selection of the input for single-channel measurements and the use of the level range control for dual-channel measurements can be found in the user manuals.

1.2.2 Software Modules

The hand-held analyzers are based on a unique platform concept that allows the user to choose different combinations of software applications and options. These applications and options can be purchased when needed and are delivered as easily installed licenses that open the relevant parts of the embedded software in the analyzer. Depending on the hand-held analyzer (Type 2250, 2250-L or 2270), different combinations of applications and options can be chosen.

All software modules that have sound level meter- or octave-based frequency analysis capability are based on the same basic sound level meter and frequency analyzer. The only differences are the number of measured quantities and the frequency range made available to the user. The specific subsets available in the individual software modules can be found in the user manuals.

Hardware and Software on the Analyzer

The *About* screen lists the hardware and software versions currently installed (click ? in the Shortcut Bar at the bottom of the display screen, and select *About*).

1.2.3 Basic PC Software

Measurement Partner Suite BZ-5503 can be used for transferring basic measurement results and setups between the analyzer and a standard PC. It is also used for maintaining the embedded software in the hand-held analyzers.

Measurement Partner Suite is included on Environmental Software DVD BZ-5298.

For instructions on this software, see the software's online help.

1.2.4 Hardware Setup

This section provides an overview of the hardware components used with the analyzers.

A hardware overview is provided in Fig. 1.1, optional accessories are designated on the diagram.

The components needed for conformance testing Hand-held Analyzer Types 2250, 2250-L and 2270 are listed in Table 1.1.

For some of the components in Table 1.1 the analyzers also conform to the standards listed in section 4.2 when using the following alternative components:

- As an alternative to Windscreen UA-1650, Windscreen UA-0237 can be used: It has the same acoustical behaviour but has no auto detection capability

- As an alternative to Microphone Extension Cable AO-0697-D-100, Microphone Extension Cable AO-0441-D-100 can be used: It is the same cable but the plugs are physically shorter
- As an alternative to Mains Power Supply ZG-0426, the analyzer's power can be supplied by Mains Power Supply ZG-0429, Utility Unit ZH-0689 or Power Panel ZH-0685 with Charger ZG-0857. If Utility Unit ZH-0689 is used, Fig. 1.2 and Table 1.2 show the additional components and their connections. If Power Panel ZH-0685 is used, Fig. 1.3 and Table 1.3 show the additional components and their connections. In both cases the microphone preamplifier can only be connected to the analyzer through a microphone extension cable.

For detailed information on the Outdoor Microphone Kit UA-1404 consult User Manual BE 1077.

Fig. 1.1
Hardware overview

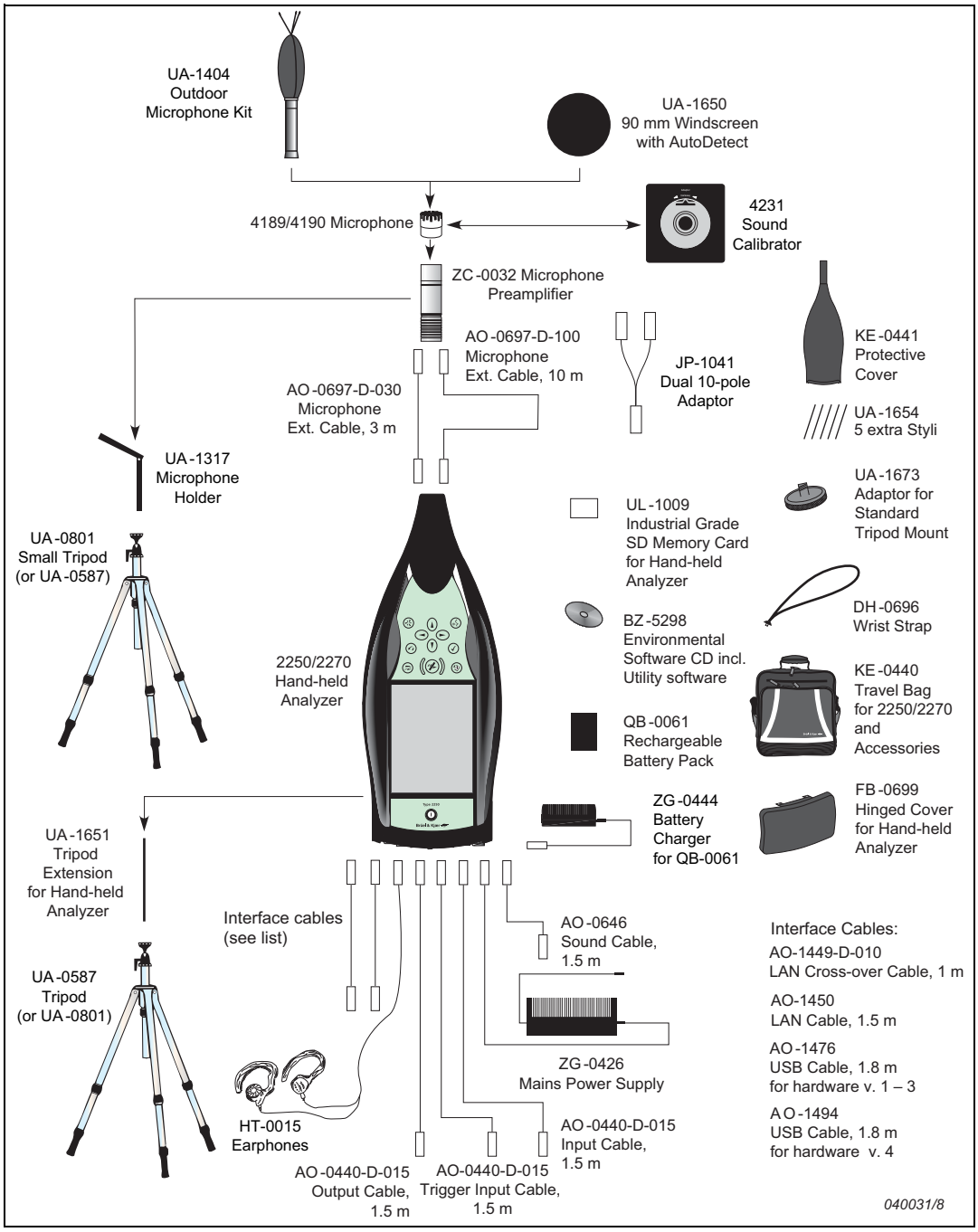


Table 1.1
Hardware components needed for conformance testing of Hand-held Analyzer Type 2250, 2250-L or 2270

Quantity*	Brüel & Kjær Type/Part Number	Description
1 or 2	Type 4189	Prepolarized Free-field ½″ Condenser Microphone
1 or 2	ZC-0032	Microphone Preamplifier
1 or 2	WA-0302-B	Electrical Substitute for Microphone Type 4189, 15 pF
1 or 2	UA-0245	10-32 UNF to BNC Adaptor
1	UA-1650	90 mm dia. Windscreen with AutoDetect
1	UA-1651	Tripod Extension for Hand-held Analyzer
1	UA-1404	Outdoor Microphone Kit
1	UA-1317	Microphone Holder
1 or 2	AO-0697-D-100	Microphone Extension Cable, Screened, 10-pin LEMO, 10 m
1	JP-1041	Dual 10-pole Adaptor, Screened, 10-pin LEMO
0 to 4	AO-0440-D-015	Signal Cable, Screened, Triaxial LEMO to BNC, 1.5 m
1	AO-1476†	USB A to Mini-B Interface Cable, Screened, 1.8 m
1	AO-1494‡	USB Micro-B to A Interface Cable, Screened, 1.8 m
1	AO-0708‡	USB A to B Interface Cable, Screened, 1.8 m
1	AO-1449-D-010	LAN Interface Cable, Crossover, Screened, 1.0 m
1	AO-1450	LAN Interface Cable, Screened, 1.5 m
1	HT-0015	Earphones, Unscreened Cable
1	ZG-0426	Mains Power Supply, 12 V DC, Screened Cable
1	QB-0061	Rechargeable Battery Pack
1 or 2	UL-1009	Industrial Grade SD Memory Card for Hand-held Analyzers
1	Type 4231	Sound Calibrator
1	Type 4226	Multifunction Acoustic Calibrator

*. Quantity depends on the hand-held analyzer to be tested.
†. Before hardware version 4.0.
‡. From hardware version 4.0.

Fig. 1.2
Additional hardware overview for 'Normal Mode of Operation' when Utility Unit ZH-0689 is used as an alternative to Mains Power Supply ZG-0426

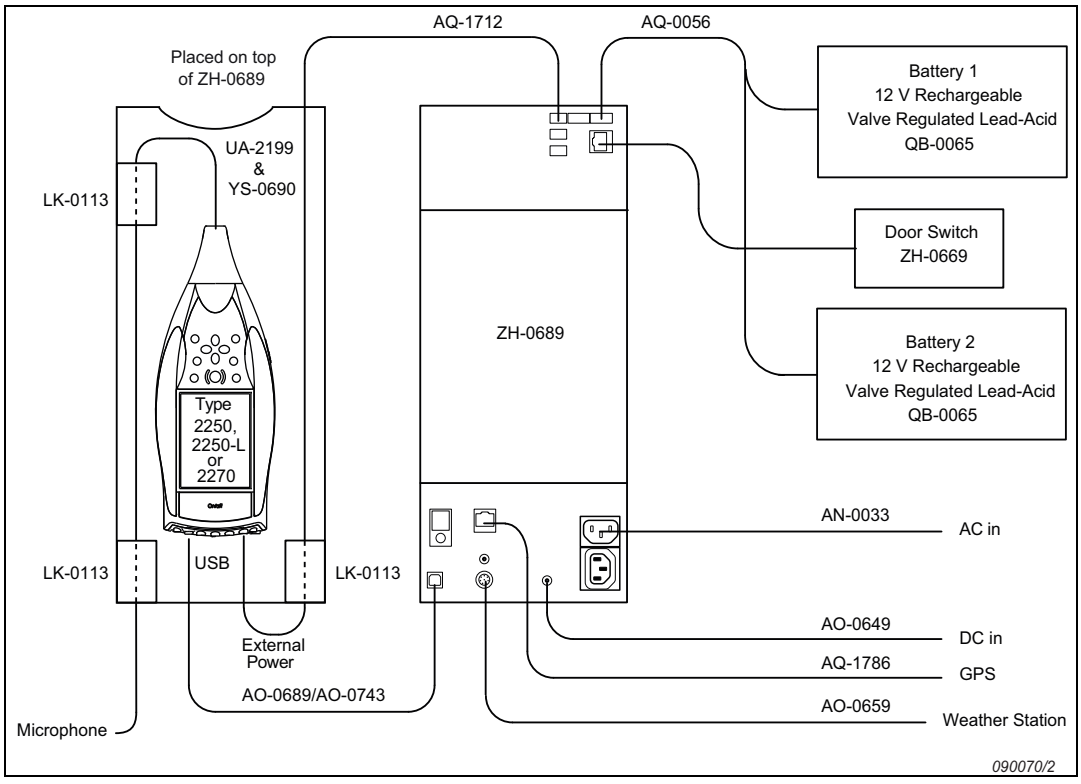


Table 1.2
Additional Hardware components needed for 'Normal Mode of Operation' when Utility Unit ZH-0689 is used as an alternative to Mains Power Supply ZG-0426

Quantity	Brüel & Kjær Type/Part Number	Description
1	ZH-0689	Utility Unit
1	UA-2199	Mounting Bracket Assembly for SLM Type 2250 in NMT
3	LK-0013	EMC ferrite core, snap-on box
1	YS-0690	Screw for mounting Type 2250 onto UA-2199
1 or 2	QB-0065	12 V Rechargeable Valve Regulated Lead-Acid Battery assembly, with cable AO-0656
1	ZH-0669	Door Switch and Charge Control with Cable, 0.9 m
1	AQ-1712	Cable, LEMO-coax to PHOENIX 2-pin, Screened, 0.55 m
1	AO-0689*	USB Mini-A to B Interface Cable, Screened, 0.35 m
1	AO-0743†	USB A to B Interface Cable, Screened, 0.2 m
1	AQ-0056	Multi-Power Cable, 0.7 m
1	AN-0033	Mains Power Cable, 2 m
1	AO-0649	DC Power Cable, LEMO to 2 x Faston 6.3 x 0.8 mm, Fused, Screened, 2.0 m
1	AQ-1786	GPS Cable, Screened, 2 m‡
1	AO-0659	Weather Station Cable M-2 8-pin to LEMO 8-pin, Screened, 10 m‡

*. Before hardware version 4.0.
†. From hardware version 4.0.
‡. According to IEC 6100043 only 1 m of these cables should be exposed to the electromagnetic field during tests.

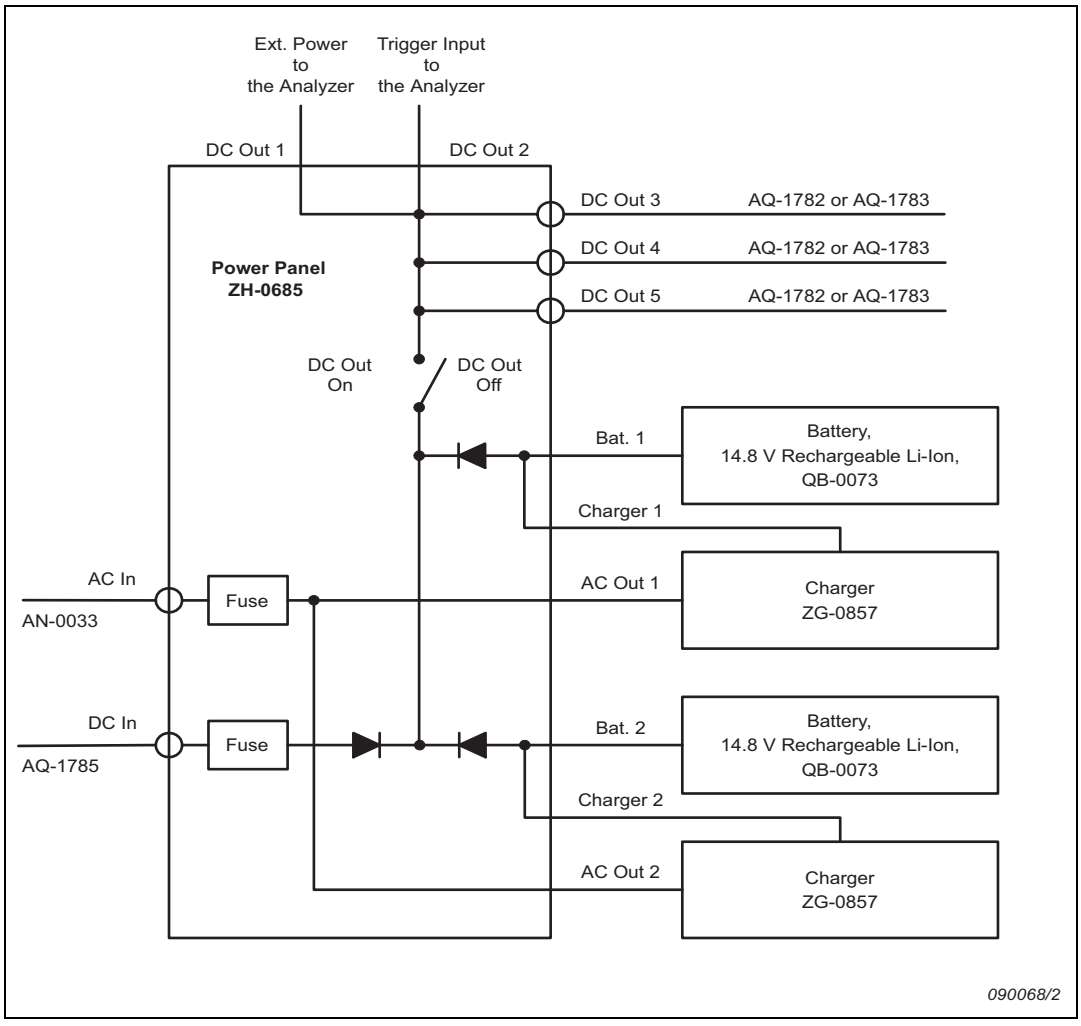


Fig.1.3
Additional Hardware Overview for 'Normal Mode of Operation' when Power Panel ZH-0685 is used as an alternative to Mains Power Supply ZG-0426

Table 1.3
Additional hardware components needed for 'Normal Mode of Operation' when Power Panel ZH-0685 is used as an alternative to Mains Power Supply ZG-0426

Quantity	Brüel & Kjær Type/Part Number	Description
1	ZH-0685	Power Panel
1 or 2	ZG-0857	Charger for 14.8 V Li-Ion Battery
1	QB-0073	Rechargeable Li-Ion Battery, 14.8 V
1	AN-0033	Mains Power Cable, 2 m
1	AQ-1785	DC Power Cable, Alligator clips to Ø 6 mm / Ø 1.3 mm Male Jack, 1.3 m
0–3	AQ-1782	DC Power Cable, Ø 4.5 mm / Ø 2.5 mm Female Jack to Ø 4.5 mm / Ø 2.1 mm Female Jack, 0.6 m
0–3	AQ-1783	DC Power Cable, Ø 4.5 mm / Ø 2.5 mm Female Jack to 4-pin Female Socket, Fused, 0.6 m

1.2.5 Block Diagrams

The Block Diagram for Hand-held Analyzers Type 2250 (Type 2250-L is a subset ot Type 2250) and Type 2270 are shown in Fig. 1.4 through Fig. 1.7.

Fig. 1.4
Block Diagram for Type 2250 before hardware version 4.0

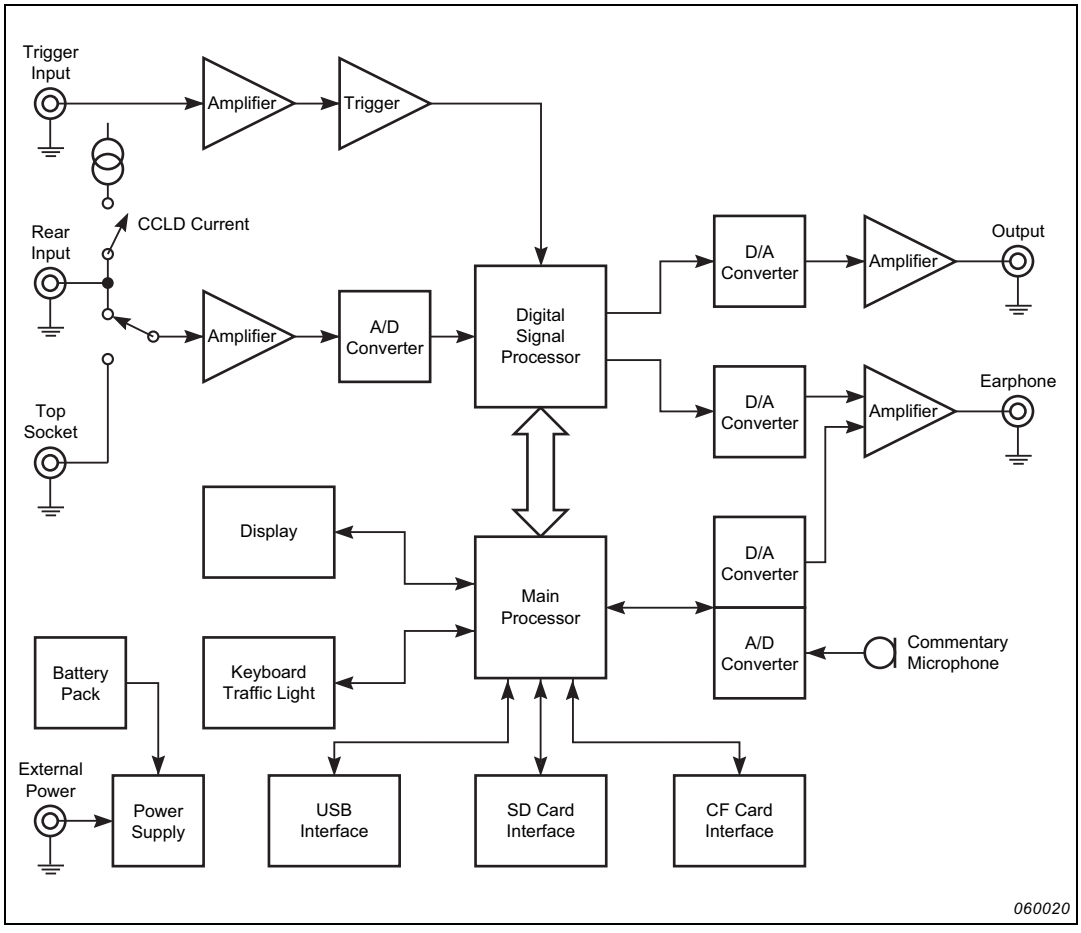
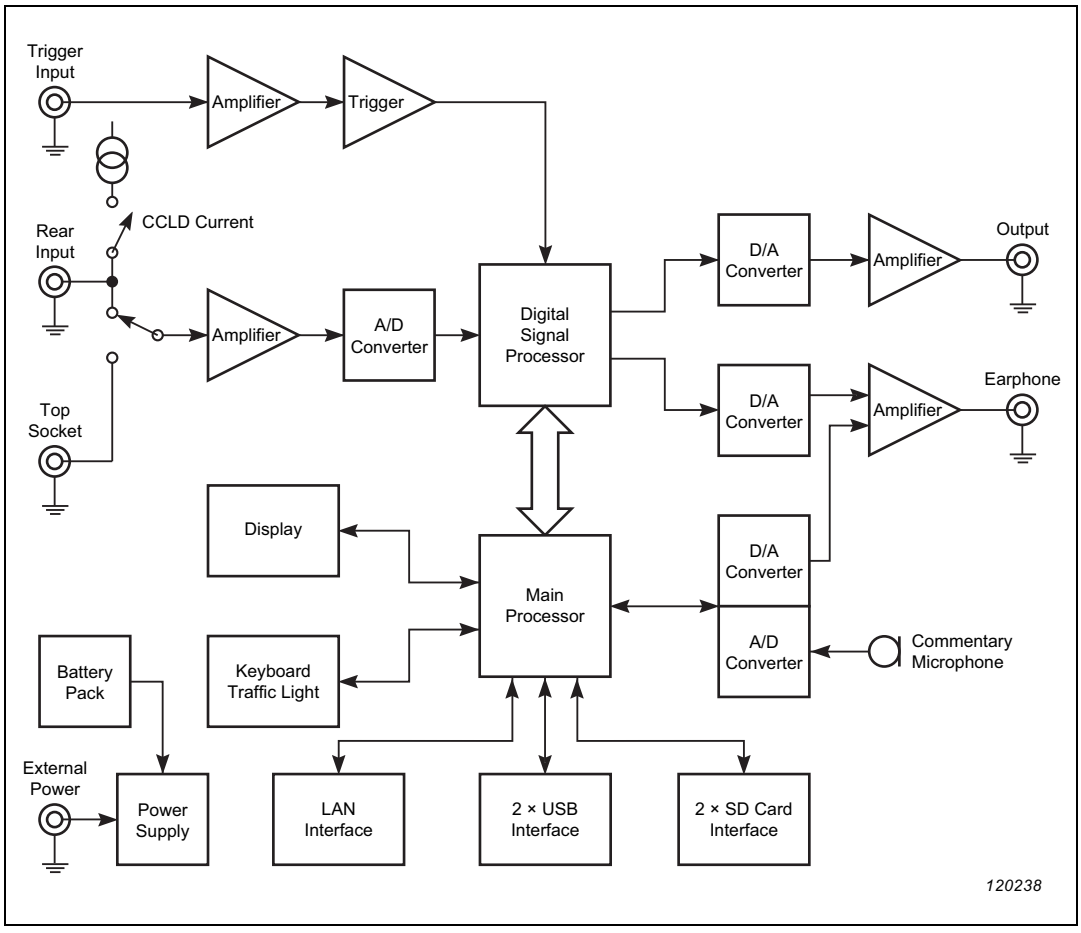


Fig.1.5
Block Diagram for Type 2250 from hardware version 4.0



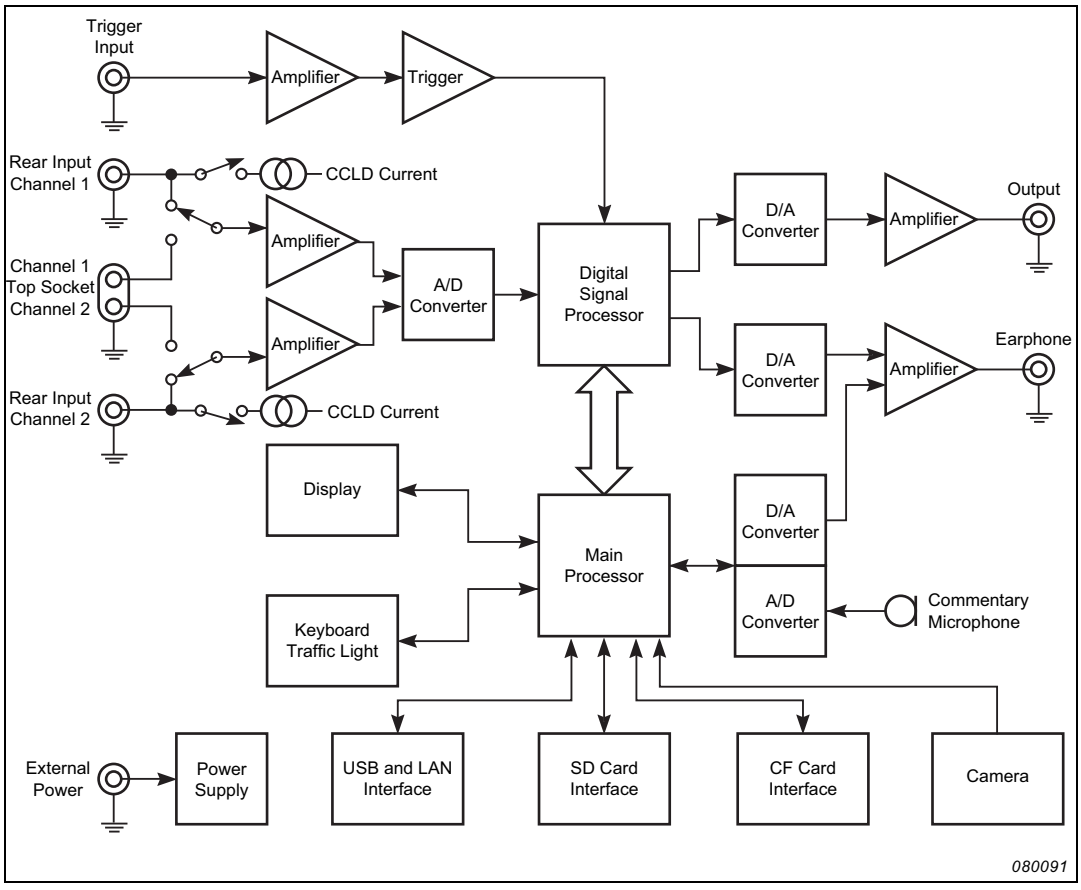


Fig. 1.6
Block Diagram for Type 2270 before hardware version 4.0

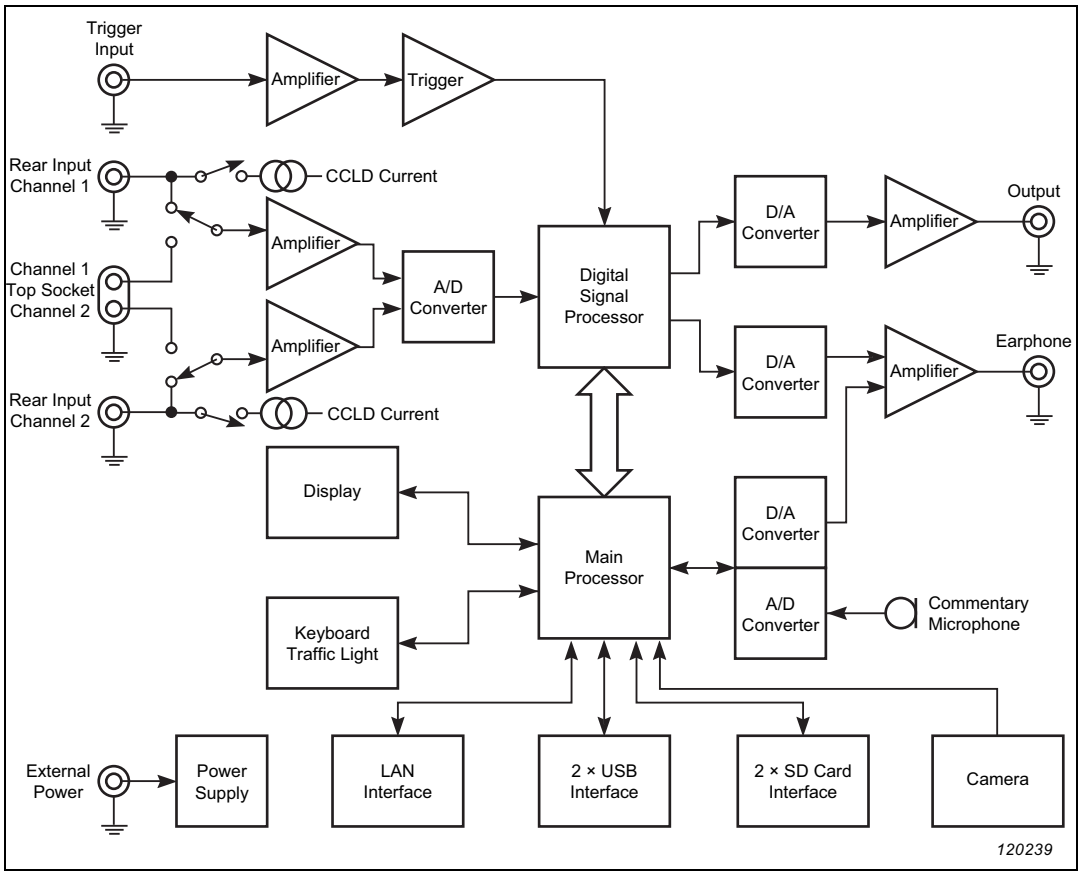


Fig.1.7
Block Diagram for Type 2270 from hardware version 4.0

Chapter 2

Information Required by the Standards

2.1 Introduction

This chapter contains the detailed information required by the standards to be described in the Instruction Manual.

2.2 Mounting and Placing the Microphone

The microphone and preamplifier assembly can either be mounted directly onto the analyzer or connected via a microphone extension cable.

- When mounting the microphone and preamplifier assembly directly onto the analyzer, it is recommended to place the analyzer on Tripod UA-0587. Use the Tripod Extension for Hand-held Analyzer UA-1651 screwed into the Tripod Mounting Thread situated on the underside of the analyzer, at the back
- When using a microphone extension cable it is recommended to mount the microphone and preamplifier assembly in Microphone Holder UA-1317 and then attach this to one of the tripods UA-0587 or UA-0801

When two microphones are needed for Type 2270, the Dual, 10-pole Adaptor (JP-1041) and two microphone extension cables can be used.

The microphone must be placed away from shielding, reflecting, or absorbing objects. In a diffuse sound field, absorbing objects will reduce the measured sound levels. In a free sound field, reflecting objects can change the measured sound levels. Typically, the sound level 0.5 m from a plain reflecting wall is 3 dB higher than if there was no wall.

The operator of the system may be personally shielding, absorbing, and reflecting, and the operator can also be an additional noise source.

The optimum position for the microphone is best found by trying different positions and observing the resulting sound levels.

2.3 Mounting the Analyzer on a Tripod

In order to minimise the influence of a tripod on measurements, the analyzer must be mounted on Small Tripod UA-0801, or Tripod UA-0587, with Tripod Extension for Hand-held Analyzer UA-1651, as described in Chapter 2 of User Manual BE 1713 for Type 2250/2270 and User Manual BE 1766 for Type 2250-L. The column of the tripod must be extended as much as possible above the base of the tripod. For all practical purposes, the analyzer fulfils the requirements of IEC 61672–1 in this configuration, with or without Windscreen UA-1650 fitted. However, tripod mounting still presents some major difficulties in the measurement of acoustical characteristics of sound level meters and it is, therefore, normally beyond the scope of Type approval for sound level meters.

2.4 Calibration

The procedures for calibrating the analyzers can be found in User Manual BE 1713 for Type 2250/2270 and User Manual BE 1766 for Type 2250-L.

The calibration procedure, which is necessary for the electrical tests during conformance testing, can be found in Section 3.5.

While performing the calibration procedures, the analyzer is automatically checked for its ability to perform the measurements.

For acoustic calibration, a Sound Level Calibrator with a calibration frequency of 1 kHz and a calibration level of approximately 94 dB is needed. It has to conform to the class 1 specifications of the International Standard IEC 60942, Electroacoustics – Sound Calibrators.

It is strongly recommended that Brüel & Kjær Sound Calibrator Type 4231 is used.

2.5 Accessories and Sound Fields

The acoustical frequency response and calibration depends on the sound field, the microphone, the microphone accessories used and the electrical frequency response. To improve the quality of the measurement and help the user to measure correctly the analyzer compensates for the sound field, the microphone and the microphone accessories used by automatically changing the electrical frequency response and calibration.

This means that a calibration of a microphone is valid for both free field and diffuse field and for all the recommended accessories.

This also means that it is very important that parameters on the *Setup* screen reflects the desired configuration. The important parameters are:

- *Setup* screen: *Input* parameters: *Input*, *Transd. Used*, *Sound Field Correction*, *Windscreen Auto Detect* and *Windscreen Correction*
- *Setup* screen: *Frequency Settings* parameters: *Low Frequency Option, Low Frequency, Broadband (excl. Peak)*, *Broadband Peak* and *Spectrum*

2.6 Measuring Low-level Sounds

If the measured sound level is within the Linear Operating Range or, for C-weighted peak sound levels, within the Peak C Range given in the specifications (see Section 4.9.7 and Section 4.9.8), then the self-generated noise and level linearity problems can be ignored.

It is possible to correct the measured sound levels, except peak levels, for the typical self-generated noise, found in the specifications, see Section 4.8.2. The correction for self-generated noise can be made by subtracting self-generated noise, L_{inh}, from the total sound level, L_{tot}, using the following equation:

$$L_{res} = 10 \lg(10^{L_{tot}/10} - 10^{L_{inh}/10})$$

If $L_{tot} - L_{inh}$ is less than 3 dB, the sound level is too low to be compensated.

Fig. 2.1
Error from self-generated noise

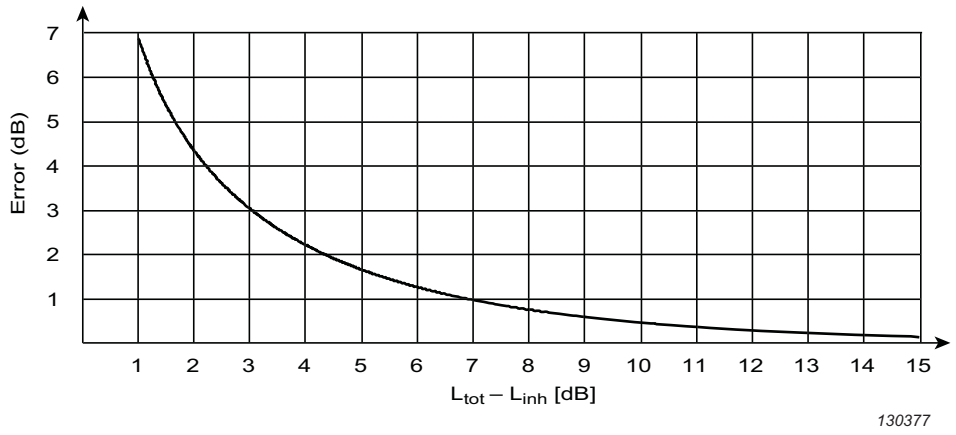


Fig. 2.1 shows the error on the measured sound levels from the presence of self-generated noise. The curve can also be used for compensation by subtracting the error from the measured sound levels. This is equivalent to using the formula.

2.7 Measuring at Low Static Pressure

The frequency response of the microphone depends on the static pressure. Using a sound level calibrator to adjust the sensitivity of a sound level meter at the calibration check frequency provides no information on the influence of static pressure on frequency response. Conformance to the specified standards ensures that the system measures within the standard's tolerances, in the range from 85 kPa to 108 kPa. Data for the frequency response as a function of static pressure for the microphone can be found in the Microphone Handbook BA 5105.

At the calibration check frequency, both the microphones and the recommended Brüel & Kjær Sound Calibrator Type 4231 are rather insensitive to variations in the static pressure – for Sound Calibrator Type 4231, below 0.001 dB/kPa.

2.8 Frequency Weightings

Both broadband and spectrum measurements can be frequency weighted with A-, B-, C- or Z-weighting.

The A- and C-weightings conform to the requirements in IEC 61672–1 and IEC 60651. The B-weighting is not defined in IEC 61672–1, but conforms to the requirements in IEC 60651.

The Z-weighting (Zero frequency weighting) is a linear, unweighted frequency weighting. It conforms to the Z-weighting defined in IEC 61672–1 and the Lin response defined in IEC 60651.

Table 2.1 states the design goal frequency responses for the frequency weightings. They are stated for the complete instrument including the microphone. The corresponding tolerance limits can be found in the standards.

Table 2.1
Frequency weighting design goals

Nominal Frequency (Hz)	Exact Frequency (6 digits) (Hz)	Frequency Weightings (1 decimal) (dB)			
		A	B	C	Z
10	10	–70.4	–38.2	–14.3	0.0
12.5	12.5893	–63.4	–33.2	–11.2	0.0
16	15.8489	–56.7	–28.5	–8.5	0.0
20	19.9526	–50.5	–24.2	–6.2	0.0
25	25.1189	–44.7	–20.4	–4.4	0.0
31.5	31.6228	–39.4	–17.1	–3.0	0.0
40	39.8107	–34.6	–14.2	–2.0	0.0
50	50.1187	–30.2	–11.6	–1.3	0.0
63	63.0957	–26.2	–9.3	–0.8	0.0
80	79.4328	–22.5	–7.4	–0.5	0.0
100	100	–19.1	–5.5	–0.3	0.0
125	125.893	–16.1	–4.2	–0.2	0.0
160	158.489	–13.4	–3.0	–0.1	0.0
200	199.526	–10.9	–2.0	0.0	0.0
250	251.189	–8.6	–1.3	0.0	0.0
315	316.228	–6.6	–0.8	0.0	0.0
400	398.107	–4.8	–0.5	0.0	0.0
500	501.187	–3.2	–0.3	0.0	0.0
630	630.957	–1.9	–0.1	0.0	0.0
800	794.328	–0.8	–0.0	0.0	0.0
1000	1000	0.0	0.0	0.0	0.0
1250	1258.93	+0.6	–0.0	0.0	0.0
1600	1584.89	+1.0	–0.0	–0.1	0.0
2000	1995.26	+1.2	–0.1	–0.2	0.0
2500	2511.89	+1.3	–0.2	–0.3	0.0
3150	3162.28	+1.2	–0.4	–0.5	0.0
4000	3981.07	+1.0	–0.7	–0.8	0.0
5000	5011.87	+0.5	–1.2	–1.3	0.0
6300	6309.57	–0.1	–1.9	–2.0	0.0
8000	7943.28	–1.1	–2.9	–3.0	0.0
10000	10000	–2.5	–4.3	–4.4	0.0
12500	12589.3	–4.3	–6.1	–6.2	0.0
16000	15848.9	–6.6	–8.4	–8.5	0.0
20000	19952.6	–9.3	–11.1	–11.2	0.0

2.9 Measured Quantities

This section gives a precise mathematical definition of the measured quantities and defines the abbreviations used on the display.

2.9.1 Instantaneous Broadband Measurements

These measurements are done continuously, independent of measurement **Start, Pause** and **Stop**. They cannot be saved and are only displayed.

Overload

For Instantaneous Measurements, the *Overload* indication is displayed as long as the overload condition exists, or for 1 s, whichever is the greater.

Overload is indicated as *Overload* on the screen and by a flashing red "traffic light" indicator.

Overload is common to all results of Instantaneous Measurements.

Under-range

The *Underrange* indication is displayed as long as the under-range condition exists, or for 1 s, whichever is the greater.

The Underrange condition is present if any measurement of time-weighted sound level, time average sound level, or sound exposure level is less than the specified lower limit of a linear operating range.

Time-weighted Sound Level, F and S Time-weighted

The time-weighted sound level, $L_{xy}(t)$, is defined as twenty times the logarithm to the base ten of the ratio of a given root-mean-square sound pressure to the reference sound pressure, root-mean-square sound pressure being obtained with a frequency weighting, *x*, and standard time weighting, *y*, where:

- *x* is A for A-weighted, B for B-weighted, C for C-weighted or Z for Z-weighted
- *y* is F for Fast-weighted or S for Slow-weighted

The time-weighted sound level is a continuous function of time and is expressed in decibels (dB). $L_{xy}(t)$ is not displayed, but is the base for $L_{xy}(T_n)$, $L_{xy}(\mathrm{SPL})(T_n)$, $L_{xymax}(T)$ and $L_{xymin}(T)$.

In symbols, frequency-weighted and time-weighted sound level, $L_{xy}(t)$, at any instant of time, *t*, is represented by:

$$L_{xy}(t) = 20 \lg \left[\sqrt{(1/\tau) \int_{-\infty}^{t} p_x^{\,2}(\xi) e^{-(t-\xi)/\tau} d\xi} \Big/ p_0 \right] \quad [\mathrm{dB}]$$

where:

- τ is the exponential time constant in seconds for time-weighting F or S
- ξ is a dummy variable of time integration from some time in the past, as indicated by $-\infty$ for the lower limit of the integral, to the time of observation *t*
- $p_x(\xi)$ is the *x* frequency-weighted instantaneous sound pressure
- p_0 is the reference sound pressure, equal to 20 µPa

The exponential time constants are stated in Table 2.2.

Table 2.2 *Exponential time constants and corresponding averaging times*

Time Weighting	Time Constant (seconds)	Averaging Time (seconds)
Fast	0.125	0.25
Slow	1	2

Time-weighted Sound Level, I Time-weighted

The I (Impulse) time-weighted sound level, $L_{xI}(t)$, is defined as ten times the logarithm to base ten of the ratio of a given mean-square sound pressure to the square of the reference sound pressure, p_0, followed by a peak detector with a decay time constant of 1500 ms. The mean-square sound pressure being obtained with a frequency weighting, *x*, and time weighting with a 35 ms time constant, where:

- *x* is A for A-weighted, B for B-weighted, C for C-weighted or Z for Z-weighted
- p_0 is the reference sound pressure, equal to 20 µPa

The I time-weighted sound level is a continuous function of time and is expressed in decibels (dB). $L_{xI}(t)$ is not displayed but is the base for $L_{xI}(T_n)$, $L_{xI}(\mathrm{SPL})(T_n)$, $L_{xImax}(T)$, $L_{xImin}(T)$ and $L_{xIm}(T)$.

Instantaneous Time-weighted Sound Level

The instantaneous time-weighted sound level, $L_{xy}(T_n)$, is defined as the time-weighted sound level, $L_{xy}(t)$, sampled at $t = T_n$ where:

- *x* is A for A-weighted, B for B-weighted, C for C-weighted or Z for Z-weighted
- *y* is F for Fast-weighted, S for Slow-weighted or I for Impulse-weighted
- $T_n = t_0 + n \cdot \Delta t$
- t_0 is some starting time
- *n* is an incrementing integer
- Δt is the display update interval

The instantaneous time-weighted sound level is, in other words, updated every Δt second and is expressed in decibels (dB).

The symbols used by the analyzer for instantaneous time-weighted sound levels are (for A, B, C and Z frequency weighting and F, S and I time weighting):

L_{AF}, L_{AS}, L_{AI}, L_{BF}, L_{BS}, L_{BI}, L_{CF}, L_{CS}, L_{CI}, L_{ZF}, L_{ZS}, L_{ZI}.

Sound Pressure Level (SPL)

The sound pressure level, $L_{xy}(\mathrm{SPL})(T_n)$, is defined as the greatest time-weighted sound level, $L_{xy}(t)$, within a time interval starting at $t = T_n$ and ending at $t = T_n + \Delta t$ where:

- *x* is A for A-weighted, B for B-weighted, C for C-weighted or Z for Z-weighted
- *y* is F for Fast-weighted, S for Slow-weighted or I for Impulse-weighted
- $T_n = t_0 + n \cdot \Delta t$
- t_0 is some starting time
- *n* is an incrementing integer
- Δt is the display update interval, equal to 1 second

The sound pressure level is, in other words, updated every 1 second and is expressed in decibels (dB).

The symbols used by the analyzer for sound pressure levels are (for A, B, C and Z frequency weighting and F, S and I time weighting):

$L_{AF}(SPL)$, $L_{AS}(SPL)$, $L_{AI}(SPL)$, $L_{BF}(SPL)$, $L_{BS}(SPL)$, $L_{BI}(SPL)$, $L_{CF}(SPL)$, $L_{CS}(SPL)$, $L_{CI}(SPL)$, $L_{ZF}(SPL)$, $L_{ZS}(SPL)$, $L_{ZI}(SPL)$

Taktmaximalpegel

The Taktmaximalpegel, $L_{AFT}(T_n)$, is defined as the greatest time-weighted sound level, $L_{AF}(t)$, within a time interval starting at $t = T_n$ and ending at $t = T_n + \Delta t$ where:

- $T_n = t_0 + n \cdot \Delta t$
- t_0 is some starting time
- *n* is an incrementing integer

- Δt is the update interval (Taktzeit), equal to 5 seconds

The Taktmaximalpegel is, in other words, updated every 5 seconds and is expressed in decibels (dB).

The Taktmaximalpegel is not displayed by the analyzer. It is only used for the calculation of Taktmaximal-Mittelungspegel.

2.9.2 Timed Broadband Measurements

These measurements are only executed when Start is activated and are paused when **Pause** is activated or when *Preset Time* has expired, whichever occurs first. The time interval between start and pause is the *Elapsed Time*. During the measurement time interval, intermediate results are displayed as if the measurements were paused at the time of display. When the measurements are paused, the set of results, including Latched *Overload* and *Overload %*, are stored under Current Measurement and this is held until either **Reset** is activated or a new set of measurements are started. The Current Measurement (if any) is displayed and can be saved, together with setup and calibration information, to a project.

At the start of a timed measurement all time-weighted sound levels are reset to zero ($-\infty$ dB). From this, they increase to their current values. The timed measurements derived from time-weighted sound levels (e.g., Minimum Time-weighted Sound Level, Maximum Time-weighted Sound Level, Equivalent Continuous I-weighted Sound Level, Taktmaximal-Mittelungspegel, and Statistics) are fist valid after this has settled. Therefore, the first value is measured and displayed after a delay from the start of the measurement depending on the present exponential averaging time. Measurement of Overload Percentage, Equivalent Continuous Sound Level, Sound Exposure Level, and Peak Sound Level starts without delay.

Latched Overload

For the timed measurements, a latched *Overload* indication is displayed and included in the set of results if the overload condition exists at any time during the measurement time interval. The latched *Overload* is indicated by a red triangle on the screen. The latched *Overload* is common to all the results of the timed measurements.

Overload Percentage

The Overload Percentage, *Overload %*, is defined as the percentage of time within a time interval starting at $t = T$ and ending at $t = T + \Delta t$ where the overload condition exists, where:

- T is the start time of the measurement, indicated as *Start Time*
- Δt is the measuring period, indicated as *Elapsed Time*

The symbol used by the analyzer for Overload Percentage is: *Overload*

Minimum Time-weighted Sound Level

The minimum time-weighted sound level, $L_{xymin}(T)$, is defined as the smallest time-weighted sound level, $L_{xy}(t)$, within a time interval starting at $t = T$ and ending at $t = T + \Delta t$ where:

- x is A for A-weighted, B for B-weighted, C for C-weighted or Z for Z-weighted
- y is F for Fast-weighted, S for Slow-weighted or I for Impulse-weighted
- T is the start time of the measurement, indicated as *Start Time*
- Δt is the measuring period, indicated as *Elapsed Time*

The minimum time-weighted sound level is expressed in decibels (dB).

The symbols used by the analyzer for maximum time-weighted sound levels are (for A, B, C and Z frequency weighting and F, S and I time weighting):

L_{AFmin}, L_{ASmin}, L_{AImin}, L_{BFmin}, L_{BSmin}, L_{BImin}, L_{CFmin}, L_{CSmin}, L_{CImin}, L_{ZFmin}, L_{ZSmin}, L_{ZImin}

Maximum Time-weighted Sound Level

The maximum time-weighted sound level, $L_{xymax}(T)$, is defined as the greatest time-weighted sound level, $L_{xy}(t)$, within a time interval starting at $t = T$ and ending at $t = T + \Delta t$ where:

- x is A for A-weighted, B for B-weighted, C for C-weighted or Z for Z-weighted
- y is F for Fast-weighted, S for Slow-weighted or I for Impulse-weighted
- T is the start time of the measurement, indicated as *Start Time*
- Δt is the measuring period, indicated as *Elapsed Time*

The maximum time-weighted sound level is expressed in decibels (dB).

The symbols used by the analyzer for maximum time-weighted sound levels are (for A, B, C and Z frequency weighting and F, S and I time weighting):

L_{AFmax}, L_{ASmax}, L_{AImax}, L_{BFmax}, L_{BSmax}, L_{BImax}, L_{CFmax}, L_{CSmax}, L_{CImax}, L_{ZFmax}, L_{ZSmax}, L_{ZImax}

Equivalent Continuous Sound Level

The equivalent continuous sound level (also called time-average sound level), $L_{xeq}(T)$, is defined as twenty times the logarithm to base ten of the ratio of a root-mean-square sound pressure during a time interval to the reference sound pressure, sound pressure being obtained with a frequency weighting, x. The time interval is starting at $t = T$ and ending at $t = T + \Delta t$ where:

- x is A for A-weighted, B for B-weighted, C for C-weighted or Z for Z-weighted
- T is the start time of the measurement, indicated as *Start Time*
- Δt is the averaging time interval, indicated as *Elapsed Time*

The equivalent continuous sound level is expressed in decibels (dB).

In symbols, equivalent continuous sound level, $L_{xeq}(T)$, is given by:

$$L_{xeq}(T) = 20 \lg \left[\sqrt{(1/\Delta t) \int_{T}^{T+\Delta t} p_x^{\,2}(\xi) d\xi} \Big/ p_0 \right] \quad [\text{dB}]$$

where:

- ξ is a dummy variable of time integration over the averaging time interval
- $p_x(\xi)$ is the x frequency-weighted instantaneous sound pressure
- p_0 is the reference sound pressure, equal to 20 µPa

The symbols used by the analyzer for equivalent continuous sound levels are (for A, B, C and Z frequency weighting):

L_{Aeq}, L_{Beq}, L_{Ceq}, L_{Zeq}

Equivalent Continuous I-weighted Sound Level

The equivalent continuous I-weighted sound level (also called average I-weighted sound level), $L_{xIeq}(T)$, is defined as ten times the logarithm to base ten of the mean of ten to the power of the I time-weighted sound level, $L_{xI}(t)$, divided by ten during a time interval. The time interval is starting at $t = T$ and ending at $t = T + \Delta t$ where:

- x is A for A-weighted, B for B-weighted, C for C-weighted or Z for Z-weighted
- T is the start time of the measurement, indicated as *Start Time*
- Δt is the averaging time interval, indicated as *Elapsed Time*

The equivalent continuous I-weighted sound level is expressed in decibels (dB).

In symbols, equivalent continuous I-weighted sound level, $L_{xIeq}(T)$, is given by:

$$L_{xIeq}(T) = 10 \lg \left[(1/\Delta t) \int_{T}^{T+\Delta t} 10^{L_{xI}(\xi)/10} d\xi \right] \quad [\text{dB}]$$

where ξ is a dummy variable of time integration over the averaging time interval

The symbols used by the analyzer for equivalent continuous I-weighted sound levels are (for A, B, C and Z frequency weighting):

L_{AIeq}, L_{BIeq}, L_{CIeq}, L_{ZIeq}

Taktmaximal-Mittelungspegel

The Taktmaximal-Mittelungspegel, $L_{AFTeq}(T)$, is defined as ten times the logarithm to base ten of the mean of ten to the power of the Taktmaximalpegel, $L_{AFT}(T_n)$, divided by ten during a time interval. The time interval is starting at $t = T$ and ending at $t = T + N \cdot \Delta t$ where:

- T is the start time of the measurement, indicated as *Start Time*
- Δt is the Taktzeit, equal to 5 seconds
- $N \cdot \Delta t$ is the averaging time interval, indicated as *Elapsed Time*

The Taktmaximal-Mittelungspegel is expressed in decibels (dB).

In symbols, Taktmaximal-Mittelungspegel, $L_{AFTeq}(T)$, is given by:

$$L_{AFTeq}(T) = 10 \lg\left[(1/N) \sum_{n=1}^{N} 10^{L_{AFT}(T_n)/10}\right] \quad [\text{dB}]$$

The symbol used by the analyzer for Taktmaximal-Mittelungspegel is:

L_{AFTeq}

Sound Exposure Level

The sound exposure level, $L_{xE}(T)$, is defined as ten times the logarithm to base ten of the ratio of integral of the squared sound pressure during a time interval to the reference sound exposure, sound pressure being obtained with a frequency weighting, x. The time interval is starting at $t = T$ and ending at $t = T + \Delta t$ where:

- x is A for A-weighted, B for B-weighted, C for C-weighted or Z for Z-weighted
- T is the start time of the measurement, indicated as *Start Time*
- Δt is the averaging time interval, indicated as *Elapsed Time*

The equivalent continuous sound level is expressed in decibels (dB).

In symbols, equivalent continuous sound level, $L_{xE}(T)$, is given by:

$$L_{xE}(T) = 10 \lg\left[\int_{T}^{T+\Delta t} p_x^2(\xi) d\xi / E_0\right] \quad [\text{dB}]$$

where:

- ξ is a dummy variable of time integration over the averaging time interval
- $p_x(\xi)$ is the x frequency-weighted instantaneous sound pressure
- E_0 is the reference sound exposure, equal to $(20\ \mu\text{Pa})^2 \times (1\ \text{s}) = 400 \times 10^{-12}\ \text{Pa}^2\text{s}$

The sound exposure level $L_{xE}(T)$ can also be expressed in terms of the equivalent continuous sound level $L_{xeq}(T)$ and *Elapsed Time* as:

$$L_{xE}(T) = L_{xeq}(T) + 10 \lg(\Delta t) \quad [\text{dB}]$$

where Δt is the averaging time interval, indicated as *Elapsed Time*, expressed in seconds

The symbols used by the analyzer for sound exposure levels are (for A, B, C and Z frequency weighting):

L_{AE}, L_{BE}, L_{CE}, L_{ZE}

Peak Sound Level

The peak sound level, $L_{xpeak}(T)$, is defined as twenty times the logarithm to base ten of the ratio of the greatest absolute instantaneous sound pressure, $p_x(t)$, within a time interval starting at $t = T$ and ending at $t = T + \Delta t$, to the reference sound pressure, p_0, instantaneous sound pressure being obtained with a frequency weighting, *x*, where:

- *x* is A for A-weighted, B for B-weighted, C for C-weighted or Z for Z-weighted
- $p_x(t)$ is the *x* frequency-weighted instantaneous sound pressure
- p_0 is the reference sound pressure, equal to 20 µPa
- *T* is the start time of the measurement, indicated as *Start Time*
- Δt is the measuring period, indicated as *Elapsed Time*

The maximum peak sound level is expressed in decibels (dB).

The symbols used by the analyzer for peak sound levels are (for A, B, C and Z frequency weighting):

L_{Apeak}, L_{Bpeak}, L_{Cpeak}, L_{Zpeak}

Statistics

Statistics can be based on sampling the continuous output of the exponential detectors F or S every 10 ms or the 1 s linearly averaged results L_{eq}. The samples are divided into 0.2 dB classes in which the frequency of appearance is counted. Based on the counted frequency distribution the percentile sound levels (also called the exceedance levels) L_{xyN} are calculated.

- x is A for A-weighted or B for B-weighted
- y is F for Fast-weighted or S for Slow-weighted and nothing for L_{eq}
- N is a percentage between 0.1 and 99.9. It notes the percentage of time that the indicated noise level was exceeded during the measurement period.

2.9.3 Spectrum Measurements

Note: These measurements require Frequency Analysis Software to be enabled.

The definition of the measured quantities is the same as for the broadband measurements.

At low frequency bands the exponential time constants for Fast and Slow weighting are modified to get a reasonable B*T product, see Section 4.11.5.

Timed Spectrum Measurements are delayed according to the same rules as Timed Broadband Measurements (Section 2.9.2). As stated above, the exponential time constant is modified at low frequencies. This leads to very long delays at very low frequencies.

2.9.4 Instantaneous Spectrum Measurements

The Instantaneous Spectrum Measurements can measure instantaneous time-weighted sound level L_{xy}, where:

- *x* is A for A-weighted, B for B-weighted, C for C-weighted or Z for Z-weighted
- *y* is F for Fast-weighted or S for Slow-weighted

The symbols used by the analyzer for instantaneous time-weighted sound level spectrums are (for A, B, C and Z frequency weighting and F and S time weighting):

L_{AF}, L_{AS}, L_{BF}, L_{BS}, L_{CF}, L_{CS}, L_{ZF}, L_{ZS}

Overload is common to the broadband measurements.

2.9.5 Timed Spectrum Measurements

The Timed Spectrum Measurements can measure minimum time-weighted sound level, L_{xymin}, maximum time-weighted sound level, L_{xymax}, and equivalent continuous sound level, L_{xeq}, where:

- *x* is A for A-weighted, B for B-weighted, C for C-weighted or Z for Z-weighted
- *y* is F for Fast-weighted or S for Slow-weighted

The symbols used by the analyzer for minimum time-weighted sound level spectrum, maximum time-weighted sound level spectrum and equivalent continuous sound level spectrum are (for A, B, C and Z frequency weighting and F and S time weighting):

L_{AFmin}, L_{ASmin}, L_{BFmin}, L_{BSmin}, L_{CFmin}, L_{CSmin}, L_{ZFmin}, L_{ZSmin},

L_{AFmax}, L_{ASmax}, L_{BFmax}, L_{BSmax}, L_{CFmax}, L_{CSmax}, L_{ZFmax}, L_{ZSmax},

L_{Aeq}, L_{Beq}, L_{Ceq}, L_{Zeq}

Latched Overload and Overload Percentage is common to the broadband measurements.

Statistics

Statistics can be based on sampling the continuous output of the exponential detectors F or S every 100 ms. At frequencies below 12.5 Hz the sampling time is doubled for every octave the frequency is reduced. The samples are divided into 1.0 dB classes in which the frequency of appearance is counted. Based on the counted frequency distribution the percentile sound levels (also called the exceedance levels) L_{xyN} are calculated.

- *x* is A for A-weighted, B for B-weighted, C for C-weighted or Z for Z-weighted
- *y* is F for Fast-weighted or S for Slow-weighted
- *N* is a percentage between 0.1 and 99.9. It notes the percentage of time that the indicated noise level was exceeded during the measurement period.

2.10 Ranges, Overload and Underrange

2.10.1 Single Range/Multi-range

Types 2250 and 2250-L can only be used as single-channel, single-range sound level meters and frequency analyzers. The range is called Single-range.

Type 2270 hardware can be used in two ways:

1) As a single-channel, single-range sound level meter and frequency analyzer like Types 2250 and 2250-L. In this case, only a single channel can be measured at a time. The input is selectable between the two physical channels in the user interface and the full level measuring range is covered in a single range without a level range control. This range is called Single-range.

2) As a dual-channel, multi-range sound level meter and frequency analyzer. In this case, both channels can be measured simultaneously. The full level measuring range is covered in two ranges with a level range control. Theses ranges are called High range for the least sensitive range, and Low range for the most sensitive range. *Hand-held Analyzer Types 2250 and 2270 – User Manual* (BE 1713) describes how to select the range setting.

2.10.2 Overload

Overload indicates that the input signal level exceed the capability of the analyzer with the current settings.

During measurement, overload is indicated as *Overload* on the screen with the icon  and by a flashing red “traffic light” indicator. The indication is displayed as long as the overload condition exists or for 1 second, whichever is the greater.

The final result of the measurement contains both an indication if there have been any overloads at all during the measurement and an Overload% that indicates the percentage of the measurement time that contained overloads.

If an overload condition exists, some of the input signal is clipped away and therefore missing in the broadband results, which becomes too small. In the spectrum measurements, due to the distortion of the signal, some of the missing signal is placed in other bands.

The Overload% is intended as a tool to help the user to assess whether he will use a measurement that contains overloads or not. Small percentages will only have a limited influence on the final results.

2.10.3 Underrange

Underrange indicates that one or more of the measured quantities time-weighted sound level, time average sound level, or sound exposure level is momentary below the specified lower limit of the Linear Operating Range. Separate indications for each of the two selectable frequency weightings for these quantities. The decision of whether there is an underrange condition is taken and displayed every 1 second and is based on the results for the last 1 second.

Underrange is only indicated on the screen during measurement and is displayed. No underrange information is saved with the final result of the measurement.

The underrange indication does not account for the influence of self-generated noise from the microphone because the specifications for the lower limit of the Linear Operating Range apply for measurements of electrical signals inserted into the preamplifier through the applicable input device. This makes the underrange indication a dubious indicator of the quality of the measurement especially on the more sensitive ranges.

Underrange is only intended as a tool to help the user to assess whether he should chose a more sensitive range if such exists.

2.10.4 Selecting the Optimum Level Range

This is only relevant for Type 2270 in dual-channel, multi-range mode; else, there is only one range.

If Type 2270 is in Low range and you get Overload warnings you can try to change to High range.

If Type 2270 is in High range and you get Underrange warnings you can try to change to Low range.

If none of these conditions occur, you should prefer Low range. It has the lowest self-generated noise. High range is only chosen when you expect that there can be very high sound levels.

2.11 Mechanical Vibration

Mechanical vibration can affect indicated levels at low levels. Section 4.12.4 gives an indication of the level of these errors.

The primary source to the vibration sensitivity is the microphone. It is most sensitive to vibrations coming from a direction perpendicular to the diaphragm.

To reduce this problem the analyzer and primary the microphone should be mounted isolated from the vibrations if measurements are taken at places where there are strong vibrations.

Chapter 3

Conformance Testing

3.1 Introduction

This chapter contains the information needed to conduct conformance testing according to the specified standards.

3.2 Mounting for Acoustical Tests

For acoustical tests, it is important that the test rig for mounting the microphone to be tested is designed to minimise the influence of reflections to a level that is comparatively smaller than the test parameter's maximum Expanded Uncertainties of Measurement. This has to be demonstrated with a good, known laboratory microphone.

Various ways in which the different microphone assemblies can be mounted to the test rig are:

- The analyzer, with the microphone and Microphone Preamplifier ZC-0032, can be mounted using Tripod Extension for Hand-held Analyzer UA-1651. The tripod extension stem is screwed into the Tripod Mounting Thread situated on the underside of the analyzer, at the back. The thread on the other end of the stem is used to mount the assembly to the test rig
- The microphone, together with Microphone Preamplifier ZC-0032, can be mounted separately in the ½″ Microphone Holder UA-1317. The Microphone Holder can be mounted using the tripod mount thread. To minimise the influence of reflections from the Microphone Holder, bend the holder part to an angle of 45° ± 15° from the straight position
- Outdoor Microphone Kit UA-1404 can be mounted using the tripod mount thread in the Mounting Ring

3.3 Periodic Testing of Acoustical Frequency Responses

Acoustical signal test of frequency response can be made with plane progressive waves in an anechoic facility. However, this is normally very time-consuming and difficult to do with sufficient accuracy. For the purpose of periodic testing, it is recommended that you use one of the following Brüel & Kjær products for acoustic frequency response tests:

- Multifunction Acoustic Calibrator Type 4226
- Electroacoustic Calibrator UA-0033

If the Multifunction Acoustic Calibrator is used, the calibrator must be set to its Calibration and Pressure sound field modes. The calibrator must be calibrated. Further details can be found in the Instruction Manual for the Multifunction Acoustic Calibrator.

Acoustical signal test with Electrostatic Actuator UA-0033 should be made only by personnel that are educated in and familiar with the use of the actuator. The actuator should be operated with a DC voltage of approximately 800 V and an RMS AC voltage of approximately 100 V.

Adjustment data, which must be applied to the sound levels displayed in response to the sound pressure produced by Multifunction Acoustic Calibrator Type 4226, or in response to simulation of sound pressure by Electrostatic Actuator UA-0033, in order to obtain the equivalent sound levels that would be displayed in response to plane progressive sinusoidal sound waves incident from the reference direction, are given in Table A.49 and Table A.50.

3.4 Mounting for Mechanical Vibrations Tests

The analyzer is mounted on the shaker using the Tripod Mounting Thread situated centrally on the underside of the analyzer.

3.5 Electrical Substitute for Microphones

To obtain a BNC Type electrical input, replace the microphone with a WA0302-B, 15 pF, fitted with a 10–32 UNF to BNC adaptor, UA-0245.

This Electrical Substitute for Microphones has (together with the preamplifier) a nominal attenuation of 0.65 dB.

The electrical input obtained in this way has a maximum input level of ±15.24 V_{Peak} and no damage will occur for signals up to ±20 V_{Peak}.

All electrical inputs can be short-circuited when needed for test.

To calibrate the analyzer for the electrical conformances test with a calibration that corresponds to the calibration you would get if the analyzer were fitted with a microphone with the nominal Open Circuit Sensitivity do the following:

1) On the **Setup** screen (*Full* tab):
   - Set *Input*, *Transd. Used* to the microphone that you intend to substitute
   - Set *Input*, *Input* to *Top Socket*
2) Calibrate the analyzer by typing in the nominal sensitivity as the *Sensitivity* on the **Calibration** screen. For Microphone Type 4189, the nominal sensitivity is the microphone's Open Circuit Sensitivity (50.00 mV/Pa), attenuated by the Microphone Preamplifier ZC-0032's nominal attenuation (0.25 dB), which equates to 48.58 mV/Pa. Do not press the **Start Calibration** button.
3) Connect an electrical sinusoidal signal with a frequency of 1 kHz to the Electrical Substitute for Microphones and adjust the amplitude of this signal until LZF (or LCF) displays 94.00 dB in the **Calibration** screen. This electrical amplitude is the 94.00 dB reference for the electrical tests. The amplitude will typically be 52.5 mV. This is due to the attenuation of the Electrical Substitute for Microphones together with the preamplifier (nominally 0.65 dB).

3.6 Testing 1/1-octave-band and 1/3-octave-band Filters

Note: These measurements require Frequency Analysis Software to be enabled.

All tests according to IEC 61260 must be conducted with *Setup* screen:

- *Input* parameter*: Transd. Used* set to *Unknown*
- *Frequency Settings* parameters *Low Frequency Option* set to *Off*, *Low Frequency* set to *Extended* and *Spectrum* set to *Z*

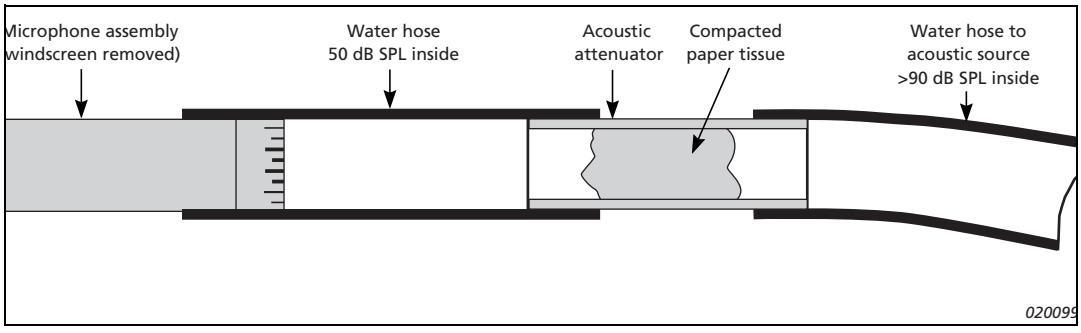
3.7 EMC Test Procedures

3.7.1 Signal Sources for Immunity Test

Acoustical Source for Testing According to IEC 61672, IEC 60651 and IEC 60804

The acoustic signal, which is used during the Immunity test according to IEC 61672, IEC 60651 and IEC 60804, is applied to the microphone through a ½ ″ plastic hose (a normal water hose) – from a source outside the test area. In this way, the acoustic source is not affected by the RF or magnetic field. The source may be a normal entertainment earphone.

Fig. 3.1
Setting up the signal source for an immunity test



To prevent the acoustic source from being affected by acoustic noise in the surroundings, the following method can be used.

Insert an acoustic attenuator in the hose close to the microphone, so that the sound pressure within the greater part of the hose is held far above the surrounding sound level. The acoustic attenuator can easily be made from a short piece of metal tubing with an outer diameter of ½ ″. Squeeze a piece of paper tissue into the tube, and compress it until the desired attenuation is obtained. Up to 40 to 60 dB of acoustic attenuation can be obtained.

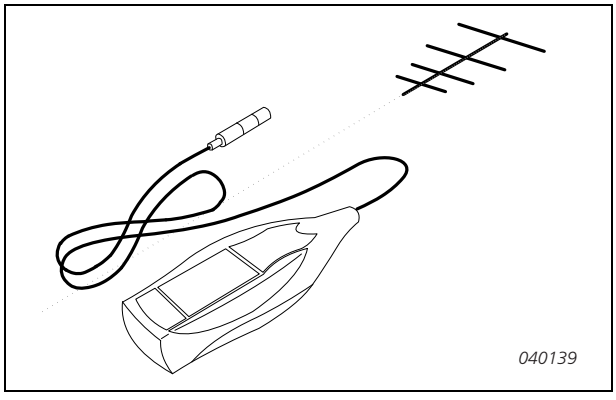
Electrical Source for Testing According to IEC 61260

The short-circuit of the Input signal may be achieved by short-circuiting the electrical substitute for microphones mounted on the microphone preamplifier.

3.7.2 Reference Orientation

Fig.3.2 shows the reference orientation of the instrument body, including the preamplifier and microphone, relative to the RF-emitter/receiver. This is common to both Emission and Immunity tests.

Fig. 3.2
Reference orientation of the analyzer relative to the RF-emitter/receiver



3.7.3 Securing of Cables During EMC Test

During test, any excessive cable is folded back on itself in an even number of figure eights, as indicated in Fig. 3.2. The microphone and preamplifier assembly is arranged approximately 25 cm above the analyzer.

The cable arrangement is common for both the Emission and Immunity tests.

3.7.4 Testing EMC According to IEC 60804

Both the exponential time-averaged detectors and the linear time-averaged detectors in the analyzer are digital, and their results are calculated based on the same samples. Therefore, the L_{xF} measurement values will be equal to short L_{xeq} values when measuring steady signal levels.

As a consequence, no special operating mode giving a short duration L_{xeq} measurement is provided, and only one test has to be carried out when testing Immunity to RF signals according to both IEC 60651 and IEC 60804.

3.7.5 Accessories Included in EMC Test

The following accessories are connected to the instrument during the EMC tests:

- The preamplifier is connected to the top socket of the analyzer using the extension cable
- Signal Cables AO-0440 are connected to all the triaxial LEMO sockets on the rear connector panel of the analyzer
- Earphones HT-0015 is connected to the Earphone socket
- Mains Power Supply ZG-0426 is connected to the 'Ext. Power' socket. If Utility Unit ZH-0689 or Power Panel ZH-0685 is used as an alternative to ZG-0426 the alternative connections are shown in Fig. 1.2 and Fig. 1.3
- USB Interface Cable:
  - Before hardware version 4.0: USB Interface Cable AO-1476 is connected to the USB socket
  - From hardware version 4.0: The USB Interface Cables AO-1494 and AO-0708 are connected to the two USB sockets
- LAN Interface Crossover Cable AO-1449-D-010 or LAN Interface Cable AO-1450 is connected to the LAN socket if the analyzer supports LAN interface

Detailed descriptions of the parts are given in Table 1.1.

3.7.6 Normal Mode of Operation During EMC Test

Testing Emission

The greatest level of radio frequency emission is radiated from the analyzer when set up as follows:

1) Make the connections described in section 3.7.5.
2) Mount the microphone on the microphone preamplifier.
3) Arrange orientation as shown in Fig. 4.34.
4) Select the **SOUND LEVEL METER** Project Template.
5) On the **Setup** screen (*Full* tab):
   - Set *Input* parameter: *Input* to *Top Socket*
   - Set *Input* parameter: *Transd. Used* to the mounted microphone
   - Set *Measurement Control* parameter: *Measurement Mode* to *Manual*
   - Set *Output Socket Signal* parameter: *Source* to *Input A-weighted* and *Gain* to *0.0 db*

6) On the **Preferences** screen:
   – Set *Headphone Settings* parameter: *Listen to signal* to *Input A-weighted*
   – Set *Headphone Settings* parameter: *Automatic Gain Control* to *Off*
   – Set *Headphone Settings* parameter: *Gain for Meas. Signal* to *0.0 dB*
7) Start the measurement and let it run during test.

Testing Immunity as a Sound Level Meter According to IEC 61672, IEC 60651 and IEC 60804

The highest Susceptibility (Susceptibility = 1/Immunity) is achieved when the is set up as follows:

1) Make the connections described in section 3.7.5.
2) Mount the microphone on the microphone preamplifier.
3) Arrange orientation as shown in Fig.4.34.
4) Select the **Sound Level Meter** Project Template.
5) On the **Setup** screen (*Full* tab):
   – Set *Input* parameter: *Input* to *Top Socket*
   – Set *Input* parameter: *Transd. Used* to the mounted microphone
   – Set *Input* parameter: *Sound Field Correction* to *Free-field*
   – Set *Input* parameter: *Windscreen Auto Detect* to *Off*, *Windscreen Correction* to *None*
   – Set *Frequency Settings* parameter: *Broadband (excl. Peak)* to the required weightings
   – Set *Measurement Control* parameter: *Measurement Mode* to *Manual*
   – Set *Output Socket Signal* parameter: *Source* to *Input A-weighted* and *Gain* to *0.0 db*
6) On the **Preferences** screen:
   – Set *Headphone Settings* parameter: *Listen to signal* to *Input A-weighted*
   – Set *Headphone Settings* parameter: *Automatic Gain Control* to *Off*
   – Set *Headphone Settings* parameter: *Gain for Meas. Signal* to *0.0 dB*
7) Calibrate the microphone.
8) Excite the microphone with an acoustical signal as described in section 3.7.1.
9) Start the measurement and let it run during test.
10) For radio-frequency tests, observe L_{AF} during test.
11) For power-frequency magnetic field tests, observe L_{AF}, L_{BF}, L_{CF} and L_{ZF} during test (only two frequency weightings can be observed simultaneously).

Testing Immunity as a Frequency Analyzer According to IEC 61260

Note: These measurements require Frequency Analysis Software to be enabled.

The highest Susceptibility (Susceptibility = 1/Immunity) for the filter sets is achieved when the analyzer is set up as follows:

1) Make the connections described in section 3.7.5.
2) Mount the electrical substitute for microphones described in section 3.5 on the microphone preamplifier and short-circuit it.
3) Arrange orientation as shown in Fig.4.34.
4) Select the **FREQUENCY ANALYZER** project template.

5) On the **Setup** screen (*Full* tab):
   - Set *Input* parameter: *Input* to *Top Socket*
   - Set *Input* parameter: *Transd. Used* to *4189* or *4950*
   - Set *Input* parameter: *Sound Field Correction* to *Free-field*
   - Set *Input* parameter: *Windscreen Auto Detect* to *Off*, *Windscreen Correction* to *None*
   - Set *Frequency Settings* parameter: *Spectrum* to *Z*
   - Set *Bandwidth* parameter: *Bandwidth* to *1/3-octave*
   - Set *Measurement Control* parameter: *Measurement Mode* to *Manual*
   - Set *Output Socket Signal* parameter: *Source* to *Input A-weighted* and *Gain* to *0.0 db*
6) On the **Preferences** screen:
   - Set *Headphone Settings* parameter: *Listen to signal* to *Input A-weighted*
   - Set *Headphone Settings* parameter: *Automatic Gain Control* to *Off*
   - Set *Headphone Settings* parameter: *Gain for Meas. Signal* to *0.0 dB*
7) Calibrate the input by typing in *48.58 mV/Pa* as the *Sensitivity* of the microphone on the **Calibration** screen, see section 3.5.
8) Start the measurement and let it run during test.
9) For radio-frequency tests, observe the L_{ZF} spectrum at 1 kHz during test.
10) For power-frequency magnetic field tests, observe the L_{ZF} spectrum during test.

Only 1/3-octave-band filters need to be tested. This is because the filters are digital, and no disturbance at the filter input will show up to be greater at 1/1-octave bandwidth than at 1/3-octave bandwidth.

Chapter 4

Specifications

4.1 Specifications

Specifications are given for the configuration detailed in Chapter 1.

Unless specifically noted, specifications are given as typical data under Reference Environmental Conditions, and with the system calibrated to the nominal microphone open circuit sensitivity.

Note: The specifications given here for the Z-weighting, as defined in IEC 61672–1, are also valid for the Lin response, as defined in IEC 60651.

4.2 Standards

Hand-held Analyzer Type 2250/2250-L/2270 conforms to the following National and International Standards and Classes/Types/Groups with the accessories and configurations specified in section 1.2.4, when the software modules provide Sound Level Meter functionality:

- **IEC 61672–1** (2002-05), Class 1, Group X/Z
- **IEC 61672–1** (2013), Class 1, Group X/Z, from software version 4.4
- **IEC 60651** (1979) plus Amendment 1 (1993–02) and Amendment 2 (2000–10), Type 1, Group X/Z
- **IEC 60804** (2000-10), Type 1, Group X/Z
- **DIN 45657** (1997-07)
- **DIN 45657** (2014-07), from software version 4.4
- **ANSI S1.4** –1983 plus ANSI S1.4A -1985 Amendment, Type 1
- **ANSI S1.43** –1997, Type 1

Hand-held Analyzer Type 2250/2250-L/2270 conforms to the following additional National and International Standards and Classes/Types/Groups when the software modules provide Frequency Analysis functionality:

- **IEC 61260** (1995-07) plus Amendment 1 (2001-09), 1/1-octave Bands and 1/3-octave Bands, Class 0, Group X/Z, all filters
- **ANSI S1.11** –1986, 1/1-octave Bands and 1/3-octave Bands, Order 3, Type 0-C, Optional Range
- **ANSI S1.11** –2004, 1/1-octave Bands and 1/3-octave Bands, Class 0, Group X/Z, all filters

Note: For Type 2270, both channels conform to the standards.

In the text elsewhere in this manual, references to these standards are shortened to the standards name but are to be understood as the full text above.

The International IEC Standards are adopted as European standards by CENELEC. When this happens, the letters IEC are replaced with EN and the number is retained. Type 2250/2250-L/2270 also conforms to these EN Standards.

4.3 Reference Environmental Conditions

Air Temperature: 23°C

Static Pressure: 101.325 kPa

Relative Humidity: 50%

4.4 Reference Conditions for Acoustic Calibration

Reference Level Range: In Single-range applications only one level range exists and this is the reference level range. In Multi-range applications the reference level range is *High Range*.

Reference Sound Pressure Level: 94.00 dB re 20 µPa

Reference Frequency: 1 kHz

4.5 Microphone

Microphone Type 4189 and Microphone Preamplifier ZC-0032:

Type: Prepolarized Free-field ½ ″ Condenser Microphone

Nominal Open Circuit Sensitivity: 50 mV/Pa, (corresponding to –26 dB re 1 V/Pa) ± 1.5 dB

Capacitance: 14 pF (at 250 Hz)

Nominal Preamplifier Attenuation: 0.25 dB

Extension Cables between Microphone Preamplifier ZC-0032 and the Analyzer: Up to 100 m without degradation of the specifications.
Note: EMC is only tested with a 10 m cable (AO-0697-D-100)

Microphone Reference Point: The centre of the front surface of the microphone protection grid. With UA-1404 mounted, this point can be difficult to find. Therefore, it is marked on the windscreen

Reference Direction of Sound Incidence: See the small drawings in the lower right corner of the directional response graphs in section 4.7.

4.6 Frequency Responses

The frequency responses are given in tabular form in Appendix A and in graphical form in this section.

The specifications for the Lin response defined in IEC 60651 are equivalent to those given here for the Z-weighting.

The acoustical frequency response depends on the sound field, the microphone, the used microphone accessories and the electrical frequency response. To improve the quality of the measurement, the analyzer compensates for the sound field, the microphone and the used microphone accessories by changing the electrical frequency response. This means that it is very important that the **Setup** and **Transducer** parameters reflect the desired configuration. The important parameters are:

- **Setup** screen, *Input* parameters: *Input*, *Transd. Used*, *Sound Field Correction*, *Windscreen Auto Detect* and *Windscreen Correction*
- **Setup** screen, *Frequency Settings* parameters: *Low Frequency Option*, *Low Frequency*, *Broadband (excl. Peak)*, *Broadband Peak* and *Spectrum*
- **Transducer** screen: *Transd. used* and *Microphone Type*

By setting the *Microphone Type* parameter to *Unknown* (on the **Transducer** screen for the transducer used), an uncompensated electrical frequency response is ensured.

Limit curves are drawn on some of the frequency response graphs in the following sections. These curves represent the IEC 61672–1:2002 limits, reduced by the Maximum Expanded Uncertainties of Measurement from Appendix A of IEC 61672–1:2002. The Maximum Expanded Uncertainties of Measurement used here are the maximum uncertainties that a test organisation may have on its measurements when it performs conformance tests according to IEC 61672:2002.

IEC 61672-1:2013 deals with uncertainty of measurement differently than the 2002 version; therefore, the terminology around the limit curves is different. Seen from an IEC 61672–1:2013 perspective, the limit curves are the standard's acceptance limits. The only difference is that the small glitch between 200 and 250 Hz in the curves is removed in the 2013 version of the standard.

The Expanded Uncertainties of Measurement in the tables are the two-sigma limits maintained in the Brüel & Kjær production for the specific product. This means that the correct value lies in the range of the measured value plus/minus the Expanded Uncertainties of Measurement with a probability of 95%.

Note: This range is **not** related to the production spread. The range is for a specific typical unit. The factory acceptance tests at Brüel & Kjær ensure that the ranges for all units are within the IEC 61672–1 limits.

