RION

Class 1 Sound Level Meter

(with low-frequency sound measurement function)

NL-63

Instruction Manual

Technical Guide

Organization of the NL-63 Instruction Manual

There are four types of instruction manuals for Class 1 Sound Level Meter (with low-frequency sound measurement function) NL-63.

Quick Start Guide

This manual describes the basic handling of Sound Level Meter NL-63.

Operation Guide

This manual describes how to use Sound Level Meter NL-63, how to connect and use peripheral devices such as sound level recorders and printers, and what to do when using an SD card.

Communication Guide

This manual describes communication between a computer and Sound Level Meter NL-63 via a serial interface. It describes such topics as the communication protocol, commands for controlling the sound level meter, and data output from the sound level meter.

Technical Guide (This Document)

This manual is a technical guide to the sound level meter and noise measurements, including the performance of Sound Level Meter NL-63, microphone structure and characteristics, and how extension cables and windscreens affect measurements.

You can download the Instruction Manuals from our website:

https://rion-sv.com/nl-43_53_63/manual/

Contents

Organization of the NL-63 Instruction Manual 3

1 Microphone 6

1.1 Structure and operating principle 6

1.2 Microphone UC-59L specifications 7

2 Preamplifier 8

2.1 Necessity of a preamplifier 8

2.2 Preamplifier specifications 8

3 Effects of Microphone Extension Cable 9

4 Frequency Weighting 10

5 Filter (LPF, HPF) Characteristics 11

6 Root-mean-square Detection Circuit and Time Weighting 12

7 Measurement Function 14

7.1 L_{Aeq} (A-weighted equivalent continuous sound level, A-weighted time-averaged sound level) 14

7.2 L_{AIeq} (I-time-weighted equivalent continuous sound level) 14

7.3 L_{AE} (A-weighted sound exposure level) 15

7.4 L_N (N percentage exceedance sound level) 15

7.5 L_{max} / L_{min} (Maximum / Minimum time-weighted sound level) 15

7.6 L_{Atm5} (Takt-max A-weighted sound level) 16

7.7 L_{peak} (Peak sound level) 16

7.8 $L_{eq,mov}$ (Moving L_{eq}) 16

8 Influence of Background Noise 17

9 Descriptions for IEC 61672-1 (JIS C 1509-1) 18

9.1 NL-63 free field characteristics 27

9.2 Reference incident direction and position of reference point 35

9.3 Microphone frequency response 35

9.4 Acoustic influence of case 36

9.5 Effects of Windscreen WS-10 37

9.6 Effects of All-Weather Windscreen WS-15 39
9.7 Effects of Rain-protection Windscreen WS-16 40
9.8 Electromagnetic compatibility (EMC) 41
9.9 Microphone free field correction amount 42
9.10 Upper and lower limits of linear operating range for sound pressure level 43
9.11 Directional characteristics 44
9.12 Random incidence response 79

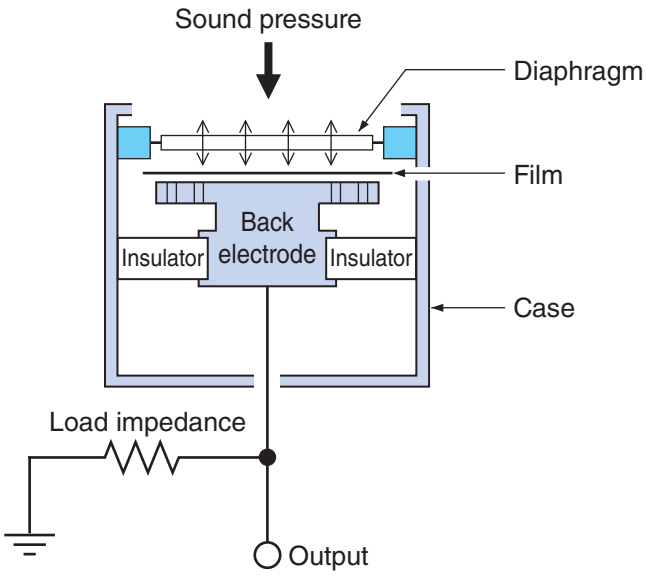
1 Microphone

Class 1 Sound Level Meter (with low-frequency sound measurement function) NL-63 is fitted with a 1/2 inch free-field electret microphone UC-59L.

1.1 Structure and operating principle

As shown in the figure below, in general, an electret condenser microphone used for taking measurements consists of five parts: a diaphragm, film, back electrode, insulator, and case. Usually, a film holding an electric charge is fixed to the back electrode.
When sound pressure is applied to the diaphragm, the distance between the diaphragm and the back electrode changes, and therefore the capacitance formed between them changes. This change in capacitance is output as voltage.
The materials and characteristics of each component and their combinations will result in differences in the frequency, temperature, and humidity characteristics, etc. The high-frequency range is determined by the vibration resonant frequency.

Structure of the electret condenser microphone



1.2 Microphone UC-59L specifications

Model	UC-59L
Nominal outer diameter	1/2 inch
Sensitivity level (representative value)	-27 dB (re. 1 V/Pa at 1 kHz, standard environmental conditions*)
Frequency response	1 Hz to 20 kHz
Capacitance (representative value)	13 pF
Dimensions	Φ13.2 mm × 14.3 mm
Weight	4.7 g

* Standard environment conditions: temperature = 23°C, humidity = 50% RH, air pressure = 101.325 kPa

2 Preamplifier

2.1 Necessity of a preamplifier

As condenser microphones are small capacitive transducers, they have high impedance, which is especially high at low frequencies. Therefore, extremely high load resistance is required to obtain an even response down to low frequencies.
The relationship between the microphone capacitance and the low cutoff frequency is as follows:

$$f_0 = \frac{1}{2\pi \times Z_{in} \times C_m}$$

f_0 : Low cutoff frequency (Hz)
Z_{in} : Preamplifier input impedance (Ω)
C_m : Capacitance of condenser microphone (F)

If the microphone output is extended as it is with a shielded wire, the sensitivity will drop significantly due to the line capacitance of the cable.

$$M_0 = \frac{C_m}{C_m + C_c} \cdot M_s$$

M_0 : Output voltage (V) when the microphone output is directly connected with a shielded wire
M_s : Output voltage when the microphone is open (V)
C_c : Line capacitance of shielded wire (F)

This is why a preamplifier that receives the microphone output directly at high impedance and outputs at low impedance is used.

2.2 Preamplifier specifications

Model	NH-26
Input impedance	Approx. 30 GΩ // 30 pF
Output resistance	Approx. 50 Ω

3

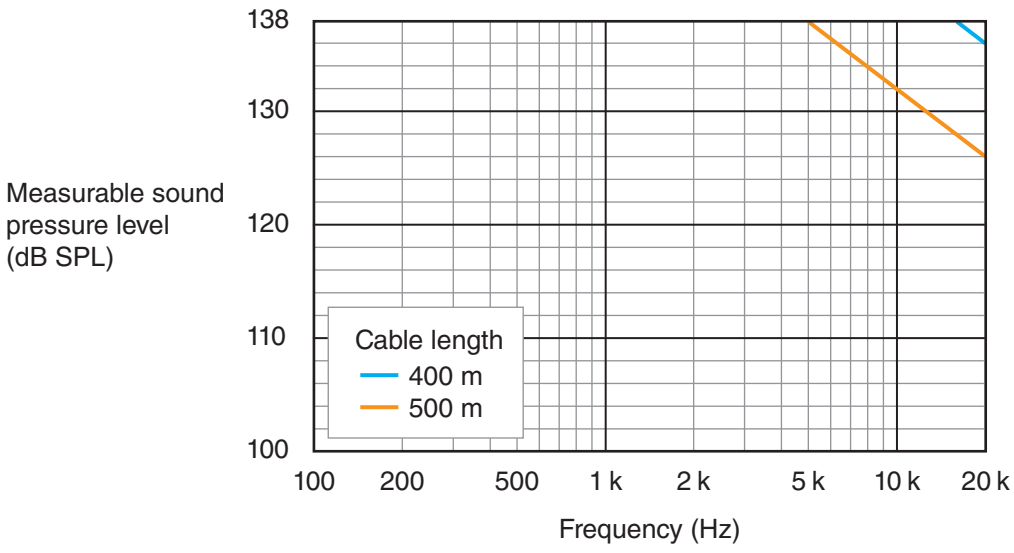
Effects of Microphone Extension Cable

If you use a microphone extension cable to extend the distance between the microphone/preamplifier and the sound level meter, the length of the cable limits the sound pressure level and frequency that can be measured. This is due to the capacity of the extension cable. That is, the longer the cable, the lower the sound pressure level and frequency that can be measured. The following types of microphone extension cables are available. You can also use multiple cables to make the distance longer.

Extension cable EC-04 series

Model	Length
EC-04	2 m
EC-04A	5 m
EC-04B	10 m
EC-04C	30 m (reel part) + 5 m (relay cable)
EC-04D	50 m (reel part) + 5 m (relay cable)
EC-04E	100 m (reel part) + 5 m (relay cable)

The figure below shows the relationship between the measurable sound pressure level and frequency in relation to the length of the extension cable.
For example, when measuring sound pressure of 132 dB up to 10 kHz, an extension cable up to about 500 meters can be used.

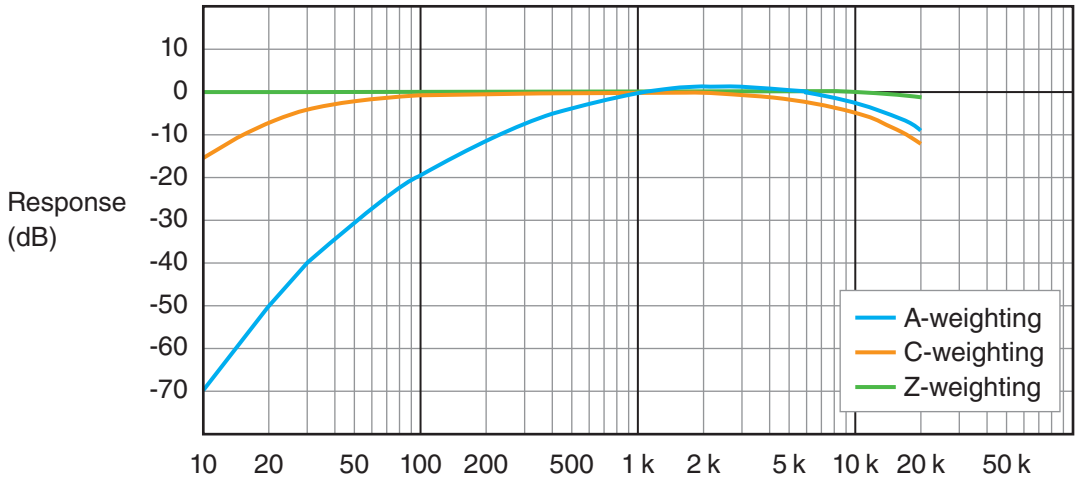


Effect of extension cable length on measurements

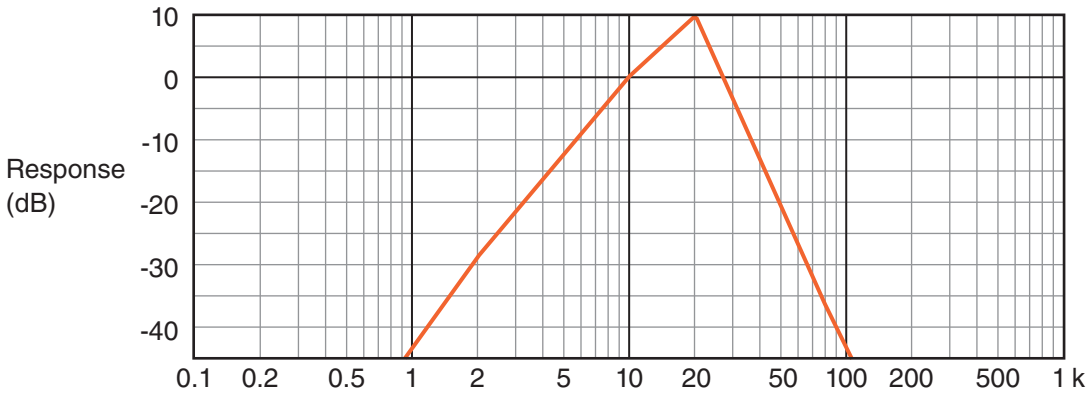
4

Frequency Weighting

Frequency weighting A, C, Z and G of the sound level meter are achieved by frequency weighting circuits with electrical characteristics as shown in the following figures.



Characteristics of frequency weighting circuits



Characteristics of frequency weighting circuits (G-weighting)

The perceived noise level is not determined by the sound pressure level alone. For example, even with the same sound pressure level, there is a difference in perceived loudness between low and high frequencies. Values measured by A-weighting have been found to be relatively close to the perceived sound level, and A-weighting is used for evaluating general environmental noise (measuring noise level).

Z-weighting has a flat frequency weighting over a wide range, and is used when measuring the sound pressure level (physical quantity) over a wide band instead of the noise level, or when performing frequency analysis of the measured sound.

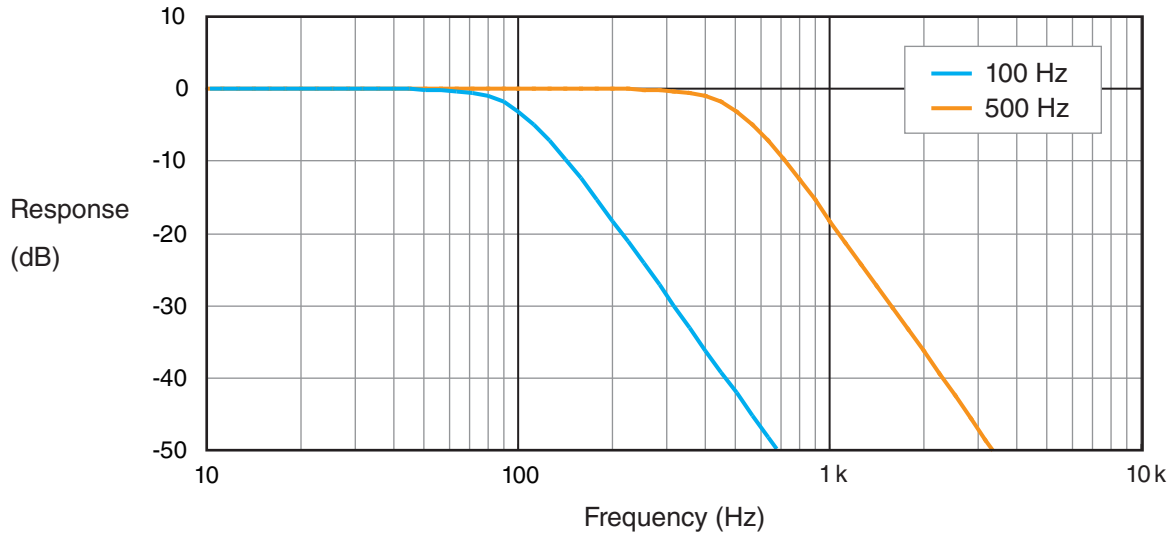
C-weighting is also almost a flat frequency, but compared to Z-weighting, the low frequency range equal to or below 31.5 Hz and the high frequency range equal to or above 8 kHz attenuate. C-weighting is used to measure sound pressure levels excluding the effects of background noise such as wind noise, analyze frequencies, and evaluate impulsive noise.

G-weighting is determined based on the threshold of human perception of infrasound, with 10 Hz as the standard. It has the characteristic of reducing the influence of sounds that can be heard by human ears and, conversely, extracting infrasonic components that are difficult to hear. Therefore, G-weighting is used to evaluate the psychological and physiological effects of infrasound from 1 Hz to 20 Hz.

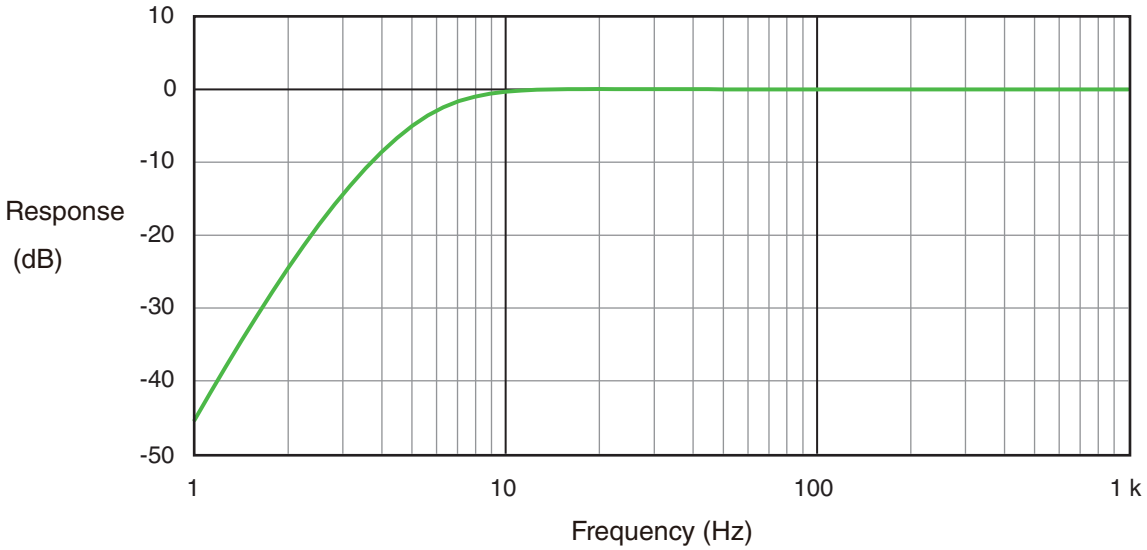
5

Filter (LPF, HPF) Characteristics

The following figures show the typical characteristics of the built-in low-pass filter (cutoff frequency 100 Hz, 500 Hz) and high-pass filter.



Low-pass filter (LPF) characteristics



High-pass filter (HPF) characteristics

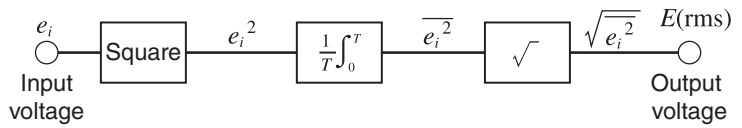
6

Root-mean-square Detection Circuit and Time Weighting

A root-mean-square detection circuit is used to convert the output signal of the microphone preamplifier to a root-mean-square value and calculate the evaluation value (decibel value).

$$E(\mathrm{rms}) = \sqrt{\frac{1}{T}\int_0^T e^2 \, \mathrm{dt}}$$

This shows that it can be calculated by squaring the instantaneous voltage (e) of the time waveform up to time (T) and taking the square root of the averaged value.
The NL-63 calculates the root-mean-square value using a digital calculation method.



However, the noise level of the sound often fluctuates rapidly, and it is difficult to read the constantly changing values with the aforementioned detection circuit alone. With the sound level meter, the root-mean-square detection circuit can also calculate the exponentially weighted average (exponential average) of the square of the instantaneous voltage. This weighting characteristic is called time weighting and is specified in the “Time constant” section (see the next page).

The main time-weighting characteristics of sound level meters are F (Fast) and S (Slow). F (Fast) narrows the time range of sound pressure that affects averaging, and S (Slow) widens it. That is, F (Fast) has a greater influence on the result of the current value, while S (Slow) has less of an influence on the current result than F (Fast).
Thinking of this in terms of measuring noise (sound pressure), F (Fast) relatively faithfully follows the phenomenon that the magnitude fluctuates in a short time, whereas S (Slow) struggles to follow minor fluctuations, resulting in a large average.

F (Fast) is used when measuring general noise, especially fluctuating sound. F (Fast) is usually used for measuring noise levels and sound levels unless otherwise stated.

S (Slow) is used to pick up sounds with little fluctuation or the average values of fluctuating sounds. Aircraft noise and Shinkansen noise are transient, relatively large fluctuating sounds. Values calculated based on noise events measured by S (Slow) are used in the evaluation of aircraft and Shinkansen noise.

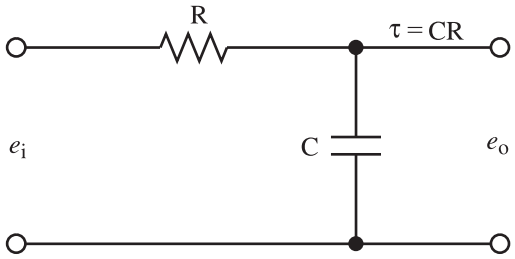
The time weighting characteristic I (Impulse) responds to short, continuous sounds more quickly than F (Fast) in the onset. Therefore, it is used for measuring impulsive sounds.

S (Slow) is usually used to measure low frequency sound, but in order to accurately capture the magnitude of infrasound of about 1 Hz, a time weighting of 10 s with a larger time constant may be used. However, care must be taken because it becomes difficult to capture small level fluctuations in low-frequency sounds.

Relationship between time weighting and time constant

Time weighting	Time constant	
	Rising characteristics	Falling characteristics
F (Fast)	125 ms	125 ms
S (Slow)	1 s	1 s
I (Impulse)	35 ms	1.5 s
τ = 10 s	10 s	10 s

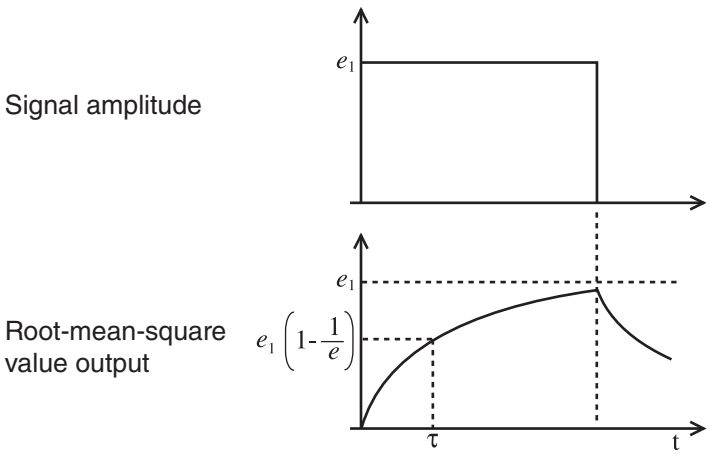
The figure below shows the circuit equivalent to the root-mean-square detection with time weighting. τ is the time constant and τ = CR.



Circuit equivalent to the root-mean-square detection with time weighting

e_i : Input voltage (proportional to the square of sound pressure)
e_o: Output voltage

The response of the root-mean-square detection circuit to a single burst signal is shown in the figure below.



Response to burst signal

e : Base of natural logarithms
τ : Time constant
t : Time
e_1 : Burst signal voltage

7 Measurement Function

7.1 L_{Aeq} (A-weighted equivalent continuous sound level, A-weighted time-averaged sound level)

L_{Aeq} (A-weighted equivalent continuous sound level, A-weighted time-averaged sound level) is the sound level of continuous stationary sound, which over a given period of time has the same total energy as the fluctuating noise. It is defined by the following formula:

$$L_{\mathrm{Aeq},T} = 20 \log_{10} \left\{ \left[\left(\frac{1}{T} \right) \int_{t_1}^{t_2} p_{\mathrm{A}}^2 \, (t) \, dt \right]^{1/2} / p_0 \right\}$$

t : Time variable of integration from an arbitrary start time at t_1 to the end of the interval at t_2

T : Time interval $T = t_2 - t_1$

$p_{\mathrm{A}}(t)$: A-weighted instantaneous sound pressure at running time t

p_0 : Reference sound pressure 20 μPa (2 x 10^{-5} N/m^2)

With NL-63, L_{Aeq} is calculated digitally using the following formula:

$$L_{\mathrm{Aeq}} = 20 \log_{10} \left\{ \left(\frac{1}{N} \sum_{i=1}^{N} p_A^2 \, (i) \right)^{1/2} / p_0 \right\}$$

N : Number of samples

The sampling cycle of NL-63 is 20.8 μs (48,000 samples per second).

7.2 L_{Aleq} (I-time-weighted equivalent continuous sound level)

L_{Aleq} (I-time-weighted equivalent continuous sound level) is different from ordinary L_{eq} (equivalent continuous sound level) and is calculated from the waveform after applying time-weighting I.

7.3 L_{AE} (A-weighted sound exposure level)

L_{AE} (A-weighted sound exposure level) is the noise level of a steady sound with a duration of 1 second that is equivalent to the total energy of fluctuating, quasi-steady, or single-event noises occurring within a given period of time.
It is defined by the following formula:

$$L_{AE,T} = 10 \log_{10} \left\{ \left[\int_{t_1}^{t_2} p_A^2(t)\, dt \right] / p_0^2 T_0 \right\} = L_{Aeq,T} + 10 \log_{10}(T / T_0)$$

t : Time variable of integration from an arbitrary start time at t_1 to the end of the interval at t_2
T : Time interval $T = t_2 - t_1$
T_0 : Reference time (1 second)
$p_A(t)$: A-weighted instantaneous sound pressure at running time t
p_0 : Reference sound pressure 20 µPa (2 x 10^{-5} N/m^2)

With NL-63, L_{AE} is calculated digitally using the following formula:

$$L_{AE} = 10 \log_{10} \frac{1}{N_0} \sum_{i=1}^{N} \frac{p_A^2(i)}{p_0^2}$$

N_0 : Number of samples per second

The sampling cycle of NL-63 is 20.8 µs (48,000 samples per second).

7.4 L_N (N percentage exceedance sound level)

If the time at which the time-weighted sound level is equal to or above a certain level is equal to or more than N% of the measurement time, this level is called the N percentage exceedance sound level (L_N). The NL-63 can measure five types of L_N rate sound levels simultaneously. The value of N can be set from 0.1 to 99.9 in increments of 0.1 for Percentile 1 to 5.
The sampling cycle for the L_N calculation of the NL-63 is 100 ms (10 samples per second) or $L_{eq,\ 1s}$.

7.5 L_{max} / L_{min} (Maximum / Minimum time-weighted sound level)

The Maximum / Minimum time-weighted sound level within the measurement time can be measured.
The NL-63 holds the maximum and minimum values after starting measuring for the sound level at each sampling cycle of 20.8 µs (48,000 samples per second). Therefore, the L_{max} and L_{min} values up to that point can be read even while measuring.

7.6 L_{Atm5} (Takt-max A-weighted sound level)

For the duration of the measurement, the maximum time-weighted sound level (L_{max}) within a 5-second interval is sampled and the power average is determined. L_{Atm5} is calculated according to the following equation.

$$L_{Atm} = 10 \log_{10} \frac{1}{N} \sum_{i=1}^{N} 10^{Lm/10}$$

L_m : Maximum time-weighted sound level (L_{max}) within interval (5 seconds)
N : Number of samples

The number of samples is determine according to the following equation.

$$\text{For } L_{Atm5}: \quad N = \frac{(t_2 - t_1)}{5}$$

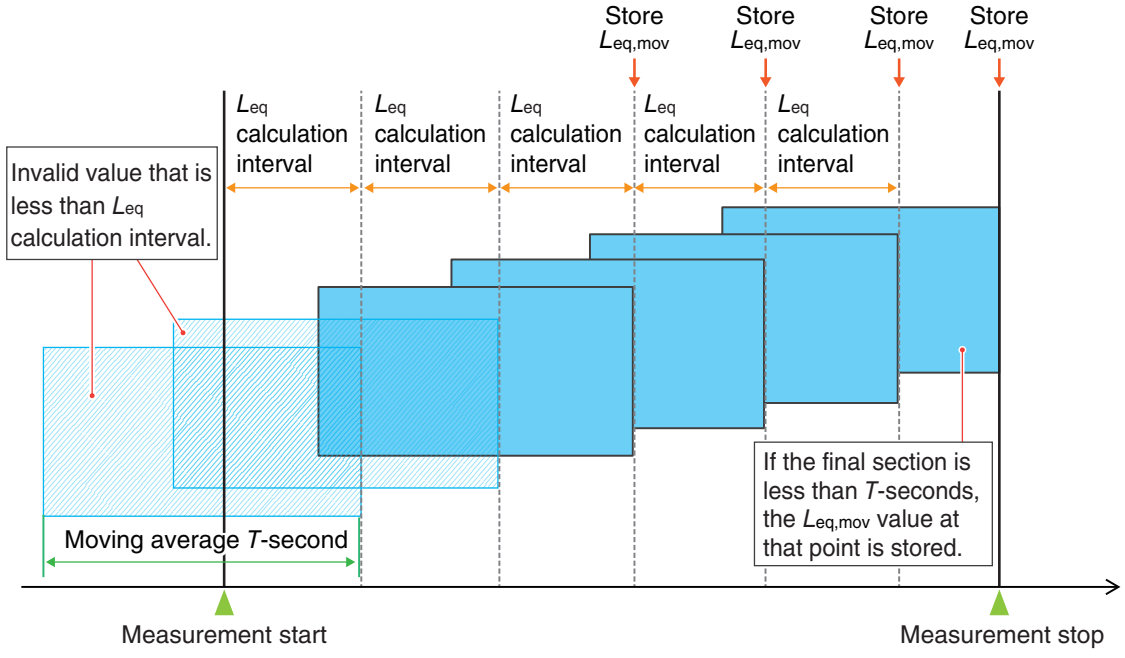
t_1 : Measurement start time
t_2 : Measurement end time

7.7 L_{peak} (Peak sound level)

The maximum absolute value of instantaneous sound pressure that reflects the set frequency weight within the measurement time can be measured.

7.8 $L_{eq,mov}$ (Moving L_{eq})

$L_{eq,mov}$ (Moving L_{eq}) calculates the moving average of the specified interval (Moving average T-second) from L_{eq} calculated at 1-second intervals. The value will be stored at the L_{eq} calculation intervals. If the measurement time is less than the specified interval, the value will be invalid.



8

Influence of Background Noise

Background noise refers to the noise in the usage environment when there is no sound that is subject to measurement. As the indicated value of the sound level meter is a mix between the sound to be measured and the background noise, the indicated value may be larger than when only the sound subject to measurement is measured.
If the difference in sound level meter readings with and without the sound subject to measurement is 10 dB or more, the influence of the background noise is almost permissible.
When the difference is less than 10 dB, the level of only the sound subject to measurement can be estimated by correcting the indicated value according to the table below.

Correction in relation to influence from background noise

Difference in readings with and without sound subject to measurement	4	5	6	7	8	9
Correction value	-2		-1			

(Unit: dB)

For example, if the noise level measured with a machine operating is 70 dB and the background noise level measured with the machine stopped is 63 dB, the difference is 7 dB. The correction value for this difference (7 dB) is -1 dB, and so the noise level generated by the machine can be estimated as 70 dB + (-1 dB) = 69 dB.
The method of correcting the amount of influence from background noise is based on the assumption that both the sound subject to measurement and the background noise are stationary sounds/noises. In particular, when the level of the background noise is close to the level of the sound subject to measurement (the difference is 3 dB or less), or when the sound subject to measurement or the background noise fluctuates, correction cannot be performed accurately and so measures such as reducing the background noise are required.

9

Descriptions for IEC 61672-1 (JIS C 1509-1)

Standard paragraph No.	Description	See also	Explanation
			NL-63
4	**Reference environment conditions**		Ambient temperature: 23°C Static pressure: 101.325 kPa Relative humidity: 50%
5	**Performance specifications**		
5.1	**General**		
5.1.3	Classification of emissions and immunity	9.2.1 a)	Group X
5.1.4	Configuration and normal mode of operation	9.2.1 b)	Configuration • NL-63 • WS-10 » [Name and Function of Each Part], [Connection with Peripheral Devices]
5.1.5	Conformance class	9.2.1 a)	Class 1
5.1.6	Microphone format Instructions for proper use of sound level meters	9.2.1 c) 9.2.6 b)	UC-59L » [Measurement]
5.1.7	Attaching the microphone	9.2.1 b)	» [Name and Function of Each Part]
5.1.8	Computer software (Component)	9.2.2 j)	Not applicable
5.1.10	All available frequency weighting features	9.2.2 c)	A, C, Z, G
5.1.12	The nominal range of sound levels that can be measured for each level range (1 kHz, A) Functions and operation method of level range switch How to select the optimum level range	9.2.2 e) 9.2.2 f)	25 dB to 138 dB No corresponding function Not applicable
5.1.13	Reference sound pressure level Reference level range Reference direction and position of microphone reference point	9.2.6 a) 9.3 a), b), c)	94 dB Not applicable Reference incident direction and position of reference point (Fig. 1)
5.1.14	Operating of the hold facility and the means for clearing a display that is held.	9.2.6 h)	» [Measurement]
5.1.15	Design targets and tolerance limits for electrical performance of electrical signal input equipment	9.3 h)	Capacitance of capacitor: 13 pF Tolerance limit: ± 1.5 pF
5.1.17	Highest sound pressure level and peak-to-peak input voltage without causing damage.	9.3 j)	148 dB 11 Vp-p
5.1.18	Characteristics and operations of each independent channel	9.2.1 e)	Not applicable (1 channel only)
5.1.19	Initial time interval after switching on power	9.2.6 d)	< 90 s
5.2	**Adjustment in calibration check frequency**		
5.2.1	Model of sound calibrator used for calibration	9.2.4 a)	NC-75/NC-74 (RION) NC-72B/NC-72A (RION) Nor1256

Standard paragraph No.	Description	See also	Explanation NL-63
5.2.3	Procedure for calibration and adjustment with sound calibrator	9.2.4 c)	» [Calibration]
5.3	**Corrections to indicated levels**		
5.3.1	General		
5.3.1.1	Correction value and expanded uncertainty of measurement	9.2.5 a)	Case reflection » Refer to Table 1 and Fig. 3 Windscreen • Free field characteristics » Refer to Table 1 and Fig. 6, 8 and 10 • Directional characteristics » Refer to Tables 7 to 11 and Fig. 14 to 18 • Random incidence response » Refer to Tables 13 to 15 and Fig. 20 to 22 Microphone free field correction amount » Refer to Table 3
5.3.2	**Reflection and diffraction**		
5.3.2.1	Correction data for the effects of reflections from, and diffraction around, the case of the sound level meter	9.2.5 b)	Refer to Table 1 and Fig. 3
5.3.3	**Windscreen**		
5.3.3.1	Typical correction data for the effects of the windscreen	9.2.5 c)	Free field characteristics » Refer to Table 1 and Fig. 6, 8 and 10 Directional characteristics » Refer to Tables 7 to 11 and Fig. 14 to 18 Random incidence response » Refer to Tables 13 to 15 and Fig. 20 to 22
5.3.3.2	Correction data in a configuration which may or not may contain the windscreen		Free field characteristics » Refer to Table 1 and Fig. 6, 8 and 10 Directional characteristics » Refer to Tables 5 to 11 and Fig. 12 to 18 Random incidence response » Refer to Tables 12 to 15 and Fig. 19 to 22
5.3.3.3	Data for rotational asymmetry in relation to the microphone shaft		Not applicable
5.3.5	**Corrections for use during periodic testing**		
5.3.5.1 5.3.5.3	Correction data of the multi-frequency sound calibrator	9.2.5 d) 9.3 d)	Refer to Table 3
5.4	**Directional characteristics**		
5.4.5	Detailed tables of relative directional response	9.2.2 b)	Refer to Tables 5 to 11
5.5	**Frequency weightings**		
5.5.5	Tables of directivity indexes applicable to the normal configuration of the sound level meter	9.3 e)	Refer to Tables 12 to 15

Standard paragraph No.	Description	See also	Explanation
			NL-63
5.5.8	Frequency response and tolerances of optional frequency responses	9.2.2 k)	No corresponding function
5.6	**Level linearity**		
5.6.10	A, C and Z-weighted levels for the lower and upper limit of the linear operating range.	9.3 f)	Refer to Table 4
5.6.11	Starting point for level linearity calculation error testing	9.3 g)	Refer to Table 4
5.7	**Self-generated noise**		
5.7.1	Self-generated noise (including microphone)	9.3 i)	A: 17 dB (Typical 15 dB) C: 25 dB (Typical 23 dB) Z: 42 dB (Typical 40 dB) G: 35 dB (Typical 33 dB)
5.7.3	Self-generated noise level (when the input terminal of the electrical input device is shorted)	9.3 i)	Dummy microphone (13 pF) Maximum value: Same value as 5.7.1 Typical A: 13 dB C: 18 dB Z: 24 dB
5.7.5	Procedure for measuring low-level sounds with consideration of the influence of self-generated noise	9.2.6 c)	» [Influence of background noise]
5.8	**Time-weighting F and S**		
5.8.1	Available time weighting	9.2.2 d)	F (Fast), S (Slow), I (Impulse), 10 s
5.11 - 5.12	**Overload and under-range indication**		
5.11.1	Operation and interpretation of overload indicators	9.2.6 j)	» [Reading the display]
5.12.2	Operation & interpretation of under-range indicators	9.2.6 j)	» [Reading the display]
5.13	**C-weighted peak sound level**		
5.13.1	Nominal range of L_{Cpeak} at for each level range	9.2.2 i)	Refer to Table 4
5.17	**Threshold**	9.2.6 k)	No corresponding function
5.18	**Display**		
5.18.1	Description of the indication of displayed quantities	9.2.2 g)	» [Reading the display]
5.18.2	Description of the display device(s)	9.2.2 g)	» [Reading the display]
5.18.3	Description of the displayed quantities	9.2.2 g) 9.2.2 a)	» [Terminology / Notation]
5.18.4	Statement of the display update rate	9.2.2 g)	1 second
5.18.5	Method for transferring or downloading digital data	9.2.6 l)	» [IO port], [USB], [LAN]

Standard paragraph No.	Description	See also	Explanation NL-63
5.19	**Analogue or digital output**		
5.19.1	Electric output connector	9.2.6 n)	• AC output Frequency weighting: A, C, Z, G Output voltage: 1 Vrms (output range upper limit) Output range: 4 Vrms or less Output resistance: 50 Ω Load impedance: > 10 kΩ • DC output Frequency weighting: A, C, Z, G Output voltage: 2.5 V (output range upper limit), 25 mV/dB Output range: 0 V to 5 V Output resistance: 50 Ω Load impedance: > 10 kΩ
5.20	**Timing facilities**		
5.20.1	Procedure to preset the integration time and time of the day	9.2.6 f)	» [Setting Menu]
5.20.2	Minimum and maximum values of integral time	9.2.6 g)	Minimum value: 1 s Maximum value: 24 h
5.21	**Radio frequency emissions and disturbances to a public power supply**		
5.21.1	Typical cable lengths and types, characteristics of devices connected by cables	9.2.6 m)	Microphone extension cable EC-04 series (up to 105 m) Output cable CC-24 (2.5 m, AC OUT and DC OUT) Communication cable CC-42R (2.5 m) USB cable (1 m) LAN cable (3 m) AC adapter NE-21P
5.21.2	Operation modes and the highest radio frequency emissions	9.3 n)	Operation mode: Normal operation Connection type: Microphone extension cable EC-04 series (105 m) Output cable CC-24 (2.5 m, AC OUT and DC OUT) Communication cable CC-42R (2.5 m) USB cable (1 m) LAN cable (3 m) AC adapter NE-21P
5.23	**Power supply**		
5.23.1	Method to check if the power supply voltage is sufficient	9.2.3 b)	» [Reading the display]
5.23.2	Maximum and minimum operable power supply voltages	9.3 k)	» [Specifications]
5.23.3	Acceptable internal battery types	9.2.3 a)	» [Specifications]