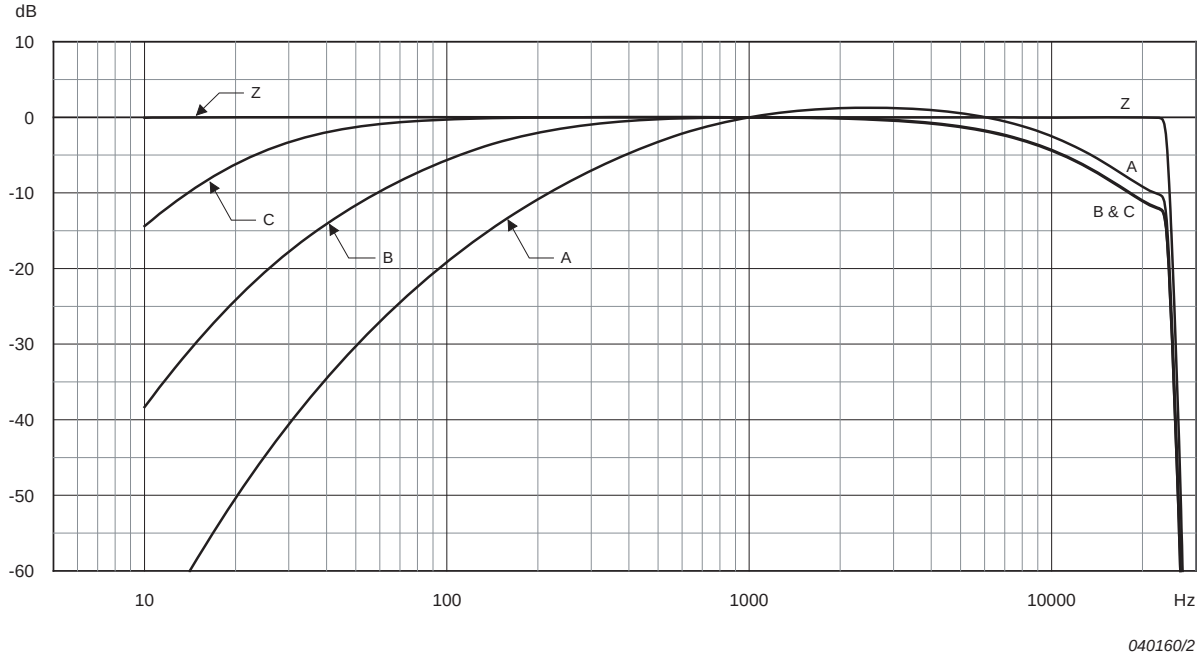
4.6.1 Electrical Frequency Responses

The uncompensated electrical frequency response for the different frequency weightings are given in Fig. 4.1 and Table A.1.

The compensated Z-weighted electrical frequency response is given in the "Electrical Response" column of the appropriate tables of Table A.2 to Table A.9 in Appendix A.

The electrical frequency responses in Fig. 4.1 and Table A.1 are valid both for introduction of the electrical signal through the recommended means to substitute the microphone with an electrical input facility (see section 3.5) and for the rear 'Input' socket.

Fig. 4.1 *Uncompensated electrical frequency response, corresponds to Table A.1*



4.6.2 Typical Low-frequency Responses

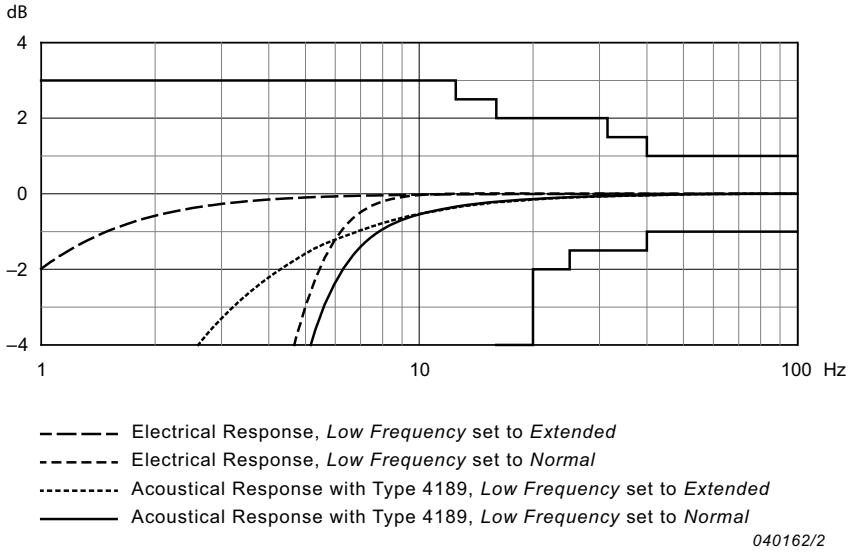
The typical Low-frequency Responses for Z frequency weighting are given in Fig. 4.2. The Electrical Responses are for the rear 'Input' socket. The Acoustical Responses include Microphone Type 4189 and Microphone Preamplifier ZC-0032.

The Low-frequency Responses depends on the state of the *Low Frequency* parameter on the **Setup** screen, under *Frequency Settings*.

The Low-frequency Responses are not influenced by the microphone accessories described in section 1.2.4.

The Low-frequency Responses for introduction of the electrical signal through the recommended means to substitute the microphone with an electrical input facility (see section 3.5) differs from the electrical responses in Fig. 4.2 because it also includes Microphone Preamplifier ZC-0032.

Fig. 4.2 *Typical low-frequency responses*



4.6.3 Flat Frequency Range According to IEC 61260

The frequency ranges of nominally flat frequency responses for the rear 'Input' socket are:

- *Low Frequency* set to *Normal*: ±0.15 dB, 8.5 Hz to 22 kHz
- *Low Frequency* set to *Extended*: ±0.15 dB, 4 Hz to 22 kHz

4.6.4 Acoustical Frequency Responses

All the acoustical frequency responses are given for Z frequency weighting.

The A-, B- and C-weighted acoustical frequency responses can be found by adding the appropriate response from the "Add to Acoustical Responses" columns of Table A.1 to the Z-weighted responses.

4.6.5 Free-field Frequency Responses

The free-field frequency responses for plane progressive sinusoidal sound waves incident from the reference direction with Z frequency weighting are provided in Fig. 4.3 to Fig. 4.8 and Table A.2 to Table A.6. The tables also provides the 'Expanded Uncertainties of Measurement' required by IEC 61672–1, see the start of section 4.6.

Fig. 4.3 *Free-field 0° frequency response for Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer's electrical response, with the microphone preamplifier connected to a microphone extension cable. Corresponds to the "Acoustical Response" column in Table A.2*

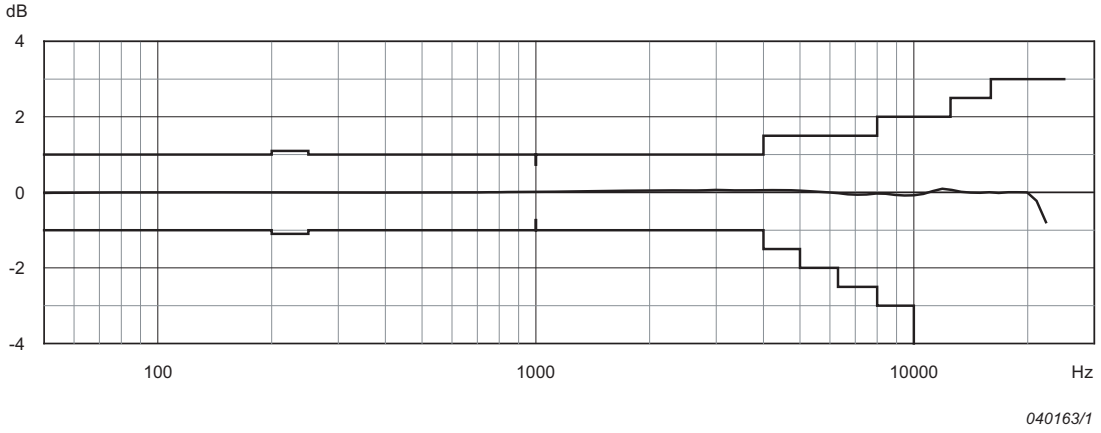


Fig. 4.4 *Influence of the analyzer's body on free-field 0° response, corresponds to the "Body Influence" column in Table A.3*

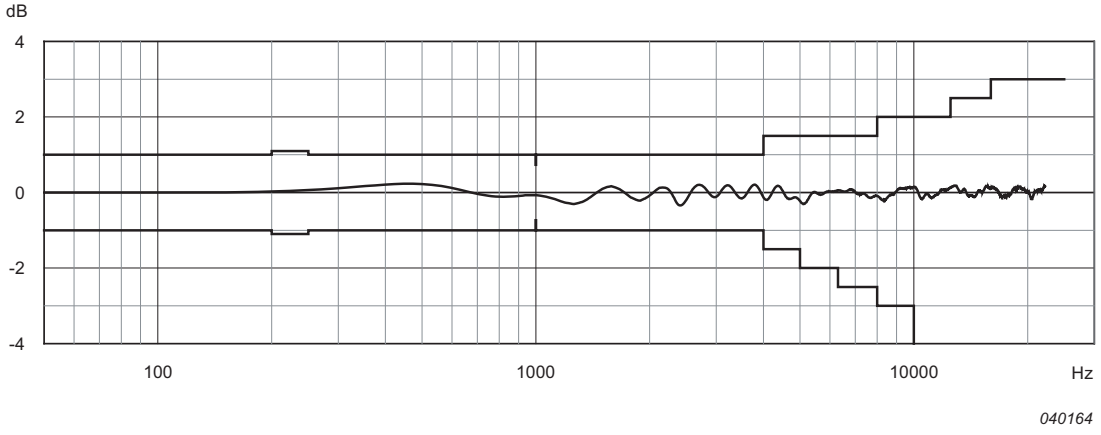


Fig. 4.5 *Free-field 0° frequency response for Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer with the microphone preamplifier mounted directly on the analyzer. Corresponds to the "Acoustical Response" column in Table A.3*

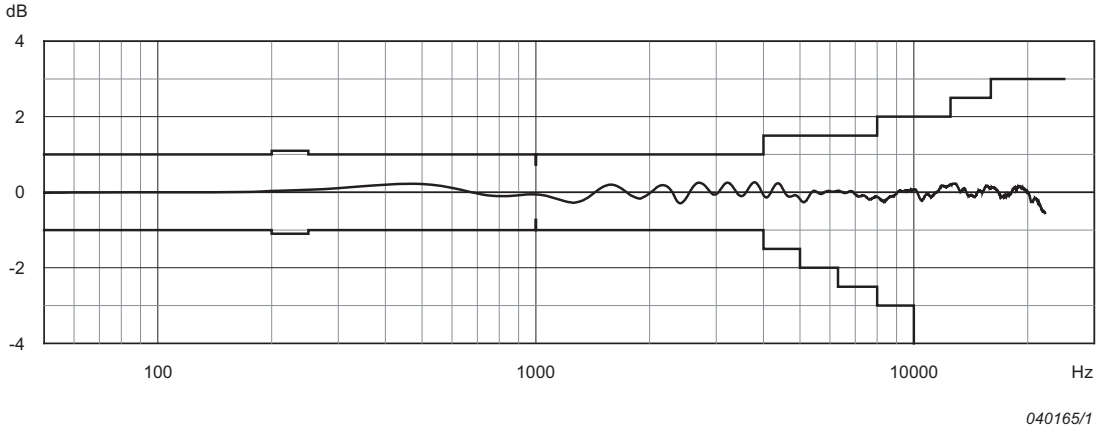


Fig. 4.6 *Free-field 0° frequency response for Windscreen UA-1650, Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer's electrical response, with the microphone preamplifier connected to a microphone extension cable. Corresponds to the "Acoustical Response" column in Table A.4*

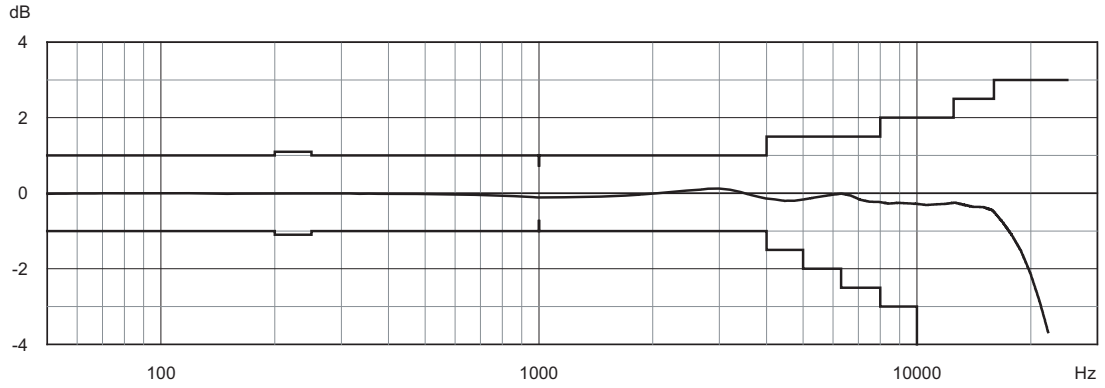


Fig. 4.7 *Free-field 0° frequency response for Windscreen UA-1650, Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer with the microphone preamplifier mounted directly on the analyzer. Corresponds to the "Acoustical Response" column in Table A.5*

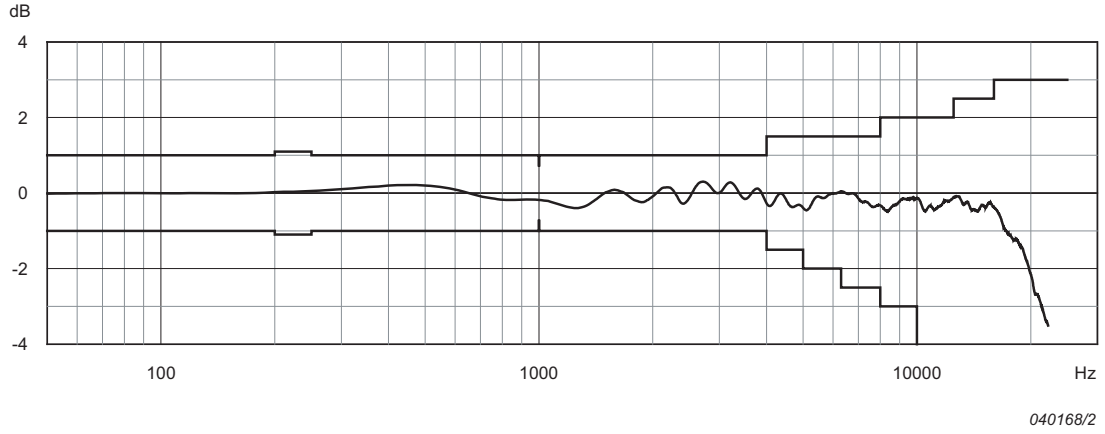
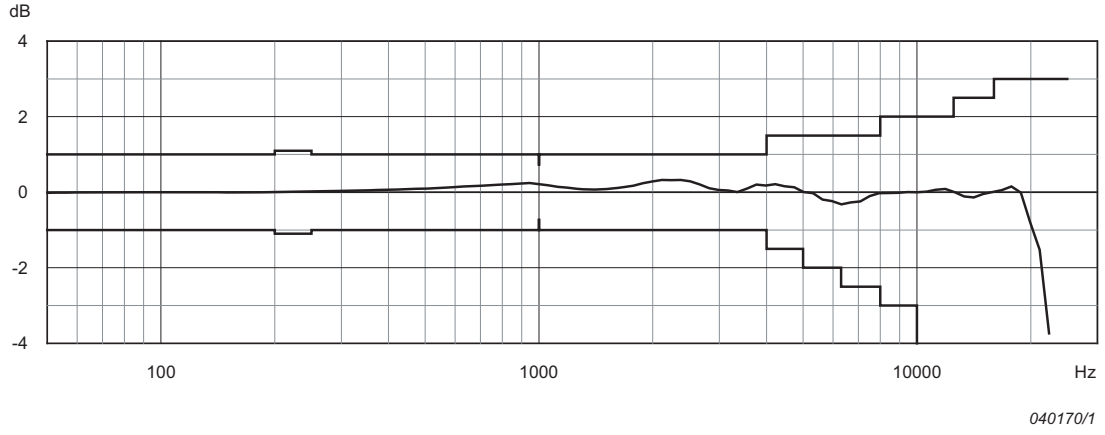


Fig. 4.8 *Free-field 0° frequency response for Outdoor Microphone Kit UA-1404, Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer's electrical response, with the microphone preamplifier connected to a microphone extension cable. Corresponds to the "Acoustical Response" column in Table A.6*



4.6.6 Diffuse-field Frequency Responses

The diffuse-field frequency responses (also called random-incidence frequency responses) with Z frequency weighting are provided in Fig. 4.9 to Fig. 4.11 and Table A.7 to Table A.9.

The diffuse-field body influence of the analyzer is so small that the diffuse-field frequency responses are the same with and without the microphone preamplifier connected to the microphone extension cable.

Fig. 4.9 *Diffuse-field frequency response for Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer with or without the microphone preamplifier connected to a microphone extension cable. Corresponds to the "Acoustical Response" column in Table A.7*

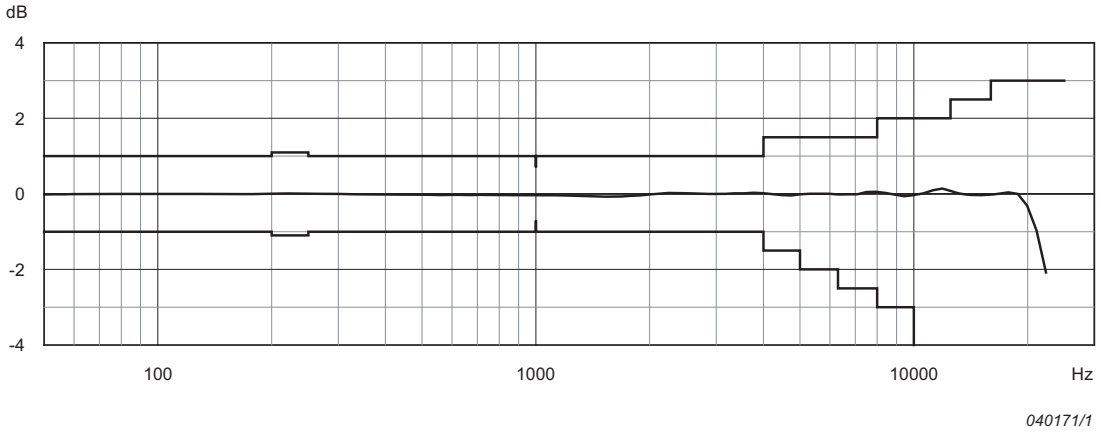


Fig. 4.10 *Diffuse-field frequency response for Windscreen UA-1650, Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer with or without the microphone preamplifier connected to a microphone extension cable. Corresponds to the "Acoustical Response" column in Table A.8*

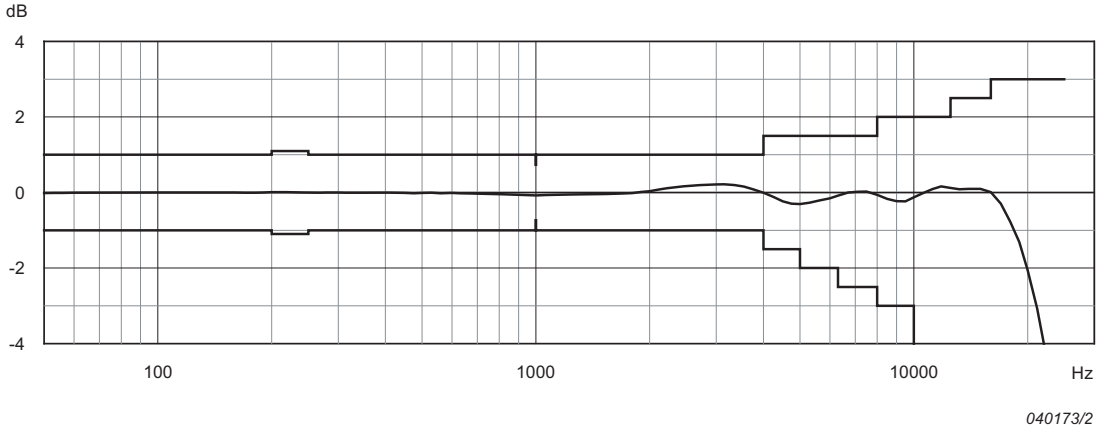
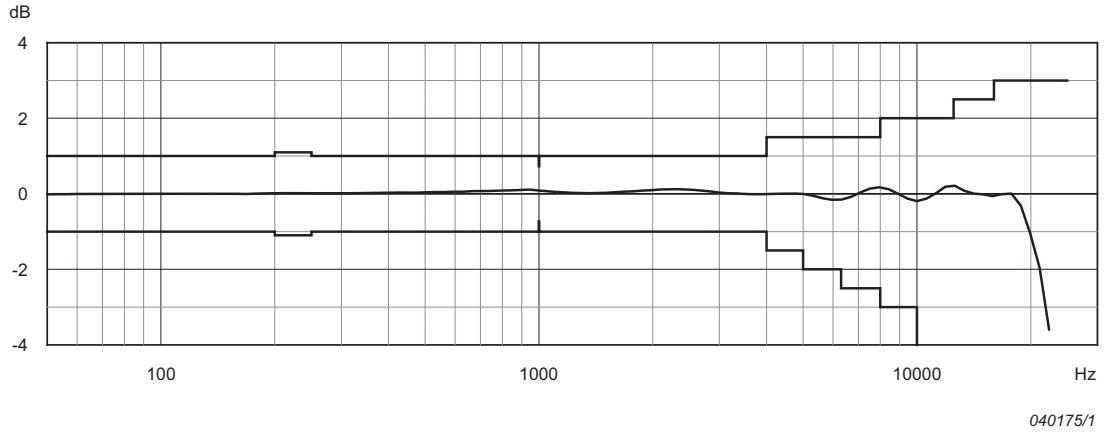


Fig. 4.11 *Diffuse-field frequency response for Outdoor Microphone Kit UA-1404, Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer with the microphone preamplifier connected to a microphone extension cable. Corresponds to the "Acoustical Response" column in Table A.9*



4.6.7 Free-field Frequency Responses for Diffuse-field Calibrated Instruments

According to IEC 60651 and IEC 60804, the free-field frequency responses in the reference direction for diffuse-field calibrated instruments must be specified. These responses are given in Table A.10.

4.7 Directional Responses

This section gives directional responses for plane progressive sinusoidal sound waves normalised to the response in the reference direction. Both influence of body and accessories, and the resulting directional responses are given as tables in Appendix A. Only the resulting directional responses are given here as graphs.

The sensitivity variation graphs show the absolute maximum difference between the sensitivities at any two sound incidence angles within the specified interval of angles. For example, at each frequency the value for ±30° is the difference between the highest and the lowest sensitivity found in a circular cone with an opening angle of 60°, the top at the position of the microphone and with the reference direction of incidence as the axis. Because the angle interval defines a three-dimensional geometric shape there is only one set of graphs with sensitivity variations, also where the directional response is shown for two planes. The graphs show the maximum variation for the two measurement planes combined. The sensitivity variations are also given as tables in Appendix A.

Limit curves are drawn on the sensitivity variation graphs in the following sections. These curves represent the IEC 61672–1:2002 limits, reduced by the 'Maximum Expanded Uncertainties of Measurement' from Appendix A of IEC 61672–1:2002. The 'Maximum Expanded Uncertainties of Measurement' used here are the maximum uncertainties that a test organisation may have on its measurements when it performs conformance tests according to IEC 61672:2002.

IEC 61672-1:2013 deals with uncertainty of measurement differently than the 2002 version; therefore, the terminology around the limit curves is different. Seen from an IEC 61672–1:2013 perspective, the limit curves are the standard's acceptance limits.

IEC 61672–1:2013 defines relative directional response in clause 3.17.

The relative directional response for a reference angle can be derived from the specified directional response by normalization with the values (in decibels) in the reference direction; i.e., for each frequency the value at the reference direction is subtracted from the values at all angles so that the resulting value in the reference direction is 0 dB.

IEC 61672–1:2013 requires information on the directivity index.

The directivity index definition in the standard is not very precise; therefore, we have chosen to use the definition in IEC 61183:1994 chapter 4 so that the directivity index in decibels equals the difference between the free-field response in the reference direction and the diffuse-field response without the analyzers electrical responses.

The directivity index for a specific microphone configuration can therefore be found by subtracting the Acoustical Response column minus the Electrical Response column in the relevant diffuse-field table (Table A.7 to Table A.9), from the Acoustical Response column minus the Electrical Response column in the relevant free-field table (Table A.2 to Table A.6).

Fig. 4.12 *Directional response for Microphone Type 4189 and Microphone Preamplifier ZC-0032 with the microphone preamplifier connected to a microphone extension cable. Corresponds to Table A.11 to Table A.13*

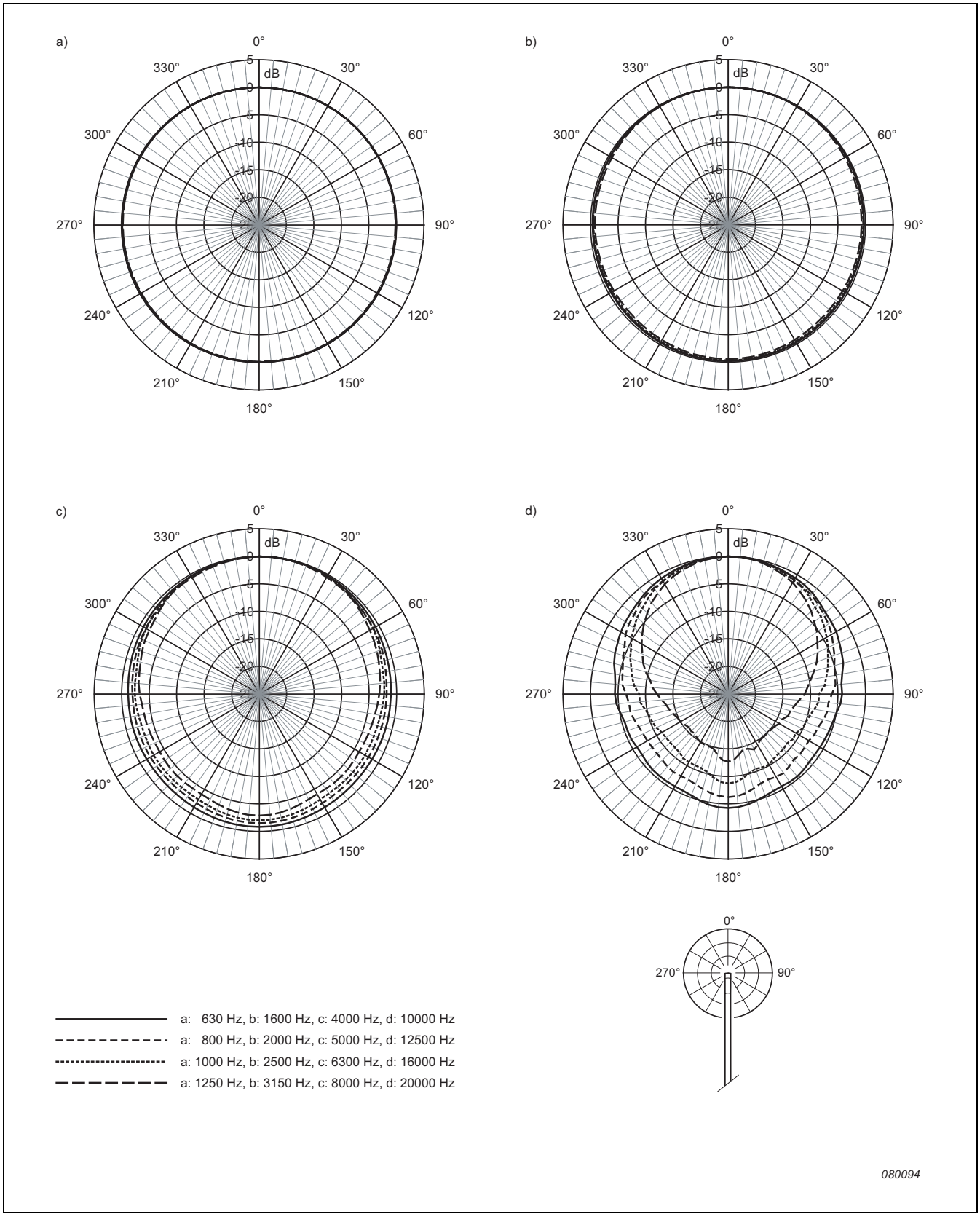


Fig. 4.13 *Sensitivity variations for Microphone Type 4189 and Microphone Preamplifier ZC-0032 with the microphone preamplifier connected to a microphone extension cable, at sound incidence angles within ±θ° from the reference direction. Corresponds to Table A.14*

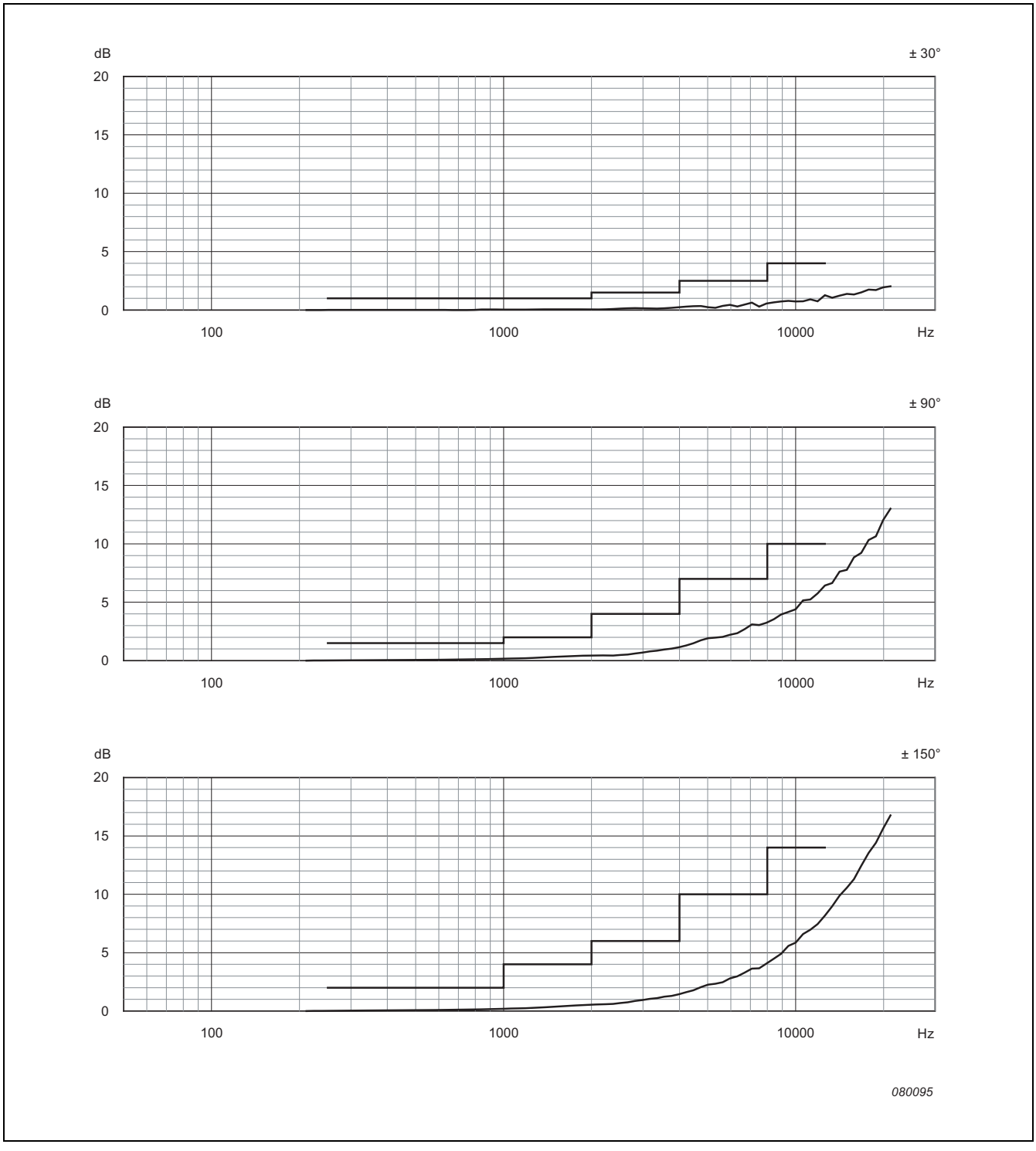


Fig. 4.14 *Directional response for Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer with the microphone preamplifier mounted directly on the analyzer, measured in a plane parallel to the display and along the microphone axis. Corresponds to Table A.21 to Table A.23*

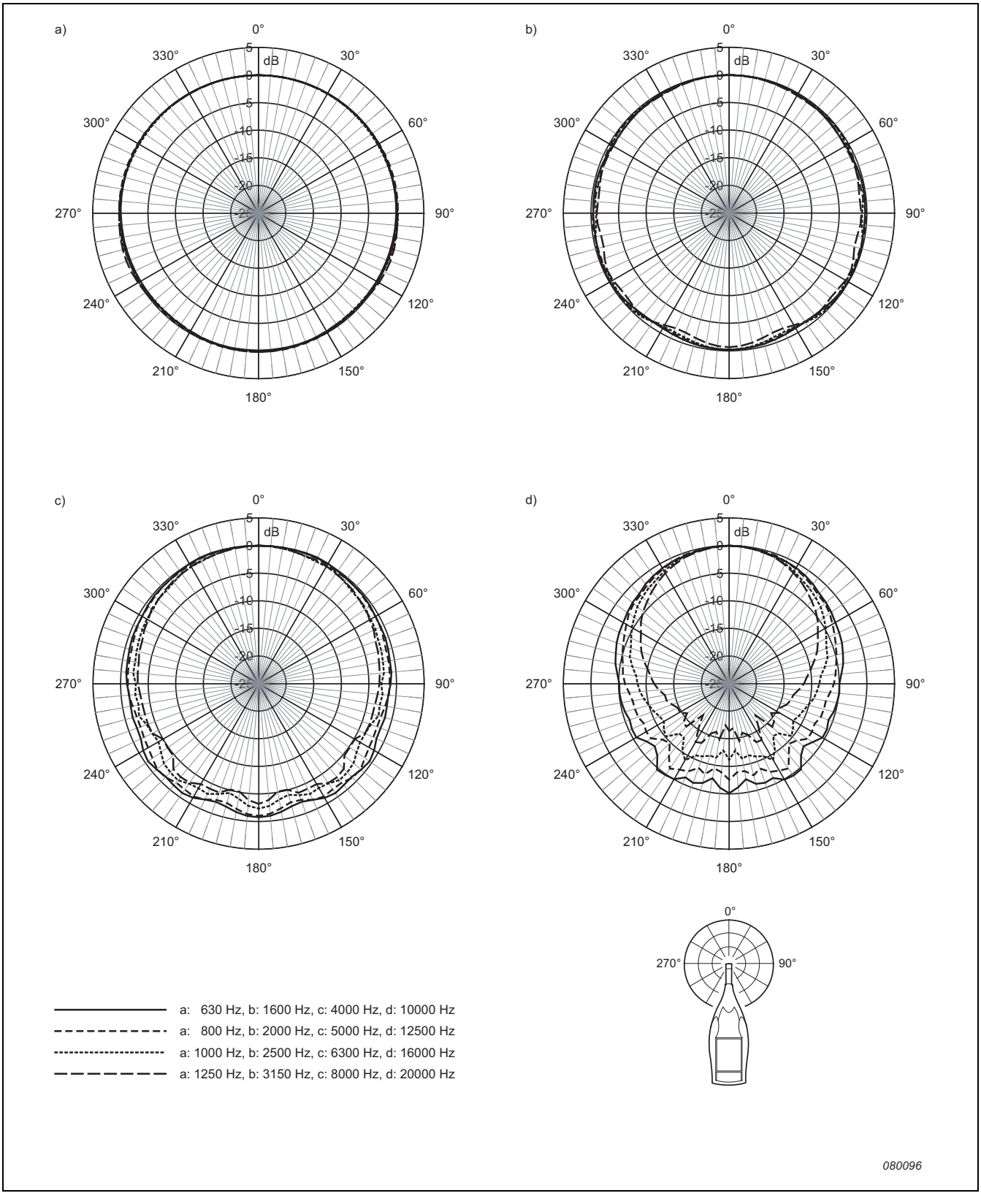


Fig. 4.15 *Directional response for Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer with the microphone preamplifier mounted directly on the analyzer, measured in a plane perpendicular to the display and along the microphone axis. Corresponds to Table A.24 to Table A.26*

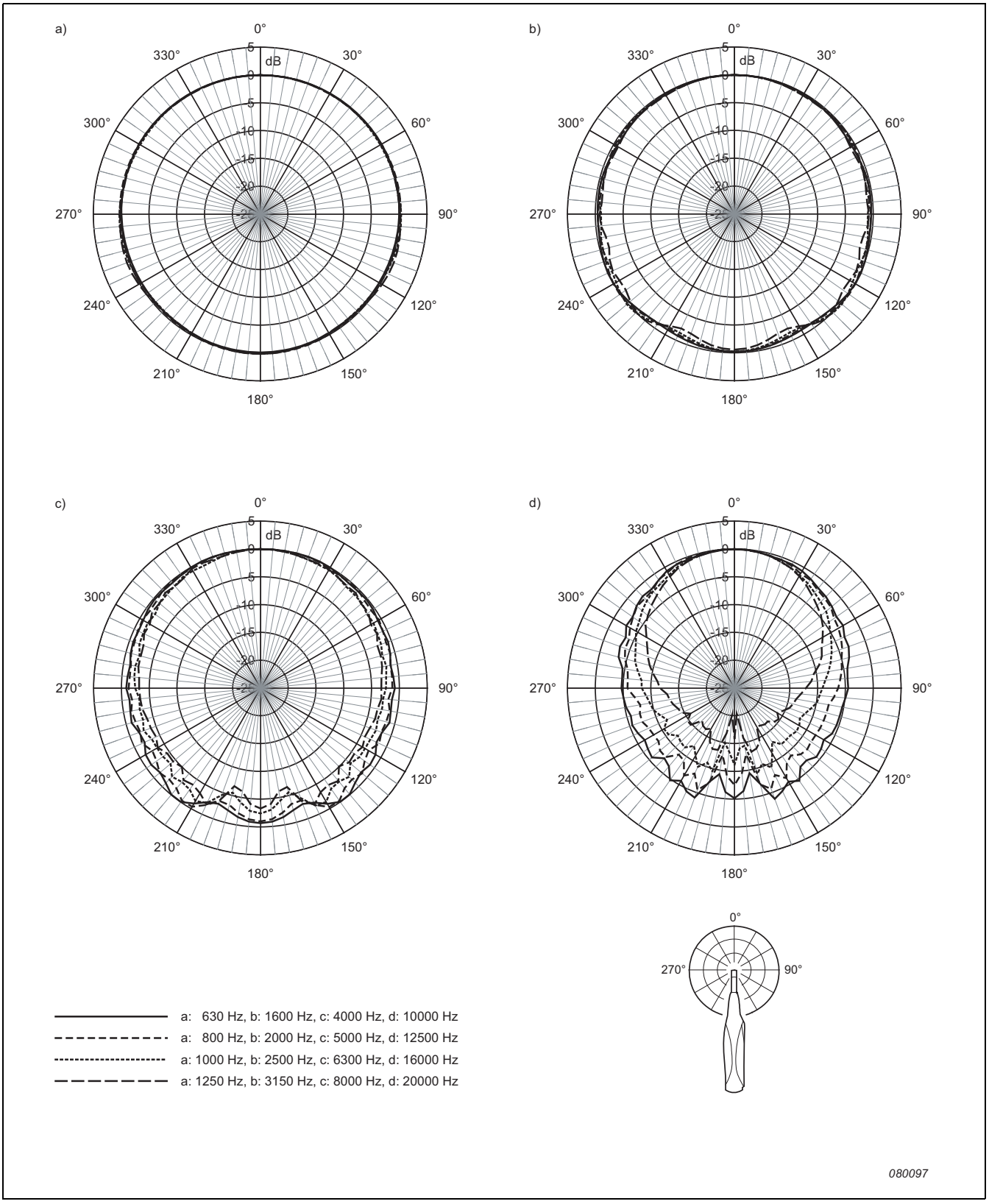


Fig. 4.16 *Sensitivity variations of Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer with the microphone preamplifier mounted directly on the analyzer, at sound incidence angles within ±θ° from the reference direction. Corresponds to Table A.27*

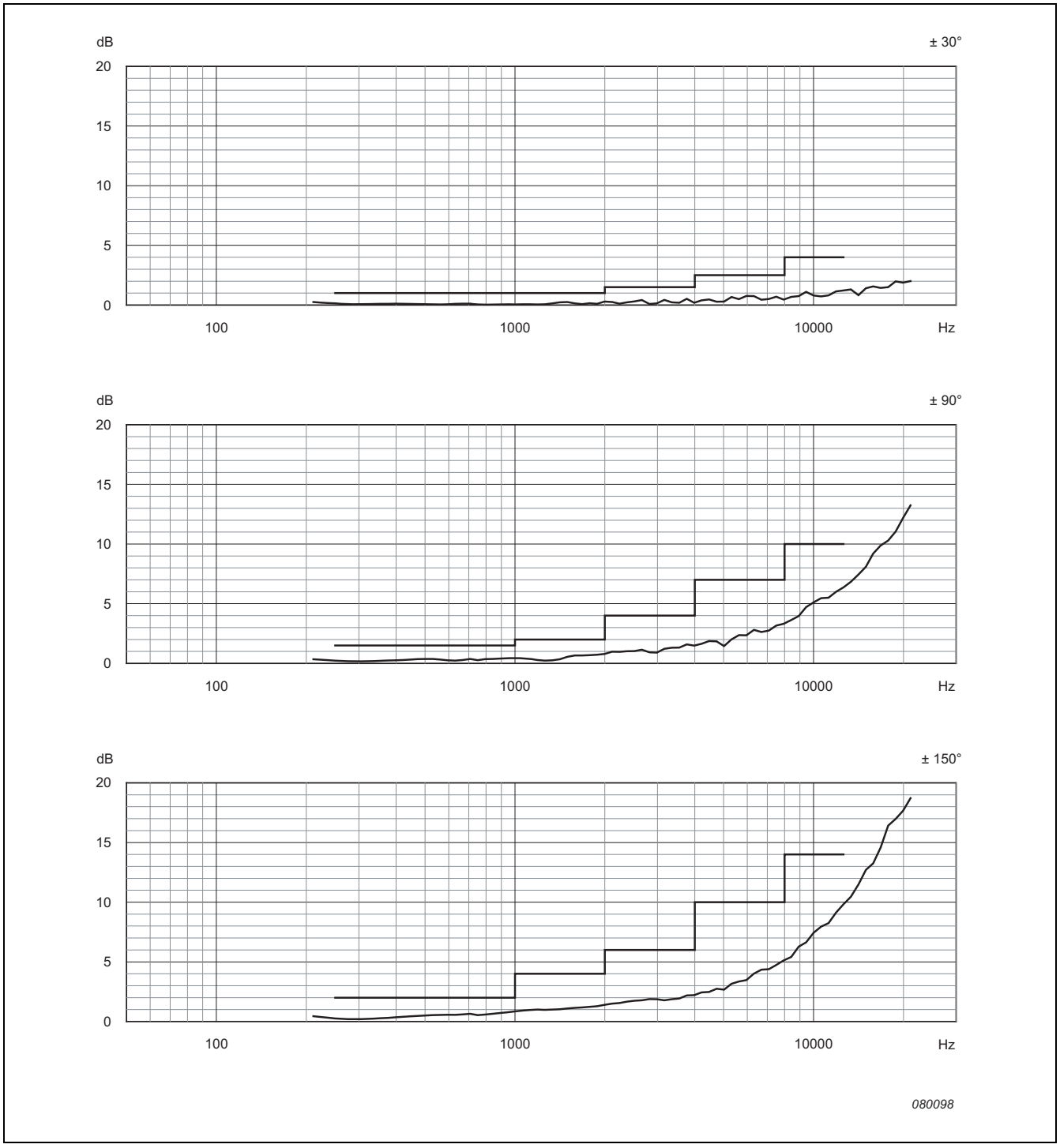


Fig. 4.17 *Directional response for Windscreen UA-1650, Microphone Type 4189 and Microphone Preamplifier ZC-0032 with the microphone preamplifier connected to a microphone extension cable. Corresponds to Table A.31 to Table A.33*

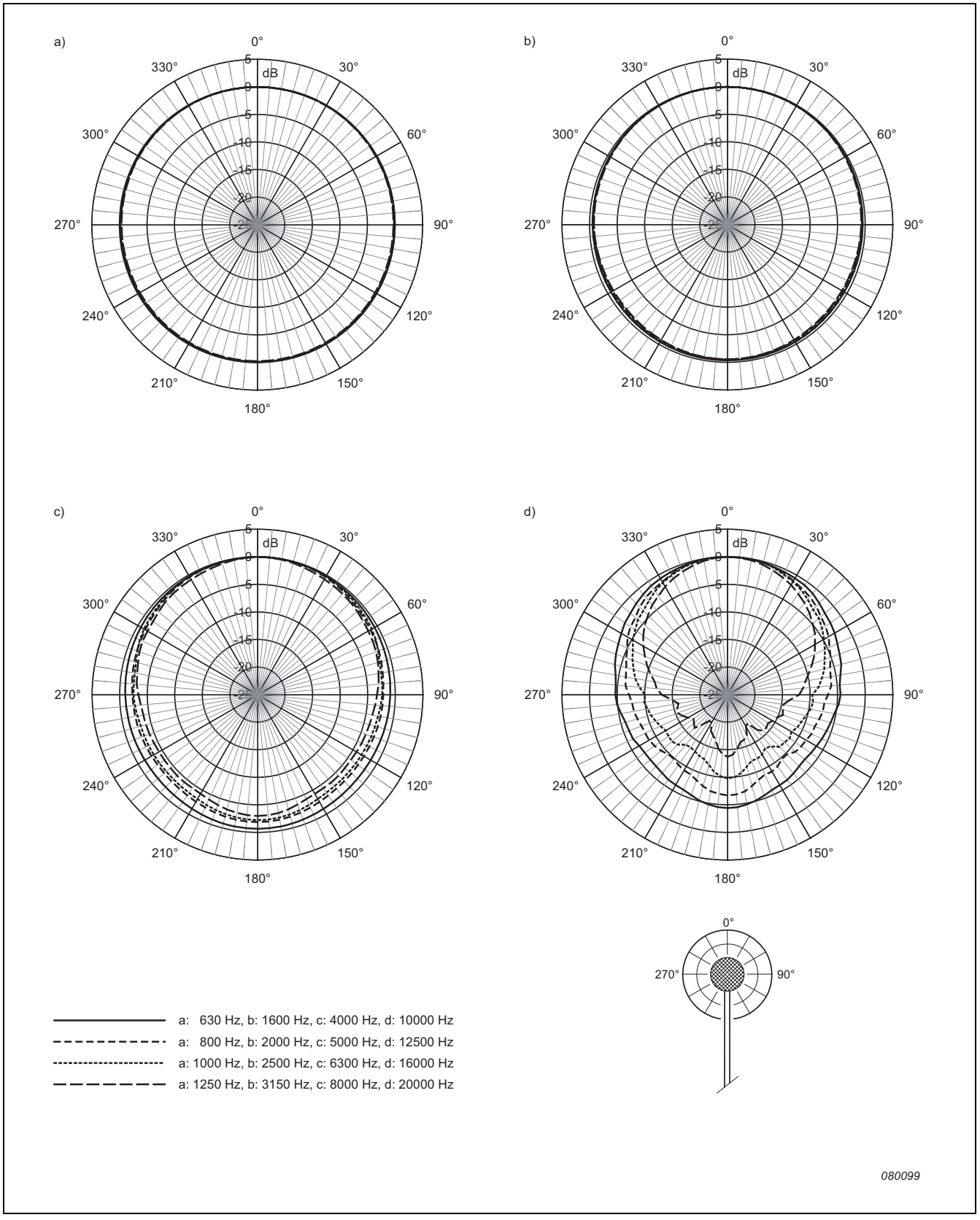


Fig. 4.18 *Sensitivity variations for Windscreen UA-1650, Microphone Type 4189 and Microphone Preamplifier ZC-0032 with the microphone preamplifier connected to a microphone extension cable, at sound incidence angles within ±θ° from the reference direction. Corresponds to Table A.34*

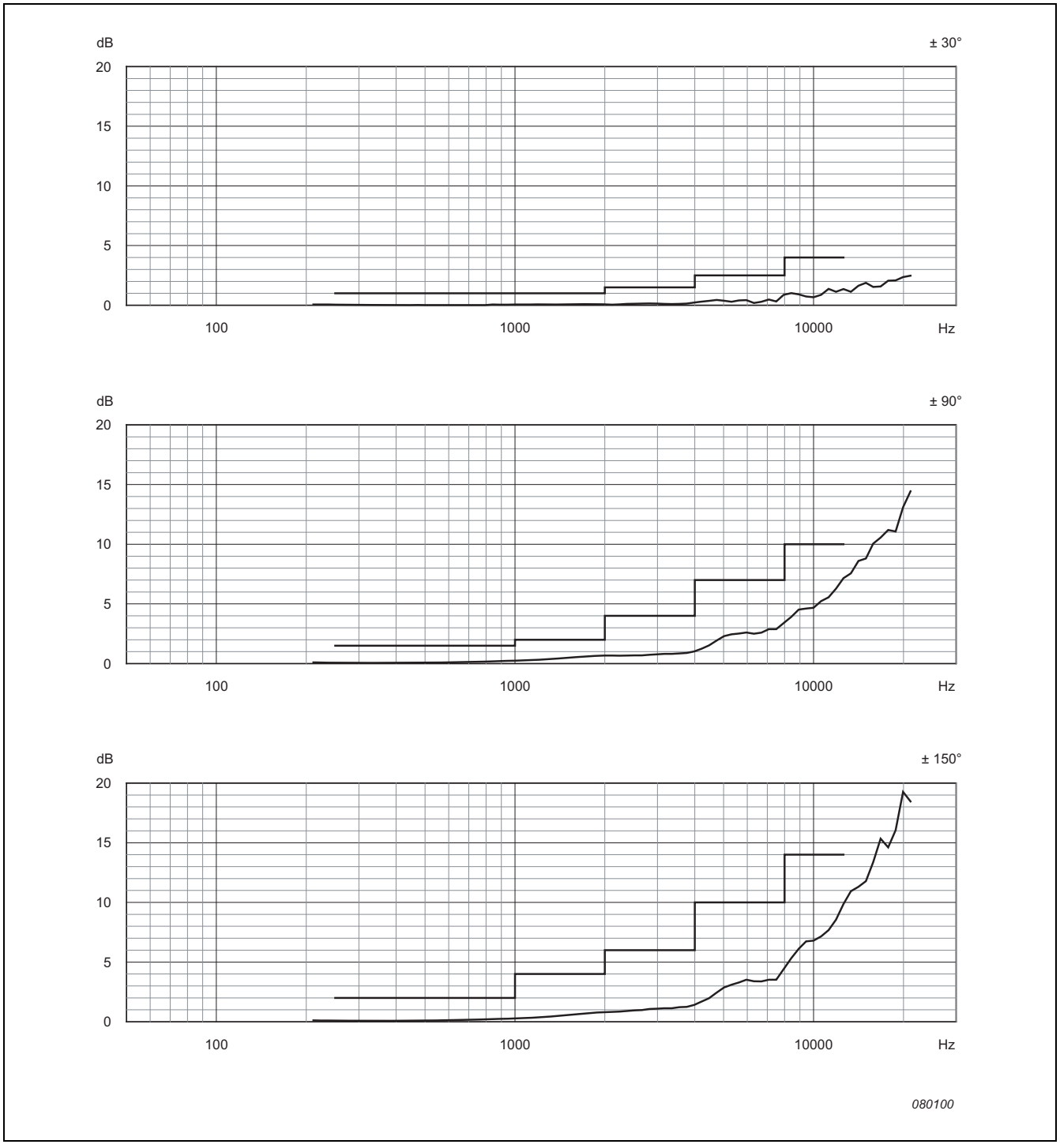


Fig. 4.19 *Directional response for Windscreen UA-1650, Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer with the microphone preamplifier mounted directly on the analyzer, measured in a plane parallel to the display and along the microphone axis. Corresponds to Table A.35 to Table A.37*

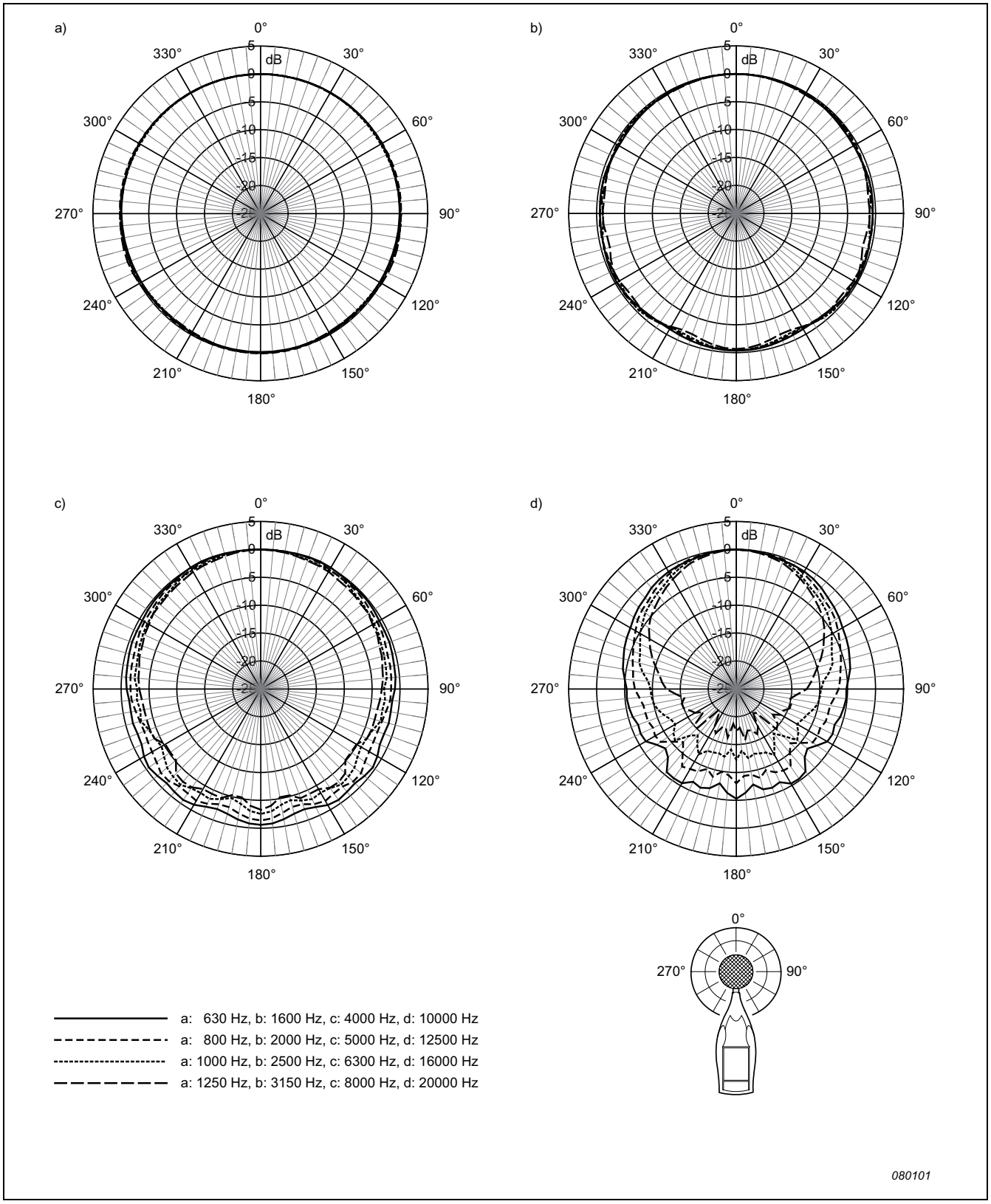


Fig. 4.20 *Directional response for Windscreen UA-1650, Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer with the microphone preamplifier mounted directly on the analyzer, measured in a plane perpendicular to the display and along the microphone axis. Corresponds to Table A.38 to Table A.40*

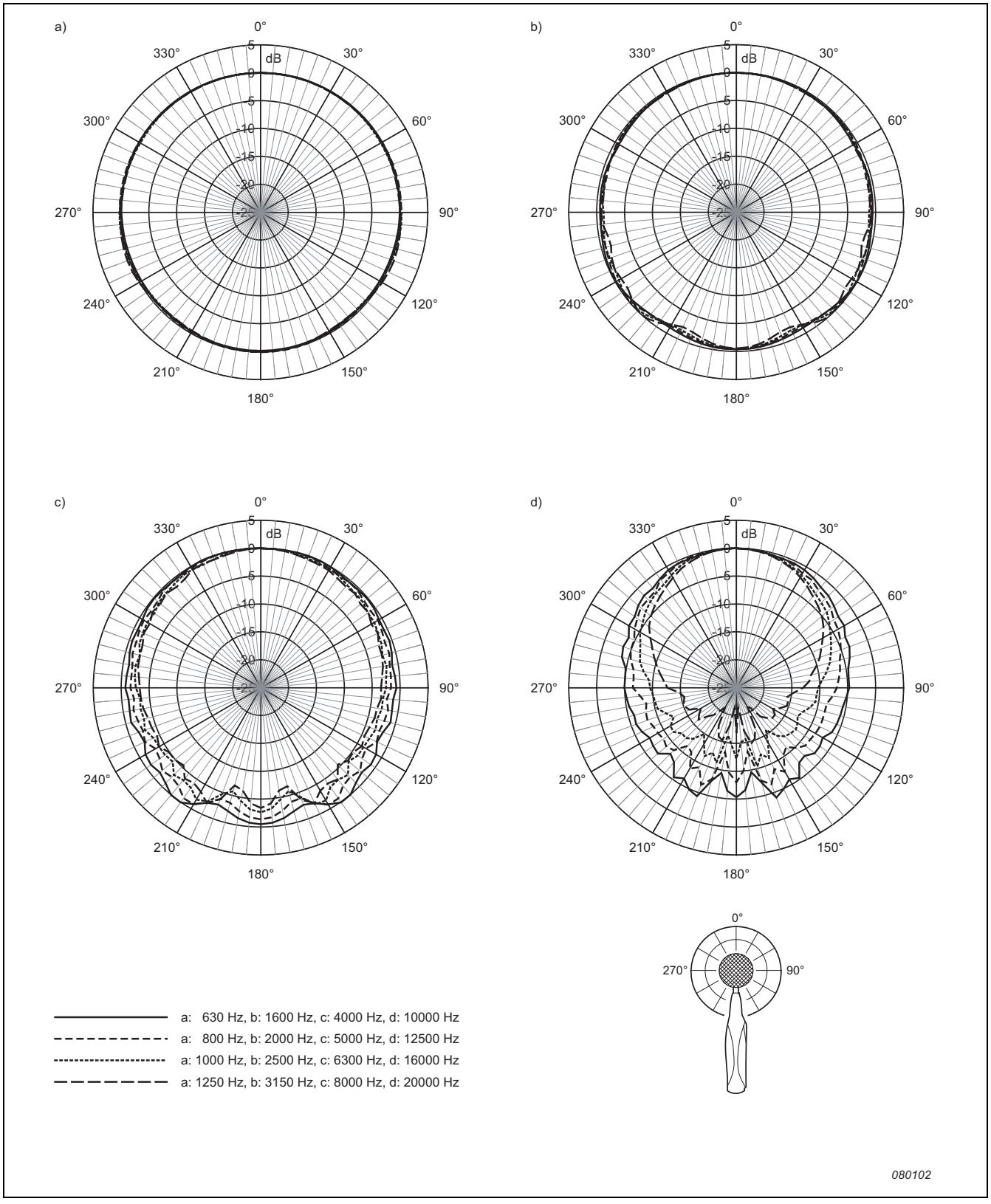


Fig. 4.21 *Sensitivity variations of Windscreen UA-1650, Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer with the microphone preamplifier mounted directly on the analyzer, at sound incidence angles within $\pm\theta°$ from the reference direction. Corresponds to Table A.41*

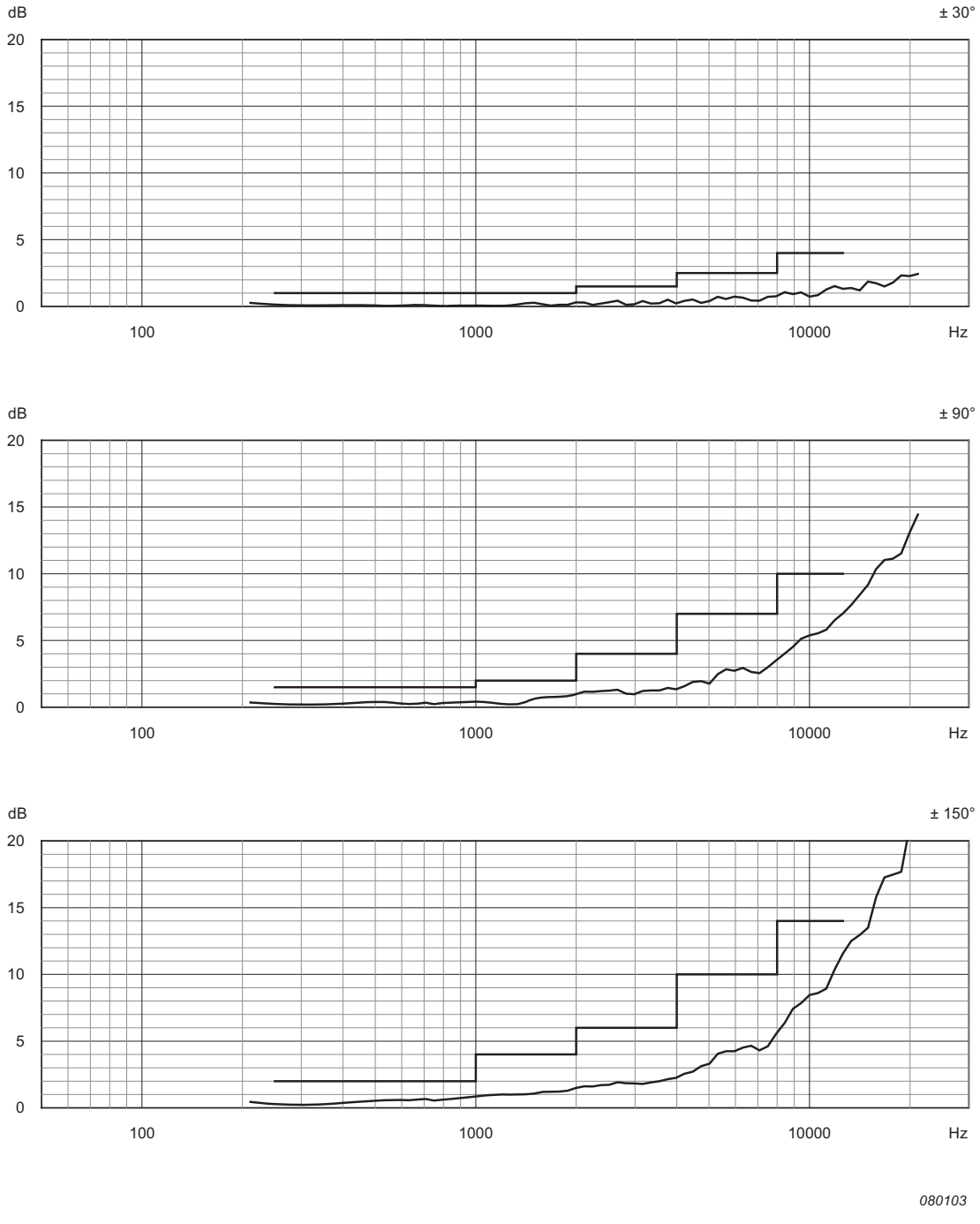


Fig. 4.22 *Directional response for Outdoor Microphone Kit UA-1404, Microphone Type 4189 and Microphone Preamplifier ZC-0032 with the microphone preamplifier connected to a microphone extension cable. Corresponds to Table A.45 to Table A.47*

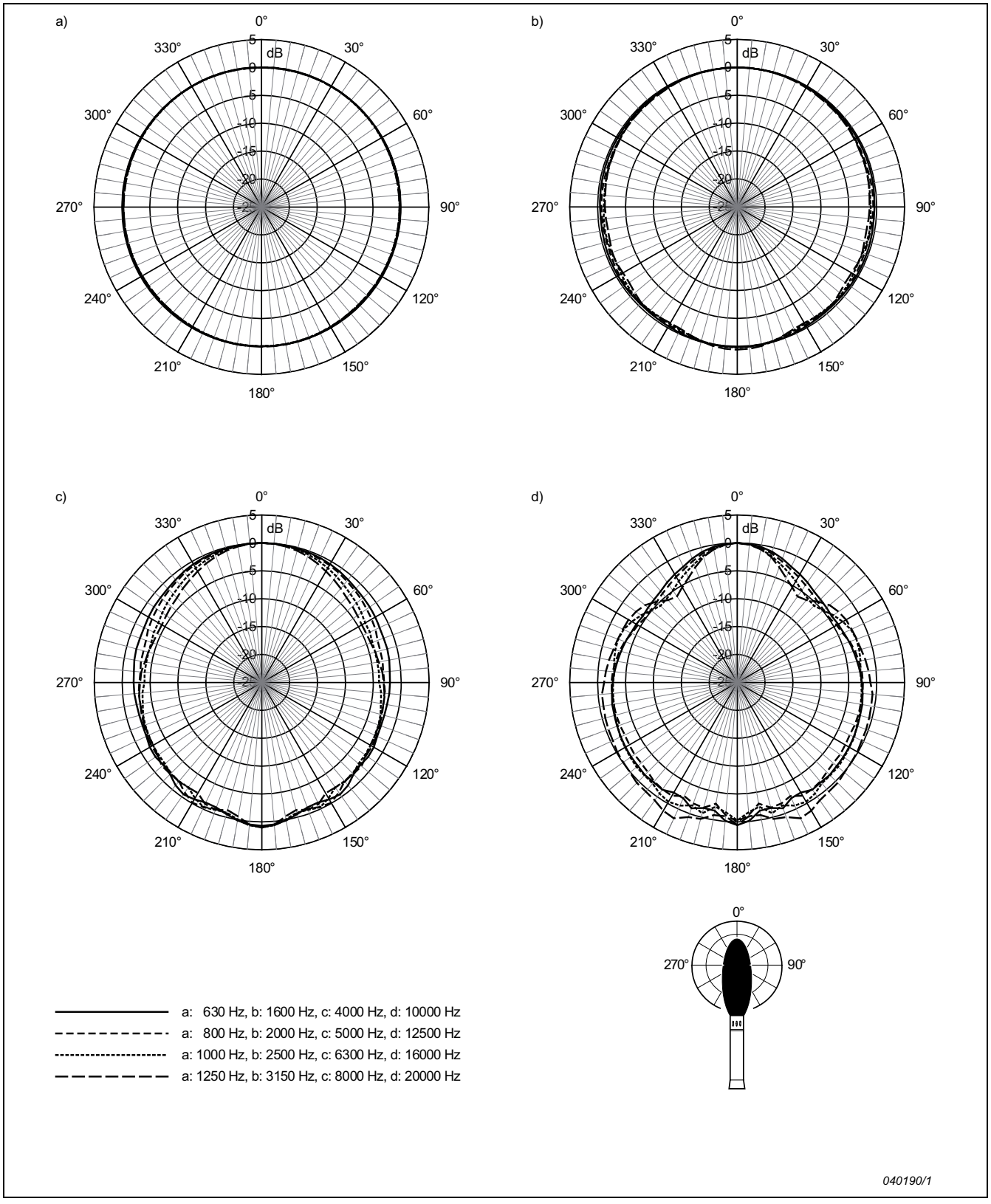
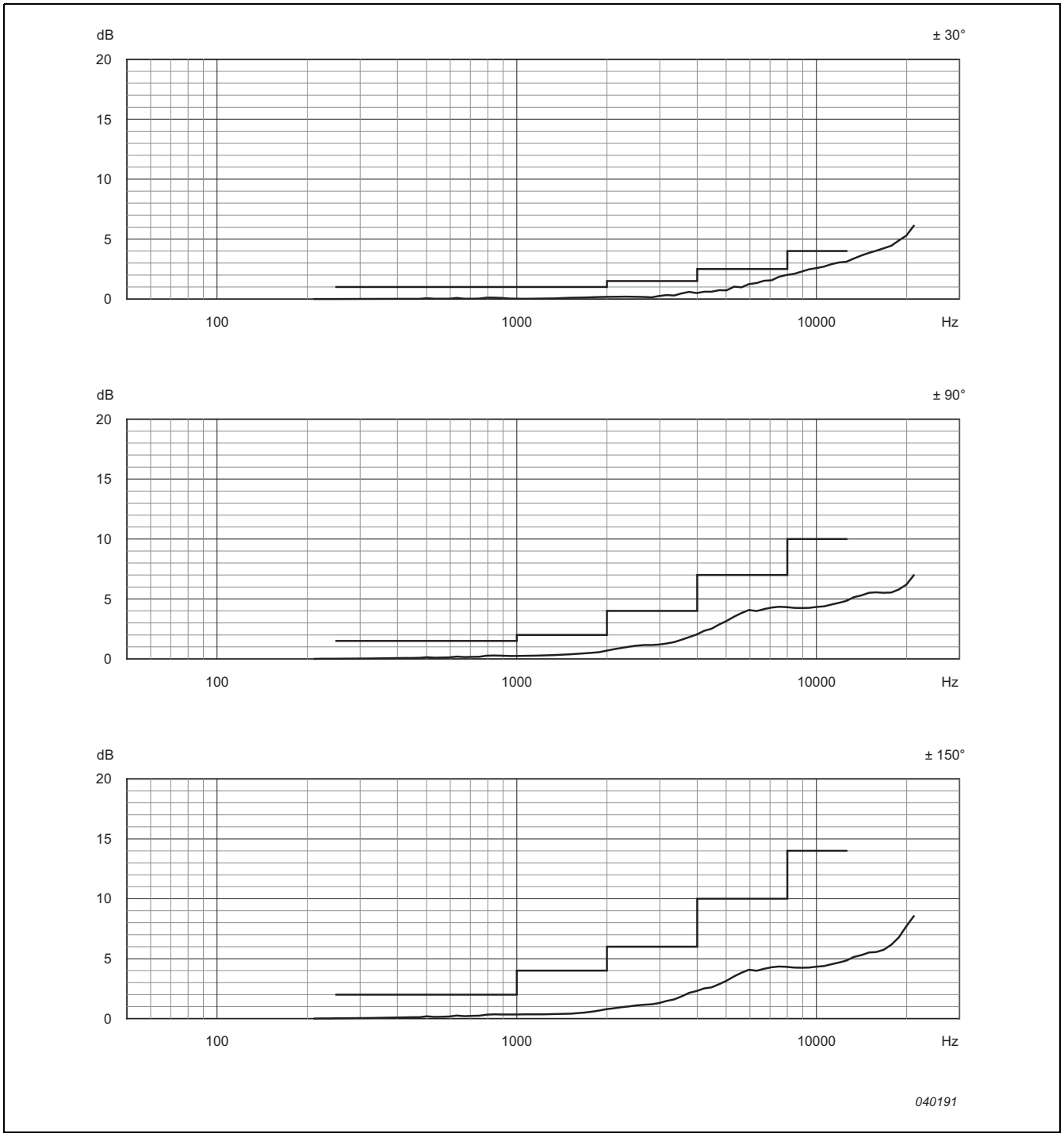


Fig. 4.23 *Sensitivity variations for Outdoor Microphone Kit UA-1404, Microphone Type 4189 and Microphone Preamplifier ZC-0032 with the microphone preamplifier connected to a microphone extension cable, at sound incidence angles within $\pm\theta°$ from the reference direction. Corresponds to Table A.48*



4.8 Self-generated Noise

Self-generated noise is given for nominal microphone Open Circuit Sensitivity, with *Sound Field Correction* set to *Free-field* and no microphone accessories selected.

4.8.1 Maximum Broadband Self-generated Noise

Table 4.1
Maximum broadband self-generated noise

Maximum Noise	Frequency Weighting				
	A-weighting (dB)	B-weighting (dB)	C-weighting (dB)	Z-weighting* Normal (dB)	Z-weighting* Extended (dB)
Single-range					
Microphone	15.6	14.4	14.5	16.3	16.3
Electrical	13.6	12.9	14.3	19.4	30.0
Total	17.7	16.7	17.4	21.1	30.2
High Range					
Microphone	15.6	14.4	14.5	16.3	16.3
Electrical	31.8	30.5	30.5	34.7	35.8
Total	31.9	30.6	30.6	34.8	35.8
Low Range					
Microphone	15.6	14.4	14.5	16.3	16.3
Electrical	13.6	12.9	14.3	19.4	30.0
Total	17.7	16.7	17.4	21.1	30.2

*. minimum 120 seconds L_{Zeq}

4.8.2 Typical Broadband Self-generated Noise

Table 4.2
Typical broadband self-generated noise

Typical Noise	Frequency Weighting				
	A-weighting (dB)	**B-weighting (dB)**	**C-weighting (dB)**	**Z-weighting* Normal (dB)**	**Z-weighting* Extended (dB)**
Single-range					
Microphone	14.6	13.4	13.5	15.3	15.3
Electrical	12.4	11.5	12.9	18.3	25.5
Total	16.6	15.6	16.2	20.1	25.9
High Range					
Microphone	14.6	13.4	13.5	15.3	15.3
Electrical	28.3	26.9	27.0	31.2	32.1
Total	28.5	27.1	27.2	31.3	32.2
Low Range					
Microphone	14.6	13.4	13.5	15.3	15.3
Electrical	12.4	11.5	12.9	18.3	25.5
Total	16.6	15.6	16.2	20.1	25.9

*. minimum 120 seconds L_{Zeq}

4.8.3 Typical Self-generated Noise Spectra

Typical spectra for self-generated noise are shown in Fig. 4.24 to Fig. 4.29.

Fig. 4.24 *Typical self-generated noise, 1/1-octave band, Single-range*

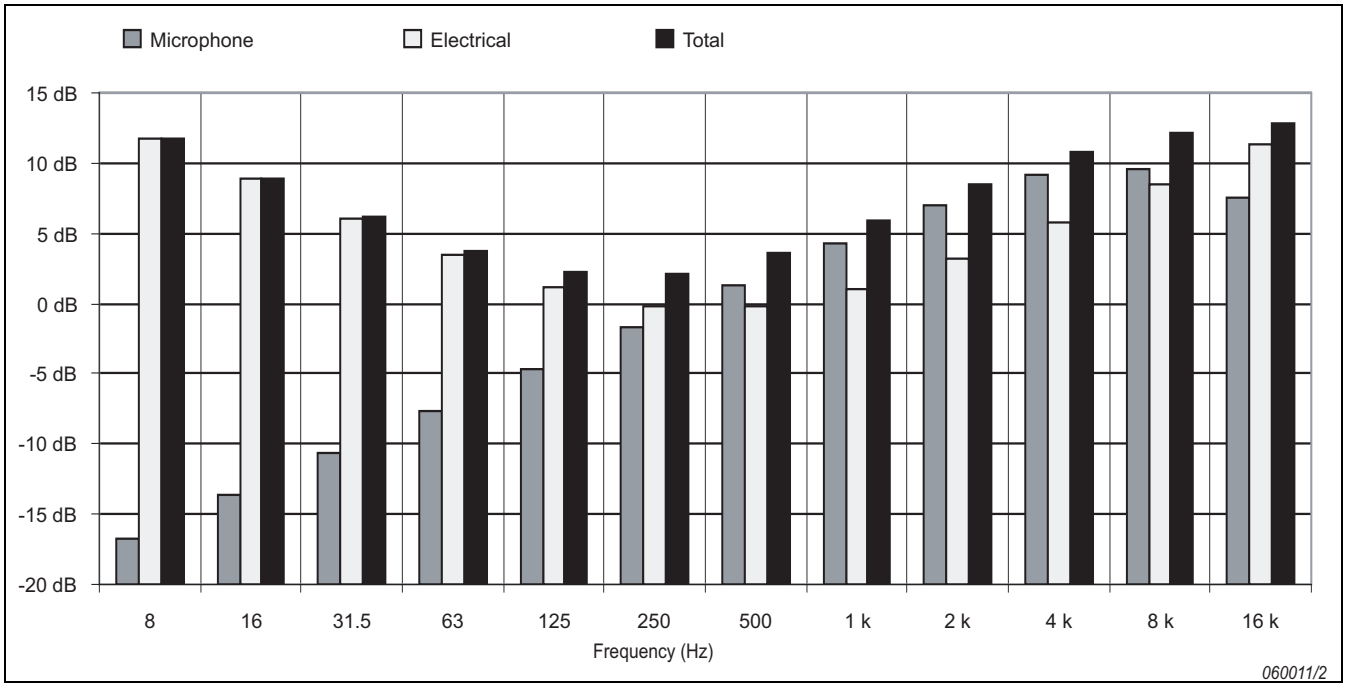


Fig. 4.25 *Typical self-generated noise, 1/1-octave band, High Range*

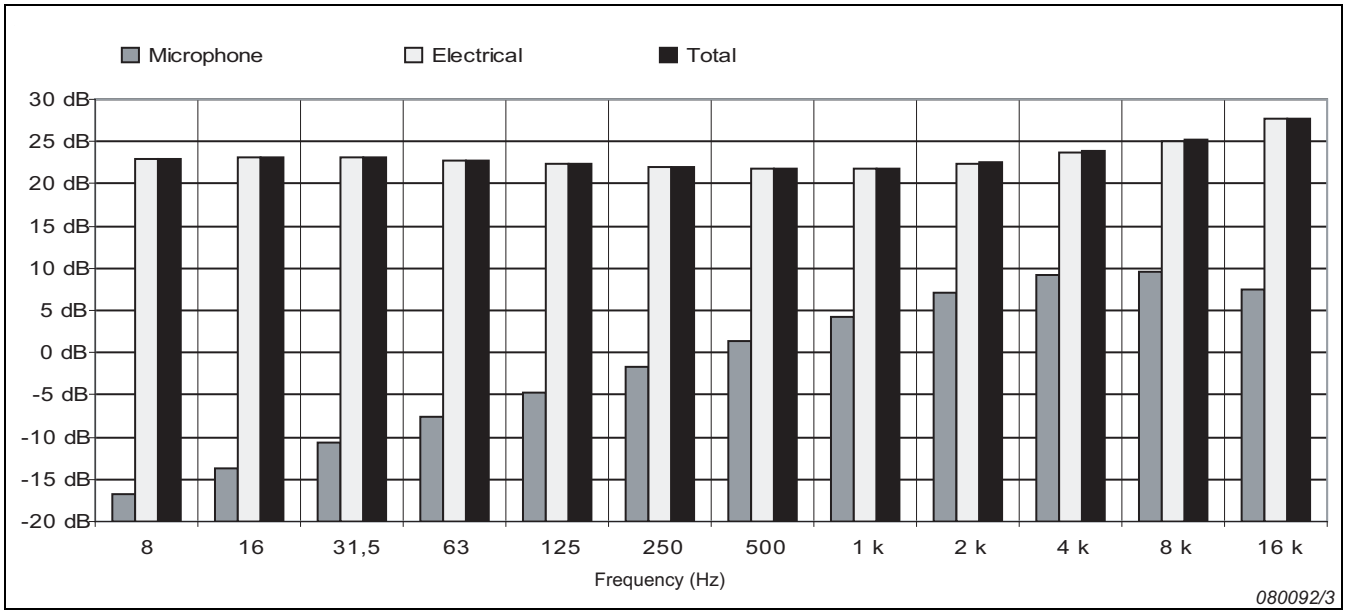


Fig. 4.26 *Typical self-generated noise, 1/1 octave band, Low Range*

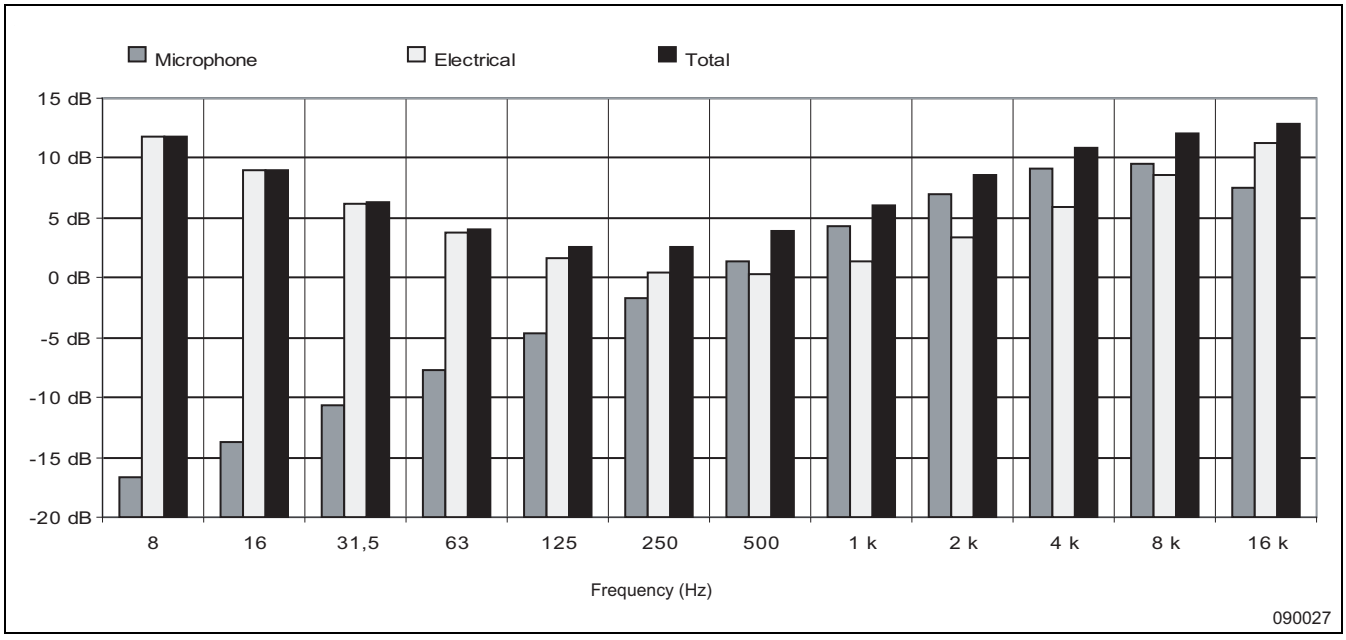


Fig. 4.27 *Typical self-generated noise, 1/3 octave band, Single-range*

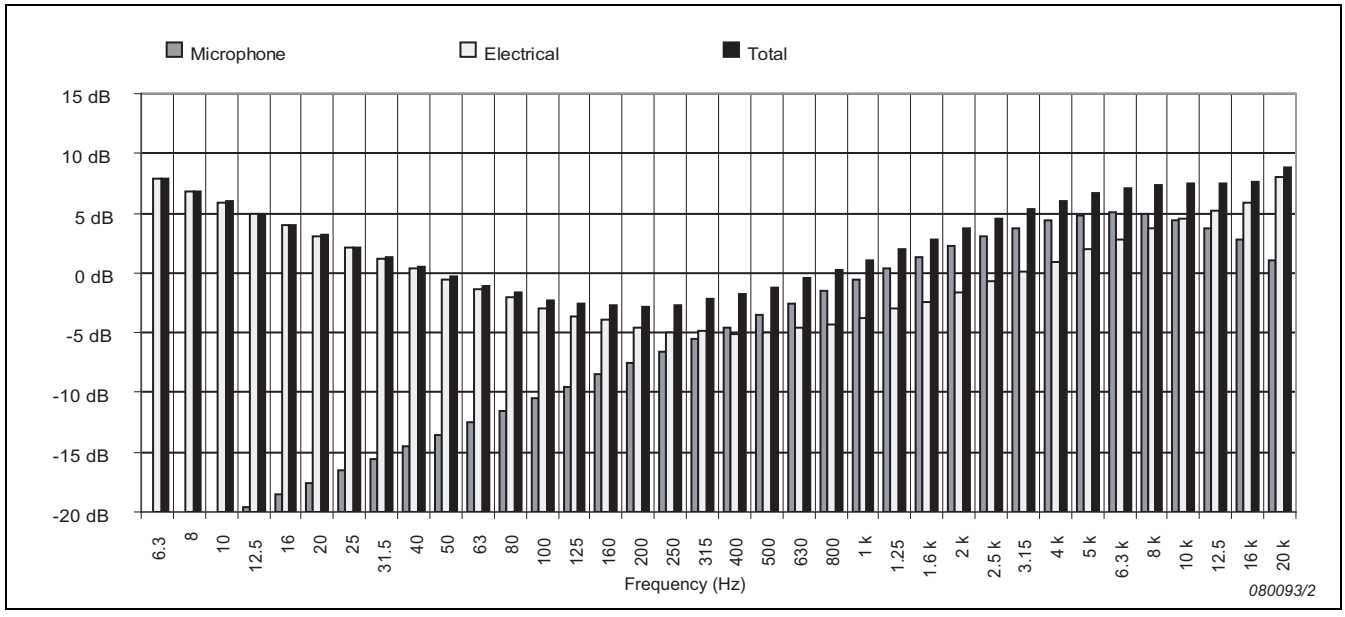


Fig. 4.28 *Typical self-generated noise, 1/3-octave band, High Range*

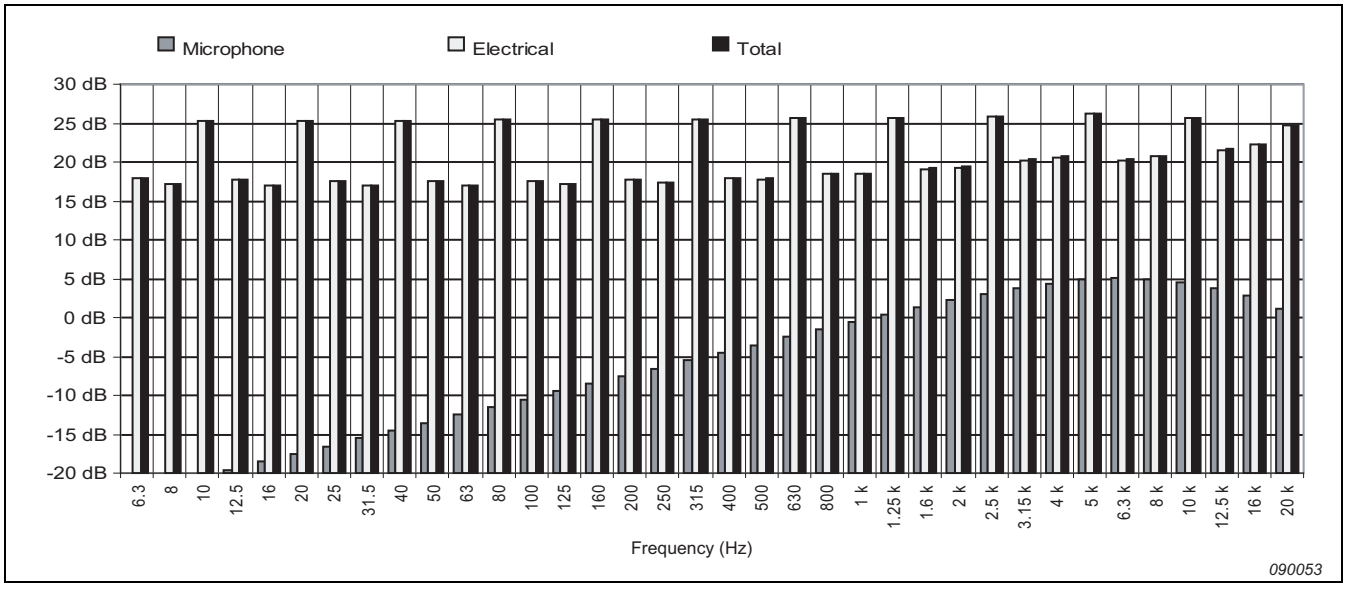
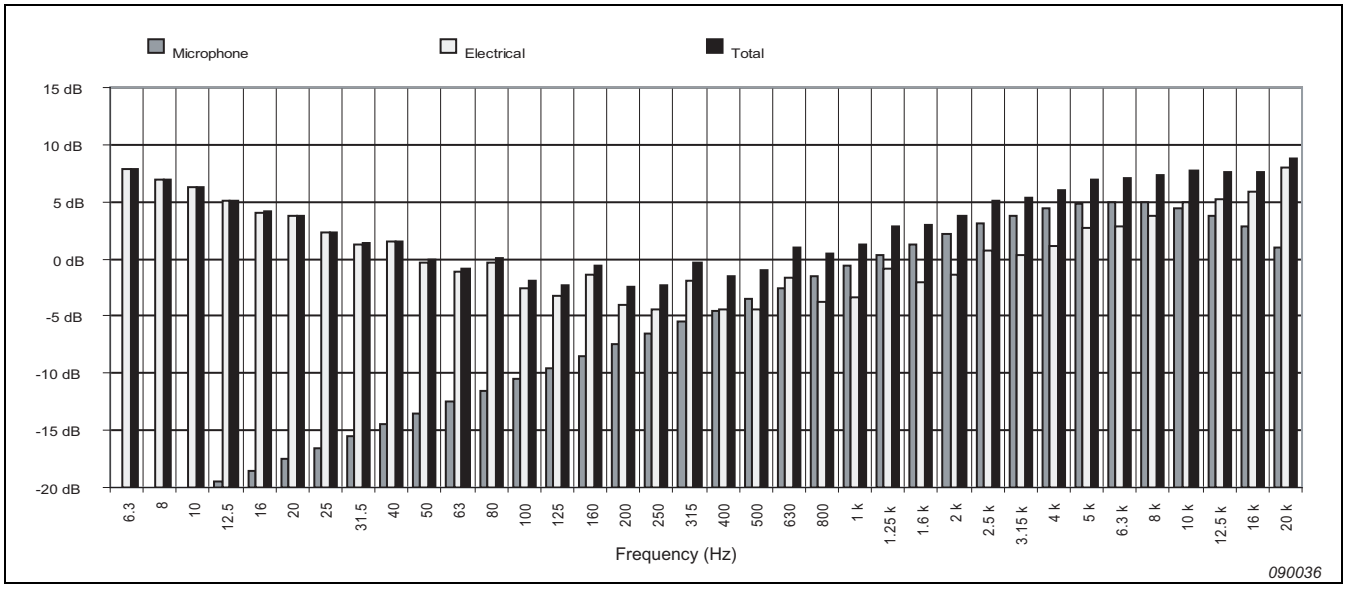


Fig. 4.29 *Typical self-generated noise, 1/3 octave band, Low Range*



4.8.4 Crosstalk

This only applies to Type 2270.