Standard paragraph No.	Description	See also	Explanation NL-63
5.23.4	Continuous operating time expected for the normal mode of operation when full capacity batteries are installed	9.2.3 a)	» [Specifications]
5.23.5	Operation from an external power supply	9.2.3 c)	» [Turning on the Power]
5.23.6	Public power supply voltage	9.2.3 d)	100 V to 240 V (tolerance limit between 90 V to 264 V) 50/60 Hz (±3 Hz)
6	**Environmental, electrostatic, and radio-frequency requirements**		
6.1	**General**		
6.1.2	Time interval for needed to stabilize after environmental changes	9.3 l)	Temperature change: < 1 h Humidity change: < 1 h Static pressure change: < 5 min
6.2	**Static pressure**		
6.2.2	Procedures to use the sound level meter at locations or under conditions where the static pressure is more than 65 kPa and less than 85 kPa	9.2.6 e)	In that environment, calibrates with a designated sound calibrator and takes measurements
6.3	**Air temperature**		
6.3.2	Components intended for operation in controlled environment	9.2.8 a)	None
6.5	**Electrostatic discharge**		
6.5.2	Degradation of functions by electrostatic discharge	9.2.8 b)	Measurement values are temporarily affected when there is an electrostatic discharge
6.6	**A.C. power-frequency and radio-frequency fields**		
6.6.1 6.6.3	Operation mode with least immunity to AC power frequency fields and radio-frequency fields	9.3 o)	Refer to Fig. 11 Operation mode: Normal operation Connection type: Microphone extension cable EC-04 series (105 m) Output cable CC-24 (2.5 m, AC OUT and DC OUT) Communication cable CC-42R (2.5 m) USB cable (1 m) LAN cable (3 m) AC adapter NE-21P
6.6.5	Electric field strength that can operate beyond the stated electric field strength values	9.3 m)	Not applicable
6.6.10	Statement for conformance to AC power frequency fields and radio-frequency fields	9.2.8 c)	Not applicable
6.7	**Mechanical vibration**	9.2.1 f)	Takes measurements without subjecting the sound level meter to vibration.
7	**Provision for use with auxiliary devices**		
7.1	Correction value applied to measurement results when extending the distance between the preamplifier and sound level meter	9.2.7 b)	Refer to Table 1 and Fig. 3 The device also conforms to the standard, however, even without correction

Standard paragraph No.	Description	See also	Explanation NL-63
7.2	Typical values of the influence of accessory installation on sound level meter performance	9.2.7 a)	Microphone extension cable EC-04 » Refer to Table 1 and Fig. 3 Windscreen • Free field characteristics » Refer to Table 1 and Fig. 6, 8 and 10 • Directional characteristics » Refer to Tables 7 to 11 and Fig. 14 to 18 • Random incidence response » Refer to Tables 13 to 15 and Fig. 20 to 22
7.3	Standards to be met when accessories are installed	9.2.1 d)	Complies with IEC 61672-1 class 1 (JIS C 1509-1 class 1) when the windscreen WS-10, WS-15, or WS-16 is installed (the various windscreen corrections are turned on) and when the preamplifier is connected to the sound level meter via the microphone extension cable EC-04 series
7.4	Operation of bandpass filters	9.2.7 c)	No corresponding function
7.5	Details about connection and effects of auxiliary devices	9.2.7 d)	» [Connection with Peripheral Devices]
9	**Instruction manual**		
9.2	**Information about operation**		
9.2.1	**General**		
9.2.1 a)	Effects of exposure to radio-frequency fields: classification group X, Y, or Z Performance designation: class 1 or class 2	5.1.3 5.1.5	Refer to 5.1.3 Refer to 5.1.5
9.2.1 b)	Overall configuration, Normal operation configuration (including microphone and windscreen)	5.1.4	Refer to 5.1.4
	Method of mounting the microphone and windscreen	5.1.7	Refer to 5.1.7
9.2.1 c)	Models of microphones	5.1.6	Refer to 5.1.6
9.2.1 d)	Compliance with standard when an extension cable is used	7.3	Refer to 7.3
9.2.1 e)	Characteristics and operations of each channel	5.1.18	Refer to 5.1.18
9.2.1 f)	Influence of mechanical vibration and how to reduce it	6.7	Refer to 6.7
9.2.2	**Design features**		
9.2.2 a)	Measurable quantity	5.18.3	Refer to 5.18.3
9.2.2 b)	Directional characteristics	5.4.5	Refer to 5.4.5
9.2.2 c)	Description of the frequency weightings	5.1.10 5.5.8	Refer to 5.1.10 Refer to 5.5.8
9.2.2 d)	Description of the time weightings	5.8.1	Refer to 5.8.1
9.2.2 e)	The level ranges by the nominal A-weighted sound levels at the lower and upper boundaries of the linear operating ranges at 1 kHz	5.1.12	Refer to 5.1.12
9.2.2 f)	Operation of the level range control	5.1.12	Refer to 5.1.12

Standard paragraph No.	Description	See also	Explanation
			NL-63
9.2.2 g)	Description of the display and update rates	5.18.1-2-3-4	Refer to 5.18.1-2-3-4
9.2.2 h)	Total range of A-weighted sound pressure level (1 kHz)		» [Specifications]
9.2.2 i)	Nominal range of L_{Cpeak} at for each level range	5.13.1	Refer to 5.13.1
9.2.2 j)	Computer software to operate the sound level meter	5.1.8	Refer to 5.1.8
9.2.2 k)	Design-goals and tolerances for quantities which are not in the standard	5.5.8	Refer to 5.5.8
9.2.3	**Power supply**		
9.2.3 a)	Recommendations for acceptable battery types and the nominal duration of continuous operation for the normal mode of operation under reference environmental conditions when full capacity batteries are installed	5.23.3 5.23.4	Refer to 5.23.3 Refer to 5.23.4
9.2.3 b)	Description of the function of battery check	5.23.1	Refer to 5.23.1
9.2.3 c)	Operation from an external power supply	5.23.5	Refer to 5.23.5
9.2.3 d)	Public power supply voltage	5.23.6	Refer to 5.23.6
9.2.4	**Adjustments at the calibration check frequency**		
9.2.4 a)	Model of sound calibrator(s)	5.2.1	Refer to 5.2.1
9.2.4 b)	Calibration check frequency		» [Specifications]
9.2.4 c)	Procedure for calibration and adjustment with sound calibrator	5.2.3	Refer to 5.2.3
9.2.5	**Corrections to indicated levels**		
9.2.5 a)	Correction data and the expanded uncertainties	5.3.1.1	Refer to 5.3.1.1
9.2.5 b)	Typical values of influence from case-related reflection and diffraction	5.3.2.1	Refer to 5.3.2.1
9.2.5 c)	Effects of a windscreen	5.3.3.1	Refer to 5.3.3.1
9.2.5 d)	Correction value for multi-frequency sound calibrator	5.3.5.1 5.3.5.3	Refer to 5.3.5.1 Refer to 5.3.5.3
9.2.6	**Operating the sound level meter**		
9.2.6 a)	Reference direction and position of microphone reference point	5.1.13	Refer to 5.1.13
9.2.6 b)	Influence from measurement procedure, case, and operator	5.1.6	Refer to 5.1.6
9.2.6 c)	Procedure for measuring fields with low-level sounds	5.7.5	Refer to 5.7.5
9.2.6 d)	Initial stabilization time (time from turning on the power until you can take measurements)	5.1.19	Refer to 5.1.19
9.2.6 e)	Measurement guidelines and procedures at 65 kPa to 85 kPa	6.2.2	Refer to 6.2.2
9.2.6 f)	Procedure for setting integration time and time of the day	5.20.1	Refer to 5.20.1

Standard paragraph No.	Description	See also	Explanation
			NL-63
9.2.6 g)	Minimum and maximum values of integral time	5.20.2	Refer to 5.20.2
9.2.6 h)	Operating of the hold facility and the means for clearing a display that is held	5.1.14	Refer to 5.1.14
9.2.6 i)	Reset function for measurement results, time required from resetting to measurement reinitialization		The measurement results (measurement values, over-display, under-display) are reset by starting to take new measurements. Time required from this operation to reinitialize measuring: < 1 second.
9.2.6 j)	Operation and interpretation of overload and under-range indications	5.11.1 5.12.2	Refer to 5.11.1 Refer to 5.12.2
9.2.6 k)	Threshold function	5.17	Refer to 5.17
9.2.6 l)	Method for downloading digital data	5.18.5	Refer to 5.18.5
9.2.6 m)	Recommended lengths and types of typical cables	5.21.1	Refer to 5.21.1
9.2.6 n)	Recommended ranges of electrical output terminals	5.19.1	Refer to 5.19.1
9.2.7	**Accessories**		
9.2.7 a)	Typical values of the influence of accessory installation on sound level meter performance	7.2	Refer to 7.2
9.2.7 b)	Correction value applied to measurement results when extending the distance between the preamplifier and sound level meter	7.1	Refer to 7.1
9.2.7 c)	How to use a bandpass filter	7.4	Refer to 7.4
9.2.7 d)	How to connect accessories and how the connection affects the performance of the sound level meter	7.5	Refer to 7.5
9.2.8	**Influence of variations in environmental conditions**		
9.2.8 a)	Components that operate only under specific environmental conditions	6.3.2	Refer to 6.3.2
9.2.8 b)	Influence of electrostatic discharge (deterioration or damage to performance/functions)	6.5.2	Refer to 6.5.2
9.2.8 c)	Compliance with immunity standard in relation to power frequency magnetic fields and radio frequency electromagnetic fields	6.6.10	Refer to Table 2 and 6.6.10
9.3	**Information for testing**		
9.3 a)	Reference sound pressure level	5.1.13	Refer to 5.1.13
9.3 b)	Reference level range	5.1.13	Refer to 5.1.13
9.3 c)	Microphone reference point	5.1.13	Refer to 5.1.13
9.3 d)	Correction value for multi-frequency sound calibrator	5.3.5.1 5.3.5.3	Refer to 5.3.5.1 Refer to 5.3.5.3
9.3 e)	Directional index in relation to random incidence	5.5.5	Refer to 5.5.5
9.3 f)	Upper and lower limits of linear operating range for A-weighted sound level	5.6.10	Refer to 5.6.10

Standard paragraph No.	Description	See also	Explanation
			NL-63
9.3 g)	Starting point for level linearity calculation error testing	5.6.11	Refer to 5.6.11
9.3 h)	Design targets and tolerance limits for electrical performance of electrical signal input equipment	5.1.15	Refer to 5.1.15
9.3 i)	Maximum noise floor level	5.7.1 5.7.3	Refer to 5.7.1/5.7.3
9.3 j)	Maximum sound pressure level that the microphone can withstand Maximum voltage the preamplifier can withstand	5.1.17	Refer to 5.1.17
9.3 k)	Maximum and minimum operable power supply voltages	5.23.2	Refer to 5.23.2
9.3 l)	Time it takes to adapt to changes in environmental conditions	6.1.2	Refer to 6.1.2
9.3 m)	Compliance with immunity standards for radio frequency fields above the specified field strengths	6.6.5	Refer to 6.6.5
9.3 n)	Operation modes and connected equipment that cause the highest radio frequency emissions	5.21.2	Refer to 5.21.2
9.3 o)	Operation mode and connection state where the effects of power frequency magnetic fields and radio frequency electromagnetic fields are maximized	6.6.1 6.6.3	Refer to 6.6.1 Refer to 6.6.3

9.1 NL-63 free field characteristics

Table 1. NL-63 free field characteristics

Direct connection between preamplifier and sound level meter, without a windscreen installed

Nominal Frequency (Hz)	Exact Frequency (Hz)	Microphone Frequency Response (dB)		Influence of Case Reflection (dB)		NL-63 Electrical Response (dB)
		UC-59L (NL-63)	Expanded Uncertainty	NL-63	Expanded Uncertainty	
63	**63.096**	**0.0**	**0.3**	**0.0**	**0.15**	**0.0**
80	**79.433**	**0.0**	**0.3**	**0.0**	**0.15**	**0.0**
100	**100.00**	**0.0**	**0.3**	**0.0**	**0.15**	**0.0**
125	**125.89**	**0.0**	**0.3**	**0.0**	**0.15**	**0.0**
160	**158.49**	**0.0**	**0.3**	**0.0**	**0.15**	**0.0**
200	**199.53**	**0.0**	**0.2**	**0.0**	**0.15**	**0.0**
250	**251.19**	**-0.1**	**0.2**	**0.0**	**0.15**	**0.0**
315	**316.23**	**0.0**	**0.2**	**0.0**	**0.15**	**0.0**
400	**398.11**	**0.0**	**0.2**	**0.1**	**0.15**	**0.0**
500	**501.19**	**0.0**	**0.2**	**0.1**	**0.15**	**0.0**
630	**630.96**	**0.0**	**0.2**	**0.1**	**0.15**	**0.0**
800	**794.33**	**0.0**	**0.2**	**0.0**	**0.15**	**0.0**
1000	**1000.0**	**0.0**	**0.2**	**-0.1**	**0.15**	**0.0**
1060	1059.3	0.0	0.3	0.0	0.15	0.0
1120	1122.0	0.0	0.3	0.0	0.15	0.0
1180	1188.5	0.0	0.3	0.0	0.15	0.0
1250	**1258.9**	**0.0**	**0.3**	**-0.2**	**0.15**	**0.0**
1320	1333.5	0.0	0.3	-0.3	0.15	0.0
1400	1412.5	0.0	0.3	-0.3	0.15	0.0
1500	1496.2	0.1	0.3	-0.3	0.15	0.0
1600	**1584.9**	**0.1**	**0.3**	**-0.2**	**0.15**	**0.0**
1700	1678.8	0.1	0.3	-0.1	0.15	0.0
1800	1778.3	0.1	0.3	0.0	0.15	0.0
1900	1883.6	0.0	0.3	0.0	0.15	0.0
2000	**1995.3**	**0.0**	**0.3**	**-0.1**	**0.15**	**0.0**
2120	2113.5	0.0	0.3	-0.1	0.15	0.0
2240	2238.7	0.1	0.3	0.1	0.15	0.0
2360	2371.4	0.1	0.3	0.0	0.15	0.0
2500	**2511.9**	**0.1**	**0.3**	**-0.1**	**0.15**	**0.0**
2650	2660.7	0.1	0.3	-0.1	0.20	0.0
2800	2818.4	0.1	0.3	0.0	0.20	0.0
3000	2985.4	0.2	0.3	0.2	0.20	0.0
3150	**3162.3**	**0.2**	**0.3**	**-0.3**	**0.20**	**0.0**
3350	3349.7	0.2	0.3	-0.4	0.20	0.0
3550	3548.1	0.2	0.3	-0.1	0.20	0.0
3750	3758.4	0.2	0.3	-0.1	0.20	0.0
4000	**3981.1**	**0.2**	**0.3**	**0.1**	**0.20**	**0.0**

Nominal Frequency (Hz)	Exact Frequency (Hz)	Microphone Frequency Response (dB)		Influence of Case Reflection (dB)		NL-63 Electrical Response (dB)
		UC-59L (NL-63)	Expanded Uncertainty	NL-63	Expanded Uncertainty	
4250	4217.0	0.3	0.3	-0.1	0.20	0.0
4500	4466.8	0.3	0.3	-0.1	0.20	0.0
4750	4731.5	0.3	0.3	0.1	0.20	0.0
5000	**5011.9**	**0.3**	**0.3**	**0.5**	**0.20**	**0.0**
5300	5308.8	0.3	0.3	-0.4	0.30	0.0
5600	5623.4	0.3	0.3	-0.3	0.30	0.0
6000	5956.6	0.3	0.3	-0.3	0.30	0.0
6300	**6309.6**	**0.3**	**0.3**	**0.0**	**0.30**	**0.0**
6700	6683.4	0.3	0.3	0.3	0.35	0.0
7100	7079.5	0.2	0.3	0.5	0.35	0.0
7500	7498.9	0.2	0.3	-0.5	0.35	0.0
8000	**7943.3**	**0.2**	**0.3**	**0.0**	**0.35**	**0.0**
8500	8414.0	0.2	0.5	-0.4	0.35	0.0
9000	8912.5	-0.1	0.5	-0.1	0.35	0.0
9500	9440.6	0.0	0.5	0.3	0.35	0.0
10000	**10000**	**0.1**	**0.5**	**-0.1**	**0.35**	**0.0**
10600	10593	-0.1	0.5	-0.3	0.35	0.0
11200	11220	-0.2	0.5	0.2	0.35	0.0
11800	11885	-0.2	0.5	0.3	0.35	0.0
12500	**12589**	**-0.2**	**0.5**	**0.2**	**0.35**	**0.0**
13200	13335	-0.4	0.5	-0.4	0.35	0.0
14000	14125	-0.5	0.5	0.0	0.35	0.0
15000	14962	-0.6	0.5	0.4	0.35	0.0
16000	**15849**	**-1.1**	**0.5**	**-0.2**	**0.35**	**0.0**

Direct connection between preamplifier and sound level meter, with Windscreen WS-10 installed

Nominal Frequency (Hz)	Exact Frequency (Hz)	Microphone Frequency Response (dB)		Influence of Case Reflection (dB)		Effect of Windscreen (dB)			NL-63 Electrical Response (dB)
		UC-59L (NL-63)	Expanded Uncertainty	NL-63	Expanded Uncertainty	WS-10 Effect	WS-10 Correction	Expanded Uncertainty	
63	**63.096**	**0.0**	**0.3**	**0.0**	**0.15**	**0.0**	**0.0**	**0.10**	**0.0**
80	**79.433**	**0.0**	**0.3**	**0.0**	**0.15**	**0.0**	**0.0**	**0.10**	**0.0**
100	**100.00**	**0.0**	**0.3**	**0.0**	**0.15**	**0.0**	**0.0**	**0.10**	**0.0**
125	**125.89**	**0.0**	**0.3**	**0.0**	**0.15**	**0.0**	**0.0**	**0.10**	**0.0**
160	**158.49**	**0.0**	**0.3**	**0.0**	**0.15**	**0.0**	**0.0**	**0.10**	**0.0**
200	**199.53**	**0.0**	**0.2**	**0.0**	**0.15**	**0.0**	**0.0**	**0.10**	**0.0**
250	**251.19**	**-0.1**	**0.2**	**0.0**	**0.15**	**0.0**	**0.0**	**0.10**	**0.0**
315	**316.23**	**0.0**	**0.2**	**0.0**	**0.15**	**0.0**	**0.0**	**0.10**	**0.0**
400	**398.11**	**0.0**	**0.2**	**0.1**	**0.15**	**0.0**	**0.0**	**0.10**	**0.0**
500	**501.19**	**0.0**	**0.2**	**0.1**	**0.15**	**0.1**	**0.0**	**0.10**	**0.0**
630	**630.96**	**0.0**	**0.2**	**0.1**	**0.15**	**0.1**	**0.0**	**0.10**	**0.0**
800	**794.33**	**0.0**	**0.2**	**0.0**	**0.15**	**0.1**	**0.0**	**0.10**	**0.0**
1000	**1000.0**	**0.0**	**0.2**	**-0.1**	**0.15**	**0.1**	**0.0**	**0.10**	**0.0**
1060	1059.3	0.0	0.3	0.0	0.15	0.1	0.0	0.15	0.0
1120	1122.0	0.0	0.3	0.0	0.15	0.1	0.0	0.15	0.0
1180	1188.5	0.0	0.3	0.0	0.15	0.1	0.0	0.15	0.0
1250	**1258.9**	**0.0**	**0.3**	**-0.2**	**0.15**	**0.2**	**0.0**	**0.15**	**0.0**
1320	1333.5	0.0	0.3	-0.3	0.15	0.2	0.0	0.15	0.0
1400	1412.5	0.0	0.3	-0.3	0.15	0.2	-0.1	0.15	0.0
1500	1496.2	0.1	0.3	-0.3	0.15	0.2	-0.1	0.15	0.0
1600	**1584.9**	**0.1**	**0.3**	**-0.2**	**0.15**	**0.3**	**-0.1**	**0.15**	**0.0**
1700	1678.8	0.1	0.3	-0.1	0.15	0.3	-0.1	0.15	0.0
1800	1778.3	0.1	0.3	0.0	0.15	0.3	-0.1	0.15	0.0
1900	1883.6	0.0	0.3	0.0	0.15	0.3	-0.1	0.15	0.0
2000	**1995.3**	**0.0**	**0.3**	**-0.1**	**0.15**	**0.4**	**-0.1**	**0.15**	**0.0**
2120	2113.5	0.0	0.3	-0.1	0.15	0.4	-0.2	0.15	0.0
2240	2238.7	0.1	0.3	0.1	0.15	0.4	-0.2	0.15	0.0
2360	2371.4	0.1	0.3	0.0	0.15	0.4	-0.2	0.15	0.0
2500	**2511.9**	**0.1**	**0.3**	**-0.1**	**0.15**	**0.4**	**-0.2**	**0.15**	**0.0**
2650	2660.7	0.1	0.3	-0.1	0.20	0.5	-0.3	0.15	0.0
2800	2818.4	0.1	0.3	0.0	0.20	0.5	-0.3	0.15	0.0
3000	2985.4	0.2	0.3	0.2	0.20	0.5	-0.3	0.15	0.0
3150	**3162.3**	**0.2**	**0.3**	**-0.3**	**0.20**	**0.5**	**-0.2**	**0.15**	**0.0**
3350	3349.7	0.2	0.3	-0.4	0.20	0.4	-0.2	0.15	0.0
3550	3548.1	0.2	0.3	-0.1	0.20	0.4	-0.2	0.15	0.0
3750	3758.4	0.2	0.3	-0.1	0.20	0.3	-0.2	0.15	0.0
4000	**3981.1**	**0.2**	**0.3**	**0.1**	**0.20**	**0.3**	**-0.2**	**0.15**	**0.0**
4250	4217.0	0.3	0.3	-0.1	0.20	0.2	-0.1	0.15	0.0
4500	4466.8	0.3	0.3	-0.1	0.20	0.1	-0.1	0.15	0.0

Nominal Frequency (Hz)	Exact Frequency (Hz)	Microphone Frequency Response (dB)		Influence of Case Reflection (dB)		Effect of Windscreen (dB)			NL-63 Electrical Response (dB)
		UC-59L (NL-63)	Expanded Uncertainty	NL-63	Expanded Uncertainty	WS-10 Effect	WS-10 Correction	Expanded Uncertainty	
4750	4731.5	0.3	0.3	0.1	0.20	0.1	-0.1	0.15	0.0
5000	**5011.9**	**0.3**	**0.3**	**0.5**	**0.20**	**-0.1**	**-0.1**	**0.15**	**0.0**
5300	5308.8	0.3	0.3	-0.4	0.30	0.0	-0.1	0.20	0.0
5600	5623.4	0.3	0.3	-0.3	0.30	0.0	-0.1	0.20	0.0
6000	5956.6	0.3	0.3	-0.3	0.30	0.1	0.0	0.20	0.0
6300	**6309.6**	**0.3**	**0.3**	**0.0**	**0.30**	**0.2**	**0.0**	**0.20**	**0.0**
6700	6683.4	0.3	0.3	0.3	0.35	0.2	0.0	0.20	0.0
7100	7079.5	0.2	0.3	0.5	0.35	-0.1	0.0	0.20	0.0
7500	7498.9	0.2	0.3	-0.5	0.35	0.2	0.0	0.20	0.0
8000	**7943.3**	**0.2**	**0.3**	**0.0**	**0.35**	**0.1**	**0.1**	**0.20**	**0.0**
8500	8414.0	0.2	0.5	-0.4	0.35	0.0	0.1	0.25	0.0
9000	8912.5	-0.1	0.5	-0.1	0.35	0.0	0.1	0.25	0.0
9500	9440.6	0.0	0.5	0.3	0.35	-0.1	0.1	0.25	0.0
10000	**10000**	**0.1**	**0.5**	**-0.1**	**0.35**	**-0.2**	**0.2**	**0.25**	**0.0**
10600	10593	-0.1	0.5	-0.3	0.35	0.0	0.2	0.25	0.0
11200	11220	-0.2	0.5	0.2	0.35	-0.1	0.2	0.25	0.0
11800	11885	-0.2	0.5	0.3	0.35	-0.4	0.3	0.25	0.0
12500	**12589**	**-0.2**	**0.5**	**0.2**	**0.35**	**-0.5**	**0.3**	**0.25**	**0.0**
13200	13335	-0.4	0.5	-0.4	0.35	-0.3	0.4	0.25	0.0
14000	14125	-0.5	0.5	0.0	0.35	-0.4	0.4	0.25	0.0
15000	14962	-0.6	0.5	0.4	0.35	-0.6	0.5	0.25	0.0
16000	**15849**	**-1.1**	**0.5**	**-0.2**	**0.35**	**-0.2**	**0.5**	**0.25**	**0.0**

Connection between preamplifier and sound level meter via microphone extension cable EC-04 series, with All-Weather Windscreen WS-15 installed

Nominal Frequency (Hz)	Exact Frequency (Hz)	Microphone Frequency Response (dB)		Influence of Case Reflection (dB)		Effect of Windscreen (dB)			NL-63 Electrical Response (dB)
		UC-59L (NL-63)	Expanded Uncertainty	NH-26 (NL-63)	Expanded Uncertainty	WS-15 Effect	WS-15 Correction	Expanded Uncertainty	
63	**63.096**	**0.0**	**0.3**	**0.0**	**0.15**	**0.0**	**0.0**	**0.10**	**0.0**
80	**79.433**	**0.0**	**0.3**	**0.0**	**0.15**	**0.0**	**0.0**	**0.10**	**0.0**
100	**100.00**	**0.0**	**0.3**	**0.0**	**0.15**	**0.0**	**0.0**	**0.10**	**0.0**
125	**125.89**	**0.0**	**0.3**	**0.0**	**0.15**	**0.0**	**0.0**	**0.10**	**0.0**
160	**158.49**	**0.0**	**0.3**	**0.0**	**0.15**	**0.0**	**0.0**	**0.10**	**0.0**
200	**199.53**	**0.0**	**0.2**	**0.0**	**0.15**	**0.1**	**0.0**	**0.10**	**0.0**
250	**251.19**	**-0.1**	**0.2**	**0.0**	**0.15**	**0.1**	**0.0**	**0.10**	**0.0**
315	**316.23**	**0.0**	**0.2**	**0.0**	**0.15**	**0.1**	**-0.1**	**0.10**	**0.0**
400	**398.11**	**0.0**	**0.2**	**0.0**	**0.15**	**0.1**	**-0.1**	**0.10**	**0.0**
500	**501.19**	**0.0**	**0.2**	**0.1**	**0.15**	**0.3**	**-0.2**	**0.10**	**0.0**
630	**630.96**	**0.0**	**0.2**	**0.0**	**0.15**	**0.4**	**-0.2**	**0.10**	**0.0**
800	**794.33**	**0.0**	**0.2**	**0.0**	**0.15**	**0.4**	**-0.3**	**0.10**	**0.0**
1000	**1000.0**	**0.0**	**0.2**	**0.1**	**0.15**	**0.5**	**-0.4**	**0.10**	**0.0**
1060	1059.3	0.0	0.3	0.1	0.15	0.6	-0.4	0.15	0.0
1120	1122.0	0.0	0.3	0.1	0.15	0.6	-0.4	0.15	0.0
1180	1188.5	0.0	0.3	0.1	0.15	0.7	-0.4	0.15	0.0
1250	**1258.9**	**0.0**	**0.3**	**0.1**	**0.15**	**0.8**	**-0.4**	**0.15**	**0.0**
1320	1333.5	0.0	0.3	0.1	0.15	0.7	-0.4	0.15	0.0
1400	1412.5	0.0	0.3	0.1	0.15	0.7	-0.4	0.15	0.0
1500	1496.2	0.1	0.3	0.0	0.15	0.6	-0.4	0.15	0.0
1600	**1584.9**	**0.1**	**0.3**	**0.0**	**0.15**	**0.5**	**-0.4**	**0.15**	**0.0**
1700	1678.8	0.1	0.3	0.0	0.15	0.3	-0.4	0.15	0.0
1800	1778.3	0.1	0.3	0.0	0.15	0.2	-0.4	0.15	0.0
1900	1883.6	0.0	0.3	0.0	0.15	0.1	-0.4	0.15	0.0
2000	**1995.3**	**0.0**	**0.3**	**0.0**	**0.15**	**0.3**	**-0.4**	**0.15**	**0.0**
2120	2113.5	0.0	0.3	-0.1	0.15	0.5	-0.4	0.15	0.0
2240	2238.7	0.1	0.3	-0.1	0.15	0.5	-0.3	0.15	0.0
2360	2371.4	0.1	0.3	-0.1	0.15	0.4	-0.3	0.15	0.0
2500	**2511.9**	**0.1**	**0.3**	**-0.1**	**0.15**	**0.2**	**-0.3**	**0.15**	**0.0**
2650	2660.7	0.1	0.3	-0.1	0.20	0.5	-0.2	0.15	0.0
2800	2818.4	0.1	0.3	-0.1	0.20	0.4	-0.2	0.15	0.0
3000	2985.4	0.2	0.3	-0.1	0.20	0.2	-0.2	0.15	0.0
3150	**3162.3**	**0.2**	**0.3**	**-0.1**	**0.20**	**-0.2**	**-0.1**	**0.15**	**0.0**
3350	3349.7	0.2	0.3	-0.1	0.20	-0.4	0.0	0.15	0.0
3550	3548.1	0.2	0.3	0.0	0.20	-0.2	0.0	0.15	0.0
3750	3758.4	0.2	0.3	0.2	0.20	0.3	0.1	0.15	0.0
4000	**3981.1**	**0.2**	**0.3**	**0.2**	**0.20**	**-0.4**	**0.2**	**0.15**	**0.0**
4250	4217.0	0.3	0.3	0.2	0.20	-0.9	0.2	0.15	0.0
4500	4466.8	0.3	0.3	0.2	0.20	-0.9	0.3	0.15	0.0

Nominal Frequency (Hz)	Exact Frequency (Hz)	Microphone Frequency Response (dB)		Influence of Case Reflection (dB)		Effect of Windscreen (dB)			NL-63 Electrical Response (dB)
		UC-59L (NL-63)	Expanded Uncertainty	NH-26 (NL-63)	Expanded Uncertainty	WS-15 Effect	WS-15 Correction	Expanded Uncertainty	
4750	4731.5	0.3	0.3	-0.2	0.20	-0.5	0.4	0.15	0.0
5000	**5011.9**	**0.3**	**0.3**	**-0.1**	**0.20**	**-0.2**	**0.5**	**0.15**	**0.0**
5300	5308.8	0.3	0.3	-0.2	0.30	-0.6	0.6	0.20	0.0
5600	5623.4	0.3	0.3	-0.1	0.30	-0.3	0.7	0.20	0.0
6000	5956.6	0.3	0.3	0.0	0.30	-0.7	0.8	0.20	0.0
6300	**6309.6**	**0.3**	**0.3**	**0.1**	**0.30**	**-1.2**	**0.9**	**0.20**	**0.0**
6700	6683.4	0.3	0.3	0.2	0.35	-0.5	0.9	0.20	0.0
7100	7079.5	0.2	0.3	0.3	0.35	-1.3	1.0	0.20	0.0
7500	7498.9	0.2	0.3	-0.2	0.35	-0.5	1.1	0.20	0.0
8000	**7943.3**	**0.2**	**0.3**	**-0.1**	**0.35**	**-0.6**	**1.2**	**0.20**	**0.0**
8500	8414.0	0.2	0.5	0.1	0.35	-1.2	1.3	0.25	0.0
9000	8912.5	-0.1	0.5	0.1	0.35	-1.3	1.4	0.25	0.0
9500	9440.6	0.0	0.5	0.0	0.35	-1.4	1.5	0.25	0.0
10000	**10000**	**0.1**	**0.5**	**0.0**	**0.35**	**-1.6**	**1.5**	**0.25**	**0.0**
10600	10593	-0.1	0.5	-0.3	0.35	-1.6	1.6	0.25	0.0
11200	11220	-0.2	0.5	0.0	0.35	-1.6	1.7	0.25	0.0
11800	11885	-0.2	0.5	-0.1	0.35	-2.0	1.8	0.25	0.0
12500	**12589**	**-0.2**	**0.5**	**0.0**	**0.35**	**-2.1**	**1.8**	**0.25**	**0.0**
13200	13335	-0.4	0.5	-0.1	0.35	-1.9	1.9	0.25	0.0
14000	14125	-0.5	0.5	0.0	0.35	-2.0	1.9	0.25	0.0
15000	14962	-0.6	0.5	0.1	0.35	-2.1	2.0	0.25	0.0
16000	**15849**	**-1.1**	**0.5**	**-0.2**	**0.35**	**-1.9**	**2.0**	**0.25**	**0.0**

Direct connection between preamplifier and sound level meter, with Rain-protection Windscreen WS-16 installed

Nominal Frequency (Hz)	Exact Frequency (Hz)	Microphone Frequency Response (dB)		Influence of Case Reflection (dB)		Effect of Windscreen (dB)			NL-63 Electrical Response (dB)
		UC-59L (NL-63)	Expanded Uncertainty	NL-63	Expanded Uncertainty	WS-16 Effect	WS-16 Correction	Expanded Uncertainty	
63	**63.096**	**0.0**	**0.3**	**0.0**	**0.15**	**0.0**	**0.0**	**0.10**	**0.0**
80	**79.433**	**0.0**	**0.3**	**0.0**	**0.15**	**0.0**	**0.0**	**0.10**	**0.0**
100	**100.00**	**0.0**	**0.3**	**0.0**	**0.15**	**0.0**	**0.0**	**0.10**	**0.0**
125	**125.89**	**0.0**	**0.3**	**0.0**	**0.15**	**0.0**	**0.0**	**0.10**	**0.0**
160	**158.49**	**0.0**	**0.3**	**0.0**	**0.15**	**0.0**	**0.0**	**0.10**	**0.0**
200	**199.53**	**0.0**	**0.2**	**0.0**	**0.15**	**0.0**	**0.0**	**0.10**	**0.0**
250	**251.19**	**-0.1**	**0.2**	**0.0**	**0.15**	**0.0**	**0.0**	**0.10**	**0.0**
315	**316.23**	**0.0**	**0.2**	**0.0**	**0.15**	**0.0**	**0.0**	**0.10**	**0.0**
400	**398.11**	**0.0**	**0.2**	**0.1**	**0.15**	**0.0**	**0.0**	**0.10**	**0.0**
500	**501.19**	**0.0**	**0.2**	**0.1**	**0.15**	**0.1**	**0.0**	**0.10**	**0.0**
630	**630.96**	**0.0**	**0.2**	**0.1**	**0.15**	**0.1**	**-0.1**	**0.10**	**0.0**
800	**794.33**	**0.0**	**0.2**	**0.0**	**0.15**	**0.1**	**-0.1**	**0.10**	**0.0**
1000	**1000.0**	**0.0**	**0.2**	**-0.1**	**0.15**	**0.2**	**-0.2**	**0.10**	**0.0**
1060	1059.3	0.0	0.3	0.0	0.15	0.3	-0.2	0.15	0.0
1120	1122.0	0.0	0.3	0.0	0.15	0.3	-0.2	0.15	0.0
1180	1188.5	0.0	0.3	0.0	0.15	0.3	-0.2	0.15	0.0
1250	**1258.9**	**0.0**	**0.3**	**-0.2**	**0.15**	**0.3**	**-0.2**	**0.15**	**0.0**
1320	1333.5	0.0	0.3	-0.3	0.15	0.4	-0.3	0.15	0.0
1400	1412.5	0.0	0.3	-0.3	0.15	0.4	-0.3	0.15	0.0
1500	1496.2	0.1	0.3	-0.3	0.15	0.5	-0.3	0.15	0.0
1600	**1584.9**	**0.1**	**0.3**	**-0.2**	**0.15**	**0.5**	**-0.3**	**0.15**	**0.0**
1700	1678.8	0.1	0.3	-0.1	0.15	0.6	-0.4	0.15	0.0
1800	1778.3	0.1	0.3	0.0	0.15	0.6	-0.4	0.15	0.0
1900	1883.6	0.0	0.3	0.0	0.15	0.6	-0.4	0.15	0.0
2000	**1995.3**	**0.0**	**0.3**	**-0.1**	**0.15**	**0.7**	**-0.5**	**0.15**	**0.0**
2120	2113.5	0.0	0.3	-0.1	0.15	0.8	-0.5	0.15	0.0
2240	2238.7	0.1	0.3	0.1	0.15	0.8	-0.6	0.15	0.0
2360	2371.4	0.1	0.3	0.0	0.15	0.8	-0.6	0.15	0.0
2500	**2511.9**	**0.1**	**0.3**	**-0.1**	**0.15**	**0.8**	**-0.6**	**0.15**	**0.0**
2650	2660.7	0.1	0.3	-0.1	0.20	1.0	-0.7	0.15	0.0
2800	2818.4	0.1	0.3	0.0	0.20	1.0	-0.7	0.15	0.0
3000	2985.4	0.2	0.3	0.2	0.20	1.0	-0.8	0.15	0.0
3150	**3162.3**	**0.2**	**0.3**	**-0.3**	**0.20**	**1.0**	**-0.8**	**0.15**	**0.0**
3350	3349.7	0.2	0.3	-0.4	0.20	1.0	-0.9	0.15	0.0
3550	3548.1	0.2	0.3	-0.1	0.20	1.0	-0.9	0.15	0.0
3750	3758.4	0.2	0.3	-0.1	0.20	1.0	-0.9	0.15	0.0
4000	**3981.1**	**0.2**	**0.3**	**0.1**	**0.20**	**1.0**	**-1.0**	**0.15**	**0.0**
4250	4217.0	0.3	0.3	-0.1	0.20	0.9	-1.0	0.15	0.0
4500	4466.8	0.3	0.3	-0.1	0.20	0.8	-1.0	0.15	0.0

Nominal Frequency (Hz)	Exact Frequency (Hz)	Microphone Frequency Response (dB)		Influence of Case Reflection (dB)		Effect of Windscreen (dB)			NL-63 Electrical Response (dB)
		UC-59L (NL-63)	Expanded Uncertainty	NL-63	Expanded Uncertainty	WS-16 Effect	WS-16 Correction	Expanded Uncertainty	
4750	4731.5	0.3	0.3	0.1	0.20	0.8	-1.1	0.15	0.0
5000	**5011.9**	**0.3**	**0.3**	**0.5**	**0.20**	**0.7**	**-1.1**	**0.15**	**0.0**
5300	5308.8	0.3	0.3	-0.4	0.30	0.9	-1.1	0.20	0.0
5600	5623.4	0.3	0.3	-0.3	0.30	1.0	-1.1	0.20	0.0
6000	5956.6	0.3	0.3	-0.3	0.30	1.2	-1.1	0.20	0.0
6300	**6309.6**	**0.3**	**0.3**	**0.0**	**0.30**	**1.4**	**-1.2**	**0.20**	**0.0**
6700	6683.4	0.3	0.3	0.3	0.35	1.3	-1.2	0.20	0.0
7100	7079.5	0.2	0.3	0.5	0.35	1.0	-1.2	0.20	0.0
7500	7498.9	0.2	0.3	-0.5	0.35	1.5	-1.1	0.20	0.0
8000	**7943.3**	**0.2**	**0.3**	**0.0**	**0.35**	**1.3**	**-1.1**	**0.20**	**0.0**
8500	8414.0	0.2	0.5	-0.4	0.35	1.3	-1.1	0.25	0.0
9000	8912.5	-0.1	0.5	-0.1	0.35	1.2	-1.0	0.25	0.0
9500	9440.6	0.0	0.5	0.3	0.35	0.9	-1.0	0.25	0.0
10000	**10000**	**0.1**	**0.5**	**-0.1**	**0.35**	**0.9**	**-0.9**	**0.25**	**0.0**
10600	10593	-0.1	0.5	-0.3	0.35	1.0	-0.8	0.25	0.0
11200	11220	-0.2	0.5	0.2	0.35	0.7	-0.7	0.25	0.0
11800	11885	-0.2	0.5	0.3	0.35	0.2	-0.5	0.25	0.0
12500	**12589**	**-0.2**	**0.5**	**0.2**	**0.35**	**0.0**	**-0.4**	**0.25**	**0.0**
13200	13335	-0.4	0.5	-0.4	0.35	0.3	-0.1	0.25	0.0
14000	14125	-0.5	0.5	0.0	0.35	-0.3	0.1	0.25	0.0
15000	14962	-0.6	0.5	0.4	0.35	-0.9	0.4	0.25	0.0
16000	**15849**	**-1.1**	**0.5**	**-0.2**	**0.35**	**-0.5**	**0.8**	**0.25**	**0.0**

9.2 Reference incident direction and position of reference point

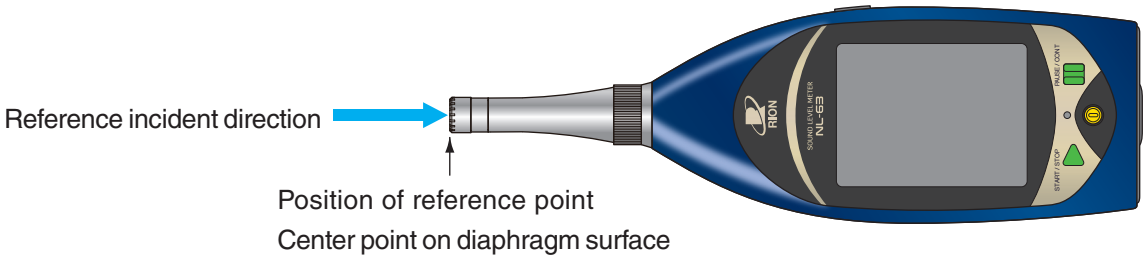


Fig. 1. Reference incident direction and position of reference point

9.3 Microphone frequency response

The frequency response of a free field microphone is represented by the response to the sound waves from the reference incident direction in a free field.
Below is an example of the frequency response of microphone UC-59L.