Crosstalk between the two channels is measured with the Dual 10-pole Adaptor JP-1041 connected to the Top Socket, two 10 m Microphone Extension Cables AO-0697-D-100 and two Microphone Preamplifiers ZC-0032, with Electrical Substitute for Microphones as described in section 3.5. The one short-circuited and the other connected to the generator: 5 Hz – 10 kHz < –110 dB, 10 kHz – 20 kHz < – 100 dB.

4.9 Measuring Ranges

The Upper Limit in the following sections is based on the guaranteed worst-case limit for the analyzer and the nominal Open Circuit Sensitivity of the microphone. The Overload Limit can, due to tolerances in the analyzer, be up to 1.5 dB higher than the worst-case limit, but tolerances specified in the International Standards are maintained as long as no Overload is indicated.

The Lower Limit in the following sections is based on the guaranteed worst-case limit for the analyzer, the nominal open circuit sensitivity of the microphone, under Reference Environmental Conditions, *Sound Field Correction* set to *Free-field* and no microphone accessories selected.

4.9.1 Maximum Sound Level

The maximum Sound Level that the Sound Level Meter can accommodate without causing damage to the Sound Level Meter: 158 dB Peak.

4.9.2 Total Range

Total Range is defined as the difference between the Upper Limit on the least sensitive level range, and the lowest sound pressure level measurable on the most sensitive level range, which can be measured at 1 kHz within the most conservative tolerance limits, specified in the International Standards IEC 61672–1, IEC 60651 and IEC 60804:

Table 4.3
Total Range

Frequency Weighting				
A-weighting (dB)	**B-weighting (dB)**	**C-weighting (dB)**	**Z-weighting Normal (dB)**	**Z-weighting Extended (dB)**
139.7 – 24.8	139.7 – 24.1	139.7 – 25.5	139.7 – 30.6	139.7 – 41.2

Note: For Sound Exposure Levels, the stated ranges are valid if 10*lg(Δ*t*) is added to the limits. Δ*t* being the averaging time interval, indicated as *Elapsed Time*, expressed in seconds.

4.9.3 Primary Indicator Range

Primary Indicator Range according to the International Standard IEC 60651:

Table 4.4
Primary Indicator Range

Range	**Upper Limit (dB)**	**Lower Limit**				
		A-weighting (dB)	**B-weighting (dB)**	**C-weighting (dB)**	**Z-weighting Normal (dB)**	**Z-weighting Extended (dB)**
Single	122.3	23.5	22.8	24.2	29.3	39.9
High	122.3	41.7	40.4	40.4	44.6	45.7
Low	92.3	23.5	22.8	24.2	29.3	39.9

4.9.4 Indicator Range

Indicator Range according to the International Standard IEC 60804:

Table 4.5
Indicator Range

Range	**Upper Limit (dB)**	**Lower Limit**				
		A-weighting (dB)	**B-weighting (dB)**	**C-weighting (dB)**	**Z-weighting Normal (dB)**	**Z-weighting Extended (dB)**
Single	139.3	23.5	22.8	24.2	29.3	39.9
High	139.3	41.7	40.4	40.4	44.6	45.7
Low	109.3	23.5	22.8	24.2	29.3	39.9

Note: For Sound Exposure Levels, the stated ranges are valid if 10*lg(Δ*t*) is added to the limits. Δ*t* being the averaging time interval, indicated as *Elapsed Time*, expressed in seconds.

4.9.5 Linearity Range

Linearity Range according to the International Standard IEC 60804 is the difference between the Upper and Lower Limit in the following table:

Table 4.6
Linearity Range

Range	Upper Limit (dB)	Lower Limit				
		A-weighting (dB)	B-weighting (dB)	C-weighting (dB)	Z-weighting Normal (dB)	Z-weighting Extended (dB)
Single	140.8	21.4	20.7	22.1	27.2	37.8
High	140.8	39.6	38.3	38.3	42.5	43.6
Low	110.8	21.4	20.7	22.1	27.2	37.8

Note: For Sound Exposure Levels, the stated ranges are valid if 10*lg(Δ*t*) is added to the limits. Δ*t* being the averaging time interval, indicated as *Elapsed Time*, expressed in seconds.

4.9.6 Pulse Range

Pulse Range according to the International Standard IEC 60804 is the difference between the Upper and Lower Limit in the following table:

Table 4.7
Pulse Range

Range	Upper Limit (dB)	Lower Limit				
		A-weighting (dB)	B-weighting (dB)	C-weighting (dB)	Z-weighting Normal (dB)	Z-weighting Extended (dB)
Single	143.8	21.4	20.7	22.1	27.2	37.8
High	143.8	39.6	38.3	38.3	42.5	43.6
Low	113.8	21.4	20.7	22.1	27.2	37.8

Note: For Sound Exposure Levels, the stated ranges are valid if 10*lg(Δ*t*) is added to the limits. Δ*t* being the averaging time interval, indicated as *Elapsed Time*, expressed in seconds.

4.9.7 Linear Operating Range

The starting point for all the Linear Operating Range tests is 94.0 dB.

Linear Operating Range according to the International Standard IEC 61672–1:

Table 4.8
Linear Operating Range

Frequency-Weighting	Upper Limit					Lower Limit
	31.5 Hz (dB)	1 kHz (dB)	4 kHz (dB)	8 kHz (dB)	12.5 kHz (dB)	All (dB)
Single range						
A-weighting	100.6	139.7	140.8	138.9	135.3	24.8
B-weighting	122.9	139.7	139.1	137.1	133.4	24.1
C-weighting	137.0	139.7	139.0	137.0	133.3	25.5
Z-weighting Normal	140.0	139.7	139.8	140.0	139.6	30.6
Z-weighting Extended	140.0	139.7	139.8	140.0	139.6	41.2
High Range						
A-weighting	100.6	139.7	140.8	138.9	135.3	43.0
B-weighting	122.9	139.7	139.1	137.1	133.4	41.7
C-weighting	137.0	139.7	139.0	137.0	133.3	41.7
Z-weighting Normal	140.0	139.7	139.8	140.0	139.6	45.9
Z-weighting Extended	140.0	139.7	139.8	140.0	139.6	47.0
Low Range						
A-weighting	70.6	109.7	110.8	108.9	105.3	24.8
B-weighting	92.9	109.7	109.1	107.1	103.4	24.1
C-weighting	107.0	109.7	109.0	107.0	103.3	25.5
Z-weighting Normal	110.0	109.7	109.8	110.0	109.6	30.6
Z-weighting Extended	110.0	109.7	109.8	110.0	109.6	41.2

Note: For Sound Exposure Levels, the stated ranges are valid if $10*\lg(\Delta t)$ is added to the limits. Δt being the averaging time interval, indicated as *Elapsed Time*, expressed in seconds.

4.9.8 Peak C Range

Peak C Range according to the International Standard IEC 61672–1 is:

Table 4.9
Peak C Range

Range	Upper Limit					Lower Limit
	31.5 Hz (dB)	1 kHz (dB)	4 kHz (dB)	8 kHz (dB)	12.5 kHz (dB)	All (dB)
Single	140.0	142.7	142.0	140.0	136.3	42.3
High	140.0	142.7	142.0	140.0	136.3	58.5
Low	110.0	112.7	112.0	110.0	106.3	42.3

4.10 Detectors

Display-update Rates: L_{xy} broadband bars and spectra every 0.2 s; all other spectra and numbers. every 1 s.

4.10.1 Exponential Averaging

Exponential Averaging Times: Fast (250 ms), Slow (2000 ms), Impulse (70 ms + 1500 ms hold time. constant)

Response to tone bursts for exponential averaging detectors according to IEC 60651 and DIN 45657:

Table 4.10 *Response to tone bursts for exponential averaging detectors*

Time Weighting	Duration of test tone burst (ms)	Maximum response to test tone burst referred to response to continuous signal (dB)	Standards tolerances on maximum response (dB)	Analyzer tolerances on maximum response (dB)
	Continuous	0		
F	200	–0.98	±1	±0.1
	100	–2.59	±2	±0.1
	50	–4.82	±2	±0.1
	20	–8.30	±2	±0.1
	10	–11.14	±2	±0.1
	5	–14.07	±2	±0.1
	2	–17.99	±2	±0.1
	1	–20.99	±2	±0.1
	0.5	–23.99	±2	±0.1
	0.25	–26.99	±2	±0.1
S	2000	–0.63	–	±0.1
	500	–4.05	±1	±0.1
	200	–7.42	–	±0.1
	50	–13.12	–	±0.1
I	20	–3.61	±1.5	±0.2
	5	–8.76	±2	±0.2
	2	–12.55	±2	±0.2

Note: The maximum response to test tone burst referred to response to continuous signal is calculated from the formula in IEC 60651 appendix C.

4.10.2 Linear Averaging

Linear Averaging Times: 1 second to 24 hours, in steps of 1 second

Settling Time According to IEC 60804: < 2 seconds

Nominal Delay Time between operation of the reset facility and re-initiation of a measurement according to IEC 61672–1: < 3 seconds

Time Interval after completion of a measurement before a reading is displayed according to IEC 61672–1: < 1 second

Minimum Hold Time according to IEC 60804: Results of a Timed Measurement are held until a new measurement is initiated or the result is reset.

4.10.3 Peak

Peak Onset Time according to IEC 60651: < 100 µs

4.11 Spectrum Analysis

Note: Spectrum analysis requires Frequency Analysis Software to be enabled. When using the 1/1-oct. Frequency Analysis Software for 2250 Light, BZ-7131, the frequency range is limited to between16 Hz and 8 kHz, and when using 1/3-oct. Frequency Analysis Software for 2250 Light, BZ-7132, the frequency range is limited to between 12.5 Hz and 16 kHz.

Analytical Filter Design: Optimised Z-transformation of analogue Butterworth filters

Base: 2

Sampling Rate: Octave-based down-sampling from 48 kHz

Reference Attenuation: 0 dB

4.11.1 1/1- octave Band Centre Frequencies

Nominal: 8 Hz*, 16 Hz, 31.5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 8 kHz, 16 kHz†

Exact (5 digits): 7.8125 Hz, 15.625 Hz, 31.25 Hz, 62.5 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 8 kHz, 16 kHz

Real-time Frequency Range: 8 Hz to 16 kHz centre frequencies.

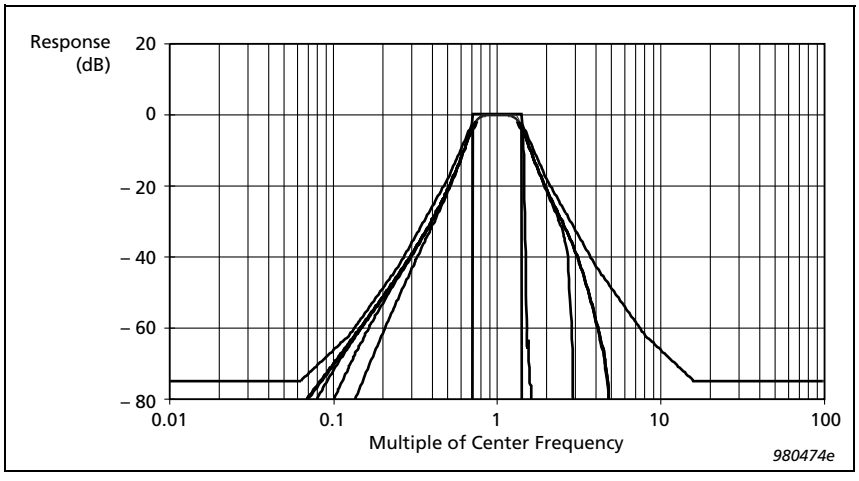
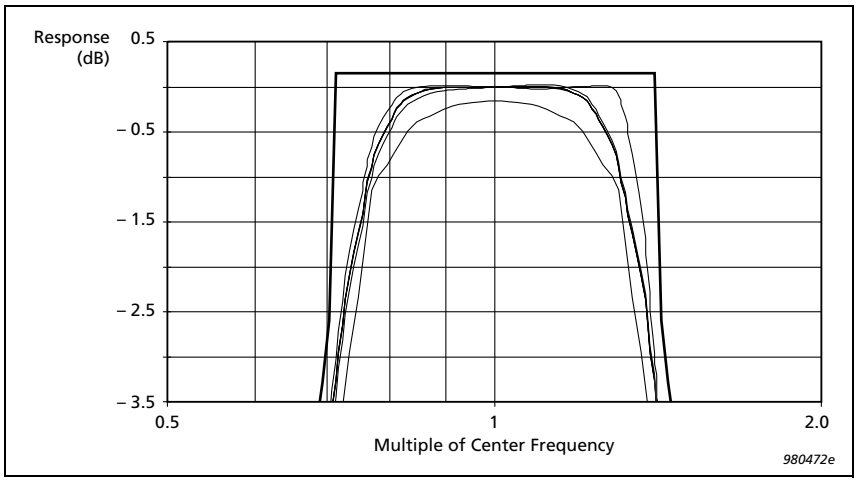


Fig. 4.30
The shapes of the 1/1- octave band filters (from 0 to –80 dB). The innermost and outermost curves show IEC 61260 limits

* Only accessible when *Low Frequency* is set to *Extended* in the **Setup** menu.

† These filters do not fulfil the requirements of paragraph 7.2.3 in the **old** ANSI S1.11-1986 standard. The paragraph states at which frequency the anti-alias filter cut-off should be set. For the realisation of the filters in BZ-7223, this has **no** influence on the quality of the measurements and **all** requirements of the **new** ANSI S1.11–2004 standard are fulfilled.

Fig.4.31
The shapes of the 1/1- octave band filters (from 0 to –3.5 dB). The innermost and outermost curves show IEC 61260 limits



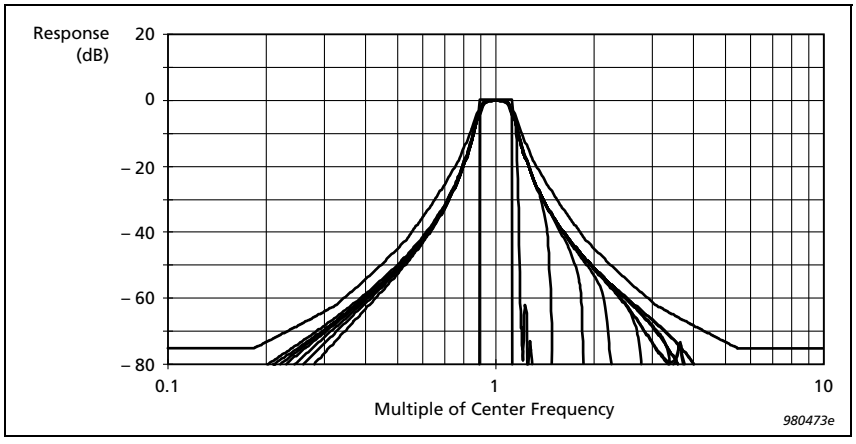
4.11.2 1/3-octave Band Centre Frequencies

Nominal: 6.3 Hz*, 8.0 Hz*, 10 Hz*, 12.5 Hz, 16 Hz, 20 Hz, 25 Hz, 31.5 Hz, 40 Hz, 50 Hz, 63 Hz, 80 Hz, 100 Hz, 125 Hz, 160 Hz, 200 Hz, 250 Hz, 315 Hz, 400 Hz, 500 Hz, 630 Hz, 800 Hz, 1 kHz, 1.25 kHz, 1.6 kHz, 2 kHz, 2.5 kHz, 3.15 kHz, 4 kHz, 5 kHz, 6.3 kHz, 8 kHz, 10 kHz, 12.5 kHz, 16 kHz†, 20 kHz[2]

Exact (5 digits): 6.201 Hz, 7.8125 Hz, 9.8485 Hz, 12.401 Hz, 15.625 Hz, 19.697 Hz, 24.803 Hz, 31.25 Hz, 39.373 Hz, 49.616 Hz, 62.5 Hz, 78.745 Hz, 99.213 Hz, 125 Hz, 157.49 Hz, 198.43 Hz, 250 Hz, 314.98 Hz, 396.85 Hz, 500 Hz, 629.96 Hz, 793.70 Hz, 1 kHz, 1.2599 kHz, 1.5874 kHz, 2 kHz, 2.5198 kHz, 3.1748 kHz, 4 kHz, 5.0397 kHz, 6.3496 kHz, 8 kHz, 10.079 kHz, 12.699 kHz, 16 kHz, 20.159 kHz

Real-time Frequency Range: 6.3 Hz to 20 kHz, centre frequencies.

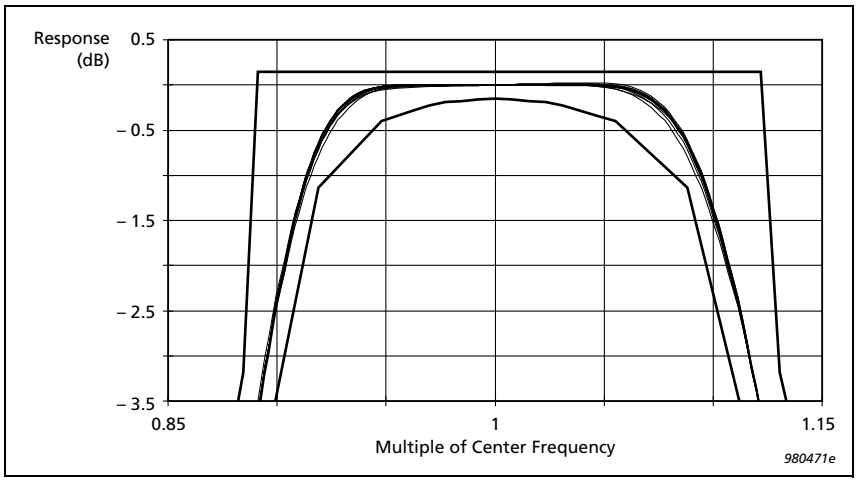
Fig.4.32
The shapes of the 1/3-octave band filters (from 0 to – 80 dB). The innermost and outermost curves show IEC 61260 limits



* Only accessible when *Low Frequency* is set to *Extended* in the **Setup** menu.

† These filters do not fulfil the requirements of paragraph 7.2.3 in the **old** ANSI S1.11-1986 standard. The paragraph states at which frequency the anti-alias filter cut-off should be set. For the realisation of the filters in BZ-7223, this has **no** influence on the quality of the measurements and **all** requirements of the **new** ANSI S1.11–2004 standard are fulfilled.

Fig. 4.33
The shapes of the 1/3-octave band filters (from 0 to – 3.5 dB). The innermost and outermost curves show IEC 61260 limits



4.11.3 Linear Operating Range

Linear Operating Range according to the International Standard IEC 61260, for electrical input, for all filters in the filter banks:

Table 4.11
Linear Operating Range

Range	Upper Limit (dB)	Lower Limit 1/1-octave (dB)	Lower Limit 1/3-octave (dB)
Single	140.0	24.4	20.5
High	140.0	43.0	39.3
Low	110.0	24.5	20.6

Below the Lower Limit, the Level Linearity Error is less than or equal to the error found in Fig. 2.1 with L_{inh} set to the Lower Limit – 11.5 dB.

4.11.4 Measurement Range

Measurement Range according to the International Standard IEC 61260 is the difference between the Upper Limit of the Linear Operating Range on the least sensitive level range and the Lower Limit of the Linear Operating Range on the most sensitive level range.

Table 4.12
Measurement Range

1/1-octave (dB)	1/3-octave (dB)
140.0 – 24.5	140.0 – 20.6

4.11.5 Octave Band Time Constants

At low centre frequencies, the B*T product for time weightings becomes too small to give statistically reliable measurements. To overcome this, the Fast time constant (125 ms) and the Slow time constant (1000 ms) are replaced by progressively longer time constants with decreasing centre frequencies (and corresponding bandwidths). See Table 4.13 and Table 4.14.

Table 4.13
Octave band Fast Time Constants

1/1-octave Centre Frequency (Hz)	1/3-octave Centre Frequency (Hz)	Time Constant (ms)	Averaging Time (ms)
≥ 63	≥100	125 (Fast)	250 (Fast)
31.5	80, 63, 50	250	500
16	40, 31.5, 25	500	1000
8	20, 16, 12.5	1000	2000
–	10, 8, 6.3	2000	4000

Table 4.14
Octave band Slow Time Constants

1/1-octave Centre Frequency (Hz)	1/3-octave Centre Frequency (Hz)	Time Constant (ms)	Averaging Time (ms)
≥ 8	≥12.5	1000 (Slow)	2000 (Slow)
–	10, 8, 6.3	2000	4000

For a white Gaussian signal and for 1/1-octave centre frequencies from 8 Hz to 63 Hz, these time constants give a maximum relative standard deviation of approximately 1.5 dB. For 1/3-octave centre frequencies from 6.3 Hz to 160 Hz, these time constants give a maximum relative standard deviation of approximately 2 dB.

4.12 Influence from the Operating Environment

The temperature and humidity specifications are given provided that no condensation inside the instrumentation results from the combination.

Excessive condensation may cause permanent damage to the instrumentation.

4.12.1 Environmental Stabilisation Time

Typical stabilisation time after change in environmental conditions is 10 minutes.

When the instruments are moved from a warm environment with high humidity, to a colder environment, care should be taken not to produce condensation inside the instruments. In this case, much longer stabilisation periods may be necessary.

4.12.2 Temperature

Operating Temperature Range: –10 to +50ºC (+14 to +122ºF)

Storage temperature range: –25 to +70ºC (–13 to +158ºF)

4.12.3 Humidity

Operating Humidity Range: 0% < RH < 90%, providing there is no condensation.

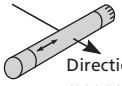
4.12.4 Vibration

Vibration Sensitivity (20 – 1000 Hz) for 1 ms^{-2}: A-weighted max. 73 dB, Z-weighted max. 83 dB.

4.12.5 Immunity to Power Magnetic Fields

Maximum sensitivity to power line (50/60 Hz) magnetic field strength of 80 A/m: is specified as the rise in the self-generated noise coming from the magnetic field. The self-generated noise is stated in section 4.8.

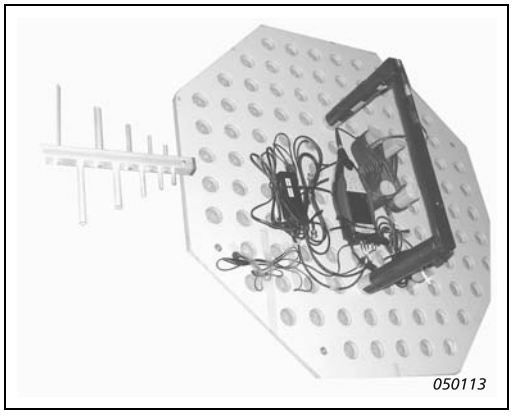
Table 4.15
Magnetic Fields

Configuration	Most Sensitive Direction	Rise in Self-generated Noise				
		A-weighted (dB)	B-weighted (dB)	C-weighted (dB)	Z-weighted (dB)	1/3-octave 50 Hz Band (dB)
Analyzer with microphone and preamplifier mounted	Magnetic field perpendicular to the display surface	Not detectable	< 4	< 11	< 7	<25
Microphone and preamplifier alone	 Note orientation	Not detectable	< 2	< 7	< 5	<21

4.12.6 Immunity to Power and Radio-frequency Fields

Conforms to IEC 61672–1, IEC 60651 and IEC 60804 down to <74 dB (for 10 seconds Sound Exposure Level down to <84 dB).

Fig. 4.34
The most sensitive direction



4.13 Electrical Input to the Analyzer

4.13.1 Input Sockets/Rear s (if Present)

Triaxial LEMO socket used for Direct input as well as CCLD input.

Direct Input:

Maximum Input Level: ±14.14 V_{Peak}, 10 V_{RMS} for sinusoidal input signals, no damage for signals up to ±20 V_{Peak}

Input Impedance: ≥ 1 MΩ

Source Impedance: ≤ 1 kΩ

CCLD Input:

Maximum Input Level: ±7.07 V_{Peak} no damage for signals in the range –10 to +25 V

CCLD Current/Voltage: 4 mA/25 V

4.13.2 Trigger Socket

Triaxial LEMO socket:

Input Range: ±20 V_{Peak}, no damage for signals up to ±50 V_{Peak}

Input Signal Slew Rate: Minimum 40 V/sec

Input Impedance: 47 kΩ

4.14 Electrical Output from the Analyzer

4.14.1 Output Socket (if Present)

Triaxial LEMO socket:

See the pertinent user manual for information on the signal source and gain

Maximum Peak Output Voltage: ±4.46 V

Maximum Sinusoidal Output Voltage: 3.16 V_{RMS}

Output Impedance: 50 Ω

Load Impedance: >15 kΩ ||< 1 nF for < 0.2 dB attenuation from DC to 20 kHz, short-circuit proof without affecting the measurement results

Max DC Offset: ±15 mV

4.14.2 Headphone Socket

3.5 mm Minijack stereo socket:

See the pertinent user manual for information on the signal source and gain

Maximum Peak Output Voltage: ±1.4 V (no load)

Output Impedance: 32 Ω in each channel, short-circuit proof without affecting the measurement results

4.15 Digital Interfaces

The digital interfaces can be used for monitoring a measurement, setting up a measurement, controlling a measurement, data storage and transferring data from instrument to PC. However, it is not possible to change or influence the measured values in any way through these interfaces.

4.15.1 USB Interface

Before hardware version 4.0: USB 1.1 OTG Mini AB socket, with host and slave functions, accepts Mini A (host functionality) and Mini B (slave functionality) plugs.

From hardware version 4.0:

- USB 2.0 OTG Micro AB socket, with host and slave functions, accepts Micro A (host functionality) and Micro B (slave functionality) plugs
- USB 2.0 Host Standard A socket, with only host functions, accepts Standard A plugs

4.15.2 LAN Interface (if Present)

Before hardware version 4.0: RJ45 8/8 MDI socket, Speed: 10 Mbps, Protocol: TCP/IP.

From hardware version 4.0: RJ45 8/8 Auto-MDIX socket, Speed: 100 Mbps, Protocol: TCP/IP.

4.15.3 Compact Flash (CF) Card Interface (if Present)

Type I and II memory cards, FAT 16 formatted.

4.15.4 Secure Digital (SD) Card Interfaces

Support SD and SDHC cards in single and 4-bit mode, formatted as FAT16 or FAT32.

4.16 Power Supply

4.16.1 External DC Power Supply Requirements

Voltage: 8 – 24 V DC, ripple voltage < 20 mV

Current Requirement: min. 1.5 A

Power Consumption: < 2.5 W without battery charging, < 10 W when charging

Connector (at cable): LEMO Type FFA.00, positive at center pin

4.16.2 External AC Main Supply Adaptor

Part No.: Mains Power Supply ZG-0426

Supply Voltage: 100 – 120/200 – 240 VAC; 47 – 63 Hz

Connector: 2–pin IEC 60320

Part No.: Mains Power Supply ZG-0429

Supply Voltage: 100 – 240 VAC; 47 – 63 Hz

Connector: 2–pin IEC 60320

Part No.: Utility Unit ZH-0689
Supply Voltage: 90 – 132/180 – 264 VAC; 47 – 63 Hz

Connector: C14 IEC 60320

Part No: Power Panel ZH-0685

Supply Voltage: 100 – 240 VAC; 50 – 60 Hz

Connector: C14 IEC 60320

4.16.3 External AC Main Charger (Optional Accessory)

Part No.: ZG-0444

Supply Voltage: 90 – 264 VAC; 47 – 63 Hz

Connector: 2–pin IEC 60320

4.16.4 Battery

Part No.: QB-0061 Rechargeable Li-Ion battery

Voltage: 3.7 V

Capacity: 5200 mAh nominal

Typical Operating Time: > 8 hours. However, if the instrument is used in low temperatures or there is extensive use of the display backlight, this may reduce the time.

Battery Cycle Life: >500 complete charge/discharge cycles.

Battery Indicator: Remaining battery capacity and expected working time may be read out in % and in time.

Battery Fuel Gauge: The battery is equipped with a built-in fuel gauge, which continuously measures and stores the actual battery capacity in the battery unit.

Charge Time: In instrument, typically 10 hours from empty at ambient temperatures below 30ºC. To protect the battery, charging will be terminated completely at ambient temperatures above 40ºC. At 30 to 40ºC charging time will be prolonged. With external charger ZG-0444 (optional accessory), typically 5 hours.

Note: It is not recommended to charge the battery at temperatures below 0ºC (32ºF) or over 50ºC (122ºF). Doing this will reduce battery lifetime.

4.17 Warm-up Time

Warm-up Time: < 2 minutes after reaching equilibrium with the ambient environment and switching on power.

4.18 Real-time Clock

Back-up Powered Clock Drift: For hardware version 1.1: < 12 seconds over a 24-hour period.
From hardware version 2.0: < 0.45 seconds over a 24-hour period

4.19 CE-mark and C-Tick mark Compliance

CE C-Tick	CE-mark indicates compliance with the EMC Directive and Low Voltage Directive. C-Tick mark indicates compliance with the EMC requirements of Australia and New Zealand.
Safety	EN/IEC 61010–1: Safety requirements for electrical equipment for measurement, control and labroratory use. UL 61010B–1: Standard for Safety – Electrical measuring and test equipment.
EMC Emission	EN/IEC 61000–6–3: Generic emission standard for residential, commercial and light industrial environments. CISPR 22: Radio disturbance characteristics of information technology equipment. Class B limits. FCC Rules: Part 15: Complies with the limits for a Class B digital device. IEC 61672–1, IEC 61260, IEC 60651 and IEC 60804: Instrumentation standards.
EMC Immunity	EN/IEC 61000–6–2: Generic standard – Immunity for industrial environment. EN/IEC 61326: Electrical equipment for measurement, control and laboratory use – EMC requirements. IEC 61672–1, IEC 61260, IEC 60651 and IEC 60804: Instrumentation standards.

Appendix A

Tables

A.1 Electrical Frequency Responses

Uncompensated electrical frequency responses for the different frequency weightings. Please see the instructions in section 4.6 on how to ensure an uncompensated electrical frequency response.

Table A.1 *Uncompensated electrical frequency responses*

Nominal Frequency (Hz)	Exact Frequency (6 digits) (Hz)	Electrical Response (dB)				Add to Acoustical Responses (dB)		
		A-weighting	B-weighting	C-weighting	Z-weighting	A-weighting	B-weighting	C-weighting
63	63.0957	–26.20	–9.35	–0.82	0.00	–26.20	–9.35	–0.82
80	79.4328	–22.50	–7.37	–0.50	0.00	–22.51	–7.37	–0.50
100	100	–19.14	–5.65	–0.30	0.00	–19.14	–5.65	–0.30
125	125.893	–16.10	–4.18	–0.17	0.00	–16.10	–4.18	–0.17
160	158.489	–13.35	–2.99	–0.08	0.00	–13.35	–2.99	–0.08
200	199.526	–10.87	–2.05	–0.03	0.00	–10.87	–2.05	–0.03
250	251.189	–8.63	–1.35	0.00	0.00	–8.63	–1.35	0.00
315	316.228	–6.61	–0.84	–0.02	0.00	–6.61	–0.85	0.02
400	398.107	–4.81	–0.50	–0.03	0.00	–4.81	–0.50	0.03
500	501.187	–3.23	–0.27	–0.03	0.00	–3.23	–0.27	0.03
630	630.957	–1.90	–0.13	–0.03	0.00	–1.90	–0.13	0.03
800	794.328	–0.82	–0.04	–0.02	0.00	–0.82	–0.04	0.02
1000	1000	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1060	1059.25	0.17	0.01	–0.01	0.00	0.17	0.01	–0.01
1120	1122.02	0.32	0.01	–0.01	0.00	0.32	0.01	–0.01
1180	1188.50	0.46	0.01	–0.02	0.00	0.46	0.01	–0.02
1250	1258.93	0.59	0.01	–0.03	0.00	0.59	0.01	–0.03
1320	1333.52	0.71	0.00	–0.04	0.00	0.71	0.00	–0.04
1400	1412.54	0.81	0.00	–0.06	0.00	0.81	0.00	–0.06
1500	1496.24	0.90	–0.01	–0.07	0.00	0.90	–0.01	–0.07

Table A.1 *(cont.) Uncompensated electrical frequency responses*

Nominal Frequency (Hz)	Exact Frequency (6 digits) (Hz)	Electrical Response (dB)				Add to Acoustical Responses (dB)		
		A-weighting	B-weighting	C-weighting	Z-weighting	A-weighting	B-weighting	C-weighting
1600	1584.89	0.98	–0.02	–0.09	0.00	0.98	-0-02	–0.09
1700	1678.80	1.05	–0.03	–0.10	0.00	1.05	–0.03	–0.10
1800	1778.28	1.11	–0.05	–0.12	0.00	1.11	–0.05	–0.12
1900	1883.65	1.16	–0.07	–0.15	0.00	1.16	–0.07	–0.14
2000	1995.26	1.20	–0.09	–0.17	0.00	1.20	–0.09	–0.17
2120	2113.49	1.23	–0.12	–0.20	0.00	1.23	–0.11	–0.20
2240	2238.72	1.25	–0.14	–0.23	0.00	1.25	–0.14	–0.23
2360	2371.37	1.26	–0.18	–0.26	0.00	1.27	–0.17	–0.26
2500	2511.89	1.27	–0.21	–0.30	0.00	1.27	–0.21	–0.30
2650	2660.73	1.26	–0.25	–0.35	0.00	1.27	–0.25	–0.34
2800	2818.38	1.25	–0.30	–0.40	0.00	1.25	–0.30	–0.39
3000	2985.38	1.22	–0.35	–0.45	0.00	1.23	–0.35	–0.45
3150	3162.28	1.19	–0.41	–0.51	–0.01	1.20	–0.41	–0.51
3350	3349.65	1.15	–0.48	–0.58	–0.01	1.16	–0.47	–0.57
3550	3548.13	1.10	–0.55	–0.65	–0.01	1.10	–0.55	–0.65
3750	3758.37	1.03	–0.64	–0.74	–0.01	1.04	–0.63	–0.73
4000	3981.07	0.96	–0.73	–0.83	–0.01	0.97	–0.72	–0.82
4250	4216.97	0.87	–0.83	–0.93	–0.01	0.88	–0.82	–0.92
4500	4466.84	0.77	–0.94	–1.04	–0.01	0.79	–0.93	–1.03
4750	4731.51	0.66	–1.07	–1.17	–0.01	0.67	–1.05	–1.16
5000	5011.87	0.54	–1.20	–1.31	–0.01	0.55	–1.19	–1.29
5300	5308.84	0.39	–1.36	–1.46	–0.01	0.41	–1.34	–1.45
5600	5623.41	0.23	–1.52	–1.63	–0.02	0.25	–1.51	–1.61
6000	5956.62	0.06	–1.71	–1.81	–0.02	0.07	–1.69	–1.80
6300	6309.57	–0.14	–1.91	–2.02	–0.02	–0.12	–1.89	–2.00
6700	6683.44	–0.35	–2.13	–2.24	–0.02	–0.33	–2.11	–2.22
7100	7079.46	–0.59	–2.37	–2.48	–0.02	–0.57	–2.35	–2.46
7500	7498.94	–0.85	–2.64	–2.74	–0.02	–0.82	–2.61	–2.72
8000	7943.28	–1.13	–2.92	–3.03	–0.02	–1.10	–2.90	–3.00
8500	8413.95	–1.43	–3.23	–3.34	–0.03	–1.41	–3.20	–3.31
9000	8912.51	–1.76	–3.57	–3.67	–0.03	–1.74	–3.54	–3.64
9500	9440.61	–2.12	–3.93	–4.03	–0.03	–2.09	–3.90	–4.01
10000	10000	–2.51	–4.32	–4.42	–0.03	–2.48	–4.29	–4.39

Table A.1 *(cont.) Uncompensated electrical frequency responses*

Nominal Frequency (Hz)	Exact Frequency (6 digits) (Hz)	Electrical Response (dB)				Add to Acoustical Responses (dB)		
		A-weighting	B-weighting	C-weighting	Z-weighting	A-weighting	B-weighting	C-weighting
10600	10592.5	–2.92	–4.73	–4.84	–0.03	–2.89	–4.70	–4.81
11200	11220.2	–3.36	–5.18	–5.28	–0.03	–3.34	–5.15	–5.25
11800	11885.0	–3.84	–5.65	–5.76	–0.03	–3.81	–5.62	–5.73
12500	12589.3	–4.34	–6.15	–6.26	–0.02	–4.31	–6.13	–6.24
13200	13335.2	–4.87	–6.69	–6.80	–0.02	–4.85	–6.67	–6.77
14000	14125.4	–5.43	–7.25	–7.36	–0.02	–5.42	–7.23	–7.34
15000	14962.4	–6.02	–7.84	–7.95	–0.01	–6.01	–7.83	–7.94
16000	15848.9	–6.64	–8.46	–8.56	–0.01	–6.63	–8.45	–8.56
17000	16788.0	–7.27	–9.09	–9.20	0.00	–7.27	–9.09	–9.20
18000	17782.8	–7.92	–9.74	–9.85	0.00	–7.92	–9.74	–9.85
19000	18836.5	–8.56	–10.38	–10.49	0.00	–8.56	–10.38	–10.49
20000	19952.6	–9.17	–10.99	–11.10	0.00	–9.16	–10.99	–11.09
21200	21134.9	–9.71	–11.53	–11.64	–0.02	–9.69	–11.51	–11.62
22400	22387.2	–10.13	–11.96	–12.06	–0.05	–10.08	–11.90	–12.01

A.2 Free-field Frequency Responses

Frequency responses with Z frequency weighting. Measured with plane progressive sinusoidal sound waves incident from the reference direction and the instrument's *Sound Field Correction* parameter set to *Free-field*, see section 4.6.

Table A.2 *Free-field 0° frequency response for Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer's electrical response with the microphone preamplifier connected to a microphone extension cable*

Nominal Frequency	Exact Frequency (6 digits)	Microphone Actuator Response dB	Microphone Free-field Correction dB	Microphone Free-field Response dB	Electrical Response dB	Acoustical Response dB	Expanded Uncertainty dB
63 Hz	63.0957 Hz	0.00	0.00	0.00	0.00	0.00	0.05
80 Hz	79.4328 Hz	0.00	0.00	0.00	0.00	0.00	0.05
100 Hz	100 Hz	0.00	0.00	0.00	0.00	0.00	0.05
125 Hz	125.893 Hz	0.00	0.00	0.00	0.00	0.00	0.05
160 Hz	158.489 Hz	0.00	0.00	0.00	0.00	0.00	0.05
200 Hz	199.526 Hz	0.01	0.00	0.01	0.00	0.01	0.05
250 Hz	251.189 Hz	0.00	0.00	0.00	0.00	0.00	0.05
315 Hz	316.228 Hz	–0.01	0.01	0.00	0.00	0.00	0.06
400 Hz	398.107 Hz	–0.02	0.01	–0.01	0.00	–0.01	0.06
500 Hz	501.187 Hz	–0.03	0.02	–0.01	0.00	–0.01	0.07
630 Hz	630.957 Hz	–0.04	0.04	0.00	0.00	0.00	0.07
800 Hz	794.328 Hz	–0.06	0.07	0.01	0.00	0.01	0.07
1000 Hz	1000 Hz	–0.08	0.10	0.01	0.00	0.01	0.07
1060 Hz	1059.25 Hz	–0.09	0.11	0.02	0.00	0.02	0.07
1120 Hz	1122.02 Hz	–0.10	0.12	0.02	0.00	0.02	0.07
1180 Hz	1188.50 Hz	–0.11	0.14	0.02	0.00	0.02	0.08
1250 Hz	1258.93 Hz	–0.13	0.15	0.02	0.00	0.02	0.08
1320 Hz	1333.52 Hz	–0.14	0.17	0.03	0.00	0.03	0.08
1400 Hz	1412.54 Hz	–0.15	0.18	0.03	0.00	0.03	0.08
1500 Hz	1496.24 Hz	–0.17	0.20	0.03	0.01	0.04	0.08
1600 Hz	1584.89 Hz	–0.19	0.22	0.03	0.01	0.04	0.08
1700 Hz	1678.80 Hz	–0.21	0.24	0.03	0.01	0.04	0.08
1800 Hz	1778.28 Hz	–0.23	0.27	0.04	0.01	0.05	0.09
1900 Hz	1883.65 Hz	–0.26	0.29	0.04	0.01	0.05	0.09
2000 Hz	1995.26 Hz	–0.28	0.32	0.04	0.01	0.05	0.09
2120 Hz	2113.49 Hz	–0.32	0.36	0.04	0.01	0.05	0.09
2240 Hz	2238.72 Hz	–0.35	0.39	0.04	0.01	0.05	0.09
2360 Hz	2371.37 Hz	–0.39	0.43	0.04	0.01	0.05	0.10
2500 Hz	2511.89 Hz	–0.44	0.48	0.04	0.01	0.05	0.10
2650 Hz	2660.73 Hz	–0.49	0.53	0.04	0.01	0.05	0.10
2800 Hz	2818.38 Hz	–0.54	0.59	0.04	0.02	0.06	0.11
3000 Hz	2985.38 Hz	–0.60	0.65	0.04	0.02	0.06	0.11
3150 Hz	3162.28 Hz	–0.67	0.71	0.04	0.02	0.06	0.12
3350 Hz	3349.65 Hz	–0.75	0.78	0.04	0.02	0.06	0.12
3550 Hz	3548.13 Hz	–0.83	0.86	0.03	0.02	0.05	0.13
3750 Hz	3758.37 Hz	–0.92	0.96	0.04	0.02	0.06	0.13
4000 Hz	3981.07 Hz	–1.03	1.07	0.04	0.02	0.06	0.14
4250 Hz	4216.97 Hz	–1.14	1.18	0.04	0.03	0.07	0.14
4500 Hz	4466.84 Hz	–1.27	1.30	0.03	0.03	0.06	0.14
4750 Hz	4731.51 Hz	–1.41	1.43	0.02	0.03	0.05	0.14
5000 Hz	5011.87 Hz	–1.56	1.57	0.01	0.03	0.04	0.15
5300 Hz	5308.84 Hz	–1.73	1.73	0.00	0.03	0.03	0.15
5600 Hz	5623.41 Hz	–1.91	1.90	–0.01	0.03	0.02	0.15
6000 Hz	5956.62 Hz	–2.11	2.09	–0.03	0.03	0.00	0.16
6300 Hz	6309.57 Hz	–2.33	2.28	–0.05	0.03	–0.02	0.16
6700 Hz	6683.44 Hz	–2.57	2.49	–0.07	0.03	–0.04	0.17
7100 Hz	7079.46 Hz	–2.82	2.74	–0.08	0.02	–0.06	0.17
7500 Hz	7498.94 Hz	–3.10	3.04	–0.06	0.01	–0.05	0.17
8000 Hz	7943.28 Hz	–3.41	3.38	–0.03	0.00	–0.03	0.18
8500 Hz	8413.95 Hz	–3.76	3.75	–0.01	–0.02	–0.03	0.19
9000 Hz	8912.51 Hz	–4.16	4.14	–0.02	–0.04	–0.06	0.20

Nominal Frequency	Exact Frequency (6 digits)	Microphone Actuator Response dB	Microphone Free-field Correction dB	Microphone Free-field Response dB	Electrical Response dB	Acoustical Response dB	Expanded Uncertainty dB
9500 Hz	9440.61 Hz	–4.60	4.60	0.00	–0.08	–0.08	0.22
10000 Hz	10000 Hz	–5.08	5.12	0.05	–0.12	–0.07	0.23
10600 Hz	10592.5 Hz	–5.55	5.68	0.14	–0.18	–0.04	0.24
11200 Hz	11220.2 Hz	–5.99	6.27	0.28	–0.25	0.03	0.26
11800 Hz	11885.0 Hz	–6.37	6.81	0.44	–0.34	0.10	0.28
12500 Hz	12589.3 Hz	–6.68	7.19	0.51	–0.45	0.06	0.29
13200 Hz	13335.2 Hz	–6.94	7.54	0.60	–0.58	0.02	0.31
14000 Hz	14125.4 Hz	–7.19	7.89	0.71	–0.71	0.00	0.33
15000 Hz	14962.4 Hz	–7.43	8.24	0.81	–0.82	–0.01	0.35
16000 Hz	15848.9 Hz	–7.71	8.59	0.87	–0.87	0.00	0.38
17000 Hz	16788.0 Hz	–8.12	8.91	0.80	–0.81	–0.01	0.40
18000 Hz	17782.8 Hz	–8.67	9.27	0.59	–0.59	0.00	0.43
19000 Hz	18836.5 Hz	–9.40	9.62	0.23	–0.22	0.01	0.45
20000 Hz	19952.6 Hz	–10.29	10.05	–0.24	0.24	0.00	0.48
21200 Hz	21134.9 Hz	–11.34	10.46	–0.88	0.66	–0.22	0.49
22400 Hz	22387.2 Hz	–12.60	10.85	–1.75	0.96	–0.79	0.49

Table A.3 *Free-field 0° frequency response for Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer with the microphone preamplifier mounted directly on the analyzer*

Nominal Frequency	Exact Frequency (6 digits)	Acoustical Response (From Table A.2) dB	Expanded Uncertainty dB	Body Influence dB	Expanded Uncertainty dB	Acoustical Response dB	Expanded Uncertainty dB
63 Hz	63.0957 Hz	0.00	0.05	0.00	0.10	0.00	0.11
80 Hz	79.4328 Hz	0.00	0.05	0.00	0.10	0.00	0.11
100 Hz	100 Hz	0.00	0.05	0.00	0.10	0.00	0.11
125 Hz	125.893 Hz	0.00	0.05	0.00	0.10	0.00	0.11
160 Hz	158.489 Hz	0.00	0.05	0.01	0.10	0.01	0.11
200 Hz	199.526 Hz	0.01	0.05	0.03	0.10	0.03	0.11
250 Hz	251.189 Hz	0.00	0.05	0.07	0.10	0.07	0.11
315 Hz	316.228 Hz	0.00	0.06	0.13	0.10	0.13	0.12
400 Hz	398.107 Hz	–0.01	0.06	0.21	0.10	0.20	0.12
500 Hz	501.187 Hz	–0.01	0.07	0.22	0.10	0.22	0.12
630 Hz	630.957 Hz	0.00	0.07	0.07	0.10	0.07	0.12
800 Hz	794.328 Hz	0.01	0.07	–0.11	0.10	–0.10	0.12
1000 Hz	1000 Hz	0.01	0.07	–0.07	0.10	–0.06	0.12
1060 Hz	1059.25 Hz	0.02	0.07	–0.10	0.10	–0.08	0.12
1120 Hz	1122.02 Hz	0.02	0.07	–0.18	0.10	–0.16	0.12
1180 Hz	1188.50 Hz	0.02	0.08	–0.26	0.10	–0.24	0.13
1250 Hz	1258.93 Hz	0.02	0.08	–0.30	0.10	–0.28	0.13
1320 Hz	1333.52 Hz	0.03	0.08	–0.24	0.10	–0.21	0.13
1400 Hz	1412.54 Hz	0.03	0.08	–0.08	0.10	–0.05	0.13
1500 Hz	1496.24 Hz	0.04	0.08	0.10	0.10	0.14	0.13
1600 Hz	1584.89 Hz	0.04	0.08	0.17	0.10	0.21	0.13
1700 Hz	1678.80 Hz	0.04	0.08	0.07	0.10	0.11	0.13
1800 Hz	1778.28 Hz	0.05	0.09	–0.12	0.10	–0.08	0.13
1900 Hz	1883.65 Hz	0.05	0.09	–0.21	0.10	–0.17	0.13
2000 Hz	1995.26 Hz	0.05	0.09	–0.09	0.10	–0.04	0.13
2120 Hz	2113.49 Hz	0.05	0.09	0.11	0.10	0.17	0.13
2240 Hz	2238.72 Hz	0.05	0.09	0.09	0.15	0.14	0.13
2360 Hz	2371.37 Hz	0.05	0.10	–0.30	0.15	–0.25	0.18
2500 Hz	2511.89 Hz	0.05	0.10	–0.17	0.15	–0.12	0.18
2650 Hz	2660.73 Hz	0.05	0.10	0.18	0.15	0.23	0.18
2800 Hz	2818.38 Hz	0.06	0.11	0.09	0.15	0.16	0.19
3000 Hz	2985.38 Hz	0.06	0.11	–0.12	0.15	–0.06	0.19
3150 Hz	3162.28 Hz	0.06	0.12	0.16	0.15	0.22	0.19
3350 Hz	3349.65 Hz	0.06	0.12	0.03	0.15	0.09	0.19
3550 Hz	3548.13 Hz	0.05	0.13	–0.13	0.15	–0.08	0.19

Nominal Frequency	Exact Frequency (6 digits)	Acoustical Response (From Table A.2) dB	Expanded Uncertainty dB	Body Influence dB	Expanded Uncertainty dB	Acoustical Response dB	Expanded Uncertainty dB
3750 Hz	3758.37 Hz	0.06	0.13	0.20	0.15	0.25	0.20
4000 Hz	3981.07 Hz	0.06	0.14	–0.09	0.15	–0.04	0.20
4250 Hz	4216.97 Hz	0.07	0.14	–0.01	0.15	0.06	0.21
4500 Hz	4466.84 Hz	0.06	0.14	0.10	0.15	0.15	0.21
4750 Hz	4731.51 Hz	0.05	0.14	–0.16	0.15	–0.11	0.21
5000 Hz	5011.87 Hz	0.04	0.15	–0.24	0.15	–0.20	0.21
5300 Hz	5308.84 Hz	0.03	0.15	–0.10	0.15	–0.07	0.21
5600 Hz	5623.41 Hz	0.02	0.15	–0.05	0.15	–0.03	0.21
6000 Hz	5956.62 Hz	0.00	0.16	0.03	0.15	0.03	0.21
6300 Hz	6309.57 Hz	–0.02	0.16	0.06	0.15	0.04	0.22
6700 Hz	6683.44 Hz	–0.04	0.17	0.05	0.15	0.01	0.22
7100 Hz	7079.46 Hz	–0.06	0.17	–0.03	0.15	–0.09	0.23
7500 Hz	7498.94 Hz	–0.05	0.17	–0.08	0.20	–0.14	0.23
8000 Hz	7943.28 Hz	–0.03	0.18	–0.08	0.20	–0.11	0.26
8500 Hz	8413.95 Hz	–0.03	0.19	–0.19	0.20	–0.22	0.27
9000 Hz	8912.51 Hz	–0.06	0.20	–0.01	0.20	–0.06	0.28
9500 Hz	9440.61 Hz	–0.08	0.22	0.11	0.20	0.03	0.28
10000 Hz	10000 Hz	–0.07	0.23	0.15	0.20	0.08	0.30
10600 Hz	10592.5 Hz	–0.04	0.24	–0.14	0.20	–0.18	0.30
11200 Hz	11220.2 Hz	0.03	0.26	–0.13	0.20	–0.10	0.33
11800 Hz	11885.0 Hz	0.10	0.28	0.08	0.20	0.18	0.34
12500 Hz	12589.3 Hz	0.06	0.29	0.15	0.20	0.21	0.35
13200 Hz	13335.2 Hz	0.02	0.31	0.00	0.20	0.02	0.37
14000 Hz	14125.4 Hz	0.00	0.33	–0.08	0.20	–0.08	0.39
15000 Hz	14962.4 Hz	–0.01	0.35	0.05	0.20	0.04	0.39
16000 Hz	15848.9 Hz	0.00	0.38	0.11	0.20	0.12	0.40
17000 Hz	16788.0 Hz	–0.01	0.40	–0.01	0.20	–0.02	0.43
18000 Hz	17782.8 Hz	0.00	0.43	–0.07	0.20	–0.06	0.45
19000 Hz	18836.5 Hz	0.01	0.45	0.12	0.20	0.13	0.47
20000 Hz	19952.6 Hz	0.00	0.48	0.00	0.20	0.00	0.49
21200 Hz	21134.9 Hz	–0.22	0.49	0.04	0.20	–0.18	0.52
22400 Hz	22387.2 Hz	–0.79	0.49	0.17	0.20	–0.62	0.53

Table A.4 *Free-field 0° frequency response for Windscreen UA-1650, Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer's electrical response, with the microphone preamplifier connected to a microphone extension cable.*

Nominal Frequency	Exact Frequency (6 digits)	Microphone Free-field Response (From Table A.2) dB	Expanded Uncertainty dB	Influence of Windscreen dB	Expanded Uncertainty dB	Electrical Response dB	Acoustical Response dB	Expanded Uncertainty dB
63 Hz	63.0957 Hz	0.00	0.05	0.00	0.15	0.00	0.00	0.16
80 Hz	79.4328 Hz	0.00	0.05	0.00	0.15	0.00	0.00	0.16
100 Hz	100 Hz	0.00	0.05	0.00	0.15	0.00	0.00	0.16
125 Hz	125.893 Hz	0.00	0.05	0.00	0.15	0.00	0.00	0.16
160 Hz	158.489 Hz	0.00	0.05	0.00	0.15	–0.01	–0.01	0.16
200 Hz	199.526 Hz	0.01	0.05	0.00	0.15	–0.01	0.00	0.16
250 Hz	251.189 Hz	0.00	0.05	0.01	0.15	–0.02	–0.01	0.16
315 Hz	316.228 Hz	0.00	0.06	0.03	0.15	–0.03	–0.01	0.16
400 Hz	398.107 Hz	–0.01	0.06	0.05	0.15	–0.05	–0.01	0.16
500 Hz	501.187 Hz	–0.01	0.07	0.07	0.15	–0.08	–0.02	0.17
630 Hz	630.957 Hz	0.00	0.07	0.10	0.15	–0.13	–0.03	0.17
800 Hz	794.328 Hz	0.01	0.07	0.14	0.15	–0.21	–0.07	0.17
1000 Hz	1000 Hz	0.01	0.07	0.18	0.15	–0.31	–0.11	0.17
1060 Hz	1059.25 Hz	0.02	0.07	0.21	0.15	–0.34	–0.11	0.17
1120 Hz	1122.02 Hz	0.02	0.07	0.25	0.15	–0.38	–0.11	0.17
1180 Hz	1188.50 Hz	0.02	0.08	0.28	0.15	–0.41	–0.10	0.17
1250 Hz	1258.93 Hz	0.02	0.08	0.32	0.15	–0.45	–0.10	0.17
1320 Hz	1333.52 Hz	0.03	0.08	0.37	0.15	–0.49	–0.10	0.17
1400 Hz	1412.54 Hz	0.03	0.08	0.41	0.15	–0.53	–0.09	0.17

Nominal Frequency	Exact Frequency (6 digits)	Microphone Free-field Response (From Table A.2)	Expanded Uncertainty	Influence of Windscreen	Expanded Uncertainty	Electrical Response	Acoustical Response	Expanded Uncertainty
		dB	dB	dB	dB	dB	dB	dB
1500 Hz	1496.24 Hz	0.03	0.08	0.45	0.15	–0.57	–0.09	0.17
1600 Hz	1584.89 Hz	0.03	0.08	0.50	0.15	–0.61	–0.08	0.17
1700 Hz	1678.80 Hz	0.03	0.08	0.55	0.15	–0.64	–0.06	0.17
1800 Hz	1778.28 Hz	0.04	0.09	0.59	0.15	–0.68	–0.05	0.17
1900 Hz	1883.65 Hz	0.04	0.09	0.63	0.15	–0.70	–0.03	0.17
2000 Hz	1995.26 Hz	0.04	0.09	0.67	0.20	–0.72	–0.01	0.22
2120 Hz	2113.49 Hz	0.04	0.09	0.70	0.20	–0.73	0.01	0.22
2240 Hz	2238.72 Hz	0.04	0.09	0.71	0.20	–0.72	0.04	0.22
2360 Hz	2371.37 Hz	0.04	0.10	0.72	0.20	–0.71	0.06	0.22
2500 Hz	2511.89 Hz	0.04	0.10	0.72	0.20	–0.68	0.08	0.22
2650 Hz	2660.73 Hz	0.04	0.10	0.70	0.20	–0.65	0.09	0.22
2800 Hz	2818.38 Hz	0.04	0.11	0.68	0.20	–0.60	0.12	0.11
3000 Hz	2985.38 Hz	0.04	0.11	0.63	0.20	–0.55	0.13	0.23
3150 Hz	3162.28 Hz	0.04	0.12	0.55	0.20	–0.49	0.10	0.23
3350 Hz	3349.65 Hz	0.04	0.12	0.44	0.20	–0.42	0.05	0.23
3550 Hz	3548.13 Hz	0.03	0.13	0.30	0.20	–0.35	–0.02	0.24
3750 Hz	3758.37 Hz	0.04	0.13	0.16	0.20	–0.29	–0.09	0.24
4000 Hz	3981.07 Hz	0.04	0.14	0.05	0.20	–0.22	–0.14	0.24
4250 Hz	4216.97 Hz	0.04	0.14	–0.05	0.20	–0.15	–0.16	0.24
4500 Hz	4466.84 Hz	0.03	0.14	–0.13	0.20	–0.10	–0.20	0.24
4750 Hz	4731.51 Hz	0.02	0.14	–0.18	0.20	–0.04	–0.20	0.24
5000 Hz	5011.87 Hz	0.01	0.15	–0.19	0.20	0.01	–0.16	0.25
5300 Hz	5308.84 Hz	0.00	0.15	–0.17	0.25	0.05	–0.12	0.29
5600 Hz	5623.41 Hz	–0.01	0.15	–0.16	0.25	0.09	–0.08	0.29
6000 Hz	5956.62 Hz	–0.03	0.16	–0.13	0.25	0.12	–0.04	0.30
6300 Hz	6309.57 Hz	–0.05	0.16	–0.11	0.25	0.15	–0.01	0.30
6700 Hz	6683.44 Hz	–0.07	0.17	–0.16	0.25	0.17	–0.06	0.30
7100 Hz	7079.46 Hz	–0.08	0.17	–0.28	0.25	0.19	–0.17	0.30
7500 Hz	7498.94 Hz	–0.06	0.17	–0.36	0.25	0.20	–0.22	0.30
8000 Hz	7943.28 Hz	–0.03	0.18	–0.41	0.25	0.21	–0.23	0.31
8500 Hz	8413.95 Hz	–0.01	0.19	–0.47	0.25	0.21	–0.27	0.31
9000 Hz	8912.51 Hz	–0.02	0.20	–0.45	0.25	0.21	–0.25	0.32
9500 Hz	9440.61 Hz	0.00	0.22	–0.47	0.25	0.20	–0.27	0.33
10000 Hz	10000 Hz	0.05	0.23	–0.52	0.25	0.19	–0.28	0.34
10600 Hz	10592.5 Hz	0.14	0.24	–0.63	0.25	0.18	–0.31	0.35
11200 Hz	11220.18 Hz	0.28	0.26	–0.74	0.25	0.16	–0.29	0.36
11800 Hz	11885.02 Hz	0.44	0.28	–0.86	0.25	0.14	–0.28	0.38
12500 Hz	12589.25 Hz	0.51	0.29	–0.88	0.25	0.12	–0.25	0.38
13200 Hz	13335.21 Hz	0.60	0.31	–0.99	0.25	0.09	–0.31	0.40
14000 Hz	14125.38 Hz	0.71	0.33	–1.13	0.25	0.06	–0.36	0.41
15000 Hz	14962.36 Hz	0.81	0.35	–1.20	0.30	0.03	–0.36	0.46
16000 Hz	15848.93 Hz	0.87	0.38	–1.33	0.30	0.00	–0.45	0.48
17000 Hz	16788.04 Hz	0.80	0.40	–1.50	0.30	–0.04	–0.75	0.50
18000 Hz	17782.79 Hz	0.59	0.43	–1.61	0.30	–0.08	–1.09	0.52
19000 Hz	18836.49 Hz	0.23	0.45	–1.64	0.30	–0.11	–1.52	0.54
20000 Hz	19952.62 Hz	–0.24	0.48	–1.73	0.30	–0.15	–2.12	0.57
21200 Hz	21134.89 Hz	–0.88	0.49	–1.81	0.30	–0.19	–2.88	0.57
22400 Hz	22387.21 Hz	–1.75	0.49	–1.79	0.30	–0.25	–3.79	0.57

Table A.5 *Free-field 0° frequency response for Windscreen UA-1650, Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer with the microphone preamplifier mounted directly on the analyzer*

Nominal Frequency	Exact Frequency (6 digits)	Acoustical Response (From Table A.4)	Expanded Uncertainty	Body Influence	Expanded Uncertainty	Acoustical Response	Expanded Uncertainty
		dB	dB	dB	dB	dB	dB
63 Hz	63.0957 Hz	0.00	0.16	0.00	0.10	0.00	0.19
80 Hz	79.4328 Hz	0.00	0.16	0.00	0.10	0.00	0.19
100 Hz	100 Hz	0.00	0.16	0.00	0.10	0.00	0.19
125 Hz	125.893 Hz	0.00	0.16	0.00	0.10	0.00	0.19
160 Hz	158.489 Hz	–0.01	0.16	0.01	0.10	0.00	0.19

Nominal Frequency	Exact Frequency (6 digits)	Acoustical Response (From Table A.4)	Expanded Uncertainty	Body Influence	Expanded Uncertainty	Acoustical Response	Expanded Uncertainty
		dB	dB	dB	dB	dB	dB
200 Hz	199.526 Hz	0.00	0.16	0.03	0.10	0.02	0.19
250 Hz	251.189 Hz	–0.01	0.16	0.07	0.10	0.06	0.19
315 Hz	316.228 Hz	–0.01	0.16	0.13	0.10	0.12	0.19
400 Hz	398.107 Hz	–0.01	0.16	0.21	0.10	0.20	0.19
500 Hz	501.187 Hz	–0.02	0.17	0.22	0.10	0.21	0.19
630 Hz	630.957 Hz	–0.03	0.17	0.07	0.10	0.04	0.19
800 Hz	794.328 Hz	–0.07	0.17	–0.11	0.10	–0.18	0.19
1000 Hz	1000 Hz	–0.11	0.17	–0.07	0.10	–0.18	0.19
1060 Hz	1059.25 Hz	–0.11	0.17	–0.10	0.10	–0.21	0.19
1120 Hz	1122.02 Hz	–0.11	0.17	–0.18	0.10	–0.29	0.19
1180 Hz	1188.50 Hz	–0.10	0.17	–0.26	0.10	–0.36	0.20
1250 Hz	1258.93 Hz	–0.10	0.17	–0.30	0.10	–0.40	0.20
1320 Hz	1333.52 Hz	–0.10	0.17	–0.24	0.10	–0.34	0.20
1400 Hz	1412.54 Hz	–0.09	0.17	–0.08	0.10	–0.17	0.20
1500 Hz	1496.24 Hz	–0.09	0.17	0.10	0.10	0.01	0.20
1600 Hz	1584.89 Hz	–0.08	0.17	0.17	0.10	0.09	0.20
1700 Hz	1678.80 Hz	–0.06	0.17	0.07	0.10	0.01	0.20
1800 Hz	1778.28 Hz	–0.05	0.17	–0.12	0.10	–0.17	0.20
1900 Hz	1883.65 Hz	–0.03	0.17	–0.21	0.10	–0.24	0.20
2000 Hz	1995.26 Hz	–0.01	0.22	–0.09	0.10	–0.10	0.24
2120 Hz	2113.49 Hz	0.01	0.22	0.11	0.10	0.12	0.24
2240 Hz	2238.72 Hz	0.04	0.22	0.09	0.15	0.13	0.27
2360 Hz	2371.37 Hz	0.06	0.22	–0.30	0.15	–0.25	0.27
2500 Hz	2511.89 Hz	0.08	0.22	–0.17	0.15	–0.09	0.27
2650 Hz	2660.73 Hz	0.09	0.22	0.18	0.15	0.28	0.27
2800 Hz	2818.38 Hz	0.12	0.11	0.09	0.15	0.22	0.19
3000 Hz	2985.38 Hz	0.13	0.23	–0.12	0.15	0.00	0.27
3150 Hz	3162.28 Hz	0.10	0.23	0.16	0.15	0.26	0.28
3350 Hz	3349.65 Hz	0.05	0.23	0.03	0.15	0.09	0.28
3550 Hz	3548.13 Hz	–0.02	0.24	–0.13	0.15	–0.14	0.28
3750 Hz	3758.37 Hz	–0.09	0.24	0.20	0.15	0.11	0.28
4000 Hz	3981.07 Hz	–0.14	0.24	–0.09	0.15	–0.23	0.29
4250 Hz	4216.97 Hz	–0.16	0.24	–0.01	0.15	–0.17	0.29
4500 Hz	4466.84 Hz	–0.20	0.24	0.10	0.15	–0.11	0.29
4750 Hz	4731.51 Hz	–0.20	0.24	–0.16	0.15	–0.36	0.29
5000 Hz	5011.87 Hz	–0.16	0.25	–0.24	0.15	–0.40	0.29
5300 Hz	5308.84 Hz	–0.12	0.29	–0.10	0.15	–0.22	0.33
5600 Hz	5623.41 Hz	–0.08	0.29	–0.05	0.15	–0.13	0.33
6000 Hz	5956.62 Hz	–0.04	0.30	0.03	0.15	–0.01	0.33
6300 Hz	6309.57 Hz	–0.01	0.30	0.06	0.15	0.05	0.33
6700 Hz	6683.44 Hz	–0.06	0.30	0.05	0.15	–0.01	0.34
7100 Hz	7079.46 Hz	–0.17	0.30	–0.03	0.15	–0.20	0.34
7500 Hz	7498.94 Hz	–0.22	0.30	–0.08	0.20	–0.31	0.36
8000 Hz	7943.28 Hz	–0.23	0.31	–0.08	0.20	–0.31	0.37
8500 Hz	8413.95 Hz	–0.27	0.31	–0.19	0.20	–0.46	0.37
9000 Hz	8912.51 Hz	–0.25	0.32	–0.01	0.20	–0.26	0.38
9500 Hz	9440.61 Hz	–0.27	0.33	0.11	0.20	–0.16	0.39
10000 Hz	10000 Hz	–0.28	0.34	0.15	0.20	–0.13	0.39
10600 Hz	10592.5 Hz	–0.31	0.35	–0.14	0.20	–0.45	0.40
11200 Hz	11220.2 Hz	–0.29	0.36	–0.13	0.20	–0.42	0.41
11800 Hz	11885.0 Hz	–0.28	0.38	0.08	0.20	–0.20	0.43
12500 Hz	12589.3 Hz	–0.25	0.38	0.15	0.20	–0.10	0.43
13200 Hz	13335.2 Hz	–0.31	0.40	0.00	0.20	–0.31	0.45
14000 Hz	14125.4 Hz	–0.36	0.41	–0.08	0.20	–0.44	0.46
15000 Hz	14962.4 Hz	–0.36	0.46	0.05	0.20	–0.32	0.50
16000 Hz	15848.9 Hz	–0.45	0.48	0.11	0.20	–0.34	0.52
17000 Hz	16788.0 Hz	–0.75	0.50	–0.01	0.20	–0.76	0.54
18000 Hz	17782.8 Hz	–1.09	0.52	–0.07	0.20	–1.16	0.56
19000 Hz	18836.5 Hz	–1.52	0.54	0.12	0.20	–1.40	0.58
20000 Hz	19952.6 Hz	–2.12	0.57	0.00	0.20	–2.12	0.60
21200 Hz	21134.9 Hz	–2.88	0.57	0.04	0.20	–2.84	0.61
22400 Hz	22387.2 Hz	–3.79	0.57	0.17	0.20	–3.62	0.61

Table A.6 *Free-field 0° frequency response for Outdoor Microphone Kit UA-1404, Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer's electrical response with the microphone preamplifier connected to a microphone extension cable*

Nominal Frequency	Exact Frequency (6 digits)	Microphone Free-field Response (From Table A.2)	Expanded Uncertainty	Influence of Outdoor Microphone Kit	Expanded Uncertainty	Electrical Response	Acoustical Response	Expanded Uncertainty
		dB	dB	dB	dB	dB	dB	dB
63 Hz	63.0957 Hz	0.00	0.05	0.00	0.15	0.00	0.00	0.16
80 Hz	79.4328 Hz	0.00	0.05	0.00	0.15	0.00	0.00	0.16
100 Hz	100 Hz	0.00	0.05	0.00	0.15	0.00	0.00	0.16
125 Hz	125.893 Hz	0.00	0.05	0.00	0.15	0.00	0.00	0.16
160 Hz	158.489 Hz	0.00	0.05	0.00	0.15	0.00	0.00	0.16
200 Hz	199.526 Hz	0.01	0.05	0.00	0.15	0.00	0.01	0.16
250 Hz	251.189 Hz	0.00	0.05	0.02	0.15	0.00	0.02	0.16
315 Hz	316.228 Hz	0.00	0.06	0.04	0.15	0.00	0.04	0.16
400 Hz	398.107 Hz	–0.01	0.06	0.07	0.15	0.00	0.07	0.16
500 Hz	501.187 Hz	–0.01	0.07	0.10	0.15	0.00	0.10	0.17
630 Hz	630.957 Hz	0.00	0.07	0.14	0.15	0.01	0.15	0.17
800 Hz	794.328 Hz	0.01	0.07	0.18	0.15	0.01	0.20	0.17
1000 Hz	1000 Hz	0.01	0.07	0.19	0.15	0.01	0.22	0.17
1060 Hz	1059.25 Hz	0.02	0.07	0.15	0.15	0.01	0.18	0.17
1120 Hz	1122.02 Hz	0.02	0.07	0.11	0.15	0.01	0.14	0.17
1180 Hz	1188.50 Hz	0.02	0.08	0.08	0.15	0.02	0.12	0.17
1250 Hz	1258.93 Hz	0.02	0.08	0.05	0.15	0.02	0.09	0.17
1320 Hz	1333.52 Hz	0.03	0.08	0.03	0.15	0.02	0.08	0.17
1400 Hz	1412.54 Hz	0.03	0.08	0.02	0.15	0.02	0.07	0.17
1500 Hz	1496.24 Hz	0.03	0.08	0.03	0.15	0.02	0.08	0.17
1600 Hz	1584.89 Hz	0.03	0.08	0.05	0.15	0.03	0.11	0.17
1700 Hz	1678.80 Hz	0.03	0.08	0.07	0.15	0.03	0.14	0.17
1800 Hz	1778.28 Hz	0.04	0.09	0.11	0.15	0.03	0.17	0.17
1900 Hz	1883.65 Hz	0.04	0.09	0.16	0.15	0.04	0.24	0.17
2000 Hz	1995.26 Hz	0.04	0.09	0.21	0.15	0.04	0.29	0.17
2120 Hz	2113.49 Hz	0.04	0.09	0.23	0.15	0.04	0.31	0.17
2240 Hz	2238.72 Hz	0.04	0.09	0.23	0.15	0.05	0.32	0.17
2360 Hz	2371.37 Hz	0.04	0.10	0.22	0.15	0.05	0.31	0.18
2500 Hz	2511.89 Hz	0.04	0.10	0.19	0.15	0.06	0.29	0.18
2650 Hz	2660.73 Hz	0.04	0.10	0.10	0.15	0.07	0.21	0.18
2800 Hz	2818.38 Hz	0.04	0.11	–0.02	0.15	0.07	0.09	0.19
3000 Hz	2985.38 Hz	0.04	0.11	–0.07	0.15	0.08	0.06	0.19
3150 Hz	3162.28 Hz	0.04	0.12	–0.08	0.15	0.09	0.05	0.19
3350 Hz	3349.65 Hz	0.04	0.12	–0.13	0.15	0.10	0.01	0.19
3550 Hz	3548.13 Hz	0.03	0.13	–0.04	0.15	0.10	0.09	0.20
3750 Hz	3758.37 Hz	0.04	0.13	0.05	0.15	0.11	0.20	0.20
4000 Hz	3981.07 Hz	0.04	0.14	0.01	0.15	0.12	0.17	0.21
4250 Hz	4216.97 Hz	0.04	0.14	0.04	0.15	0.13	0.20	0.21
4500 Hz	4466.84 Hz	0.03	0.14	–0.02	0.15	0.14	0.15	0.21
4750 Hz	4731.51 Hz	0.02	0.14	–0.05	0.15	0.15	0.12	0.21
5000 Hz	5011.87 Hz	0.01	0.15	–0.17	0.15	0.15	0.00	0.21
5300 Hz	5308.84 Hz	0.00	0.15	–0.19	0.15	0.16	–0.03	0.21
5600 Hz	5623.41 Hz	–0.01	0.15	–0.35	0.15	0.16	–0.20	0.21
6000 Hz	5956.62 Hz	–0.03	0.16	–0.37	0.15	0.16	–0.24	0.22
6300 Hz	6309.57 Hz	–0.05	0.16	–0.43	0.15	0.15	–0.33	0.22
6700 Hz	6683.44 Hz	–0.07	0.17	–0.35	0.15	0.14	–0.28	0.23
7100 Hz	7079.46 Hz	–0.08	0.17	–0.29	0.15	0.12	–0.25	0.23
7500 Hz	7498.94 Hz	–0.06	0.17	–0.14	0.15	0.09	–0.11	0.23
8000 Hz	7943.28 Hz	–0.03	0.18	–0.05	0.15	0.05	–0.03	0.23
8500 Hz	8413.95 Hz	–0.01	0.19	–0.01	0.15	0.00	–0.02	0.24
9000 Hz	8912.51 Hz	–0.02	0.20	0.06	0.15	–0.06	–0.02	0.25
9500 Hz	9440.61 Hz	0.00	0.22	0.15	0.15	–0.14	0.00	0.27
10000 Hz	10000 Hz	0.05	0.23	0.17	0.15	–0.21	0.00	0.27
10600 Hz	10592.5 Hz	0.14	0.24	0.15	0.15	–0.26	0.02	0.28
11200 Hz	11220.2 Hz	0.28	0.26	0.06	0.15	–0.28	0.07	0.30

Nominal Frequency	Exact Frequency (6 digits)	Microphone Free-field Response (From Table A.2) dB	Expanded Uncertainty dB	Influence of Outdoor Microphone Kit dB	Expanded Uncertainty dB	Electrical Response dB	Acoustical Response dB	Expanded Uncertainty dB
11800 Hz	11885.0 Hz	0.44	0.28	–0.14	0.15	–0.21	0.09	0.32
12500 Hz	12589.3 Hz	0.51	0.29	–0.50	0.15	–0.01	0.00	0.33
13200 Hz	13335.2 Hz	0.60	0.31	–1.08	0.15	0.37	–0.11	0.34
14000 Hz	14125.4 Hz	0.71	0.33	–1.78	0.15	0.93	–0.15	0.36
15000 Hz	14962.4 Hz	0.81	0.35	–2.53	0.15	1.66	–0.06	0.38
16000 Hz	15848.9 Hz	0.87	0.38	–3.36	0.15	2.49	0.00	0.41
17000 Hz	16788.0 Hz	0.80	0.40	–4.08	0.15	3.33	0.04	0.43
18000 Hz	17782.8 Hz	0.59	0.43	–4.57	0.15	4.13	0.15	0.46
19000 Hz	18836.5 Hz	0.23	0.45	–5.06	0.15	4.83	–0.00	0.47
20000 Hz	19952.6 Hz	–0.24	0.48	–5.95	0.15	5.40	–0.79	0.50
21200 Hz	21134.9 Hz	–0.88	0.49	–6.46	0.15	5.83	–1.52	0.51
22400 Hz	22387.2 Hz	–1.75	0.49	–8.06	0.15	6.09	–3.72	0.51

A.3 Diffuse-field Frequency Responses

Diffuse-field frequency responses with Z frequency weighting. Measured with sounds at random incidence and the instrument's *Sound Field Correction* parameter set to *Diffuse-field*, see section 4.6.

Table A.7 *Diffuse-field frequency response for Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer with or without the microphone preamplifier connected to a microphone extension cable*

Nominal Frequency	Exact Frequency (6 digits)	Microphone Actuator Response dB	Microphone Diffuse-field Correction dB	Microphone Diffuse-field Response dB	Electrical Response dB	Acoustical Response dB	Expanded Uncertainty dB
63 Hz	63.0957 Hz	0.00	0.00	0.00	0.00	0.00	0.05
80 Hz	79.4328 Hz	0.00	0.00	0.00	0.00	0.00	0.05
100 Hz	100 Hz	0.00	0.00	0.00	0.00	0.00	0.05
125 Hz	125.893 Hz	0.00	0.00	0.00	0.00	0.00	0.05
160 Hz	158.489 Hz	0.00	0.00	0.00	0.00	0.00	0.05
200 Hz	199.526 Hz	0.01	0.00	0.01	0.00	0.01	0.05
250 Hz	251.189 Hz	0.00	0.00	0.00	0.01	0.01	0.05
315 Hz	316.228 Hz	–0.01	–0.01	–0.02	0.01	–0.01	0.06
400 Hz	398.107 Hz	–0.02	–0.01	–0.03	0.01	–0.02	0.06
500 Hz	501.187 Hz	–0.03	–0.01	–0.04	0.02	–0.02	0.10
630 Hz	630.957 Hz	–0.04	–0.02	–0.06	0.03	–0.03	0.10
800 Hz	794.328 Hz	–0.06	–0.02	–0.08	0.05	–0.03	0.10
1000 Hz	1000 Hz	–0.08	–0.02	–0.10	0.07	–0.03	0.10
1060 Hz	1059.25 Hz	–0.09	–0.02	–0.11	0.08	–0.03	0.10
1120 Hz	1122.02 Hz	–0.10	–0.02	–0.13	0.09	–0.04	0.10
1180 Hz	1188.50 Hz	–0.11	–0.03	–0.14	0.10	–0.04	0.10
1250 Hz	1258.93 Hz	–0.13	–0.03	–0.16	0.11	–0.05	0.10
1320 Hz	1333.52 Hz	–0.14	–0.04	–0.18	0.12	–0.06	0.10
1400 Hz	1412.54 Hz	–0.15	–0.05	–0.20	0.14	–0.06	0.10
1500 Hz	1496.24 Hz	–0.17	–0.05	–0.22	0.15	–0.07	0.10
1600 Hz	1584.89 Hz	–0.19	–0.05	–0.24	0.17	–0.07	0.10
1700 Hz	1678.80 Hz	–0.21	–0.05	–0.26	0.19	–0.07	0.10
1800 Hz	1778.28 Hz	–0.23	–0.04	–0.27	0.22	–0.05	0.10
1900 Hz	1883.65 Hz	–0.26	–0.03	–0.28	0.24	–0.04	0.10
2000 Hz	1995.26 Hz	–0.28	0.00	–0.29	0.27	–0.02	0.10
2120 Hz	2113.49 Hz	–0.32	0.02	–0.30	0.30	0.00	0.10
2240 Hz	2238.72 Hz	–0.35	0.04	–0.32	0.34	0.02	0.11
2360 Hz	2371.37 Hz	–0.39	0.04	–0.35	0.37	0.02	0.11
2500 Hz	2511.89 Hz	–0.44	0.04	–0.40	0.42	0.02	0.12
2650 Hz	2660.73 Hz	–0.49	0.03	–0.46	0.46	0.00	0.12
2800 Hz	2818.38 Hz	–0.54	0.03	–0.52	0.52	0.00	0.13
3000 Hz	2985.38 Hz	–0.60	0.03	–0.57	0.57	0.00	0.13
3150 Hz	3162.28 Hz	–0.67	0.04	–0.64	0.64	0.00	0.13
3350 Hz	3349.65 Hz	–0.75	0.05	–0.70	0.71	0.01	0.14
3550 Hz	3548.13 Hz	–0.83	0.07	–0.77	0.78	0.01	0.14

Nominal Frequency	Exact Frequency (6 digits)	Microphone Actuator Response dB	Microphone Diffuse-field Correction dB	Microphone Diffuse-field Response dB	Electrical Response dB	Acoustical Response dB	Expanded Uncertainty dB
3750 Hz	3758.37 Hz	–0.92	0.09	–0.84	0.87	0.03	0.15
4000 Hz	3981.07 Hz	–1.03	0.09	–0.94	0.96	0.02	0.15
4250 Hz	4216.97 Hz	–1.14	0.08	–1.06	1.06	0.00	0.15
4500 Hz	4466.84 Hz	–1.27	0.07	–1.20	1.17	–0.03	0.16
4750 Hz	4731.51 Hz	–1.41	0.09	–1.32	1.28	–0.04	0.16
5000 Hz	5011.87 Hz	–1.56	0.14	–1.42	1.41	–0.01	0.16
5300 Hz	5308.84 Hz	–1.73	0.19	–1.54	1.54	0.00	0.17
5600 Hz	5623.41 Hz	–1.91	0.24	–1.67	1.68	0.01	0.17
6000 Hz	5956.62 Hz	–2.11	0.28	–1.84	1.84	0.00	0.17
6300 Hz	6309.57 Hz	–2.33	0.32	–2.01	2.00	–0.01	0.18
6700 Hz	6683.44 Hz	–2.57	0.39	–2.18	2.17	–0.01	0.18
7100 Hz	7079.46 Hz	–2.82	0.47	–2.35	2.34	–0.01	0.18
7500 Hz	7498.94 Hz	–3.10	0.63	–2.48	2.53	0.05	0.19
8000 Hz	7943.28 Hz	–3.41	0.75	–2.66	2.72	0.06	0.19
8500 Hz	8413.95 Hz	–3.76	0.87	–2.89	2.91	0.02	0.22
9000 Hz	8912.51 Hz	–4.16	1.03	–3.13	3.11	–0.02	0.25
9500 Hz	9440.61 Hz	–4.60	1.23	–3.37	3.31	–0.06	0.28
10000 Hz	10000 Hz	–5.08	1.53	–3.54	3.51	–0.03	0.31
10600 Hz	10592.5 Hz	–5.55	1.86	–3.69	3.70	0.01	0.34
11200 Hz	11220.2 Hz	–5.99	2.20	–3.79	3.89	0.10	0.37
11800 Hz	11885.0 Hz	–6.37	2.44	–3.93	4.07	0.14	0.40
12500 Hz	12589.3 Hz	–6.68	2.51	–4.17	4.24	0.07	0.43
13200 Hz	13335.2 Hz	–6.94	2.54	–4.40	4.40	0.00	0.46
14000 Hz	14125.4 Hz	–7.19	2.59	–4.60	4.58	–0.02	0.49
15000 Hz	14962.4 Hz	–7.43	2.60	–4.83	4.79	–0.04	0.52
16000 Hz	15848.9 Hz	–7.71	2.58	–5.13	5.11	–0.02	0.55
17000 Hz	16788.0 Hz	–8.12	2.52	–5.59	5.60	0.01	0.57
18000 Hz	17782.8 Hz	–8.67	2.47	–6.20	6.24	0.04	0.59
19000 Hz	18836.5 Hz	–9.40	2.47	–6.93	6.93	0.00	0.61
20000 Hz	19952.6 Hz	–10.29	2.48	–7.81	7.50	–0.31	0.63
21200 Hz	21134.9 Hz	–11.34	2.48	–8.86	7.89	–0.97	0.65
22400 Hz	22387.2 Hz	–12.60	2.42	–10.18	8.10	–2.08	0.67

Table A.8 *Diffuse-field frequency response for Windscreen UA-1650, Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer with or without the microphone preamplifier connected to a microphone extension cable*

Nominal Frequency	Exact Frequency (6 digits)	Microphone Diffuse-field Response (From Table A.7) dB	Expanded Uncertainty dB	Influence of Windscreen dB	Expanded Uncertainty dB	Electrical Response dB	Acoustical Response dB	Expanded Uncertainty dB
63 Hz	63.0957 Hz	0.00	0.05	0.00	0.05	0.00	0.00	0.07
80 Hz	79.4328 Hz	0.00	0.05	0.00	0.05	0.00	0.00	0.07
100 Hz	100 Hz	0.00	0.05	0.00	0.05	0.00	0.00	0.07
125 Hz	125.893 Hz	0.00	0.05	0.00	0.05	0.00	0.00	0.07
160 Hz	158.489 Hz	0.00	0.05	0.00	0.05	0.00	0.00	0.07
200 Hz	199.526 Hz	0.01	0.05	0.00	0.05	0.00	0.01	0.07
250 Hz	251.189 Hz	0.00	0.05	0.01	0.05	–0.01	0.00	0.07
315 Hz	316.228 Hz	–0.02	0.06	0.02	0.05	–0.01	0.00	0.08
400 Hz	398.107 Hz	–0.03	0.06	0.04	0.05	–0.02	–0.01	0.08
500 Hz	501.187 Hz	–0.04	0.10	0.06	0.05	–0.03	–0.02	0.11
630 Hz	630.957 Hz	–0.06	0.10	0.08	0.05	–0.05	–0.03	0.11
800 Hz	794.328 Hz	–0.08	0.10	0.11	0.05	–0.08	–0.05	0.11
1000 Hz	1000 Hz	–0.10	0.10	0.15	0.05	–0.12	–0.08	0.11
1060 Hz	1059.25 Hz	–0.11	0.10	0.17	0.08	–0.13	–0.07	0.13
1120 Hz	1122.02 Hz	–0.13	0.10	0.20	0.08	–0.14	–0.07	0.13
1180 Hz	1188.50 Hz	–0.14	0.10	0.24	0.08	–0.16	–0.06	0.13
1250 Hz	1258.93 Hz	–0.16	0.10	0.28	0.08	–0.17	–0.05	0.13
1320 Hz	1333.52 Hz	–0.18	0.10	0.32	0.10	–0.19	–0.05	0.14
1400 Hz	1412.54 Hz	–0.20	0.10	0.36	0.10	–0.21	–0.05	0.14

Nominal Frequency	Exact Frequency (6 digits)	Microphone Diffuse-field Response (From Table A.7)	Expanded Uncertainty	Influence of Windscreen	Expanded Uncertainty	Electrical Response	Acoustical Response	Expanded Uncertainty
		dB	dB	dB	dB	dB	dB	dB
1500 Hz	1496.24 Hz	–0.22	0.10	0.40	0.10	–0.22	–0.04	0.14
1600 Hz	1584.89 Hz	–0.24	0.10	0.44	0.12	–0.24	–0.04	0.16
1700 Hz	1678.80 Hz	–0.26	0.10	0.48	0.15	–0.25	–0.03	0.18
1800 Hz	1778.28 Hz	–0.27	0.10	0.52	0.15	–0.26	–0.02	0.18
1900 Hz	1883.65 Hz	–0.28	0.10	0.55	0.15	–0.26	0.01	0.18
2000 Hz	1995.26 Hz	–0.29	0.10	0.58	0.15	–0.25	0.05	0.18
2120 Hz	2113.49 Hz	–0.30	0.10	0.62	0.15	–0.24	0.08	0.18
2240 Hz	2238.72 Hz	–0.32	0.11	0.64	0.15	–0.21	0.12	0.19
2360 Hz	2371.37 Hz	–0.35	0.11	0.67	0.15	–0.17	0.15	0.19
2500 Hz	2511.89 Hz	–0.40	0.12	0.68	0.15	–0.11	0.17	0.19
2650 Hz	2660.73 Hz	–0.46	0.12	0.68	0.15	–0.03	0.19	0.19
2800 Hz	2818.38 Hz	–0.52	0.13	0.66	0.15	0.06	0.20	0.20
3000 Hz	2985.38 Hz	–0.57	0.13	0.62	0.15	0.17	0.21	0.20
3150 Hz	3162.28 Hz	–0.64	0.13	0.55	0.15	0.30	0.21	0.20
3350 Hz	3349.65 Hz	–0.70	0.14	0.45	0.15	0.44	0.19	0.20
3550 Hz	3548.13 Hz	–0.77	0.14	0.33	0.15	0.59	0.15	0.21
3750 Hz	3758.37 Hz	–0.84	0.15	0.18	0.15	0.74	0.08	0.21
4000 Hz	3981.07 Hz	–0.94	0.15	0.03	0.15	0.90	–0.01	0.21
4250 Hz	4216.97 Hz	–1.06	0.15	–0.13	0.15	1.07	–0.12	0.21
4500 Hz	4466.84 Hz	–1.20	0.16	–0.27	0.15	1.23	–0.24	0.22
4750 Hz	4731.51 Hz	–1.32	0.16	–0.39	0.25	1.40	–0.30	0.30
5000 Hz	5011.87 Hz	–1.42	0.16	–0.46	0.35	1.57	–0.31	0.39
5300 Hz	5308.84 Hz	–1.54	0.17	–0.50	0.45	1.75	–0.28	0.48
5600 Hz	5623.41 Hz	–1.67	0.17	–0.48	0.50	1.93	–0.23	0.53
6000 Hz	5956.62 Hz	–1.84	0.17	–0.44	0.50	2.11	–0.16	0.53
6300 Hz	6309.57 Hz	–2.01	0.18	–0.38	0.50	2.31	–0.08	0.53
6700 Hz	6683.44 Hz	–2.18	0.18	–0.34	0.50	2.51	–0.01	0.53
7100 Hz	7079.46 Hz	–2.35	0.18	–0.36	0.50	2.72	0.01	0.53
7500 Hz	7498.94 Hz	–2.48	0.19	–0.45	0.50	2.95	0.03	0.53
8000 Hz	7943.28 Hz	–2.66	0.19	–0.58	0.50	3.18	–0.06	0.53
8500 Hz	8413.95 Hz	–2.89	0.22	–0.71	0.50	3.43	–0.17	0.55
9000 Hz	8912.51 Hz	–3.13	0.25	–0.79	0.50	3.69	–0.23	0.56
9500 Hz	9440.61 Hz	–3.37	0.28	–0.82	0.50	3.96	–0.23	0.57
10000 Hz	10000 Hz	–3.54	0.31	–0.82	0.50	4.24	–0.12	0.59
10600 Hz	10592.5 Hz	–3.69	0.34	–0.86	0.80	4.54	–0.01	0.87
11200 Hz	11220.18 Hz	–3.79	0.37	–0.96	0.80	4.84	0.09	0.88
11800 Hz	11885.02 Hz	–3.93	0.40	–1.07	0.80	5.16	0.16	0.89
12500 Hz	12589.25 Hz	–4.17	0.43	–1.19	0.80	5.48	0.12	0.91
13200 Hz	13335.21 Hz	–4.40	0.46	–1.31	0.80	5.80	0.09	0.92
14000 Hz	14125.38 Hz	–4.60	0.49	–1.43	0.80	6.13	0.10	0.94
15000 Hz	14962.36 Hz	–4.83	0.52	–1.53	0.80	6.45	0.10	0.95
16000 Hz	15848.93 Hz	–5.13	0.55	–1.63	0.80	6.77	0.01	0.97
17000 Hz	16788.04 Hz	–5.59	0.57	–1.77	0.80	7.07	–0.29	0.98
18000 Hz	17782.79 Hz	–6.20	0.59	–1.92	0.80	7.35	–0.77	0.99
19000 Hz	18836.49 Hz	–6.93	0.61	–1.98	0.80	7.60	–1.31	1.01
20000 Hz	19952.62 Hz	–7.81	0.63	–2.07	0.80	7.81	–2.06	1.02
21200 Hz	21134.89 Hz	–8.86	0.65	–2.18	0.80	7.97	–3.07	1.03
22400 Hz	22387.21 Hz	–10.18	0.67	–2.19	0.80	8.05	–4.31	1.04

Table A.9 *Diffuse-field frequency response for Outdoor Microphone Kit UA-1404, Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer with the microphone preamplifier connected to a microphone extension cable*

Nominal Frequency	Exact Frequency (6 digits)	Microphone Diffuse-field Response (From Table A.7)	Expanded Uncertainty	Influence of Outdoor Microphone Kit	Expanded Uncertainty	Electrical Response	Acoustical Response	Expanded Uncertainty
		dB	dB	dB	dB	dB	dB	dB
63 Hz	63.0957 Hz	0.00	0.05	0.00	0.05	0.00	0.00	0.07
80 Hz	79.4328 Hz	0.00	0.05	0.00	0.05	0.00	0.00	0.07
100 Hz	100 Hz	0.00	0.05	0.00	0.05	0.00	0.00	0.07
125 Hz	125.893 Hz	0.00	0.05	0.00	0.05	0.00	0.00	0.07
160 Hz	158.489 Hz	0.00	0.05	0.00	0.05	0.00	0.00	0.07
200 Hz	199.526 Hz	0.01	0.05	0.00	0.05	0.01	0.02	0.07
250 Hz	251.189 Hz	0.00	0.05	0.01	0.05	0.01	0.02	0.07
315 Hz	316.228 Hz	–0.02	0.06	0.02	0.05	0.01	0.02	0.08
400 Hz	398.107 Hz	–0.03	0.06	0.04	0.05	0.02	0.03	0.08
500 Hz	501.187 Hz	–0.04	0.10	0.06	0.05	0.03	0.04	0.11
630 Hz	630.957 Hz	–0.06	0.10	0.08	0.05	0.04	0.06	0.11
800 Hz	794.328 Hz	–0.08	0.10	0.10	0.05	0.06	0.08	0.11
1000 Hz	1000 Hz	–0.10	0.10	0.09	0.05	0.10	0.09	0.11
1060 Hz	1059.25 Hz	–0.11	0.10	0.07	0.08	0.11	0.07	0.13
1120 Hz	1122.02 Hz	–0.13	0.10	0.05	0.08	0.13	0.05	0.13
1180 Hz	1188.50 Hz	–0.14	0.10	0.03	0.08	0.14	0.03	0.13
1250 Hz	1258.93 Hz	–0.16	0.10	0.02	0.08	0.16	0.02	0.13
1320 Hz	1333.52 Hz	–0.18	0.10	0.02	0.10	0.18	0.02	0.14
1400 Hz	1412.54 Hz	–0.20	0.10	0.02	0.10	0.20	0.02	0.14
1500 Hz	1496.24 Hz	–0.22	0.10	0.03	0.10	0.22	0.03	0.14
1600 Hz	1584.89 Hz	–0.24	0.10	0.03	0.12	0.25	0.04	0.16
1700 Hz	1678.80 Hz	–0.26	0.10	0.03	0.15	0.28	0.05	0.18
1800 Hz	1778.28 Hz	–0.27	0.10	0.03	0.15	0.31	0.07	0.18
1900 Hz	1883.65 Hz	–0.28	0.10	0.02	0.15	0.35	0.08	0.18
2000 Hz	1995.26 Hz	–0.29	0.10	–0.01	0.15	0.39	0.10	0.18
2120 Hz	2113.49 Hz	–0.30	0.10	–0.03	0.15	0.44	0.12	0.18
2240 Hz	2238.72 Hz	–0.32	0.11	–0.05	0.15	0.49	0.12	0.19
2360 Hz	2371.37 Hz	–0.35	0.11	–0.08	0.15	0.55	0.13	0.19
2500 Hz	2511.89 Hz	–0.40	0.12	–0.10	0.15	0.61	0.11	0.19
2650 Hz	2660.73 Hz	–0.46	0.12	–0.13	0.15	0.68	0.09	0.19
2800 Hz	2818.38 Hz	–0.52	0.13	–0.18	0.15	0.76	0.07	0.20
3000 Hz	2985.38 Hz	–0.57	0.13	–0.23	0.15	0.85	0.04	0.20
3150 Hz	3162.28 Hz	–0.64	0.13	–0.29	0.15	0.94	0.02	0.20
3350 Hz	3349.65 Hz	–0.70	0.14	–0.35	0.15	1.05	0.01	0.20
3550 Hz	3548.13 Hz	–0.77	0.14	–0.40	0.15	1.16	–0.01	0.21
3750 Hz	3758.37 Hz	–0.84	0.15	–0.46	0.15	1.29	–0.01	0.21
4000 Hz	3981.07 Hz	–0.94	0.15	–0.50	0.15	1.43	–0.01	0.21
4250 Hz	4216.97 Hz	–1.06	0.15	–0.52	0.15	1.58	–0.01	0.21
4500 Hz	4466.84 Hz	–1.20	0.16	–0.55	0.15	1.75	0.00	0.22
4750 Hz	4731.51 Hz	–1.32	0.16	–0.60	0.25	1.92	0.00	0.30
5000 Hz	5011.87 Hz	–1.42	0.16	–0.70	0.35	2.11	–0.01	0.39
5300 Hz	5308.84 Hz	–1.54	0.17	–0.83	0.45	2.30	–0.06	0.48
5600 Hz	5623.41 Hz	–1.67	0.17	–0.94	0.50	2.49	–0.13	0.53
6000 Hz	5956.62 Hz	–1.84	0.17	–1.01	0.50	2.67	–0.18	0.53
6300 Hz	6309.57 Hz	–2.01	0.18	–1.00	0.50	2.84	–0.17	0.53
6700 Hz	6683.44 Hz	–2.18	0.18	–0.89	0.50	2.97	–0.10	0.53
7100 Hz	7079.46 Hz	–2.35	0.18	–0.67	0.50	3.03	0.01	0.53
7500 Hz	7498.94 Hz	–2.48	0.19	–0.42	0.50	3.02	0.12	0.53
8000 Hz	7943.28 Hz	–2.66	0.19	–0.08	0.50	2.90	0.16	0.53
8500 Hz	8413.95 Hz	–2.89	0.22	0.30	0.50	2.70	0.11	0.55
9000 Hz	8912.51 Hz	–3.13	0.25	0.67	0.50	2.46	0.00	0.56
9500 Hz	9440.61 Hz	–3.37	0.28	1.00	0.50	2.24	–0.13	0.57
10000 Hz	10000 Hz	–3.54	0.31	1.23	0.50	2.13	–0.18	0.59
10600 Hz	10592.5 Hz	–3.69	0.34	1.40	0.80	2.16	–0.13	0.87
11200 Hz	11220.2 Hz	–3.79	0.37	1.47	0.80	2.35	0.02	0.88

Nominal Frequency	Exact Frequency (6 digits)	Microphone Diffuse-field Response (From Table A.7)	Expanded Uncertainty	Influence of Outdoor Microphone Kit	Expanded Uncertainty	Electrical Response	Acoustical Response	Expanded Uncertainty
		dB	dB	dB	dB	dB	dB	dB
11800 Hz	11885.0 Hz	–3.93	0.40	1.47	0.80	2.65	0.20	0.89
12500 Hz	12589.3 Hz	–4.17	0.43	1.36	0.80	3.04	0.22	0.91
13200 Hz	13335.2 Hz	–4.40	0.46	1.02	0.80	3.47	0.09	0.92
14000 Hz	14125.4 Hz	–4.60	0.49	0.69	0.80	3.93	0.02	0.94
15000 Hz	14962.4 Hz	–4.83	0.52	0.43	0.80	4.38	–0.01	0.95
16000 Hz	15848.9 Hz	–5.13	0.55	0.25	0.80	4.83	–0.05	0.97
17000 Hz	16788.0 Hz	–5.59	0.57	0.34	0.80	5.25	–0.01	0.98
18000 Hz	17782.8 Hz	–6.20	0.59	0.56	0.80	5.64	0.00	0.99
19000 Hz	18836.5 Hz	–6.93	0.61	0.63	0.80	5.98	–0.32	1.01
20000 Hz	19952.6 Hz	–7.81	0.63	0.49	0.80	6.27	–1.05	1.02
21200 Hz	21134.9 Hz	–8.86	0.65	0.40	0.80	6.48	–1.98	1.03
22400 Hz	22387.2 Hz	–10.18	0.67	–0.02	0.80	6.61	–3.59	1.04

A.4 Free-field Frequency Responses for Diffuse-field Calibrated Instruments

Free-field frequency response in the reference direction for diffuse-field calibrated instruments according to IEC 60651 and IEC 60804. Measured with plane progressive sinusoidal sound waves incident from the reference direction and the instrument's *Sound Field Correction* parameter set to *Diffuse-field*, see section 4.6.

Table A.10 *Free-field 0° frequency response with the Sound Field Correction parameter set to Diffuse-field for the configurations for which there are specified normal Free-field responses*

Nominal Frequency	Exact Frequency (6 digits)	Configuration as in Table A.2	Configuration as in Table A.3	Configuration as in Table A.4	Configuration as in Table A.5	Configuration as in Table A.6
		dB	dB	dB	dB	dB
63 Hz	63.0957 Hz	0.00	0.00	0.00	0.00	0.00
80 Hz	79.4328 Hz	0.00	0.00	0.00	0.00	0.00
100 Hz	100 Hz	0.00	0.00	0.00	0.00	0.00
125 Hz	125.893 Hz	0.00	0.00	0.00	0.00	0.00
160 Hz	158.489 Hz	0.00	0.01	0.00	0.01	0.00
200 Hz	199.526 Hz	0.01	0.03	0.01	0.03	0.02
250 Hz	251.189 Hz	0.01	0.08	0.00	0.07	0.03
315 Hz	316.228 Hz	0.01	0.14	0.01	0.14	0.05
400 Hz	398.107 Hz	0.00	0.21	0.02	0.23	0.09
500 Hz	501.187 Hz	0.01	0.24	0.03	0.26	0.13
630 Hz	630.957 Hz	0.03	0.10	0.05	0.12	0.18
800 Hz	794.328 Hz	0.06	–0.05	0.06	–0.05	0.25
1000 Hz	1000 Hz	0.08	0.01	0.08	0.01	0.31
1060 Hz	1059.25 Hz	0.10	0.00	0.10	0.00	0.28
1120 Hz	1122.02 Hz	0.11	–0.07	0.13	–0.05	0.26
1180 Hz	1188.50 Hz	0.12	–0.14	0.15	–0.11	0.24
1250 Hz	1258.93 Hz	0.13	–0.17	0.18	–0.12	0.23
1320 Hz	1333.52 Hz	0.15	–0.09	0.20	–0.04	0.24
1400 Hz	1412.54 Hz	0.17	0.09	0.23	0.15	0.25
1500 Hz	1496.24 Hz	0.18	0.28	0.26	0.36	0.28
1600 Hz	1584.89 Hz	0.20	0.37	0.29	0.46	0.33
1700 Hz	1678.80 Hz	0.22	0.29	0.33	0.40	0.39
1800 Hz	1778.28 Hz	0.26	0.13	0.37	0.25	0.45
1900 Hz	1883.65 Hz	0.28	0.06	0.41	0.20	0.55
2000 Hz	1995.26 Hz	0.31	0.22	0.46	0.37	0.64
2120 Hz	2113.49 Hz	0.34	0.46	0.50	0.61	0.71
2240 Hz	2238.72 Hz	0.38	0.47	0.55	0.64	0.76
2360 Hz	2371.37 Hz	0.41	0.11	0.60	0.29	0.81
2500 Hz	2511.89 Hz	0.46	0.29	0.65	0.48	0.84
2650 Hz	2660.73 Hz	0.50	0.68	0.71	0.90	0.82
2800 Hz	2818.38 Hz	0.56	0.66	0.78	0.88	0.78

Nominal Frequency	Exact Frequency (6 digits)	Configuration as in Table A.2 dB	Configuration as in Table A.3 dB	Configuration as in Table A.4 dB	Configuration as in Table A.5 dB	Configuration as in Table A.6 dB
3000 Hz	2985.38 Hz	0.61	0.49	0.85	0.72	0.83
3150 Hz	3162.28 Hz	0.68	0.84	0.89	1.05	0.90
3350 Hz	3349.65 Hz	0.75	0.78	0.91	0.95	0.96
3550 Hz	3548.13 Hz	0.81	0.68	0.92	0.80	1.15
3750 Hz	3758.37 Hz	0.91	1.10	0.94	1.14	1.38
4000 Hz	3981.07 Hz	1.00	0.90	0.98	0.89	1.48
4250 Hz	4216.97 Hz	1.10	1.09	1.06	1.05	1.65
4500 Hz	4466.84 Hz	1.20	1.29	1.13	1.22	1.76
4750 Hz	4731.51 Hz	1.30	1.14	1.24	1.08	1.89
5000 Hz	5011.87 Hz	1.42	1.18	1.40	1.16	1.96
5300 Hz	5308.84 Hz	1.54	1.44	1.58	1.48	2.11
5600 Hz	5623.41 Hz	1.67	1.62	1.76	1.71	2.13
6000 Hz	5956.62 Hz	1.81	1.84	1.95	1.98	2.27
6300 Hz	6309.57 Hz	1.95	2.01	2.15	2.21	2.36
6700 Hz	6683.44 Hz	2.10	2.15	2.28	2.33	2.55
7100 Hz	7079.46 Hz	2.26	2.23	2.36	2.33	2.66
7500 Hz	7498.94 Hz	2.47	2.38	2.53	2.44	2.82
8000 Hz	7943.28 Hz	2.69	2.61	2.74	2.66	2.82
8500 Hz	8413.95 Hz	2.90	2.71	2.95	2.76	2.68
9000 Hz	8912.51 Hz	3.09	3.09	3.23	3.22	2.50
9500 Hz	9440.61 Hz	3.31	3.42	3.49	3.60	2.38
10000 Hz	10000 Hz	3.56	3.71	3.77	3.92	2.34
10600 Hz	10592.5 Hz	3.84	3.70	4.05	3.91	2.44
11200 Hz	11220.2 Hz	4.17	4.04	4.39	4.26	2.70
11800 Hz	11885.0 Hz	4.51	4.59	4.74	4.82	2.95
12500 Hz	12589.3 Hz	4.75	4.90	5.11	5.26	3.05
13200 Hz	13335.2 Hz	5.00	5.00	5.40	5.40	2.99
14000 Hz	14125.4 Hz	5.29	5.21	5.71	5.63	2.85
15000 Hz	14962.4 Hz	5.60	5.65	6.06	6.10	2.66
16000 Hz	15848.9 Hz	5.98	6.10	6.32	6.43	2.34
17000 Hz	16788.0 Hz	6.40	6.39	6.36	6.35	1.96
18000 Hz	17782.8 Hz	6.83	6.77	6.34	6.27	1.66
19000 Hz	18836.5 Hz	7.16	7.28	6.19	6.31	1.15
20000 Hz	19952.6 Hz	7.26	7.26	5.84	5.84	0.08
21200 Hz	21134.9 Hz	7.01	7.05	5.28	5.32	–0.87
22400 Hz	22387.2 Hz	6.35	6.52	4.51	4.68	–3.20

A.5 Directional Responses

Directional responses for plane progressive sinusoidal sound waves normalised to the response in the reference direction, including sensitivity variations.

Table A.11 *Directional response for Microphone Type 4189 and Microphone Preamplifier ZC-0032 with the microphone preamplifier connected to a microphone extension cable, 500 Hz – 3550 Hz, in dB*

	Frequency											
Angle	**500 Hz**	**630 Hz**	**800 Hz**	**1000 Hz**	**1250 Hz**	**1600 Hz**	**2000 Hz**	2240 Hz	**2500 Hz**	2800 Hz	**3150 Hz**	3550 Hz
0°	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5°	0.00	0.00	0.00	–0.01	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00
10°	0.01	0.00	0.00	–0.01	–0.01	0.00	0.00	0.00	–0.01	–0.01	–0.01	–0.01
15°	0.01	0.00	0.00	–0.02	–0.01	–0.01	0.00	0.00	–0.02	–0.03	–0.02	–0.02
20°	0.01	0.01	–0.01	–0.02	–0.02	–0.02	–0.01	–0.01	–0.04	–0.06	–0.05	–0.05
25°	0.01	0.01	–0.01	–0.02	–0.03	–0.03	–0.02	–0.03	–0.06	–0.10	–0.09	–0.08
30°	0.02	0.01	–0.01	–0.03	–0.04	–0.05	–0.04	–0.04	–0.09	–0.14	–0.13	–0.13
35°	0.01	0.00	–0.02	–0.04	–0.05	–0.07	–0.05	–0.06	–0.12	–0.19	–0.18	–0.18
40°	0.00	–0.01	–0.03	–0.05	–0.06	–0.09	–0.07	–0.07	–0.14	–0.24	–0.25	–0.24
45°	0.00	–0.01	–0.03	–0.06	–0.08	–0.11	–0.10	–0.09	–0.17	–0.29	–0.31	–0.31
50°	–0.01	–0.02	–0.04	–0.07	–0.10	–0.14	–0.13	–0.11	–0.19	–0.33	–0.38	–0.38
55°	–0.01	–0.02	–0.05	–0.08	–0.11	–0.17	–0.16	–0.14	–0.21	–0.38	–0.46	–0.46
60°	–0.02	–0.03	–0.06	–0.08	–0.13	–0.19	–0.19	–0.17	–0.24	–0.42	–0.52	–0.55
65°	–0.02	–0.04	–0.06	–0.10	–0.14	–0.21	–0.23	–0.21	–0.27	–0.45	–0.58	–0.63
70°	–0.03	–0.04	–0.07	–0.11	–0.16	–0.24	–0.27	–0.24	–0.30	–0.48	–0.64	–0.70
75°	–0.03	–0.05	–0.08	–0.12	–0.17	–0.26	–0.30	–0.29	–0.34	–0.51	–0.68	–0.78
80°	–0.04	–0.06	–0.09	–0.13	–0.19	–0.28	–0.34	–0.33	–0.37	–0.54	–0.72	–0.84
85°	–0.04	–0.06	–0.09	–0.14	–0.21	–0.31	–0.38	–0.37	–0.42	–0.57	–0.75	–0.90
90°	–0.05	–0.07	–0.10	–0.15	–0.22	–0.33	–0.41	–0.41	–0.46	–0.61	–0.78	–0.94
95°	–0.05	–0.07	–0.11	–0.16	–0.23	–0.35	–0.44	–0.45	–0.51	–0.65	–0.81	–0.98
100°	–0.05	–0.08	–0.11	–0.17	–0.25	–0.36	–0.46	–0.48	–0.55	–0.69	–0.85	–1.01
105°	–0.05	–0.08	–0.11	–0.17	–0.26	–0.38	–0.49	–0.51	–0.58	–0.73	–0.89	–1.05
110°	–0.06	–0.08	–0.12	–0.18	–0.26	–0.39	–0.51	–0.54	–0.62	–0.77	–0.93	–1.08
115°	–0.06	–0.08	–0.12	–0.18	–0.26	–0.40	–0.52	–0.56	–0.64	–0.81	–0.96	–1.12
120°	–0.06	–0.09	–0.12	–0.18	–0.27	–0.40	–0.53	–0.57	–0.67	–0.84	–1.00	–1.16
125°	–0.06	–0.09	–0.12	–0.18	–0.26	–0.39	–0.52	–0.57	–0.68	–0.85	–1.03	–1.19
130°	–0.06	–0.08	–0.12	–0.18	–0.25	–0.38	–0.51	–0.56	–0.67	–0.86	–1.04	–1.22
135°	–0.06	–0.08	–0.12	–0.17	–0.25	–0.37	–0.50	–0.55	–0.65	–0.84	–1.03	–1.21
140°	–0.05	–0.08	–0.11	–0.16	–0.24	–0.36	–0.48	–0.52	–0.63	–0.81	–1.00	–1.19
145°	–0.05	–0.08	–0.11	–0.16	–0.23	–0.34	–0.45	–0.49	–0.59	–0.77	–0.96	–1.14
150°	–0.05	–0.07	–0.11	–0.15	–0.22	–0.32	–0.42	–0.45	–0.55	–0.72	–0.90	–1.08
155°	–0.05	–0.07	–0.10	–0.14	–0.20	–0.31	–0.39	–0.42	–0.51	–0.66	–0.83	–1.01
160°	–0.05	–0.07	–0.10	–0.13	–0.19	–0.29	–0.37	–0.39	–0.47	–0.61	–0.77	–0.93
165°	–0.04	–0.07	–0.10	–0.13	–0.19	–0.28	–0.35	–0.36	–0.43	–0.57	–0.72	–0.87
170°	–0.04	–0.06	–0.10	–0.13	–0.18	–0.27	–0.33	–0.34	–0.41	–0.54	–0.68	–0.82
175°	–0.04	–0.06	–0.09	–0.13	–0.18	–0.26	–0.32	–0.33	–0.39	–0.52	–0.65	–0.78
180°	–0.04	–0.06	–0.09	–0.12	–0.18	–0.26	–0.32	–0.33	–0.39	–0.51	–0.64	–0.77
185°	–0.04	–0.06	–0.09	–0.12	–0.18	–0.27	–0.32	–0.33	–0.39	–0.52	–0.65	–0.78
190°	–0.04	–0.06	–0.10	–0.13	–0.18	–0.27	–0.33	–0.34	–0.41	–0.54	–0.67	–0.81
195°	–0.04	–0.07	–0.10	–0.13	–0.19	–0.28	–0.35	–0.36	–0.43	–0.57	–0.71	–0.86
200°	–0.05	–0.07	–0.10	–0.13	–0.20	–0.29	–0.37	–0.39	–0.46	–0.61	–0.76	–0.92
205°	–0.05	–0.07	–0.10	–0.14	–0.20	–0.31	–0.39	–0.42	–0.51	–0.66	–0.82	–0.99
210°	–0.05	–0.07	–0.11	–0.14	–0.22	–0.32	–0.42	–0.45	–0.55	–0.71	–0.89	–1.07
215°	–0.05	–0.08	–0.11	–0.15	–0.23	–0.34	–0.45	–0.49	–0.59	–0.76	–0.94	–1.14
220°	–0.05	–0.08	–0.11	–0.15	–0.24	–0.36	–0.47	–0.52	–0.63	–0.81	–0.99	–1.20
225°	–0.06	–0.08	–0.12	–0.16	–0.25	–0.38	–0.50	–0.55	–0.66	–0.84	–1.03	–1.23
230°	–0.06	–0.08	–0.12	–0.17	–0.26	–0.39	–0.52	–0.57	–0.68	–0.86	–1.04	–1.24
235°	–0.06	–0.09	–0.12	–0.17	–0.26	–0.40	–0.53	–0.58	–0.68	–0.86	–1.04	–1.22
240°	–0.06	–0.09	–0.12	–0.17	–0.27	–0.40	–0.53	–0.58	–0.68	–0.85	–1.02	–1.19
245°	–0.06	–0.08	–0.12	–0.17	–0.27	–0.40	–0.53	–0.57	–0.66	–0.83	–0.99	–1.14
250°	–0.06	–0.08	–0.12	–0.18	–0.27	–0.40	–0.52	–0.55	–0.64	–0.79	–0.94	–1.10
255°	–0.05	–0.08	–0.11	–0.17	–0.26	–0.39	–0.50	–0.53	–0.61	–0.75	–0.90	–1.05
260°	–0.05	–0.08	–0.11	–0.16	–0.25	–0.38	–0.48	–0.50	–0.57	–0.70	–0.85	–1.01
265°	–0.05	–0.07	–0.11	–0.16	–0.24	–0.36	–0.46	–0.47	–0.52	–0.66	–0.81	–0.98
270°	–0.05	–0.07	–0.10	–0.15	–0.23	–0.35	–0.43	–0.43	–0.47	–0.61	–0.77	–0.95
275°	–0.04	–0.06	–0.09	–0.14	–0.21	–0.33	–0.39	–0.39	–0.42	–0.56	–0.75	–0.93
280°	–0.04	–0.06	–0.09	–0.12	–0.20	–0.31	–0.36	–0.34	–0.38	–0.53	–0.72	–0.89
285°	–0.03	–0.05	–0.08	–0.11	–0.18	–0.28	–0.32	–0.29	–0.34	–0.51	–0.70	–0.84
290°	–0.03	–0.04	–0.07	–0.10	–0.17	–0.26	–0.28	–0.25	–0.30	–0.49	–0.68	–0.76
295°	–0.02	–0.04	–0.06	–0.10	–0.15	–0.23	–0.24	–0.21	–0.28	–0.47	–0.63	–0.67
300°	–0.02	–0.03	–0.06	–0.08	–0.13	–0.21	–0.20	–0.18	–0.25	–0.44	–0.57	–0.57
305°	–0.01	–0.02	–0.05	–0.06	–0.12	–0.18	–0.16	–0.15	–0.24	–0.41	–0.49	–0.47
310°	–0.01	–0.02	–0.04	–0.05	–0.10	–0.16	–0.13	–0.13	–0.22	–0.37	–0.41	–0.39
315°	0.00	–0.01	–0.03	–0.05	–0.08	–0.13	–0.10	–0.10	–0.19	–0.32	–0.33	–0.31
320°	0.00	–0.01	–0.03	–0.03	–0.07	–0.10	–0.08	–0.09	–0.17	–0.27	–0.26	–0.25
325°	0.01	0.00	–0.02	–0.03	–0.06	–0.08	–0.06	–0.07	–0.15	–0.22	–0.19	–0.20
330°	0.02	0.01	–0.01	–0.01	–0.04	–0.06	–0.04	–0.06	–0.12	–0.16	–0.14	–0.15
335°	0.01	0.01	–0.01	0.00	–0.03	–0.04	–0.03	–0.05	–0.09	–0.12	–0.09	–0.10
340°	0.01	0.01	–0.01	0.01	–0.02	–0.03	–0.02	–0.03	–0.07	–0.08	–0.06	–0.07
345°	0.01	0.00	0.00	0.01	–0.01	–0.02	–0.01	–0.03	–0.05	–0.05	–0.03	–0.03
350°	0.01	0.00	0.00	0.01	0.00	–0.02	0.00	–0.02	–0.03	–0.03	0.00	–0.01
355°	0.00	0.00	0.00	0.01	0.00	–0.01	0.00	–0.01	–0.02	–0.02	0.00	0.00

Table A.12 *Directional response for Microphone Type 4189 and Microphone Preamplifier ZC-0032 with the microphone preamplifier connected to a microphone extension cable, 4000 Hz – 10600 Hz, in dB*

	Frequency											
Angle	**4000 Hz**	4500 Hz	**5000 Hz**	5600 Hz	**6300 Hz**	7100 Hz	**8000 Hz**	8500 Hz	9000 Hz	9500 Hz	**10000 Hz**	10600 Hz
0°	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5°	–0.01	–0.01	–0.01	–0.01	0.00	0.00	–0.01	0.00	–0.01	0.00	–0.02	–0.01
10°	–0.02	–0.03	–0.02	–0.04	–0.02	–0.03	–0.06	–0.04	–0.08	–0.04	–0.09	–0.04
15°	–0.05	–0.07	–0.04	–0.09	–0.05	–0.09	–0.15	–0.10	–0.20	–0.10	–0.21	–0.10
20°	–0.09	–0.13	–0.08	–0.16	–0.11	–0.19	–0.26	–0.19	–0.35	–0.21	–0.36	–0.20
25°	–0.14	–0.21	–0.15	–0.24	–0.18	–0.33	–0.38	–0.32	–0.55	–0.38	–0.53	–0.39
30°	–0.20	–0.30	–0.24	–0.31	–0.28	–0.51	–0.50	–0.51	–0.73	–0.65	–0.67	–0.68
35°	–0.25	–0.39	–0.37	–0.37	–0.42	–0.71	–0.61	–0.74	–0.90	–0.98	–0.82	–1.04
40°	–0.32	–0.49	–0.52	–0.42	–0.60	–0.87	–0.72	–0.96	–1.10	–1.30	–1.11	–1.33
45°	–0.39	–0.57	–0.70	–0.51	–0.80	–1.01	–0.92	–1.13	–1.38	–1.52	–1.55	–1.55
50°	–0.47	–0.65	–0.86	–0.66	–0.95	–1.16	–1.21	–1.26	–1.70	–1.73	–1.96	–1.93
55°	–0.56	–0.75	–0.99	–0.89	–1.04	–1.36	–1.55	–1.46	–1.94	–2.08	–2.14	–2.56
60°	–0.66	–0.86	–1.08	–1.15	–1.16	–1.58	–1.83	–1.80	–2.10	–2.47	–2.34	–2.97
65°	–0.75	–0.99	–1.17	–1.36	–1.38	–1.74	–2.04	–2.14	–2.39	–2.72	–2.76	–3.12
70°	–0.83	–1.12	–1.31	–1.46	–1.72	–1.86	–2.28	–2.36	–2.80	–3.02	–3.07	–3.50
75°	–0.91	–1.23	–1.49	–1.50	–2.03	–2.06	–2.55	–2.54	–3.03	–3.53	–3.35	–3.83
80°	–0.98	–1.31	–1.68	–1.61	–2.19	–2.41	–2.78	–2.85	–3.11	–3.81	–3.98	–4.01
85°	–1.05	–1.37	–1.82	–1.81	–2.23	–2.76	–2.98	–3.23	–3.41	–3.77	–4.38	–4.59
90°	–1.10	–1.42	–1.89	–2.03	–2.31	–2.96	–3.21	–3.50	–3.89	–4.03	–4.29	–5.03
95°	–1.16	–1.48	–1.93	–2.19	–2.49	–3.06	–3.47	–3.69	–4.19	–4.59	–4.55	–5.08
100°	–1.21	–1.54	–1.97	–2.26	–2.67	–3.18	–3.68	–3.89	–4.32	–4.90	–5.07	–5.45
105°	–1.24	–1.58	–2.02	–2.29	–2.79	–3.33	–3.83	–4.11	–4.49	–5.03	–5.33	–5.84
110°	–1.27	–1.61	–2.06	–2.31	–2.84	–3.44	–3.92	–4.24	–4.66	–5.22	–5.49	–6.04
115°	–1.30	–1.63	–2.08	–2.32	–2.85	–3.51	–4.01	–4.33	–4.77	–5.35	–5.64	–6.25
120°	–1.34	–1.66	–2.10	–2.33	–2.84	–3.51	–4.05	–4.42	–4.87	–5.45	–5.72	–6.34
125°	–1.38	–1.70	–2.14	–2.35	–2.83	–3.47	–4.02	–4.44	–4.90	–5.54	–5.83	–6.44
130°	–1.41	–1.74	–2.19	–2.39	–2.85	–3.45	–3.93	–4.35	–4.81	–5.47	–5.81	–6.52
135°	–1.42	–1.75	–2.23	–2.44	–2.90	–3.48	–3.87	–4.26	–4.68	–5.30	–5.60	–6.34
140°	–1.40	–1.75	–2.24	–2.47	–2.96	–3.56	–3.91	–4.25	–4.65	–5.24	–5.48	–6.15
145°	–1.35	–1.70	–2.21	–2.44	–2.97	–3.63	–4.00	–4.34	–4.73	–5.30	–5.52	–6.16
150°	–1.27	–1.62	–2.12	–2.34	–2.90	–3.60	–4.02	–4.40	–4.80	–5.39	–5.63	–6.28
155°	–1.18	–1.50	–2.00	–2.20	–2.74	–3.45	–3.90	–4.32	–4.73	–5.33	–5.60	–6.28
160°	–1.10	–1.39	–1.86	–2.03	–2.55	–3.24	–3.66	–4.08	–4.50	–5.09	–5.36	–6.04
165°	–1.01	–1.29	–1.74	–1.88	–2.35	–3.00	–3.38	–3.79	–4.19	–4.75	–5.00	–5.64
170°	–0.95	–1.21	–1.64	–1.75	–2.20	–2.81	–3.15	–3.53	–3.90	–4.44	–4.65	–5.25
175°	–0.91	–1.16	–1.58	–1.67	–2.10	–2.69	–2.99	–3.36	–3.71	–4.22	–4.41	–4.98
180°	–0.90	–1.13	–1.56	–1.65	–2.07	–2.65	–2.94	–3.29	–3.64	–4.13	–4.31	–4.88
185°	–0.91	–1.15	–1.58	–1.68	–2.10	–2.69	–2.98	–3.34	–3.69	–4.18	–4.37	–4.96
190°	–0.94	–1.19	–1.64	–1.76	–2.20	–2.81	–3.11	–3.49	–3.85	–4.37	–4.61	–5.24
195°	–1.00	–1.27	–1.74	–1.88	–2.35	–2.99	–3.33	–3.73	–4.13	–4.69	–4.98	–5.66
200°	–1.08	–1.37	–1.86	–2.04	–2.54	–3.20	–3.58	–4.03	–4.46	–5.08	–5.40	–6.06
205°	–1.17	–1.49	–2.01	–2.20	–2.72	–3.40	–3.83	–4.31	–4.76	–5.37	–5.65	–6.27
210°	–1.26	–1.60	–2.13	–2.35	–2.86	–3.55	–4.00	–4.46	–4.87	–5.43	–5.66	–6.29
215°	–1.34	–1.69	–2.22	–2.43	–2.94	–3.61	–4.03	–4.44	–4.79	–5.35	–5.60	–6.28
220°	–1.40	–1.75	–2.26	–2.46	–2.95	–3.60	–3.97	–4.33	–4.70	–5.31	–5.58	–6.24
225°	–1.43	–1.76	–2.24	–2.44	–2.91	–3.54	–3.91	–4.29	–4.73	–5.35	–5.58	–6.27
230°	–1.43	–1.74	–2.21	–2.39	–2.85	–3.49	–3.92	–4.34	–4.80	–5.42	–5.69	–6.48
235°	–1.40	–1.71	–2.15	–2.34	–2.81	–3.48	–4.00	–4.41	–4.86	–5.53	–5.85	–6.59
240°	–1.36	–1.67	–2.11	–2.30	–2.80	–3.52	–4.07	–4.44	–4.90	–5.57	–5.81	–6.40
245°	–1.31	–1.62	–2.07	–2.28	–2.83	–3.57	–4.05	–4.41	–4.85	–5.42	–5.59	–6.25
250°	–1.27	–1.59	–2.04	–2.29	–2.87	–3.54	–3.94	–4.29	–4.71	–5.24	–5.54	–6.29
255°	–1.23	–1.56	–2.02	–2.32	–2.84	–3.37	–3.82	–4.18	–4.60	–5.18	–5.50	–6.01
260°	–1.20	–1.54	–2.00	–2.30	–2.69	–3.20	–3.75	–4.04	–4.47	–5.02	–5.10	–5.51
265°	–1.17	–1.51	–1.98	–2.18	–2.48	–3.13	–3.58	–3.78	–4.24	–4.64	–4.61	–5.28
270°	–1.14	–1.47	–1.92	–2.00	–2.35	–3.09	–3.24	–3.52	–3.96	–4.17	–4.39	–5.15
275°	–1.09	–1.40	–1.80	–1.80	–2.32	–2.85	–2.97	–3.33	–3.54	–3.87	–4.39	–4.74
280°	–1.02	–1.31	–1.65	–1.65	–2.27	–2.44	–2.85	–3.01	–3.16	–3.84	–4.11	–4.23
285°	–0.93	–1.22	–1.50	–1.58	–2.06	–2.12	–2.66	–2.60	–3.04	–3.69	–3.52	–3.96
290°	–0.83	–1.12	–1.36	–1.50	–1.73	–1.96	–2.31	–2.37	–2.95	–3.20	–3.11	–3.68
295°	–0.74	–1.02	–1.24	–1.34	–1.42	–1.85	–2.03	–2.26	–2.58	–2.78	–2.85	–3.30
300°	–0.65	–0.91	–1.13	–1.11	–1.24	–1.63	–1.90	–1.98	–2.15	–2.55	–2.48	–3.03
305°	–0.56	–0.82	–1.01	–0.86	–1.14	–1.36	–1.69	–1.55	–1.95	–2.24	–2.17	–2.66
310°	–0.50	–0.73	–0.84	–0.68	–1.02	–1.17	–1.33	–1.26	–1.81	–1.86	–1.96	–2.16
315°	–0.42	–0.63	–0.67	–0.55	–0.84	–1.06	–0.95	–1.15	–1.54	–1.54	–1.66	–1.74
320°	–0.36	–0.52	–0.49	–0.48	–0.63	–0.97	–0.71	–1.06	–1.21	–1.31	–1.28	–1.42
325°	–0.30	–0.42	–0.36	–0.42	–0.44	–0.82	–0.62	–0.88	–0.93	–1.07	–0.97	–1.09
330°	–0.24	–0.31	–0.24	–0.35	–0.30	–0.62	–0.56	–0.65	–0.72	–0.79	–0.73	–0.75
335°	–0.19	–0.22	–0.16	–0.27	–0.20	–0.41	–0.48	–0.42	–0.56	–0.53	–0.55	–0.49
340°	–0.13	–0.13	–0.11	–0.18	–0.14	–0.24	–0.37	–0.24	–0.40	–0.33	–0.36	–0.32
345°	–0.10	–0.06	–0.08	–0.11	–0.09	–0.12	–0.26	–0.11	–0.25	–0.20	–0.20	–0.20
350°	–0.07	–0.02	–0.05	–0.05	–0.06	–0.03	–0.15	–0.03	–0.13	–0.11	–0.08	–0.12
355°	–0.05	0.01	–0.04	–0.01	–0.03	0.01	–0.09	0.02	–0.06	–0.05	0.00	–0.07

Table A.13 *Directional response for Microphone Type 4189 and Microphone Preamplifier ZC-0032 with the microphone preamplifier connected to a microphone extension cable, 11200 Hz – 20000 Hz, in dB*

	Frequency										
Angle	11200 Hz	11800 Hz	**12500 Hz**	13200 Hz	14000 Hz	15000 Hz	**16000 Hz**	17000 Hz	18000 Hz	19000 Hz	**20000 Hz**
0°	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5°	–0.01	–0.01	–0.01	–0.03	–0.03	–0.02	–0.02	–0.03	–0.04	–0.04	–0.02
10°	–0.08	–0.08	–0.08	–0.12	–0.13	–0.06	–0.09	–0.13	–0.19	–0.19	–0.16
15°	–0.21	–0.17	–0.19	–0.28	–0.29	–0.14	–0.25	–0.33	–0.43	–0.42	–0.41
20°	–0.39	–0.29	–0.40	–0.48	–0.48	–0.31	–0.51	–0.61	–0.78	–0.74	–0.77
25°	–0.59	–0.44	–0.71	–0.71	–0.70	–0.66	–0.86	–0.95	–1.17	–1.08	–1.17
30°	–0.75	–0.67	–1.04	–0.95	–0.99	–1.18	–1.15	–1.25	–1.53	–1.52	–1.61
35°	–0.93	–1.04	–1.30	–1.29	–1.42	–1.67	–1.43	–1.67	–2.06	–2.21	–2.28
40°	–1.23	–1.40	–1.51	–1.81	–1.82	–2.01	–2.01	–2.26	–2.70	–2.81	–2.93
45°	–1.69	–1.67	–1.89	–2.31	–2.16	–2.55	–2.70	–2.76	–3.16	–3.31	–3.71
50°	–2.04	–2.04	–2.41	–2.57	–2.74	–3.20	–3.05	–3.51	–3.87	–4.17	–4.59
55°	–2.26	–2.61	–2.78	–3.03	–3.34	–3.61	–3.70	–4.33	–4.55	–4.72	–5.33
60°	–2.79	–2.99	–3.28	–3.61	–3.68	–4.28	–4.35	–4.79	–5.35	–5.78	–6.28
65°	–3.44	–3.33	–3.97	–3.91	–4.44	–4.59	–5.00	–5.67	–5.92	–6.67	–7.07
70°	–3.68	–3.92	–4.45	–4.53	–4.97	–5.15	–5.73	–6.05	–6.88	–7.57	–7.90
75°	–4.10	–4.18	–5.05	–5.13	–5.54	–5.89	–6.26	–6.77	–7.65	–8.14	–8.85
80°	–4.60	–4.56	–5.31	–5.72	–6.15	–6.59	–6.91	–7.47	–8.35	–8.87	–9.79
85°	–4.75	–5.26	–5.44	–6.27	–6.50	–7.48	–7.42	–8.45	–8.79	–9.90	–10.51
90°	–5.16	–5.58	–6.17	–6.30	–7.28	–7.47	–8.51	–8.77	–9.94	–10.45	–11.14
95°	–5.53	–5.77	–6.73	–6.97	–7.40	–8.20	–8.53	–9.66	–10.47	–11.43	–12.07
100°	–5.77	–6.04	–6.73	–7.51	–8.09	–8.55	–9.12	–9.87	–11.01	–12.09	–12.78
105°	–6.15	–6.55	–7.08	–7.45	–8.35	–9.17	–9.72	–10.40	–11.38	–12.37	–13.30
110°	–6.36	–6.80	–7.58	–8.06	–8.52	–9.14	–9.97	–11.01	–12.07	–12.99	–13.42
115°	–6.63	–7.01	–7.70	–8.32	–9.19	–9.70	–10.18	–11.06	–12.30	–13.39	–14.18
120°	–6.75	–7.27	–8.08	–8.52	–9.23	–9.90	–10.81	–11.68	–12.64	–13.65	–14.27
125°	–6.74	–7.21	–8.07	–8.77	–9.63	–10.10	–10.68	–11.78	–13.20	–14.22	–14.77
130°	–6.87	–7.33	–7.98	–8.54	–9.46	–10.32	–11.09	–11.99	–13.09	–14.29	–14.87
135°	–6.74	–7.34	–8.17	–8.71	–9.46	–10.04	–10.84	–12.04	–13.31	–14.41	–14.98
140°	–6.47	–6.95	–7.83	–8.60	–9.56	–10.21	–10.83	–11.87	–13.16	–14.22	–14.93
145°	–6.47	–6.84	–7.49	–8.10	–9.00	–9.82	–10.64	–11.71	–12.99	–14.27	–14.86
150°	–6.62	–7.07	–7.65	–8.13	–8.80	–9.43	–10.21	–11.23	–12.35	–13.42	–14.32
155°	–6.63	–7.21	–7.89	–8.46	–9.12	–9.65	–10.35	–11.36	–12.39	–13.27	–13.89
160°	–6.37	–6.98	–7.74	–8.44	–9.22	–9.85	–10.54	–11.64	–12.78	–13.86	–14.43
165°	–5.94	–6.51	–7.25	–7.97	–8.77	–9.47	–10.16	–11.24	–12.42	–13.59	–14.60
170°	–5.53	–6.05	–6.74	–7.41	–8.16	–8.83	–9.49	–10.51	–11.59	–12.62	–13.82
175°	–5.25	–5.74	–6.40	–7.03	–7.72	–8.34	–8.97	–9.94	–10.95	–11.86	–13.04
180°	–5.15	–5.65	–6.29	–6.89	–7.53	–8.15	–8.77	–9.76	–10.76	–11.59	–12.73
185°	–5.27	–5.79	–6.43	–7.01	–7.64	–8.27	–8.97	–10.04	–11.05	–11.79	–12.96
190°	–5.59	–6.12	–6.75	–7.32	–8.01	–8.74	–9.57	–10.71	–11.67	–12.36	–13.77
195°	–6.01	–6.53	–7.16	–7.81	–8.63	–9.50	–10.34	–11.39	–12.34	–13.16	–14.74
200°	–6.37	–6.88	–7.57	–8.33	–9.23	–10.00	–10.70	–11.75	–12.83	–13.57	–14.89
205°	–6.55	–7.11	–7.85	–8.56	–9.32	–9.94	–10.71	–11.83	–12.75	–13.31	–14.85
210°	–6.61	–7.17	–7.81	–8.40	–9.18	–9.92	–10.71	–11.70	–12.70	–13.53	–14.90
215°	–6.58	–7.07	–7.68	–8.41	–9.32	–10.03	–10.77	–11.99	–13.12	–13.74	–15.17
220°	–6.53	–7.08	–7.83	–8.65	–9.51	–10.25	–11.19	–12.27	–13.30	–14.26	–15.60
225°	–6.69	–7.32	–8.06	–8.82	–9.80	–10.56	–11.30	–12.44	–13.55	–14.18	–15.48
230°	–6.96	–7.44	–8.15	–8.97	–9.88	–10.44	–11.26	–12.29	–13.25	–14.24	–15.64
235°	–6.91	–7.36	–8.13	–8.86	–9.72	–10.42	–11.21	–12.24	–13.45	–14.13	–15.31
240°	–6.70	–7.32	–8.02	–8.77	–9.77	–10.29	–11.08	–11.99	–12.80	–13.59	–14.93
245°	–6.69	–7.28	–7.93	–8.72	–9.37	–9.85	–10.56	–11.43	–12.65	–13.37	–14.86
250°	–6.58	–7.00	–7.70	–8.21	–8.87	–9.53	–10.30	–11.37	–12.32	–13.18	–14.40
255°	–6.19	–6.66	–7.27	–7.81	–8.69	–9.34	–10.08	–10.92	–11.88	–12.47	–13.95
260°	–5.92	–6.27	–6.93	–7.72	–8.37	–8.96	–9.62	–10.30	–11.26	–12.18	–13.57
265°	–5.67	–5.89	–6.87	–7.27	–7.86	–8.56	–8.87	–10.01	–10.86	–11.59	–12.85
270°	–5.24	–5.76	–6.43	–6.65	–7.62	–7.77	–8.84	–9.23	–10.33	–10.65	–12.05
275°	–4.94	–5.46	–5.68	–6.52	–6.84	–7.72	–7.88	–8.84	–9.21	–10.16	–11.19
280°	–4.72	–4.77	–5.48	–5.96	–6.50	–7.00	–7.22	–7.96	–8.75	–9.07	–10.59
285°	–4.24	–4.38	–5.18	–5.43	–5.95	–6.14	–6.76	–7.13	–8.05	–8.50	–9.46
290°	–3.82	–4.04	–4.68	–4.87	–5.25	–5.60	–6.04	–6.49	–7.36	–7.75	–8.54
295°	–3.48	–3.52	–4.23	–4.11	–4.91	–4.81	–5.49	–6.05	–6.28	–6.99	–7.79
300°	–2.94	–3.19	–3.43	–3.91	–3.96	–4.65	–4.68	–5.27	–5.73	–6.05	–6.84
305°	–2.46	–2.74	–2.94	–3.35	–3.57	–3.95	–4.09	–4.65	–4.90	–4.98	–5.93
310°	–2.13	–2.18	–2.65	–2.72	–3.16	–3.43	–3.37	–3.92	–4.20	–4.38	–5.05
315°	–1.71	–1.86	–2.07	–2.53	–2.40	–2.91	–2.95	–3.08	–3.49	–3.55	–4.22
320°	–1.32	–1.58	–1.63	–2.11	–1.99	–2.27	–2.33	–2.50	–2.98	–2.97	–3.31
325°	–1.08	–1.15	–1.47	–1.47	–1.67	–1.84	–1.71	–1.93	–2.30	–2.43	–2.67
330°	–0.91	–0.75	–1.27	–1.05	–1.24	–1.38	–1.33	–1.51	–1.75	–1.71	–1.95
335°	–0.69	–0.51	–0.88	–0.83	–0.86	–0.87	–1.00	–1.14	–1.38	–1.22	–1.40
340°	–0.45	–0.38	–0.50	–0.63	–0.59	–0.49	–0.64	–0.74	–0.96	–0.88	–0.99
345°	–0.24	–0.27	–0.24	–0.40	–0.36	–0.27	–0.37	–0.40	–0.54	–0.54	–0.59
350°	–0.09	–0.16	–0.09	–0.20	–0.18	–0.13	–0.19	–0.18	–0.23	–0.25	–0.28
355°	0.00	–0.08	–0.02	–0.07	–0.04	–0.05	–0.09	–0.05	–0.04	–0.07	–0.09

Table A.14 *Sensitivity variations for Microphone Type 4189 and Microphone Preamplifier ZC-0032 with the microphone preamplifier connected to a microphone extension cable, at sound incidence angles within $\pm\theta°$ from the reference direction*

Nominal Frequency	Exact Frequency	Max Variation ± 30° dB	Max Variation ± 90° dB	Max Variation ± 150° dB
500 Hz	501.187 Hz	0.02	0.06	0.08
630 Hz	630.957 Hz	0.01	0.08	0.10
800 Hz	794.328 Hz	0.01	0.10	0.12
1000 Hz	1000 Hz	0.04	0.17	0.19
1250 Hz	1258.93 Hz	0.04	0.23	0.27
1600 Hz	1584.89 Hz	0.07	0.35	0.41
2000 Hz	1995.26 Hz	0.05	0.44	0.54
2240 Hz	2238.72 Hz	0.06	0.43	0.58
2500 Hz	2511.89 Hz	0.13	0.48	0.69
2800 Hz	2818.38 Hz	0.16	0.61	0.86
3150 Hz	3162.28 Hz	0.14	0.78	1.05
3550 Hz	3548.13 Hz	0.15	0.95	1.24
4000 Hz	3981.07 Hz	0.24	1.14	1.43
4500 Hz	4466.84 Hz	0.33	1.48	1.78
5000 Hz	5011.87 Hz	0.24	1.92	2.26
5600 Hz	5623.41 Hz	0.35	2.03	2.47
6300 Hz	6309.57 Hz	0.30	2.35	2.97
7100 Hz	7079.46 Hz	0.63	3.09	3.64
8000 Hz	7943.28 Hz	0.56	3.24	4.07
8500 Hz	8413.95 Hz	0.66	3.54	4.48
9000 Hz	8912.51 Hz	0.73	3.96	4.90
9500 Hz	9440.61 Hz	0.79	4.17	5.57
10000 Hz	10000 Hz	0.74	4.40	5.85
10600 Hz	10592.5 Hz	0.75	5.15	6.59
11200 Hz	11220.2 Hz	0.91	5.24	6.96
11800 Hz	11885.0 Hz	0.75	5.76	7.44
12500 Hz	12589.3 Hz	1.27	6.43	8.17
13200 Hz	13335.2 Hz	1.05	6.65	8.97
14000 Hz	14125.4 Hz	1.24	7.62	9.88
15000 Hz	14962.4 Hz	1.38	7.77	10.56
16000 Hz	15848.9 Hz	1.33	8.84	11.30
17000 Hz	16788.0 Hz	1.51	9.23	12.44
18000 Hz	17782.8 Hz	1.75	10.33	13.55
19000 Hz	18836.5 Hz	1.71	10.65	14.41
20000 Hz	19952.6 Hz	1.95	12.05	15.64

Table A.15 *Influence of the analyzer's body on the directional response, measured in a plane parallel to the display and along the microphone's axis, 500 Hz – 3550 Hz*

	Frequency											
Angle	**500 Hz**	**630 Hz**	**800 Hz**	**1000 Hz**	**1250 Hz**	**1600 Hz**	**2000 Hz**	2240 Hz	**2500 Hz**	2800 Hz	**3150 Hz**	3550 Hz
0°	0.01	0.01	–0.01	0.00	0.00	0.00	0.01	0.00	–0.01	–0.01	0.00	0.00
5°	0.00	0.01	0.00	0.00	0.00	0.00	–0.01	0.01	–0.03	–0.01	–0.01	0.00
10°	0.00	0.01	–0.01	0.00	0.00	0.00	–0.04	0.03	–0.06	0.02	–0.05	–0.02
15°	–0.01	0.00	–0.02	0.02	–0.01	–0.01	–0.08	0.05	–0.11	0.07	–0.11	–0.02
20°	0.00	0.02	0.00	0.01	0.00	–0.02	–0.14	0.10	–0.16	0.12	–0.18	0.04
25°	0.01	0.04	0.00	0.02	0.00	–0.04	–0.20	0.13	–0.18	0.16	–0.26	0.14
30°	0.00	0.04	0.01	0.01	0.03	–0.08	–0.24	0.12	–0.17	0.15	–0.30	0.25
35°	0.01	0.06	0.03	0.02	0.06	–0.16	–0.25	0.06	–0.09	0.07	–0.26	0.29
40°	0.01	0.08	0.06	0.01	0.10	–0.25	–0.22	–0.06	0.04	–0.05	–0.16	0.23
45°	0.00	0.11	0.10	0.00	0.16	–0.36	–0.13	–0.19	0.14	–0.15	–0.07	0.12
50°	0.00	0.15	0.15	–0.02	0.22	–0.44	–0.02	–0.28	0.14	–0.14	–0.08	0.09
55°	–0.04	0.16	0.20	–0.02	0.26	–0.48	0.05	–0.24	–0.01	–0.01	–0.18	0.19
60°	–0.05	0.16	0.26	–0.01	0.28	–0.45	0.01	–0.10	–0.21	0.09	–0.26	0.25
65°	–0.06	0.15	0.31	0.02	0.27	–0.35	–0.14	0.03	–0.30	0.02	–0.18	0.16
70°	–0.09	0.15	0.37	0.07	0.25	–0.21	–0.34	0.02	–0.16	–0.21	–0.09	0.08
75°	–0.12	0.12	0.38	0.15	0.23	–0.08	–0.45	–0.17	0.04	–0.34	–0.18	0.16
80°	–0.14	0.08	0.39	0.24	0.23	–0.01	–0.38	–0.41	0.02	–0.20	–0.43	0.21
85°	–0.17	0.05	0.38	0.32	0.27	–0.02	–0.15	–0.49	–0.25	–0.04	–0.47	0.01
90°	–0.19	0.01	0.34	0.39	0.35	–0.06	0.09	–0.28	–0.49	–0.18	–0.28	–0.19
95°	–0.22	–0.05	0.28	0.42	0.47	–0.10	0.21	0.06	–0.36	–0.49	–0.30	–0.05
100°	–0.23	–0.08	0.20	0.40	0.58	–0.05	0.18	0.28	0.07	–0.48	–0.60	0.04
105°	–0.28	–0.15	0.12	0.34	0.66	0.07	0.09	0.26	0.39	–0.01	–0.63	–0.22
110°	–0.29	–0.18	0.04	0.23	0.66	0.21	0.07	0.11	0.41	0.41	–0.12	–0.25
115°	–0.30	–0.23	–0.03	0.09	0.59	0.30	0.19	0.06	0.22	0.43	0.35	0.33
120°	–0.30	–0.25	–0.08	–0.06	0.45	0.29	0.37	0.19	0.14	0.19	0.35	0.82
125°	–0.29	–0.26	–0.11	–0.19	0.25	0.15	0.46	0.40	0.28	0.09	0.05	0.72
130°	–0.29	–0.27	–0.12	–0.28	0.06	–0.08	0.37	0.48	0.47	0.29	–0.04	0.35
135°	–0.28	–0.27	–0.10	–0.32	–0.10	–0.34	0.11	0.31	0.47	0.47	0.18	0.35
140°	–0.24	–0.24	–0.07	–0.30	–0.19	–0.55	–0.24	–0.06	0.18	0.33	0.27	0.59
145°	–0.24	–0.21	–0.03	–0.24	–0.21	–0.65	–0.55	–0.48	–0.27	–0.13	–0.06	0.49
150°	–0.18	–0.19	0.02	–0.17	–0.15	–0.63	–0.69	–0.75	–0.67	–0.67	–0.67	–0.09
155°	–0.18	–0.17	0.07	–0.08	–0.06	–0.51	–0.64	–0.76	–0.81	–0.95	–1.16	–0.77
160°	–0.15	–0.14	0.12	0.00	0.05	–0.36	–0.47	–0.58	–0.67	–0.86	–1.20	–1.03
165°	–0.15	–0.11	0.15	0.08	0.14	–0.21	–0.27	–0.33	–0.40	–0.55	–0.89	–0.76
170°	–0.14	–0.11	0.18	0.13	0.22	–0.10	–0.10	–0.10	–0.13	–0.21	–0.49	–0.30
175°	–0.13	–0.10	0.19	0.18	0.27	–0.02	0.01	0.05	0.05	0.02	–0.20	0.06
180°	–0.12	–0.10	0.20	0.18	0.28	0.00	0.05	0.10	0.12	0.10	–0.10	0.20
185°	–0.12	–0.10	0.19	0.17	0.27	–0.02	0.01	0.06	0.06	0.02	–0.19	0.08
190°	–0.12	–0.10	0.19	0.15	0.22	–0.09	–0.10	–0.09	–0.11	–0.19	–0.47	–0.27
195°	–0.15	–0.13	0.16	0.10	0.15	–0.21	–0.27	–0.30	–0.38	–0.52	–0.88	–0.74
200°	–0.17	–0.15	0.13	0.02	0.04	–0.35	–0.47	–0.55	–0.66	–0.85	–1.21	–1.05
205°	–0.20	–0.17	0.09	–0.06	–0.07	–0.49	–0.63	–0.73	–0.82	–0.97	–1.20	–0.82
210°	–0.19	–0.19	0.04	–0.15	–0.16	–0.60	–0.68	–0.72	–0.71	–0.71	–0.71	–0.12
215°	–0.24	–0.24	–0.01	–0.23	–0.22	–0.62	–0.54	–0.48	–0.32	–0.17	–0.06	0.51
220°	–0.25	–0.25	–0.05	–0.29	–0.22	–0.52	–0.24	–0.08	0.17	0.34	0.32	0.64
225°	–0.27	–0.27	–0.08	–0.30	–0.13	–0.31	0.13	0.30	0.51	0.53	0.27	0.39
230°	–0.29	–0.28	–0.09	–0.27	0.04	–0.05	0.40	0.50	0.55	0.38	0.02	0.33
235°	–0.30	–0.29	–0.08	–0.20	0.24	0.18	0.50	0.45	0.36	0.16	0.03	0.68
240°	–0.29	–0.26	–0.06	–0.08	0.45	0.32	0.42	0.26	0.18	0.19	0.31	0.85
245°	–0.30	–0.22	–0.01	0.06	0.62	0.33	0.25	0.11	0.22	0.41	0.37	0.41
250°	–0.28	–0.18	0.05	0.21	0.71	0.24	0.12	0.14	0.39	0.43	–0.05	–0.20
255°	–0.24	–0.14	0.13	0.33	0.71	0.09	0.12	0.25	0.41	0.06	–0.57	–0.21
260°	–0.22	–0.09	0.21	0.40	0.65	–0.04	0.21	0.27	0.14	–0.41	–0.60	0.06
265°	–0.20	–0.04	0.28	0.43	0.53	–0.08	0.24	0.09	–0.27	–0.48	–0.31	–0.02
270°	–0.16	0.01	0.34	0.41	0.41	–0.05	0.12	–0.22	–0.45	–0.20	–0.25	–0.18
275°	–0.15	0.06	0.39	0.36	0.31	0.00	–0.12	–0.43	–0.26	–0.03	–0.43	0.03
280°	–0.11	0.08	0.40	0.28	0.25	0.02	–0.34	–0.39	0.00	–0.15	–0.42	0.28
285°	–0.08	0.11	0.39	0.19	0.24	–0.03	–0.41	–0.18	0.06	–0.28	–0.18	0.25
290°	–0.08	0.11	0.37	0.11	0.26	–0.15	–0.30	–0.01	–0.09	–0.18	–0.02	0.14
295°	–0.04	0.15	0.33	0.06	0.28	–0.29	–0.12	0.02	–0.21	0.03	–0.09	0.21
300°	–0.02	0.14	0.28	0.02	0.28	–0.40	0.01	–0.09	–0.15	0.13	–0.19	0.30
305°	–0.01	0.14	0.23	0.00	0.26	–0.44	0.05	–0.21	0.03	0.06	–0.15	0.23
310°	–0.02	0.13	0.18	0.00	0.22	–0.41	–0.02	–0.23	0.16	–0.05	–0.04	0.10
315°	0.01	0.11	0.12	0.01	0.17	–0.33	–0.12	–0.15	0.17	–0.07	–0.02	0.09
320°	0.02	0.08	0.09	0.01	0.12	–0.22	–0.21	–0.02	0.08	0.01	–0.10	0.23
325°	0.00	0.05	0.05	0.02	0.07	–0.13	–0.25	0.09	–0.03	0.11	–0.22	0.32
330°	0.00	0.05	0.02	0.01	0.04	–0.06	–0.24	0.15	–0.10	0.18	–0.28	0.30
335°	0.01	0.01	0.02	0.01	0.01	–0.02	–0.18	0.15	–0.12	0.20	–0.26	0.20
340°	0.01	0.02	0.01	0.01	0.00	0.00	–0.13	0.12	–0.10	0.16	–0.19	0.10
345°	0.01	0.01	0.01	–0.01	0.00	0.01	–0.07	0.08	–0.05	0.11	–0.11	0.03
350°	0.00	0.00	0.01	–0.01	–0.01	0.01	–0.03	0.04	–0.01	0.07	–0.06	0.00
355°	0.01	0.00	0.01	0.00	0.00	0.01	–0.01	0.01	0.02	0.04	–0.02	0.00

Table A.16 *Influence of the analyzer's body on the directional response, measured in a plane parallel to the display and along the microphone's axis, 4000 Hz – 10600 Hz*

	Frequency											
Angle	**4000 Hz**	4500 Hz	**5000 Hz**	5600 Hz	**6300 Hz**	7100 Hz	**8000 Hz**	8500 Hz	9000 Hz	9500 Hz	**10000 Hz**	10600 Hz
0°	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
5°	0.01	0.02	0.02	–0.01	–0.04	–0.01	–0.02	–0.02	–0.02	–0.04	–0.02	–0.02
10°	0.06	0.07	0.06	–0.02	–0.11	0.00	–0.06	–0.08	–0.06	–0.12	–0.07	–0.08
15°	0.15	0.14	0.11	–0.02	–0.20	0.06	–0.10	–0.13	–0.09	–0.21	–0.14	–0.16
20°	0.26	0.20	0.15	0.00	–0.32	0.13	–0.09	–0.11	–0.04	–0.22	–0.14	–0.09
25°	0.33	0.17	0.14	0.03	–0.38	0.12	0.04	–0.03	0.07	–0.21	–0.06	0.12
30°	0.30	0.05	0.09	0.05	–0.23	0.09	0.08	–0.04	0.03	–0.33	–0.08	0.19
35°	0.18	–0.07	0.08	–0.03	–0.10	0.29	–0.08	–0.02	–0.04	–0.31	–0.22	0.16
40°	0.09	–0.03	0.25	–0.16	–0.26	0.38	–0.06	0.11	–0.01	–0.16	–0.30	0.24
45°	0.12	0.09	0.46	–0.12	–0.43	–0.05	–0.05	–0.03	0.05	–0.21	–0.34	0.05
50°	0.20	0.10	0.47	–0.04	–0.34	0.07	–0.04	0.01	0.14	–0.27	–0.16	–0.05
55°	0.16	0.03	0.42	–0.09	–0.50	0.06	0.26	–0.13	0.17	–0.18	–0.28	0.20
60°	0.05	0.04	0.48	0.09	–0.43	–0.21	–0.02	0.14	0.00	–0.03	–0.45	0.26
65°	0.10	0.06	0.47	0.21	–0.33	–0.10	0.02	–0.01	0.13	–0.13	–0.26	0.08
70°	0.21	0.06	0.35	0.17	–0.26	–0.28	–0.26	–0.11	0.12	–0.08	–0.19	0.18
75°	0.14	0.09	0.33	0.29	0.01	–0.09	–0.09	–0.34	–0.08	0.08	–0.32	0.27
80°	0.07	0.09	0.54	0.01	0.02	0.09	–0.12	–0.21	–0.46	–0.17	–0.05	–0.07
85°	0.13	0.07	0.61	–0.04	–0.01	0.18	–0.03	–0.05	–0.25	–0.67	–0.24	0.09
90°	–0.02	–0.02	0.58	0.21	–0.50	0.32	0.06	0.16	–0.01	–0.37	–0.75	0.02
95°	–0.32	–0.17	0.58	0.32	–0.03	0.08	0.06	0.09	0.24	–0.16	–0.43	–0.11
100°	–0.25	–0.40	0.20	0.43	–0.09	0.20	0.07	–0.01	0.05	–0.01	–0.12	0.10
105°	–0.10	–0.51	–0.07	–0.01	0.23	0.24	0.15	0.10	–0.12	–0.13	–0.09	0.12
110°	–0.27	–0.30	–0.16	–0.54	–0.56	0.45	0.28	0.59	0.26	0.03	–0.36	0.21
115°	–0.18	–0.35	–0.01	–0.55	–0.88	–0.23	0.23	0.08	0.43	0.44	0.17	0.68
120°	0.46	–0.15	0.16	–0.34	–0.99	–0.71	–0.89	–0.21	–0.06	–0.12	0.22	0.86
125°	0.87	0.62	0.59	0.15	–0.55	–0.78	–0.88	–0.96	–1.29	–1.01	–0.76	–0.19
130°	0.61	0.84	1.28	0.60	0.25	0.14	–0.84	–0.95	–0.88	–1.12	–1.62	–1.23
135°	0.23	0.31	1.27	0.99	0.56	0.96	0.63	0.51	–0.16	–0.72	–1.00	–0.55
140°	0.34	0.04	0.62	0.73	0.72	1.16	0.98	1.06	1.15	1.07	0.69	0.82
145°	0.51	0.32	0.53	0.17	–0.01	0.81	0.92	1.12	0.99	0.92	0.80	1.44
150°	0.13	0.20	0.71	0.27	–0.35	0.06	0.01	0.26	0.47	0.68	0.66	1.11
155°	–0.65	–0.58	0.17	0.08	–0.25	0.09	–0.15	–0.19	–0.45	–0.60	–0.61	0.18
160°	–1.18	–1.35	–0.79	–0.90	–0.99	–0.47	–0.35	–0.10	–0.20	–0.37	–0.58	–0.34
165°	–1.03	–1.33	–1.04	–1.59	–1.84	–1.64	–1.76	–1.51	–1.38	–1.28	–1.24	–0.58
170°	–0.53	–0.76	–0.45	–1.13	–1.52	–1.51	–2.05	–2.14	–2.28	–2.50	–2.81	–2.36
175°	–0.10	–0.24	0.20	–0.34	–0.69	–0.54	–0.91	–0.94	–1.10	–1.40	–1.79	–1.59
180°	0.06	–0.05	0.47	0.03	–0.33	–0.11	–0.33	–0.28	–0.36	–0.57	–0.87	–0.60
185°	–0.08	–0.22	0.26	–0.19	–0.73	–0.58	–0.87	–0.91	–1.05	–1.34	–1.75	–1.52
190°	–0.49	–0.73	–0.34	–0.89	–1.69	–1.58	–2.03	–2.17	–2.36	–2.61	–3.03	–2.57
195°	–1.00	–1.30	–0.92	–1.51	–2.19	–1.71	–1.86	–1.65	–1.64	–1.53	–1.43	–0.75
200°	–1.18	–1.34	–0.76	–1.11	–1.24	–0.49	–0.48	–0.19	–0.30	–0.36	–0.52	–0.38
205°	–0.70	–0.61	0.13	–0.16	–0.29	0.11	–0.22	–0.22	–0.46	–0.62	–0.66	0.05
210°	0.07	0.19	0.72	0.12	–0.30	0.00	–0.03	0.19	0.40	0.61	0.61	0.95
215°	0.50	0.35	0.58	–0.03	0.01	0.74	0.86	1.16	0.89	0.80	0.77	1.45
220°	0.39	0.05	0.59	0.51	0.74	1.08	1.00	1.02	1.18	1.18	0.91	1.01
225°	0.25	0.27	1.16	0.98	0.57	1.09	0.77	0.67	–0.10	–0.59	–1.02	–0.58
230°	0.58	0.80	1.24	0.75	0.31	0.23	–0.82	–1.03	–0.91	–1.11	–1.73	–1.47
235°	0.87	0.62	0.66	0.28	–0.56	–0.85	–0.85	–0.97	–1.41	–1.10	–0.93	–0.13
240°	0.52	–0.09	0.26	–0.26	–1.21	–0.71	–0.91	–0.37	–0.13	–0.10	0.23	0.81
245°	–0.13	–0.30	0.03	–0.66	–0.89	–0.23	0.28	0.11	0.43	0.48	0.00	0.64
250°	–0.26	–0.31	–0.16	–0.67	–0.52	0.43	0.32	0.52	0.35	0.04	–0.29	0.39
255°	–0.12	–0.50	–0.09	–0.14	0.30	0.34	0.16	0.17	–0.08	0.02	0.05	0.17
260°	–0.24	–0.41	0.21	0.47	–0.22	0.26	0.17	0.06	0.13	0.08	–0.11	0.14
265°	–0.28	–0.17	0.59	0.39	–0.07	0.15	0.15	0.09	0.21	–0.06	–0.45	0.06
270°	0.02	0.03	0.63	0.15	–0.37	0.48	0.15	0.14	0.00	–0.28	–0.71	0.13
275°	0.18	0.12	0.58	–0.09	0.15	0.25	–0.02	–0.03	–0.14	–0.62	–0.29	0.17
280°	0.13	0.13	0.47	0.00	0.01	0.21	–0.08	–0.15	–0.48	–0.20	0.02	0.06
285°	0.18	0.12	0.35	0.39	–0.05	–0.06	0.05	–0.38	–0.15	0.22	–0.22	0.36
290°	0.23	0.06	0.41	0.22	–0.18	–0.14	–0.21	–0.19	0.23	0.09	–0.20	0.34
295°	0.12	0.09	0.53	0.14	–0.32	0.05	–0.06	0.04	0.24	–0.13	–0.18	0.23
300°	0.05	0.10	0.53	0.07	–0.35	–0.13	0.04	0.23	0.00	0.02	–0.37	0.27
305°	0.16	0.12	0.42	–0.05	–0.44	0.08	0.34	–0.09	0.11	–0.03	–0.32	0.27
310°	0.23	0.19	0.43	0.00	–0.20	0.06	0.08	–0.09	0.19	–0.18	–0.19	0.20
315°	0.17	0.16	0.42	–0.14	–0.38	0.02	–0.07	–0.06	0.18	–0.24	–0.30	0.15
320°	0.15	0.00	0.25	–0.26	–0.39	0.50	–0.09	0.15	0.05	–0.21	–0.15	0.33
325°	0.24	–0.06	0.13	–0.10	–0.20	0.43	–0.08	0.08	–0.05	–0.25	–0.16	0.16
330°	0.35	0.02	0.12	0.09	–0.24	0.23	0.11	0.07	–0.01	–0.22	–0.07	0.27
335°	0.38	0.13	0.17	0.16	–0.31	0.22	0.11	0.03	0.05	–0.11	–0.07	0.20
340°	0.32	0.17	0.17	0.14	–0.19	0.19	0.02	–0.11	–0.02	–0.13	–0.17	0.01
345°	0.22	0.13	0.13	0.10	–0.06	0.09	0.02	–0.13	–0.06	–0.12	–0.15	–0.05
350°	0.13	0.06	0.07	0.05	0.02	0.01	0.04	–0.09	–0.03	–0.05	–0.09	–0.02
355°	0.07	0.00	0.04	0.02	0.04	–0.02	0.06	–0.05	0.00	0.01	–0.05	0.03