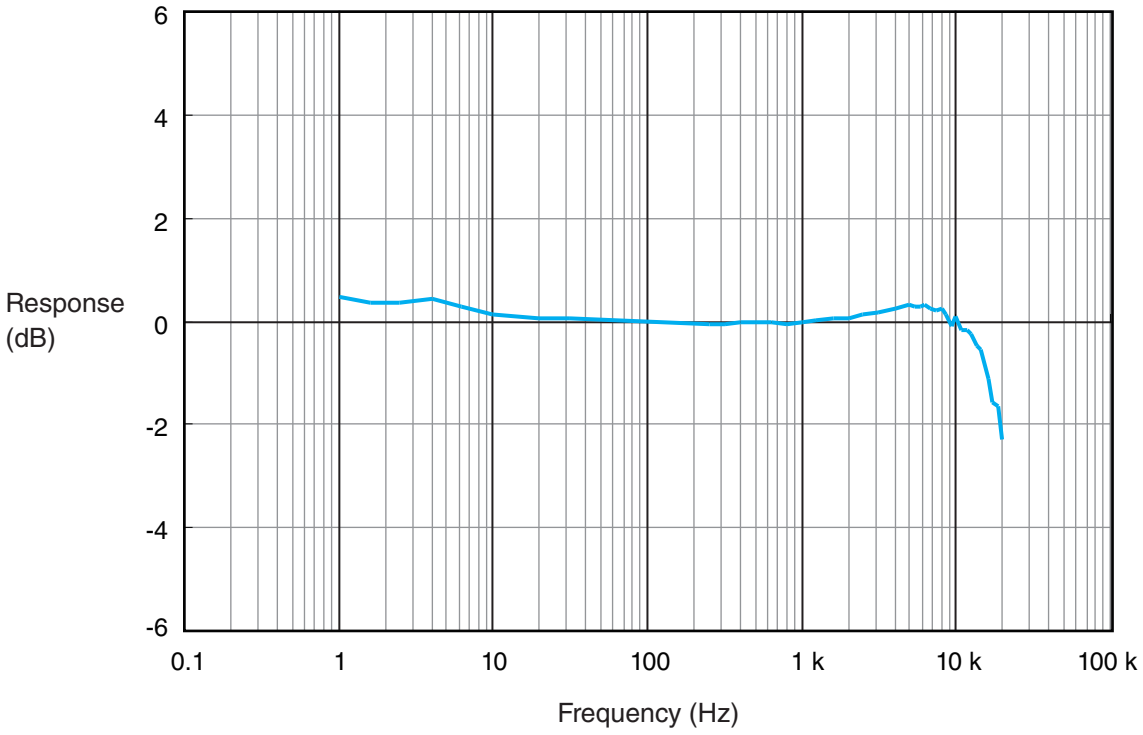
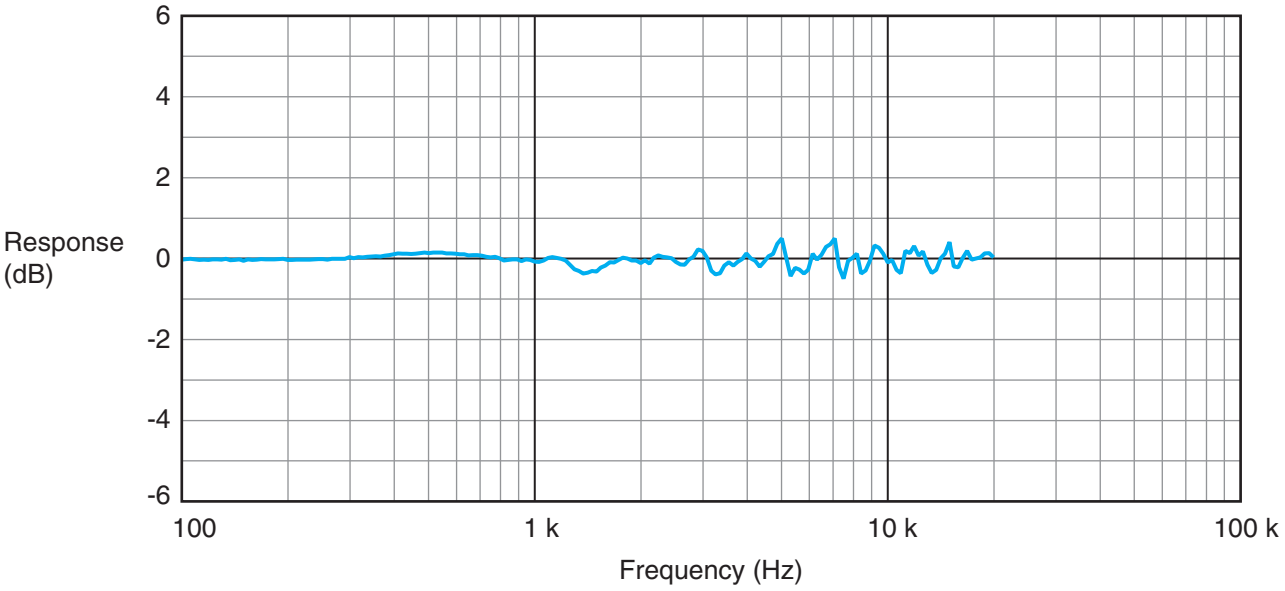


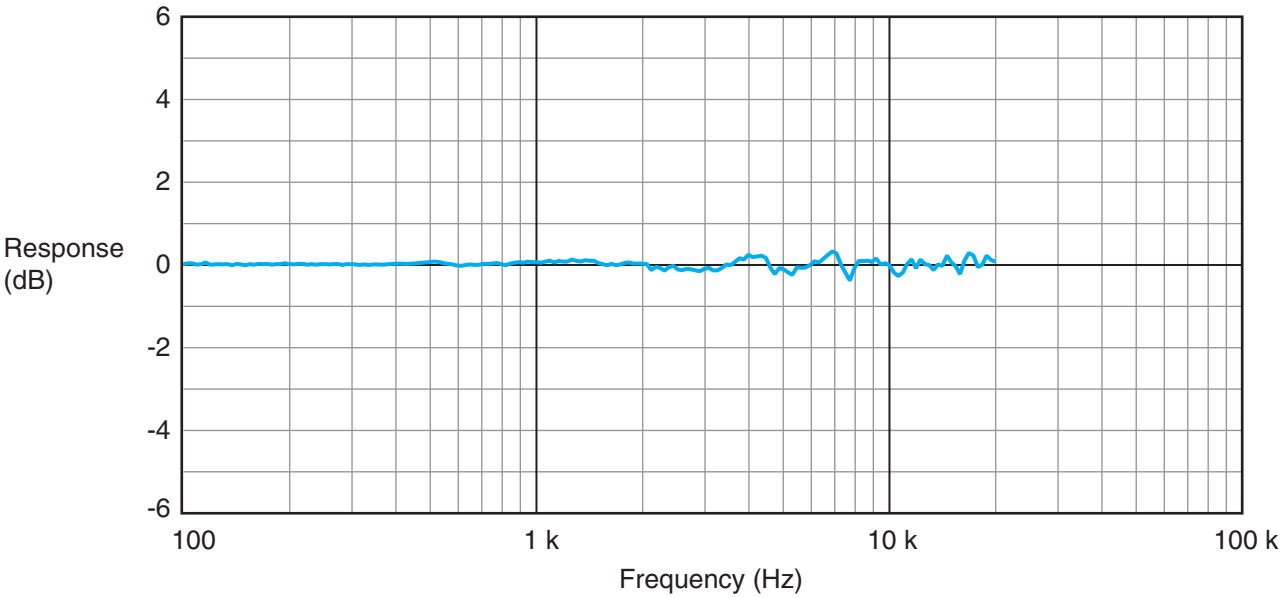
Fig. 2. Frequency response of Microphone UC-59L (1 kHz reference)

9.4 Acoustic influence of case

The NL-63 is designed to minimize the influence of case-related acoustic reflections on measurements. Below are examples of the acoustic influence from the case of the sound level meter.



When the preamplifier and sound level meter unit are directly connected



When connecting the preamplifier to the sound level meter unit via the microphone extension cable EC-04 series

Fig. 3. Acoustic influence of case

9.5 Effects of Windscreen WS-10

The influence of wind noise on measurement results can be a problem when taking measurements outdoors in the wind or of a ventilation system. In such cases, attach the included Windscreen WS-10 to the microphone.
The figures below show the effects of wind noise suppression produced by WS-10. The amount of suppression is approximately 25 dB with frequency weighting A and approximately 15 dB with frequency weighting C.
The influence of the WS-10 on the free field characteristics of the sound level meter is within ±1.0 dB up to 20 kHz, as shown in the figure on the next page. It is possible to reduce the influence of wind by using the windscreen correction function that corresponds to the model of the windscreen attached to the sound level meter.

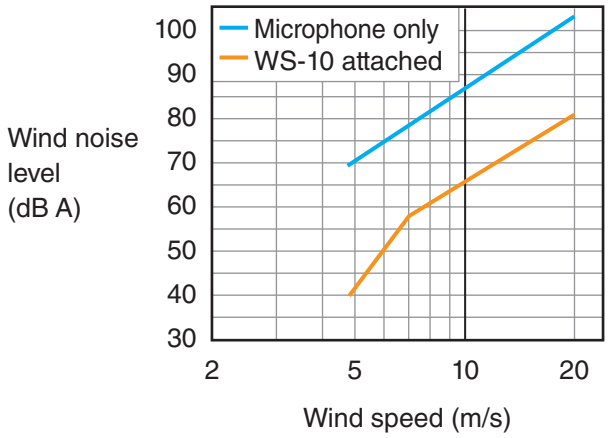


Fig. 4-1. Wind noise suppression with frequency weighting A

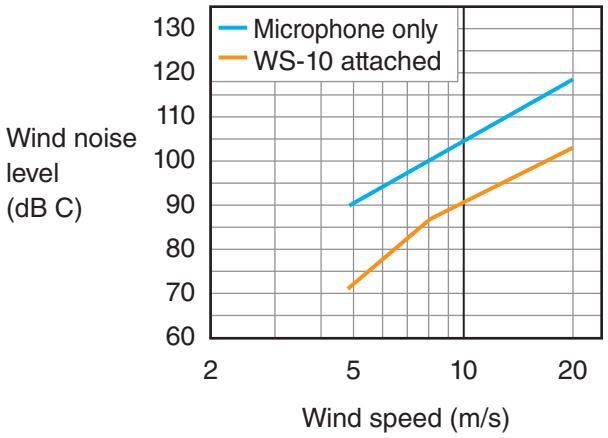


Fig. 4-2. Wind noise suppression with frequency weighting C

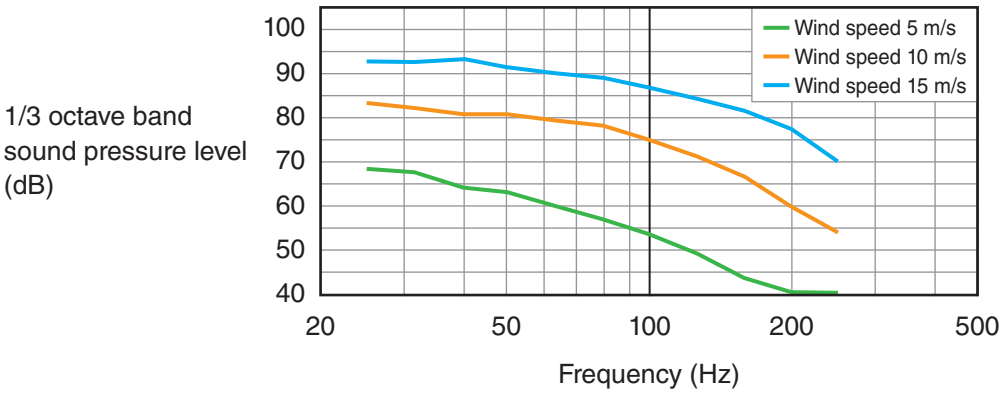


Fig. 5. Wind noise frequency response measured with Windscreen WS-10 attached to the microphone

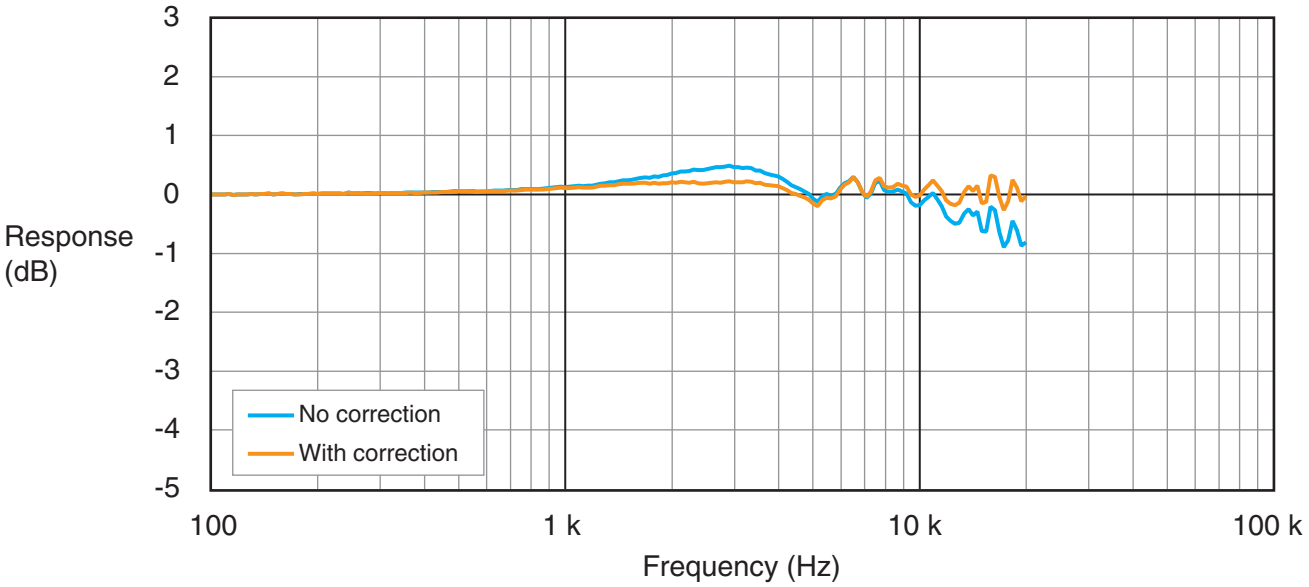


Fig. 6. Windscreen (WS-10) frequency response

9.6 Effects of All-Weather Windscreen WS-15

The All-Weather Windscreen WS-15 not only suppresses wind noise but also protects the microphone from rain. The following figures show the characteristics of WS-15.

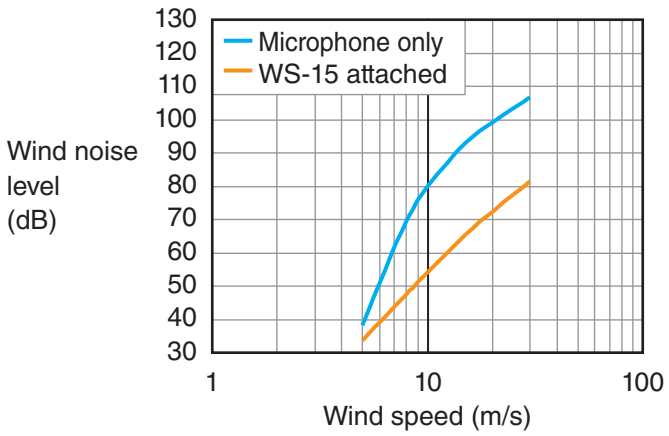


Fig. 7-1. Wind noise suppression with frequency weighting A

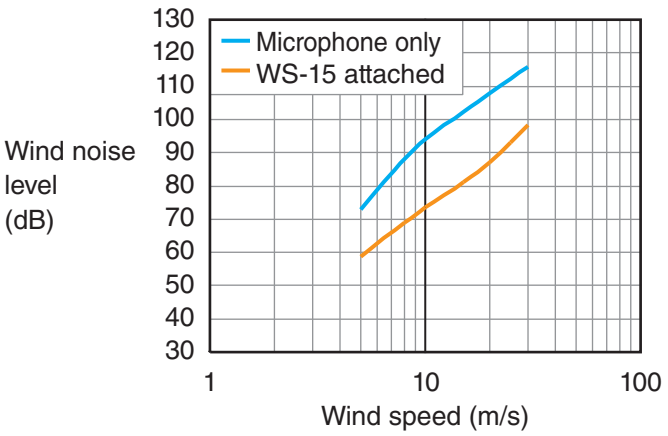


Fig. 7-2. Wind noise suppression with frequency weighting C

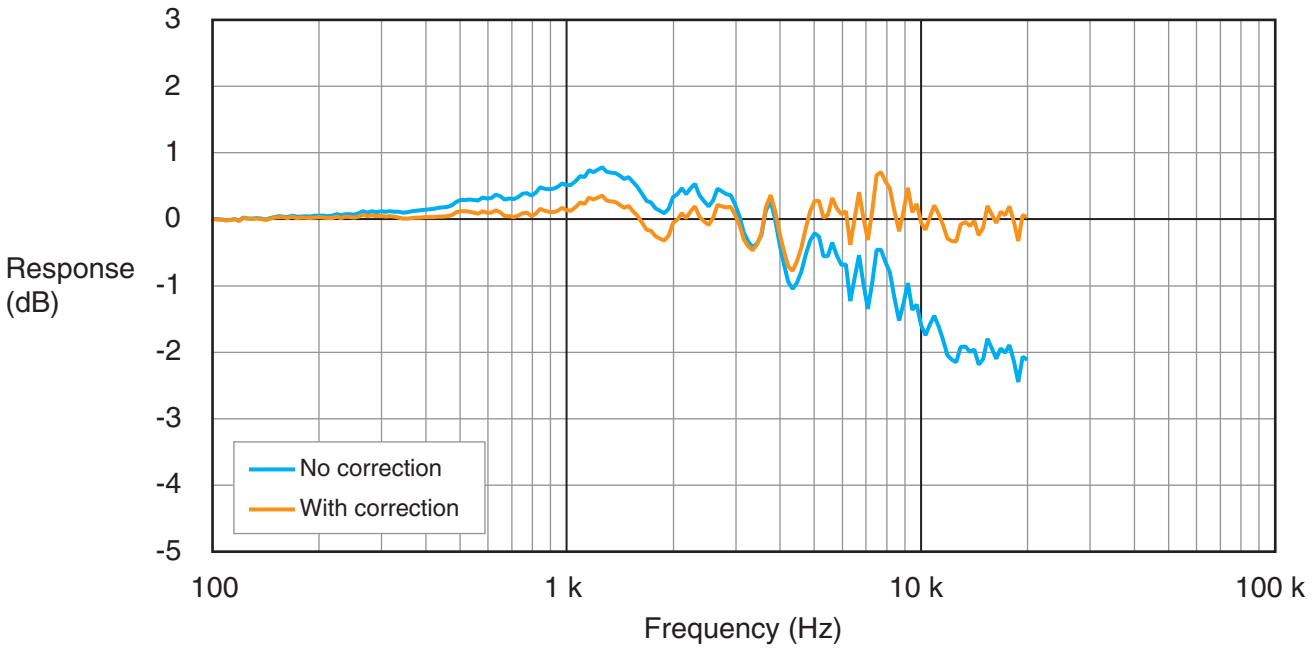


Fig. 8. Windscreen (WS-15) frequency response

9.7 Effects of Rain-protection Windscreen WS-16

The Rain-protection Windscreen WS-16 not only suppresses wind noise but also protects the microphone from rain. The following figures show the characteristics of WS-16.