Table A.17 *Influence of the analyzer's body on the directional response, measured in a plane parallel to the display and along the microphone's axis, 11200 Hz – 20000 Hz*

	Frequency										
Angle	11200 Hz	11800 Hz	**12500 Hz**	13200 Hz	14000 Hz	15000 Hz	**16000 Hz**	17000 Hz	18000 Hz	19000 Hz	**20000 Hz**
0°	0.00	0.00	0.00	0.01	0.00	–0.01	–0.01	–0.02	–0.01	0.01	0.02
5°	–0.01	–0.03	–0.03	0.00	–0.03	–0.01	–0.04	–0.06	–0.03	–0.04	–0.04
10°	–0.02	–0.06	–0.08	–0.02	–0.01	–0.04	–0.07	–0.07	–0.02	–0.12	–0.08
15°	–0.06	–0.12	–0.04	–0.09	0.12	–0.18	–0.13	0.00	0.03	–0.07	–0.05
20°	–0.09	–0.24	0.10	–0.12	0.23	–0.45	–0.10	0.08	0.13	–0.12	0.08
25°	–0.02	–0.37	0.11	–0.07	0.18	–0.34	–0.14	–0.01	0.14	–0.27	–0.05
30°	0.00	–0.35	0.12	–0.27	0.27	–0.19	–0.34	–0.03	0.16	–0.32	–0.16
35°	–0.13	–0.41	–0.02	–0.19	0.19	0.07	–0.62	–0.17	0.28	–0.15	–0.10
40°	0.06	–0.18	–0.22	–0.14	0.14	–0.01	–0.41	–0.32	0.22	–0.14	–0.18
45°	0.05	–0.29	–0.31	–0.11	0.00	–0.07	–0.18	–0.42	–0.03	–0.27	–0.15
50°	0.06	–0.16	0.05	–0.36	–0.03	0.05	–0.32	–0.17	–0.12	–0.22	0.05
55°	–0.14	–0.08	0.00	–0.32	–0.01	–0.13	–0.40	0.08	–0.09	–0.58	–0.08
60°	–0.22	–0.28	–0.11	–0.15	–0.12	–0.22	–0.45	–0.36	0.15	–0.23	–0.19
65°	0.09	–0.54	0.02	–0.42	0.33	–0.43	–0.61	–0.12	–0.18	–0.09	–0.19
70°	–0.04	–0.27	0.02	–0.45	0.20	–0.21	–0.52	–0.62	0.05	–0.15	–0.16
75°	0.06	–0.37	0.19	–0.32	–0.07	–0.17	–0.28	–0.54	–0.08	–0.38	–0.21
80°	0.38	–0.39	–0.02	–0.20	0.06	–0.44	–0.49	–0.23	–0.03	–0.56	–0.23
85°	–0.07	0.10	–0.23	–0.15	–0.03	–0.05	–0.91	–0.25	–0.12	–0.22	–0.33
90°	–0.17	–0.18	0.14	–0.31	0.18	–0.39	–0.16	–0.67	0.04	–0.36	–0.33
95°	–0.37	–0.51	0.07	–0.15	0.03	–0.15	–0.53	–0.06	–0.19	–0.22	–0.28
100°	–0.06	–0.68	–0.48	–0.31	0.20	–0.36	–0.36	–0.49	0.02	–0.14	–0.43
105°	0.17	–0.25	–0.15	–0.83	–0.25	–0.16	–0.47	–0.56	–0.01	–0.29	–0.15
110°	–0.08	–0.46	0.22	–0.12	–0.33	–0.52	–0.74	–0.35	–0.14	–0.20	–0.51
115°	–0.01	–0.36	–0.21	–0.40	0.30	–0.05	–0.94	–0.60	–0.11	–0.36	–0.62
120°	0.55	0.67	0.38	–0.28	0.20	–0.31	–0.81	–0.37	–0.31	–0.18	–0.19
125°	0.31	0.39	0.42	0.70	1.34	0.37	–0.19	–0.42	–0.03	–0.89	–0.96
130°	–1.16	–1.38	–1.03	–0.20	0.38	0.23	0.80	0.93	1.36	0.69	0.50
135°	–1.09	–1.68	–1.50	–1.74	–2.02	–2.41	–1.44	–0.70	0.30	0.97	1.00
140°	0.13	–0.48	–0.33	–0.84	–0.76	–1.28	–1.81	–2.68	–3.22	–2.74	–2.62
145°	1.55	1.28	1.19	0.66	1.01	0.73	0.05	–0.13	–0.18	–0.34	–1.08
150°	0.72	0.50	0.80	0.96	1.54	1.28	1.13	1.19	1.48	1.35	1.09
155°	0.28	0.27	0.50	0.14	0.55	–0.11	–0.22	0.35	0.93	0.86	0.56
160°	–0.71	–1.00	–0.93	–0.93	–0.42	–0.41	–0.45	–0.01	0.08	–0.43	–0.77
165°	–0.75	–0.73	–0.60	–0.83	–0.47	–1.04	–1.46	–1.41	–1.37	–1.52	–1.22
170°	–2.56	–2.64	–2.21	–2.36	–1.69	–1.81	–1.73	–1.19	–0.93	–1.20	–0.64
175°	–2.06	–2.58	–2.49	–2.87	–2.76	–3.31	–3.86	–3.77	–3.77	–4.46	–3.90
180°	–0.98	–1.41	–1.34	–1.57	–1.45	–1.95	–2.47	–2.48	–2.69	–3.43	–3.71
185°	–1.93	–2.52	–2.50	–2.92	–2.96	–3.49	–3.91	–3.50	–3.82	–4.67	–4.54
190°	–2.75	–3.04	–2.70	–2.88	–2.13	–2.18	–1.87	–1.22	–0.84	–1.53	–1.00
195°	–0.99	–1.00	–0.86	–1.01	–0.61	–1.00	–1.18	–1.02	–1.23	–2.03	–1.27
200°	–0.83	–1.19	–1.25	–1.16	–0.54	–0.34	–0.32	0.12	0.24	–0.64	–0.54
205°	–0.04	0.01	0.36	0.13	0.67	0.05	0.02	0.93	1.41	0.82	1.64
210°	0.55	0.36	0.76	1.09	1.84	1.77	1.67	1.74	2.16	1.66	2.08
215°	1.58	1.52	1.44	0.98	1.38	1.06	0.57	0.37	0.25	–0.45	–0.26
220°	0.20	–0.29	–0.22	–0.72	–0.83	–1.16	–1.05	–1.89	–2.52	–2.59	–2.05
225°	–1.17	–1.79	–1.76	–1.55	–1.65	–2.14	–0.94	–0.25	0.75	0.84	1.45
230°	–1.28	–1.41	–1.11	0.07	0.88	0.34	1.17	1.54	1.96	1.01	1.44
235°	0.22	0.54	0.37	0.72	1.60	0.86	0.68	0.58	0.77	–0.66	–0.39
240°	0.45	0.67	0.38	–0.03	0.84	0.22	–0.29	0.36	0.04	–0.53	0.26
245°	0.12	–0.22	–0.02	–0.09	0.50	0.17	–0.51	0.17	0.65	–0.34	0.12
250°	0.05	–0.38	0.25	0.03	–0.01	–0.05	–0.17	0.49	0.40	–0.37	0.37
255°	0.13	–0.06	–0.08	–0.57	0.11	0.18	0.12	0.45	0.71	–0.17	0.68
260°	0.01	–0.52	–0.34	–0.15	0.45	0.11	0.29	0.36	0.59	–0.25	0.38
265°	–0.32	–0.44	0.08	0.06	0.47	0.22	0.08	0.79	0.38	–0.20	0.63
270°	–0.26	–0.02	0.31	–0.10	0.47	0.01	0.43	0.14	0.51	–0.39	0.64
275°	0.01	0.29	–0.03	–0.10	0.25	0.26	–0.21	0.49	0.41	–0.05	0.41
280°	0.42	–0.16	0.04	–0.11	0.35	0.08	0.02	0.58	0.42	–0.50	0.55
285°	0.19	–0.24	0.21	–0.16	0.27	0.20	0.38	0.03	0.36	–0.15	0.44
290°	0.11	–0.25	0.13	–0.28	0.47	0.37	–0.01	–0.01	0.54	–0.04	0.45
295°	0.04	–0.41	0.16	–0.37	0.79	–0.12	0.08	0.36	0.24	0.16	0.47
300°	–0.13	–0.16	–0.08	0.05	0.14	0.22	0.04	0.29	0.58	–0.02	0.29
305°	0.01	0.01	0.11	–0.11	0.16	0.31	0.07	0.50	0.27	–0.34	0.44
310°	0.13	–0.08	0.21	–0.31	0.37	0.34	0.07	0.34	0.22	–0.06	0.41
315°	–0.02	–0.17	–0.20	0.00	0.27	0.34	0.14	–0.04	0.32	–0.05	0.24
320°	0.18	–0.04	–0.17	0.04	0.27	0.30	–0.02	–0.04	0.54	0.00	0.09
325°	–0.02	–0.34	0.10	–0.06	0.38	0.28	–0.30	0.05	0.52	0.04	0.19
330°	0.11	–0.29	0.25	–0.25	0.50	0.07	–0.14	0.21	0.44	–0.14	0.09
335°	0.04	–0.31	0.25	0.00	0.30	–0.12	0.02	0.20	0.42	–0.13	0.09
340°	–0.05	–0.20	0.17	–0.02	0.33	–0.28	0.04	0.17	0.31	0.01	0.21
345°	–0.05	–0.03	0.00	0.00	0.18	–0.06	0.03	0.05	0.18	0.05	0.07
350°	–0.05	0.05	–0.06	0.03	0.03	0.04	0.06	0.02	0.03	–0.05	0.00
355°	–0.04	0.06	–0.03	0.02	0.00	0.03	0.07	–0.02	–0.02	–0.01	–0.01

Table A.18 *Influence of the analyzer's body on the directional response, measured in a plane perpendicular to the display and along the microphone's axis, 500 Hz – 3550 Hz*

	Frequency											
Angle	**500 Hz**	**630 Hz**	**800 Hz**	**1000 Hz**	**1250 Hz**	**1600 Hz**	**2000 Hz**	2240 Hz	**2500 Hz**	2800 Hz	**3150 Hz**	3550 Hz
0°	0.02	0.00	–0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5°	0.00	–0.01	0.00	0.01	0.00	0.00	–0.01	0.00	–0.02	0.00	–0.01	–0.01
10°	–0.01	0.01	–0.01	0.02	0.00	0.00	–0.02	0.02	–0.04	0.03	–0.04	–0.01
15°	–0.01	0.02	–0.01	0.03	–0.02	0.00	–0.05	0.04	–0.08	0.07	–0.08	–0.01
20°	–0.02	0.03	–0.01	0.03	–0.02	–0.01	–0.09	0.08	–0.14	0.12	–0.15	0.03
25°	–0.03	0.02	–0.01	0.04	–0.03	–0.02	–0.14	0.12	–0.20	0.16	–0.22	0.09
30°	–0.01	0.06	–0.02	0.04	–0.01	–0.04	–0.19	0.14	–0.21	0.17	–0.25	0.19
35°	–0.02	0.06	–0.01	0.04	0.01	–0.10	–0.23	0.13	–0.16	0.10	–0.22	0.21
40°	–0.05	0.11	0.02	0.05	0.05	–0.18	–0.22	0.05	–0.05	–0.03	–0.10	0.12
45°	–0.03	0.13	0.04	0.03	0.11	–0.29	–0.16	–0.06	0.07	–0.19	0.02	–0.06
50°	–0.05	0.16	0.09	0.01	0.17	–0.39	–0.07	–0.16	0.11	–0.20	0.01	–0.14
55°	–0.07	0.18	0.14	–0.01	0.22	–0.45	0.01	–0.16	0.00	–0.01	–0.20	0.02
60°	–0.12	0.19	0.21	0.00	0.23	–0.43	–0.01	–0.05	–0.18	0.20	–0.42	0.20
65°	–0.10	0.19	0.27	0.03	0.22	–0.35	–0.13	0.07	–0.26	0.19	–0.32	0.07
70°	–0.12	0.18	0.33	0.08	0.19	–0.22	–0.32	0.08	–0.13	–0.06	–0.01	–0.25
75°	–0.15	0.15	0.36	0.18	0.16	–0.10	–0.47	–0.09	0.03	–0.21	0.02	–0.15
80°	–0.18	0.13	0.38	0.28	0.16	–0.05	–0.44	–0.34	–0.02	–0.03	–0.27	0.22
85°	–0.21	0.08	0.37	0.39	0.23	–0.06	–0.27	–0.44	–0.31	0.14	–0.32	0.10
90°	–0.23	0.03	0.34	0.47	0.34	–0.11	–0.09	–0.29	–0.56	–0.11	–0.05	–0.22
95°	–0.31	–0.01	0.29	0.50	0.50	–0.12	–0.02	–0.02	–0.45	–0.56	–0.13	0.08
100°	–0.32	–0.08	0.22	0.49	0.66	–0.03	–0.05	0.10	–0.12	–0.53	–0.69	0.17
105°	–0.33	–0.15	0.15	0.42	0.76	0.15	–0.06	0.04	0.07	–0.05	–0.81	–0.48
110°	–0.36	–0.20	0.06	0.30	0.78	0.35	0.07	–0.01	–0.01	0.20	–0.22	–0.70
115°	–0.41	–0.23	–0.02	0.15	0.70	0.48	0.34	0.17	–0.08	0.03	0.12	0.03
120°	–0.40	–0.27	–0.09	–0.01	0.53	0.47	0.59	0.52	0.17	–0.06	–0.10	0.35
125°	–0.38	–0.29	–0.12	–0.15	0.30	0.33	0.67	0.80	0.61	0.34	–0.18	0.03
130°	–0.39	–0.30	–0.14	–0.25	0.07	0.05	0.51	0.81	0.87	0.89	0.37	0.17
135°	–0.38	–0.28	–0.13	–0.30	–0.11	–0.25	0.14	0.50	0.75	1.04	0.94	0.95
140°	–0.32	–0.28	–0.09	–0.29	–0.22	–0.51	–0.30	–0.01	0.24	0.65	0.89	1.34
145°	–0.32	–0.25	–0.06	–0.24	–0.23	–0.64	–0.65	–0.51	–0.42	–0.12	0.17	0.84
150°	–0.27	–0.23	0.00	–0.17	–0.17	–0.63	–0.79	–0.79	–0.91	–0.85	–0.85	–0.29
155°	–0.25	–0.20	0.04	–0.08	–0.07	–0.53	–0.70	–0.77	–1.01	–1.14	–1.48	–1.30
160°	–0.23	–0.16	0.10	0.00	0.04	–0.38	–0.50	–0.55	–0.78	–0.94	–1.39	–1.46
165°	–0.20	–0.13	0.13	0.07	0.14	–0.23	–0.28	–0.28	–0.44	–0.53	–0.90	–0.94
170°	–0.20	–0.12	0.17	0.13	0.22	–0.11	–0.10	–0.05	–0.15	–0.15	–0.41	–0.35
175°	–0.17	–0.11	0.19	0.17	0.27	–0.03	0.01	0.10	0.04	0.09	–0.10	0.04
180°	–0.17	–0.10	0.19	0.17	0.28	–0.01	0.05	0.14	0.10	0.16	0.01	0.18
185°	–0.18	–0.11	0.19	0.17	0.28	–0.03	0.01	0.10	0.04	0.09	–0.09	0.05
190°	–0.19	–0.12	0.17	0.14	0.23	–0.11	–0.10	–0.04	–0.15	–0.15	–0.40	–0.34
195°	–0.23	–0.12	0.15	0.09	0.16	–0.22	–0.28	–0.27	–0.44	–0.53	–0.88	–0.93
200°	–0.23	–0.16	0.11	0.02	0.06	–0.38	–0.50	–0.55	–0.78	–0.95	–1.38	–1.46
205°	–0.26	–0.19	0.06	–0.07	–0.05	–0.54	–0.71	–0.78	–1.02	–1.18	–1.50	–1.32
210°	–0.29	–0.20	0.00	–0.16	–0.15	–0.66	–0.81	–0.81	–0.95	–0.91	–0.89	–0.31
215°	–0.31	–0.23	–0.04	–0.24	–0.21	–0.68	–0.68	–0.55	–0.47	–0.15	0.13	0.83
220°	–0.34	–0.26	–0.09	–0.30	–0.21	–0.56	–0.34	–0.03	0.22	0.67	0.90	1.36
225°	–0.39	–0.27	–0.13	–0.30	–0.11	–0.31	0.12	0.51	0.76	1.10	1.01	1.01
230°	–0.39	–0.28	–0.14	–0.26	0.06	0.01	0.51	0.84	0.92	0.96	0.47	0.25
235°	–0.42	–0.28	–0.13	–0.16	0.28	0.30	0.70	0.85	0.68	0.42	–0.12	0.08
240°	–0.42	–0.26	–0.10	–0.02	0.51	0.48	0.64	0.58	0.24	0.01	–0.09	0.36
245°	–0.42	–0.23	–0.03	0.15	0.70	0.52	0.41	0.23	–0.01	0.08	0.13	0.05
250°	–0.40	–0.19	0.05	0.32	0.79	0.41	0.14	0.06	0.04	0.22	–0.18	–0.66
255°	–0.38	–0.18	0.13	0.44	0.78	0.21	–0.01	0.11	0.11	–0.03	–0.77	–0.47
260°	–0.35	–0.09	0.23	0.51	0.69	0.03	0.00	0.17	–0.08	–0.49	–0.67	0.17
265°	–0.33	–0.02	0.31	0.53	0.55	–0.06	0.04	0.04	–0.43	–0.53	–0.10	0.10
270°	–0.29	0.04	0.37	0.49	0.39	–0.06	–0.01	–0.25	–0.54	–0.10	–0.01	–0.18
275°	–0.25	0.07	0.40	0.42	0.27	–0.02	–0.19	–0.43	–0.28	0.16	–0.31	0.13
280°	–0.23	0.13	0.41	0.31	0.21	–0.01	–0.38	–0.34	0.03	0.00	–0.27	0.30
285°	–0.19	0.15	0.40	0.21	0.20	–0.06	–0.43	–0.07	0.07	–0.20	0.07	–0.01
290°	–0.19	0.20	0.36	0.12	0.23	–0.17	–0.31	0.13	–0.11	–0.06	0.09	–0.11
295°	–0.12	0.18	0.31	0.06	0.25	–0.30	–0.12	0.13	–0.26	0.22	–0.19	0.14
300°	–0.14	0.21	0.25	0.01	0.27	–0.38	0.01	0.00	–0.17	0.27	–0.29	0.20
305°	–0.07	0.19	0.19	0.00	0.25	–0.40	0.04	–0.13	0.03	0.09	–0.13	0.02
310°	–0.09	0.19	0.13	0.02	0.20	–0.34	–0.03	–0.15	0.16	–0.07	0.03	–0.12
315°	–0.06	0.16	0.08	0.04	0.14	–0.24	–0.13	–0.06	0.14	–0.07	0.01	–0.02
320°	–0.08	0.15	0.05	0.04	0.08	–0.14	–0.19	0.06	0.03	0.04	–0.10	0.15
325°	–0.07	0.12	0.03	0.06	0.04	–0.06	–0.21	0.14	–0.08	0.16	–0.21	0.24
330°	–0.03	0.08	0.01	0.05	0.01	–0.02	–0.18	0.16	–0.12	0.20	–0.23	0.22
335°	–0.05	0.06	0.02	0.03	0.00	0.01	–0.14	0.15	–0.12	0.18	–0.18	0.14
340°	–0.04	0.05	0.01	0.02	–0.01	0.03	–0.09	0.11	–0.08	0.13	–0.12	0.07
345°	–0.03	0.03	0.01	0.00	–0.01	0.02	–0.05	0.08	–0.04	0.09	–0.07	0.02
350°	–0.02	0.04	0.01	0.00	0.00	0.02	–0.02	0.04	0.00	0.04	–0.03	0.00
355°	–0.04	0.02	0.00	0.00	0.00	0.01	0.00	0.02	0.02	0.03	–0.01	0.00

Table A.19 *Influence of the analyzer's body on the directional response, measured in a plane perpendicular to the display and along the microphone's axis, 4000 Hz – 10600 Hz*

	Frequency											
Angle	**4000 Hz**	4500 Hz	**5000 Hz**	5600 Hz	**6300 Hz**	7100 Hz	**8000 Hz**	8500 Hz	9000 Hz	9500 Hz	**10000 Hz**	10600 Hz
0°	0.00	0.00	0.00	0.00	0.00	–0.01	0.00	–0.01	0.00	0.00	–0.01	0.00
5°	0.02	0.02	0.03	–0.01	–0.03	0.00	–0.02	–0.03	0.01	–0.05	–0.02	–0.03
10°	0.07	0.08	0.06	0.04	–0.08	0.06	–0.04	–0.06	0.04	–0.09	–0.08	–0.06
15°	0.15	0.15	0.11	0.16	–0.17	0.15	–0.07	–0.08	0.09	–0.18	–0.17	–0.11
20°	0.22	0.17	0.14	0.30	–0.28	0.23	–0.07	–0.08	0.18	–0.22	–0.10	–0.05
25°	0.26	0.11	0.10	0.39	–0.32	0.19	0.03	–0.11	0.18	–0.28	0.06	0.04
30°	0.21	–0.07	0.02	0.26	–0.21	0.06	0.12	–0.16	0.05	–0.29	–0.03	–0.03
35°	0.05	–0.17	0.06	–0.03	–0.26	0.21	–0.12	–0.01	0.01	–0.10	–0.27	0.12
40°	–0.05	0.00	0.36	–0.05	–0.54	0.27	–0.23	0.18	–0.07	–0.13	–0.44	0.25
45°	0.06	0.27	0.53	0.11	–0.40	–0.12	0.08	–0.07	0.26	–0.31	–0.19	0.07
50°	0.28	0.21	0.27	–0.08	–0.28	0.12	–0.21	–0.01	0.37	–0.46	–0.20	–0.04
55°	0.24	–0.08	0.29	0.01	–0.66	0.06	0.21	–0.03	0.09	0.02	–0.49	0.19
60°	–0.03	0.00	0.64	0.29	–0.42	–0.07	–0.29	0.01	0.36	–0.31	–0.13	0.14
65°	–0.02	0.27	0.43	0.07	–0.45	–0.12	0.13	–0.25	0.08	0.19	–0.45	0.22
70°	0.22	0.00	0.28	0.52	–0.25	–0.20	–0.39	0.07	0.05	–0.17	–0.07	0.03
75°	0.04	–0.09	0.62	0.40	–0.33	–0.05	–0.10	–0.56	0.27	–0.26	–0.31	0.27
80°	–0.31	0.20	0.42	0.13	0.14	0.04	–0.03	–0.27	–0.42	0.07	–0.40	–0.08
85°	0.00	–0.22	0.53	0.25	–0.12	0.17	–0.21	0.11	–0.29	–0.39	–0.23	–0.16
90°	0.24	–0.35	0.56	0.10	–0.15	0.46	–0.11	–0.12	0.38	–0.69	–0.26	–0.37
95°	–0.15	0.23	–0.03	0.50	–0.42	0.21	0.27	–0.04	0.19	–0.17	–0.45	–0.13
100°	–0.03	–0.17	0.52	0.10	–0.17	0.22	0.04	0.18	0.20	0.06	–0.27	0.16
105°	0.22	–0.19	0.39	0.21	–0.45	0.01	0.12	0.17	0.22	0.17	–0.10	0.51
110°	–0.50	0.11	0.17	0.16	–0.07	–0.15	–0.17	–0.11	0.36	–0.06	0.01	0.42
115°	–0.72	–0.74	0.58	–0.09	–0.38	0.35	–0.33	–0.09	–0.19	–0.25	–0.01	0.16
120°	0.19	–0.69	–0.49	0.40	–0.50	–0.07	0.20	–0.17	–0.08	–0.09	–0.75	–0.15
125°	0.38	0.32	–0.03	–0.78	–0.53	0.06	–0.44	0.14	0.42	–0.20	–0.17	0.16
130°	–0.05	0.18	1.01	0.28	–1.12	–0.80	–0.32	–0.42	–0.46	–0.29	0.03	0.48
135°	0.44	–0.05	0.45	0.74	0.42	0.08	–1.24	–0.90	–0.48	–0.63	–1.07	–0.52
140°	1.31	0.87	0.73	0.11	–0.13	0.99	0.67	0.21	–0.22	–0.84	–1.08	–0.78
145°	1.30	1.41	1.90	1.35	0.05	0.07	0.22	0.69	1.03	0.99	0.84	0.93
150°	0.26	0.70	1.77	2.04	1.52	1.55	0.59	0.31	0.12	–0.14	0.02	0.92
155°	–1.16	–0.90	0.14	0.75	1.00	1.87	1.90	1.96	1.94	1.47	1.00	1.15
160°	–1.76	–2.05	–1.69	–1.71	–1.44	–0.36	0.22	0.77	1.22	1.38	1.52	2.14
165°	–1.28	–1.75	–1.74	–2.64	–3.28	–2.91	–3.24	–2.94	–2.63	–2.50	–2.23	–1.36
170°	–0.53	–0.86	–0.64	–1.41	–2.29	–2.16	–3.05	–3.38	–3.65	–4.27	–4.85	–4.80
175°	–0.01	–0.21	0.21	–0.25	–0.95	–0.67	–1.12	–1.23	–1.27	–1.65	–2.05	–1.92
180°	0.16	0.00	0.50	0.19	–0.42	–0.13	–0.44	–0.44	–0.38	–0.66	–0.91	–0.65
185°	–0.01	–0.21	0.24	–0.06	–0.77	–0.64	–1.12	–1.17	–1.21	–1.57	–1.89	–1.75
190°	–0.53	–0.84	–0.53	–1.00	–1.97	–2.24	–3.04	–3.31	–3.51	–4.01	–4.71	–4.61
195°	–1.28	–1.69	–1.53	–2.21	–3.22	–3.45	–3.44	–3.16	–2.86	–2.84	–2.60	–1.75
200°	–1.80	–2.02	–1.55	–1.80	–2.01	–0.82	0.01	0.66	1.07	1.24	1.33	2.02
205°	–1.23	–0.94	0.14	0.35	0.45	1.80	1.88	2.15	2.13	1.59	1.11	1.26
210°	0.21	0.68	1.73	1.64	1.30	1.81	0.80	0.56	0.18	–0.28	–0.13	0.79
215°	1.31	1.45	1.89	1.08	0.17	0.26	0.23	0.64	0.84	0.88	0.82	0.80
220°	1.39	0.95	0.78	0.06	–0.06	0.87	0.53	0.23	–0.22	–0.85	–1.09	–1.05
225°	0.54	–0.01	0.45	0.77	0.43	0.02	–1.08	–0.79	–0.55	–0.77	–1.61	–1.00
230°	0.00	0.17	0.89	0.47	–1.03	–0.73	–0.56	–0.72	–0.88	–0.56	0.04	0.60
235°	0.40	0.30	0.00	–0.62	–0.76	–0.15	–0.53	0.35	0.65	0.02	–0.15	0.50
240°	0.23	–0.68	–0.41	0.23	–0.70	–0.10	0.41	–0.01	0.08	0.31	–0.57	–0.38
245°	–0.68	–0.76	0.60	–0.35	–0.57	0.70	–0.21	0.26	–0.04	–0.67	–0.27	0.21
250°	–0.49	0.12	0.08	0.01	0.25	–0.07	–0.05	–0.33	0.28	0.00	0.10	0.73
255°	0.24	–0.22	0.32	0.46	–0.27	0.10	–0.05	0.41	0.48	0.42	–0.21	0.73
260°	–0.01	–0.22	0.61	0.33	–0.24	0.02	0.34	0.44	0.33	0.12	–0.10	0.27
265°	–0.15	0.29	0.17	0.43	–0.64	0.52	0.31	0.16	0.37	0.02	–0.38	–0.02
270°	0.29	–0.15	0.65	–0.14	–0.10	0.58	0.08	0.07	0.64	–0.52	–0.28	–0.31
275°	0.11	–0.09	0.42	0.22	0.11	0.16	–0.09	0.42	–0.19	–0.35	–0.34	–0.18
280°	–0.18	0.21	0.34	0.40	0.16	0.23	0.17	–0.11	–0.35	0.10	–0.47	0.43
285°	0.12	–0.12	0.61	0.57	–0.40	0.03	–0.04	–0.40	0.37	–0.18	0.08	0.55
290°	0.22	–0.01	0.47	0.37	–0.09	–0.01	–0.27	0.20	0.19	0.20	0.01	–0.02
295°	–0.02	0.30	0.62	–0.07	–0.27	–0.11	0.15	–0.03	0.49	0.32	–0.59	0.28
300°	0.02	0.12	0.67	0.32	–0.33	0.08	–0.12	0.40	0.56	–0.45	–0.04	0.39
305°	0.29	0.07	0.27	0.29	–0.70	0.02	0.53	0.25	–0.03	0.24	–0.49	0.42
310°	0.35	0.34	0.25	0.14	–0.27	0.01	0.06	–0.04	0.47	–0.35	–0.07	0.09
315°	0.17	0.33	0.54	0.04	–0.31	0.09	0.20	–0.16	0.51	–0.22	0.00	0.10
320°	0.07	0.02	0.43	–0.22	–0.37	0.66	–0.35	0.47	0.13	–0.09	–0.51	0.32
325°	0.15	–0.17	0.21	–0.11	–0.19	0.47	–0.24	0.22	0.20	0.07	–0.30	0.22
330°	0.28	–0.06	0.14	0.28	–0.34	0.22	0.33	0.01	0.12	–0.32	0.05	0.08
335°	0.32	0.12	0.18	0.48	–0.54	0.29	0.28	0.12	0.33	–0.41	0.09	0.20
340°	0.27	0.19	0.18	0.41	–0.42	0.30	0.02	0.06	0.35	–0.21	–0.07	0.18
345°	0.19	0.16	0.14	0.26	–0.18	0.16	–0.05	–0.06	0.16	–0.06	–0.18	0.10
350°	0.11	0.08	0.08	0.12	–0.03	0.03	0.00	–0.07	0.03	0.02	–0.14	0.08
355°	0.07	0.02	0.05	0.04	0.03	–0.02	0.06	–0.04	0.01	0.05	–0.06	0.07

Table A.20 *Influence of the analyzer's body on the directional response, measured in a plane perpendicular to the display and along the microphone's axis, 11200 Hz – 20000 Hz*

	Frequency										
Angle	11200 Hz	11800 Hz	**12500 Hz**	13200 Hz	14000 Hz	15000 Hz	**16000 Hz**	17000 Hz	18000 Hz	19000 Hz	**20000 Hz**
0°	0.00	0.00	0.00	0.00	0.00	0.01	0.00	–0.01	–0.03	0.00	0.00
5°	0.00	–0.04	–0.03	–0.01	–0.02	0.02	–0.02	–0.07	–0.02	–0.06	–0.06
10°	0.05	–0.07	–0.11	0.01	–0.04	–0.03	–0.08	–0.05	–0.04	–0.05	–0.03
15°	0.11	–0.08	–0.17	0.08	0.00	–0.21	–0.15	–0.14	0.06	–0.09	0.01
20°	0.09	–0.08	–0.04	0.05	0.13	–0.37	–0.30	–0.04	–0.02	–0.15	0.01
25°	–0.04	–0.28	0.00	–0.02	0.01	–0.34	–0.26	–0.06	0.16	–0.28	0.03
30°	0.00	–0.32	–0.18	–0.19	0.18	–0.21	–0.41	–0.17	0.06	–0.46	–0.14
35°	0.01	–0.30	0.06	–0.27	0.17	–0.13	–0.60	–0.48	0.14	–0.34	–0.19
40°	–0.13	–0.30	–0.34	–0.49	0.30	–0.15	–0.58	–0.43	0.11	–0.28	–0.37
45°	0.11	–0.23	–0.20	–0.14	0.05	–0.27	–0.38	–0.42	–0.18	–0.38	–0.30
50°	0.10	–0.37	0.02	–0.47	–0.21	0.04	–0.45	–0.42	–0.49	–0.37	–0.10
55°	–0.36	–0.19	–0.35	–0.44	–0.19	–0.25	–0.59	0.07	–0.44	–0.76	–0.26
60°	0.00	–0.30	–0.13	–0.35	–0.13	–0.28	–0.71	–0.53	–0.16	–0.53	–0.42
65°	–0.02	–0.39	0.12	–0.51	0.22	–0.51	–0.77	–0.69	–0.37	–0.27	–0.62
70°	–0.03	–0.44	0.05	–0.51	0.15	–0.55	–0.70	–0.77	–0.62	–0.37	–0.41
75°	–0.16	–0.46	–0.04	–0.30	–0.10	–0.43	–0.84	–0.83	–0.50	–0.87	–0.44
80°	0.41	–0.66	–0.10	–0.34	0.08	–0.62	–0.93	–0.69	–0.29	–0.88	–0.75
85°	–0.01	–0.05	–0.46	–0.27	0.07	–0.24	–1.19	–0.47	–0.42	–0.48	–0.63
90°	–0.05	–0.42	–0.20	–0.53	0.03	–0.61	–0.68	–1.09	–0.32	–0.52	–1.02
95°	–0.26	–0.69	–0.30	–0.45	–0.03	–0.52	–1.14	–0.29	–0.78	–0.79	–0.95
100°	–0.44	–0.30	–1.07	–0.39	0.08	–0.67	–0.85	–0.36	–0.71	–0.53	–0.96
105°	–0.33	–0.12	–0.78	–0.55	–0.73	–0.41	–1.07	–0.86	–0.64	–0.43	–0.78
110°	–0.09	0.07	–0.37	–0.15	–0.81	–0.53	–1.59	–0.47	–0.89	–0.61	–1.10
115°	0.12	–0.16	–0.31	0.38	0.00	–0.47	–1.87	–0.28	–0.98	–1.08	–1.19
120°	0.17	–0.39	–0.07	–0.04	–0.15	0.16	–0.73	–0.38	–1.19	–0.61	–1.85
125°	–0.29	–1.07	–0.13	–0.14	–0.31	–0.21	–0.74	–0.63	0.62	0.12	–0.51
130°	–0.06	–0.37	0.06	–0.76	–1.05	–0.52	–0.75	–0.98	0.24	–0.73	–0.77
135°	–0.37	–0.06	0.00	–0.71	0.03	–0.21	–1.05	–1.83	–0.43	–0.67	–1.57
140°	–0.98	–1.38	–1.39	–1.30	0.19	–0.12	–1.02	–1.43	0.18	0.01	–1.57
145°	0.15	–0.95	–1.11	–1.60	–0.86	–1.46	–2.60	–1.70	–0.44	–0.31	–1.97
150°	1.15	1.29	1.31	0.76	0.42	–0.60	–1.24	–0.50	–0.22	–1.54	–2.68
155°	0.63	0.01	0.09	0.13	0.95	0.87	1.09	1.56	1.20	0.17	–0.42
160°	2.06	2.02	2.01	1.67	1.69	0.78	–0.01	0.08	0.48	0.69	0.98
165°	–1.07	–0.64	0.13	0.56	1.47	1.25	1.10	1.84	1.81	1.66	1.43
170°	–5.41	–6.19	–6.20	–6.14	–5.17	–5.02	–5.03	–4.99	–3.65	–2.89	–2.11
175°	–2.32	–2.93	–3.29	–3.99	–3.95	–4.71	–5.19	–5.14	–5.58	–7.31	–7.34
180°	–0.88	–1.22	–1.29	–1.69	–1.64	–2.21	–2.44	–2.00	–2.17	–2.86	–3.13
185°	–2.08	–2.60	–2.78	–3.39	–3.60	–4.43	–4.65	–4.83	–5.40	–6.13	–7.23
190°	–5.22	–5.94	–6.07	–6.22	–5.95	–5.70	–5.51	–4.28	–3.77	–4.36	–2.99
195°	–1.42	–0.97	–0.20	–0.01	0.85	0.78	0.79	1.31	1.67	0.96	1.22
200°	2.06	1.97	2.03	1.45	1.44	0.57	–0.07	0.20	0.65	0.29	1.50
205°	0.70	0.05	–0.22	–0.32	0.55	0.89	1.32	1.86	2.01	0.52	0.36
210°	0.89	1.01	0.93	0.44	0.38	–0.28	–0.28	0.75	0.92	–0.31	–1.71
215°	–0.04	–0.96	–1.43	–1.20	–0.16	–0.58	–1.57	–0.46	0.24	–0.56	–0.83
220°	–1.11	–1.70	–1.60	–0.88	0.89	0.77	0.11	0.11	1.34	0.50	–0.60
225°	–0.53	0.29	0.60	0.12	0.89	0.73	–0.03	–0.36	0.23	–1.28	–1.28
230°	0.37	0.18	0.61	0.17	–0.46	–0.31	–0.46	–0.21	1.26	–0.05	0.88
235°	0.23	–0.74	–0.21	–0.30	–0.49	0.45	0.69	1.30	1.49	0.00	0.56
240°	0.00	–0.42	–0.20	0.57	0.85	1.37	0.70	0.54	–0.84	–0.80	–0.93
245°	0.21	0.29	–0.08	1.52	0.86	0.26	–1.06	0.24	–0.11	–0.45	0.28
250°	–0.01	0.60	0.34	0.59	–0.53	–0.07	–0.50	0.16	0.27	–0.21	0.18
255°	–0.01	0.28	–0.12	–0.23	–0.16	0.20	0.20	0.25	0.20	0.10	0.32
260°	–0.15	0.04	–0.88	–0.11	0.98	0.55	0.05	0.40	0.01	–0.03	0.41
265°	–0.07	–0.50	–0.07	0.44	0.89	0.05	–0.20	0.63	0.66	–0.45	0.01
270°	0.02	0.07	0.67	–0.01	0.18	0.21	0.49	–0.12	0.19	–0.17	0.42
275°	0.57	0.51	–0.08	–0.17	0.76	0.68	–0.33	–0.08	0.53	0.21	0.09
280°	0.78	–0.46	–0.01	0.36	0.85	–0.21	–0.11	0.19	0.56	–0.54	0.42
285°	–0.11	–0.28	0.58	0.30	0.02	0.27	0.25	–0.04	0.19	–0.10	0.25
290°	0.07	0.08	0.57	–0.54	0.79	0.27	–0.01	0.00	0.38	0.12	0.12
295°	0.37	0.15	0.14	–0.10	0.96	–0.25	0.04	0.21	0.47	0.32	0.08
300°	0.41	–0.13	0.13	0.35	0.09	0.27	0.11	0.25	0.49	–0.02	0.12
305°	–0.25	–0.08	0.20	–0.11	–0.04	0.62	0.01	0.44	0.42	–0.38	0.44
310°	0.13	0.00	0.53	–0.61	0.60	0.32	0.03	0.38	0.25	0.00	0.37
315°	0.23	0.21	–0.13	0.12	0.49	0.19	0.20	–0.12	0.34	0.06	0.29
320°	0.14	0.08	–0.46	0.16	0.35	0.33	0.06	0.00	0.69	0.00	0.06
325°	0.33	–0.25	0.29	0.06	0.23	0.47	–0.29	–0.04	0.51	0.11	0.15
330°	0.32	–0.39	0.27	–0.17	0.46	0.17	–0.17	0.35	0.35	–0.07	0.11
335°	0.03	–0.28	0.46	–0.23	0.56	–0.16	0.09	0.21	0.49	–0.01	0.25
340°	0.03	0.10	0.32	–0.18	0.59	–0.35	0.09	0.06	0.20	0.00	0.28
345°	0.08	0.07	0.09	–0.06	0.31	–0.21	0.18	–0.02	0.23	0.07	0.21
350°	0.02	0.01	0.01	–0.01	0.08	–0.04	0.17	0.08	0.15	0.07	0.14
355°	–0.02	0.04	0.00	0.02	0.01	0.01	0.09	0.07	0.03	0.06	0.09

Table A.21 *Directional response for Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer with the microphone preamplifier mounted directly on the analyzer, measured in a plane parallel to the display and along the microphone's axis, 500 Hz – 3550 Hz*

	Frequency											
Angle	**500 Hz**	**630 Hz**	**800 Hz**	**1000 Hz**	**1250 Hz**	**1600 Hz**	**2000 Hz**	2240 Hz	**2500 Hz**	2800 Hz	**3150 Hz**	3550 Hz
0°	0.01	0.01	–0.01	0.00	0.00	0.00	0.01	0.00	–0.01	–0.01	0.00	0.00
5°	0.00	0.01	0.00	–0.01	0.00	0.00	–0.01	0.01	–0.03	–0.01	–0.01	–0.01
10°	0.00	0.01	–0.02	–0.01	–0.01	0.00	–0.04	0.03	–0.07	0.00	–0.06	–0.03
15°	0.00	0.00	–0.02	0.00	–0.01	–0.02	–0.09	0.05	–0.13	0.03	–0.13	–0.04
20°	0.01	0.02	–0.01	0.00	–0.02	–0.04	–0.15	0.09	–0.20	0.06	–0.23	–0.01
25°	0.02	0.04	–0.01	–0.01	–0.02	–0.08	–0.22	0.10	–0.24	0.06	–0.34	0.05
30°	0.01	0.04	0.00	–0.02	–0.01	–0.13	–0.28	0.08	–0.26	0.00	–0.43	0.12
35°	0.02	0.06	0.01	–0.02	0.01	–0.23	–0.31	0.00	–0.20	–0.12	–0.45	0.11
40°	0.01	0.08	0.03	–0.04	0.04	–0.34	–0.29	–0.13	–0.10	–0.29	–0.40	–0.01
45°	0.00	0.10	0.07	–0.06	0.08	–0.47	–0.22	–0.28	–0.03	–0.44	–0.38	–0.19
50°	–0.01	0.13	0.11	–0.08	0.12	–0.59	–0.14	–0.39	–0.05	–0.48	–0.46	–0.30
55°	–0.05	0.13	0.15	–0.10	0.15	–0.65	–0.11	–0.38	–0.22	–0.39	–0.64	–0.28
60°	–0.07	0.13	0.21	–0.10	0.15	–0.64	–0.19	–0.27	–0.45	–0.32	–0.78	–0.30
65°	–0.08	0.11	0.25	–0.08	0.13	–0.56	–0.37	–0.17	–0.56	–0.43	–0.77	–0.47
70°	–0.12	0.11	0.29	–0.03	0.09	–0.45	–0.60	–0.22	–0.46	–0.69	–0.72	–0.63
75°	–0.15	0.07	0.31	0.03	0.06	–0.34	–0.76	–0.45	–0.30	–0.84	–0.86	–0.62
80°	–0.17	0.02	0.31	0.11	0.04	–0.30	–0.72	–0.74	–0.35	–0.74	–1.15	–0.64
85°	–0.21	–0.01	0.28	0.18	0.06	–0.33	–0.52	–0.86	–0.66	–0.61	–1.22	–0.89
90°	–0.24	–0.05	0.24	0.23	0.13	–0.39	–0.32	–0.69	–0.95	–0.79	–1.06	–1.13
95°	–0.27	–0.12	0.17	0.26	0.23	–0.44	–0.22	–0.39	–0.86	–1.14	–1.12	–1.03
100°	–0.28	–0.16	0.09	0.24	0.33	–0.42	–0.28	–0.21	–0.48	–1.17	–1.45	–0.98
105°	–0.34	–0.22	0.00	0.16	0.40	–0.31	–0.40	–0.25	–0.19	–0.75	–1.51	–1.27
110°	–0.35	–0.26	–0.08	0.05	0.40	–0.18	–0.44	–0.42	–0.21	–0.36	–1.05	–1.34
115°	–0.36	–0.31	–0.15	–0.09	0.33	–0.09	–0.33	–0.50	–0.42	–0.38	–0.61	–0.79
120°	–0.36	–0.34	–0.20	–0.24	0.18	–0.10	–0.15	–0.38	–0.53	–0.65	–0.65	–0.34
125°	–0.35	–0.34	–0.24	–0.37	–0.01	–0.24	–0.06	–0.17	–0.40	–0.76	–0.98	–0.48
130°	–0.35	–0.35	–0.24	–0.45	–0.20	–0.47	–0.14	–0.08	–0.20	–0.57	–1.08	–0.87
135°	–0.33	–0.35	–0.22	–0.48	–0.35	–0.72	–0.39	–0.23	–0.18	–0.37	–0.85	–0.87
140°	–0.29	–0.31	–0.18	–0.46	–0.43	–0.91	–0.72	–0.58	–0.44	–0.48	–0.73	–0.61
145°	–0.29	–0.29	–0.14	–0.40	–0.43	–0.99	–1.00	–0.97	–0.86	–0.89	–1.01	–0.66
150°	–0.23	–0.27	–0.09	–0.32	–0.37	–0.95	–1.11	–1.20	–1.22	–1.38	–1.57	–1.17
155°	–0.23	–0.24	–0.03	–0.22	–0.26	–0.82	–1.03	–1.18	–1.31	–1.62	–1.99	–1.77
160°	–0.20	–0.21	0.02	–0.13	–0.15	–0.65	–0.84	–0.97	–1.14	–1.48	–1.97	–1.96
165°	–0.20	–0.18	0.05	–0.05	–0.05	–0.49	–0.62	–0.69	–0.83	–1.12	–1.60	–1.63
170°	–0.19	–0.17	0.08	0.01	0.04	–0.37	–0.43	–0.44	–0.54	–0.75	–1.17	–1.12
175°	–0.17	–0.16	0.10	0.05	0.09	–0.29	–0.31	–0.28	–0.34	–0.50	–0.85	–0.72
180°	–0.16	–0.16	0.11	0.06	0.11	–0.26	–0.27	–0.23	–0.27	–0.42	–0.74	–0.58
185°	–0.16	–0.16	0.10	0.05	0.09	–0.29	–0.31	–0.28	–0.33	–0.50	–0.84	–0.71
190°	–0.16	–0.17	0.09	0.02	0.04	–0.36	–0.43	–0.43	–0.52	–0.73	–1.15	–1.08
195°	–0.19	–0.19	0.06	–0.03	–0.04	–0.49	–0.62	–0.66	–0.81	–1.09	–1.59	–1.60
200°	–0.21	–0.22	0.03	–0.11	–0.15	–0.64	–0.84	–0.94	–1.13	–1.46	–1.98	–1.97
205°	–0.24	–0.24	–0.02	–0.20	–0.27	–0.80	–1.03	–1.14	–1.33	–1.63	–2.02	–1.81
210°	–0.25	–0.26	–0.07	–0.30	–0.38	–0.92	–1.10	–1.17	–1.26	–1.42	–1.60	–1.19
215°	–0.29	–0.32	–0.12	–0.38	–0.45	–0.96	–0.99	–0.97	–0.91	–0.93	–1.00	–0.63
220°	–0.30	–0.33	–0.16	–0.45	–0.46	–0.88	–0.71	–0.60	–0.46	–0.46	–0.67	–0.55
225°	–0.32	–0.35	–0.19	–0.47	–0.38	–0.69	–0.37	–0.24	–0.15	–0.31	–0.76	–0.84
230°	–0.35	–0.36	–0.21	–0.45	–0.22	–0.44	–0.11	–0.07	–0.13	–0.47	–1.03	–0.91
235°	–0.36	–0.38	–0.20	–0.37	–0.02	–0.22	–0.02	–0.13	–0.32	–0.70	–1.01	–0.54
240°	–0.36	–0.35	–0.18	–0.25	0.19	–0.08	–0.11	–0.32	–0.50	–0.66	–0.71	–0.34
245°	–0.36	–0.30	–0.13	–0.11	0.35	–0.07	–0.28	–0.46	–0.44	–0.41	–0.62	–0.73
250°	–0.34	–0.26	–0.07	0.04	0.45	–0.16	–0.40	–0.42	–0.25	–0.36	–0.99	–1.29
255°	–0.30	–0.22	0.02	0.16	0.45	–0.30	–0.38	–0.28	–0.19	–0.69	–1.47	–1.26
260°	–0.28	–0.17	0.10	0.24	0.39	–0.41	–0.28	–0.23	–0.43	–1.11	–1.45	–0.95
265°	–0.25	–0.11	0.18	0.27	0.29	–0.45	–0.22	–0.38	–0.79	–1.14	–1.12	–1.00
270°	–0.20	–0.06	0.24	0.27	0.18	–0.40	–0.31	–0.65	–0.92	–0.80	–1.02	–1.13
275°	–0.19	–0.01	0.29	0.22	0.09	–0.32	–0.51	–0.82	–0.68	–0.60	–1.17	–0.90
280°	–0.14	0.02	0.31	0.15	0.05	–0.29	–0.70	–0.73	–0.38	–0.68	–1.15	–0.61
285°	–0.12	0.06	0.31	0.08	0.06	–0.31	–0.73	–0.47	–0.28	–0.78	–0.88	–0.59
290°	–0.11	0.07	0.30	0.01	0.09	–0.41	–0.58	–0.25	–0.39	–0.67	–0.69	–0.62
295°	–0.06	0.11	0.27	–0.04	0.12	–0.52	–0.36	–0.19	–0.49	–0.44	–0.72	–0.46
300°	–0.04	0.11	0.23	–0.06	0.14	–0.61	–0.18	–0.27	–0.41	–0.32	–0.75	–0.26
305°	–0.02	0.11	0.18	–0.07	0.14	–0.62	–0.12	–0.35	–0.21	–0.35	–0.64	–0.24
310°	–0.03	0.11	0.14	–0.06	0.12	–0.56	–0.15	–0.36	–0.05	–0.42	–0.45	–0.29
315°	0.01	0.10	0.09	–0.04	0.09	–0.46	–0.22	–0.25	–0.02	–0.40	–0.35	–0.22
320°	0.02	0.07	0.06	–0.02	0.05	–0.33	–0.29	–0.11	–0.09	–0.26	–0.36	–0.03
325°	0.01	0.05	0.04	–0.01	0.02	–0.22	–0.31	0.02	–0.17	–0.10	–0.41	0.12
330°	0.02	0.06	0.01	0.00	–0.01	–0.12	–0.28	0.09	–0.22	0.02	–0.41	0.15
335°	0.03	0.02	0.01	0.01	–0.02	–0.07	–0.21	0.11	–0.22	0.08	–0.35	0.10
340°	0.02	0.02	0.00	0.01	–0.02	–0.03	–0.15	0.09	–0.17	0.08	–0.25	0.03
345°	0.01	0.01	0.00	0.01	–0.02	–0.01	–0.08	0.06	–0.10	0.06	–0.14	0.00
350°	0.00	0.01	0.00	0.00	–0.01	0.00	–0.04	0.03	–0.04	0.04	–0.06	–0.01
355°	0.02	0.00	0.01	0.01	0.00	0.00	–0.01	0.01	–0.01	0.02	–0.02	0.00

Table A.22 *Directional response for Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer with the microphone preamplifier mounted directly on the analyzer, measured in a plane parallel to the display and along the microphone's axis, 4000 Hz – 10600 Hz*

	Frequency											
Angle	**4000 Hz**	4500 Hz	**5000 Hz**	5600 Hz	**6300 Hz**	7100 Hz	**8000 Hz**	8500 Hz	9000 Hz	9500 Hz	**10000 Hz**	10600 Hz
0°	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
5°	0.01	0.01	0.02	–0.02	–0.04	–0.02	–0.03	–0.03	–0.03	–0.04	–0.04	–0.03
10°	0.04	0.04	0.04	–0.06	–0.12	–0.03	–0.12	–0.11	–0.14	–0.16	–0.16	–0.12
15°	0.10	0.07	0.07	–0.11	–0.26	–0.04	–0.25	–0.23	–0.29	–0.31	–0.35	–0.26
20°	0.17	0.07	0.07	–0.17	–0.43	–0.06	–0.35	–0.30	–0.39	–0.43	–0.51	–0.29
25°	0.19	–0.04	0.00	–0.22	–0.56	–0.22	–0.34	–0.35	–0.48	–0.60	–0.59	–0.28
30°	0.10	–0.25	–0.16	–0.27	–0.51	–0.42	–0.42	–0.55	–0.70	–0.98	–0.75	–0.49
35°	–0.07	–0.46	–0.29	–0.40	–0.52	–0.41	–0.69	–0.76	–0.94	–1.29	–1.05	–0.88
40°	–0.23	–0.52	–0.27	–0.59	–0.87	–0.49	–0.78	–0.85	–1.11	–1.46	–1.41	–1.09
45°	–0.27	–0.48	–0.24	–0.63	–1.23	–1.06	–0.97	–1.16	–1.33	–1.73	–1.89	–1.50
50°	–0.27	–0.56	–0.39	–0.69	–1.29	–1.09	–1.25	–1.25	–1.56	–2.00	–2.12	–1.98
55°	–0.41	–0.72	–0.57	–0.98	–1.54	–1.30	–1.30	–1.60	–1.77	–2.26	–2.42	–2.36
60°	–0.61	–0.82	–0.60	–1.06	–1.59	–1.79	–1.85	–1.65	–2.09	–2.50	–2.79	–2.71
65°	–0.65	–0.93	–0.70	–1.14	–1.70	–1.84	–2.02	–2.15	–2.26	–2.85	–3.02	–3.04
70°	–0.63	–1.06	–0.96	–1.29	–1.98	–2.15	–2.53	–2.47	–2.68	–3.10	–3.26	–3.32
75°	–0.77	–1.14	–1.16	–1.22	–2.02	–2.15	–2.64	–2.88	–3.11	–3.44	–3.67	–3.56
80°	–0.91	–1.22	–1.13	–1.60	–2.17	–2.31	–2.89	–3.07	–3.56	–3.98	–4.03	–4.09
85°	–0.92	–1.30	–1.22	–1.85	–2.24	–2.58	–3.01	–3.29	–3.66	–4.43	–4.61	–4.50
90°	–1.12	–1.44	–1.31	–1.83	–2.81	–2.63	–3.15	–3.34	–3.90	–4.40	–5.05	–5.01
95°	–1.48	–1.65	–1.35	–1.87	–2.51	–2.98	–3.41	–3.60	–3.95	–4.74	–4.98	–5.20
100°	–1.45	–1.94	–1.77	–1.83	–2.76	–2.98	–3.61	–3.90	–4.27	–4.92	–5.19	–5.35
105°	–1.34	–2.09	–2.08	–2.30	–2.56	–3.08	–3.68	–4.01	–4.61	–5.17	–5.42	–5.73
110°	–1.54	–1.91	–2.21	–2.85	–3.40	–3.00	–3.64	–3.65	–4.40	–5.18	–5.85	–5.83
115°	–1.48	–1.98	–2.09	–2.86	–3.73	–3.74	–3.78	–4.25	–4.34	–4.90	–5.47	–5.57
120°	–0.88	–1.81	–1.94	–2.67	–3.83	–4.22	–4.94	–4.63	–4.93	–5.57	–5.51	–5.48
125°	–0.51	–1.08	–1.56	–2.20	–3.38	–4.25	–4.90	–5.40	–6.19	–6.54	–6.59	–6.63
130°	–0.80	–0.90	–0.91	–1.80	–2.60	–3.31	–4.76	–5.30	–5.70	–6.59	–7.43	–7.75
135°	–1.19	–1.45	–0.96	–1.45	–2.34	–2.52	–3.24	–3.75	–4.84	–6.02	–6.60	–6.89
140°	–1.06	–1.71	–1.63	–1.74	–2.24	–2.40	–2.93	–3.19	–3.50	–4.17	–4.79	–5.33
145°	–0.84	–1.38	–1.68	–2.27	–2.99	–2.81	–3.08	–3.22	–3.74	–4.39	–4.72	–4.72
150°	–1.14	–1.41	–1.41	–2.08	–3.25	–3.54	–4.01	–4.14	–4.33	–4.71	–4.97	–5.18
155°	–1.83	–2.08	–1.83	–2.12	–2.99	–3.36	–4.05	–4.50	–5.18	–5.93	–6.21	–6.10
160°	–2.27	–2.74	–2.65	–2.93	–3.54	–3.71	–4.01	–4.18	–4.70	–5.46	–5.94	–6.38
165°	–2.05	–2.62	–2.78	–3.46	–4.19	–4.64	–5.14	–5.30	–5.57	–6.03	–6.24	–6.22
170°	–1.48	–1.97	–2.09	–2.88	–3.72	–4.32	–5.20	–5.67	–6.18	–6.94	–7.46	–7.62
175°	–1.01	–1.39	–1.38	–2.01	–2.80	–3.23	–3.90	–4.30	–4.81	–5.62	–6.20	–6.57
180°	–0.84	–1.18	–1.09	–1.62	–2.41	–2.76	–3.26	–3.57	–4.00	–4.70	–5.18	–5.48
185°	–0.99	–1.37	–1.32	–1.86	–2.83	–3.27	–3.85	–4.25	–4.74	–5.52	–6.12	–6.49
190°	–1.44	–1.92	–1.97	–2.65	–3.89	–4.39	–5.14	–5.66	–6.21	–6.98	–7.63	–7.81
195°	–2.00	–2.56	–2.66	–3.39	–4.55	–4.70	–5.18	–5.39	–5.77	–6.22	–6.41	–6.41
200°	–2.26	–2.71	–2.63	–3.15	–3.78	–3.69	–4.07	–4.22	–4.77	–5.44	–5.92	–6.44
205°	–1.87	–2.10	–1.88	–2.37	–3.01	–3.29	–4.05	–4.53	–5.22	–5.99	–6.31	–6.22
210°	–1.19	–1.41	–1.41	–2.23	–3.16	–3.54	–4.03	–4.28	–4.47	–4.82	–5.06	–5.34
215°	–0.85	–1.35	–1.64	–2.46	–2.93	–2.87	–3.17	–3.28	–3.90	–4.55	–4.84	–4.82
220°	–1.02	–1.70	–1.67	–1.95	–2.21	–2.52	–2.97	–3.32	–3.52	–4.13	–4.68	–5.24
225°	–1.18	–1.50	–1.09	–1.45	–2.34	–2.45	–3.14	–3.62	–4.82	–5.94	–6.60	–6.85
230°	–0.84	–0.95	–0.97	–1.64	–2.55	–3.25	–4.74	–5.37	–5.71	–6.53	–7.42	–7.95
235°	–0.53	–1.09	–1.49	–2.06	–3.38	–4.33	–4.84	–5.38	–6.27	–6.63	–6.78	–6.72
240°	–0.84	–1.75	–1.84	–2.56	–4.01	–4.23	–4.97	–4.81	–5.03	–5.67	–5.58	–5.59
245°	–1.44	–1.92	–2.04	–2.94	–3.73	–3.80	–3.77	–4.30	–4.42	–4.94	–5.58	–5.61
250°	–1.53	–1.90	–2.20	–2.96	–3.39	–3.10	–3.62	–3.77	–4.36	–5.20	–5.84	–5.90
255°	–1.35	–2.06	–2.11	–2.46	–2.54	–3.03	–3.66	–4.00	–4.67	–5.16	–5.46	–5.85
260°	–1.44	–1.94	–1.80	–1.82	–2.90	–2.94	–3.58	–3.97	–4.34	–4.95	–5.21	–5.37
265°	–1.45	–1.67	–1.39	–1.79	–2.55	–2.99	–3.43	–3.69	–4.03	–4.70	–5.05	–5.21
270°	–1.12	–1.44	–1.29	–1.85	–2.72	–2.61	–3.09	–3.38	–3.96	–4.46	–5.10	–5.02
275°	–0.92	–1.29	–1.22	–1.89	–2.17	–2.59	–2.99	–3.36	–3.68	–4.49	–4.68	–4.56
280°	–0.89	–1.19	–1.18	–1.66	–2.26	–2.23	–2.93	–3.16	–3.64	–4.04	–4.09	–4.17
285°	–0.75	–1.10	–1.15	–1.19	–2.11	–2.18	–2.61	–2.98	–3.19	–3.47	–3.74	–3.61
290°	–0.60	–1.06	–0.95	–1.28	–1.91	–2.10	–2.52	–2.57	–2.72	–3.11	–3.32	–3.34
295°	–0.62	–0.93	–0.71	–1.20	–1.74	–1.80	–2.09	–2.22	–2.33	–2.91	–3.03	–3.08
300°	–0.60	–0.81	–0.60	–1.04	–1.59	–1.76	–1.86	–1.75	–2.16	–2.53	–2.85	–2.76
305°	–0.41	–0.70	–0.59	–0.92	–1.58	–1.28	–1.35	–1.64	–1.84	–2.28	–2.49	–2.40
310°	–0.27	–0.54	–0.42	–0.68	–1.22	–1.11	–1.24	–1.35	–1.61	–2.04	–2.15	–1.96
315°	–0.25	–0.47	–0.25	–0.70	–1.22	–1.04	–1.02	–1.21	–1.36	–1.78	–1.96	–1.59
320°	–0.22	–0.52	–0.24	–0.73	–1.02	–0.48	–0.81	–0.91	–1.15	–1.52	–1.43	–1.09
325°	–0.06	–0.48	–0.23	–0.52	–0.64	–0.39	–0.70	–0.80	–0.97	–1.32	–1.13	–0.93
330°	0.11	–0.29	–0.12	–0.26	–0.54	–0.39	–0.45	–0.57	–0.74	–1.00	–0.80	–0.49
335°	0.19	–0.08	0.01	–0.11	–0.51	–0.19	–0.37	–0.39	–0.51	–0.64	–0.62	–0.28
340°	0.18	0.04	0.06	–0.04	–0.33	–0.06	–0.35	–0.34	–0.42	–0.46	–0.53	–0.30
345°	0.12	0.07	0.05	–0.01	–0.14	–0.03	–0.24	–0.25	–0.31	–0.32	–0.35	–0.25
350°	0.06	0.04	0.02	0.01	–0.03	–0.02	–0.11	–0.12	–0.16	–0.16	–0.17	–0.14
355°	0.02	0.01	0.00	0.01	0.00	–0.01	–0.03	–0.04	–0.05	–0.05	–0.05	–0.04

Table A.23 *Directional response for Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer with the microphone preamplifier mounted directly on the analyzer, measured in a plane parallel to the display and along the microphone's axis, 11200 Hz – 20000 Hz*

	Frequency										
Angle	11200 Hz	11800 Hz	**12500 Hz**	13200 Hz	14000 Hz	15000 Hz	**16000 Hz**	17000 Hz	18000 Hz	19000 Hz	**20000 Hz**
0°	0.00	0.00	0.00	0.01	0.00	–0.01	–0.01	–0.02	–0.01	0.01	0.02
5°	–0.02	–0.05	–0.05	–0.03	–0.05	–0.03	–0.06	–0.09	–0.07	–0.08	–0.07
10°	–0.11	–0.14	–0.15	–0.14	–0.15	–0.10	–0.16	–0.20	–0.21	–0.31	–0.25
15°	–0.27	–0.29	–0.23	–0.37	–0.17	–0.32	–0.38	–0.33	–0.41	–0.49	–0.47
20°	–0.48	–0.52	–0.30	–0.60	–0.25	–0.76	–0.61	–0.53	–0.66	–0.85	–0.69
25°	–0.61	–0.81	–0.61	–0.78	–0.52	–1.00	–1.00	–0.96	–1.02	–1.35	–1.22
30°	–0.76	–1.02	–0.93	–1.22	–0.72	–1.37	–1.49	–1.28	–1.37	–1.84	–1.77
35°	–1.05	–1.45	–1.32	–1.48	–1.23	–1.60	–2.05	–1.84	–1.78	–2.37	–2.39
40°	–1.17	–1.58	–1.73	–1.95	–1.69	–2.01	–2.41	–2.57	–2.47	–2.95	–3.11
45°	–1.64	–1.96	–2.20	–2.41	–2.16	–2.62	–2.89	–3.18	–3.19	–3.58	–3.86
50°	–1.98	–2.20	–2.36	–2.93	–2.77	–3.15	–3.36	–3.67	–3.98	–4.39	–4.54
55°	–2.40	–2.69	–2.77	–3.36	–3.35	–3.74	–4.10	–4.25	–4.63	–5.31	–5.40
60°	–3.01	–3.27	–3.39	–3.76	–3.79	–4.50	–4.80	–5.15	–5.20	–6.01	–6.47
65°	–3.35	–3.87	–3.95	–4.33	–4.11	–5.02	–5.61	–5.78	–6.10	–6.76	–7.27
70°	–3.71	–4.18	–4.44	–4.98	–4.77	–5.35	–6.25	–6.67	–6.83	–7.72	–8.06
75°	–4.03	–4.56	–4.87	–5.45	–5.61	–6.06	–6.54	–7.30	–7.73	–8.52	–9.06
80°	–4.22	–4.95	–5.33	–5.91	–6.09	–7.03	–7.40	–7.71	–8.39	–9.43	–10.02
85°	–4.82	–5.16	–5.66	–6.42	–6.53	–7.52	–8.32	–8.70	–8.90	–10.12	–10.84
90°	–5.33	–5.76	–6.03	–6.62	–7.10	–7.86	–8.67	–9.44	–9.90	–10.82	–11.47
95°	–5.90	–6.28	–6.66	–7.12	–7.37	–8.35	–9.06	–9.73	–10.67	–11.65	–12.35
100°	–5.83	–6.73	–7.21	–7.83	–7.89	–8.91	–9.48	–10.37	–10.99	–12.23	–13.20
105°	–5.97	–6.80	–7.24	–8.27	–8.61	–9.33	–10.19	–10.96	–11.38	–12.65	–13.46
110°	–6.43	–7.26	–7.35	–8.18	–8.85	–9.66	–10.71	–11.36	–12.21	–13.20	–13.93
115°	–6.64	–7.37	–7.91	–8.73	–8.89	–9.74	–11.12	–11.66	–12.40	–13.75	–14.80
120°	–6.20	–6.61	–7.70	–8.80	–9.03	–10.21	–11.62	–12.05	–12.95	–13.83	–14.46
125°	–6.43	–6.81	–7.65	–8.06	–8.29	–9.73	–10.87	–12.20	–13.23	–15.11	–15.73
130°	–8.02	–8.71	–9.01	–8.74	–9.09	–10.09	–10.28	–11.06	–11.73	–13.60	–14.37
135°	–7.83	–9.01	–9.67	–10.46	–11.48	–12.45	–12.28	–12.74	–13.01	–13.44	–13.98
140°	–6.34	–7.43	–8.15	–9.44	–10.32	–11.49	–12.64	–14.55	–16.38	–16.96	–17.56
145°	–4.92	–5.56	–6.30	–7.44	–7.99	–9.09	–10.59	–11.84	–13.17	–14.61	–15.94
150°	–5.90	–6.56	–6.85	–7.16	–7.26	–8.15	–9.07	–10.04	–10.87	–12.07	–13.22
155°	–6.35	–6.94	–7.39	–8.33	–8.57	–9.76	–10.57	–11.01	–11.46	–12.41	–13.33
160°	–7.09	–7.98	–8.66	–9.37	–9.65	–10.26	–10.99	–11.65	–12.71	–14.28	–15.20
165°	–6.70	–7.24	–7.85	–8.80	–9.24	–10.51	–11.62	–12.65	–13.79	–15.11	–15.83
170°	–8.09	–8.69	–8.95	–9.77	–9.85	–10.64	–11.23	–11.70	–12.51	–13.82	–14.47
175°	–7.31	–8.32	–8.89	–9.89	–10.48	–11.66	–12.84	–13.71	–14.72	–16.31	–16.95
180°	–6.14	–7.06	–7.63	–8.46	–8.99	–10.10	–11.24	–12.24	–13.45	–15.02	–16.44
185°	–7.21	–8.31	–8.92	–9.93	–10.59	–11.75	–12.88	–13.54	–14.86	–16.46	–17.51
190°	–8.34	–9.16	–9.45	–10.21	–10.14	–10.92	–11.44	–11.92	–12.51	–13.90	–14.76
195°	–7.00	–7.53	–8.02	–8.82	–9.23	–10.49	–11.52	–12.42	–13.57	–15.18	–16.01
200°	–7.20	–8.07	–8.82	–9.49	–9.77	–10.34	–11.02	–11.63	–12.59	–14.21	–15.43
205°	–6.59	–7.10	–7.49	–8.43	–8.66	–9.89	–10.69	–10.91	–11.34	–12.49	–13.21
210°	–6.06	–6.82	–7.05	–7.31	–7.35	–8.16	–9.04	–9.95	–10.54	–11.87	–12.82
215°	–5.00	–5.56	–6.24	–7.43	–7.94	–8.97	–10.20	–11.62	–12.87	–14.19	–15.43
220°	–6.33	–7.37	–8.04	–9.37	–10.34	–11.41	–12.24	–14.17	–15.83	–16.85	–17.65
225°	–7.87	–9.11	–9.81	–10.37	–11.44	–12.70	–12.24	–12.69	–12.79	–13.34	–14.03
230°	–8.24	–8.85	–9.26	–8.90	–9.00	–10.10	–10.10	–10.75	–11.29	–13.23	–14.20
235°	–6.69	–6.83	–7.76	–8.14	–8.12	–9.56	–10.53	–11.66	–12.68	–14.79	–15.71
240°	–6.25	–6.65	–7.64	–8.81	–8.93	–10.07	–11.37	–11.63	–12.76	–14.11	–14.67
245°	–6.57	–7.49	–7.95	–8.81	–8.87	–9.68	–11.07	–11.26	–12.01	–13.71	–14.74
250°	–6.52	–7.39	–7.45	–8.18	–8.88	–9.58	–10.47	–10.88	–11.92	–13.55	–14.03
255°	–6.06	–6.72	–7.35	–8.38	–8.59	–9.17	–9.96	–10.47	–11.17	–12.65	–13.27
260°	–5.90	–6.79	–7.26	–7.88	–7.92	–8.85	–9.33	–9.94	–10.67	–12.43	–13.19
265°	–5.99	–6.33	–6.79	–7.21	–7.40	–8.34	–8.79	–9.22	–10.48	–11.80	–12.22
270°	–5.50	–5.79	–6.12	–6.75	–7.15	–7.77	–8.41	–9.09	–9.81	–11.04	–11.40
275°	–4.93	–5.17	–5.71	–6.63	–6.58	–7.47	–8.08	–8.35	–8.80	–10.21	–10.77
280°	–4.30	–4.93	–5.44	–6.08	–6.15	–6.92	–7.20	–7.38	–8.33	–9.57	–10.04
285°	–4.05	–4.61	–4.97	–5.59	–5.68	–5.94	–6.38	–7.09	–7.69	–8.65	–9.02
290°	–3.71	–4.29	–4.54	–5.14	–4.78	–5.23	–6.06	–6.50	–6.81	–7.79	–8.09
295°	–3.44	–3.93	–4.07	–4.48	–4.12	–4.93	–5.42	–5.70	–6.05	–6.84	–7.32
300°	–3.07	–3.36	–3.51	–3.87	–3.82	–4.42	–4.64	–4.97	–5.15	–6.07	–6.55
305°	–2.45	–2.73	–2.83	–3.45	–3.41	–3.64	–4.02	–4.15	–4.63	–5.33	–5.49
310°	–2.00	–2.26	–2.44	–3.03	–2.79	–3.08	–3.30	–3.58	–3.98	–4.44	–4.64
315°	–1.73	–2.04	–2.27	–2.54	–2.14	–2.57	–2.81	–3.12	–3.18	–3.60	–3.98
320°	–1.14	–1.62	–1.80	–2.06	–1.72	–1.97	–2.35	–2.54	–2.44	–2.98	–3.22
325°	–1.10	–1.48	–1.37	–1.52	–1.29	–1.56	–2.01	–1.89	–1.78	–2.40	–2.49
330°	–0.80	–1.04	–1.02	–1.30	–0.74	–1.31	–1.47	–1.30	–1.31	–1.85	–1.86
335°	–0.65	–0.82	–0.63	–0.84	–0.56	–0.99	–0.98	–0.94	–0.95	–1.35	–1.31
340°	–0.50	–0.58	–0.33	–0.64	–0.26	–0.77	–0.60	–0.57	–0.65	–0.87	–0.77
345°	–0.29	–0.30	–0.23	–0.40	–0.18	–0.33	–0.35	–0.35	–0.36	–0.49	–0.53
350°	–0.13	–0.11	–0.14	–0.16	–0.15	–0.09	–0.14	–0.16	–0.20	–0.31	–0.28
355°	–0.04	–0.02	–0.05	–0.05	–0.04	–0.02	–0.02	–0.07	–0.06	–0.08	–0.09

Table A.24 *Directional response for Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer with the microphone preamplifier mounted directly on the analyzer, measured in a plane perpendicular to the display and along the microphone's axis, 500 Hz – 3550 Hz*

	Frequency											
Angle	**500 Hz**	**630 Hz**	**800 Hz**	**1000 Hz**	**1250 Hz**	**1600 Hz**	**2000 Hz**	2240 Hz	**2500 Hz**	2800 Hz	**3150 Hz**	3550 Hz
0°	0.02	0.00	–0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5°	0.00	–0.01	0.00	0.00	–0.01	0.00	0.00	0.00	–0.01	0.00	–0.02	–0.01
10°	–0.01	0.01	–0.01	0.01	–0.01	0.00	–0.02	0.02	–0.05	0.02	–0.05	–0.02
15°	0.00	0.02	–0.01	0.01	–0.02	–0.01	–0.05	0.04	–0.10	0.03	–0.11	–0.03
20°	–0.01	0.03	–0.01	0.01	–0.04	–0.03	–0.10	0.06	–0.18	0.06	–0.20	–0.02
25°	–0.02	0.03	–0.02	0.01	–0.06	–0.06	–0.17	0.09	–0.26	0.06	–0.31	0.01
30°	0.00	0.07	–0.03	0.01	–0.05	–0.09	–0.23	0.10	–0.30	0.03	–0.38	0.06
35°	–0.01	0.06	–0.03	0.01	–0.04	–0.17	–0.28	0.07	–0.27	–0.09	–0.40	0.03
40°	–0.04	0.11	–0.01	0.00	–0.01	–0.28	–0.30	–0.02	–0.19	–0.27	–0.35	–0.12
45°	–0.03	0.12	0.01	–0.03	0.03	–0.40	–0.26	–0.15	–0.09	–0.47	–0.29	–0.36
50°	–0.06	0.15	0.04	–0.05	0.08	–0.53	–0.19	–0.28	–0.08	–0.53	–0.38	–0.52
55°	–0.08	0.16	0.09	–0.08	0.11	–0.61	–0.15	–0.30	–0.21	–0.39	–0.66	–0.45
60°	–0.14	0.16	0.15	–0.09	0.11	–0.62	–0.20	–0.22	–0.42	–0.22	–0.94	–0.35
65°	–0.12	0.15	0.21	–0.07	0.08	–0.56	–0.36	–0.14	–0.53	–0.26	–0.90	–0.56
70°	–0.15	0.13	0.26	–0.02	0.03	–0.46	–0.59	–0.17	–0.43	–0.54	–0.65	–0.95
75°	–0.18	0.10	0.28	0.06	–0.01	–0.37	–0.77	–0.38	–0.31	–0.72	–0.66	–0.93
80°	–0.22	0.08	0.30	0.15	–0.03	–0.33	–0.78	–0.67	–0.39	–0.57	–0.98	–0.63
85°	–0.25	0.02	0.28	0.25	0.02	–0.37	–0.64	–0.81	–0.73	–0.43	–1.06	–0.80
90°	–0.28	–0.04	0.24	0.32	0.12	–0.44	–0.50	–0.70	–1.03	–0.72	–0.83	–1.16
95°	–0.36	–0.08	0.19	0.34	0.27	–0.47	–0.45	–0.47	–0.96	–1.20	–0.94	–0.90
100°	–0.37	–0.16	0.11	0.32	0.41	–0.40	–0.51	–0.38	–0.66	–1.22	–1.53	–0.84
105°	–0.38	–0.22	0.03	0.25	0.51	–0.23	–0.55	–0.47	–0.51	–0.78	–1.70	–1.53
110°	–0.42	–0.28	–0.06	0.12	0.52	–0.04	–0.43	–0.54	–0.62	–0.57	–1.15	–1.78
115°	–0.47	–0.31	–0.14	–0.03	0.44	0.08	–0.18	–0.39	–0.72	–0.78	–0.84	–1.09
120°	–0.46	–0.35	–0.21	–0.19	0.27	0.07	0.07	–0.05	–0.50	–0.90	–1.10	–0.81
125°	–0.44	–0.38	–0.24	–0.33	0.04	–0.07	0.15	0.23	–0.07	–0.51	–1.21	–1.17
130°	–0.45	–0.38	–0.26	–0.43	–0.18	–0.33	0.00	0.25	0.20	0.04	–0.66	–1.05
135°	–0.44	–0.36	–0.24	–0.47	–0.36	–0.63	–0.36	–0.04	0.09	0.20	–0.09	–0.27
140°	–0.37	–0.36	–0.21	–0.46	–0.46	–0.87	–0.78	–0.53	–0.39	–0.16	–0.11	0.14
145°	–0.37	–0.33	–0.17	–0.40	–0.46	–0.98	–1.10	–1.00	–1.01	–0.89	–0.79	–0.30
150°	–0.32	–0.31	–0.11	–0.31	–0.39	–0.96	–1.21	–1.25	–1.46	–1.57	–1.74	–1.37
155°	–0.29	–0.27	–0.06	–0.22	–0.28	–0.83	–1.09	–1.19	–1.51	–1.80	–2.31	–2.31
160°	–0.27	–0.23	0.00	–0.13	–0.16	–0.67	–0.87	–0.94	–1.25	–1.55	–2.17	–2.39
165°	–0.25	–0.20	0.03	–0.06	–0.05	–0.51	–0.63	–0.64	–0.88	–1.10	–1.62	–1.81
170°	–0.25	–0.18	0.07	0.01	0.04	–0.38	–0.43	–0.39	–0.56	–0.69	–1.09	–1.16
175°	–0.21	–0.18	0.09	0.05	0.09	–0.30	–0.31	–0.23	–0.36	–0.44	–0.75	–0.74
180°	–0.20	–0.16	0.10	0.05	0.11	–0.27	–0.27	–0.18	–0.29	–0.35	–0.64	–0.60
185°	–0.22	–0.17	0.09	0.05	0.10	–0.29	–0.31	–0.23	–0.35	–0.43	–0.74	–0.73
190°	–0.24	–0.19	0.07	0.01	0.05	–0.37	–0.43	–0.39	–0.55	–0.69	–1.07	–1.15
195°	–0.27	–0.19	0.05	–0.04	–0.03	–0.50	–0.63	–0.63	–0.87	–1.10	–1.59	–1.79
200°	–0.28	–0.23	0.00	–0.11	–0.14	–0.67	–0.87	–0.93	–1.24	–1.56	–2.14	–2.38
205°	–0.31	–0.26	–0.04	–0.21	–0.25	–0.85	–1.10	–1.20	–1.53	–1.84	–2.32	–2.31
210°	–0.34	–0.27	–0.10	–0.31	–0.37	–0.99	–1.23	–1.27	–1.49	–1.62	–1.78	–1.37
215°	–0.36	–0.31	–0.15	–0.39	–0.44	–1.02	–1.13	–1.03	–1.05	–0.91	–0.81	–0.31
220°	–0.40	–0.34	–0.20	–0.45	–0.45	–0.92	–0.81	–0.55	–0.41	–0.14	–0.09	0.16
225°	–0.45	–0.35	–0.24	–0.47	–0.36	–0.68	–0.38	–0.04	0.10	0.26	–0.02	–0.22
230°	–0.45	–0.37	–0.26	–0.43	–0.20	–0.38	–0.01	0.27	0.25	0.11	–0.58	–0.99
235°	–0.48	–0.36	–0.25	–0.33	0.02	–0.09	0.17	0.28	0.00	–0.44	–1.17	–1.14
240°	–0.48	–0.35	–0.22	–0.19	0.25	0.08	0.11	0.00	–0.44	–0.84	–1.11	–0.83
245°	–0.48	–0.32	–0.15	–0.02	0.43	0.12	–0.12	–0.34	–0.68	–0.75	–0.85	–1.09
250°	–0.46	–0.27	–0.07	0.14	0.52	0.01	–0.38	–0.50	–0.60	–0.57	–1.12	–1.76
255°	–0.44	–0.26	0.01	0.27	0.52	–0.17	–0.51	–0.42	–0.49	–0.78	–1.67	–1.52
260°	–0.40	–0.16	0.12	0.35	0.44	–0.34	–0.48	–0.34	–0.65	–1.20	–1.52	–0.84
265°	–0.38	–0.09	0.20	0.37	0.31	–0.42	–0.42	–0.43	–0.95	–1.19	–0.91	–0.88
270°	–0.34	–0.03	0.27	0.35	0.16	–0.41	–0.44	–0.68	–1.02	–0.70	–0.78	–1.13
275°	–0.30	0.01	0.30	0.28	0.06	–0.35	–0.59	–0.82	–0.70	–0.40	–1.06	–0.80
280°	–0.26	0.07	0.33	0.19	0.01	–0.32	–0.73	–0.67	–0.35	–0.53	–0.99	–0.59
285°	–0.22	0.10	0.32	0.10	0.02	–0.35	–0.75	–0.36	–0.27	–0.71	–0.64	–0.84
290°	–0.21	0.15	0.29	0.01	0.06	–0.43	–0.59	–0.12	–0.41	–0.55	–0.59	–0.87
295°	–0.14	0.14	0.25	–0.04	0.10	–0.53	–0.36	–0.08	–0.53	–0.25	–0.81	–0.53
300°	–0.15	0.18	0.19	–0.06	0.13	–0.59	–0.18	–0.18	–0.43	–0.18	–0.85	–0.36
305°	–0.09	0.17	0.14	–0.06	0.13	–0.58	–0.13	–0.28	–0.21	–0.32	–0.62	–0.46
310°	–0.10	0.17	0.09	–0.04	0.10	–0.50	–0.16	–0.27	–0.06	–0.44	–0.38	–0.50
315°	–0.06	0.15	0.05	–0.01	0.06	–0.37	–0.23	–0.16	–0.06	–0.39	–0.32	–0.34
320°	–0.07	0.15	0.03	0.01	0.01	–0.25	–0.27	–0.03	–0.14	–0.23	–0.36	–0.10
325°	–0.06	0.12	0.01	0.03	–0.02	–0.15	–0.27	0.07	–0.22	–0.06	–0.40	0.04
330°	–0.02	0.08	0.00	0.03	–0.03	–0.08	–0.22	0.10	–0.25	0.03	–0.36	0.07
335°	–0.03	0.07	0.01	0.03	–0.03	–0.03	–0.17	0.10	–0.22	0.06	–0.28	0.04
340°	–0.03	0.06	0.01	0.02	–0.02	–0.01	–0.11	0.08	–0.15	0.05	–0.17	0.00
345°	–0.02	0.03	0.00	0.01	–0.02	0.00	–0.06	0.05	–0.09	0.03	–0.09	–0.01
350°	–0.01	0.04	0.01	0.01	–0.01	0.01	–0.03	0.03	–0.03	0.01	–0.03	–0.01
355°	–0.04	0.02	0.00	0.02	0.00	0.01	0.00	0.01	–0.01	0.01	–0.01	0.00

Table A.25 *Directional response for Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer with the microphone preamplifier mounted directly on the analyzer, measured in a plane perpendicular to the display and along the microphone's axis, 4000 Hz – 10600 Hz*

	Frequency											
Angle	**4000 Hz**	4500 Hz	**5000 Hz**	5600 Hz	**6300 Hz**	7100 Hz	**8000 Hz**	8500 Hz	9000 Hz	9500 Hz	**10000 Hz**	10600 Hz
0°	0.00	0.00	0.00	0.00	0.00	–0.01	0.00	–0.01	0.00	0.00	–0.01	0.00
5°	0.01	0.01	0.02	–0.02	–0.03	0.00	–0.03	–0.04	0.00	–0.05	–0.04	–0.03
10°	0.05	0.05	0.04	0.00	–0.09	0.02	–0.10	–0.10	–0.04	–0.14	–0.18	–0.10
15°	0.10	0.08	0.07	0.07	–0.23	0.06	–0.21	–0.18	–0.11	–0.28	–0.37	–0.20
20°	0.13	0.05	0.06	0.14	–0.39	0.04	–0.32	–0.27	–0.17	–0.43	–0.46	–0.25
25°	0.12	–0.10	–0.05	0.15	–0.50	–0.15	–0.35	–0.44	–0.37	–0.66	–0.47	–0.35
30°	0.01	–0.36	–0.22	–0.06	–0.49	–0.46	–0.38	–0.67	–0.69	–0.94	–0.69	–0.72
35°	–0.20	–0.57	–0.31	–0.40	–0.68	–0.50	–0.73	–0.75	–0.89	–1.08	–1.09	–0.92
40°	–0.37	–0.48	–0.16	–0.47	–1.14	–0.60	–0.95	–0.78	–1.17	–1.43	–1.55	–1.08
45°	–0.32	–0.30	–0.17	–0.40	–1.19	–1.13	–0.84	–1.20	–1.11	–1.84	–1.75	–1.48
50°	–0.20	–0.44	–0.58	–0.74	–1.23	–1.03	–1.42	–1.28	–1.33	–2.19	–2.16	–1.97
55°	–0.32	–0.83	–0.70	–0.87	–1.70	–1.30	–1.35	–1.49	–1.85	–2.05	–2.63	–2.37
60°	–0.68	–0.87	–0.44	–0.87	–1.57	–1.64	–2.12	–1.78	–1.74	–2.78	–2.47	–2.83
65°	–0.77	–0.73	–0.74	–1.28	–1.83	–1.86	–1.91	–2.39	–2.31	–2.53	–3.21	–2.90
70°	–0.61	–1.12	–1.02	–0.94	–1.96	–2.07	–2.66	–2.28	–2.75	–3.18	–3.14	–3.48
75°	–0.87	–1.33	–0.87	–1.10	–2.36	–2.12	–2.65	–3.10	–2.76	–3.79	–3.67	–3.56
80°	–1.29	–1.10	–1.26	–1.48	–2.05	–2.37	–2.81	–3.12	–3.53	–3.74	–4.39	–4.09
85°	–1.05	–1.59	–1.29	–1.56	–2.35	–2.59	–3.19	–3.12	–3.69	–4.16	–4.60	–4.74
90°	–0.86	–1.77	–1.33	–1.93	–2.46	–2.50	–3.32	–3.62	–3.51	–4.72	–4.55	–5.40
95°	–1.32	–1.25	–1.95	–1.69	–2.91	–2.85	–3.20	–3.72	–4.00	–4.75	–4.99	–5.21
100°	–1.24	–1.70	–1.45	–2.16	–2.84	–2.96	–3.64	–3.72	–4.12	–4.85	–5.34	–5.28
105°	–1.02	–1.77	–1.63	–2.08	–3.24	–3.31	–3.71	–3.94	–4.27	–4.86	–5.43	–5.33
110°	–1.77	–1.50	–1.89	–2.15	–2.91	–3.59	–4.09	–4.35	–4.30	–5.28	–5.48	–5.62
115°	–2.02	–2.38	–1.49	–2.41	–3.23	–3.17	–4.34	–4.42	–4.96	–5.60	–5.65	–6.10
120°	–1.15	–2.35	–2.60	–1.94	–3.34	–3.58	–3.85	–4.60	–4.95	–5.54	–6.47	–6.49
125°	–1.00	–1.38	–2.17	–3.13	–3.36	–3.41	–4.46	–4.30	–4.48	–5.74	–6.00	–6.28
130°	–1.46	–1.56	–1.18	–2.11	–3.97	–4.25	–4.24	–4.77	–5.27	–5.76	–5.78	–6.04
135°	–0.98	–1.81	–1.78	–1.70	–2.49	–3.40	–5.12	–5.16	–5.17	–5.93	–6.68	–6.86
140°	–0.09	–0.87	–1.52	–2.36	–3.09	–2.57	–3.25	–4.04	–4.87	–6.08	–6.56	–6.93
145°	–0.05	–0.29	–0.30	–1.09	–2.93	–3.56	–3.78	–3.66	–3.70	–4.32	–4.68	–5.23
150°	–1.01	–0.91	–0.35	–0.31	–1.38	–2.05	–3.43	–4.10	–4.68	–5.53	–5.60	–5.36
155°	–2.34	–2.40	–1.85	–1.45	–1.74	–1.58	–2.00	–2.36	–2.80	–3.86	–4.60	–5.13
160°	–2.85	–3.44	–3.55	–3.74	–3.98	–3.60	–3.44	–3.31	–3.27	–3.70	–3.84	–3.89
165°	–2.30	–3.03	–3.48	–4.52	–5.64	–5.91	–6.62	–6.72	–6.81	–7.25	–7.23	–7.00
170°	–1.48	–2.06	–2.28	–3.16	–4.49	–4.97	–6.20	–6.91	–7.55	–8.71	–9.50	–10.05
175°	–0.92	–1.37	–1.37	–1.93	–3.05	–3.36	–4.11	–4.59	–4.98	–5.87	–6.46	–6.90
180°	–0.74	–1.13	–1.06	–1.46	–2.49	–2.78	–3.37	–3.73	–4.02	–4.79	–5.22	–5.53
185°	–0.92	–1.36	–1.34	–1.74	–2.88	–3.33	–4.10	–4.52	–4.90	–5.75	–6.26	–6.71
190°	–1.47	–2.03	–2.17	–2.76	–4.17	–5.05	–6.15	–6.80	–7.37	–8.38	–9.32	–9.85
195°	–2.29	–2.96	–3.27	–4.10	–5.58	–6.45	–6.76	–6.90	–6.99	–7.53	–7.58	–7.42
200°	–2.88	–3.40	–3.42	–3.84	–4.55	–4.02	–3.58	–3.36	–3.40	–3.84	–4.07	–4.05
205°	–2.40	–2.42	–1.87	–1.86	–2.27	–1.60	–1.96	–2.16	–2.63	–3.77	–4.55	–5.00
210°	–1.05	–0.92	–0.40	–0.71	–1.56	–1.73	–3.20	–3.90	–4.68	–5.71	–5.80	–5.49
215°	–0.03	–0.24	–0.33	–1.34	–2.77	–3.35	–3.80	–3.80	–3.95	–4.47	–4.79	–5.48
220°	–0.02	–0.81	–1.47	–2.40	–3.00	–2.73	–3.44	–4.10	–4.93	–6.17	–6.67	–7.30
225°	–0.89	–1.77	–1.80	–1.67	–2.48	–3.52	–4.98	–5.08	–5.28	–6.12	–7.19	–7.27
230°	–1.43	–1.57	–1.31	–1.92	–3.88	–4.21	–4.48	–5.05	–5.68	–5.99	–5.65	–5.87
235°	–1.00	–1.40	–2.16	–2.96	–3.57	–3.62	–4.53	–4.06	–4.21	–5.50	–6.00	–6.10
240°	–1.12	–2.34	–2.52	–2.07	–3.50	–3.62	–3.66	–4.46	–4.82	–5.27	–6.38	–6.78
245°	–1.99	–2.38	–1.47	–2.63	–3.40	–2.87	–4.27	–4.15	–4.89	–6.09	–5.85	–6.05
250°	–1.75	–1.47	–1.95	–2.28	–2.62	–3.61	–3.99	–4.62	–4.43	–5.24	–5.44	–5.56
255°	–1.00	–1.78	–1.70	–1.86	–3.11	–3.27	–3.87	–3.77	–4.12	–4.76	–5.71	–5.29
260°	–1.21	–1.76	–1.40	–1.97	–2.93	–3.18	–3.41	–3.60	–4.14	–4.91	–5.20	–5.25
265°	–1.33	–1.22	–1.81	–1.75	–3.13	–2.62	–3.27	–3.63	–3.88	–4.63	–4.98	–5.30
270°	–0.85	–1.61	–1.27	–2.14	–2.45	–2.51	–3.16	–3.45	–3.32	–4.69	–4.68	–5.46
275°	–0.98	–1.49	–1.38	–1.57	–2.21	–2.68	–3.06	–2.91	–3.74	–4.22	–4.73	–4.92
280°	–1.20	–1.10	–1.31	–1.25	–2.11	–2.20	–2.69	–3.12	–3.51	–3.74	–4.57	–3.80
285°	–0.82	–1.34	–0.89	–1.01	–2.46	–2.09	–2.70	–3.01	–2.67	–3.87	–3.44	–3.42
290°	–0.62	–1.13	–0.89	–1.13	–1.82	–1.97	–2.58	–2.17	–2.77	–3.00	–3.11	–3.69
295°	–0.75	–0.72	–0.63	–1.41	–1.69	–1.96	–1.89	–2.29	–2.08	–2.46	–3.44	–3.02
300°	–0.63	–0.79	–0.46	–0.78	–1.57	–1.55	–2.01	–1.57	–1.60	–3.00	–2.53	–2.64
305°	–0.28	–0.75	–0.74	–0.58	–1.84	–1.34	–1.16	–1.31	–1.98	–2.01	–2.67	–2.24
310°	–0.14	–0.39	–0.59	–0.54	–1.29	–1.16	–1.27	–1.30	–1.34	–2.21	–2.03	–2.07
315°	–0.26	–0.30	–0.13	–0.51	–1.15	–0.97	–0.75	–1.31	–1.03	–1.76	–1.66	–1.64
320°	–0.30	–0.51	–0.06	–0.70	–1.00	–0.32	–1.06	–0.59	–1.08	–1.40	–1.79	–1.09
325°	–0.15	–0.59	–0.15	–0.54	–0.62	–0.35	–0.86	–0.67	–0.73	–0.99	–1.27	–0.86
330°	0.04	–0.37	–0.10	–0.07	–0.64	–0.40	–0.23	–0.63	–0.60	–1.10	–0.69	–0.67
335°	0.14	–0.10	0.01	0.20	–0.74	–0.13	–0.20	–0.30	–0.23	–0.94	–0.46	–0.28
340°	0.14	0.06	0.07	0.22	–0.56	0.05	–0.35	–0.18	–0.04	–0.54	–0.44	–0.14
345°	0.09	0.09	0.06	0.15	–0.27	0.04	–0.31	–0.17	–0.09	–0.25	–0.39	–0.10
350°	0.04	0.06	0.03	0.07	–0.08	0.00	–0.15	–0.10	–0.11	–0.09	–0.22	–0.05
355°	0.02	0.03	0.01	0.04	0.00	–0.01	–0.03	–0.02	–0.04	0.00	–0.06	0.00

Table A.26 *Directional response for Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer with the microphone preamplifier mounted directly on the analyzer, measured in a plane perpendicular to the display and along the microphone's axis, 11200 Hz – 20000 Hz*

	Frequency										
Angle	11200 Hz	11800 Hz	**12500 Hz**	13200 Hz	14000 Hz	15000 Hz	**16000 Hz**	17000 Hz	18000 Hz	19000 Hz	**20000 Hz**
0°	0.00	0.00	0.00	0.00	0.00	0.01	0.00	–0.01	–0.03	0.00	0.00
5°	–0.01	–0.05	–0.04	–0.04	–0.05	0.00	–0.04	–0.09	–0.06	–0.10	–0.08
10°	–0.04	–0.15	–0.18	–0.11	–0.17	–0.08	–0.17	–0.18	–0.23	–0.23	–0.19
15°	–0.10	–0.25	–0.36	–0.20	–0.29	–0.35	–0.40	–0.47	–0.38	–0.51	–0.40
20°	–0.30	–0.37	–0.44	–0.44	–0.35	–0.68	–0.81	–0.66	–0.80	–0.89	–0.76
25°	–0.63	–0.72	–0.71	–0.73	–0.69	–1.00	–1.12	–1.00	–1.01	–1.35	–1.14
30°	–0.76	–0.99	–1.22	–1.14	–0.82	–1.39	–1.56	–1.41	–1.47	–1.98	–1.75
35°	–0.92	–1.34	–1.25	–1.56	–1.26	–1.80	–2.03	–2.14	–1.93	–2.55	–2.47
40°	–1.36	–1.70	–1.86	–2.31	–1.52	–2.16	–2.59	–2.69	–2.59	–3.08	–3.29
45°	–1.58	–1.90	–2.09	–2.45	–2.11	–2.82	–3.08	–3.18	–3.34	–3.69	–4.01
50°	–1.94	–2.41	–2.39	–3.04	–2.96	–3.16	–3.50	–3.93	–4.36	–4.53	–4.70
55°	–2.62	–2.80	–3.13	–3.47	–3.53	–3.86	–4.30	–4.27	–4.98	–5.48	–5.59
60°	–2.79	–3.28	–3.41	–3.95	–3.80	–4.55	–5.06	–5.32	–5.51	–6.31	–6.70
65°	–3.45	–3.71	–3.86	–4.41	–4.22	–5.10	–5.77	–6.35	–6.30	–6.94	–7.69
70°	–3.71	–4.36	–4.40	–5.04	–4.82	–5.69	–6.43	–6.81	–7.50	–7.95	–8.31
75°	–4.25	–4.64	–5.09	–5.43	–5.64	–6.32	–7.10	–7.60	–8.14	–9.01	–9.29
80°	–4.19	–5.22	–5.41	–6.06	–6.07	–7.21	–7.84	–8.16	–8.64	–9.74	–10.54
85°	–4.76	–5.31	–5.90	–6.55	–6.43	–7.72	–8.60	–8.93	–9.21	–10.38	–11.14
90°	–5.21	–6.00	–6.37	–6.83	–7.25	–8.08	–9.19	–9.85	–10.26	–10.97	–12.16
95°	–5.79	–6.45	–7.03	–7.43	–7.43	–8.71	–9.66	–9.95	–11.26	–12.22	–13.02
100°	–6.22	–6.35	–7.81	–7.90	–8.02	–9.22	–9.98	–10.24	–11.72	–12.62	–13.74
105°	–6.47	–6.67	–7.87	–7.99	–9.09	–9.58	–10.79	–11.26	–12.02	–12.80	–14.09
110°	–6.44	–6.74	–7.95	–8.21	–9.33	–9.67	–11.56	–11.48	–12.95	–13.60	–14.52
115°	–6.51	–7.18	–8.01	–7.94	–9.19	–10.16	–12.05	–11.34	–13.27	–14.47	–15.38
120°	–6.58	–7.66	–8.15	–8.56	–9.38	–9.74	–11.54	–12.06	–13.83	–14.25	–16.12
125°	–7.03	–8.28	–8.20	–8.91	–9.94	–10.32	–11.42	–12.41	–12.58	–14.10	–15.28
130°	–6.92	–7.70	–7.93	–9.30	–10.51	–10.84	–11.83	–12.97	–12.85	–15.02	–15.65
135°	–7.12	–7.40	–8.17	–9.42	–9.43	–10.25	–11.89	–13.87	–13.74	–15.08	–16.55
140°	–7.45	–8.33	–9.22	–9.90	–9.37	–10.32	–11.85	–13.31	–12.98	–14.21	–16.50
145°	–6.32	–7.78	–8.60	–9.70	–9.87	–11.28	–13.24	–13.41	–13.43	–14.58	–16.83
150°	–5.47	–5.77	–6.34	–7.37	–8.38	–10.03	–11.44	–11.74	–12.57	–14.96	–17.00
155°	–6.00	–7.20	–7.79	–8.34	–8.17	–8.78	–9.26	–9.80	–11.19	–13.09	–14.31
160°	–4.31	–4.97	–5.73	–6.77	–7.53	–9.06	–10.55	–11.55	–12.30	–13.17	–13.45
165°	–7.02	–7.15	–7.11	–7.41	–7.30	–8.22	–9.06	–9.40	–10.61	–11.93	–13.18
170°	–10.94	–12.23	–12.94	–13.55	–13.32	–13.86	–14.52	–15.50	–15.23	–15.51	–15.94
175°	–7.57	–8.67	–9.69	–11.01	–11.66	–13.06	–14.16	–15.08	–16.53	–19.17	–20.39
180°	–6.03	–6.87	–7.58	–8.58	–9.17	–10.35	–11.21	–11.76	–12.93	–14.45	–15.86
185°	–7.35	–8.38	–9.21	–10.40	–11.23	–12.70	–13.62	–14.87	–16.44	–17.92	–20.19
190°	–10.81	–12.06	–12.82	–13.55	–13.96	–14.44	–15.08	–14.98	–15.44	–16.72	–16.76
195°	–7.43	–7.50	–7.36	–7.82	–7.77	–8.71	–9.55	–10.09	–10.67	–12.20	–13.52
200°	–4.31	–4.91	–5.54	–6.89	–7.79	–9.42	–10.77	–11.55	–12.18	–13.28	–13.39
205°	–5.85	–7.06	–8.07	–8.88	–8.77	–9.05	–9.39	–9.97	–10.74	–12.79	–14.49
210°	–5.73	–6.16	–6.88	–7.95	–8.80	–10.20	–10.99	–10.95	–11.78	–13.84	–16.61
215°	–6.62	–8.03	–9.11	–9.61	–9.48	–10.60	–12.34	–12.46	–12.88	–14.30	–16.00
220°	–7.64	–8.79	–9.42	–9.53	–8.62	–9.48	–11.08	–12.17	–11.96	–13.77	–16.20
225°	–7.22	–7.03	–7.46	–8.70	–8.90	–9.83	–11.33	–12.80	–13.32	–15.45	–16.76
230°	–6.58	–7.26	–7.54	–8.80	–10.34	–10.75	–11.72	–12.50	–11.99	–14.29	–14.76
235°	–6.68	–8.10	–8.34	–9.16	–10.21	–9.97	–10.53	–10.95	–11.97	–14.13	–14.75
240°	–6.70	–7.73	–8.22	–8.20	–8.92	–8.92	–10.38	–11.45	–13.64	–14.39	–15.86
245°	–6.48	–6.98	–8.01	–7.20	–8.51	–9.59	–11.62	–11.18	–12.76	–13.82	–14.58
250°	–6.59	–6.40	–7.36	–7.62	–9.39	–9.60	–10.80	–11.21	–12.05	–13.39	–14.21
255°	–6.20	–6.38	–7.39	–8.04	–8.85	–9.14	–9.88	–10.67	–11.68	–12.37	–13.63
260°	–6.06	–6.24	–7.80	–7.83	–7.39	–8.41	–9.57	–9.89	–11.25	–12.21	–13.16
265°	–5.74	–6.39	–6.94	–6.83	–6.97	–8.51	–9.07	–9.39	–10.20	–12.04	–12.84
270°	–5.22	–5.69	–5.76	–6.66	–7.44	–7.56	–8.35	–9.35	–10.14	–10.82	–11.63
275°	–4.37	–4.96	–5.76	–6.69	–6.07	–7.04	–8.21	–8.91	–8.68	–9.95	–11.10
280°	–3.94	–5.23	–5.49	–5.60	–5.64	–7.21	–7.34	–7.77	–8.19	–9.60	–10.17
285°	–4.35	–4.66	–4.60	–5.13	–5.93	–5.87	–6.51	–7.16	–7.86	–8.60	–9.22
290°	–3.74	–3.96	–4.10	–5.40	–4.46	–5.33	–6.05	–6.49	–6.98	–7.63	–8.42
295°	–3.11	–3.37	–4.09	–4.21	–3.94	–5.06	–5.45	–5.84	–5.82	–6.67	–7.71
300°	–2.53	–3.33	–3.31	–3.57	–3.87	–4.38	–4.57	–5.02	–5.24	–6.07	–6.72
305°	–2.71	–2.82	–2.73	–3.45	–3.61	–3.33	–4.08	–4.21	–4.49	–5.36	–5.48
310°	–2.00	–2.18	–2.12	–3.33	–2.56	–3.11	–3.35	–3.54	–3.95	–4.38	–4.68
315°	–1.48	–1.65	–2.20	–2.41	–1.92	–2.71	–2.74	–3.20	–3.15	–3.49	–3.92
320°	–1.18	–1.50	–2.09	–1.94	–1.63	–1.94	–2.27	–2.50	–2.29	–2.97	–3.25
325°	–0.75	–1.40	–1.18	–1.40	–1.44	–1.38	–2.00	–1.98	–1.79	–2.33	–2.52
330°	–0.59	–1.14	–0.99	–1.22	–0.78	–1.21	–1.50	–1.16	–1.40	–1.78	–1.84
335°	–0.66	–0.79	–0.42	–1.06	–0.30	–1.03	–0.91	–0.93	–0.89	–1.23	–1.15
340°	–0.42	–0.29	–0.18	–0.81	0.00	–0.85	–0.55	–0.68	–0.76	–0.88	–0.70
345°	–0.16	–0.21	–0.15	–0.46	–0.05	–0.48	–0.19	–0.41	–0.31	–0.47	–0.38
350°	–0.06	–0.15	–0.08	–0.21	–0.09	–0.17	–0.02	–0.10	–0.08	–0.18	–0.14
355°	–0.02	–0.03	–0.02	–0.05	–0.03	–0.04	0.00	0.02	–0.01	–0.01	0.01

Table A.27 *Sensitivity variations of Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer with the microphone preamplifier mounted directly on the analyzer, at sound incidence angles within ±θ° from the reference direction*

Nominal Frequency	Exact Frequency	Max Variation ± 30° dB	Max Variation ± 90° dB	Max Variation ± 150° dB
500 Hz	501.187 Hz	0.06	0.37	0.51
630 Hz	630.957 Hz	0.10	0.23	0.56
800 Hz	794.328 Hz	0.04	0.36	0.59
1000 Hz	1000 Hz	0.05	0.44	0.86
1250 Hz	1258.93 Hz	0.06	0.23	0.98
1600 Hz	1584.89 Hz	0.14	0.66	1.14
2000 Hz	1995.26 Hz	0.29	0.79	1.40
2240 Hz	2238.72 Hz	0.11	0.97	1.54
2500 Hz	2511.89 Hz	0.30	1.03	1.74
2800 Hz	2818.38 Hz	0.09	0.93	1.88
3150 Hz	3162.28 Hz	0.43	1.22	1.78
3550 Hz	3548.13 Hz	0.19	1.32	1.94
4000 Hz	3981.07 Hz	0.20	1.49	2.22
4500 Hz	4466.84 Hz	0.47	1.87	2.47
5000 Hz	5011.87 Hz	0.29	1.45	2.67
5600 Hz	5623.41 Hz	0.49	2.36	3.35
6300 Hz	6309.57 Hz	0.75	2.81	4.02
7100 Hz	7079.46 Hz	0.51	2.74	4.39
8000 Hz	7943.28 Hz	0.46	3.32	5.12
8500 Hz	8413.95 Hz	0.68	3.63	5.41
9000 Hz	8912.51 Hz	0.75	3.97	6.28
9500 Hz	9440.61 Hz	1.10	4.72	6.631
10000 Hz	10000 Hz	0.81	5.11	7.44
10600 Hz	10592.5 Hz	0.72	5.46	7.95
11200 Hz	11220.2 Hz	0.81	5.50	8.24
11800 Hz	11885.0 Hz	1.14	6.00	9.12
12500 Hz	12589.3 Hz	1.23	6.37	9.82
13200 Hz	13335.2 Hz	1.31	6.84	10.46
14000 Hz	14125.4 Hz	0.82	7.44	11.48
15000 Hz	14962.4 Hz	1.41	8.09	12.71
16000 Hz	15848.9 Hz	1.57	9.20	13.25
17000 Hz	16788.0 Hz	1.44	9.88	14.57
18000 Hz	17782.8 Hz	1.50	10.29	16.41
19000 Hz	18836.5 Hz	1.99	11.04	16.97
20000 Hz	19952.6 Hz	1.88	12.18	17.67

Table A.28 *Influence of Windscreen UA-1650 on directional response, with or without Microphone Preamplifier ZC-0032 connected to a microphone extension cable, 500 Hz – 3550 Hz*

	Frequency											
Angle	**500 Hz**	**630 Hz**	**800 Hz**	**1000 Hz**	**1250 Hz**	**1600 Hz**	**2000 Hz**	2240 Hz	**2500 Hz**	2800 Hz	**3150 Hz**	3550 Hz
0°	0.00	0.00	0.00	0.00	0.00	0.00	–0.01	–0.01	–0.01	–0.01	–0.01	–0.01
5°	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	–0.01	–0.01	–0.01
10°	–0.01	0.00	0.00	–0.01	–0.01	0.00	–0.01	0.00	0.00	0.00	0.00	0.00
15°	0.00	0.00	0.00	–0.01	–0.01	–0.01	–0.01	–0.01	0.00	–0.01	0.01	0.00
20°	0.00	0.00	0.00	–0.01	–0.01	–0.01	–0.01	–0.01	0.00	0.00	0.02	0.01
25°	–0.01	–0.01	0.00	–0.01	–0.01	–0.02	–0.01	–0.02	0.00	0.00	0.03	0.03
30°	–0.01	–0.01	0.00	–0.01	–0.02	–0.02	–0.02	–0.02	–0.01	0.00	0.04	0.04
35°	–0.01	–0.02	–0.01	–0.01	–0.03	–0.03	–0.03	–0.03	–0.02	0.01	0.05	0.06
40°	0.00	–0.01	–0.01	–0.02	–0.04	–0.04	–0.05	–0.03	–0.03	0.02	0.06	0.07
45°	–0.01	–0.02	–0.02	–0.02	–0.05	–0.05	–0.07	–0.04	–0.04	0.02	0.06	0.09
50°	0.00	–0.01	–0.02	–0.02	–0.06	–0.06	–0.08	–0.06	–0.05	0.01	0.07	0.11
55°	–0.01	–0.01	–0.02	–0.03	–0.07	–0.08	–0.10	–0.08	–0.06	–0.01	0.07	0.12
60°	–0.01	–0.01	–0.03	–0.04	–0.07	–0.10	–0.11	–0.11	–0.07	–0.01	0.07	0.14
65°	–0.01	–0.01	–0.03	–0.05	–0.08	–0.12	–0.12	–0.13	–0.10	–0.02	0.07	0.15
70°	–0.01	–0.01	–0.03	–0.05	–0.09	–0.13	–0.14	–0.14	–0.13	–0.04	0.06	0.15
75°	–0.02	–0.02	–0.04	–0.06	–0.09	–0.15	–0.16	–0.15	–0.15	–0.06	0.06	0.15
80°	–0.02	–0.02	–0.04	–0.06	–0.10	–0.16	–0.19	–0.17	–0.16	–0.09	0.04	0.14
85°	–0.03	–0.03	–0.04	–0.07	–0.11	–0.17	–0.22	–0.19	–0.18	–0.10	0.01	0.14
90°	–0.02	–0.02	–0.05	–0.07	–0.12	–0.18	–0.23	–0.22	–0.20	–0.11	–0.01	0.12
95°	–0.02	–0.03	–0.05	–0.07	–0.13	–0.18	–0.24	–0.24	–0.23	–0.14	–0.02	0.09
100°	–0.02	–0.03	–0.05	–0.07	–0.12	–0.19	–0.25	–0.25	–0.24	–0.17	–0.04	0.08
105°	–0.02	–0.02	–0.06	–0.07	–0.12	–0.19	–0.26	–0.26	–0.25	–0.19	–0.08	0.06
110°	–0.03	–0.03	–0.05	–0.08	–0.12	–0.19	–0.26	–0.27	–0.25	–0.19	–0.09	0.02
115°	–0.03	–0.04	–0.05	–0.07	–0.12	–0.19	–0.26	–0.27	–0.26	–0.18	–0.08	0.00
120°	–0.04	–0.04	–0.05	–0.07	–0.12	–0.19	–0.26	–0.26	–0.26	–0.18	–0.07	0.03
125°	–0.03	–0.03	–0.05	–0.07	–0.12	–0.18	–0.25	–0.25	–0.26	–0.18	–0.07	0.04
130°	–0.03	–0.04	–0.05	–0.07	–0.13	–0.18	–0.25	–0.24	–0.24	–0.17	–0.06	0.04
135°	–0.03	–0.04	–0.05	–0.07	–0.12	–0.17	–0.24	–0.23	–0.23	–0.15	–0.04	0.06
140°	–0.03	–0.04	–0.05	–0.07	–0.12	–0.16	–0.24	–0.22	–0.22	–0.13	–0.03	0.08
145°	–0.03	–0.04	–0.06	–0.08	–0.13	–0.15	–0.24	–0.22	–0.21	–0.12	–0.01	0.11
150°	–0.03	–0.04	–0.06	–0.08	–0.12	–0.15	–0.24	–0.22	–0.20	–0.12	0.00	0.12
155°	–0.03	–0.04	–0.06	–0.07	–0.13	–0.15	–0.23	–0.22	–0.20	–0.11	0.01	0.13
160°	–0.03	–0.04	–0.06	–0.07	–0.13	–0.15	–0.23	–0.21	–0.19	–0.11	0.02	0.13
165°	–0.03	–0.04	–0.06	–0.07	–0.13	–0.15	–0.23	–0.21	–0.19	–0.10	0.02	0.14
170°	–0.03	–0.04	–0.06	–0.07	–0.13	–0.15	–0.22	–0.21	–0.19	–0.10	0.03	0.15
175°	–0.04	–0.04	–0.06	–0.07	–0.13	–0.16	–0.22	–0.21	–0.19	–0.10	0.03	0.15
180°	–0.05	–0.05	–0.05	–0.07	–0.13	–0.16	–0.22	–0.21	–0.19	–0.10	0.03	0.15
185°	–0.03	–0.03	–0.06	–0.07	–0.12	–0.16	–0.23	–0.21	–0.19	–0.10	0.03	0.15
190°	–0.04	–0.05	–0.06	–0.07	–0.13	–0.16	–0.23	–0.22	–0.20	–0.11	0.02	0.14
195°	–0.03	–0.04	–0.06	–0.07	–0.13	–0.16	–0.23	–0.22	–0.20	–0.11	0.02	0.13
200°	–0.03	–0.04	–0.06	–0.07	–0.13	–0.16	–0.24	–0.22	–0.21	–0.12	0.01	0.13
205°	–0.03	–0.04	–0.06	–0.07	–0.13	–0.16	–0.24	–0.23	–0.21	–0.12	0.00	0.12
210°	–0.03	–0.04	–0.06	–0.07	–0.13	–0.16	–0.24	–0.23	–0.22	–0.12	0.00	0.11
215°	–0.03	–0.04	–0.06	–0.08	–0.13	–0.16	–0.25	–0.23	–0.22	–0.13	–0.01	0.10
220°	–0.04	–0.05	–0.06	–0.08	–0.13	–0.17	–0.25	–0.23	–0.22	–0.14	–0.03	0.08
225°	–0.04	–0.04	–0.06	–0.08	–0.13	–0.18	–0.25	–0.24	–0.23	–0.15	–0.05	0.05
230°	–0.03	–0.04	–0.06	–0.08	–0.13	–0.18	–0.25	–0.25	–0.24	–0.17	–0.07	0.04
235°	–0.03	–0.04	–0.06	–0.08	–0.13	–0.19	–0.26	–0.26	–0.26	–0.19	–0.07	0.04
240°	–0.03	–0.04	–0.06	–0.08	–0.12	–0.20	–0.26	–0.27	–0.26	–0.19	–0.07	0.03
245°	–0.03	–0.04	–0.06	–0.08	–0.13	–0.20	–0.27	–0.27	–0.26	–0.18	–0.08	0.00
250°	–0.03	–0.04	–0.05	–0.08	–0.13	–0.20	–0.26	–0.27	–0.26	–0.19	–0.09	0.01
255°	–0.03	–0.04	–0.06	–0.08	–0.13	–0.20	–0.26	–0.26	–0.25	–0.19	–0.08	0.06
260°	–0.02	–0.03	–0.05	–0.07	–0.13	–0.19	–0.25	–0.25	–0.25	–0.18	–0.04	0.08
265°	–0.03	–0.04	–0.05	–0.07	–0.13	–0.18	–0.24	–0.24	–0.23	–0.14	–0.01	0.09
270°	–0.02	–0.03	–0.05	–0.07	–0.12	–0.17	–0.23	–0.22	–0.21	–0.11	0.00	0.11
275°	–0.04	–0.04	–0.04	–0.07	–0.12	–0.16	–0.21	–0.20	–0.18	–0.10	0.01	0.15
280°	–0.02	–0.02	–0.04	–0.07	–0.10	–0.15	–0.19	–0.17	–0.16	–0.08	0.04	0.15
285°	–0.02	–0.03	–0.04	–0.06	–0.10	–0.14	–0.16	–0.15	–0.14	–0.05	0.06	0.15
290°	–0.02	–0.02	–0.04	–0.05	–0.09	–0.13	–0.14	–0.13	–0.12	–0.03	0.07	0.16
295°	–0.01	–0.01	–0.03	–0.05	–0.08	–0.11	–0.12	–0.12	–0.09	–0.01	0.07	0.16
300°	–0.02	–0.03	–0.03	–0.04	–0.07	–0.09	–0.11	–0.10	–0.06	0.00	0.08	0.15
305°	–0.01	–0.02	–0.03	–0.03	–0.06	–0.08	–0.09	–0.07	–0.05	0.01	0.08	0.14
310°	–0.01	–0.02	–0.02	–0.03	–0.05	–0.06	–0.08	–0.05	–0.04	0.02	0.08	0.12
315°	–0.02	–0.03	–0.02	–0.02	–0.04	–0.05	–0.06	–0.03	–0.03	0.03	0.07	0.11
320°	0.00	–0.01	–0.01	–0.02	–0.03	–0.03	–0.04	–0.02	–0.02	0.02	0.07	0.08
325°	–0.01	–0.01	–0.01	–0.01	–0.02	–0.02	–0.02	–0.02	0.00	0.02	0.07	0.07
330°	–0.01	–0.01	0.00	–0.01	–0.01	–0.02	–0.01	–0.01	0.01	0.02	0.06	0.06
335°	0.00	–0.01	0.00	0.00	–0.01	–0.01	0.00	–0.01	0.01	0.02	0.05	0.05
340°	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.03	0.04
345°	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.02	0.03	0.03
350°	–0.01	–0.01	0.00	0.00	0.01	0.00	0.01	0.01	0.01	0.02	0.02	0.02
355°	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.02	0.02

Table A.29 *Influence of Windscreen UA-1650 on directional response, with or without Microphone Preamplifier ZC-0032 connected to a microphone extension cable, 4000 Hz – 10600 Hz*

	Frequency											
Angle	**4000 Hz**	4500 Hz	**5000 Hz**	5600 Hz	**6300 Hz**	7100 Hz	**8000 Hz**	8500 Hz	9000 Hz	9500 Hz	**10000 Hz**	10600 Hz
0°	–0.01	–0.01	–0.01	–0.01	–0.01	–0.01	–0.01	–0.02	–0.02	–0.01	–0.01	–0.01
5°	–0.01	–0.01	–0.01	–0.01	–0.01	–0.01	–0.02	–0.02	–0.01	0.00	0.00	–0.02
10°	–0.01	–0.01	–0.02	–0.01	0.01	0.00	–0.06	–0.04	–0.02	0.02	0.00	–0.05
15°	–0.01	–0.02	–0.03	–0.01	0.03	0.02	–0.11	–0.10	–0.03	0.06	0.01	–0.08
20°	0.00	–0.03	–0.06	–0.02	0.06	0.05	–0.20	–0.18	–0.05	0.08	0.03	–0.10
25°	0.00	–0.04	–0.09	–0.03	0.09	0.10	–0.27	–0.26	–0.08	0.10	0.05	–0.11
30°	0.01	–0.05	–0.13	–0.06	0.10	0.14	–0.31	–0.36	–0.17	0.06	0.07	–0.11
35°	0.02	–0.06	–0.16	–0.08	0.12	0.19	–0.34	–0.50	–0.28	0.03	0.12	–0.07
40°	0.03	–0.07	–0.19	–0.11	0.15	0.28	–0.37	–0.56	–0.38	–0.04	0.08	–0.05
45°	0.04	–0.07	–0.24	–0.18	0.14	0.34	–0.32	–0.62	–0.54	–0.17	0.06	0.03
50°	0.06	–0.08	–0.28	–0.24	0.11	0.35	–0.25	–0.65	–0.59	–0.30	–0.03	0.00
55°	0.09	–0.07	–0.30	–0.27	0.10	0.43	–0.14	–0.58	–0.67	–0.40	–0.11	–0.01
60°	0.11	–0.06	–0.31	–0.34	0.02	0.42	–0.04	–0.51	–0.64	–0.47	–0.25	–0.08
65°	0.12	–0.05	–0.33	–0.40	0.00	0.41	0.05	–0.40	–0.61	–0.48	–0.30	–0.20
70°	0.14	–0.03	–0.33	–0.40	–0.04	0.35	0.11	–0.34	–0.51	–0.47	–0.32	–0.23
75°	0.15	–0.01	–0.32	–0.43	–0.10	0.29	0.10	–0.28	–0.48	–0.40	–0.32	–0.22
80°	0.15	–0.01	–0.32	–0.44	–0.10	0.24	0.01	–0.28	–0.46	–0.39	–0.25	–0.19
85°	0.14	–0.01	–0.33	–0.45	–0.12	0.23	–0.02	–0.35	–0.46	–0.40	–0.24	–0.13
90°	0.14	–0.02	–0.35	–0.47	–0.12	0.22	–0.17	–0.36	–0.51	–0.39	–0.24	–0.08
95°	0.12	–0.04	–0.38	–0.50	–0.15	0.26	–0.15	–0.42	–0.53	–0.42	–0.25	–0.08
100°	0.07	–0.08	–0.42	–0.55	–0.16	0.28	–0.22	–0.46	–0.54	–0.45	–0.27	–0.11
105°	0.05	–0.13	–0.47	–0.60	–0.20	0.32	–0.21	–0.46	–0.60	–0.49	–0.31	–0.18
110°	0.03	–0.17	–0.55	–0.68	–0.23	0.33	–0.22	–0.52	–0.63	–0.57	–0.42	–0.23
115°	–0.01	–0.20	–0.62	–0.77	–0.33	0.32	–0.22	–0.57	–0.76	–0.69	–0.49	–0.31
120°	–0.01	–0.25	–0.65	–0.84	–0.42	0.25	–0.26	–0.66	–0.86	–0.83	–0.67	–0.33
125°	0.02	–0.23	–0.68	–0.89	–0.47	0.16	–0.37	–0.82	–1.06	–1.03	–0.76	–0.42
130°	0.03	–0.20	–0.64	–0.88	–0.52	0.10	–0.43	–0.95	–1.27	–1.25	–0.96	–0.62
135°	0.05	–0.18	–0.60	–0.79	–0.45	0.09	–0.40	–0.94	–1.31	–1.31	–1.08	–0.76
140°	0.08	–0.15	–0.57	–0.77	–0.40	0.12	–0.35	–0.85	–1.12	–1.13	–0.93	–0.75
145°	0.10	–0.11	–0.52	–0.71	–0.36	0.13	–0.32	–0.79	–0.99	–0.86	–0.64	–0.52
150°	0.13	–0.07	–0.46	–0.65	–0.30	0.17	–0.28	–0.73	–0.92	–0.75	–0.47	–0.38
155°	0.15	–0.05	–0.43	–0.60	–0.25	0.20	–0.23	–0.63	–0.76	–0.59	–0.38	–0.31
160°	0.16	–0.03	–0.41	–0.57	–0.21	0.22	–0.19	–0.53	–0.63	–0.45	–0.24	–0.26
165°	0.16	–0.02	–0.39	–0.55	–0.20	0.25	–0.14	–0.48	–0.55	–0.35	–0.17	–0.20
170°	0.17	0.00	–0.38	–0.53	–0.21	0.27	–0.11	–0.44	–0.48	–0.29	–0.17	–0.17
175°	0.18	0.01	–0.36	–0.52	–0.21	0.27	–0.10	–0.41	–0.45	–0.27	–0.15	–0.19
180°	0.18	0.01	–0.37	–0.53	–0.22	0.27	–0.11	–0.41	–0.45	–0.29	–0.16	–0.21
185°	0.17	0.00	–0.37	–0.54	–0.23	0.26	–0.13	–0.44	–0.48	–0.32	–0.19	–0.23
190°	0.16	–0.01	–0.39	–0.56	–0.24	0.25	–0.15	–0.48	–0.52	–0.34	–0.21	–0.21
195°	0.15	–0.03	–0.41	–0.58	–0.23	0.25	–0.15	–0.50	–0.57	–0.37	–0.20	–0.21
200°	0.14	–0.04	–0.43	–0.59	–0.23	0.24	–0.18	–0.55	–0.66	–0.48	–0.27	–0.28
205°	0.13	–0.05	–0.45	–0.61	–0.27	0.20	–0.24	–0.64	–0.77	–0.60	–0.37	–0.30
210°	0.12	–0.08	–0.48	–0.66	–0.32	0.19	–0.29	–0.73	–0.92	–0.75	–0.47	–0.37
215°	0.10	–0.12	–0.53	–0.73	–0.37	0.16	–0.32	–0.79	–1.01	–0.88	–0.63	–0.49
220°	0.07	–0.15	–0.58	–0.79	–0.40	0.13	–0.35	–0.85	–1.14	–1.15	–0.93	–0.72
225°	0.04	–0.18	–0.61	–0.81	–0.46	0.10	–0.39	–0.95	–1.34	–1.34	–1.10	–0.74
230°	0.03	–0.20	–0.65	–0.89	–0.52	0.10	–0.43	–0.96	–1.30	–1.30	–1.01	–0.64
235°	0.03	–0.24	–0.70	–0.91	–0.48	0.14	–0.36	–0.85	–1.13	–1.09	–0.81	–0.43
240°	–0.01	–0.26	–0.67	–0.87	–0.44	0.24	–0.28	–0.68	–0.91	–0.89	–0.70	–0.33
245°	–0.02	–0.20	–0.63	–0.81	–0.35	0.30	–0.21	–0.57	–0.78	–0.72	–0.50	–0.30
250°	0.03	–0.18	–0.57	–0.71	–0.27	0.30	–0.20	–0.51	–0.66	–0.61	–0.45	–0.23
255°	0.06	–0.15	–0.49	–0.62	–0.22	0.30	–0.19	–0.47	–0.62	–0.52	–0.33	–0.18
260°	0.07	–0.08	–0.43	–0.57	–0.18	0.27	–0.20	–0.46	–0.56	–0.49	–0.29	–0.10
265°	0.11	–0.05	–0.39	–0.52	–0.16	0.27	–0.15	–0.43	–0.55	–0.45	–0.26	–0.06
270°	0.14	–0.03	–0.36	–0.48	–0.13	0.23	–0.14	–0.36	–0.54	–0.42	–0.26	–0.07
275°	0.14	–0.01	–0.34	–0.46	–0.12	0.25	–0.01	–0.35	–0.48	–0.42	–0.26	–0.12
280°	0.15	–0.01	–0.32	–0.44	–0.10	0.26	0.04	–0.29	–0.48	–0.42	–0.27	–0.19
285°	0.16	–0.01	–0.32	–0.43	–0.09	0.32	0.11	–0.29	–0.50	–0.43	–0.33	–0.21
290°	0.15	–0.02	–0.33	–0.40	–0.03	0.36	0.12	–0.35	–0.53	–0.49	–0.33	–0.21
295°	0.14	–0.03	–0.33	–0.39	0.02	0.43	0.05	–0.40	–0.63	–0.50	–0.30	–0.19
300°	0.12	–0.05	–0.31	–0.33	0.05	0.43	–0.01	–0.52	–0.66	–0.49	–0.25	–0.07
305°	0.10	–0.06	–0.29	–0.26	0.12	0.45	–0.14	–0.59	–0.69	–0.41	–0.11	0.00
310°	0.08	–0.07	–0.26	–0.23	0.13	0.39	–0.24	–0.65	–0.61	–0.30	–0.03	0.00
315°	0.06	–0.06	–0.22	–0.17	0.16	0.37	–0.31	–0.63	–0.54	–0.17	0.06	0.03
320°	0.05	–0.05	–0.17	–0.10	0.17	0.29	–0.37	–0.56	–0.38	–0.04	0.08	–0.05
325°	0.03	–0.04	–0.14	–0.06	0.14	0.20	–0.34	–0.49	–0.27	0.04	0.13	–0.07
330°	0.02	–0.03	–0.11	–0.03	0.12	0.16	–0.30	–0.35	–0.16	0.07	0.08	–0.10
335°	0.02	–0.02	–0.07	–0.01	0.11	0.12	–0.26	–0.24	–0.07	0.11	0.06	–0.09
340°	0.02	0.00	–0.04	0.01	0.09	0.07	–0.18	–0.16	–0.03	0.11	0.05	–0.08
345°	0.01	0.01	–0.01	0.01	0.06	0.04	–0.09	–0.08	–0.01	0.08	0.03	–0.06
350°	0.01	0.01	0.01	0.02	0.04	0.02	–0.03	–0.03	0.01	0.05	0.02	–0.03
355°	0.01	0.01	0.01	0.02	0.03	0.02	0.00	0.00	0.02	0.03	0.02	0.00

Table A.30 *Influence of Windscreen UA-1650 on directional response, with or without Microphone Preamplifier ZC-0032 connected to a microphone extension cable, 11200 Hz – 20000 Hz*

	Frequency										
Angle	11200 Hz	11800 Hz	**12500 Hz**	13200 Hz	14000 Hz	15000 Hz	**16000 Hz**	17000 Hz	18000 Hz	19000 Hz	**20000 Hz**
0°	–0.01	–0.01	–0.01	–0.01	–0.01	–0.01	–0.01	–0.01	–0.01	–0.01	–0.02
5°	–0.03	–0.02	0.00	–0.01	–0.03	–0.01	0.00	–0.01	–0.02	–0.01	–0.03
10°	–0.08	–0.05	0.00	–0.03	–0.09	–0.02	0.01	–0.02	–0.04	–0.02	–0.08
15°	–0.16	–0.11	0.01	–0.05	–0.17	–0.09	0.04	–0.03	–0.11	–0.05	–0.15
20°	–0.25	–0.18	0.00	–0.09	–0.26	–0.20	0.04	–0.06	–0.20	–0.12	–0.22
25°	–0.35	–0.25	–0.01	–0.08	–0.36	–0.30	–0.07	–0.02	–0.27	–0.25	–0.31
30°	–0.46	–0.39	–0.09	–0.07	–0.38	–0.46	–0.16	–0.04	–0.28	–0.33	–0.37
35°	–0.49	–0.50	–0.18	–0.09	–0.40	–0.51	–0.33	–0.06	–0.21	–0.36	–0.40
40°	–0.52	–0.63	–0.30	–0.11	–0.33	–0.54	–0.40	–0.17	–0.08	–0.25	–0.37
45°	–0.46	–0.65	–0.41	–0.18	–0.31	–0.49	–0.40	–0.29	–0.02	–0.09	–0.30
50°	–0.43	–0.68	–0.53	–0.29	–0.29	–0.40	–0.38	–0.40	–0.16	–0.04	–0.29
55°	–0.36	–0.64	–0.57	–0.39	–0.32	–0.41	–0.39	–0.47	–0.39	–0.19	–0.36
60°	–0.38	–0.61	–0.58	–0.52	–0.43	–0.47	–0.46	–0.52	–0.58	–0.41	–0.44
65°	–0.45	–0.66	–0.63	–0.62	–0.55	–0.56	–0.53	–0.54	–0.65	–0.50	–0.53
70°	–0.51	–0.71	–0.70	–0.73	–0.66	–0.60	–0.56	–0.58	–0.63	–0.54	–0.81
75°	–0.51	–0.74	–0.73	–0.79	–0.80	–0.65	–0.59	–0.66	–0.71	–0.66	–0.90
80°	–0.45	–0.69	–0.73	–0.78	–0.90	–0.82	–0.74	–0.82	–0.80	–0.79	–0.85
85°	–0.37	–0.58	–0.70	–0.78	–0.94	–1.02	–1.01	–1.04	–0.80	–0.66	–0.77
90°	–0.32	–0.51	–0.64	–0.81	–0.95	–1.08	–1.14	–1.13	–0.83	–0.54	–0.91
95°	–0.29	–0.54	–0.68	–0.90	–0.91	–1.00	–0.93	–0.94	–0.81	–0.84	–1.70
100°	–0.33	–0.57	–0.75	–1.07	–0.94	–0.81	–0.65	–0.66	–0.86	–1.27	–1.98
105°	–0.36	–0.57	–0.74	–1.03	–1.05	–0.87	–0.57	–0.61	–0.88	–1.35	–1.35
110°	–0.39	–0.54	–0.61	–0.89	–1.09	–0.91	–0.80	–0.99	–0.99	–1.05	–0.90
115°	–0.42	–0.49	–0.51	–0.74	–1.10	–0.94	–0.86	–1.05	–1.12	–1.27	–1.01
120°	–0.40	–0.44	–0.50	–0.79	–1.10	–0.84	–0.82	–0.88	–1.32	–1.22	–1.30
125°	–0.48	–0.55	–0.64	–0.90	–1.04	–0.71	–0.58	–0.76	–1.30	–1.14	–1.29
130°	–0.70	–0.76	–0.96	–1.32	–1.09	–0.55	–0.48	–0.79	–0.94	–0.87	–0.95
135°	–0.92	–1.18	–1.61	–1.97	–1.32	–0.81	–0.82	–1.58	–0.59	–0.52	–0.82
140°	–0.99	–1.42	–1.93	–2.12	–1.62	–1.54	–1.96	–2.68	–1.05	–0.71	–1.78
145°	–0.86	–1.33	–1.70	–1.71	–1.58	–1.79	–2.53	–2.83	–1.56	–1.77	–3.84
150°	–0.80	–1.21	–1.29	–1.12	–1.14	–1.61	–2.29	–2.00	–1.49	–2.18	–4.05
155°	–0.74	–1.17	–1.15	–0.84	–0.84	–1.54	–1.89	–1.21	–0.94	–2.22	–2.77
160°	–0.71	–1.02	–0.88	–0.57	–0.77	–1.49	–1.73	–0.86	–0.77	–2.32	–1.91
165°	–0.67	–0.89	–0.66	–0.40	–0.68	–1.44	–1.37	–0.53	–0.64	–2.22	–1.47
170°	–0.58	–0.79	–0.47	–0.23	–0.59	–1.32	–1.16	–0.33	–0.57	–2.09	–1.28
175°	–0.57	–0.74	–0.47	–0.21	–0.58	–1.19	–1.07	–0.25	–0.43	–1.93	–1.08
180°	–0.60	–0.75	–0.48	–0.25	–0.60	–1.21	–1.08	–0.30	–0.43	–1.95	–1.03
185°	–0.62	–0.80	–0.54	–0.29	–0.64	–1.28	–1.22	–0.39	–0.49	–2.08	–1.24
190°	–0.61	–0.83	–0.51	–0.24	–0.60	–1.36	–1.25	–0.37	–0.56	–2.18	–1.38
195°	–0.67	–0.92	–0.70	–0.43	–0.70	–1.50	–1.54	–0.64	–0.62	–2.39	–1.76
200°	–0.73	–1.05	–0.95	–0.59	–0.74	–1.52	–1.88	–0.90	–0.69	–2.49	–2.34
205°	–0.73	–1.21	–1.24	–0.88	–0.83	–1.57	–2.09	–1.29	–0.79	–2.26	–3.02
210°	–0.80	–1.26	–1.40	–1.15	–1.08	–1.56	–2.44	–2.15	–1.37	–2.11	–4.31
215°	–0.82	–1.36	–1.80	–1.80	–1.54	–1.74	–2.59	–3.04	–1.46	–1.56	–4.08
220°	–0.96	–1.42	–2.02	–2.24	–1.68	–1.46	–1.99	–3.04	–1.21	–0.72	–2.45
225°	–0.89	–1.22	–1.73	–2.11	–1.49	–0.77	–0.94	–1.76	–0.53	–0.53	–1.05
230°	–0.68	–0.84	–1.08	–1.40	–1.11	–0.54	–0.56	–0.85	–0.82	–0.94	–1.40
235°	–0.47	–0.57	–0.71	–0.96	–1.03	–0.71	–0.71	–0.85	–1.14	–0.98	–2.13
240°	–0.39	–0.46	–0.56	–0.87	–1.08	–0.81	–0.99	–1.11	–1.14	–0.86	–1.81
245°	–0.41	–0.52	–0.59	–0.81	–1.06	–0.85	–1.00	–1.36	–1.03	–0.95	–1.15
250°	–0.37	–0.57	–0.70	–0.97	–1.05	–0.80	–0.82	–1.30	–1.04	–0.75	–0.95
255°	–0.33	–0.59	–0.82	–1.15	–1.07	–0.76	–0.55	–0.81	–0.97	–1.25	–1.60
260°	–0.29	–0.57	–0.83	–1.19	–0.98	–0.73	–0.65	–0.77	–0.88	–1.16	–2.36
265°	–0.26	–0.53	–0.76	–1.02	–0.95	–0.95	–0.95	–1.06	–0.83	–0.71	–1.96
270°	–0.29	–0.51	–0.71	–0.90	–0.97	–1.02	–1.19	–1.32	–0.86	–0.41	–1.04
275°	–0.35	–0.59	–0.75	–0.86	–0.94	–0.95	–1.07	–1.21	–0.89	–0.59	–0.90
280°	–0.43	–0.70	–0.78	–0.86	–0.90	–0.77	–0.77	–0.93	–0.86	–0.76	–1.00
285°	–0.50	–0.74	–0.80	–0.87	–0.80	–0.63	–0.61	–0.73	–0.71	–0.60	–1.07
290°	–0.50	–0.72	–0.77	–0.80	–0.66	–0.59	–0.60	–0.65	–0.61	–0.54	–0.92
295°	–0.44	–0.67	–0.70	–0.66	–0.53	–0.55	–0.57	–0.60	–0.65	–0.53	–0.66
300°	–0.37	–0.63	–0.62	–0.52	–0.39	–0.46	–0.50	–0.56	–0.60	–0.46	–0.49
305°	–0.37	–0.66	–0.59	–0.38	–0.29	–0.41	–0.43	–0.51	–0.42	–0.22	–0.40
310°	–0.44	–0.70	–0.54	–0.28	–0.27	–0.42	–0.42	–0.44	–0.17	–0.06	–0.32
315°	–0.48	–0.66	–0.41	–0.17	–0.32	–0.52	–0.45	–0.34	–0.03	–0.12	–0.36
320°	–0.52	–0.63	–0.29	–0.10	–0.35	–0.57	–0.45	–0.20	–0.08	–0.29	–0.42
325°	–0.48	–0.49	–0.17	–0.09	–0.40	–0.53	–0.37	–0.08	–0.22	–0.40	–0.44
330°	–0.45	–0.37	–0.07	–0.07	–0.39	–0.48	–0.19	–0.05	–0.29	–0.36	–0.40
335°	–0.34	–0.23	0.01	–0.07	–0.35	–0.32	–0.08	–0.01	–0.28	–0.27	–0.33
340°	–0.23	–0.15	0.02	–0.07	–0.25	–0.21	0.04	–0.03	–0.20	–0.13	–0.23
345°	–0.14	–0.08	0.03	–0.03	–0.17	–0.10	0.05	–0.02	–0.11	–0.05	–0.14
350°	–0.06	–0.03	0.03	–0.01	–0.09	–0.02	0.02	–0.01	–0.03	–0.02	–0.06
355°	–0.01	0.00	0.02	0.01	–0.01	0.01	0.02	0.01	0.00	0.00	0.00

Table A.31 *Directional response for Windscreen UA-1650, Microphone Type 4189 and Microphone Preamplifier ZC-0032, with the microphone preamplifier connected to a microphone extension cable, 500 Hz – 3550 Hz*

	Frequency											
Angle	**500 Hz**	**630 Hz**	**800 Hz**	**1000 Hz**	**1250 Hz**	**1600 Hz**	**2000 Hz**	2240 Hz	**2500 Hz**	2800 Hz	**3150 Hz**	3550 Hz
0°	0.00	0.00	0.00	0.00	0.00	0.00	–0.01	–0.01	–0.01	–0.01	–0.01	–0.01
5°	0.00	0.01	0.00	–0.01	0.00	0.00	0.00	0.00	0.00	–0.01	–0.01	–0.01
10°	0.00	0.00	–0.01	–0.02	–0.01	–0.01	0.00	–0.01	–0.01	–0.01	–0.01	–0.01
15°	0.01	0.00	–0.01	–0.03	–0.01	–0.02	–0.01	–0.01	–0.02	–0.04	–0.02	–0.02
20°	0.01	0.01	–0.01	–0.02	–0.03	–0.03	–0.02	–0.03	–0.04	–0.06	–0.03	–0.04
25°	0.00	0.00	–0.01	–0.03	–0.04	–0.05	–0.04	–0.04	–0.07	–0.10	–0.06	–0.06
30°	0.01	0.00	–0.01	–0.04	–0.06	–0.07	–0.06	–0.06	–0.09	–0.14	–0.09	–0.09
35°	0.00	–0.02	–0.02	–0.05	–0.07	–0.10	–0.09	–0.08	–0.13	–0.18	–0.14	–0.12
40°	0.00	–0.01	–0.04	–0.06	–0.10	–0.13	–0.12	–0.10	–0.17	–0.22	–0.19	–0.17
45°	–0.01	–0.03	–0.05	–0.08	–0.13	–0.17	–0.16	–0.14	–0.21	–0.27	–0.25	–0.22
50°	–0.01	–0.03	–0.06	–0.09	–0.15	–0.21	–0.21	–0.17	–0.25	–0.33	–0.32	–0.27
55°	–0.02	–0.04	–0.07	–0.11	–0.18	–0.24	–0.26	–0.22	–0.27	–0.39	–0.38	–0.34
60°	–0.02	–0.04	–0.08	–0.13	–0.20	–0.29	–0.30	–0.28	–0.31	–0.43	–0.45	–0.41
65°	–0.03	–0.05	–0.09	–0.15	–0.22	–0.33	–0.35	–0.33	–0.36	–0.48	–0.52	–0.47
70°	–0.04	–0.06	–0.11	–0.16	–0.24	–0.37	–0.41	–0.38	–0.43	–0.52	–0.58	–0.55
75°	–0.05	–0.07	–0.12	–0.18	–0.27	–0.41	–0.47	–0.44	–0.48	–0.57	–0.62	–0.63
80°	–0.05	–0.08	–0.13	–0.19	–0.29	–0.44	–0.53	–0.50	–0.54	–0.62	–0.68	–0.70
85°	–0.07	–0.09	–0.14	–0.21	–0.32	–0.48	–0.59	–0.56	–0.60	–0.67	–0.74	–0.76
90°	–0.06	–0.09	–0.15	–0.22	–0.34	–0.50	–0.64	–0.63	–0.67	–0.72	–0.79	–0.83
95°	–0.07	–0.10	–0.15	–0.23	–0.36	–0.53	–0.68	–0.69	–0.74	–0.78	–0.83	–0.89
100°	–0.08	–0.10	–0.16	–0.24	–0.37	–0.55	–0.71	–0.73	–0.79	–0.87	–0.89	–0.94
105°	–0.07	–0.10	–0.17	–0.25	–0.38	–0.57	–0.74	–0.77	–0.83	–0.93	–0.96	–0.99
110°	–0.08	–0.11	–0.17	–0.26	–0.38	–0.58	–0.77	–0.80	–0.87	–0.96	–1.02	–1.07
115°	–0.09	–0.12	–0.17	–0.25	–0.39	–0.59	–0.78	–0.82	–0.90	–0.99	–1.05	–1.12
120°	–0.10	–0.13	–0.18	–0.25	–0.39	–0.58	–0.78	–0.83	–0.93	–1.02	–1.07	–1.13
125°	–0.09	–0.12	–0.18	–0.25	–0.38	–0.58	–0.77	–0.82	–0.93	–1.03	–1.10	–1.15
130°	–0.09	–0.12	–0.17	–0.25	–0.38	–0.56	–0.76	–0.80	–0.91	–1.02	–1.10	–1.18
135°	–0.09	–0.12	–0.17	–0.24	–0.37	–0.54	–0.74	–0.77	–0.88	–0.99	–1.08	–1.16
140°	–0.08	–0.12	–0.17	–0.24	–0.36	–0.52	–0.72	–0.74	–0.84	–0.94	–1.03	–1.11
145°	–0.08	–0.11	–0.17	–0.23	–0.35	–0.49	–0.69	–0.71	–0.80	–0.89	–0.97	–1.04
150°	–0.08	–0.11	–0.16	–0.22	–0.34	–0.48	–0.66	–0.67	–0.75	–0.83	–0.89	–0.96
155°	–0.08	–0.11	–0.16	–0.21	–0.33	–0.46	–0.63	–0.64	–0.70	–0.77	–0.82	–0.88
160°	–0.08	–0.11	–0.16	–0.20	–0.32	–0.44	–0.60	–0.60	–0.66	–0.72	–0.76	–0.80
165°	–0.07	–0.11	–0.15	–0.19	–0.32	–0.43	–0.57	–0.58	–0.63	–0.67	–0.70	–0.73
170°	–0.07	–0.11	–0.15	–0.19	–0.31	–0.43	–0.56	–0.55	–0.60	–0.64	–0.65	–0.67
175°	–0.08	–0.11	–0.15	–0.20	–0.30	–0.42	–0.54	–0.54	–0.58	–0.62	–0.62	–0.63
180°	–0.09	–0.11	–0.14	–0.19	–0.30	–0.42	–0.54	–0.54	–0.58	–0.61	–0.61	–0.62
185°	–0.07	–0.09	–0.15	–0.19	–0.30	–0.42	–0.55	–0.54	–0.59	–0.62	–0.62	–0.63
190°	–0.08	–0.11	–0.16	–0.20	–0.31	–0.43	–0.56	–0.56	–0.60	–0.65	–0.65	–0.67
195°	–0.08	–0.11	–0.16	–0.20	–0.32	–0.44	–0.58	–0.58	–0.63	–0.68	–0.70	–0.73
200°	–0.08	–0.11	–0.16	–0.20	–0.33	–0.45	–0.61	–0.61	–0.67	–0.72	–0.76	–0.79
205°	–0.08	–0.12	–0.16	–0.21	–0.33	–0.47	–0.64	–0.65	–0.72	–0.78	–0.82	–0.87
210°	–0.08	–0.11	–0.16	–0.22	–0.35	–0.49	–0.67	–0.69	–0.76	–0.83	–0.89	–0.95
215°	–0.08	–0.12	–0.17	–0.23	–0.36	–0.51	–0.70	–0.72	–0.81	–0.89	–0.96	–1.04
220°	–0.09	–0.12	–0.17	–0.23	–0.37	–0.53	–0.72	–0.75	–0.85	–0.94	–1.02	–1.12
225°	–0.09	–0.12	–0.17	–0.24	–0.37	–0.55	–0.75	–0.78	–0.89	–0.99	–1.08	–1.18
230°	–0.09	–0.12	–0.18	–0.25	–0.38	–0.57	–0.77	–0.82	–0.92	–1.03	–1.11	–1.20
235°	–0.09	–0.12	–0.18	–0.25	–0.39	–0.59	–0.79	–0.83	–0.94	–1.05	–1.12	–1.18
240°	–0.09	–0.13	–0.18	–0.25	–0.39	–0.60	–0.79	–0.84	–0.94	–1.04	–1.09	–1.16
245°	–0.09	–0.12	–0.18	–0.25	–0.40	–0.60	–0.80	–0.84	–0.92	–1.01	–1.07	–1.14
250°	–0.09	–0.12	–0.17	–0.25	–0.39	–0.60	–0.78	–0.82	–0.90	–0.98	–1.04	–1.08
255°	–0.08	–0.11	–0.17	–0.25	–0.39	–0.59	–0.76	–0.79	–0.86	–0.94	–0.98	–0.99
260°	–0.07	–0.10	–0.16	–0.24	–0.38	–0.57	–0.73	–0.75	–0.82	–0.88	–0.89	–0.93
265°	–0.08	–0.11	–0.16	–0.22	–0.37	–0.54	–0.70	–0.71	–0.76	–0.80	–0.82	–0.89
270°	–0.07	–0.10	–0.15	–0.21	–0.35	–0.52	–0.66	–0.65	–0.68	–0.72	–0.78	–0.84
275°	–0.08	–0.10	–0.14	–0.20	–0.33	–0.49	–0.61	–0.58	–0.60	–0.66	–0.73	–0.78
280°	–0.05	–0.08	–0.13	–0.19	–0.30	–0.46	–0.55	–0.51	–0.54	–0.61	–0.68	–0.74
285°	–0.05	–0.08	–0.12	–0.17	–0.28	–0.43	–0.48	–0.44	–0.48	–0.56	–0.64	–0.68
290°	–0.04	–0.07	–0.11	–0.15	–0.26	–0.39	–0.42	–0.38	–0.42	–0.51	–0.61	–0.60
295°	–0.03	–0.05	–0.10	–0.14	–0.23	–0.34	–0.36	–0.33	–0.37	–0.48	–0.55	–0.51
300°	–0.03	–0.06	–0.09	–0.12	–0.20	–0.30	–0.30	–0.27	–0.32	–0.45	–0.48	–0.41
305°	–0.02	–0.04	–0.08	–0.10	–0.18	–0.26	–0.25	–0.22	–0.29	–0.40	–0.41	–0.33
310°	–0.01	–0.03	–0.06	–0.08	–0.16	–0.21	–0.21	–0.18	–0.26	–0.35	–0.33	–0.26
315°	–0.02	–0.04	–0.05	–0.07	–0.12	–0.17	–0.16	–0.14	–0.23	–0.30	–0.26	–0.21
320°	0.01	–0.01	–0.04	–0.05	–0.11	–0.14	–0.12	–0.11	–0.19	–0.25	–0.19	–0.17
325°	0.00	–0.01	–0.03	–0.04	–0.08	–0.11	–0.08	–0.09	–0.15	–0.20	–0.12	–0.13
330°	0.01	0.00	–0.01	–0.02	–0.05	–0.08	–0.05	–0.07	–0.12	–0.14	–0.08	–0.09
335°	0.01	0.00	–0.01	0.00	–0.04	–0.06	–0.03	–0.05	–0.08	–0.10	–0.05	–0.05
340°	0.01	0.00	0.00	0.00	–0.02	–0.04	–0.02	–0.03	–0.05	–0.06	–0.02	–0.03
345°	0.01	0.01	–0.01	0.01	–0.01	–0.02	0.00	–0.02	–0.04	–0.04	0.00	0.00
350°	0.00	–0.01	0.00	0.01	0.01	–0.01	0.01	0.00	–0.02	–0.01	0.01	0.01
355°	0.00	0.00	0.00	0.02	0.01	0.00	0.01	0.00	–0.01	–0.01	0.02	0.02

Table A.32 *Directional response for Windscreen UA-1650, Microphone Type 4189 and Microphone Preamplifier ZC-0032, with the microphone preamplifier connected to a microphone extension cable, 4000 Hz – 10600 Hz*

	Frequency											
Angle	**4000 Hz**	4500 Hz	**5000 Hz**	5600 Hz	**6300 Hz**	7100 Hz	**8000 Hz**	8500 Hz	9000 Hz	9500 Hz	**10000 Hz**	10600 Hz
0°	–0.01	–0.01	–0.01	–0.01	–0.01	–0.01	–0.01	–0.02	–0.02	–0.01	–0.01	–0.01
5°	–0.02	–0.02	–0.02	–0.02	–0.01	–0.01	–0.03	–0.02	–0.02	0.00	–0.02	–0.02
10°	–0.03	–0.04	–0.04	–0.05	–0.01	–0.04	–0.12	–0.08	–0.10	–0.02	–0.09	–0.09
15°	–0.05	–0.09	–0.07	–0.10	–0.02	–0.08	–0.26	–0.20	–0.23	–0.05	–0.20	–0.18
20°	–0.09	–0.15	–0.14	–0.18	–0.05	–0.14	–0.45	–0.37	–0.40	–0.13	–0.34	–0.30
25°	–0.14	–0.25	–0.24	–0.28	–0.09	–0.24	–0.65	–0.58	–0.63	–0.29	–0.48	–0.50
30°	–0.19	–0.35	–0.37	–0.37	–0.18	–0.37	–0.81	–0.87	–0.90	–0.59	–0.60	–0.80
35°	–0.23	–0.45	–0.53	–0.45	–0.30	–0.51	–0.95	–1.24	–1.18	–0.95	–0.71	–1.11
40°	–0.29	–0.55	–0.72	–0.53	–0.45	–0.59	–1.10	–1.52	–1.48	–1.34	–1.03	–1.38
45°	–0.34	–0.64	–0.94	–0.69	–0.65	–0.67	–1.24	–1.75	–1.92	–1.69	–1.50	–1.52
50°	–0.41	–0.73	–1.14	–0.90	–0.83	–0.80	–1.46	–1.91	–2.29	–2.02	–1.99	–1.93
55°	–0.48	–0.82	–1.29	–1.16	–0.94	–0.93	–1.70	–2.05	–2.61	–2.47	–2.25	–2.57
60°	–0.55	–0.92	–1.40	–1.49	–1.13	–1.16	–1.87	–2.31	–2.73	–2.94	–2.59	–3.05
65°	–0.62	–1.04	–1.51	–1.75	–1.38	–1.34	–1.99	–2.54	–2.99	–3.20	–3.06	–3.32
70°	–0.69	–1.15	–1.63	–1.86	–1.76	–1.52	–2.17	–2.70	–3.31	–3.48	–3.39	–3.73
75°	–0.75	–1.24	–1.81	–1.94	–2.13	–1.77	–2.45	–2.82	–3.51	–3.93	–3.67	–4.05
80°	–0.82	–1.32	–2.00	–2.04	–2.29	–2.17	–2.77	–3.14	–3.56	–4.20	–4.23	–4.20
85°	–0.90	–1.38	–2.16	–2.26	–2.35	–2.53	–3.00	–3.58	–3.86	–4.17	–4.61	–4.72
90°	–0.96	–1.44	–2.24	–2.50	–2.42	–2.73	–3.38	–3.87	–4.40	–4.42	–4.53	–5.12
95°	–1.04	–1.52	–2.31	–2.69	–2.63	–2.80	–3.62	–4.11	–4.73	–5.01	–4.80	–5.16
100°	–1.14	–1.61	–2.39	–2.81	–2.83	–2.90	–3.90	–4.35	–4.86	–5.36	–5.35	–5.56
105°	–1.19	–1.71	–2.48	–2.89	–2.98	–3.01	–4.04	–4.57	–5.08	–5.52	–5.64	–6.02
110°	–1.24	–1.78	–2.60	–2.99	–3.07	–3.12	–4.14	–4.76	–5.30	–5.79	–5.91	–6.28
115°	–1.32	–1.84	–2.70	–3.09	–3.18	–3.19	–4.22	–4.90	–5.53	–6.04	–6.13	–6.56
120°	–1.35	–1.91	–2.76	–3.17	–3.26	–3.26	–4.31	–5.09	–5.73	–6.28	–6.40	–6.67
125°	–1.36	–1.93	–2.83	–3.24	–3.30	–3.31	–4.40	–5.26	–5.96	–6.57	–6.59	–6.86
130°	–1.38	–1.93	–2.83	–3.27	–3.37	–3.35	–4.36	–5.30	–6.08	–6.71	–6.77	–7.14
135°	–1.37	–1.94	–2.83	–3.24	–3.35	–3.39	–4.27	–5.20	–5.99	–6.61	–6.68	–7.10
140°	–1.32	–1.90	–2.81	–3.24	–3.36	–3.44	–4.26	–5.10	–5.77	–6.38	–6.41	–6.89
145°	–1.25	–1.81	–2.72	–3.15	–3.34	–3.50	–4.32	–5.14	–5.72	–6.16	–6.17	–6.68
150°	–1.14	–1.69	–2.58	–2.99	–3.20	–3.43	–4.30	–5.13	–5.72	–6.13	–6.10	–6.66
155°	–1.04	–1.55	–2.42	–2.80	–2.99	–3.25	–4.13	–4.95	–5.49	–5.92	–5.98	–6.60
160°	–0.94	–1.42	–2.27	–2.60	–2.75	–3.01	–3.85	–4.61	–5.13	–5.53	–5.60	–6.30
165°	–0.85	–1.30	–2.13	–2.42	–2.56	–2.76	–3.52	–4.27	–4.73	–5.10	–5.17	–5.84
170°	–0.78	–1.21	–2.02	–2.28	–2.41	–2.54	–3.26	–3.97	–4.38	–4.73	–4.82	–5.42
175°	–0.74	–1.15	–1.94	–2.19	–2.32	–2.42	–3.09	–3.77	–4.16	–4.49	–4.56	–5.17
180°	–0.72	–1.12	–1.93	–2.17	–2.29	–2.38	–3.05	–3.71	–4.09	–4.42	–4.47	–5.09
185°	–0.74	–1.15	–1.95	–2.21	–2.33	–2.44	–3.11	–3.79	–4.17	–4.50	–4.56	–5.20
190°	–0.78	–1.20	–2.02	–2.32	–2.44	–2.56	–3.27	–3.98	–4.38	–4.71	–4.82	–5.45
195°	–0.85	–1.29	–2.15	–2.46	–2.59	–2.74	–3.48	–4.23	–4.69	–5.06	–5.18	–5.87
200°	–0.94	–1.41	–2.29	–2.63	–2.77	–2.96	–3.77	–4.57	–5.12	–5.55	–5.67	–6.34
205°	–1.04	–1.54	–2.46	–2.81	–2.99	–3.20	–4.07	–4.94	–5.53	–5.97	–6.02	–6.57
210°	–1.15	–1.68	–2.62	–3.00	–3.18	–3.35	–4.29	–5.19	–5.79	–6.18	–6.14	–6.65
215°	–1.25	–1.81	–2.76	–3.16	–3.30	–3.45	–4.35	–5.23	–5.81	–6.23	–6.24	–6.76
220°	–1.33	–1.90	–2.84	–3.25	–3.34	–3.47	–4.32	–5.18	–5.85	–6.46	–6.51	–6.97
225°	–1.39	–1.94	–2.85	–3.25	–3.37	–3.44	–4.30	–5.24	–6.07	–6.69	–6.68	–7.01
230°	–1.39	–1.94	–2.86	–3.28	–3.37	–3.38	–4.36	–5.29	–6.09	–6.72	–6.70	–7.11
235°	–1.37	–1.95	–2.86	–3.25	–3.29	–3.33	–4.35	–5.26	–5.99	–6.62	–6.66	–7.03
240°	–1.36	–1.92	–2.77	–3.17	–3.24	–3.28	–4.35	–5.12	–5.81	–6.46	–6.51	–6.72
245°	–1.33	–1.82	–2.69	–3.09	–3.18	–3.28	–4.26	–4.98	–5.64	–6.14	–6.09	–6.55
250°	–1.24	–1.77	–2.61	–3.00	–3.14	–3.23	–4.14	–4.80	–5.37	–5.85	–5.99	–6.52
255°	–1.17	–1.71	–2.51	–2.94	–3.06	–3.07	–4.01	–4.65	–5.22	–5.70	–5.83	–6.19
260°	–1.13	–1.62	–2.44	–2.86	–2.87	–2.93	–3.95	–4.49	–5.03	–5.51	–5.39	–5.61
265°	–1.06	–1.56	–2.37	–2.70	–2.64	–2.87	–3.73	–4.22	–4.79	–5.09	–4.87	–5.34
270°	–1.00	–1.50	–2.28	–2.48	–2.48	–2.85	–3.38	–3.89	–4.50	–4.59	–4.65	–5.22
275°	–0.95	–1.41	–2.14	–2.26	–2.44	–2.60	–2.98	–3.69	–4.02	–4.29	–4.65	–4.86
280°	–0.87	–1.32	–1.98	–2.09	–2.37	–2.17	–2.82	–3.31	–3.64	–4.26	–4.38	–4.42
285°	–0.77	–1.23	–1.82	–2.01	–2.16	–1.80	–2.55	–2.89	–3.54	–4.13	–3.85	–4.17
290°	–0.68	–1.14	–1.69	–1.89	–1.76	–1.60	–2.19	–2.72	–3.49	–3.69	–3.44	–3.89
295°	–0.60	–1.05	–1.57	–1.73	–1.40	–1.43	–1.98	–2.66	–3.20	–3.28	–3.15	–3.49
300°	–0.53	–0.96	–1.44	–1.44	–1.19	–1.19	–1.91	–2.50	–2.81	–3.04	–2.73	–3.10
305°	–0.46	–0.88	–1.30	–1.13	–1.02	–0.91	–1.83	–2.14	–2.64	–2.65	–2.28	–2.66
310°	–0.42	–0.79	–1.11	–0.90	–0.89	–0.79	–1.57	–1.91	–2.41	–2.16	–1.99	–2.16
315°	–0.36	–0.69	–0.89	–0.72	–0.68	–0.70	–1.26	–1.78	–2.09	–1.71	–1.59	–1.72
320°	–0.32	–0.57	–0.66	–0.57	–0.46	–0.69	–1.08	–1.62	–1.59	–1.35	–1.20	–1.46
325°	–0.27	–0.46	–0.50	–0.48	–0.30	–0.62	–0.96	–1.38	–1.20	–1.03	–0.84	–1.15
330°	–0.22	–0.34	–0.35	–0.39	–0.18	–0.45	–0.86	–1.00	–0.89	–0.72	–0.65	–0.86
335°	–0.16	–0.23	–0.24	–0.28	–0.08	–0.30	–0.74	–0.66	–0.62	–0.41	–0.49	–0.58
340°	–0.12	–0.13	–0.14	–0.17	–0.05	–0.17	–0.55	–0.39	–0.43	–0.23	–0.32	–0.40
345°	–0.09	–0.06	–0.09	–0.09	–0.02	–0.08	–0.35	–0.20	–0.25	–0.12	–0.17	–0.26
350°	–0.05	–0.01	–0.05	–0.03	–0.01	–0.01	–0.19	–0.06	–0.13	–0.06	–0.05	–0.15
355°	–0.04	0.02	–0.03	0.01	–0.01	0.03	–0.09	0.02	–0.04	–0.03	0.02	–0.07

Table A.33 *Directional response for Windscreen UA-1650, Microphone Type 4189 and Microphone Preamplifier ZC-0032 with the microphone preamplifier connected to a microphone extension cable, 11200 Hz – 20000 Hz*