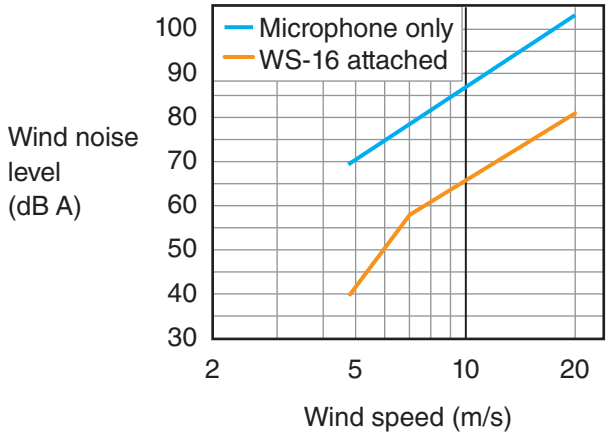


Fig. 9-1. Wind noise suppression with frequency weighting A

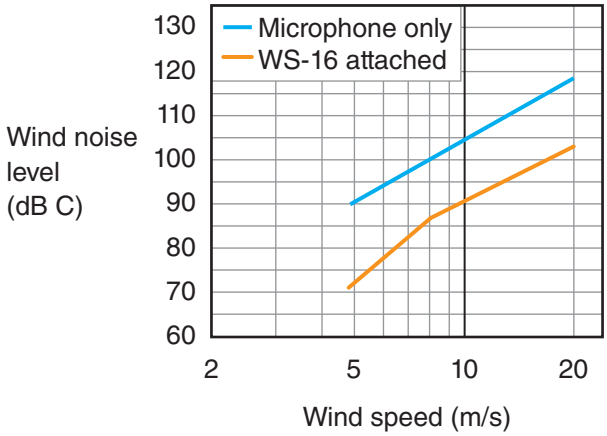


Fig. 9-2. Wind noise suppression with frequency weighting C

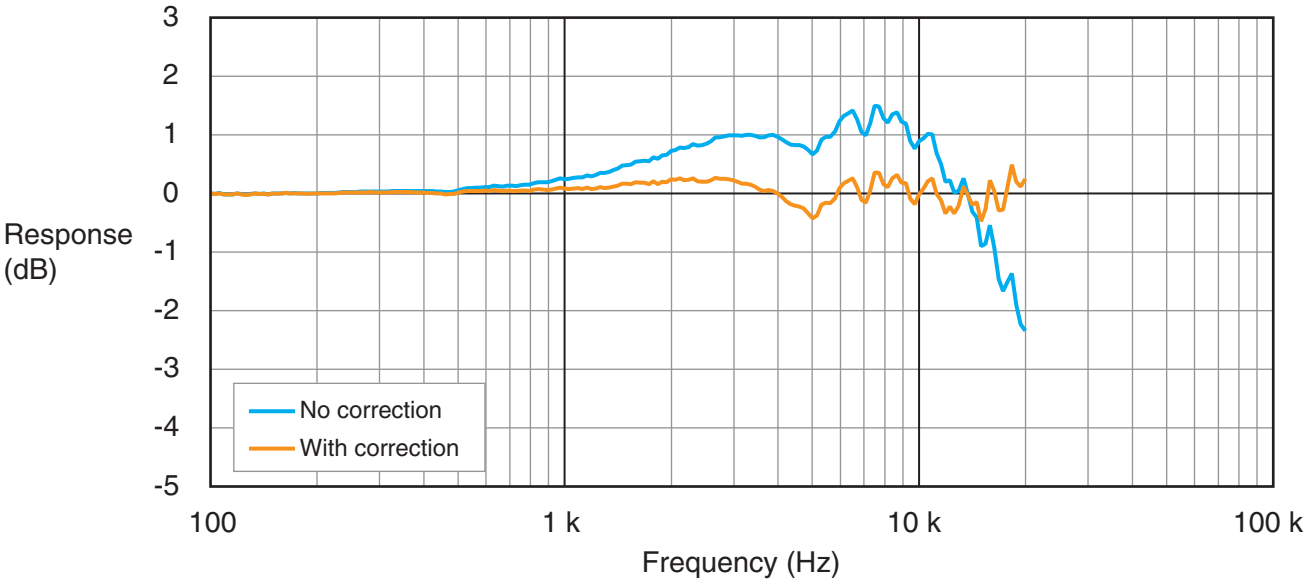


Fig. 10. Windscreen (WS-16) frequency response

9.8 Electromagnetic compatibility (EMC)

The following figure shows the immunity test conditions (NL-63 direction, operation mode and connection state) against power frequency magnetic fields and radio frequency electromagnetic fields. Under these conditions, the effects of exposure to power frequency magnetic field and radio frequency electromagnetic field are at their largest. The same applies to the operation mode and connection state in which radio frequency emissions are at their largest.

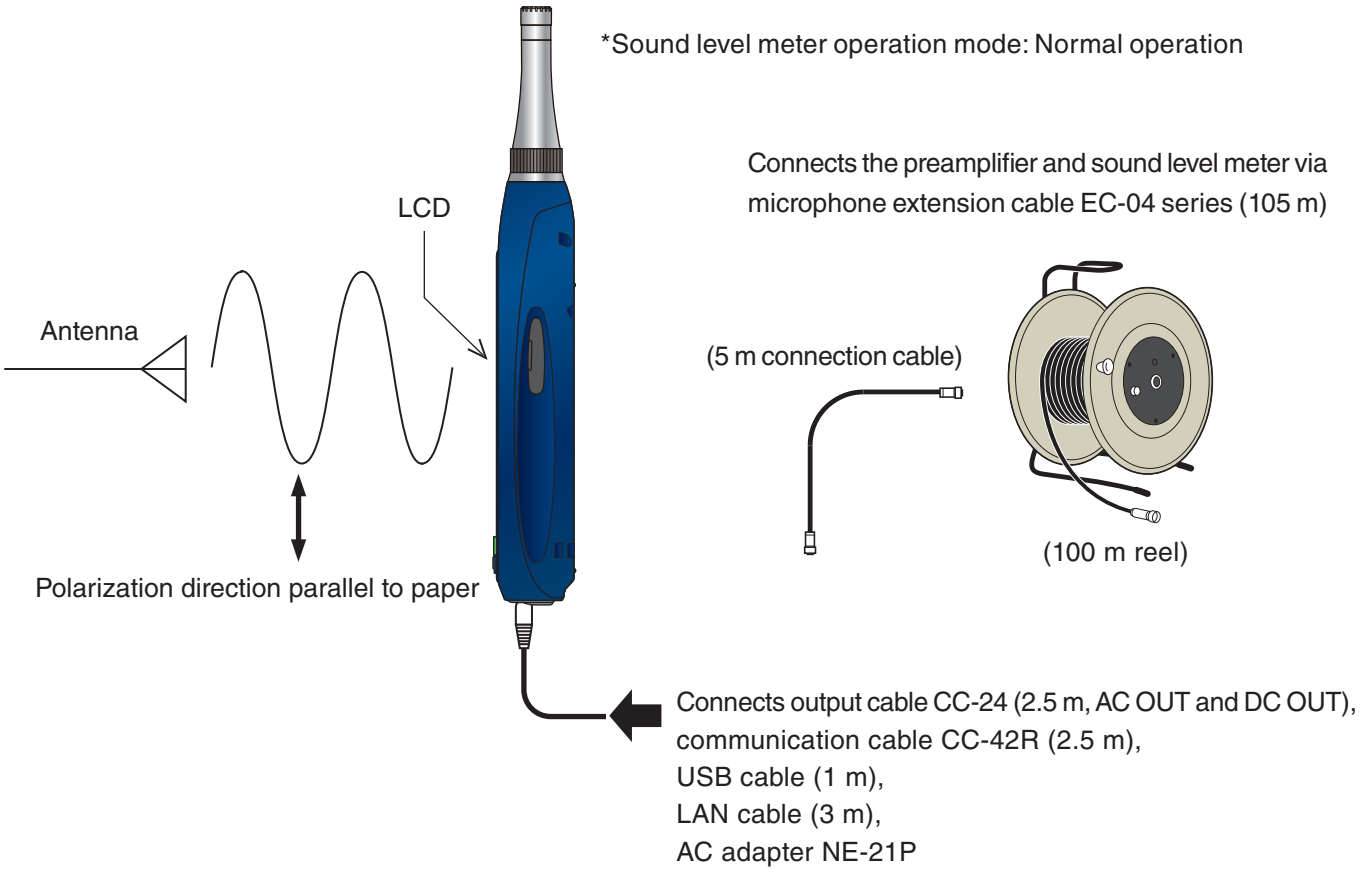


Fig. 11. Immunity test conditions in relation to power frequency magnetic fields and radio frequency electromagnetic fields

Table 2. Compliance with electromagnetic compatibility (EMC) standard

Immunity to power frequency magnetic fields	The specification of IEC 61672-1 class 1 is satisfied
Immunity to radio frequency fields	The specification of IEC 61672-1 class 1 is satisfied
Radio frequency emissions	The specification of IEC 61672-1 class 1 is satisfied
Electrostatic discharge	The specification of IEC 61672-1 class 1 is satisfied

9.9 Microphone free field correction amount

Table 3. Free field correction amount for microphones when calibrating sound pressure using a sound calibrator

Nominal frequency (Hz)	Exact frequency (Hz)	UC-59L (NL-63) correction amount (dB)	Expanded uncertainty (dB)
31.5	31.623	0.0	0.20
63	63.096	0.0	0.20
125	125.89	0.0	0.20
250	251.19	0.0	0.20
500	501.19	0.0	0.20
1000	1000.0	0.0	0.20
2000	1995.3	0.2	0.25
4000	3981.1	0.9	0.25
8000	7943.3	3.0	0.30
12500	12589	5.9	0.45
16000	15849	7.3	0.45

9.10 Upper and lower limits of linear operating range for sound pressure level

Table 4. Upper and lower limits of linear operating range for sound pressure level

A-weighting

	31.5 Hz	1 kHz	4 kHz	8 kHz	12.5 kHz
Upper limit	98.0	138.0	138.0	136.0	133.0
Start point	94.0	94.0	94.0	94.0	94.0
Lower limit	25.0	25.0	25.0	25.0	25.0

C-weighting

	31.5 Hz	1 kHz	4 kHz	8 kHz	12.5 kHz
Upper limit	135.0	138.0	137.0	135.0	131.0
Start point	94.0	94.0	94.0	94.0	94.0
Lower limit	33.0	33.0	33.0	33.0	33.0

Z-weighting

	31.5 Hz	1 kHz	4 kHz	8 kHz	12.5 kHz
Upper limit	138.0	138.0	138.0	138.0	138.0
Start point	94.0	94.0	94.0	94.0	94.0
Lower limit	50.0	50.0	50.0	50.0	50.0

Measurement range

	L_A (dB)	L_C (dB)	L_Z (dB)	L_{Cpeak} (dB)	L_{Zpeak} (dB)
Upper limit	138.0	138.0	138.0	141.0	141.0
Lower limit	25.0	33.0	50.0	60.0	65.0

9.11 Directional characteristics

The directional characteristics of the sound level meter are expressed as the difference between the measurement value of the reference incident direction (0°) and the measurement value of any incident angle θ.
The electret condenser microphone used in the NL-63 is a pressure-type microphone, so it is primarily omnidirectional. However, at higher frequencies, it becomes directional due to the effects of structure-related diffraction and dents. The following figures show the directional characteristics of NL-63.

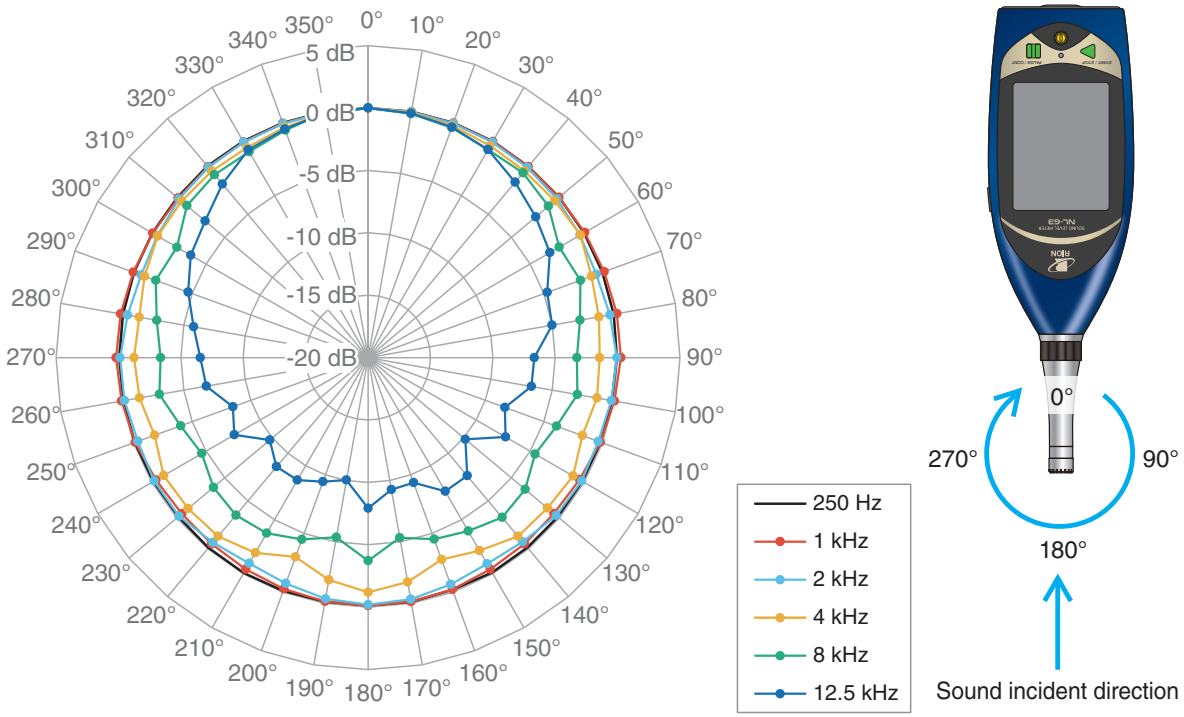


Fig. 12. Directional characteristics of NL-63 (horizontal direction)

Table 5. Directional characteristics of NL-63 (horizontal direction)

Angle (degrees)	Nominal frequency / exact frequency (Hz)							
	250/251.19	315/316.23	400/398.11	500/501.19	630/630.96	800/794.33	1000/1000.0	1250/1258.9
0°	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10°	0.02	-0.01	-0.03	-0.06	0.01	0.00	-0.01	-0.01
20°	0.01	-0.01	-0.02	-0.08	0.01	0.00	0.00	0.01
30°	0.02	0.00	-0.04	-0.09	0.04	0.03	-0.01	0.08
40°	0.00	-0.05	-0.07	-0.12	0.05	0.04	-0.01	0.13
50°	0.00	-0.05	-0.11	-0.15	0.05	0.09	-0.03	0.16
60°	-0.01	-0.03	-0.10	-0.15	0.04	0.13	0.06	0.14
70°	-0.02	-0.09	-0.16	-0.22	0.02	0.12	0.13	0.08
80°	-0.01	-0.10	-0.19	-0.28	-0.04	0.10	0.25	0.02
90°	-0.06	-0.13	-0.27	-0.36	-0.13	-0.01	0.26	0.02
100°	-0.15	-0.21	-0.30	-0.34	-0.25	-0.14	0.05	0.14
110°	-0.16	-0.24	-0.31	-0.36	-0.31	-0.26	-0.19	0.24
120°	-0.16	-0.25	-0.36	-0.42	-0.35	-0.36	-0.43	0.04
130°	-0.15	-0.25	-0.36	-0.42	-0.36	-0.40	-0.54	-0.29
140°	-0.13	-0.24	-0.35	-0.41	-0.32	-0.36	-0.51	-0.44
150°	-0.12	-0.23	-0.32	-0.40	-0.28	-0.32	-0.39	-0.35
160°	-0.20	-0.24	-0.33	-0.36	-0.24	-0.24	-0.23	-0.15
170°	-0.12	-0.22	-0.33	-0.38	-0.21	-0.19	-0.14	0.00
180°	-0.14	-0.21	-0.31	-0.38	-0.22	-0.18	-0.11	0.04
190°	-0.14	-0.19	-0.32	-0.40	-0.27	-0.20	-0.16	-0.05
200°	-0.11	-0.19	-0.31	-0.37	-0.28	-0.26	-0.27	-0.21
210°	-0.07	-0.18	-0.32	-0.39	-0.31	-0.31	-0.40	-0.38
220°	-0.10	-0.18	-0.33	-0.39	-0.35	-0.35	-0.50	-0.42
230°	-0.16	-0.19	-0.33	-0.44	-0.36	-0.38	-0.53	-0.22
240°	-0.13	-0.21	-0.32	-0.43	-0.35	-0.33	-0.38	0.10
250°	-0.11	-0.17	-0.31	-0.38	-0.31	-0.22	-0.13	0.26
260°	-0.10	-0.15	-0.28	-0.34	-0.24	-0.11	0.07	0.16
270°	-0.06	-0.12	-0.22	-0.26	-0.17	0.01	0.20	0.03
280°	-0.06	-0.10	-0.11	-0.09	-0.10	0.08	0.14	0.05
290°	-0.04	-0.13	-0.10	-0.08	-0.07	0.10	0.02	0.10
300°	-0.04	-0.12	-0.06	-0.01	-0.01	0.11	-0.07	0.15
310°	-0.05	-0.08	-0.01	-0.02	0.01	0.07	-0.11	0.18
320°	0.04	-0.04	0.01	0.02	0.02	0.07	-0.05	0.18
330°	0.02	-0.03	0.01	0.00	0.01	0.03	-0.04	0.12
340°	0.02	-0.03	0.00	0.01	-0.01	0.01	-0.02	0.05
350°	0.00	-0.03	0.00	-0.01	-0.01	0.00	-0.01	0.03

Angle (degrees)	Nominal frequency / exact frequency (Hz)							
	1600/1584.9	**2000/1995.3**	2240/2238.7	**2500/2511.9**	2800/2818.4	**3150/3162.3**	3550/3548.1	**4000/3981.1**
0°	**0.00**	**0.00**	0.00	**0.00**	0.00	**0.00**	0.00	**0.00**
10°	**-0.04**	**-0.01**	-0.02	**0.01**	-0.03	**-0.02**	-0.01	**-0.06**
20°	**-0.09**	**-0.03**	-0.09	**0.03**	-0.09	**-0.05**	-0.02	**-0.22**
30°	**-0.19**	**-0.06**	-0.20	**0.05**	-0.08	**-0.19**	-0.03	**-0.41**
40°	**-0.27**	**-0.13**	-0.33	**-0.12**	-0.01	**-0.40**	-0.16	**-0.48**
50°	**-0.25**	**-0.22**	-0.41	**-0.36**	0.03	**-0.49**	-0.48	**-0.45**
60°	**-0.07**	**-0.39**	-0.53	**-0.62**	-0.15	**-0.35**	-0.70	**-0.35**
70°	**0.05**	**-0.53**	-0.78	**-0.67**	-0.54	**-0.52**	-0.76	**-0.93**
80°	**0.09**	**-0.31**	-0.74	**-0.91**	-0.71	**-0.86**	-0.90	**-1.21**
90°	**-0.14**	**-0.05**	-0.40	**-0.81**	-0.87	**-1.30**	-1.17	**-1.43**
100°	**-0.28**	**-0.19**	-0.36	**-0.18**	-0.58	**-1.26**	-1.52	**-1.36**
110°	**-0.11**	**-0.37**	-0.68	**-0.34**	-0.30	**-0.64**	-1.17	**-1.72**
120°	**-0.11**	**-0.23**	-0.70	**-0.53**	-0.58	**-0.79**	-0.75	**-1.03**
130°	**-0.43**	**-0.30**	-0.55	**-0.38**	-0.61	**-1.11**	-1.13	**-1.24**
140°	**-0.71**	**-0.73**	-0.95	**-0.68**	-0.73	**-1.18**	-1.31	**-1.31**
150°	**-0.76**	**-0.92**	-1.34	**-1.17**	-1.29	**-1.82**	-1.98	**-2.13**
160°	**-0.54**	**-0.65**	-1.05	**-0.84**	-1.11	**-1.67**	-2.02	**-2.77**
170°	**-0.33**	**-0.33**	-0.66	**-0.31**	-0.57	**-0.92**	-1.14	**-1.73**
180°	**-0.24**	**-0.20**	-0.49	**-0.12**	-0.34	**-0.62**	-0.74	**-1.19**
190°	**-0.37**	**-0.38**	-0.70	**-0.38**	-0.62	**-1.02**	-1.26	**-1.91**
200°	**-0.56**	**-0.73**	-1.14	**-0.97**	-1.18	**-1.71**	-2.35	**-2.99**
210°	**-0.72**	**-0.95**	-1.33	**-1.07**	-1.20	**-1.58**	-2.04	**-1.93**
220°	**-0.59**	**-0.66**	-0.89	**-0.57**	-0.67	**-1.12**	-1.31	**-1.31**
230°	**-0.28**	**-0.23**	-0.55	**-0.43**	-0.67	**-1.17**	-1.20	**-1.17**
240°	**-0.01**	**-0.21**	-0.75	**-0.62**	-0.54	**-0.68**	-0.62	**-1.09**
250°	**-0.06**	**-0.37**	-0.67	**-0.34**	-0.31	**-0.82**	-1.36	**-1.79**
260°	**-0.24**	**-0.17**	-0.38	**-0.30**	-0.66	**-1.29**	-1.59	**-1.40**
270°	**-0.10**	**-0.13**	-0.54	**-0.92**	-0.89	**-1.16**	-1.31	**-1.24**
280°	**0.07**	**-0.42**	-0.96	**-0.68**	-0.76	**-0.97**	-0.80	**-1.38**
290°	**-0.01**	**-0.66**	-0.93	**-0.45**	-0.71	**-0.48**	-0.81	**-0.93**
300°	**-0.14**	**-0.48**	-0.64	**-0.46**	-0.28	**-0.39**	-0.86	**-0.54**
310°	**-0.27**	**-0.23**	-0.51	**-0.26**	-0.06	**-0.52**	-0.48	**-0.49**
320°	**-0.24**	**-0.10**	-0.41	**-0.04**	-0.10	**-0.30**	-0.30	**-0.49**
330°	**-0.19**	**-0.07**	-0.27	**0.09**	-0.19	**-0.12**	-0.17	**-0.57**
340°	**-0.11**	**-0.06**	-0.15	**0.05**	-0.15	**-0.05**	-0.06	**-0.37**
350°	**-0.05**	**-0.03**	-0.06	**0.03**	-0.05	**-0.04**	-0.01	**-0.11**