	Frequency										
Angle	11200 Hz	11800 Hz	**12500 Hz**	13200 Hz	14000 Hz	15000 Hz	**16000 Hz**	17000 Hz	18000 Hz	19000 Hz	**20000 Hz**
0°	–0.01	–0.01	–0.01	–0.01	–0.01	–0.01	–0.01	–0.01	–0.01	–0.01	–0.02
5°	–0.04	–0.03	–0.02	–0.04	–0.06	–0.02	–0.02	–0.04	–0.06	–0.05	–0.05
10°	–0.17	–0.13	–0.07	–0.15	–0.23	–0.08	–0.08	–0.15	–0.23	–0.21	–0.24
15°	–0.37	–0.28	–0.18	–0.33	–0.46	–0.23	–0.21	–0.37	–0.55	–0.47	–0.56
20°	–0.64	–0.46	–0.40	–0.57	–0.74	–0.52	–0.47	–0.67	–0.98	–0.86	–0.99
25°	–0.94	–0.68	–0.72	–0.80	–1.06	–0.96	–0.92	–0.96	–1.43	–1.32	–1.47
30°	–1.22	–1.06	–1.13	–1.02	–1.37	–1.64	–1.31	–1.29	–1.81	–1.84	–1.97
35°	–1.41	–1.54	–1.48	–1.38	–1.82	–2.18	–1.76	–1.73	–2.28	–2.57	–2.68
40°	–1.75	–2.04	–1.81	–1.92	–2.16	–2.55	–2.41	–2.43	–2.78	–3.06	–3.30
45°	–2.16	–2.33	–2.30	–2.49	–2.47	–3.04	–3.10	–3.05	–3.18	–3.40	–4.01
50°	–2.47	–2.72	–2.94	–2.85	–3.03	–3.60	–3.43	–3.91	–4.02	–4.21	–4.88
55°	–2.62	–3.25	–3.34	–3.43	–3.66	–4.01	–4.10	–4.80	–4.94	–4.91	–5.68
60°	–3.17	–3.59	–3.86	–4.12	–4.11	–4.74	–4.81	–5.31	–5.93	–6.18	–6.71
65°	–3.88	–3.98	–4.61	–4.53	–5.00	–5.15	–5.53	–6.21	–6.57	–7.17	–7.61
70°	–4.19	–4.63	–5.15	–5.26	–5.63	–5.75	–6.29	–6.63	–7.51	–8.11	–8.70
75°	–4.61	–4.92	–5.78	–5.92	–6.34	–6.54	–6.85	–7.42	–8.36	–8.80	–9.75
80°	–5.05	–5.25	–6.04	–6.50	–7.05	–7.41	–7.65	–8.29	–9.15	–9.65	–10.65
85°	–5.12	–5.84	–6.13	–7.05	–7.44	–8.49	–8.43	–9.49	–9.59	–10.56	–11.28
90°	–5.48	–6.09	–6.82	–7.11	–8.23	–8.55	–9.65	–9.90	–10.77	–10.99	–12.04
95°	–5.82	–6.31	–7.41	–7.87	–8.31	–9.20	–9.45	–10.61	–11.29	–12.27	–13.77
100°	–6.10	–6.61	–7.49	–8.58	–9.04	–9.35	–9.77	–10.54	–11.87	–13.36	–14.75
105°	–6.51	–7.11	–7.82	–8.47	–9.41	–10.03	–10.29	–11.01	–12.26	–13.71	–14.66
110°	–6.75	–7.34	–8.19	–8.95	–9.61	–10.05	–10.77	–11.99	–13.06	–14.04	–14.32
115°	–7.04	–7.50	–8.21	–9.06	–10.29	–10.64	–11.04	–12.11	–13.42	–14.67	–15.19
120°	–7.15	–7.72	–8.58	–9.31	–10.33	–10.74	–11.63	–12.57	–13.96	–14.86	–15.57
125°	–7.22	–7.75	–8.71	–9.66	–10.67	–10.81	–11.26	–12.54	–14.49	–15.36	–16.07
130°	–7.56	–8.09	–8.94	–9.86	–10.55	–10.87	–11.57	–12.78	–14.03	–15.17	–15.83
135°	–7.66	–8.51	–9.78	–10.68	–10.78	–10.84	–11.66	–13.62	–13.90	–14.93	–15.80
140°	–7.47	–8.37	–9.76	–10.72	–11.18	–11.75	–12.79	–14.55	–14.21	–14.93	–16.72
145°	–7.32	–8.17	–9.19	–9.81	–10.58	–11.61	–13.17	–14.54	–14.55	–16.04	–18.70
150°	–7.42	–8.28	–8.94	–9.25	–9.94	–11.04	–12.50	–13.24	–13.85	–15.60	–18.36
155°	–7.37	–8.38	–9.04	–9.31	–9.96	–11.20	–12.24	–12.57	–13.33	–15.49	–16.66
160°	–7.08	–8.00	–8.61	–9.02	–10.00	–11.33	–12.27	–12.50	–13.55	–16.17	–16.34
165°	–6.61	–7.40	–7.91	–8.37	–9.45	–10.91	–11.53	–11.77	–13.07	–15.81	–16.08
170°	–6.11	–6.84	–7.21	–7.64	–8.74	–10.15	–10.65	–10.83	–12.16	–14.71	–15.10
175°	–5.82	–6.48	–6.87	–7.24	–8.29	–9.53	–10.04	–10.19	–11.38	–13.79	–14.12
180°	–5.75	–6.40	–6.78	–7.14	–8.13	–9.36	–9.85	–10.06	–11.19	–13.55	–13.76
185°	–5.90	–6.59	–6.97	–7.29	–8.28	–9.55	–10.19	–10.44	–11.53	–13.87	–14.20
190°	–6.20	–6.95	–7.26	–7.57	–8.60	–10.11	–10.82	–11.08	–12.23	–14.54	–15.15
195°	–6.69	–7.45	–7.86	–8.24	–9.32	–11.00	–11.88	–12.04	–12.96	–15.54	–16.50
200°	–7.10	–7.94	–8.51	–8.92	–9.97	–11.52	–12.58	–12.65	–13.52	–16.06	–17.23
205°	–7.28	–8.32	–9.09	–9.44	–10.15	–11.51	–12.80	–13.12	–13.54	–15.57	–17.87
210°	–7.41	–8.44	–9.21	–9.54	–10.26	–11.49	–13.15	–13.84	–14.07	–15.64	–19.21
215°	–7.40	–8.43	–9.48	–10.21	–10.87	–11.76	–13.36	–15.03	–14.58	–15.30	–19.25
220°	–7.49	–8.50	–9.84	–10.89	–11.19	–11.71	–13.18	–15.32	–14.51	–14.99	–18.05
225°	–7.58	–8.54	–9.79	–10.93	–11.29	–11.33	–12.23	–14.19	–14.07	–14.71	–16.52
230°	–7.64	–8.28	–9.24	–10.37	–10.99	–10.98	–11.82	–13.14	–14.07	–15.18	–17.04
235°	–7.38	–7.94	–8.84	–9.82	–10.75	–11.13	–11.92	–13.09	–14.60	–15.11	–17.45
240°	–7.09	–7.78	–8.58	–9.64	–10.85	–11.10	–12.06	–13.10	–13.93	–14.45	–16.74
245°	–7.10	–7.80	–8.53	–9.53	–10.43	–10.70	–11.56	–12.78	–13.68	–14.32	–16.01
250°	–6.95	–7.58	–8.40	–9.18	–9.92	–10.33	–11.12	–12.67	–13.36	–13.93	–15.35
255°	–6.52	–7.25	–8.09	–8.96	–9.76	–10.11	–10.63	–11.72	–12.85	–13.72	–15.55
260°	–6.20	–6.84	–7.75	–8.92	–9.34	–9.68	–10.26	–11.06	–12.13	–13.34	–15.94
265°	–5.93	–6.42	–7.63	–8.29	–8.81	–9.51	–9.82	–11.07	–11.69	–12.30	–14.81
270°	–5.54	–6.27	–7.14	–7.55	–8.59	–8.80	–10.04	–10.55	–11.18	–11.06	–13.09
275°	–5.29	–6.05	–6.43	–7.38	–7.78	–8.67	–8.95	–10.04	–10.10	–10.75	–12.09
280°	–5.15	–5.47	–6.26	–6.83	–7.40	–7.77	–8.00	–8.89	–9.61	–9.82	–11.59
285°	–4.73	–5.12	–5.98	–6.30	–6.75	–6.76	–7.36	–7.85	–8.76	–9.10	–10.53
290°	–4.32	–4.76	–5.45	–5.66	–5.91	–6.19	–6.64	–7.14	–7.97	–8.29	–9.46
295°	–3.92	–4.19	–4.93	–4.76	–5.43	–5.36	–6.06	–6.65	–6.93	–7.52	–8.45
300°	–3.31	–3.83	–4.06	–4.44	–4.35	–5.11	–5.18	–5.83	–6.33	–6.51	–7.33
305°	–2.83	–3.40	–3.53	–3.73	–3.86	–4.36	–4.52	–5.16	–5.32	–5.20	–6.33
310°	–2.57	–2.88	–3.19	–2.99	–3.43	–3.85	–3.79	–4.36	–4.37	–4.44	–5.38
315°	–2.19	–2.52	–2.48	–2.70	–2.73	–3.42	–3.39	–3.41	–3.52	–3.67	–4.58
320°	–1.84	–2.22	–1.93	–2.20	–2.34	–2.84	–2.78	–2.71	–3.06	–3.27	–3.73
325°	–1.56	–1.63	–1.64	–1.55	–2.07	–2.38	–2.08	–2.01	–2.53	–2.84	–3.11
330°	–1.36	–1.12	–1.34	–1.12	–1.62	–1.86	–1.52	–1.56	–2.05	–2.07	–2.35
335°	–1.03	–0.74	–0.87	–0.90	–1.22	–1.19	–1.08	–1.15	–1.65	–1.48	–1.73
340°	–0.68	–0.53	–0.48	–0.69	–0.84	–0.71	–0.60	–0.77	–1.16	–1.01	–1.21
345°	–0.38	–0.36	–0.20	–0.44	–0.53	–0.36	–0.32	–0.41	–0.65	–0.59	–0.73
350°	–0.15	–0.19	–0.06	–0.21	–0.27	–0.15	–0.17	–0.18	–0.26	–0.27	–0.34
355°	–0.01	–0.07	0.00	–0.06	–0.06	–0.04	–0.07	–0.04	–0.04	–0.06	–0.08

Table A.34 *Sensitivity variations for Windscreen UA-1650, Microphone Type 4189 and Microphone Preamplifier ZC-0032, with the microphone preamplifier connected to a microphone extension cable, at sound incidence angles within ±θ° from the reference direction*

Nominal Frequency	Exact Frequency	Max Variation ± 30° dB	Max Variation ± 90° dB	Max Variation ± 150° dB
500 Hz	501.187 Hz	0.01	0.09	0.11
630 Hz	630.957 Hz	0.02	0.11	0.14
800 Hz	794.328 Hz	0.01	0.15	0.19
1000 Hz	1000 Hz	0.06	0.24	0.27
1250 Hz	1258.93 Hz	0.06	0.36	0.40
1600 Hz	1584.89 Hz	0.09	0.52	0.61
2000 Hz	1995.26 Hz	0.07	0.67	0.81
2240 Hz	2238.72 Hz	0.08	0.66	0.85
2500 Hz	2511.89 Hz	0.13	0.69	0.95
2800 Hz	2818.38 Hz	0.16	0.74	1.06
3150 Hz	3162.28 Hz	0.11	0.81	1.14
3550 Hz	3548.13 Hz	0.11	0.86	1.21
4000 Hz	3981.07 Hz	0.23	1.01	1.40
4500 Hz	4466.84 Hz	0.37	1.52	1.97
5000 Hz	5011.87 Hz	0.39	2.29	2.88
5600 Hz	5623.41 Hz	0.40	2.52	3.30
6300 Hz	6309.57 Hz	0.19	2.50	3.39
7100 Hz	7079.46 Hz	0.48	2.88	3.52
8000 Hz	7943.28 Hz	0.87	3.40	4.41
8500 Hz	8413.95 Hz	1.02	3.91	5.32
9000 Hz	8912.51 Hz	0.92	4.52	6.11
9500 Hz	9440.61 Hz	0.73	4.61	6.74
10000 Hz	10000 Hz	0.68	4.68	6.80
10600 Hz	10592.5 Hz	0.87	5.24	7.16
11200 Hz	11220.2 Hz	1.38	5.55	7.68
11800 Hz	11885.0 Hz	1.13	6.28	8.55
12500 Hz	12589.3 Hz	1.35	7.15	9.86
13200 Hz	13335.2 Hz	1.14	7.56	10.95
14000 Hz	14125.4 Hz	1.63	8.61	11.30
15000 Hz	14962.4 Hz	1.87	8.81	11.77
16000 Hz	15848.9 Hz	1.53	10.05	13.37
17000 Hz	16788.0 Hz	1.57	10.56	15.33
18000 Hz	17782.8 Hz	2.06	11.19	14.61
19000 Hz	18836.5 Hz	2.08	11.07	16.05
20000 Hz	19952.6 Hz	2.36	13.10	19.27

Table A.35 *Directional response for Windscreen UA-1650, Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer with the microphone preamplifier mounted directly on the analyzer, measured in a plane parallel to the display and along the microphone's axis, 500 Hz – 3550 Hz*

	Frequency											
Angle	**500 Hz**	**630 Hz**	**800 Hz**	**1000 Hz**	**1250 Hz**	**1600 Hz**	**2000 Hz**	2240 Hz	**2500 Hz**	2800 Hz	**3150 Hz**	3550 Hz
0°	0.01	0.02	–0.01	–0.01	0.00	0.00	0.00	0.00	–0.02	–0.02	–0.01	–0.01
5°	0.00	0.02	0.00	–0.01	0.00	0.00	–0.01	0.01	–0.03	–0.02	–0.02	–0.02
10°	–0.01	0.01	–0.02	–0.02	–0.01	–0.01	–0.04	0.02	–0.07	0.00	–0.06	–0.03
15°	0.00	0.00	–0.02	–0.01	–0.02	–0.03	–0.09	0.04	–0.13	0.03	–0.13	–0.04
20°	0.00	0.02	–0.01	–0.01	–0.03	–0.05	–0.16	0.08	–0.20	0.06	–0.22	0.01
25°	0.01	0.04	–0.01	–0.01	–0.04	–0.10	–0.23	0.09	–0.25	0.06	–0.32	0.08
30°	0.00	0.03	0.00	–0.03	–0.03	–0.16	–0.30	0.06	–0.26	0.01	–0.39	0.16
35°	0.01	0.04	0.00	–0.04	–0.01	–0.26	–0.34	–0.02	–0.22	–0.11	–0.40	0.16
40°	0.01	0.07	0.02	–0.06	0.00	–0.38	–0.34	–0.16	–0.13	–0.28	–0.35	0.06
45°	–0.01	0.08	0.05	–0.08	0.03	–0.52	–0.29	–0.33	–0.07	–0.43	–0.32	–0.10
50°	–0.01	0.11	0.09	–0.11	0.07	–0.65	–0.22	–0.45	–0.11	–0.47	–0.39	–0.19
55°	–0.06	0.12	0.13	–0.13	0.08	–0.73	–0.21	–0.47	–0.28	–0.40	–0.56	–0.15
60°	–0.07	0.11	0.18	–0.14	0.08	–0.74	–0.30	–0.38	–0.53	–0.34	–0.71	–0.16
65°	–0.09	0.10	0.22	–0.13	0.05	–0.68	–0.49	–0.30	–0.66	–0.46	–0.70	–0.32
70°	–0.13	0.09	0.26	–0.09	0.01	–0.58	–0.74	–0.36	–0.58	–0.73	–0.66	–0.47
75°	–0.16	0.05	0.27	–0.03	–0.04	–0.49	–0.92	–0.60	–0.45	–0.90	–0.81	–0.48
80°	–0.19	0.00	0.27	0.05	–0.06	–0.46	–0.91	–0.91	–0.51	–0.82	–1.11	–0.49
85°	–0.24	–0.04	0.24	0.11	–0.05	–0.49	–0.74	–1.06	–0.84	–0.72	–1.20	–0.75
90°	–0.25	–0.08	0.19	0.17	0.01	–0.57	–0.55	–0.91	–1.15	–0.90	–1.07	–1.01
95°	–0.30	–0.15	0.12	0.19	0.11	–0.62	–0.47	–0.63	–1.09	–1.28	–1.13	–0.94
100°	–0.31	–0.18	0.04	0.16	0.21	–0.61	–0.53	–0.46	–0.72	–1.35	–1.49	–0.90
105°	–0.35	–0.25	–0.05	0.09	0.28	–0.51	–0.66	–0.51	–0.44	–0.94	–1.59	–1.21
110°	–0.38	–0.29	–0.13	–0.02	0.28	–0.38	–0.70	–0.69	–0.46	–0.55	–1.14	–1.32
115°	–0.38	–0.35	–0.20	–0.17	0.20	–0.28	–0.59	–0.77	–0.68	–0.56	–0.70	–0.79
120°	–0.40	–0.38	–0.26	–0.31	0.06	–0.29	–0.41	–0.64	–0.79	–0.83	–0.72	–0.31
125°	–0.38	–0.37	–0.29	–0.44	–0.13	–0.42	–0.31	–0.42	–0.65	–0.94	–1.05	–0.44
130°	–0.38	–0.39	–0.29	–0.52	–0.32	–0.64	–0.39	–0.32	–0.44	–0.73	–1.14	–0.82
135°	–0.36	–0.39	–0.27	–0.56	–0.47	–0.88	–0.63	–0.46	–0.41	–0.52	–0.89	–0.81
140°	–0.32	–0.35	–0.24	–0.54	–0.55	–1.07	–0.96	–0.81	–0.66	–0.61	–0.76	–0.52
145°	–0.32	–0.33	–0.19	–0.48	–0.56	–1.14	–1.24	–1.19	–1.07	–1.02	–1.02	–0.55
150°	–0.26	–0.30	–0.14	–0.40	–0.49	–1.10	–1.34	–1.42	–1.42	–1.50	–1.57	–1.04
155°	–0.27	–0.28	–0.09	–0.29	–0.39	–0.97	–1.26	–1.40	–1.51	–1.73	–1.98	–1.64
160°	–0.23	–0.25	–0.04	–0.20	–0.28	–0.80	–1.07	–1.18	–1.33	–1.58	–1.96	–1.83
165°	–0.22	–0.22	0.00	–0.12	–0.17	–0.64	–0.85	–0.90	–1.02	–1.22	–1.58	–1.49
170°	–0.22	–0.22	0.02	–0.06	–0.09	–0.52	–0.65	–0.65	–0.73	–0.85	–1.14	–0.97
175°	–0.21	–0.20	0.05	–0.02	–0.03	–0.44	–0.53	–0.49	–0.53	–0.60	–0.82	–0.57
180°	–0.21	–0.21	0.05	–0.01	–0.02	–0.42	–0.49	–0.44	–0.46	–0.52	–0.71	–0.42
185°	–0.19	–0.19	0.04	–0.02	–0.04	–0.44	–0.53	–0.49	–0.52	–0.60	–0.81	–0.56
190°	–0.20	–0.22	0.03	–0.05	–0.09	–0.52	–0.66	–0.64	–0.72	–0.84	–1.12	–0.94
195°	–0.22	–0.24	0.00	–0.10	–0.17	–0.64	–0.85	–0.88	–1.01	–1.20	–1.57	–1.47
200°	–0.24	–0.26	–0.03	–0.18	–0.28	–0.80	–1.08	–1.16	–1.33	–1.58	–1.97	–1.84
205°	–0.28	–0.29	–0.08	–0.27	–0.40	–0.96	–1.27	–1.37	–1.54	–1.75	–2.02	–1.69
210°	–0.28	–0.30	–0.12	–0.37	–0.51	–1.08	–1.35	–1.41	–1.47	–1.54	–1.60	–1.07
215°	–0.32	–0.36	–0.18	–0.45	–0.58	–1.13	–1.24	–1.20	–1.13	–1.05	–1.01	–0.54
220°	–0.34	–0.38	–0.22	–0.52	–0.58	–1.05	–0.96	–0.83	–0.68	–0.60	–0.70	–0.48
225°	–0.36	–0.40	–0.25	–0.54	–0.51	–0.86	–0.62	–0.48	–0.38	–0.46	–0.81	–0.79
230°	–0.38	–0.40	–0.27	–0.52	–0.35	–0.63	–0.37	–0.32	–0.37	–0.65	–1.10	–0.87
235°	–0.39	–0.42	–0.26	–0.45	–0.15	–0.41	–0.28	–0.38	–0.58	–0.89	–1.09	–0.50
240°	–0.39	–0.39	–0.24	–0.33	0.06	–0.28	–0.37	–0.58	–0.76	–0.85	–0.78	–0.31
245°	–0.40	–0.34	–0.19	–0.19	0.22	–0.27	–0.55	–0.73	–0.70	–0.60	–0.70	–0.73
250°	–0.37	–0.29	–0.12	–0.04	0.32	–0.36	–0.67	–0.68	–0.50	–0.55	–1.09	–1.28
255°	–0.33	–0.26	–0.04	0.09	0.33	–0.50	–0.64	–0.54	–0.45	–0.88	–1.55	–1.20
260°	–0.29	–0.19	0.05	0.17	0.26	–0.60	–0.53	–0.48	–0.68	–1.29	–1.49	–0.86
265°	–0.28	–0.15	0.13	0.21	0.16	–0.63	–0.46	–0.62	–1.03	–1.28	–1.13	–0.91
270°	–0.23	–0.09	0.19	0.20	0.06	–0.57	–0.54	–0.87	–1.13	–0.91	–1.03	–1.01
275°	–0.22	–0.04	0.25	0.16	–0.02	–0.49	–0.72	–1.02	–0.86	–0.69	–1.16	–0.75
280°	–0.16	0.00	0.27	0.09	–0.05	–0.44	–0.89	–0.90	–0.53	–0.76	–1.11	–0.46
285°	–0.14	0.02	0.27	0.02	–0.04	–0.46	–0.89	–0.62	–0.42	–0.84	–0.82	–0.44
290°	–0.13	0.05	0.27	–0.04	0.00	–0.53	–0.72	–0.39	–0.51	–0.70	–0.63	–0.46
295°	–0.07	0.10	0.23	–0.08	0.05	–0.63	–0.48	–0.31	–0.58	–0.45	–0.64	–0.30
300°	–0.06	0.09	0.20	–0.10	0.07	–0.70	–0.29	–0.37	–0.47	–0.32	–0.67	–0.11
305°	–0.03	0.09	0.15	–0.10	0.08	–0.70	–0.21	–0.43	–0.26	–0.35	–0.56	–0.10
310°	–0.03	0.09	0.11	–0.08	0.06	–0.62	–0.23	–0.41	–0.10	–0.40	–0.37	–0.17
315°	–0.01	0.07	0.07	–0.06	0.04	–0.50	–0.28	–0.28	–0.05	–0.37	–0.28	–0.11
320°	0.02	0.07	0.05	–0.04	0.01	–0.36	–0.33	–0.13	–0.10	–0.24	–0.29	0.06
325°	0.01	0.04	0.03	–0.02	0.00	–0.24	–0.33	0.00	–0.18	–0.08	–0.34	0.19
330°	0.01	0.04	0.01	–0.01	–0.02	–0.14	–0.29	0.08	–0.22	0.04	–0.36	0.21
335°	0.02	0.01	0.01	0.01	–0.02	–0.08	–0.21	0.10	–0.20	0.10	–0.30	0.15
340°	0.01	0.02	0.01	0.01	–0.02	–0.03	–0.14	0.09	–0.15	0.10	–0.21	0.07
345°	0.02	0.02	0.00	0.00	–0.01	–0.01	–0.08	0.06	–0.09	0.08	–0.11	0.03
350°	–0.01	0.00	0.01	0.00	–0.01	0.00	–0.03	0.04	–0.03	0.06	–0.04	0.01
355°	0.02	0.00	0.01	0.01	0.00	0.00	0.00	0.02	0.00	0.03	0.00	0.02

Table A.36 *Directional response for Windscreen UA-1650, Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer with the microphone preamplifier mounted directly on the analyzer, measured in a plane parallel to the display and along the microphone's axis, 4000 Hz – 10600 Hz*

	Frequency											
Angle	**4000 Hz**	4500 Hz	**5000 Hz**	5600 Hz	**6300 Hz**	7100 Hz	**8000 Hz**	8500 Hz	9000 Hz	9500 Hz	**10000 Hz**	10600 Hz
0°	–0.01	–0.01	–0.01	–0.02	–0.01	–0.02	–0.02	–0.01	–0.01	–0.01	–0.01	–0.01
5°	0.00	0.00	0.00	–0.03	–0.04	–0.02	–0.05	–0.04	–0.04	–0.04	–0.04	–0.04
10°	0.03	0.02	0.02	–0.07	–0.11	–0.04	–0.17	–0.16	–0.16	–0.14	–0.16	–0.17
15°	0.09	0.05	0.04	–0.13	–0.22	–0.02	–0.36	–0.33	–0.32	–0.25	–0.33	–0.34
20°	0.17	0.04	0.01	–0.19	–0.37	–0.01	–0.54	–0.48	–0.44	–0.34	–0.48	–0.39
25°	0.19	–0.08	–0.09	–0.25	–0.47	–0.12	–0.61	–0.61	–0.55	–0.50	–0.55	–0.38
30°	0.11	–0.30	–0.29	–0.32	–0.41	–0.28	–0.73	–0.91	–0.87	–0.92	–0.68	–0.60
35°	–0.05	–0.52	–0.45	–0.48	–0.40	–0.22	–1.03	–1.26	–1.22	–1.25	–0.93	–0.96
40°	–0.20	–0.59	–0.47	–0.70	–0.71	–0.21	–1.15	–1.41	–1.49	–1.50	–1.33	–1.14
45°	–0.22	–0.55	–0.48	–0.81	–1.09	–0.72	–1.29	–1.78	–1.87	–1.89	–1.83	–1.47
50°	–0.21	–0.64	–0.67	–0.93	–1.18	–0.74	–1.50	–1.89	–2.16	–2.30	–2.15	–1.98
55°	–0.32	–0.79	–0.87	–1.24	–1.44	–0.87	–1.44	–2.18	–2.44	–2.66	–2.53	–2.37
60°	–0.50	–0.88	–0.92	–1.40	–1.57	–1.37	–1.89	–2.16	–2.73	–2.97	–3.04	–2.79
65°	–0.52	–0.98	–1.04	–1.54	–1.71	–1.43	–1.97	–2.54	–2.87	–3.33	–3.31	–3.25
70°	–0.49	–1.09	–1.28	–1.69	–2.02	–1.80	–2.42	–2.80	–3.18	–3.56	–3.58	–3.55
75°	–0.61	–1.15	–1.48	–1.65	–2.12	–1.86	–2.54	–3.16	–3.60	–3.85	–4.00	–3.78
80°	–0.75	–1.23	–1.45	–2.04	–2.27	–2.08	–2.89	–3.35	–4.02	–4.37	–4.28	–4.28
85°	–0.77	–1.30	–1.55	–2.30	–2.36	–2.34	–3.03	–3.64	–4.11	–4.83	–4.85	–4.63
90°	–0.98	–1.47	–1.67	–2.29	–2.92	–2.41	–3.32	–3.70	–4.41	–4.79	–5.28	–5.09
95°	–1.36	–1.69	–1.73	–2.37	–2.66	–2.72	–3.56	–4.02	–4.49	–5.17	–5.23	–5.28
100°	–1.38	–2.01	–2.19	–2.38	–2.92	–2.70	–3.83	–4.36	–4.81	–5.37	–5.46	–5.46
105°	–1.29	–2.23	–2.55	–2.90	–2.75	–2.77	–3.89	–4.47	–5.21	–5.65	–5.72	–5.90
110°	–1.51	–2.08	–2.76	–3.53	–3.64	–2.67	–3.86	–4.17	–5.03	–5.75	–6.27	–6.07
115°	–1.50	–2.18	–2.71	–3.64	–4.06	–3.42	–4.00	–4.82	–5.10	–5.59	–5.96	–5.88
120°	–0.89	–2.06	–2.59	–3.50	–4.26	–3.97	–5.20	–5.29	–5.79	–6.40	–6.18	–5.81
125°	–0.49	–1.31	–2.24	–3.09	–3.85	–4.09	–5.28	–6.22	–7.26	–7.57	–7.36	–7.05
130°	–0.76	–1.09	–1.55	–2.67	–3.11	–3.21	–5.19	–6.25	–6.97	–7.83	–8.39	–8.37
135°	–1.14	–1.63	–1.56	–2.25	–2.80	–2.43	–3.64	–4.69	–6.15	–7.33	–7.68	–7.65
140°	–0.98	–1.86	–2.20	–2.51	–2.64	–2.28	–3.28	–4.04	–4.62	–5.30	–5.72	–6.08
145°	–0.74	–1.49	–2.20	–2.98	–3.35	–2.68	–3.40	–4.01	–4.73	–5.24	–5.37	–5.24
150°	–1.02	–1.48	–1.87	–2.72	–3.55	–3.36	–4.29	–4.87	–5.25	–5.46	–5.44	–5.56
155°	–1.69	–2.13	–2.25	–2.72	–3.24	–3.16	–4.28	–5.13	–5.94	–6.51	–6.58	–6.42
160°	–2.12	–2.77	–3.05	–3.50	–3.74	–3.48	–4.20	–4.71	–5.33	–5.90	–6.18	–6.64
165°	–1.88	–2.64	–3.17	–4.01	–4.40	–4.39	–5.28	–5.78	–6.11	–6.38	–6.41	–6.42
170°	–1.31	–1.97	–2.46	–3.41	–3.93	–4.05	–5.31	–6.11	–6.66	–7.23	–7.63	–7.78
175°	–0.84	–1.38	–1.74	–2.53	–3.01	–2.95	–4.00	–4.71	–5.25	–5.89	–6.34	–6.76
180°	–0.66	–1.17	–1.46	–2.15	–2.63	–2.49	–3.37	–3.99	–4.45	–4.99	–5.34	–5.69
185°	–0.82	–1.37	–1.69	–2.40	–3.06	–3.01	–3.98	–4.69	–5.22	–5.84	–6.31	–6.72
190°	–1.27	–1.93	–2.36	–3.21	–4.13	–4.14	–5.29	–6.15	–6.73	–7.32	–7.84	–8.01
195°	–1.85	–2.59	–3.07	–3.97	–4.78	–4.45	–5.33	–5.88	–6.33	–6.60	–6.61	–6.62
200°	–2.12	–2.75	–3.05	–3.74	–4.01	–3.45	–4.25	–4.76	–5.42	–5.92	–6.20	–6.72
205°	–1.75	–2.15	–2.32	–2.98	–3.28	–3.09	–4.28	–5.16	–5.99	–6.59	–6.68	–6.52
210°	–1.08	–1.49	–1.90	–2.88	–3.48	–3.35	–4.32	–5.00	–5.39	–5.57	–5.53	–5.70
215°	–0.75	–1.46	–2.17	–3.19	–3.30	–2.71	–3.49	–4.07	–4.92	–5.43	–5.47	–5.31
220°	–0.95	–1.85	–2.25	–2.74	–2.61	–2.39	–3.32	–4.16	–4.67	–5.28	–5.61	–5.96
225°	–1.15	–1.67	–1.69	–2.27	–2.80	–2.35	–3.53	–4.57	–6.16	–7.28	–7.69	–7.59
230°	–0.81	–1.14	–1.62	–2.53	–3.07	–3.15	–5.18	–6.33	–7.00	–7.83	–8.43	–8.59
235°	–0.50	–1.33	–2.19	–2.97	–3.86	–4.19	–5.20	–6.23	–7.40	–7.72	–7.59	–7.15
240°	–0.84	–2.01	–2.51	–3.43	–4.46	–3.99	–5.25	–5.49	–5.94	–6.56	–6.27	–5.91
245°	–1.45	–2.13	–2.66	–3.75	–4.07	–3.50	–3.98	–4.87	–5.21	–5.66	–6.08	–5.91
250°	–1.50	–2.08	–2.77	–3.67	–3.66	–2.80	–3.82	–4.28	–5.01	–5.81	–6.29	–6.13
255°	–1.29	–2.21	–2.60	–3.08	–2.76	–2.73	–3.84	–4.47	–5.29	–5.68	–5.78	–6.03
260°	–1.37	–2.02	–2.23	–2.39	–3.09	–2.67	–3.78	–4.43	–4.90	–5.43	–5.50	–5.47
265°	–1.34	–1.72	–1.78	–2.31	–2.71	–2.72	–3.58	–4.12	–4.58	–5.15	–5.32	–5.28
270°	–0.98	–1.46	–1.65	–2.33	–2.86	–2.37	–3.23	–3.75	–4.50	–4.88	–5.36	–5.09
275°	–0.77	–1.29	–1.56	–2.35	–2.30	–2.35	–3.00	–3.72	–4.16	–4.91	–4.94	–4.68
280°	–0.74	–1.19	–1.50	–2.09	–2.36	–1.97	–2.90	–3.45	–4.12	–4.46	–4.36	–4.36
285°	–0.59	–1.11	–1.47	–1.62	–2.20	–1.86	–2.50	–3.27	–3.69	–3.90	–4.07	–3.82
290°	–0.45	–1.08	–1.27	–1.67	–1.94	–1.74	–2.40	–2.91	–3.26	–3.60	–3.65	–3.55
295°	–0.48	–0.96	–1.04	–1.59	–1.72	–1.38	–2.04	–2.62	–2.96	–3.41	–3.33	–3.27
300°	–0.48	–0.86	–0.91	–1.37	–1.53	–1.33	–1.87	–2.27	–2.81	–3.01	–3.10	–2.83
305°	–0.31	–0.76	–0.87	–1.18	–1.46	–0.83	–1.49	–2.23	–2.53	–2.69	–2.60	–2.40
310°	–0.18	–0.61	–0.68	–0.91	–1.09	–0.73	–1.49	–1.99	–2.22	–2.34	–2.17	–1.97
315°	–0.19	–0.53	–0.47	–0.86	–1.06	–0.68	–1.33	–1.84	–1.91	–1.95	–1.89	–1.56
320°	–0.17	–0.57	–0.41	–0.83	–0.85	–0.19	–1.18	–1.47	–1.54	–1.56	–1.35	–1.13
325°	–0.03	–0.52	–0.37	–0.58	–0.50	–0.19	–1.04	–1.29	–1.24	–1.28	–1.00	–1.00
330°	0.13	–0.32	–0.23	–0.30	–0.41	–0.22	–0.75	–0.93	–0.90	–0.93	–0.72	–0.59
335°	0.22	–0.10	–0.06	–0.12	–0.39	–0.07	–0.63	–0.63	–0.58	–0.53	–0.56	–0.38
340°	0.20	0.03	0.02	–0.03	–0.24	0.02	–0.53	–0.50	–0.45	–0.36	–0.48	–0.38
345°	0.14	0.07	0.04	0.01	–0.08	0.01	–0.33	–0.33	–0.32	–0.24	–0.32	–0.32
350°	0.08	0.05	0.03	0.02	0.01	0.00	–0.14	–0.16	–0.16	–0.11	–0.15	–0.16
355°	0.03	0.02	0.02	0.03	0.03	0.01	–0.03	–0.03	–0.04	–0.02	–0.03	–0.04

Table A.37 *Directional response for Windscreen UA-1650, Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer with the microphone preamplifier mounted directly on the analyzer, measured in a plane parallel to the display and along the microphone's axis, 11200 Hz – 20000 Hz*

	Frequency										
Angle	11200 Hz	11800 Hz	**12500 Hz**	13200 Hz	14000 Hz	15000 Hz	**16000 Hz**	17000 Hz	18000 Hz	19000 Hz	**20000 Hz**
0°	–0.01	–0.01	–0.01	–0.01	–0.01	–0.02	–0.02	–0.04	–0.02	0.00	0.00
5°	–0.05	–0.07	–0.05	–0.05	–0.08	–0.04	–0.06	–0.11	–0.09	–0.09	–0.10
10°	–0.19	–0.19	–0.15	–0.18	–0.24	–0.12	–0.15	–0.22	–0.25	–0.33	–0.32
15°	–0.43	–0.40	–0.22	–0.42	–0.34	–0.41	–0.33	–0.37	–0.52	–0.54	–0.62
20°	–0.73	–0.70	–0.30	–0.69	–0.51	–0.96	–0.57	–0.59	–0.85	–0.97	–0.92
25°	–0.96	–1.06	–0.61	–0.86	–0.88	–1.30	–1.07	–0.97	–1.29	–1.60	–1.52
30°	–1.22	–1.41	–1.01	–1.29	–1.10	–1.83	–1.65	–1.32	–1.65	–2.17	–2.13
35°	–1.54	–1.95	–1.51	–1.57	–1.63	–2.11	–2.38	–1.90	–2.00	–2.73	–2.78
40°	–1.69	–2.22	–2.03	–2.06	–2.02	–2.55	–2.81	–2.74	–2.55	–3.20	–3.48
45°	–2.11	–2.61	–2.61	–2.59	–2.47	–3.11	–3.28	–3.47	–3.21	–3.67	–4.15
50°	–2.40	–2.88	–2.89	–3.21	–3.06	–3.55	–3.74	–4.07	–4.14	–4.43	–4.83
55°	–2.76	–3.32	–3.34	–3.75	–3.67	–4.14	–4.49	–4.72	–5.03	–5.49	–5.76
60°	–3.39	–3.87	–3.97	–4.27	–4.22	–4.97	–5.26	–5.67	–5.77	–6.41	–6.90
65°	–3.79	–4.52	–4.58	–4.95	–4.67	–5.58	–6.14	–6.32	–6.75	–7.26	–7.80
70°	–4.23	–4.89	–5.13	–5.71	–5.43	–5.96	–6.81	–7.25	–7.46	–8.26	–8.87
75°	–4.55	–5.29	–5.60	–6.23	–6.41	–6.70	–7.13	–7.96	–8.44	–9.18	–9.97
80°	–4.68	–5.64	–6.06	–6.69	–6.98	–7.85	–8.14	–8.53	–9.19	–10.22	–10.87
85°	–5.19	–5.73	–6.36	–7.20	–7.47	–8.54	–9.33	–9.74	–9.71	–10.78	–11.61
90°	–5.64	–6.27	–6.67	–7.43	–8.05	–8.94	–9.81	–10.57	–10.73	–11.36	–12.38
95°	–6.19	–6.82	–7.34	–8.02	–8.28	–9.36	–9.98	–10.67	–11.48	–12.50	–14.05
100°	–6.16	–7.30	–7.97	–8.90	–8.83	–9.71	–10.13	–11.03	–11.85	–13.50	–15.18
105°	–6.33	–7.36	–7.98	–9.30	–9.66	–10.20	–10.75	–11.57	–12.27	–14.00	–14.81
110°	–6.83	–7.79	–7.97	–9.07	–9.94	–10.57	–11.51	–12.35	–13.20	–14.25	–14.83
115°	–7.06	–7.86	–8.42	–9.46	–9.99	–10.68	–11.99	–12.71	–13.52	–15.03	–15.81
120°	–6.60	–7.05	–8.20	–9.59	–10.13	–11.05	–12.43	–12.93	–14.26	–15.04	–15.76
125°	–6.92	–7.36	–8.29	–8.96	–9.33	–10.44	–11.45	–12.95	–14.53	–16.25	–17.03
130°	–8.72	–9.47	–9.97	–10.06	–10.18	–10.64	–10.76	–11.86	–12.67	–14.47	–15.32
135°	–8.75	–10.19	–11.28	–12.42	–12.80	–13.26	–13.10	–14.32	–13.60	–13.96	–14.80
140°	–7.34	–8.85	–10.09	–11.56	–11.94	–13.03	–14.60	–17.23	–17.43	–17.67	–19.34
145°	–5.78	–6.89	–8.00	–9.15	–9.57	–10.88	–13.12	–14.67	–14.73	–16.38	–19.77
150°	–6.70	–7.78	–8.14	–8.28	–8.40	–9.76	–11.37	–12.05	–12.36	–14.25	–17.27
155°	–7.08	–8.12	–8.55	–9.17	–9.41	–11.31	–12.46	–12.22	–12.40	–14.63	–16.10
160°	–7.80	–9.00	–9.54	–9.95	–10.42	–11.74	–12.72	–12.51	–13.47	–16.60	–17.11
165°	–7.36	–8.13	–8.51	–9.20	–9.92	–11.95	–12.99	–13.18	–14.43	–17.34	–17.30
170°	–8.67	–9.48	–9.42	–10.00	–10.43	–11.96	–12.38	–12.02	–13.08	–15.91	–15.74
175°	–7.88	–9.06	–9.36	–10.11	–11.06	–12.85	–13.91	–13.96	–15.15	–18.25	–18.03
180°	–6.74	–7.81	–8.12	–8.71	–9.58	–11.31	–12.32	–12.54	–13.88	–16.98	–17.47
185°	–7.83	–9.11	–9.46	–10.21	–11.24	–13.04	–14.10	–13.94	–15.35	–18.54	–18.75
190°	–8.95	–9.99	–9.96	–10.45	–10.74	–12.28	–12.69	–12.30	–13.07	–16.08	–16.14
195°	–7.68	–8.45	–8.72	–9.25	–9.93	–12.00	–13.06	–13.06	–14.20	–17.57	–17.77
200°	–7.93	–9.12	–9.77	–10.08	–10.51	–11.86	–12.91	–12.54	–13.28	–16.70	–17.77
205°	–7.32	–8.32	–8.73	–9.31	–9.49	–11.47	–12.78	–12.19	–12.13	–14.76	–16.23
210°	–6.86	–8.08	–8.45	–8.45	–8.43	–9.72	–11.48	–12.10	–11.91	–13.99	–17.13
215°	–5.82	–6.92	–8.05	–9.23	–9.48	–10.71	–12.79	–14.66	–14.33	–15.75	–19.51
220°	–7.29	–8.79	–10.06	–11.61	–12.01	–12.87	–14.23	–17.21	–17.04	–17.58	–20.10
225°	–8.76	–10.33	–11.54	–12.48	–12.94	–13.47	–13.18	–14.45	–13.32	–13.87	–15.07
230°	–8.92	–9.69	–10.35	–10.29	–10.11	–10.64	–10.66	–11.60	–12.11	–14.17	–15.60
235°	–7.16	–7.40	–8.47	–9.10	–9.15	–10.28	–11.24	–12.51	–13.82	–15.78	–17.84
240°	–6.64	–7.12	–8.20	–9.67	–10.01	–10.89	–12.35	–12.75	–13.90	–14.98	–16.48
245°	–6.98	–8.02	–8.55	–9.62	–9.93	–10.53	–12.07	–12.61	–13.04	–14.66	–15.88
250°	–6.90	–7.96	–8.15	–9.15	–9.93	–10.38	–11.29	–12.18	–12.96	–14.30	–14.98
255°	–6.39	–7.30	–8.17	–9.52	–9.65	–9.93	–10.50	–11.28	–12.14	–13.90	–14.87
260°	–6.19	–7.36	–8.09	–9.07	–8.90	–9.58	–9.98	–10.71	–11.55	–13.59	–15.55
265°	–6.25	–6.86	–7.55	–8.24	–8.34	–9.29	–9.74	–10.28	–11.31	–12.51	–14.18
270°	–5.80	–6.29	–6.83	–7.65	–8.12	–8.79	–9.61	–10.41	–10.67	–11.44	–12.44
275°	–5.27	–5.75	–6.45	–7.48	–7.52	–8.41	–9.16	–9.55	–9.69	–10.80	–11.68
280°	–4.72	–5.63	–6.22	–6.94	–7.05	–7.69	–7.97	–8.31	–9.19	–10.32	–11.03
285°	–4.55	–5.36	–5.77	–6.46	–6.48	–6.56	–6.99	–7.82	–8.40	–9.25	–10.09
290°	–4.21	–5.01	–5.31	–5.94	–5.44	–5.82	–6.65	–7.15	–7.43	–8.33	–9.01
295°	–3.87	–4.61	–4.77	–5.13	–4.64	–5.48	–5.98	–6.29	–6.70	–7.36	–7.98
300°	–3.44	–3.99	–4.13	–4.39	–4.21	–4.88	–5.14	–5.54	–5.75	–6.53	–7.04
305°	–2.82	–3.39	–3.42	–3.84	–3.70	–4.05	–4.45	–4.66	–5.05	–5.55	–5.89
310°	–2.43	–2.96	–2.97	–3.30	–3.06	–3.50	–3.72	–4.02	–4.14	–4.50	–4.96
315°	–2.21	–2.70	–2.68	–2.70	–2.46	–3.08	–3.25	–3.45	–3.20	–3.72	–4.34
320°	–1.66	–2.26	–2.09	–2.16	–2.07	–2.54	–2.80	–2.75	–2.52	–3.27	–3.65
325°	–1.58	–1.97	–1.54	–1.61	–1.69	–2.10	–2.37	–1.97	–2.00	–2.80	–2.93
330°	–1.26	–1.41	–1.09	–1.37	–1.13	–1.80	–1.66	–1.34	–1.60	–2.21	–2.26
335°	–0.99	–1.05	–0.62	–0.91	–0.92	–1.31	–1.06	–0.95	–1.23	–1.61	–1.64
340°	–0.72	–0.73	–0.30	–0.71	–0.51	–0.98	–0.56	–0.60	–0.85	–1.00	–1.00
345°	–0.43	–0.38	–0.20	–0.44	–0.35	–0.43	–0.29	–0.37	–0.47	–0.54	–0.67
350°	–0.19	–0.14	–0.12	–0.18	–0.24	–0.11	–0.11	–0.17	–0.23	–0.32	–0.33
355°	–0.05	–0.02	–0.03	–0.04	–0.06	–0.01	–0.01	–0.06	–0.05	–0.07	–0.09

Table A.38 *Directional response for Windscreen UA-1650, Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer with the microphone preamplifier mounted directly on the analyzer, measured in a plane perpendicular to the display and along the microphone's axis, 500 Hz – 3550 Hz*

	Frequency											
Angle	**500 Hz**	**630 Hz**	**800 Hz**	**1000 Hz**	**1250 Hz**	**1600 Hz**	**2000 Hz**	2240 Hz	**2500 Hz**	2800 Hz	**3150 Hz**	3550 Hz
0°	0.02	0.00	–0.01	–0.01	0.00	–0.01	–0.01	–0.01	–0.01	–0.02	–0.01	–0.01
5°	0.00	0.00	0.00	0.00	–0.01	0.00	–0.01	0.00	–0.02	–0.01	–0.02	–0.02
10°	–0.02	0.01	–0.02	0.00	–0.02	–0.01	–0.03	0.01	–0.05	0.01	–0.05	–0.02
15°	0.00	0.02	–0.02	0.00	–0.03	–0.02	–0.06	0.03	–0.11	0.03	–0.10	–0.03
20°	–0.01	0.03	–0.01	0.01	–0.04	–0.04	–0.11	0.05	–0.19	0.06	–0.18	–0.01
25°	–0.03	0.02	–0.02	0.01	–0.07	–0.08	–0.18	0.07	–0.27	0.06	–0.28	0.04
30°	0.00	0.06	–0.03	0.00	–0.07	–0.12	–0.25	0.09	–0.30	0.03	–0.34	0.09
35°	–0.02	0.04	–0.04	–0.01	–0.07	–0.20	–0.31	0.04	–0.29	–0.08	–0.36	0.08
40°	–0.04	0.10	–0.02	–0.01	–0.05	–0.31	–0.34	–0.06	–0.22	–0.26	–0.29	–0.05
45°	–0.04	0.10	–0.01	–0.05	–0.02	–0.45	–0.33	–0.19	–0.13	–0.46	–0.23	–0.27
50°	–0.06	0.13	0.02	–0.08	0.02	–0.60	–0.28	–0.33	–0.14	–0.52	–0.31	–0.41
55°	–0.09	0.14	0.07	–0.12	0.04	–0.69	–0.25	–0.38	–0.27	–0.39	–0.58	–0.32
60°	–0.15	0.15	0.12	–0.13	0.03	–0.72	–0.31	–0.33	–0.50	–0.23	–0.87	–0.21
65°	–0.13	0.14	0.18	–0.12	0.00	–0.68	–0.48	–0.26	–0.63	–0.28	–0.84	–0.40
70°	–0.16	0.12	0.23	–0.07	–0.06	–0.59	–0.73	–0.30	–0.56	–0.58	–0.59	–0.80
75°	–0.20	0.08	0.25	0.00	–0.11	–0.51	–0.94	–0.53	–0.45	–0.78	–0.60	–0.79
80°	–0.24	0.05	0.26	0.09	–0.13	–0.49	–0.97	–0.84	–0.56	–0.65	–0.95	–0.48
85°	–0.28	–0.01	0.23	0.18	–0.09	–0.53	–0.86	–1.00	–0.91	–0.53	–1.05	–0.66
90°	–0.30	–0.06	0.19	0.25	0.00	–0.61	–0.73	–0.92	–1.23	–0.84	–0.83	–1.05
95°	–0.38	–0.11	0.14	0.28	0.14	–0.65	–0.70	–0.71	–1.19	–1.34	–0.96	–0.82
100°	–0.40	–0.18	0.06	0.25	0.29	–0.58	–0.76	–0.63	–0.91	–1.40	–1.57	–0.76
105°	–0.40	–0.25	–0.02	0.17	0.38	–0.42	–0.80	–0.73	–0.76	–0.97	–1.78	–1.47
110°	–0.44	–0.31	–0.12	0.05	0.40	–0.23	–0.69	–0.81	–0.88	–0.76	–1.24	–1.76
115°	–0.50	–0.34	–0.19	–0.10	0.31	–0.11	–0.44	–0.66	–0.98	–0.96	–0.92	–1.08
120°	–0.49	–0.40	–0.26	–0.27	0.15	–0.11	–0.19	–0.31	–0.76	–1.09	–1.17	–0.78
125°	–0.46	–0.41	–0.30	–0.40	–0.08	–0.25	–0.10	–0.02	–0.32	–0.69	–1.28	–1.13
130°	–0.48	–0.42	–0.31	–0.50	–0.31	–0.51	–0.25	0.01	–0.04	–0.13	–0.73	–1.01
135°	–0.47	–0.40	–0.30	–0.54	–0.48	–0.79	–0.60	–0.27	–0.14	0.05	–0.14	–0.21
140°	–0.40	–0.40	–0.26	–0.53	–0.58	–1.03	–1.02	–0.75	–0.60	–0.30	–0.14	0.23
145°	–0.40	–0.37	–0.23	–0.48	–0.58	–1.13	–1.34	–1.22	–1.22	–1.01	–0.80	–0.20
150°	–0.35	–0.34	–0.17	–0.39	–0.51	–1.11	–1.44	–1.46	–1.66	–1.68	–1.74	–1.24
155°	–0.33	–0.31	–0.12	–0.29	–0.40	–0.99	–1.33	–1.41	–1.71	–1.91	–2.30	–2.18
160°	–0.31	–0.27	–0.06	–0.20	–0.29	–0.82	–1.10	–1.16	–1.44	–1.65	–2.15	–2.26
165°	–0.28	–0.24	–0.02	–0.12	–0.18	–0.66	–0.86	–0.86	–1.07	–1.20	–1.60	–1.67
170°	–0.28	–0.23	0.01	–0.06	–0.09	–0.53	–0.66	–0.60	–0.75	–0.79	–1.06	–1.02
175°	–0.24	–0.22	0.04	–0.02	–0.03	–0.45	–0.53	–0.44	–0.55	–0.53	–0.72	–0.59
180°	–0.25	–0.22	0.04	–0.01	–0.02	–0.43	–0.49	–0.39	–0.48	–0.45	–0.61	–0.44
185°	–0.25	–0.20	0.04	–0.02	–0.03	–0.45	–0.54	–0.44	–0.55	–0.53	–0.71	–0.58
190°	–0.27	–0.23	0.01	–0.06	–0.08	–0.53	–0.66	–0.60	–0.75	–0.79	–1.05	–1.01
195°	–0.30	–0.23	–0.01	–0.11	–0.16	–0.66	–0.86	–0.85	–1.07	–1.21	–1.57	–1.66
200°	–0.31	–0.27	–0.05	–0.18	–0.27	–0.83	–1.11	–1.16	–1.45	–1.68	–2.14	–2.25
205°	–0.34	–0.30	–0.10	–0.28	–0.38	–1.00	–1.35	–1.42	–1.74	–1.95	–2.32	–2.19
210°	–0.37	–0.31	–0.16	–0.38	–0.50	–1.15	–1.47	–1.50	–1.71	–1.74	–1.78	–1.26
215°	–0.39	–0.35	–0.21	–0.47	–0.57	–1.19	–1.38	–1.27	–1.27	–1.04	–0.83	–0.21
220°	–0.44	–0.39	–0.26	–0.53	–0.58	–1.09	–1.06	–0.79	–0.63	–0.27	–0.12	0.23
225°	–0.48	–0.39	–0.30	–0.55	–0.49	–0.86	–0.63	–0.28	–0.13	0.11	–0.07	–0.17
230°	–0.48	–0.41	–0.32	–0.51	–0.32	–0.56	–0.26	0.03	0.01	–0.07	–0.64	–0.95
235°	–0.50	–0.40	–0.31	–0.41	–0.10	–0.28	–0.09	0.02	–0.26	–0.63	–1.24	–1.10
240°	–0.51	–0.39	–0.28	–0.26	0.12	–0.12	–0.15	–0.26	–0.70	–1.03	–1.19	–0.80
245°	–0.51	–0.35	–0.21	–0.10	0.30	–0.08	–0.39	–0.61	–0.94	–0.93	–0.93	–1.09
250°	–0.49	–0.31	–0.13	0.07	0.39	–0.19	–0.65	–0.76	–0.86	–0.76	–1.22	–1.74
255°	–0.47	–0.29	–0.04	0.20	0.39	–0.37	–0.77	–0.68	–0.75	–0.97	–1.75	–1.46
260°	–0.42	–0.19	0.07	0.28	0.31	–0.53	–0.73	–0.59	–0.90	–1.37	–1.56	–0.76
265°	–0.41	–0.13	0.15	0.31	0.17	–0.60	–0.66	–0.67	–1.19	–1.33	–0.93	–0.79
270°	–0.36	–0.06	0.22	0.28	0.04	–0.58	–0.67	–0.90	–1.22	–0.81	–0.78	–1.02
275°	–0.33	–0.03	0.26	0.21	–0.06	–0.51	–0.80	–1.01	–0.88	–0.50	–1.04	–0.65
280°	–0.28	0.05	0.28	0.12	–0.09	–0.47	–0.92	–0.84	–0.51	–0.60	–0.95	–0.44
285°	–0.24	0.07	0.28	0.04	–0.08	–0.49	–0.91	–0.51	–0.41	–0.76	–0.58	–0.69
290°	–0.23	0.13	0.25	–0.03	–0.03	–0.55	–0.73	–0.25	–0.53	–0.57	–0.52	–0.71
295°	–0.15	0.13	0.22	–0.08	0.03	–0.64	–0.48	–0.19	–0.62	–0.26	–0.74	–0.37
300°	–0.17	0.15	0.17	–0.10	0.06	–0.68	–0.29	–0.27	–0.49	–0.18	–0.77	–0.21
305°	–0.09	0.15	0.12	–0.09	0.07	–0.65	–0.22	–0.35	–0.26	–0.32	–0.54	–0.32
310°	–0.10	0.15	0.07	–0.06	0.04	–0.55	–0.24	–0.33	–0.10	–0.43	–0.30	–0.38
315°	–0.08	0.12	0.03	–0.03	0.02	–0.42	–0.29	–0.20	–0.09	–0.37	–0.24	–0.23
320°	–0.07	0.14	0.01	0.00	–0.03	–0.28	–0.31	–0.05	–0.16	–0.21	–0.29	–0.02
325°	–0.07	0.11	0.00	0.02	–0.04	–0.17	–0.29	0.05	–0.23	–0.04	–0.33	0.11
330°	–0.03	0.07	0.01	0.02	–0.04	–0.10	–0.23	0.09	–0.24	0.05	–0.31	0.13
335°	–0.04	0.06	0.01	0.03	–0.03	–0.04	–0.17	0.10	–0.20	0.08	–0.23	0.09
340°	–0.03	0.05	0.01	0.02	–0.02	–0.01	–0.11	0.08	–0.14	0.07	–0.14	0.04
345°	–0.02	0.03	0.00	0.01	–0.01	0.00	–0.06	0.06	–0.08	0.05	–0.07	0.02
350°	–0.02	0.03	0.01	0.01	0.00	0.01	–0.02	0.04	–0.02	0.03	–0.02	0.01
355°	–0.03	0.02	0.00	0.02	0.01	0.01	0.01	0.02	0.00	0.02	0.01	0.02

Table A.39 *Directional response for Windscreen UA-1650, Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer with the microphone preamplifier mounted directly on the analyzer, measured in a plane perpendicular to the display and along the microphone's axis, 4000 Hz – 10600 Hz*

	Frequency											
Angle	**4000 Hz**	4500 Hz	**5000 Hz**	5600 Hz	**6300 Hz**	7100 Hz	**8000 Hz**	8500 Hz	9000 Hz	9500 Hz	**10000 Hz**	10600 Hz
0°	–0.01	–0.01	–0.01	–0.02	–0.02	–0.02	–0.02	–0.03	–0.02	–0.01	–0.02	–0.01
5°	0.00	0.00	0.01	–0.03	–0.03	–0.01	–0.05	–0.05	–0.01	–0.05	–0.04	–0.05
10°	0.04	0.04	0.02	–0.01	–0.08	0.02	–0.15	–0.14	–0.06	–0.11	–0.17	–0.15
15°	0.09	0.06	0.04	0.05	–0.19	0.07	–0.33	–0.28	–0.14	–0.22	–0.36	–0.29
20°	0.13	0.02	0.01	0.12	–0.33	0.09	–0.52	–0.45	–0.22	–0.35	–0.43	–0.35
25°	0.12	–0.14	–0.14	0.11	–0.41	–0.05	–0.62	–0.69	–0.45	–0.57	–0.42	–0.46
30°	0.02	–0.41	–0.35	–0.11	–0.39	–0.31	–0.68	–1.04	–0.85	–0.88	–0.63	–0.83
35°	–0.18	–0.62	–0.47	–0.48	–0.56	–0.31	–1.07	–1.25	–1.17	–1.04	–0.97	–1.00
40°	–0.34	–0.55	–0.35	–0.58	–0.99	–0.32	–1.32	–1.34	–1.55	–1.47	–1.47	–1.13
45°	–0.28	–0.37	–0.41	–0.58	–1.05	–0.79	–1.16	–1.82	–1.65	–2.00	–1.69	–1.45
50°	–0.13	–0.52	–0.87	–0.98	–1.12	–0.68	–1.67	–1.92	–1.92	–2.49	–2.19	–1.98
55°	–0.23	–0.90	–1.00	–1.14	–1.60	–0.87	–1.49	–2.08	–2.52	–2.45	–2.75	–2.38
60°	–0.57	–0.93	–0.76	–1.20	–1.55	–1.22	–2.16	–2.30	–2.37	–3.25	–2.72	–2.91
65°	–0.64	–0.77	–1.08	–1.68	–1.84	–1.46	–1.86	–2.79	–2.91	–3.01	–3.50	–3.10
70°	–0.48	–1.15	–1.35	–1.34	–2.01	–1.72	–2.55	–2.62	–3.26	–3.65	–3.47	–3.71
75°	–0.72	–1.34	–1.20	–1.54	–2.46	–1.82	–2.55	–3.38	–3.24	–4.19	–3.99	–3.78
80°	–1.14	–1.12	–1.58	–1.91	–2.15	–2.13	–2.80	–3.41	–3.98	–4.13	–4.64	–4.28
85°	–0.90	–1.60	–1.62	–2.01	–2.47	–2.36	–3.21	–3.48	–4.15	–4.56	–4.84	–4.87
90°	–0.72	–1.79	–1.69	–2.40	–2.58	–2.28	–3.48	–3.99	–4.02	–5.11	–4.79	–5.49
95°	–1.20	–1.29	–2.33	–2.19	–3.06	–2.59	–3.35	–4.15	–4.54	–5.18	–5.25	–5.29
100°	–1.17	–1.78	–1.87	–2.71	–3.00	–2.67	–3.86	–4.18	–4.66	–5.30	–5.62	–5.40
105°	–0.97	–1.90	–2.09	–2.67	–3.44	–3.00	–3.92	–4.40	–4.87	–5.35	–5.74	–5.51
110°	–1.74	–1.67	–2.44	–2.83	–3.14	–3.27	–4.31	–4.87	–4.93	–5.85	–5.89	–5.85
115°	–2.04	–2.58	–2.11	–3.18	–3.56	–2.85	–4.55	–4.99	–5.72	–6.29	–6.14	–6.40
120°	–1.16	–2.60	–3.25	–2.77	–3.76	–3.33	–4.11	–5.26	–5.81	–6.38	–7.14	–6.82
125°	–0.98	–1.61	–2.86	–4.02	–3.83	–3.25	–4.83	–5.12	–5.54	–6.77	–6.77	–6.71
130°	–1.43	–1.75	–1.82	–2.98	–4.49	–4.15	–4.67	–5.72	–6.54	–7.00	–6.74	–6.66
135°	–0.93	–1.99	–2.38	–2.49	–2.94	–3.31	–5.52	–6.10	–6.48	–7.24	–7.76	–7.62
140°	–0.01	–1.03	–2.09	–3.13	–3.49	–2.45	–3.59	–4.89	–5.99	–7.21	–7.49	–7.68
145°	0.05	–0.40	–0.82	–1.80	–3.29	–3.43	–4.10	–4.45	–4.69	–5.17	–5.32	–5.75
150°	–0.89	–0.98	–0.81	–0.95	–1.68	–1.87	–3.71	–4.83	–5.60	–6.28	–6.07	–5.74
155°	–2.19	–2.45	–2.28	–2.05	–1.99	–1.38	–2.23	–2.99	–3.55	–4.45	–4.97	–5.45
160°	–2.70	–3.47	–3.96	–4.31	–4.19	–3.37	–3.62	–3.84	–3.91	–4.15	–4.08	–4.16
165°	–2.13	–3.05	–3.87	–5.07	–5.84	–5.66	–6.76	–7.20	–7.36	–7.60	–7.40	–7.19
170°	–1.31	–2.06	–2.65	–3.69	–4.70	–4.70	–6.31	–7.35	–8.03	–9.00	–9.66	–10.22
175°	–0.75	–1.36	–1.74	–2.45	–3.27	–3.09	–4.21	–5.00	–5.42	–6.15	–6.61	–7.09
180°	–0.56	–1.13	–1.43	–1.98	–2.71	–2.52	–3.48	–4.15	–4.47	–5.07	–5.38	–5.74
185°	–0.75	–1.35	–1.71	–2.28	–3.10	–3.07	–4.23	–4.96	–5.38	–6.07	–6.45	–6.95
190°	–1.31	–2.04	–2.56	–3.32	–4.41	–4.80	–6.30	–7.29	–7.89	–8.72	–9.53	–10.06
195°	–2.14	–2.99	–3.67	–4.68	–5.81	–6.19	–6.91	–7.39	–7.55	–7.90	–7.78	–7.63
200°	–2.74	–3.44	–3.84	–4.43	–4.78	–3.79	–3.76	–3.91	–4.05	–4.31	–4.34	–4.33
205°	–2.27	–2.48	–2.31	–2.47	–2.54	–1.39	–2.19	–2.79	–3.40	–4.38	–4.92	–5.31
210°	–0.94	–1.00	–0.88	–1.36	–1.88	–1.54	–3.49	–4.63	–5.60	–6.46	–6.27	–5.86
215°	0.06	–0.36	–0.86	–2.07	–3.13	–3.19	–4.12	–4.59	–4.96	–5.35	–5.42	–5.97
220°	0.05	–0.96	–2.05	–3.19	–3.40	–2.60	–3.79	–4.95	–6.07	–7.31	–7.60	–8.02
225°	–0.86	–1.95	–2.40	–2.48	–2.94	–3.42	–5.37	–6.03	–6.62	–7.46	–8.29	–8.01
230°	–1.39	–1.77	–1.97	–2.81	–4.40	–4.11	–4.91	–6.01	–6.97	–7.29	–6.66	–6.51
235°	–0.97	–1.64	–2.86	–3.88	–4.05	–3.48	–4.88	–4.91	–5.34	–6.59	–6.81	–6.53
240°	–1.13	–2.60	–3.18	–2.94	–3.94	–3.38	–3.94	–5.13	–5.73	–6.16	–7.08	–7.10
245°	–2.01	–2.58	–2.10	–3.44	–3.75	–2.57	–4.47	–4.72	–5.68	–6.81	–6.35	–6.35
250°	–1.72	–1.65	–2.53	–2.99	–2.89	–3.30	–4.19	–5.13	–5.09	–5.85	–5.89	–5.79
255°	–0.94	–1.93	–2.19	–2.48	–3.33	–2.97	–4.06	–4.24	–4.74	–5.28	–6.04	–5.46
260°	–1.14	–1.84	–1.83	–2.53	–3.11	–2.91	–3.61	–4.05	–4.70	–5.39	–5.49	–5.35
265°	–1.21	–1.27	–2.20	–2.27	–3.29	–2.35	–3.42	–4.06	–4.42	–5.07	–5.25	–5.36
270°	–0.71	–1.64	–1.63	–2.62	–2.58	–2.27	–3.30	–3.81	–3.86	–5.12	–4.94	–5.53
275°	–0.84	–1.50	–1.72	–2.04	–2.34	–2.44	–3.07	–3.26	–4.21	–4.64	–4.99	–5.04
280°	–1.04	–1.11	–1.64	–1.69	–2.21	–1.94	–2.65	–3.42	–3.99	–4.16	–4.84	–3.99
285°	–0.65	–1.35	–1.21	–1.44	–2.56	–1.77	–2.59	–3.29	–3.17	–4.31	–3.77	–3.63
290°	–0.46	–1.15	–1.22	–1.53	–1.85	–1.61	–2.47	–2.52	–3.30	–3.49	–3.43	–3.91
295°	–0.62	–0.75	–0.96	–1.80	–1.67	–1.54	–1.84	–2.69	–2.71	–2.95	–3.74	–3.21
300°	–0.51	–0.84	–0.77	–1.12	–1.52	–1.11	–2.03	–2.10	–2.25	–3.49	–2.78	–2.71
305°	–0.17	–0.81	–1.03	–0.84	–1.72	–0.88	–1.31	–1.90	–2.67	–2.42	–2.78	–2.24
310°	–0.06	–0.46	–0.85	–0.77	–1.16	–0.78	–1.51	–1.95	–1.94	–2.51	–2.06	–2.07
315°	–0.19	–0.36	–0.35	–0.68	–0.99	–0.61	–1.06	–1.94	–1.58	–1.93	–1.60	–1.62
320°	–0.25	–0.56	–0.23	–0.80	–0.83	–0.03	–1.43	–1.15	–1.46	–1.44	–1.70	–1.14
325°	–0.12	–0.63	–0.29	–0.60	–0.49	–0.15	–1.20	–1.16	–1.00	–0.95	–1.14	–0.93
330°	0.07	–0.40	–0.21	–0.11	–0.52	–0.24	–0.53	–0.99	–0.76	–1.03	–0.61	–0.77
335°	0.16	–0.11	–0.06	0.19	–0.63	–0.01	–0.46	–0.53	–0.29	–0.83	–0.40	–0.38
340°	0.15	0.06	0.03	0.23	–0.47	0.12	–0.53	–0.34	–0.07	–0.44	–0.39	–0.22
345°	0.11	0.10	0.05	0.16	–0.20	0.08	–0.40	–0.26	–0.10	–0.17	–0.35	–0.16
350°	0.06	0.07	0.04	0.09	–0.04	0.02	–0.19	–0.14	–0.10	–0.04	–0.19	–0.07
355°	0.03	0.04	0.03	0.05	0.02	0.01	–0.03	–0.02	–0.02	0.02	–0.04	0.00

Table A.40 *Directional response for Windscreen UA-1650, Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer with the microphone preamplifier mounted directly on the analyzer, measured in a plane perpendicular to the display and along the microphone's axis, 11200 Hz – 20000 Hz*

	Frequency										
Angle	11200 Hz	11800 Hz	**12500 Hz**	13200 Hz	14000 Hz	15000 Hz	**16000 Hz**	17000 Hz	18000 Hz	19000 Hz	**20000 Hz**
0°	–0.01	–0.01	–0.01	–0.01	–0.01	0.00	–0.01	–0.02	–0.04	–0.01	–0.01
5°	–0.04	–0.07	–0.04	–0.06	–0.07	0.00	–0.04	–0.11	–0.07	–0.11	–0.11
10°	–0.12	–0.20	–0.18	–0.15	–0.26	–0.11	–0.16	–0.20	–0.27	–0.26	–0.27
15°	–0.26	–0.36	–0.35	–0.25	–0.46	–0.45	–0.36	–0.50	–0.49	–0.56	–0.55
20°	–0.55	–0.54	–0.44	–0.52	–0.61	–0.88	–0.77	–0.71	–1.00	–1.01	–0.99
25°	–0.98	–0.96	–0.72	–0.81	–1.05	–1.30	–1.18	–1.02	–1.27	–1.60	–1.45
30°	–1.22	–1.38	–1.31	–1.22	–1.20	–1.85	–1.72	–1.45	–1.75	–2.31	–2.11
35°	–1.40	–1.84	–1.43	–1.65	–1.65	–2.31	–2.36	–2.21	–2.14	–2.91	–2.87
40°	–1.88	–2.33	–2.15	–2.41	–1.85	–2.70	–2.99	–2.86	–2.67	–3.33	–3.66
45°	–2.04	–2.56	–2.50	–2.63	–2.42	–3.31	–3.48	–3.47	–3.36	–3.78	–4.30
50°	–2.37	–3.09	–2.91	–3.32	–3.24	–3.56	–3.88	–4.33	–4.52	–4.57	–4.99
55°	–2.98	–3.44	–3.70	–3.86	–3.85	–4.26	–4.69	–4.73	–5.38	–5.67	–5.95
60°	–3.17	–3.89	–3.99	–4.47	–4.23	–5.02	–5.52	–5.84	–6.08	–6.72	–7.13
65°	–3.90	–4.37	–4.49	–5.04	–4.78	–5.66	–6.30	–6.89	–6.94	–7.44	–8.23
70°	–4.23	–5.07	–5.10	–5.77	–5.48	–6.29	–6.99	–7.40	–8.13	–8.49	–9.11
75°	–4.77	–5.38	–5.82	–6.22	–6.44	–6.97	–7.69	–8.25	–8.85	–9.67	–10.19
80°	–4.64	–5.91	–6.14	–6.84	–6.96	–8.03	–8.58	–8.98	–9.44	–10.53	–11.39
85°	–5.13	–5.88	–6.59	–7.33	–7.37	–8.74	–9.62	–9.97	–10.01	–11.04	–11.91
90°	–5.53	–6.50	–7.01	–7.64	–8.20	–9.15	–10.33	–10.98	–11.09	–11.51	–13.07
95°	–6.08	–6.99	–7.71	–8.33	–8.34	–9.72	–10.59	–10.89	–12.07	–13.06	–14.71
100°	–6.54	–6.91	–8.56	–8.97	–8.96	–10.03	–10.63	–10.90	–12.58	–13.89	–15.72
105°	–6.83	–7.23	–8.61	–9.02	–10.14	–10.44	–11.36	–11.87	–12.91	–14.14	–15.44
110°	–6.84	–7.27	–8.56	–9.09	–10.42	–10.58	–12.36	–12.46	–13.95	–14.65	–15.42
115°	–6.93	–7.66	–8.52	–8.68	–10.29	–11.10	–12.91	–12.39	–14.39	–15.74	–16.39
120°	–6.98	–8.11	–8.65	–9.35	–10.48	–10.58	–12.35	–12.95	–15.15	–15.47	–17.42
125°	–7.52	–8.82	–8.84	–9.80	–10.98	–11.02	–12.00	–13.17	–13.87	–15.24	–16.58
130°	–7.62	–8.46	–8.89	–10.62	–11.60	–11.39	–12.32	–13.76	–13.79	–15.89	–16.60
135°	–8.04	–8.58	–9.78	–11.39	–10.75	–11.06	–12.72	–15.46	–14.33	–15.60	–17.37
140°	–8.44	–9.75	–11.15	–12.01	–10.99	–11.87	–13.81	–15.99	–14.03	–14.92	–18.28
145°	–7.18	–9.12	–10.30	–11.41	–11.44	–13.06	–15.77	–16.24	–14.99	–16.35	–20.66
150°	–6.27	–6.99	–7.63	–8.49	–9.52	–11.64	–13.74	–13.74	–14.06	–17.14	–21.05
155°	–6.74	–8.38	–8.95	–9.18	–9.01	–10.33	–11.15	–11.01	–12.13	–15.32	–17.08
160°	–5.02	–5.98	–6.61	–7.34	–8.31	–10.55	–12.28	–12.41	–13.07	–15.49	–15.36
165°	–7.68	–8.04	–7.77	–7.81	–7.98	–9.66	–10.43	–9.93	–11.26	–14.16	–14.65
170°	–11.52	–13.03	–13.41	–13.78	–13.91	–15.17	–15.68	–15.83	–15.80	–17.59	–17.21
175°	–8.15	–9.41	–10.16	–11.23	–12.24	–14.25	–15.23	–15.34	–16.96	–21.11	–21.47
180°	–6.63	–7.62	–8.06	–8.83	–9.77	–11.57	–12.29	–12.06	–13.37	–16.41	–16.89
185°	–7.98	–9.18	–9.75	–10.68	–11.87	–13.98	–14.84	–15.27	–16.93	–20.00	–21.43
190°	–11.42	–12.89	–13.33	–13.79	–14.55	–15.80	–16.33	–15.36	–16.00	–18.90	–18.14
195°	–8.11	–8.42	–8.06	–8.25	–8.47	–10.22	–11.09	–10.73	–11.29	–14.58	–15.28
200°	–5.04	–5.96	–6.49	–7.47	–8.53	–10.94	–12.66	–12.46	–12.87	–15.77	–15.72
205°	–6.58	–8.27	–9.31	–9.76	–9.60	–10.62	–11.48	–11.26	–11.53	–15.05	–17.51
210°	–6.52	–7.43	–8.28	–9.10	–9.88	–11.76	–13.43	–13.10	–13.15	–15.95	–20.92
215°	–7.44	–9.39	–10.91	–11.41	–11.02	–12.34	–14.93	–15.50	–14.34	–15.86	–20.08
220°	–8.60	–10.20	–11.44	–11.77	–10.30	–10.94	–13.07	–15.21	–13.17	–14.49	–18.65
225°	–8.11	–8.25	–9.19	–10.81	–10.40	–10.60	–12.27	–14.56	–13.85	–15.99	–17.81
230°	–7.27	–8.10	–8.63	–10.20	–11.45	–11.29	–12.28	–13.35	–12.81	–15.23	–16.15
235°	–7.15	–8.67	–9.05	–10.12	–11.24	–10.68	–11.23	–11.80	–13.11	–15.12	–16.89
240°	–7.09	–8.20	–8.77	–9.07	–10.00	–9.73	–11.36	–12.56	–14.77	–15.25	–17.67
245°	–6.89	–7.51	–8.60	–8.02	–9.57	–10.44	–12.62	–12.54	–13.79	–14.77	–15.73
250°	–6.96	–6.97	–8.06	–8.59	–10.45	–10.40	–11.62	–12.51	–13.09	–14.14	–15.16
255°	–6.53	–6.97	–8.21	–9.18	–9.92	–9.91	–10.43	–11.47	–12.65	–13.62	–15.23
260°	–6.35	–6.80	–8.63	–9.03	–8.36	–9.13	–10.21	–10.66	–12.12	–13.37	–15.52
265°	–6.00	–6.92	–7.70	–7.85	–7.92	–9.46	–10.02	–10.44	–11.03	–12.75	–14.80
270°	–5.51	–6.20	–6.47	–7.56	–8.41	–8.58	–9.54	–10.67	–11.00	–11.23	–12.67
275°	–4.72	–5.54	–6.51	–7.55	–7.02	–7.99	–9.28	–10.12	–9.57	–10.55	–12.00
280°	–4.37	–5.93	–6.28	–6.47	–6.54	–7.98	–8.11	–8.70	–9.05	–10.36	–11.17
285°	–4.85	–5.40	–5.39	–6.00	–6.73	–6.49	–7.12	–7.89	–8.57	–9.20	–10.28
290°	–4.24	–4.68	–4.87	–6.20	–5.12	–5.92	–6.65	–7.14	–7.59	–8.17	–9.34
295°	–3.54	–4.04	–4.79	–4.86	–4.47	–5.61	–6.02	–6.44	–6.47	–7.19	–8.37
300°	–2.90	–3.96	–3.93	–4.09	–4.26	–4.84	–5.07	–5.58	–5.84	–6.53	–7.21
305°	–3.09	–3.49	–3.32	–3.84	–3.91	–3.74	–4.52	–4.72	–4.90	–5.58	–5.89
310°	–2.44	–2.88	–2.66	–3.61	–2.83	–3.53	–3.76	–3.98	–4.11	–4.44	–5.01
315°	–1.96	–2.32	–2.61	–2.58	–2.24	–3.23	–3.19	–3.53	–3.18	–3.61	–4.29
320°	–1.70	–2.13	–2.38	–2.04	–1.98	–2.51	–2.72	–2.70	–2.37	–3.26	–3.67
325°	–1.24	–1.89	–1.35	–1.49	–1.84	–1.91	–2.36	–2.06	–2.01	–2.73	–2.96
330°	–1.04	–1.51	–1.06	–1.29	–1.16	–1.69	–1.69	–1.21	–1.69	–2.14	–2.24
335°	–1.00	–1.02	–0.41	–1.13	–0.66	–1.35	–1.00	–0.94	–1.17	–1.49	–1.47
340°	–0.65	–0.43	–0.16	–0.87	–0.25	–1.06	–0.51	–0.71	–0.96	–1.01	–0.93
345°	–0.29	–0.29	–0.12	–0.49	–0.22	–0.58	–0.14	–0.43	–0.42	–0.52	–0.52
350°	–0.12	–0.18	–0.05	–0.22	–0.18	–0.19	0.00	–0.10	–0.11	–0.20	–0.20
355°	–0.02	–0.03	0.00	–0.04	–0.05	–0.03	0.02	0.03	–0.01	–0.01	0.01

Table A.41 *Sensitivity variations of Windscreen UA-1650, Microphone Type 4189, Microphone Preamplifier ZC-0032 and the analyzer with the microphone preamplifier mounted directly on the analyzer, at sound incidence angles within ±θ° from the reference direction*

Nominal Frequency	Exact Frequency	Max Variation ± 30° dB	Max Variation ± 90° dB	Max Variation ± 150° dB
500 Hz	501.187 Hz	0.06	0.39	0.54
630 Hz	630.957 Hz	0.09	0.24	0.57
800 Hz	794.328 Hz	0.04	0.32	0.61
1000 Hz	1000 Hz	0.06	0.42	0.86
1250 Hz	1258.93 Hz	0.08	0.21	0.99
1600 Hz	1584.89 Hz	0.17	0.75	1.20
2000 Hz	1995.26 Hz	0.31	0.98	1.48
2240 Hz	2238.72 Hz	0.11	1.16	1.60
2500 Hz	2511.89 Hz	0.32	1.25	1.73
2800 Hz	2818.38 Hz	0.12	1.02	1.85
3150 Hz	3162.28 Hz	0.41	1.22	1.80
3550 Hz	3548.13 Hz	0.25	1.26	2.00
4000 Hz	3981.07 Hz	0.23	1.35	2.25
4500 Hz	4466.84 Hz	0.51	1.89	2.70
5000 Hz	5011.87 Hz	0.40	1.77	3.30
5600 Hz	5623.41 Hz	0.56	2.85	4.25
6300 Hz	6309.57 Hz	0.66	2.95	4.52
7100 Hz	7079.46 Hz	0.44	2.56	4.31
8000 Hz	7943.28 Hz	0.77	3.50	5.54
8500 Hz	8413.95 Hz	1.07	4.01	6.36
9000 Hz	8912.51 Hz	0.92	4.52	7.42
9500 Hz	9440.61 Hz	1.06	5.14	7.86
10000 Hz	10000 Hz	0.74	5.39	8.45
10600 Hz	10592.5 Hz	0.85	5.54	8.60
11200 Hz	11220.2 Hz	1.27	5.81	8.94
11800 Hz	11885.0 Hz	1.53	6.52	10.35
12500 Hz	12589.3 Hz	1.25	7.03	11.56
13200 Hz	13335.2 Hz	1.60	7.66	12.50
14000 Hz	14125.4 Hz	1.09	8.42	12.95
15000 Hz	14962.4 Hz	1.87	9.17	13.49
16000 Hz	15848.9 Hz	1.74	10.36	15.80
17000 Hz	16788.0 Hz	1.49	11.02	17.27
18000 Hz	17782.8 Hz	1.80	11.13	17.47
19000 Hz	18836.5 Hz	2.32	11.52	17.68
20000 Hz	19952.6 Hz	2.27	13.08	21.06

Table A.42 *Influence of Outdoor Microphone Kit UA-1404 on directional response with Microphone Preamplifier ZC-0032 connected to a microphone extension cable, 500 Hz – 3550 Hz*

	Frequency											
Angle	**500 Hz**	**630 Hz**	**800 Hz**	**1000 Hz**	**1250 Hz**	**1600 Hz**	**2000 Hz**	2240 Hz	**2500 Hz**	2800 Hz	**3150 Hz**	3550 Hz
0°	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5°	0.04	0.06	0.08	0.01	0.00	–0.01	–0.02	–0.01	–0.02	–0.01	–0.01	–0.02
10°	0.04	0.06	0.08	0.01	–0.01	–0.01	–0.03	–0.02	–0.02	–0.02	–0.03	–0.06
15°	0.04	0.05	0.08	0.01	–0.01	–0.02	–0.05	–0.04	–0.03	–0.02	–0.06	–0.14
20°	0.02	0.04	0.06	0.00	–0.01	–0.04	–0.08	–0.07	–0.05	–0.02	–0.09	–0.21
25°	0.01	0.02	0.04	0.00	0.00	–0.05	–0.11	–0.10	–0.08	–0.01	–0.14	–0.29
30°	–0.03	–0.03	–0.03	0.00	0.00	–0.07	–0.15	–0.13	–0.12	0.00	–0.19	–0.34
35°	–0.02	–0.01	0.00	–0.02	0.01	–0.09	–0.20	–0.18	–0.16	–0.01	–0.24	–0.38
40°	–0.03	–0.02	–0.01	–0.05	0.02	–0.10	–0.24	–0.24	–0.21	–0.03	–0.25	–0.43
45°	–0.03	–0.02	–0.01	–0.07	0.02	–0.11	–0.28	–0.31	–0.25	–0.07	–0.22	–0.50
50°	–0.02	–0.02	–0.01	–0.09	0.01	–0.09	–0.32	–0.37	–0.29	–0.12	–0.18	–0.59
55°	–0.02	–0.02	0.00	–0.10	–0.01	–0.07	–0.36	–0.42	–0.36	–0.15	–0.17	–0.62
60°	–0.06	–0.07	–0.09	–0.10	–0.03	–0.05	–0.40	–0.47	–0.43	–0.18	–0.22	–0.55
65°	–0.02	–0.02	–0.01	–0.11	–0.05	–0.03	–0.43	–0.52	–0.51	–0.23	–0.27	–0.46
70°	–0.02	–0.02	–0.01	–0.11	–0.06	–0.02	–0.42	–0.56	–0.55	–0.31	–0.28	–0.48
75°	–0.03	–0.02	–0.01	–0.11	–0.08	–0.03	–0.38	–0.59	–0.60	–0.39	–0.29	–0.56
80°	–0.03	–0.02	–0.01	–0.11	–0.09	–0.05	–0.31	–0.58	–0.65	–0.44	–0.38	–0.55
85°	–0.03	–0.03	–0.02	–0.10	–0.08	–0.08	–0.25	–0.50	–0.68	–0.48	–0.48	–0.55
90°	–0.05	–0.07	–0.09	–0.09	–0.07	–0.09	–0.22	–0.39	–0.63	–0.55	–0.51	–0.66
95°	–0.04	–0.04	–0.03	–0.09	–0.05	–0.09	–0.25	–0.33	–0.49	–0.55	–0.56	–0.75
100°	–0.04	–0.05	–0.04	–0.09	–0.02	–0.06	–0.29	–0.34	–0.37	–0.40	–0.63	–0.74
105°	–0.05	–0.06	–0.06	–0.11	–0.01	–0.01	–0.29	–0.40	–0.37	–0.21	–0.49	–0.80
110°	–0.06	–0.06	–0.07	–0.12	–0.01	0.03	–0.25	–0.41	–0.44	–0.20	–0.22	–0.72
115°	–0.07	–0.07	–0.08	–0.13	–0.02	0.07	–0.15	–0.33	–0.46	–0.31	–0.19	–0.36
120°	–0.07	–0.10	–0.14	–0.15	–0.04	0.07	–0.05	–0.20	–0.33	–0.32	–0.35	–0.28
125°	–0.08	–0.09	–0.10	–0.17	–0.08	0.05	–0.01	–0.08	–0.13	–0.12	–0.34	–0.50
130°	–0.08	–0.09	–0.10	–0.17	–0.10	0.00	–0.03	–0.04	0.00	0.15	–0.01	–0.42
135°	–0.08	–0.09	–0.10	–0.17	–0.11	–0.05	–0.10	–0.11	–0.01	0.27	0.35	0.14
140°	–0.07	–0.08	–0.08	–0.16	–0.10	–0.07	–0.17	–0.22	–0.14	0.17	0.40	0.56
145°	–0.05	–0.06	–0.05	–0.13	–0.07	–0.05	–0.20	–0.28	–0.27	–0.04	0.16	0.44
150°	–0.05	–0.07	–0.09	–0.11	–0.03	0.01	–0.15	–0.26	–0.30	–0.15	–0.10	0.01
155°	–0.02	–0.02	–0.01	–0.06	0.03	0.09	–0.05	–0.14	–0.17	–0.05	–0.08	–0.19
160°	–0.01	0.00	0.02	–0.03	0.09	0.18	0.09	0.04	0.05	0.22	0.23	0.09
165°	0.01	0.02	0.04	0.00	0.13	0.26	0.22	0.21	0.27	0.51	0.63	0.61
170°	0.02	0.03	0.05	0.02	0.17	0.32	0.32	0.33	0.44	0.75	0.95	1.07
175°	0.02	0.04	0.06	0.04	0.19	0.36	0.37	0.41	0.54	0.89	1.15	1.35
180°	0.00	0.00	0.01	0.04	0.20	0.37	0.39	0.44	0.58	0.93	1.21	1.44
185°	0.02	0.04	0.06	0.03	0.19	0.36	0.37	0.41	0.55	0.89	1.15	1.35
190°	0.02	0.03	0.05	0.02	0.17	0.32	0.31	0.33	0.44	0.75	0.95	1.06
195°	0.01	0.02	0.04	0.00	0.13	0.26	0.22	0.21	0.27	0.51	0.62	0.60
200°	–0.01	0.00	0.02	–0.03	0.09	0.18	0.09	0.04	0.04	0.21	0.22	0.08
205°	–0.02	–0.02	–0.01	–0.07	0.03	0.09	–0.05	–0.14	–0.17	–0.05	–0.09	–0.20
210°	–0.05	–0.07	–0.09	–0.11	–0.03	0.01	–0.15	–0.26	–0.30	–0.16	–0.11	0.00
215°	–0.05	–0.06	–0.05	–0.14	–0.07	–0.05	–0.20	–0.29	–0.28	–0.05	0.14	0.43
220°	–0.07	–0.08	–0.08	–0.17	–0.10	–0.06	–0.17	–0.21	–0.14	0.16	0.39	0.57
225°	–0.08	–0.09	–0.10	–0.18	–0.11	–0.04	–0.10	–0.11	–0.01	0.27	0.35	0.15
230°	–0.08	–0.09	–0.10	–0.17	–0.10	0.01	–0.02	–0.04	0.01	0.16	0.00	–0.41
235°	–0.08	–0.09	–0.10	–0.17	–0.08	0.06	0.00	–0.07	–0.13	–0.11	–0.33	–0.47
240°	–0.07	–0.10	–0.14	–0.16	–0.04	0.08	–0.05	–0.19	–0.32	–0.31	–0.33	–0.25
245°	–0.07	–0.07	–0.08	–0.14	–0.02	0.07	–0.14	–0.32	–0.44	–0.29	–0.17	–0.33
250°	–0.06	–0.06	–0.07	–0.12	–0.01	0.04	–0.23	–0.39	–0.42	–0.18	–0.21	–0.70
255°	–0.05	–0.06	–0.06	–0.11	–0.01	–0.01	–0.28	–0.38	–0.34	–0.20	–0.48	–0.80
260°	–0.04	–0.05	–0.04	–0.10	–0.02	–0.05	–0.27	–0.32	–0.34	–0.39	–0.62	–0.74
265°	–0.04	–0.04	–0.03	–0.10	–0.04	–0.08	–0.23	–0.31	–0.47	–0.54	–0.56	–0.75
270°	–0.05	–0.07	–0.09	–0.10	–0.06	–0.07	–0.20	–0.37	–0.62	–0.55	–0.51	–0.65
275°	–0.03	–0.03	–0.02	–0.11	–0.08	–0.06	–0.23	–0.49	–0.68	–0.50	–0.48	–0.52
280°	–0.03	–0.02	–0.01	–0.11	–0.08	–0.03	–0.29	–0.57	–0.65	–0.45	–0.38	–0.50
285°	–0.03	–0.02	–0.01	–0.12	–0.07	–0.01	–0.36	–0.58	–0.59	–0.39	–0.27	–0.50
290°	–0.02	–0.02	–0.01	–0.11	–0.05	0.00	–0.41	–0.56	–0.55	–0.30	–0.24	–0.42
295°	–0.02	–0.02	–0.01	–0.11	–0.04	–0.01	–0.42	–0.51	–0.50	–0.21	–0.23	–0.42
300°	–0.06	–0.07	–0.09	–0.11	–0.02	–0.03	–0.39	–0.47	–0.42	–0.16	–0.17	–0.53
305°	–0.02	–0.02	0.00	–0.11	0.00	–0.06	–0.35	–0.42	–0.33	–0.12	–0.14	–0.61
310°	–0.02	–0.02	–0.01	–0.10	0.02	–0.08	–0.31	–0.36	–0.27	–0.08	–0.16	–0.58
315°	–0.03	–0.02	–0.01	–0.08	0.02	–0.10	–0.28	–0.30	–0.22	–0.03	–0.21	–0.49
320°	–0.03	–0.02	–0.01	–0.06	0.03	–0.09	–0.23	–0.22	–0.17	0.00	–0.24	–0.42
325°	–0.02	–0.01	0.00	–0.04	0.02	–0.08	–0.19	–0.17	–0.13	0.02	–0.23	–0.36
330°	–0.03	–0.03	–0.03	–0.02	0.01	–0.06	–0.15	–0.12	–0.08	0.02	–0.19	–0.32
335°	0.01	0.02	0.04	–0.02	0.00	–0.04	–0.11	–0.08	–0.05	0.01	–0.13	–0.27
340°	0.02	0.04	0.06	–0.02	–0.01	–0.02	–0.07	–0.05	–0.03	0.00	–0.09	–0.19
345°	0.04	0.05	0.08	–0.02	0.00	–0.01	–0.04	–0.02	0.00	0.00	–0.06	–0.12
350°	0.04	0.06	0.08	–0.02	–0.01	0.00	–0.02	–0.01	0.00	0.01	–0.03	–0.06
355°	0.04	0.06	0.08	–0.01	0.00	0.00	–0.01	0.00	0.01	0.01	–0.02	–0.02

Table A.43 *Influence of Outdoor Microphone Kit UA-1404 on directional response with Microphone Preamplifier ZC-0032 connected to a microphone extension cable, 4000 Hz – 10600 Hz*

	Frequency											
Angle	**4000 Hz**	4500 Hz	**5000 Hz**	5600 Hz	**6300 Hz**	7100 Hz	**8000 Hz**	8500 Hz	9000 Hz	9500 Hz	**10000 Hz**	10600 Hz
0°	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5°	–0.01	–0.01	–0.03	–0.03	–0.04	–0.06	–0.07	–0.08	–0.07	–0.08	–0.08	–0.10
10°	–0.05	–0.05	–0.09	–0.10	–0.14	–0.20	–0.20	–0.24	–0.20	–0.26	–0.25	–0.35
15°	–0.09	–0.10	–0.19	–0.22	–0.29	–0.39	–0.41	–0.49	–0.40	–0.56	–0.54	–0.74
20°	–0.14	–0.16	–0.30	–0.35	–0.50	–0.62	–0.70	–0.83	–0.72	–1.01	–1.00	–1.26
25°	–0.21	–0.22	–0.39	–0.49	–0.77	–0.83	–1.07	–1.22	–1.15	–1.55	–1.56	–1.82
30°	–0.30	–0.31	–0.48	–0.66	–1.06	–1.05	–1.51	–1.58	–1.56	–1.83	–1.91	–2.03
35°	–0.46	–0.44	–0.60	–0.92	–1.33	–1.35	–1.90	–1.87	–1.91	–1.98	–2.27	–2.18
40°	–0.64	–0.58	–0.77	–1.32	–1.58	–1.73	–2.28	–2.21	–2.20	–2.19	–2.53	–2.40
45°	–0.81	–0.69	–0.85	–1.56	–1.77	–1.95	–2.58	–2.47	–2.28	–2.34	–2.38	–2.44
50°	–0.86	–0.81	–0.91	–1.58	–1.91	–2.20	–2.59	–2.64	–2.32	–2.35	–2.17	–2.29
55°	–0.85	–1.03	–1.06	–1.66	–2.18	–2.43	–2.54	–2.73	–2.26	–2.18	–2.19	–1.82
60°	–0.89	–1.21	–1.19	–1.71	–2.46	–2.44	–2.49	–2.40	–2.14	–1.76	–1.79	–1.19
65°	–0.99	–1.18	–1.34	–1.74	–2.28	–2.41	–2.28	–2.11	–1.64	–1.29	–1.23	–0.84
70°	–0.95	–1.11	–1.61	–1.88	–2.22	–2.42	–1.96	–1.62	–1.06	–0.70	–0.59	–0.18
75°	–0.81	–1.22	–1.56	–2.01	–1.95	–1.99	–1.40	–1.24	–0.51	0.00	–0.10	0.39
80°	–0.82	–1.21	–1.34	–2.22	–1.80	–1.54	–0.96	–0.60	–0.22	0.60	0.78	0.86
85°	–0.95	–1.01	–1.34	–1.89	–1.70	–0.98	–0.34	0.03	0.38	0.77	1.46	1.71
90°	–0.93	–1.05	–1.17	–1.54	–1.67	–0.56	0.02	0.65	1.10	1.25	1.62	2.40
95°	–0.93	–1.10	–0.92	–1.26	–1.04	–0.41	0.52	0.91	1.65	2.11	2.09	2.65
100°	–1.03	–1.04	–0.90	–0.80	–0.68	0.06	0.79	1.31	1.90	2.53	2.82	3.19
105°	–1.04	–1.01	–0.82	–0.63	–0.17	0.37	1.12	1.52	2.16	2.83	3.11	3.62
110°	–1.03	–0.99	–0.64	–0.48	0.08	0.78	1.36	1.95	2.46	3.06	3.38	3.89
115°	–0.89	–0.96	–0.51	–0.29	0.20	1.01	1.69	2.13	2.74	3.41	3.66	4.15
120°	–0.48	–0.69	–0.45	–0.15	0.35	1.06	1.85	2.41	3.01	3.58	3.85	4.37
125°	–0.37	–0.15	–0.06	–0.06	0.42	1.16	1.84	2.47	3.11	3.75	4.03	4.51
130°	–0.58	–0.15	0.51	0.41	0.48	1.16	1.87	2.50	3.06	3.71	4.06	4.69
135°	–0.36	–0.34	0.39	0.74	1.00	1.34	1.79	2.35	2.94	3.66	4.02	4.68
140°	0.43	0.25	0.34	0.53	1.03	1.69	2.09	2.50	2.93	3.54	3.80	4.48
145°	0.81	1.17	1.27	0.89	0.92	1.48	1.94	2.42	2.97	3.63	3.96	4.64
150°	0.44	1.21	1.99	1.93	1.82	1.93	1.90	2.19	2.56	3.12	3.38	4.12
155°	–0.09	0.56	1.61	1.99	2.42	2.91	2.92	3.10	3.22	3.47	3.47	3.95
160°	–0.09	0.19	0.95	1.27	1.83	2.52	2.91	3.35	3.74	4.20	4.33	4.82
165°	0.44	0.59	1.03	1.15	1.51	1.96	2.04	2.35	2.64	3.09	3.26	3.82
170°	1.04	1.28	1.68	1.75	2.09	2.56	2.51	2.68	2.80	3.01	2.96	3.27
175°	1.44	1.78	2.24	2.36	2.78	3.41	3.54	3.79	4.01	4.27	4.27	4.66
180°	1.57	1.94	2.44	2.58	3.04	3.73	3.94	4.23	4.50	4.80	4.86	5.32
185°	1.44	1.77	2.24	2.36	2.78	3.41	3.53	3.77	3.98	4.23	4.23	4.64
190°	1.04	1.27	1.67	1.75	2.10	2.56	2.48	2.64	2.76	2.95	2.91	3.26
195°	0.43	0.57	1.04	1.15	1.50	1.95	1.98	2.29	2.58	3.03	3.25	3.84
200°	–0.11	0.17	0.96	1.28	1.82	2.49	2.84	3.30	3.71	4.19	4.37	4.84
205°	–0.10	0.54	1.62	2.00	2.40	2.86	2.85	3.09	3.25	3.51	3.53	3.93
210°	0.43	1.20	2.01	1.93	1.79	1.88	1.88	2.25	2.63	3.16	3.42	4.12
215°	0.80	1.16	1.29	0.88	0.88	1.47	1.98	2.52	3.03	3.68	4.03	4.76
220°	0.43	0.26	0.35	0.51	1.01	1.72	2.15	2.58	2.99	3.61	3.90	4.58
225°	–0.34	–0.33	0.41	0.74	1.01	1.40	1.83	2.39	2.99	3.70	4.00	4.62
230°	–0.56	–0.14	0.53	0.41	0.49	1.20	1.87	2.48	3.05	3.67	3.94	4.65
235°	–0.35	–0.14	–0.05	–0.07	0.40	1.17	1.81	2.43	3.07	3.74	4.05	4.66
240°	–0.46	–0.69	–0.45	–0.19	0.31	1.07	1.86	2.43	3.05	3.70	3.93	4.42
245°	–0.88	–0.97	–0.52	–0.32	0.18	1.07	1.74	2.20	2.82	3.48	3.60	4.15
250°	–1.03	–1.01	–0.66	–0.49	0.11	0.87	1.38	2.00	2.51	3.08	3.43	4.14
255°	–1.05	–1.03	–0.82	–0.60	–0.12	0.41	1.11	1.59	2.27	2.98	3.28	3.79
260°	–1.04	–1.04	–0.87	–0.76	–0.67	0.08	0.87	1.45	2.04	2.65	2.85	3.26
265°	–0.92	–1.07	–0.87	–1.26	–1.04	–0.34	0.63	1.00	1.70	2.17	2.15	2.85
270°	–0.90	–1.01	–1.14	–1.58	–1.63	–0.44	0.05	0.67	1.17	1.40	1.72	2.52
275°	–0.90	–0.98	–1.36	–1.90	–1.61	–0.89	–0.35	0.13	0.51	0.87	1.47	1.86
280°	–0.78	–1.20	–1.36	–2.17	–1.72	–1.51	–0.88	–0.44	–0.16	0.63	0.91	1.08
285°	–0.79	–1.23	–1.55	–1.93	–1.92	–1.93	–1.29	–1.18	–0.50	0.17	0.07	0.53
290°	–0.95	–1.12	–1.56	–1.84	–2.21	–2.32	–1.93	–1.61	–0.90	–0.51	–0.55	–0.01
295°	–1.00	–1.15	–1.27	–1.75	–2.24	–2.30	–2.29	–1.99	–1.46	–1.22	–1.14	–0.65
300°	–0.90	–1.17	–1.14	–1.76	–2.37	–2.39	–2.42	–2.22	–2.09	–1.68	–1.64	–1.13
305°	–0.84	–0.96	–1.05	–1.69	–2.09	–2.43	–2.40	–2.64	–2.25	–2.01	–2.15	–1.72
310°	–0.84	–0.73	–0.92	–1.56	–1.83	–2.18	–2.48	–2.65	–2.21	–2.22	–2.18	–2.06
315°	–0.77	–0.63	–0.87	–1.51	–1.73	–1.90	–2.55	–2.45	–2.12	–2.32	–2.28	–2.25
320°	–0.60	–0.55	–0.80	–1.26	–1.55	–1.62	–2.28	–2.10	–2.09	–2.17	–2.36	–2.32
325°	–0.40	–0.41	–0.61	–0.87	–1.31	–1.23	–1.89	–1.73	–1.88	–1.89	–2.13	–2.14
330°	–0.25	–0.29	–0.48	–0.62	–1.04	–0.94	–1.45	–1.45	–1.57	–1.70	–1.85	–1.96
335°	–0.16	–0.21	–0.38	–0.47	–0.75	–0.75	–0.98	–1.13	–1.14	–1.41	–1.54	–1.72
340°	–0.10	–0.15	–0.27	–0.33	–0.47	–0.56	–0.58	–0.78	–0.67	–0.89	–1.00	–1.15
345°	–0.04	–0.11	–0.16	–0.20	–0.26	–0.37	–0.29	–0.48	–0.35	–0.46	–0.55	–0.64
350°	0.00	–0.06	–0.06	–0.10	–0.10	–0.19	–0.11	–0.25	–0.15	–0.19	–0.27	–0.27
355°	0.03	–0.04	0.01	–0.04	–0.01	–0.07	0.02	–0.10	–0.02	–0.03	–0.09	–0.04

Table A.44 *Influence of Outdoor Microphone Kit UA-1404 on directional response with Microphone Preamplifier ZC-0032 connected to a microphone extension cable, 11200 Hz – 20000 Hz*

	Frequency										
Angle	11200 Hz	11800 Hz	**12500 Hz**	13200 Hz	14000 Hz	15000 Hz	**16000 Hz**	17000 Hz	18000 Hz	19000 Hz	**20000 Hz**
0°	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5°	–0.12	–0.12	–0.12	–0.13	–0.13	–0.16	–0.16	–0.13	–0.11	–0.15	–0.18
10°	–0.38	–0.42	–0.43	–0.48	–0.50	–0.63	–0.61	–0.51	–0.43	–0.52	–0.62
15°	–0.75	–0.88	–0.88	–0.96	–1.05	–1.32	–1.24	–1.12	–1.01	–1.16	–1.26
20°	–1.21	–1.44	–1.40	–1.46	–1.68	–2.05	–1.90	–1.84	–1.83	–2.13	–2.25
25°	–1.75	–1.99	–1.82	–1.97	–2.18	–2.40	–2.39	–2.35	–2.35	–2.81	–3.14
30°	–2.15	–2.37	–2.07	–2.42	–2.64	–2.67	–2.88	–2.98	–2.91	–3.36	–3.68
35°	–2.44	–2.48	–2.40	–2.65	–2.83	–2.96	–3.43	–3.39	–3.30	–3.59	–3.90
40°	–2.65	–2.61	–2.65	–2.69	–3.01	–3.17	–3.36	–3.26	–2.84	–2.90	–2.79
45°	–2.40	–2.60	–2.69	–2.64	–3.13	–2.97	–2.86	–2.51	–1.85	–1.48	–0.80
50°	–2.32	–2.53	–2.39	–2.58	–2.52	–2.03	–1.85	–0.90	0.00	0.55	1.16
55°	–2.28	–2.06	–2.07	–1.94	–1.52	–0.90	–0.27	0.95	1.59	1.82	2.46
60°	–1.46	–1.40	–1.15	–0.78	–0.50	0.49	1.17	2.22	2.99	3.38	3.77
65°	–0.68	–0.88	–0.19	–0.08	0.84	1.49	2.46	3.51	3.87	4.39	4.67
70°	–0.03	0.20	0.90	1.17	1.98	2.52	3.44	3.99	4.89	5.43	5.66
75°	0.63	0.85	1.90	2.19	2.78	3.37	3.88	4.63	5.61	6.17	6.80
80°	1.48	1.52	2.42	2.90	3.41	3.85	4.32	5.20	6.34	6.95	8.11
85°	1.95	2.59	2.84	3.59	3.74	4.63	4.54	5.86	6.59	8.03	9.12
90°	2.54	3.03	3.69	3.74	4.62	4.71	5.75	6.34	7.82	8.69	9.99
95°	3.07	3.32	4.27	4.40	4.76	5.49	5.89	7.38	8.60	9.97	11.40
100°	3.39	3.62	4.20	4.82	5.36	5.86	6.55	7.68	9.19	10.69	12.12
105°	3.85	4.17	4.53	4.79	5.75	6.66	7.41	8.53	9.88	11.27	12.78
110°	3.99	4.35	4.95	5.36	5.89	6.67	7.76	9.23	10.71	11.97	12.99
115°	4.33	4.52	4.94	5.52	6.60	7.49	8.31	9.75	11.36	12.60	13.79
120°	4.59	4.85	5.41	5.70	6.59	7.57	9.01	10.63	11.94	13.22	14.12
125°	4.58	4.82	5.55	6.13	7.20	7.99	9.07	10.64	12.52	13.78	14.72
130°	4.78	5.04	5.45	5.90	7.01	8.32	9.63	11.24	12.70	14.11	14.94
135°	4.84	5.24	5.85	6.19	7.02	8.02	9.36	11.28	13.04	14.47	15.42
140°	4.83	5.25	5.98	6.54	7.54	8.38	9.42	11.03	12.89	14.27	15.44
145°	4.93	5.21	5.83	6.46	7.55	8.68	9.92	11.45	13.03	14.59	15.63
150°	4.62	5.27	6.06	6.74	7.68	8.63	9.88	11.46	12.98	14.40	15.84
155°	4.13	4.65	5.34	6.05	7.11	8.20	9.67	11.57	13.22	14.53	15.73
160°	4.96	5.28	5.80	6.34	7.10	7.84	8.97	10.63	12.27	13.83	15.08
165°	4.07	4.67	5.45	6.28	7.34	8.33	9.42	10.92	12.30	13.60	14.91
170°	3.20	3.39	3.78	4.24	5.02	6.00	7.09	8.66	10.16	11.44	12.94
175°	4.68	4.85	5.23	5.45	5.89	6.47	7.30	8.53	9.77	10.80	12.09
180°	5.44	5.72	6.21	6.55	7.03	7.62	8.47	9.74	10.92	11.93	13.26
185°	4.70	4.90	5.26	5.43	5.81	6.40	7.30	8.63	9.86	10.73	12.01
190°	3.25	3.46	3.79	4.15	4.87	5.91	7.17	8.86	10.25	11.18	12.88
195°	4.14	4.68	5.36	6.12	7.19	8.36	9.59	11.08	12.22	13.16	15.04
200°	4.96	5.18	5.64	6.23	7.10	7.99	9.13	10.74	12.31	13.54	15.54
205°	4.06	4.54	5.30	6.15	7.31	8.49	10.03	12.04	13.58	14.58	16.69
210°	4.61	5.37	6.22	7.01	8.07	9.12	10.38	11.92	13.33	14.50	16.41
215°	5.04	5.45	6.03	6.77	7.87	8.89	10.05	11.73	13.16	14.07	15.94
220°	4.88	5.38	5.98	6.60	7.49	8.42	9.77	11.43	13.03	14.31	16.10
225°	4.79	5.22	5.73	6.30	7.36	8.54	9.81	11.67	13.28	14.24	15.91
230°	4.88	5.16	5.62	6.33	7.43	8.44	9.81	11.54	12.86	14.06	15.71
235°	4.75	4.98	5.61	6.22	7.28	8.30	9.60	11.10	12.78	13.69	15.26
240°	4.53	4.89	5.35	5.95	7.13	7.96	9.28	10.94	12.10	13.16	14.78
245°	4.39	4.79	5.17	5.91	6.79	7.65	8.69	10.12	11.71	12.57	14.47
250°	4.21	4.55	5.08	5.52	6.23	7.05	8.08	9.59	10.96	12.15	13.96
255°	3.89	4.29	4.72	5.15	6.09	6.84	7.77	9.04	10.38	11.37	13.42
260°	3.53	3.85	4.39	5.03	5.63	6.28	7.05	8.10	9.44	10.78	12.92
265°	3.21	3.44	4.41	4.70	5.23	5.85	6.23	7.73	8.98	10.13	12.18
270°	2.62	3.21	3.95	4.08	4.96	5.01	6.08	6.80	8.20	8.88	10.90
275°	2.14	2.79	3.08	3.84	4.07	4.88	5.00	6.24	7.01	8.30	9.80
280°	1.60	1.73	2.59	3.14	3.76	4.26	4.63	5.69	6.74	7.15	8.91
285°	0.77	1.04	2.03	2.49	3.19	3.62	4.38	4.98	6.02	6.53	7.42
290°	0.11	0.32	1.12	1.51	2.26	2.97	3.76	4.44	5.37	5.61	6.30
295°	–0.63	–0.69	0.07	0.13	1.31	1.71	2.96	3.90	4.23	4.71	5.39
300°	–1.31	–1.19	–0.99	–0.47	–0.21	0.86	1.49	2.69	3.38	3.65	4.33
305°	–2.07	–1.94	–1.91	–1.63	–1.29	–0.55	0.11	1.26	1.94	2.08	3.06
310°	–2.23	–2.39	–2.15	–2.43	–2.11	–1.80	–1.53	–0.48	0.34	0.77	1.62
315°	–2.38	–2.41	–2.52	–2.41	–2.89	–2.61	–2.61	–2.19	–1.52	–1.24	–0.30
320°	–2.55	–2.43	–2.53	–2.40	–2.84	–2.90	–3.04	–3.01	–2.56	–2.74	–2.41
325°	–2.29	–2.37	–2.23	–2.47	–2.58	–2.79	–3.15	–3.13	–3.06	–3.37	–3.51
330°	–1.99	–2.30	–1.85	–2.32	–2.40	–2.47	–2.70	–2.72	–2.69	–3.17	–3.34
335°	–1.65	–1.91	–1.66	–1.85	–2.01	–2.19	–2.25	–2.16	–2.14	–2.67	–2.90
340°	–1.15	–1.34	–1.31	–1.32	–1.57	–1.87	–1.76	–1.71	–1.65	–1.99	–2.03
345°	–0.73	–0.78	–0.83	–0.83	–0.98	–1.19	–1.12	–1.06	–0.90	–1.04	–1.08
350°	–0.38	–0.34	–0.42	–0.41	–0.45	–0.55	–0.50	–0.47	–0.39	–0.45	–0.50
355°	–0.13	–0.06	–0.12	–0.10	–0.12	–0.13	–0.09	–0.11	–0.12	–0.12	–0.12

Table A.45 *Directional response for Outdoor Microphone Kit UA-1404, Microphone Type 4189 and Microphone Preamplifier ZC-0032, with the microphone preamplifier connected to a microphone extension cable, 500 Hz – 3550 Hz*

	Frequency											
Angle	**500 Hz**	**630 Hz**	**800 Hz**	**1000 Hz**	**1250 Hz**	**1600 Hz**	**2000 Hz**	2240 Hz	**2500 Hz**	2800 Hz	**3150 Hz**	3550 Hz
0°	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5°	0.05	0.06	0.07	0.00	–0.01	–0.01	–0.01	–0.01	–0.01	–0.01	–0.01	–0.02
10°	0.05	0.06	0.08	0.00	–0.01	–0.02	–0.03	–0.03	–0.03	–0.03	–0.04	–0.07
15°	0.05	0.06	0.07	0.00	–0.02	–0.03	–0.05	–0.05	–0.05	–0.05	–0.08	–0.16
20°	0.03	0.04	0.05	–0.02	–0.03	–0.06	–0.09	–0.08	–0.09	–0.08	–0.14	–0.26
25°	0.02	0.03	0.03	–0.02	–0.03	–0.08	–0.13	–0.12	–0.14	–0.11	–0.23	–0.37
30°	–0.02	–0.03	–0.04	–0.03	–0.03	–0.12	–0.19	–0.17	–0.20	–0.15	–0.33	–0.47
35°	–0.01	–0.01	–0.02	–0.06	–0.04	–0.16	–0.25	–0.24	–0.27	–0.20	–0.43	–0.56
40°	–0.02	–0.03	–0.04	–0.09	–0.04	–0.20	–0.31	–0.31	–0.34	–0.27	–0.50	–0.67
45°	–0.03	–0.04	–0.05	–0.13	–0.06	–0.22	–0.38	–0.40	–0.41	–0.36	–0.54	–0.81
50°	–0.03	–0.04	–0.05	–0.15	–0.08	–0.24	–0.44	–0.48	–0.48	–0.45	–0.57	–0.97
55°	–0.03	–0.04	–0.05	–0.17	–0.12	–0.24	–0.51	–0.57	–0.57	–0.53	–0.63	–1.08
60°	–0.07	–0.10	–0.14	–0.19	–0.16	–0.24	–0.59	–0.65	–0.68	–0.60	–0.74	–1.09
65°	–0.04	–0.06	–0.07	–0.20	–0.19	–0.25	–0.66	–0.72	–0.78	–0.68	–0.85	–1.09
70°	–0.05	–0.06	–0.08	–0.22	–0.22	–0.26	–0.69	–0.80	–0.86	–0.79	–0.91	–1.18
75°	–0.06	–0.07	–0.09	–0.23	–0.25	–0.29	–0.68	–0.88	–0.93	–0.90	–0.97	–1.34
80°	–0.06	–0.08	–0.10	–0.24	–0.28	–0.33	–0.65	–0.91	–1.02	–0.98	–1.10	–1.39
85°	–0.07	–0.09	–0.11	–0.24	–0.29	–0.38	–0.62	–0.87	–1.10	–1.06	–1.23	–1.45
90°	–0.10	–0.14	–0.19	–0.25	–0.29	–0.42	–0.63	–0.80	–1.09	–1.16	–1.29	–1.60
95°	–0.09	–0.11	–0.14	–0.25	–0.28	–0.44	–0.68	–0.77	–0.99	–1.20	–1.37	–1.73
100°	–0.10	–0.12	–0.15	–0.26	–0.27	–0.43	–0.75	–0.83	–0.91	–1.09	–1.48	–1.75
105°	–0.11	–0.14	–0.17	–0.28	–0.27	–0.40	–0.78	–0.91	–0.95	–0.95	–1.38	–1.85
110°	–0.11	–0.14	–0.18	–0.29	–0.27	–0.36	–0.75	–0.95	–1.06	–0.97	–1.15	–1.80
115°	–0.13	–0.16	–0.20	–0.31	–0.29	–0.33	–0.67	–0.89	–1.10	–1.12	–1.16	–1.48
120°	–0.13	–0.19	–0.26	–0.33	–0.31	–0.32	–0.58	–0.76	–1.00	–1.16	–1.35	–1.44
125°	–0.14	–0.17	–0.22	–0.35	–0.34	–0.34	–0.53	–0.65	–0.81	–0.98	–1.37	–1.70
130°	–0.14	–0.17	–0.22	–0.35	–0.35	–0.38	–0.54	–0.60	–0.67	–0.70	–1.05	–1.64
135°	–0.13	–0.17	–0.21	–0.34	–0.36	–0.42	–0.60	–0.65	–0.66	–0.57	–0.68	–1.08
140°	–0.12	–0.15	–0.19	–0.32	–0.34	–0.42	–0.65	–0.73	–0.77	–0.64	–0.60	–0.63
145°	–0.10	–0.13	–0.17	–0.29	–0.30	–0.39	–0.65	–0.77	–0.86	–0.81	–0.80	–0.71
150°	–0.10	–0.14	–0.20	–0.25	–0.24	–0.32	–0.58	–0.71	–0.85	–0.87	–1.00	–1.06
155°	–0.07	–0.09	–0.11	–0.21	–0.18	–0.22	–0.44	–0.56	–0.68	–0.71	–0.91	–1.19
160°	–0.05	–0.07	–0.08	–0.16	–0.11	–0.11	–0.28	–0.35	–0.42	–0.40	–0.54	–0.84
165°	–0.04	–0.05	–0.06	–0.13	–0.06	–0.02	–0.13	–0.16	–0.17	–0.06	–0.09	–0.26
170°	–0.03	–0.03	–0.04	–0.10	–0.01	0.05	–0.02	–0.01	0.03	0.21	0.27	0.25
175°	–0.02	–0.03	–0.03	–0.09	0.01	0.09	0.05	0.08	0.15	0.37	0.50	0.56
180°	–0.04	–0.06	–0.08	–0.08	0.03	0.11	0.07	0.11	0.19	0.42	0.57	0.67
185°	–0.02	–0.03	–0.03	–0.09	0.01	0.09	0.05	0.08	0.15	0.37	0.50	0.56
190°	–0.03	–0.03	–0.04	–0.10	–0.01	0.05	–0.02	–0.01	0.03	0.21	0.27	0.25
195°	–0.04	–0.05	–0.06	–0.13	–0.06	–0.02	–0.13	–0.16	–0.17	–0.06	–0.09	–0.26
200°	–0.05	–0.07	–0.08	–0.16	–0.11	–0.11	–0.28	–0.35	–0.42	–0.40	–0.54	–0.84
205°	–0.07	–0.09	–0.11	–0.21	–0.18	–0.22	–0.44	–0.56	–0.68	–0.71	–0.91	–1.19
210°	–0.10	–0.14	–0.20	–0.25	–0.24	–0.32	–0.58	–0.71	–0.85	–0.87	–1.00	–1.06
215°	–0.10	–0.13	–0.17	–0.29	–0.30	–0.39	–0.65	–0.77	–0.86	–0.81	–0.80	–0.71
220°	–0.12	–0.15	–0.19	–0.32	–0.34	–0.42	–0.65	–0.73	–0.77	–0.64	–0.60	–0.63
225°	–0.13	–0.17	–0.21	–0.34	–0.36	–0.42	–0.60	–0.65	–0.66	–0.57	–0.68	–1.08
230°	–0.14	–0.17	–0.22	–0.35	–0.35	–0.38	–0.54	–0.60	–0.67	–0.70	–1.05	–1.64
235°	–0.14	–0.17	–0.22	–0.35	–0.34	–0.34	–0.53	–0.65	–0.81	–0.98	–1.37	–1.70
240°	–0.13	–0.19	–0.26	–0.33	–0.31	–0.32	–0.58	–0.76	–1.00	–1.16	–1.35	–1.44
245°	–0.13	–0.16	–0.20	–0.31	–0.29	–0.33	–0.67	–0.89	–1.10	–1.12	–1.16	–1.48
250°	–0.11	–0.14	–0.18	–0.29	–0.27	–0.36	–0.75	–0.95	–1.06	–0.97	–1.15	–1.80
255°	–0.11	–0.14	–0.17	–0.28	–0.27	–0.40	–0.78	–0.91	–0.95	–0.95	–1.38	–1.85
260°	–0.10	–0.12	–0.15	–0.26	–0.27	–0.43	–0.75	–0.83	–0.91	–1.09	–1.48	–1.75
265°	–0.09	–0.11	–0.14	–0.25	–0.28	–0.44	–0.68	–0.77	–0.99	–1.20	–1.37	–1.73
270°	–0.10	–0.14	–0.19	–0.25	–0.29	–0.42	–0.63	–0.80	–1.09	–1.16	–1.29	–1.60
275°	–0.07	–0.09	–0.11	–0.24	–0.29	–0.38	–0.62	–0.87	–1.10	–1.06	–1.23	–1.45
280°	–0.06	–0.08	–0.10	–0.24	–0.28	–0.33	–0.65	–0.91	–1.02	–0.98	–1.10	–1.39
285°	–0.06	–0.07	–0.09	–0.23	–0.25	–0.29	–0.68	–0.88	–0.93	–0.90	–0.97	–1.34
290°	–0.05	–0.06	–0.08	–0.22	–0.22	–0.26	–0.69	–0.80	–0.86	–0.79	–0.91	–1.18
295°	–0.04	–0.06	–0.07	–0.20	–0.19	–0.25	–0.66	–0.72	–0.78	–0.68	–0.85	–1.09
300°	–0.07	–0.10	–0.14	–0.19	–0.16	–0.24	–0.59	–0.65	–0.68	–0.60	–0.74	–1.09
305°	–0.03	–0.04	–0.05	–0.17	–0.12	–0.24	–0.51	–0.57	–0.57	–0.53	–0.63	–1.08
310°	–0.03	–0.04	–0.05	–0.15	–0.08	–0.24	–0.44	–0.48	–0.48	–0.45	–0.57	–0.97
315°	–0.03	–0.04	–0.05	–0.13	–0.06	–0.22	–0.38	–0.40	–0.41	–0.36	–0.54	–0.81
320°	–0.02	–0.03	–0.04	–0.09	–0.04	–0.20	–0.31	–0.31	–0.34	–0.27	–0.50	–0.67
325°	–0.01	–0.01	–0.02	–0.06	–0.04	–0.16	–0.25	–0.24	–0.27	–0.20	–0.43	–0.56
330°	–0.02	–0.03	–0.04	–0.03	–0.03	–0.12	–0.19	–0.17	–0.20	–0.15	–0.33	–0.47
335°	0.02	0.03	0.03	–0.02	–0.03	–0.08	–0.13	–0.12	–0.14	–0.11	–0.23	–0.37
340°	0.03	0.04	0.05	–0.02	–0.03	–0.06	–0.09	–0.08	–0.09	–0.08	–0.14	–0.26
345°	0.05	0.06	0.07	0.00	–0.02	–0.03	–0.05	–0.05	–0.05	–0.05	–0.08	–0.16
350°	0.05	0.06	0.08	0.00	–0.01	–0.02	–0.03	–0.03	–0.03	–0.03	–0.04	–0.07
355°	0.05	0.06	0.07	0.00	–0.01	–0.01	–0.01	–0.01	–0.01	–0.01	–0.01	–0.02

Table A.46 *Directional response for Outdoor Microphone Kit UA-1404, Microphone Type 4189 and Microphone Preamplifier ZC-0032, with the microphone preamplifier connected to a microphone extension cable, 4000 Hz – 10600 Hz*

	Frequency											
Angle	**4000 Hz**	4500 Hz	**5000 Hz**	5600 Hz	**6300 Hz**	7100 Hz	**8000 Hz**	8500 Hz	9000 Hz	9500 Hz	**10000 Hz**	10600 Hz
0°	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5°	–0.02	–0.02	–0.03	–0.04	–0.04	–0.06	–0.07	–0.08	–0.08	–0.08	–0.09	–0.11
10°	–0.07	–0.08	–0.11	–0.14	–0.16	–0.23	–0.26	–0.28	–0.28	–0.30	–0.34	–0.40
15°	–0.14	–0.17	–0.23	–0.30	–0.34	–0.48	–0.55	–0.59	–0.60	–0.66	–0.75	–0.84
20°	–0.23	–0.29	–0.38	–0.51	–0.61	–0.81	–0.95	–1.02	–1.07	–1.22	–1.36	–1.46
25°	–0.35	–0.43	–0.54	–0.74	–0.94	–1.16	–1.46	–1.55	–1.70	–1.93	–2.09	–2.21
30°	–0.49	–0.61	–0.72	–0.97	–1.33	–1.56	–2.01	–2.10	–2.29	–2.48	–2.58	–2.71
35°	–0.70	–0.83	–0.97	–1.29	–1.75	–2.06	–2.51	–2.61	–2.81	–2.96	–3.10	–3.22
40°	–0.96	–1.07	–1.30	–1.74	–2.18	–2.60	–3.00	–3.17	–3.30	–3.48	–3.64	–3.73
45°	–1.19	–1.26	–1.54	–2.06	–2.57	–2.97	–3.50	–3.60	–3.66	–3.86	–3.93	–3.99
50°	–1.33	–1.46	–1.77	–2.24	–2.85	–3.35	–3.80	–3.91	–4.02	–4.08	–4.13	–4.22
55°	–1.41	–1.78	–2.06	–2.55	–3.23	–3.78	–4.09	–4.19	–4.20	–4.25	–4.33	–4.38
60°	–1.55	–2.08	–2.27	–2.86	–3.61	–4.02	–4.32	–4.20	–4.24	–4.23	–4.13	–4.16
65°	–1.73	–2.17	–2.52	–3.09	–3.66	–4.15	–4.32	–4.25	–4.03	–4.00	–3.99	–3.96
70°	–1.79	–2.23	–2.92	–3.34	–3.94	–4.28	–4.24	–3.98	–3.86	–3.71	–3.66	–3.69
75°	–1.72	–2.45	–3.05	–3.51	–3.98	–4.05	–3.95	–3.78	–3.54	–3.52	–3.45	–3.44
80°	–1.80	–2.51	–3.02	–3.82	–3.99	–3.95	–3.73	–3.45	–3.33	–3.20	–3.20	–3.15
85°	–1.99	–2.38	–3.16	–3.70	–3.93	–3.74	–3.31	–3.20	–3.03	–3.00	–2.92	–2.88
90°	–2.04	–2.47	–3.06	–3.58	–3.98	–3.52	–3.19	–2.85	–2.79	–2.77	–2.67	–2.63
95°	–2.09	–2.58	–2.85	–3.45	–3.52	–3.47	–2.95	–2.78	–2.54	–2.47	–2.46	–2.43
100°	–2.24	–2.57	–2.87	–3.06	–3.36	–3.11	–2.88	–2.59	–2.43	–2.37	–2.26	–2.26
105°	–2.28	–2.59	–2.84	–2.92	–2.96	–2.96	–2.71	–2.59	–2.33	–2.20	–2.22	–2.23
110°	–2.30	–2.60	–2.69	–2.79	–2.76	–2.67	–2.56	–2.29	–2.20	–2.16	–2.11	–2.15
115°	–2.19	–2.59	–2.58	–2.60	–2.65	–2.51	–2.32	–2.20	–2.03	–1.94	–1.98	–2.11
120°	–1.82	–2.36	–2.55	–2.49	–2.49	–2.46	–2.20	–2.02	–1.86	–1.88	–1.88	–1.97
125°	–1.75	–1.84	–2.20	–2.41	–2.41	–2.30	–2.19	–1.98	–1.79	–1.79	–1.80	–1.94
130°	–1.99	–1.88	–1.68	–1.98	–2.37	–2.29	–2.06	–1.85	–1.75	–1.75	–1.75	–1.83
135°	–1.77	–2.09	–1.84	–1.70	–1.90	–2.14	–2.08	–1.90	–1.74	–1.65	–1.58	–1.66
140°	–0.97	–1.49	–1.90	–1.95	–1.93	–1.87	–1.82	–1.75	–1.72	–1.70	–1.68	–1.66
145°	–0.54	–0.53	–0.93	–1.55	–2.06	–2.15	–2.05	–1.92	–1.76	–1.67	–1.57	–1.52
150°	–0.83	–0.40	–0.13	–0.41	–1.08	–1.67	–2.12	–2.21	–2.24	–2.27	–2.25	–2.16
155°	–1.27	–0.95	–0.39	–0.21	–0.32	–0.54	–0.99	–1.22	–1.51	–1.86	–2.13	–2.33
160°	–1.19	–1.20	–0.91	–0.76	–0.72	–0.71	–0.74	–0.73	–0.75	–0.88	–1.03	–1.22
165°	–0.57	–0.70	–0.70	–0.73	–0.85	–1.05	–1.34	–1.44	–1.54	–1.66	–1.74	–1.82
170°	0.09	0.07	0.04	0.00	–0.11	–0.25	–0.63	–0.85	–1.10	–1.42	–1.69	–1.98
175°	0.53	0.62	0.66	0.68	0.67	0.72	0.55	0.43	0.30	0.05	–0.14	–0.33
180°	0.68	0.81	0.88	0.94	0.96	1.08	1.00	0.93	0.86	0.67	0.55	0.44
185°	0.53	0.62	0.66	0.68	0.67	0.72	0.55	0.43	0.30	0.05	–0.14	–0.33
190°	0.09	0.07	0.04	0.00	–0.11	–0.25	–0.63	–0.85	–1.10	–1.42	–1.69	–1.98
195°	–0.57	–0.70	–0.70	–0.73	–0.85	–1.05	–1.34	–1.44	–1.54	–1.66	–1.74	–1.82
200°	–1.19	–1.20	–0.91	–0.76	–0.72	–0.71	–0.74	–0.73	–0.75	–0.88	–1.03	–1.22
205°	–1.27	–0.95	–0.39	–0.21	–0.32	–0.54	–0.99	–1.22	–1.51	–1.86	–2.13	–2.33
210°	–0.83	–0.40	–0.13	–0.41	–1.08	–1.67	–2.12	–2.21	–2.24	–2.27	–2.25	–2.16
215°	–0.54	–0.53	–0.93	–1.55	–2.06	–2.15	–2.05	–1.92	–1.76	–1.67	–1.57	–1.52
220°	–0.97	–1.49	–1.90	–1.95	–1.93	–1.87	–1.82	–1.75	–1.72	–1.70	–1.68	–1.66
225°	–1.77	–2.09	–1.84	–1.70	–1.90	–2.14	–2.08	–1.90	–1.74	–1.65	–1.58	–1.66
230°	–1.99	–1.88	–1.68	–1.98	–2.37	–2.29	–2.06	–1.85	–1.75	–1.75	–1.75	–1.83
235°	–1.75	–1.84	–2.20	–2.41	–2.41	–2.30	–2.19	–1.98	–1.79	–1.79	–1.80	–1.94
240°	–1.82	–2.36	–2.55	–2.49	–2.49	–2.46	–2.20	–2.02	–1.86	–1.88	–1.88	–1.97
245°	–2.19	–2.59	–2.58	–2.60	–2.65	–2.51	–2.32	–2.20	–2.03	–1.94	–1.98	–2.11
250°	–2.30	–2.60	–2.69	–2.79	–2.76	–2.67	–2.56	–2.29	–2.20	–2.16	–2.11	–2.15
255°	–2.28	–2.59	–2.84	–2.92	–2.96	–2.96	–2.71	–2.59	–2.33	–2.20	–2.22	–2.23
260°	–2.24	–2.57	–2.87	–3.06	–3.36	–3.11	–2.88	–2.59	–2.43	–2.37	–2.26	–2.26
265°	–2.09	–2.58	–2.85	–3.45	–3.52	–3.47	–2.95	–2.78	–2.54	–2.47	–2.46	–2.43
270°	–2.04	–2.47	–3.06	–3.58	–3.98	–3.52	–3.19	–2.85	–2.79	–2.77	–2.67	–2.63
275°	–1.99	–2.38	–3.16	–3.70	–3.93	–3.74	–3.31	–3.20	–3.03	–3.00	–2.92	–2.88
280°	–1.80	–2.51	–3.02	–3.82	–3.99	–3.95	–3.73	–3.45	–3.33	–3.20	–3.20	–3.15
285°	–1.72	–2.45	–3.05	–3.51	–3.98	–4.05	–3.95	–3.78	–3.54	–3.52	–3.45	–3.44
290°	–1.79	–2.23	–2.92	–3.34	–3.94	–4.28	–4.24	–3.98	–3.86	–3.71	–3.66	–3.69
295°	–1.73	–2.17	–2.52	–3.09	–3.66	–4.15	–4.32	–4.25	–4.03	–4.00	–3.99	–3.96
300°	–1.55	–2.08	–2.27	–2.86	–3.61	–4.02	–4.32	–4.20	–4.24	–4.23	–4.13	–4.16
305°	–1.41	–1.78	–2.06	–2.55	–3.23	–3.78	–4.09	–4.19	–4.20	–4.25	–4.33	–4.38
310°	–1.33	–1.46	–1.77	–2.24	–2.85	–3.35	–3.80	–3.91	–4.02	–4.08	–4.13	–4.22
315°	–1.19	–1.26	–1.54	–2.06	–2.57	–2.97	–3.50	–3.60	–3.66	–3.86	–3.93	–3.99
320°	–0.96	–1.07	–1.30	–1.74	–2.18	–2.60	–3.00	–3.17	–3.30	–3.48	–3.64	–3.73
325°	–0.70	–0.83	–0.97	–1.29	–1.75	–2.06	–2.51	–2.61	–2.81	–2.96	–3.10	–3.22
330°	–0.49	–0.61	–0.72	–0.97	–1.33	–1.56	–2.01	–2.10	–2.29	–2.48	–2.58	–2.71
335°	–0.35	–0.43	–0.54	–0.74	–0.94	–1.16	–1.46	–1.55	–1.70	–1.93	–2.09	–2.21
340°	–0.23	–0.29	–0.38	–0.51	–0.61	–0.81	–0.95	–1.02	–1.07	–1.22	–1.36	–1.46
345°	–0.14	–0.17	–0.23	–0.30	–0.34	–0.48	–0.55	–0.59	–0.60	–0.66	–0.75	–0.84
350°	–0.07	–0.08	–0.11	–0.14	–0.16	–0.23	–0.26	–0.28	–0.28	–0.30	–0.34	–0.40
355°	–0.02	–0.02	–0.03	–0.04	–0.04	–0.06	–0.07	–0.08	–0.08	–0.08	–0.09	–0.11

Table A.47 *Directional response for Outdoor Microphone Kit UA-1404, Microphone Type 4189 and Microphone Preamplifier ZC-0032, with the microphone preamplifier connected to a microphone extension cable, 11200 Hz – 20000 Hz*

	Frequency										
Angle	11200 Hz	11800 Hz	**12500 Hz**	13200 Hz	14000 Hz	15000 Hz	**16000 Hz**	17000 Hz	18000 Hz	19000 Hz	**20000 Hz**
0°	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5°	–0.13	–0.14	–0.14	–0.16	–0.16	–0.18	–0.18	–0.16	–0.16	–0.19	–0.21
10°	–0.47	–0.50	–0.50	–0.61	–0.63	–0.68	–0.70	–0.65	–0.61	–0.70	–0.78
15°	–0.96	–1.06	–1.07	–1.24	–1.34	–1.46	–1.49	–1.46	–1.44	–1.58	–1.67
20°	–1.60	–1.72	–1.80	–1.94	–2.16	–2.36	–2.41	–2.45	–2.61	–2.87	–3.02
25°	–2.34	–2.42	–2.54	–2.68	–2.88	–3.06	–3.25	–3.30	–3.52	–3.88	–4.30
30°	–2.90	–3.05	–3.11	–3.37	–3.63	–3.85	–4.03	–4.23	–4.44	–4.88	–5.29
35°	–3.37	–3.52	–3.70	–3.94	–4.25	–4.63	–4.86	–5.06	–5.36	–5.80	–6.18
40°	–3.87	–4.01	–4.17	–4.51	–4.83	–5.18	–5.37	–5.51	–5.53	–5.71	–5.72
45°	–4.09	–4.28	–4.59	–4.94	–5.29	–5.52	–5.56	–5.27	–5.01	–4.78	–4.51
50°	–4.36	–4.57	–4.80	–5.15	–5.27	–5.23	–4.90	–4.40	–3.86	–3.61	–3.43
55°	–4.54	–4.67	–4.85	–4.97	–4.86	–4.50	–3.98	–3.39	–2.96	–2.91	–2.87
60°	–4.25	–4.38	–4.43	–4.39	–4.17	–3.79	–3.19	–2.57	–2.36	–2.40	–2.51
65°	–4.11	–4.21	–4.16	–3.98	–3.60	–3.10	–2.54	–2.16	–2.06	–2.28	–2.40
70°	–3.71	–3.72	–3.55	–3.36	–2.99	–2.63	–2.29	–2.06	–1.99	–2.14	–2.24
75°	–3.47	–3.34	–3.15	–2.94	–2.76	–2.52	–2.38	–2.14	–2.04	–1.97	–2.05
80°	–3.12	–3.04	–2.89	–2.82	–2.74	–2.74	–2.59	–2.27	–2.02	–1.92	–1.68
85°	–2.80	–2.67	–2.60	–2.68	–2.76	–2.85	–2.88	–2.59	–2.19	–1.86	–1.39
90°	–2.62	–2.55	–2.48	–2.56	–2.66	–2.76	–2.76	–2.43	–2.12	–1.77	–1.15
95°	–2.45	–2.45	–2.46	–2.57	–2.63	–2.71	–2.64	–2.28	–1.88	–1.46	–0.67
100°	–2.38	–2.43	–2.53	–2.69	–2.73	–2.68	–2.57	–2.20	–1.82	–1.40	–0.65
105°	–2.30	–2.37	–2.55	–2.66	–2.60	–2.50	–2.31	–1.87	–1.50	–1.10	–0.52
110°	–2.36	–2.46	–2.63	–2.70	–2.63	–2.47	–2.22	–1.78	–1.36	–1.03	–0.44
115°	–2.30	–2.49	–2.76	–2.81	–2.58	–2.20	–1.87	–1.31	–0.94	–0.80	–0.40
120°	–2.16	–2.43	–2.67	–2.82	–2.64	–2.33	–1.79	–1.05	–0.70	–0.43	–0.15
125°	–2.16	–2.39	–2.52	–2.64	–2.43	–2.12	–1.61	–1.14	–0.68	–0.44	–0.06
130°	–2.08	–2.29	–2.53	–2.64	–2.45	–2.00	–1.46	–0.75	–0.39	–0.18	0.07
135°	–1.91	–2.10	–2.33	–2.52	–2.44	–2.02	–1.48	–0.77	–0.27	0.06	0.43
140°	–1.65	–1.70	–1.84	–2.05	–2.01	–1.83	–1.42	–0.84	–0.28	0.05	0.51
145°	–1.54	–1.62	–1.65	–1.64	–1.45	–1.14	–0.72	–0.26	0.04	0.33	0.77
150°	–2.00	–1.80	–1.59	–1.38	–1.11	–0.80	–0.33	0.22	0.63	0.97	1.52
155°	–2.50	–2.57	–2.55	–2.41	–2.01	–1.45	–0.68	0.21	0.83	1.27	1.84
160°	–1.41	–1.70	–1.93	–2.11	–2.13	–2.00	–1.57	–1.01	–0.52	–0.03	0.65
165°	–1.87	–1.84	–1.80	–1.69	–1.44	–1.13	–0.75	–0.32	–0.12	0.01	0.30
170°	–2.33	–2.65	–2.96	–3.17	–3.14	–2.83	–2.40	–1.85	–1.42	–1.18	–0.88
175°	–0.57	–0.89	–1.17	–1.58	–1.82	–1.87	–1.67	–1.41	–1.18	–1.06	–0.96
180°	0.28	0.07	–0.08	–0.34	–0.51	–0.52	–0.30	–0.02	0.16	0.33	0.53
185°	–0.57	–0.89	–1.17	–1.58	–1.82	–1.87	–1.67	–1.41	–1.18	–1.06	–0.96
190°	–2.33	–2.65	–2.96	–3.17	–3.14	–2.83	–2.40	–1.85	–1.42	–1.18	–0.88
195°	–1.87	–1.84	–1.80	–1.69	–1.44	–1.13	–0.75	–0.32	–0.12	0.01	0.30
200°	–1.41	–1.70	–1.93	–2.11	–2.13	–2.00	–1.57	–1.01	–0.52	–0.03	0.65
205°	–2.50	–2.57	–2.55	–2.41	–2.01	–1.45	–0.68	0.21	0.83	1.27	1.84
210°	–2.00	–1.80	–1.59	–1.38	–1.11	–0.80	–0.33	0.22	0.63	0.97	1.52
215°	–1.54	–1.62	–1.65	–1.64	–1.45	–1.14	–0.72	–0.26	0.04	0.33	0.77
220°	–1.65	–1.70	–1.84	–2.05	–2.01	–1.83	–1.42	–0.84	–0.28	0.05	0.51
225°	–1.91	–2.10	–2.33	–2.52	–2.44	–2.02	–1.48	–0.77	–0.27	0.06	0.43
230°	–2.08	–2.29	–2.53	–2.64	–2.45	–2.00	–1.46	–0.75	–0.39	–0.18	0.07
235°	–2.16	–2.39	–2.52	–2.64	–2.43	–2.12	–1.61	–1.14	–0.68	–0.44	–0.06
240°	–2.16	–2.43	–2.67	–2.82	–2.64	–2.33	–1.79	–1.05	–0.70	–0.43	–0.15
245°	–2.30	–2.49	–2.76	–2.81	–2.58	–2.20	–1.87	–1.31	–0.94	–0.80	–0.40
250°	–2.36	–2.46	–2.63	–2.70	–2.63	–2.47	–2.22	–1.78	–1.36	–1.03	–0.44
255°	–2.30	–2.37	–2.55	–2.66	–2.60	–2.50	–2.31	–1.87	–1.50	–1.10	–0.52
260°	–2.38	–2.43	–2.53	–2.69	–2.73	–2.68	–2.57	–2.20	–1.82	–1.40	–0.65
265°	–2.45	–2.45	–2.46	–2.57	–2.63	–2.71	–2.64	–2.28	–1.88	–1.46	–0.67
270°	–2.62	–2.55	–2.48	–2.56	–2.66	–2.76	–2.76	–2.43	–2.12	–1.77	–1.15
275°	–2.80	–2.67	–2.60	–2.68	–2.76	–2.85	–2.88	–2.59	–2.19	–1.86	–1.39
280°	–3.12	–3.04	–2.89	–2.82	–2.74	–2.74	–2.59	–2.27	–2.02	–1.92	–1.68
285°	–3.47	–3.34	–3.15	–2.94	–2.76	–2.52	–2.38	–2.14	–2.04	–1.97	–2.05
290°	–3.71	–3.72	–3.55	–3.36	–2.99	–2.63	–2.29	–2.06	–1.99	–2.14	–2.24
295°	–4.11	–4.21	–4.16	–3.98	–3.60	–3.10	–2.54	–2.16	–2.06	–2.28	–2.40
300°	–4.25	–4.38	–4.43	–4.39	–4.17	–3.79	–3.19	–2.57	–2.36	–2.40	–2.51
305°	–4.54	–4.67	–4.85	–4.97	–4.86	–4.50	–3.98	–3.39	–2.96	–2.91	–2.87
310°	–4.36	–4.57	–4.80	–5.15	–5.27	–5.23	–4.90	–4.40	–3.86	–3.61	–3.43
315°	–4.09	–4.28	–4.59	–4.94	–5.29	–5.52	–5.56	–5.27	–5.01	–4.78	–4.51
320°	–3.87	–4.01	–4.17	–4.51	–4.83	–5.18	–5.37	–5.51	–5.53	–5.71	–5.72
325°	–3.37	–3.52	–3.70	–3.94	–4.25	–4.63	–4.86	–5.06	–5.36	–5.80	–6.18
330°	–2.90	–3.05	–3.11	–3.37	–3.63	–3.85	–4.03	–4.23	–4.44	–4.88	–5.29
335°	–2.34	–2.42	–2.54	–2.68	–2.88	–3.06	–3.25	–3.30	–3.52	–3.88	–4.30
340°	–1.60	–1.72	–1.80	–1.94	–2.16	–2.36	–2.41	–2.45	–2.61	–2.87	–3.02
345°	–0.96	–1.06	–1.07	–1.24	–1.34	–1.46	–1.49	–1.46	–1.44	–1.58	–1.67
350°	–0.47	–0.50	–0.50	–0.61	–0.63	–0.68	–0.70	–0.65	–0.61	–0.70	–0.78
355°	–0.13	–0.14	–0.14	–0.16	–0.16	–0.18	–0.18	–0.16	–0.16	–0.19	–0.21

Table A.48 *Sensitivity variations for Outdoor Microphone Kit UA-1404, Microphone Type 4189 and Microphone Preamplifier ZC-0032, with the microphone preamplifier connected to a microphone extension cable, at sound incidence angles within ±θ° from the reference direction*

Nominal Frequency	Exact Frequency	Max Variation ± 30° dB	Max Variation ± 90° dB	Max Variation ± 150° dB
500 Hz	501.187 Hz	0.07	0.14	0.19
630 Hz	630.957 Hz	0.09	0.20	0.25
800 Hz	794.328 Hz	0.11	0.26	0.34
1000 Hz	1000 Hz	0.03	0.25	0.35
1250 Hz	1258.93 Hz	0.03	0.29	0.36
1600 Hz	1584.89 Hz	0.12	0.42	0.44
2000 Hz	1995.26 Hz	0.19	0.69	0.78
2240 Hz	2238.72 Hz	0.17	0.91	0.95
2500 Hz	2511.89 Hz	0.20	1.10	1.10
2800 Hz	2818.38 Hz	0.15	1.16	1.20
3150 Hz	3162.28 Hz	0.33	1.29	1.48
3550 Hz	3548.13 Hz	0.47	1.60	1.85
4000 Hz	3981.07 Hz	0.49	2.04	2.30
4500 Hz	4466.84 Hz	0.61	2.51	2.60
5000 Hz	5011.87 Hz	0.72	3.16	3.16
5600 Hz	5623.41 Hz	0.97	3.82	3.82
6300 Hz	6309.57 Hz	1.33	3.99	3.99
7100 Hz	7079.46 Hz	1.56	4.28	4.28
8000 Hz	7943.28 Hz	2.01	4.32	4.32
8500 Hz	8413.95 Hz	2.10	4.25	4.25
9000 Hz	8912.51 Hz	2.29	4.24	4.24
9500 Hz	9440.61 Hz	2.48	4.25	4.25
10000 Hz	10000 Hz	2.58	4.33	4.33
10600 Hz	10592.5 Hz	2.71	4.38	4.38
11200 Hz	11220.2 Hz	2.90	4.54	4.54
11800 Hz	11885.0 Hz	3.05	4.67	4.67
12500 Hz	12589.3 Hz	3.11	4.85	4.85
13200 Hz	13335.2 Hz	3.37	5.15	5.15
14000 Hz	14125.4 Hz	3.63	5.29	5.29
15000 Hz	14962.4 Hz	3.85	5.52	5.52
16000 Hz	15848.9 Hz	4.03	5.56	5.56
17000 Hz	16788.0 Hz	4.23	5.51	5.74
18000 Hz	17782.8 Hz	4.44	5.53	6.16
19000 Hz	18836.5 Hz	4.88	5.80	6.77
20000 Hz	19952.6 Hz	5.29	6.18	7.70

A.6 Periodic Testing of Acoustical Frequency Responses

This section gives the adjustment data that must be applied to sound levels displayed in response to the sound pressure produced by Multifunction Acoustic Calibrator Type 4226, or in response to simulation of sound pressure by Electrostatic Actuator UA-0033, in order to obtain the equivalent sound levels that would be displayed under reference environmental conditions in response to plane progressive sinusoidal sound waves incident from the reference direction. See Table A.49 and Table A.50 to view the data.

Table A.49 *Acoustical test with Multifunction Acoustic Calibrator Type 4226. Adjustment data that must be applied to the readings of the analyzer in order to obtain equivalent sound levels that would be displayed in response to plane progressive sinusoidal sound waves incident from the reference direction*

Nominal Frequency	Correction Data For Preamplifier Connected to an Extension Cable	Expanded Uncertainty	Correction Data For Preamplifier Mounted Directly on the analyzer	Expanded Uncertainty
	dB	dB	dB	dB
31.5 Hz	0.00	0.30	0.00	0.32
63 Hz	0.00	0.06	0.00	0.12
125 Hz	0.00	0.05	0.00	0.11
250 Hz	0.00	0.05	0.07	0.11
500 Hz	0.01	0.05	0.23	0.11
1000 Hz	0.08	0.05	0.01	0.11
2000 Hz	0.27	0.09	0.18	0.14
4000 Hz	0.89	0.11	0.80	0.19
8000 Hz	2.80	0.22	2.72	0.30
12500 Hz	5.43	0.27	5.58	0.34
16000 Hz	6.50	0.32	6.61	0.38

Table A.50 *Acoustical test with Electrostatic Actuator UA-0033. Adjustment data that must be applied to the readings of the analyzer in order to obtain equivalent sound levels that would be displayed in response to plane progressive sinusoidal sound waves incident from the reference direction*

Nominal Frequency	Exact Frequency	Correction Data For Preamplifier Connected to an Extension Cable	Expanded Uncertainty	Correction Data For Preamplifier Mounted Directly on the analyzer	Expanded Uncertainty
		dB	dB	dB	dB
31.5 Hz	31.6228 Hz	0.00	0.02	0.00	0.10
63 Hz	63.0957 Hz	0.00	0.02	0.00	0.10
125 Hz	125.893 Hz	0.00	0.02	0.00	0.10
250 Hz	251.189 Hz	0.00	0.02	0.07	0.10
500 Hz	501.187 Hz	0.02	0.02	0.25	0.10
1000 Hz	1000.00 Hz	0.10	0.02	0.03	0.10
2000 Hz	1995.26 Hz	0.32	0.05	0.24	0.11
4000 Hz	3981.07 Hz	1.07	0.08	0.97	0.17
8000 Hz	7943.28 Hz	3.38	0.09	3.30	0.22
12500 Hz	12589.3 Hz	7.19	0.11	7.34	0.23
16000 Hz	15848.9 Hz	8.59	0.12	8.70	0.23

Appendix B

Cross-references to Standards

B.1 Introduction

This appendix provides cross-references between specific paragraphs in the standards that require topics to be documented in an instruction manual and the corresponding sections in this manual and User Manual BE 1713 for Type 2250/2270 or User Manual BE 1766 for Type 2250-L that conform to those paragraphs.

Section B.2 contains the cross-reference tables to the following relevant standards: IEC 60651; IEC 60804; IEC 61260; IEC 61672–1.

Section B.3 provides a list of cross-references to topics that are not provided in, or are irrelevant to this product. (For example, the cross-reference ‘B.3 a’ in the table refers to section B.3, item a.)

A normal index can be found at the end of this manual.

B.2 Cross-references to Standards

IEC 60651		
Standard's Paragraph	**This Manual's Section**	**User Manual**
3.6	4.5	
3.7	4.4	
3.8	4.4	
3.9	4.4	
3.10	3.7.2	
3.13	B.3 a	
4.2	4.17, 2.4	
4.4	4.6	
4.9	4.17	
5.1	4.5, 3.2	
6.3	4.4	
6.6 (2.p)	4.9.2	
6.7 (2.p)	1.2.1	
7.2 (Note)	4.10.1	
7.5	4.10.3	
7.6	4.9.3	
7.8 (2.p)	B.3 c	
8.3	4.12.4, 3.4	
8.4	4.12.5	
8.5	4.12.2, B.3 e, 4.12.3	
8.6	4.12.3	
9.2 (Note)	3	
9.2.1	2.4	
9.3.1 (2.p)	B.3 b	
9.3.1 (3.p)	3.5	
9.4.2 (4.p)	4.6, 4.6.1	
9.4.4	4.10.3	
10.1	B.3 e, 4.5	
10.1 (Note)	B.3 e	
10.2	4.14	
10.3	B.3 d	
10.4	4.14.1	
11.2 1)	4.5, 3.2, 2.2	
11.2 2)	4.5	
11.2 3)	4.9.2	
11.2 4)	4.4	
11.2 5)	2.8	
11.2 6)	2.9	
11.2 7)	4.12.4	
11.2 8)	4.12.5	
11.2 9)	4.12.2	

IEC 60651		
Standard's Paragraph	**This Manual's Section**	**User Manual**
11.2 10)	2.2	
11.2 11)	4.12.3	
11.2 12)	4.12	
11.2 13)	B.3 e, 4.5	
11.2 14)	4.6, 4.7	
11.2 15)	2.4	
11.2 16)	2.2	
11.2 17)	B.3 d	
11.2 18)	4.14	
11.2 19)	4.4	
11.2 20)	4.4	
11.2 21)	4.17	
11.2 22)	4.6	
11.2 23)	4.6.7	
11.2 24)	4.7	
11.2 25)	3.5	
11.2 26)	4.9.3	
11.2 27)	1.2.1	
11.2 28)	3	
11.2 29)	4.12.6	
11.2 30)	3.7.5	
11.2 31)	3.7.6	
11.2 32)	B.3 f	
11.2 33)	3.7.2, 3.7.3	
11.2 34)	3.7.6	
11.2 35)	3.7.6	
11.2 Note i)	4.6	
11.2 Note ii)	4.10.1	
12.2.3	3.7.6	
12.3.2 (2.p)	B.3 f	
12.4.5	3.7.6	
12.4.8	4.12.6	
12.4.9	3.7.6	
12.5.1.2	3.7.6	
12.5.2.1	3.7.6	
12.5.2.7	4.2	
12.5.3.5	B.3 f	
12.5.4.5	3.7.6, 4.2	
12.5.4.10	4.12.6, 3.7.1	

IEC 60804		
Standard's Paragraph	**This Manual's Section**	**User Manual**
3.7	4.4	
3.11 (1.p)	4.5	
3.11 (2.p)	4.6.7	
3.12	4.4	
3.15	4.4	
3.17	3.7.2	
3.20	B.3 a	
4.2	4.17, 2.4	
4.10	4.17	
6.2 (1.p)	4.9.5, B.3 g	
6.2 (2.p)	4.9.6, B.3 g	
6.5 (1.p)	4.10.2	
6.5 (4.p)	4.10.2	
9.1 (Note 1)	3	
9.2.3 (2.p)	4.5	
10.1	B.3 e, 4.5	
10.1 (Note)	B.3 e	
10.2	4.14	
10.3	B.3 d	
10.4	B.3 c	
11.2 1)	4.5, 2.2, 3.2	
11.2 2)	4.5, 4.6.7	
11.2 3)	4.9.2	
11.2 4)	4.9.5, 4.9.6	
11.2 5)	4.10.2	
11.2 6)	4.4	
11.2 7)	4.4	
11.2 8)	4.4	
11.2 9)	4.12.4	
11.2 10)	4.12.5	
11.2 11)	4.12.2	
11.2 12)	4.12.3	
11.2 13)	4.12	
11.2 14)	B.3 e, 4.5	
11.2 15)	4.6, 4.7	
11.2 16)	2.4	

IEC 60804		
Standard's Paragraph	**This Manual's Section**	**User Manual**
11.2 17)	2.2	
11.2 18)	B.3 d	
11.2 19)	4.14	
11.2 20)	4.17	
11.2 21)	4.10.2	
11.2 22)	4.16.4	
11.2 23)	4.6.7	
11.2 24)	4.7	
11.2 25)	3.5	
11.2 26)	2.5	
11.2 27)	4.9.4	
11.2 28)	3	
11.2 29)	4.12.6	
11.2 30)	3.7.5	
11.2 31)	3.7.6	
11.2 32)	B.3 f	
11.2 33)	3.7.2, 3.7.3	
11.2 34)	3.7.6	
11.2 35)	3.7.6	
12.2.3	3.7.6	
12.3.2 (2.p)	B.3 f	
12.4.5	3.7.6	
12.4.8	4.12.6	
12.4.9	3.7.6	
12.5.1	3.7.4	
12.5.1.2	3.7.6	
12.5.1.3	3.7.4	
12.5.2.1	3.7.6	
12.5.2.7	4.2	
12.5.3.5	B.3 f	
12.5.4.5	3.7.6, 4.2	
12.5.4.10	4.12.6, 3.7.1	
App. B.3 (5.p)	4.9.4	
App. C (5.p)	2.5	

IEC 61260		
Standard's Paragraph	**This Manual's Section**	**User Manual**
3.13	4.11	
3.18	4.4	
3.19	4.4	
4.3	4.11	
4.6.4	4.11.3	
4.7	4.11.1, 4.11.2	
4.10	4.6.3	
4.11	4.13.1	
4.12	B.3 h, 4.13.1	
4.14.2	4.12.3	
5.1 (1.p)	3.6	
5.1 (2.p)	4.17	
5.2.5	B.3 c	
5.3.2	B.3 h, 4.13.1	
5.5.1	4.6.3	
5.5.4	B.3 i	
5.9	4.6.3	
7 a)	4.2	
7 b)	4.11	
7 c)	4.11	
7 d)	4.11.1, 4.11.2	
7 e)	4.11	
7 f)	4.4	
7 g)	4.4	
7 h)	4.11	
7 i)	4.11.3	
7 j)	1.2.1	See User Manual
7 k)	4.11.1, 4.11.2	
7 l)	4.6.3	

IEC 61260		
Standard's Paragraph	**This Manual's Section**	**User Manual**
7 m)	4.13.1	
7 n)	B.3 h, 4.13.1	
7 o)	4.12.2	
7 p)	4.12.5	
7 q)	B.3 j	
7 r)	B.3 j	
7 s)		See User Manual
7 t)	B.3 h	
7 u)	4.17	
7 v)	3.6	
7 w)	3.7.6	
7 x)	3.7.5	
7 y)	3.7.6	
7 z)	B.3 f	
7 aa)	3.7.2	
7 bb)	3.7.6	
7 cc)	3.7.6	
8.2.3	3.7.6	
8.3.2 (2.p)	B.3 f	
8.4.4	3.7.6	
8.4.5	3.7.6	
8.4.8	3.7.6	
8.5.1.2	3.7.6	
8.5.2.1	3.7.6	
8.5.2.7	4.2	
8.5.3.5	B.3 f	
8.5.4.5	3.7.6, 4.2	

IEC 61672–1:2002		
Standard's Paragraph	**This Manual's Section**	**User Manual**
5.1.4	1.2.4, 3.7.6	
5.1.5	4.2	
5.1.6	4.5	See User Manual
5.1.7	2.2, 3.2, B.3 k	
5.1.8	1.2.2	
5.1.10	2.8, E*	
5.1.12	1.2.1, 2.10, 4.9.7	
5.1.13	4.4, 3.7.2, 4.5	
5.1.14	2.9.2	
5.1.15	3.5	
5.1.16	4.9.1, 3.5, 4.13.1	
5.1.17	1.2.1, B.3 p	
5.1.18	4.17	
5.2.1	2.4	
5.2.3	2.4	
5.2.4	4.6.5, 4.6.6, A.2, A.3	
5.2.7	3.3, A.3	
5.4.12	2.8, B.3 l	
5.4.13	B.3 m	
5.5.3	4.9.7	
5.5.9	4.9.7	
5.5.10	4.9.7	
5.5.11	B.3 n	
5.6.1	4.8.1	
5.6.2	4.8.1	
5.6.3	4.8.1, 3.5	
5.6.4	4.8.1	
5.6.5	2.6	
5.7.1	2.9.1	
5.10.1	2.9, 2.10	
5.11.1	2.9, 2.10	
5.12.1	4.9.8	
5.14	B.3 o	
5.15.2	2.9	
5.15.3	B.3 s	See User Manual
5.15.4	2.9	See User Manual
5.15.5	4.10, 2.9.2	
5.15.6	4.10.2	
5.15.7	1.2.3	
5.15.8	B.3 s	
5.16.1	4.14, 4.15	
5.17.1		See User Manual
5.17.1 (Note 2)	4.18	
5.17.2	4.10.2	
5.18.1	1.2.4	
5.18.2	3.7.6	

IEC 61672–1:2002		
Standard's Paragraph	**This Manual's Section**	**User Manual**
5.19.2	4.8.4	
5.20.2	4.16	
5.20.3	4.16.4	
5.20.4	1.2.4, 4.16.1, 4.16.2	
5.20.5	4.16.2	
6.1.2	4.12.1	
6.2.2 (Note)	2.7	
6.3.2	B.3 q	
6.5.2	B.3 f	
6.6.1	3.7.6	
6.6.3	4.12.6	
6.6.4 (Note)	B.3 r	
6.6.9	4.12.6	
7.1	B.3 e, 4.5	
7.2	4.2, 4.6, 4.7	
7.3	4.2	
7.4		See User Manual
7.5	1.2.4, 4.6, 4.7	
9.1 b)	1.2.4	
9.2.1 a)	4.2	
9.2.1 b)	1.2.4, 2.2, 3.7.6	See User Manual
9.2.1 c)	4.5	
9.2.1 d)	B.3 k	
9.2.1 e)	1.2.1 B.3 p	
9.2.2 a)	2.9	
9.2.2 b)	A.5	
9.2.2 c)	2.8, E*	
9.2.2 d)	2.9.1	
9.2.2 e)	4.9.7	
9.2.2 f)	1.2.1, 2.10	
9.2.2 g)	4.10, B.3 s	See User Manual
9.2.2 h)	4.9.2	
9.2.2 i)	4.9.8	
9.2.2 j)	1.2.2	
9.2.2 k)	2.8, 4.2, B.3 l	
9.2.3 a)	4.16.4	
9.2.3 b)		See User Manual
9.2.3 c)	1.2.4, 4.16.1, 4.16.2	
9.2.3 d)	4.16.2	
9.2.4 a)	2.4	
9.2.4 b)	2.4, 4.4	
9.2.4 c)	2.4	
9.2.4 d)	4.6.5	
9.2.5 a)	4.5	
9.2.5 b)	2.2, 2.3, 2.5	
9.2.5 c)	2.10	

IEC 61672–1:2002		
Standard's Paragraph	**This Manual's Section**	**User Manual**
9.2.5 d)	2.6	
9.2.5 e)	4.17	
9.2.5 f)	4.10.2	
9.2.5 g)		See User Manual
9.2.5 h)	4.10.2	
9.2.5 i)	2.9.2	
9.2.5 j)	2.9.2, 4.10.2	See User Manual
9.2.5 k)	2.9, 2.10	
9.2.5 l)	B.3 o	
9.2.5 m)	1.2.3	
9.2.5 n)	1.2.4	
9.2.5 o)	4.8.1	
9.2.5 p)	4.14	
9.2.6 a)	4.2, 4.6, 4.7	
9.2.6 b)	B.3 e, 4.5	
9.2.6 c)		See User Manual
9.2.6 d)	1.2.4, 4.6, 4.7	
9.2.7 a)	B.3 q	
9.2.7 b)	B.3 f	
9.2.7 c)	4.12.6	
9.3 a)	4.4	

IEC 61672–1:2002		
Standard's Paragraph	**This Manual's Section**	**User Manual**
9.3 b)	4.4	
9.3 c)	4.5	
9.3 d)	3.3, A.6	
9.3 e)	4.9.7	
9.3 f)	4.9.7	
9.3 g)	3.5	
9.3 h)	4.8.1	
9.3 i)	4.9.1, 3.5, 4.13.1	
9.3 j)	4.16	
9.3 k)	B.3 n	
9.3 l)	4.12.1	
9.3 m)	B.3 r	
9.3 n)	3.7.6	
9.3 o)	3.7.2, 3.7.6, 4.12.6	
App. C 3	4.9.7	

*. Referring to instruction manual supplement for microphone Type 4193 and supplement for microphone Type 4964.

IEC 61672–1:2013		
Standard's Paragraph	**This Manual's Section**	**User Manual**
5.1.4	1.2.4, 3.7.6	
5.1.5	4.2	
5.1.6	4.5	See User Manual
5.1.7	2.2, 3.2, B.3 k	
5.1.8	1.2.2	
5.1.10	2.8, E*	
5.1.12	1.2.1, 2.10, 4.9.7	
5.1.13	4.4, 3.7.2, 4.5	
5.1.14	2.9.2	
5.1.15	3.5	
5.1.17	4.9.1, 3.5, 4.13.1	
5.1.18	1.2.1, B.3 p	
5.1.19	4.17	
5.2.1	2.4	
5.2.3	2.4	
5.3.2.1	4.6.5, 4.6.6, A.2, A.3	
5.3.5.1	3.3, A.6	
5.5.5	4.7, A.5	
5.5.8	2.8, B.3 l	
5.6.3	4.9.7	
5.6.10	4.9.7	
5.6.11	4.9.7	
5.7.1	4.8.1	
5.7.2	4.8.1	
5.7.3	4.8.1, 3.5	
5.7.4	4.8.1	
5.7.5	2.6	
5.8.1	2.9.1	
5.11.1	2.9, 2.10	
5.12.2	2.9, 2.10	
5.13.1	4.9.8	
5,17	B.3 o	
5.18.1	2.9	
5.18.2	B.3 s	See User Manual
5.18.3	2.9	See User Manual
5.18.4	4.10, 2.9.2	
5.18.5	1.2.3	
5.18.6	B.3 s	
5.19.1	4.14, 4.15	
5.20.1	4.18	See User Manual
5.20.2	4.10.2	
5.21.1	1.2.4	
5.21.2	3.7.6	
5.22.2	4.8.4	
5.23.2	4.16	
5.23.3	4.16.4	

IEC 61672–1:2013		
Standard's Paragraph	**This Manual's Section**	**User Manual**
5.23.4	4.16.4	
5.23.5	1.2.4, 4.16.1, 4.16.2	
5.23.6	4.16.2	
6.1.2	4.12.1	
6.2.2	2.7	
6.3.2	B.3 q	
6.5.2	B.3 f	
6.6.1	3.7.6	
6.6.3	4.12.6	
6.6.5	B.3 r	
6.6.10	4.12.6	
6.7	2.11	
7.1	B.3 e, 4.5	
7.2	4.2, 4.6, 4.7	
7.3	4.2	
7.4		See User Manual
7.5	1.2.4, 4.6, 4.7	
9.1 b	1.2.4	
9.2.1 a	4.2	
9.2.1 b	1.2.4, 3.7.6, 2.2	See User Manual
9.2.1 c	4.5	
9.2.1 d	B.3 k	
9.2.1 e	1.2.1, B.3 p	
9.2.1 f	2.11	
9.2.2 a	2.9	
9.2.2 b	A.5	
9.2.2 c	2.8, E	
9.2.2 d	2.9.1	
9.2.2 e	4.9.7	
9.2.2 f	1.2.1, 2.10	
9.2.2 g	4.10, B.3 s	See User Manual
9.2.2 h	4.9.2	
9.2.2 i	4.9.8	
9.2.2 j	1.2.2	
9.2.2 k	4.2, 2.8, B.3 l	
9.2.3 a	4.16.4	
9.2.3 b		See User Manual
9.2.3 c	1.2.4, 4.16.1, 4.16.2	
9.2.3 d	4.16.2	
9.2.4 a	2.4	
9.2.4 b	2.4	
9.2.4 c	2.4	
9.2.5 a	A.2, A.3	
9.2.5 b	4.6.5, 4.6.6, A.2, A.3	
9.2.5 c	4.6.5, 4.6.6, A.2, A.3	
9.2.5 d	3.3, A.6	

IEC 61672–1:2013		
Standard's Paragraph	**This Manual's Section**	**User Manual**
9.2.6 a	4.5	
9.2.6 b	2.2, 2.3, 2.5	
9.2.6 c	2.6	
9.2.6 d	4.17	
9.2.6 e	2.7	
9.2.6 f		See User Manual
9.2.6 g	4.10.2	
9.2.6 h	2.9.2	
9.2.6 i	2.9.2, 4.10.2	See User Manual
9.2.6 j	2.9.2, 2.10	
9.2.6 k	B.3 o	
9.2.6 l	1.2.3	
9.2.6 m	1.2.4	
9.2.6 n	4.14	
9.2.7 a	4.2, 4.6, 4.7	
9.2.7 b	B.3 e, 4.5	
9.2.7 c		See User Manual
9.2.7 d	1.2.4, 4.6, 4.7	
9.2.8 a	B.3 q	

IEC 61672–1:2013		
Standard's Paragraph	**This Manual's Section**	**User Manual**
9.2.8 b	B.3 f	
9.2.8 c	4.12.6	
9.3 a	4.4	
9.3 b	4.4	
9.3 c	4.5	
9.3 d	3.3, A.6	
9.3 e	4.7, A.5	
9.3 f	4.9.7	
9.3 g	4.9.7	
9.3 h	3.5	
9.3 i	4.8.1	
9.3 j	4.9.1, 3.5, 4.13.1	
9.3 k	4.16	
9.3 l	4.12.1	
9.3 m	B.3 r	
9.3 n	3.7.6	
9.3 o	3.7.6, 4.12.6, 3.7.2	

*. Referring to instruction manual supplement for microphone Type 4193 and supplement for microphone Type 4964.

B.3 Irrelevant Topics

This section provides a list of the cross-references to topics that are not provided in, or are irrelevant to this product. References in the previous tables are made to the following items:

a. “Not relevant, if the analyzer is tested as Group X. If it is tested as Group Z then see section 1.2.4”

b. “All settings can be used.”

c. “No electrical digital output in the sense of IEC 60651, IEC 60804 or IEC 61260, is provided.”

d. “No connections are provided to permit insertion of an external filter or analyzer.”

e. “No correction information needed.”

f. “No performance degradation or loss of function specified.”

g. “No reduction specified.”

h. “The filter is an integral part of the analyzer.”

i. “Neither recommended nor harmful.”

j. “Only the limitations specified according to chapter 8 of the standard.”

k. “Conforms both with and without a microphone extension cable.”

l. “If appendix E does not exist in the relevant manual or supplement, no optional frequency responses are provided for the microphone configuration detailed in that manual or supplement.”

m. “No separate tolerance limits stated.”

n. “The extent of the display device is greater than the linear operating range on any level range.”

o. “No user-selectable thresholds are provided.”

p “For Type 2270 the two channels are identical”

q. “No components of the sound level meter are intended to be operated only in an environmentally controlled enclosure.”

r. “No greater field strengths specified.”

s. “Only one display in the sense of IEC 61672, is provided.”

Index

Numerics

A

B

C

D

E

F

H

I

L

M

N

O

P

R

S

T

U

V

W

HEADQUARTERS: Brüel & Kjær Sound & Vibration Measurement A/S · DK-2850 Nærum · Denmark
Telephone: +45 7741 2000 · Fax: +45 4580 1405 · www.bksv.com · info@bksv.com

Local representatives and service organisations worldwide