Angle (degrees)	Nominal frequency / exact frequency (Hz)							
	4500/4466.8	**5000/5011.9**	5600/5623.4	**6300/6309.6**	7100/7079.5	**8000/7943.3**	8500/8414.0	9000/8912.5
0°	0.00	**0.00**	0.00	**0.00**	0.00	**0.00**	0.00	0.00
10°	0.00	**0.06**	0.01	**-0.03**	0.11	**-0.16**	-0.07	-0.13
20°	-0.05	**0.10**	-0.07	**-0.19**	0.03	**-0.38**	-0.27	-0.41
30°	-0.13	**-0.01**	-0.34	**-0.42**	-0.38	**-0.77**	-0.76	-0.80
40°	-0.33	**-0.23**	-0.63	**-0.45**	-0.93	**-0.66**	-0.97	-1.45
50°	-0.85	**-0.45**	-1.00	**-0.58**	-1.51	**-1.12**	-1.25	-1.59
60°	-0.89	**-0.73**	-0.90	**-1.19**	-1.16	**-2.30**	-1.97	-2.34
70°	-0.35	**-1.21**	-1.35	**-1.59**	-2.06	**-1.89**	-2.63	-3.28
80°	-1.11	**-1.18**	-1.59	**-1.96**	-2.03	**-2.74**	-2.63	-2.93
90°	-1.78	**-1.33**	-1.45	**-2.22**	-2.88	**-3.26**	-3.88	-4.11
100°	-1.87	**-1.77**	-2.41	**-2.20**	-3.04	**-2.97**	-3.51	-4.33
110°	-1.60	**-2.23**	-2.76	**-3.15**	-3.29	**-3.91**	-3.80	-4.02
120°	-1.50	**-1.50**	-2.39	**-3.49**	-3.80	**-4.54**	-5.45	-5.80
130°	-1.07	**-0.74**	-1.81	**-2.56**	-3.18	**-3.57**	-4.24	-4.97
140°	-1.32	**-1.98**	-1.65	**-1.84**	-2.83	**-3.28**	-3.64	-4.03
150°	-1.60	**-1.86**	-2.44	**-2.68**	-3.42	**-3.94**	-4.19	-4.43
160°	-3.00	**-3.09**	-3.80	**-3.77**	-4.09	**-4.51**	-4.57	-5.13
170°	-1.69	**-2.10**	-3.17	**-3.54**	-3.98	**-5.34**	-5.35	-6.97
180°	-0.92	**-1.18**	-2.14	**-2.23**	-2.29	**-3.72**	-3.53	-4.54
190°	-1.76	**-2.32**	-3.30	**-3.57**	-4.01	**-5.38**	-5.56	-6.71
200°	-2.75	**-2.97**	-3.43	**-3.45**	-3.83	**-4.49**	-4.79	-5.32
210°	-1.64	**-1.70**	-2.52	**-2.68**	-3.45	**-3.75**	-4.09	-4.32
220°	-1.68	**-1.75**	-1.67	**-1.94**	-2.84	**-3.52**	-3.74	-4.01
230°	-1.07	**-1.01**	-2.00	**-2.50**	-3.50	**-3.82**	-4.26	-5.17
240°	-1.53	**-1.80**	-2.46	**-3.41**	-4.08	**-4.62**	-5.38	-5.84
250°	-1.87	**-2.22**	-2.48	**-3.02**	-3.00	**-4.01**	-3.87	-4.10
260°	-2.04	**-1.73**	-2.45	**-2.16**	-3.35	**-3.03**	-3.80	-4.56
270°	-1.44	**-1.48**	-1.69	**-2.13**	-2.77	**-3.37**	-3.67	-3.87
280°	-1.02	**-1.18**	-1.57	**-1.74**	-2.02	**-2.81**	-2.64	-3.10
290°	-0.89	**-1.17**	-1.35	**-1.32**	-2.35	**-1.89**	-2.68	-3.42
300°	-0.98	**-0.84**	-0.81	**-1.02**	-1.45	**-2.31**	-1.97	-2.15
310°	-0.73	**-0.15**	-0.86	**-0.55**	-1.47	**-1.06**	-1.27	-1.75
320°	-0.29	**-0.11**	-0.80	**-0.48**	-1.00	**-0.86**	-1.15	-1.47
330°	-0.19	**0.07**	-0.43	**-0.45**	-0.22	**-0.95**	-0.68	-0.89
340°	-0.18	**0.15**	-0.01	**-0.11**	0.01	**-0.60**	-0.28	-0.50
350°	-0.09	**0.08**	0.02	**-0.08**	-0.06	**-0.05**	-0.10	-0.11

Angle (degrees)	Nominal frequency / exact frequency (Hz)					
	9500/9440.6	**10000/10000**	10600/10593	11200/11220	11800/11885	**12500/12589**
0°	0.00	**0.00**	0.00	0.00	0.00	**0.00**
10°	-0.19	**0.05**	-0.04	-0.17	-0.02	**-0.12**
20°	-0.68	**0.03**	-0.27	-0.65	-0.40	**-0.33**
30°	-1.26	**-0.50**	-0.53	-1.03	-1.01	**-0.75**
40°	-1.69	**-1.27**	-0.97	-1.31	-1.75	**-1.65**
50°	-2.38	**-2.18**	-1.77	-2.19	-2.12	**-2.46**
60°	-2.42	**-2.77**	-2.96	-3.12	-3.21	**-3.18**
70°	-3.64	**-3.31**	-3.31	-3.84	-4.25	**-4.71**
80°	-3.89	**-4.33**	-4.15	-4.83	-4.93	**-5.02**
90°	-4.54	**-4.38**	-4.56	-5.34	-5.97	**-6.68**
100°	-5.68	**-5.38**	-5.33	-6.02	-6.67	**-6.71**
110°	-5.05	**-5.20**	-5.46	-6.40	-7.25	**-8.33**
120°	-6.61	**-6.39**	-5.76	-6.32	-7.00	**-7.28**
130°	-5.74	**-6.30**	-7.11	-7.92	-8.94	**-9.82**
140°	-4.49	**-4.53**	-5.02	-5.75	-6.66	**-7.64**
150°	-4.86	**-4.89**	-5.38	-6.11	-7.09	**-7.64**
160°	-5.89	**-6.19**	-6.73	-7.14	-8.15	**-9.33**
170°	-7.17	**-7.26**	-7.71	-8.09	-9.62	**-9.26**
180°	-4.80	**-5.57**	-6.14	-6.64	-7.27	**-7.92**
190°	-7.26	**-7.12**	-7.96	-8.20	-8.73	**-10.04**
200°	-6.05	**-6.11**	-6.80	-7.42	-8.26	**-9.41**
210°	-5.16	**-5.46**	-5.47	-6.53	-7.59	**-8.66**
220°	-4.94	**-5.33**	-5.30	-6.41	-7.92	**-8.59**
230°	-6.69	**-7.21**	-7.44	-8.82	-9.61	**-9.70**
240°	-6.29	**-6.15**	-5.87	-6.51	-7.14	**-7.62**
250°	-5.34	**-5.43**	-5.45	-6.62	-7.87	**-8.47**
260°	-5.48	**-5.43**	-5.09	-6.29	-6.91	**-6.85**
270°	-4.75	**-4.77**	-4.64	-5.44	-6.38	**-6.55**
280°	-4.67	**-4.20**	-4.32	-4.86	-5.31	**-5.80**
290°	-3.82	**-3.31**	-3.45	-4.50	-5.09	**-4.66**
300°	-3.02	**-2.99**	-2.96	-3.37	-3.52	**-3.60**
310°	-2.96	**-2.26**	-1.97	-2.35	-2.60	**-2.96**
320°	-1.96	**-1.34**	-1.16	-1.56	-2.03	**-1.85**
330°	-1.35	**-0.56**	-0.67	-1.16	-1.38	**-0.79**
340°	-0.85	**-0.32**	-0.41	-0.92	-0.76	**-0.52**
350°	-0.30	**-0.12**	-0.07	-0.32	-0.23	**-0.10**

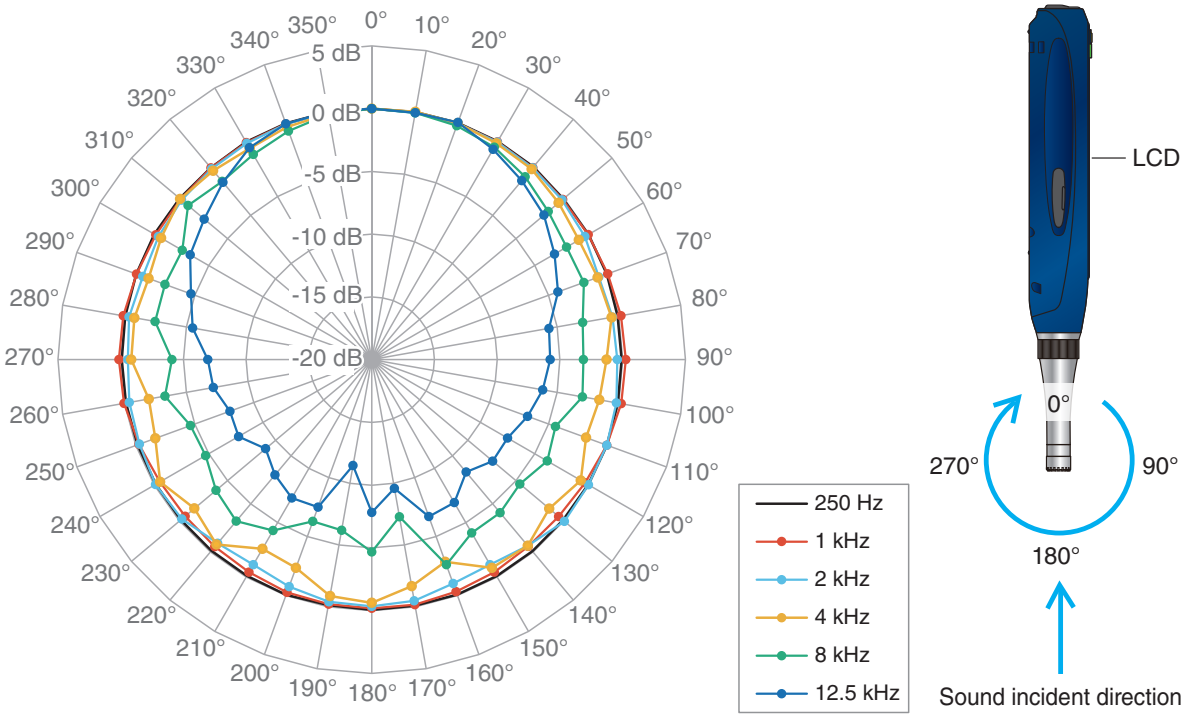


Fig. 13. Directional characteristics of NL-63 (vertical direction)

Table 6. Directional characteristics of NL-63 (vertical direction)

Angle (degrees)	Nominal frequency / exact frequency (Hz)							
	250/251.19	315/316.23	400/398.11	500/501.19	630/630.96	800/794.33	1000/1000.0	1250/1258.9
0°	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10°	0.03	-0.04	-0.02	-0.02	-0.01	0.00	-0.01	0.03
20°	0.08	0.04	0.05	0.05	0.06	0.04	0.03	0.14
30°	0.08	0.04	0.06	0.09	0.05	0.07	0.03	0.19
40°	0.05	-0.01	0.00	0.07	0.03	0.08	-0.03	0.18
50°	-0.08	-0.08	-0.09	-0.09	0.00	0.09	-0.14	0.13
60°	-0.06	-0.06	-0.08	-0.08	0.02	0.13	-0.08	0.13
70°	-0.07	-0.10	-0.08	-0.12	0.01	0.18	0.02	0.14
80°	-0.10	-0.12	-0.14	-0.17	-0.06	0.13	0.16	0.10
90°	-0.09	-0.16	-0.23	-0.25	-0.14	0.02	0.25	0.06
100°	-0.07	-0.13	-0.22	-0.23	-0.18	-0.06	0.19	0.24
110°	-0.06	-0.11	-0.24	-0.22	-0.23	-0.16	-0.06	0.42
120°	-0.09	-0.16	-0.31	-0.27	-0.31	-0.27	-0.36	0.28
130°	-0.10	-0.17	-0.32	-0.28	-0.34	-0.33	-0.56	-0.17
140°	-0.07	-0.15	-0.31	-0.25	-0.33	-0.34	-0.58	-0.53
150°	-0.09	-0.13	-0.27	-0.21	-0.30	-0.27	-0.46	-0.50
160°	-0.07	-0.17	-0.28	-0.30	-0.26	-0.22	-0.33	-0.28
170°	-0.09	-0.10	-0.23	-0.14	-0.22	-0.14	-0.18	-0.04
180°	-0.06	-0.17	-0.30	-0.29	-0.25	-0.16	-0.18	0.01
190°	-0.13	-0.19	-0.31	-0.31	-0.26	-0.18	-0.21	-0.03
200°	-0.07	-0.16	-0.31	-0.29	-0.25	-0.20	-0.26	-0.14
210°	-0.10	-0.21	-0.35	-0.37	-0.32	-0.31	-0.45	-0.45
220°	-0.13	-0.19	-0.37	-0.37	-0.36	-0.37	-0.54	-0.60
230°	-0.14	-0.22	-0.39	-0.40	-0.40	-0.41	-0.59	-0.41
240°	-0.14	-0.24	-0.38	-0.41	-0.38	-0.38	-0.51	0.04
250°	-0.14	-0.22	-0.37	-0.41	-0.34	-0.30	-0.26	0.29
260°	-0.12	-0.19	-0.32	-0.33	-0.30	-0.20	0.04	0.11
270°	-0.08	-0.23	-0.28	-0.29	-0.19	-0.06	0.15	-0.05
280°	-0.06	-0.19	-0.21	-0.25	-0.11	0.04	0.10	-0.03
290°	-0.04	-0.16	-0.18	-0.21	-0.05	0.11	-0.06	0.00
300°	-0.01	-0.13	-0.14	-0.13	0.01	0.11	-0.13	0.04
310°	-0.01	-0.09	-0.10	-0.10	0.01	0.09	-0.11	0.09
320°	-0.05	-0.06	-0.05	-0.04	-0.01	0.05	-0.07	0.11
330°	0.03	0.00	-0.02	-0.03	0.01	0.02	-0.03	0.08
340°	0.04	-0.01	0.00	-0.01	0.00	0.03	-0.01	0.04
350°	0.04	-0.01	0.02	-0.02	0.00	0.00	0.00	0.02

Angle (degrees)	Nominal frequency / exact frequency (Hz)							
	1600/1584.9	**2000/1995.3**	2240/2238.7	**2500/2511.9**	2800/2818.4	**3150/3162.3**	3550/3548.1	**4000/3981.1**
0°	**0.00**	**0.00**	0.00	**0.00**	0.00	**0.00**	0.00	**0.00**
10°	**-0.06**	**-0.04**	-0.04	**-0.02**	-0.04	**-0.03**	0.01	**0.05**
20°	**-0.09**	**0.03**	-0.06	**0.11**	-0.06	**-0.03**	0.07	**0.05**
30°	**-0.17**	**0.02**	-0.20	**0.16**	-0.10	**-0.09**	-0.11	**-0.10**
40°	**-0.27**	**-0.06**	-0.35	**0.08**	-0.11	**-0.22**	-0.26	**-0.18**
50°	**-0.34**	**-0.20**	-0.37	**-0.18**	-0.12	**-0.38**	-0.42	**-0.56**
60°	**-0.20**	**-0.38**	-0.45	**-0.31**	-0.20	**-0.35**	-0.45	**-0.93**
70°	**-0.07**	**-0.74**	-0.78	**-0.40**	-0.45	**-0.48**	-0.36	**-0.83**
80°	**0.12**	**-0.52**	-1.10	**-0.80**	-0.54	**-0.86**	-0.73	**-0.60**
90°	**0.03**	**-0.43**	-0.73	**-0.92**	-0.80	**-0.87**	-1.25	**-1.29**
100°	**-0.29**	**-0.20**	-0.33	**-0.84**	-1.04	**-1.29**	-0.97	**-1.58**
110°	**-0.10**	**-0.07**	-0.75	**-0.44**	-0.48	**-0.90**	-1.09	**-1.82**
120°	**0.18**	**-0.06**	-0.41	**-0.60**	-0.79	**-0.87**	-0.66	**-0.76**
130°	**-0.10**	**0.04**	-0.16	**-0.08**	-0.37	**-0.81**	-1.34	**-1.54**
140°	**-0.59**	**-0.64**	-0.72	**-0.33**	-0.25	**-0.24**	-0.05	**-0.66**
150°	**-0.77**	**-1.14**	-1.47	**-1.24**	-1.32	**-1.25**	-1.15	**-0.85**
160°	**-0.66**	**-1.01**	-1.21	**-1.50**	-1.61	**-1.94**	-2.41	**-2.86**
170°	**-0.34**	**-0.48**	-0.68	**-0.66**	-0.81	**-0.97**	-1.14	**-1.67**
180°	**-0.26**	**-0.35**	-0.41	**-0.39**	-0.41	**-0.39**	-0.21	**-0.62**
190°	**-0.32**	**-0.41**	-0.51	**-0.51**	-0.58	**-0.52**	-0.37	**-0.87**
200°	**-0.54**	**-0.76**	-0.90	**-1.04**	-1.18	**-1.24**	-1.20	**-2.35**
210°	**-0.79**	**-1.13**	-1.37	**-1.57**	-1.52	**-1.72**	-1.78	**-2.60**
220°	**-0.78**	**-0.91**	-0.98	**-0.97**	-0.71	**-0.86**	-0.90	**-0.77**
230°	**-0.42**	**-0.26**	-0.31	**-0.30**	-0.48	**-0.73**	-1.06	**-1.55**
240°	**0.03**	**-0.11**	-0.44	**-0.69**	-0.92	**-1.18**	-0.84	**-0.54**
250°	**-0.07**	**-0.31**	-0.82	**-0.80**	-0.64	**-0.72**	-0.48	**-1.65**
260°	**-0.44**	**-0.38**	-0.54	**-0.68**	-0.64	**-0.88**	-1.28	**-1.96**
270°	**-0.25**	**-0.57**	-0.41	**-0.60**	-0.81	**-1.17**	-1.32	**-0.84**
280°	**-0.08**	**-0.36**	-0.84	**-0.89**	-0.90	**-1.28**	-0.46	**-0.80**
290°	**-0.23**	**-0.60**	-0.75	**-0.78**	-0.84	**-0.57**	-0.27	**-1.08**
300°	**-0.26**	**-0.39**	-0.62	**-0.67**	-0.32	**-0.33**	-0.54	**-0.61**
310°	**-0.29**	**-0.23**	-0.57	**-0.36**	-0.04	**-0.38**	-0.69	**-0.07**
320°	**-0.25**	**-0.15**	-0.47	**-0.01**	-0.05	**-0.41**	-0.28	**-0.35**
330°	**-0.16**	**-0.10**	-0.25	**0.13**	-0.10	**-0.26**	0.03	**-0.57**
340°	**-0.06**	**-0.03**	-0.09	**0.10**	-0.07	**-0.12**	0.09	**-0.27**
350°	**0.00**	**0.00**	-0.03	**0.06**	-0.02	**-0.03**	0.04	**-0.09**

Angle (degrees)	Nominal frequency / exact frequency (Hz)							
	4500/4466.8	**5000/5011.9**	5600/5623.4	**6300/6309.6**	7100/7079.5	**8000/7943.3**	8500/8414.0	9000/8912.5
0°	0.00	**0.00**	0.00	**0.00**	0.00	**0.00**	0.00	0.00
10°	-0.01	**-0.03**	-0.11	**-0.04**	-0.02	**-0.03**	-0.03	-0.17
20°	-0.11	**-0.11**	-0.11	**-0.39**	0.02	**-0.17**	0.04	-0.49
30°	-0.21	**-0.42**	-0.29	**-0.59**	-0.18	**-0.46**	-0.41	-1.07
40°	-0.37	**-0.55**	-0.35	**-0.52**	-0.42	**-0.98**	-0.49	-1.31
50°	-0.66	**-0.85**	-0.84	**-0.96**	-1.03	**-1.63**	-0.76	-1.66
60°	-0.80	**-1.26**	-0.95	**-1.07**	-1.55	**-2.07**	-1.73	-2.04
70°	-1.23	**-0.88**	-1.35	**-1.29**	-1.37	**-2.01**	-1.89	-3.17
80°	-1.36	**-1.63**	-1.62	**-1.79**	-1.67	**-2.92**	-2.40	-3.38
90°	-1.54	**-2.14**	-1.83	**-2.30**	-2.56	**-3.13**	-3.38	-3.44
100°	-1.66	**-1.42**	-1.74	**-2.51**	-3.60	**-2.94**	-3.24	-3.47
110°	-2.08	**-2.05**	-2.12	**-2.31**	-2.44	**-4.41**	-4.13	-4.31
120°	-2.31	**-2.87**	-2.39	**-3.18**	-3.43	**-3.84**	-3.89	-4.49
130°	-1.39	**-1.37**	-2.32	**-2.89**	-3.83	**-4.59**	-4.23	-5.09
140°	-1.70	**-2.70**	-2.26	**-1.79**	-2.19	**-4.07**	-4.21	-4.80
150°	-0.86	**-0.68**	-1.16	**-2.14**	-3.34	**-4.06**	-3.96	-4.47
160°	-3.18	**-3.48**	-2.60	**-2.31**	-2.33	**-2.61**	-2.13	-2.86
170°	-2.40	**-3.71**	-4.07	**-4.67**	-5.76	**-7.28**	-6.13	-8.02
180°	-1.11	**-1.35**	-2.24	**-2.34**	-2.37	**-4.68**	-3.83	-4.25
190°	-1.56	**-1.88**	-3.16	**-3.34**	-3.83	**-6.20**	-5.49	-6.60
200°	-3.65	**-4.21**	-5.35	**-5.66**	-5.20	**-6.28**	-5.44	-5.83
210°	-2.48	**-2.02**	-1.98	**-1.67**	-2.38	**-4.28**	-3.63	-5.09
220°	-0.85	**-2.72**	-2.69	**-2.81**	-3.06	**-3.20**	-2.73	-3.87
230°	-2.39	**-1.77**	-1.36	**-2.53**	-4.18	**-3.80**	-3.72	-5.53
240°	-1.35	**-2.02**	-3.13	**-3.40**	-3.51	**-4.72**	-4.29	-5.11
250°	-2.68	**-2.34**	-3.28	**-2.34**	-3.15	**-4.63**	-3.86	-5.22
260°	-2.07	**-2.59**	-1.99	**-2.77**	-3.44	**-3.27**	-3.13	-4.93
270°	-1.79	**-1.44**	-2.65	**-1.98**	-2.33	**-4.09**	-3.19	-3.63
280°	-1.41	**-1.91**	-1.06	**-2.03**	-2.31	**-2.48**	-2.48	-3.32
290°	-1.08	**-1.67**	-1.84	**-1.55**	-1.90	**-2.47**	-2.45	-3.41
300°	-1.20	**-0.82**	-1.42	**-1.04**	-0.79	**-2.58**	-1.64	-1.96
310°	-0.89	**-0.92**	-0.55	**-1.17**	-1.80	**-0.90**	-1.04	-2.11
320°	-0.38	**-1.05**	-0.58	**-0.38**	-1.14	**-1.47**	-0.81	-1.25
330°	-0.25	**-0.56**	-0.63	**-0.88**	0.05	**-1.12**	-0.22	-0.93
340°	-0.07	**0.01**	-0.09	**-0.52**	0.72	**-0.61**	0.31	-0.56
350°	-0.02	**0.10**	0.07	**-0.13**	0.27	**-0.14**	0.18	-0.05

Angle (degrees)	Nominal frequency / exact frequency (Hz)					
	9500/9440.6	**10000/10000**	10600/10593	11200/11220	11800/11885	**12500/12589**
0°	0.00	**0.00**	0.00	0.00	0.00	**0.00**
10°	-0.06	**-0.02**	0.00	-0.26	0.09	**-0.02**
20°	-0.33	**-0.14**	-0.29	-0.61	0.00	**0.11**
30°	-0.89	**-0.30**	-0.69	-0.68	-0.88	**-0.64**
40°	-1.90	**-0.83**	-0.86	-1.56	-1.29	**-1.39**
50°	-2.48	**-1.86**	-1.77	-1.82	-2.59	**-2.09**
60°	-2.45	**-2.60**	-2.71	-2.96	-3.15	**-3.19**
70°	-3.20	**-2.82**	-3.25	-4.07	-4.40	**-4.20**
80°	-3.87	**-3.71**	-4.30	-4.44	-4.88	**-5.65**
90°	-4.40	**-4.55**	-4.86	-5.34	-5.62	**-5.77**
100°	-5.37	**-4.78**	-5.12	-6.26	-6.21	**-6.16**
110°	-5.46	**-5.20**	-5.38	-6.16	-6.53	**-6.79**
120°	-5.40	**-5.42**	-6.81	-6.93	-7.06	**-7.49**
130°	-5.99	**-5.62**	-6.28	-6.95	-7.24	**-7.42**
140°	-5.70	**-5.47**	-6.25	-7.51	-8.01	**-8.30**
150°	-4.90	**-4.68**	-5.18	-5.81	-6.34	**-6.84**
160°	-3.68	**-4.02**	-5.07	-5.75	-6.16	**-6.69**
170°	-8.06	**-7.28**	-8.43	-8.70	-9.44	**-9.58**
180°	-5.22	**-5.83**	-6.87	-6.99	-6.52	**-7.82**
190°	-7.23	**-8.21**	-9.94	-9.72	-10.20	**-11.44**
200°	-6.17	**-5.84**	-6.69	-6.84	-6.70	**-7.50**
210°	-5.98	**-6.00**	-6.11	-6.11	-6.73	**-7.28**
220°	-4.47	**-5.31**	-6.50	-6.71	-7.00	**-8.00**
230°	-6.93	**-6.66**	-7.07	-6.88	-7.48	**-8.96**
240°	-5.60	**-6.04**	-7.06	-7.11	-7.50	**-7.75**
250°	-5.06	**-4.82**	-6.03	-6.71	-7.25	**-7.98**
260°	-5.45	**-5.15**	-5.12	-5.78	-6.76	**-7.18**
270°	-4.31	**-4.55**	-5.11	-5.44	-5.83	**-6.94**
280°	-4.22	**-4.01**	-4.76	-4.43	-5.31	**-5.52**
290°	-3.51	**-2.63**	-3.93	-4.28	-4.41	**-4.67**
300°	-3.06	**-2.84**	-2.85	-3.08	-3.44	**-3.29**
310°	-2.40	**-1.94**	-1.92	-2.28	-2.24	**-2.57**
320°	-1.89	**-1.22**	-1.05	-1.27	-1.84	**-1.56**
330°	-1.07	**-0.38**	-0.53	-0.83	-1.00	**-0.50**
340°	-1.05	**0.22**	-0.16	-0.34	-0.34	**0.00**
350°	-0.15	**-0.02**	-0.08	0.13	0.18	**0.05**

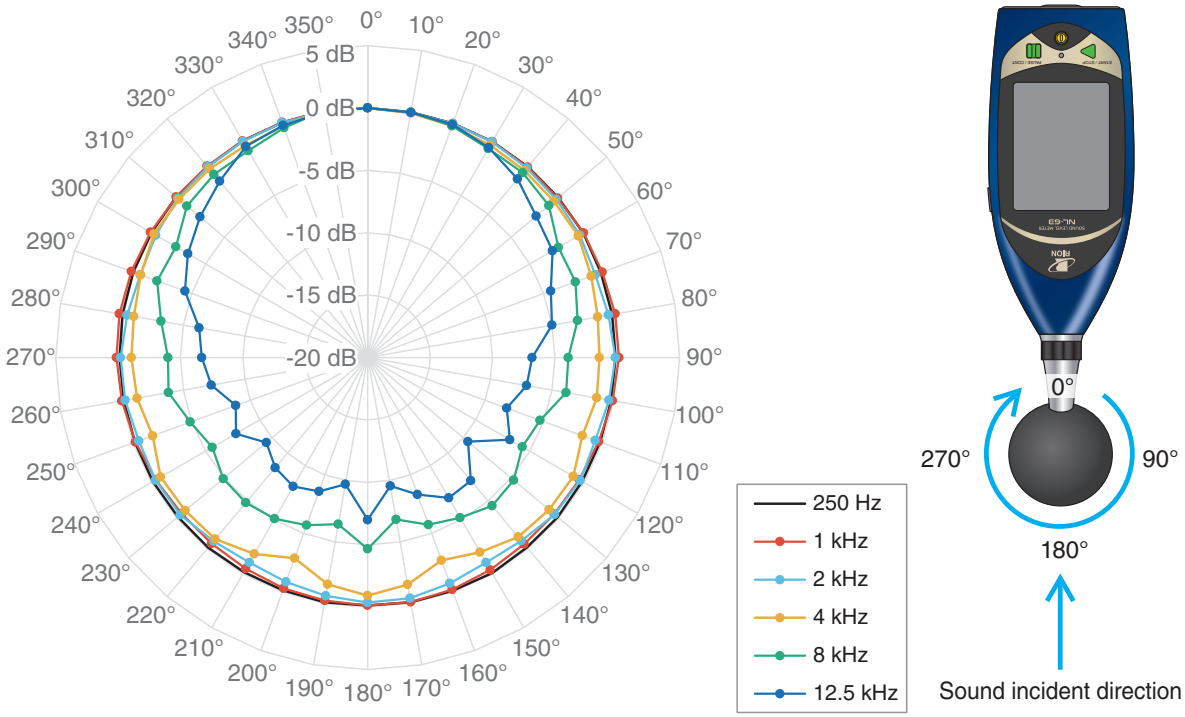


Fig. 14. Directional characteristics of NL-63 with WS-10 attached (horizontal direction)

Table 7. Directional characteristics of NL-63 with WS-10 attached (horizontal direction)

Angle (degrees)	Nominal frequency / exact frequency (Hz)							
	250/251.19	315/316.23	400/398.11	500/501.19	630/630.96	800/794.33	1000/1000.0	1250/1258.9
0°	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10°	-0.03	0.01	-0.01	-0.03	0.02	-0.05	-0.07	0.01
20°	-0.03	-0.02	-0.01	-0.04	0.03	-0.02	-0.04	0.06
30°	-0.01	0.00	0.00	0.00	0.05	0.02	-0.01	0.11
40°	-0.05	-0.06	-0.03	-0.07	0.02	0.00	-0.07	0.14
50°	-0.07	-0.09	-0.09	-0.12	0.02	0.00	-0.12	0.16
60°	-0.05	-0.09	-0.11	-0.10	0.02	0.07	-0.02	0.16
70°	-0.11	-0.16	-0.21	-0.23	-0.06	0.03	0.00	0.00
80°	-0.10	-0.14	-0.22	-0.27	-0.08	0.01	0.14	-0.03
90°	-0.14	-0.21	-0.30	-0.33	-0.16	-0.11	0.14	-0.04
100°	-0.19	-0.24	-0.40	-0.43	-0.32	-0.25	-0.06	0.01
110°	-0.17	-0.29	-0.45	-0.48	-0.38	-0.40	-0.30	0.11
120°	-0.14	-0.24	-0.43	-0.44	-0.35	-0.45	-0.43	-0.01
130°	-0.12	-0.20	-0.41	-0.41	-0.35	-0.46	-0.49	-0.33
140°	-0.14	-0.27	-0.43	-0.39	-0.32	-0.45	-0.49	-0.50
150°	-0.05	-0.20	-0.36	-0.36	-0.24	-0.37	-0.35	-0.38
160°	-0.12	-0.20	-0.39	-0.35	-0.22	-0.31	-0.22	-0.19
170°	-0.09	-0.18	-0.36	-0.31	-0.19	-0.24	-0.11	-0.03
180°	-0.13	-0.21	-0.41	-0.34	-0.21	-0.26	-0.13	-0.05
190°	-0.09	-0.16	-0.28	-0.31	-0.32	-0.22	-0.22	-0.21
200°	-0.14	-0.15	-0.33	-0.34	-0.32	-0.29	-0.31	-0.35
210°	-0.15	-0.21	-0.36	-0.38	-0.35	-0.38	-0.45	-0.52
220°	-0.11	-0.21	-0.38	-0.39	-0.38	-0.43	-0.54	-0.57
230°	-0.15	-0.18	-0.37	-0.40	-0.39	-0.43	-0.53	-0.33
240°	-0.13	-0.22	-0.38	-0.41	-0.37	-0.39	-0.39	-0.01
250°	-0.15	-0.20	-0.36	-0.39	-0.34	-0.30	-0.19	0.16
260°	-0.15	-0.18	-0.30	-0.33	-0.28	-0.18	0.00	0.04
270°	-0.12	-0.17	-0.24	-0.29	-0.19	-0.05	0.13	-0.10
280°	-0.05	-0.10	-0.16	-0.12	-0.02	0.03	0.20	-0.03
290°	0.00	-0.06	-0.09	-0.04	0.06	0.10	0.16	0.10
300°	0.01	0.04	-0.01	-0.02	0.09	0.10	0.08	0.21
310°	0.03	0.01	0.00	0.04	0.10	0.09	0.03	0.24
320°	-0.03	0.02	0.00	0.06	0.09	0.07	0.02	0.21
330°	0.05	0.04	0.04	0.10	0.08	0.04	0.05	0.18
340°	0.05	0.05	0.04	0.06	0.07	0.01	0.06	0.11
350°	0.06	0.06	0.08	0.10	0.07	0.04	0.08	0.07

Angle (degrees)	Nominal frequency / exact frequency (Hz)							
	1600/1584.9	**2000/1995.3**	2240/2238.7	**2500/2511.9**	2800/2818.4	**3150/3162.3**	3550/3548.1	**4000/3981.1**
0°	**0.00**	**0.00**	0.00	**0.00**	0.00	**0.00**	0.00	**0.00**
10°	**-0.11**	**-0.06**	-0.08	**0.07**	-0.08	**-0.08**	0.07	**-0.12**
20°	**-0.15**	**-0.05**	-0.12	**0.12**	-0.13	**-0.10**	0.09	**-0.24**
30°	**-0.19**	**-0.04**	-0.20	**0.10**	-0.13	**-0.16**	0.08	**-0.34**
40°	**-0.34**	**-0.17**	-0.40	**-0.05**	-0.10	**-0.43**	-0.05	**-0.44**
50°	**-0.40**	**-0.27**	-0.53	**-0.29**	-0.07	**-0.61**	-0.40	**-0.51**
60°	**-0.21**	**-0.37**	-0.66	**-0.41**	-0.15	**-0.52**	-0.91	**-0.50**
70°	**-0.11**	**-0.59**	-0.93	**-0.61**	-0.58	**-0.65**	-0.87	**-0.93**
80°	**-0.01**	**-0.40**	-0.91	**-0.76**	-0.69	**-0.99**	-0.97	**-1.27**
90°	**-0.22**	**-0.15**	-0.62	**-0.74**	-0.90	**-1.50**	-1.30	**-1.42**
100°	**-0.43**	**-0.36**	-0.61	**-0.31**	-0.72	**-1.45**	-1.69	**-1.36**
110°	**-0.22**	**-0.58**	-0.91	**-0.54**	-0.43	**-0.73**	-1.20	**-1.68**
120°	**-0.17**	**-0.34**	-0.89	**-0.56**	-0.64	**-0.92**	-0.89	**-0.97**
130°	**-0.42**	**-0.44**	-0.73	**-0.51**	-0.70	**-1.21**	-1.20	**-1.03**
140°	**-0.77**	**-0.83**	-1.23	**-0.67**	-0.83	**-1.36**	-1.49	**-1.23**
150°	**-0.76**	**-1.02**	-1.55	**-1.23**	-1.30	**-1.98**	-2.11	**-1.99**
160°	**-0.58**	**-0.75**	-1.33	**-0.87**	-1.14	**-1.85**	-2.11	**-2.71**
170°	**-0.34**	**-0.42**	-0.90	**-0.36**	-0.62	**-1.03**	-1.11	**-1.52**
180°	**-0.28**	**-0.37**	-0.80	**-0.32**	-0.45	**-0.72**	-0.71	**-0.92**
190°	**-0.33**	**-0.61**	-0.86	**-0.79**	-0.84	**-0.95**	-1.08	**-1.54**
200°	**-0.60**	**-0.87**	-1.33	**-1.16**	-1.33	**-1.75**	-2.32	**-2.88**
210°	**-0.79**	**-1.03**	-1.56	**-1.21**	-1.32	**-1.72**	-2.05	**-1.82**
220°	**-0.66**	**-0.80**	-1.04	**-0.85**	-0.81	**-1.18**	-1.24	**-1.00**
230°	**-0.31**	**-0.38**	-0.67	**-0.68**	-0.78	**-1.20**	-1.06	**-0.92**
240°	**-0.03**	**-0.36**	-0.91	**-0.79**	-0.61	**-0.72**	-0.55	**-0.83**
250°	**-0.14**	**-0.48**	-0.81	**-0.50**	-0.38	**-0.89**	-1.47	**-1.67**
260°	**-0.31**	**-0.26**	-0.52	**-0.48**	-0.77	**-1.35**	-1.53	**-1.23**
270°	**-0.18**	**-0.20**	-0.63	**-1.02**	-0.93	**-1.16**	-1.18	**-1.06**
280°	**0.12**	**-0.41**	-0.94	**-0.88**	-0.61	**-0.88**	-0.60	**-0.97**
290°	**0.13**	**-0.60**	-0.81	**-0.58**	-0.50	**-0.41**	-0.56	**-0.64**
300°	**-0.03**	**-0.38**	-0.52	**-0.48**	-0.07	**-0.29**	-0.57	**-0.22**
310°	**-0.20**	**-0.14**	-0.40	**-0.27**	0.13	**-0.42**	-0.34	**-0.26**
320°	**-0.20**	**-0.05**	-0.32	**-0.07**	0.03	**-0.25**	-0.15	**-0.28**
330°	**-0.12**	**0.01**	-0.17	**0.10**	-0.05	**-0.06**	0.01	**-0.40**
340°	**-0.04**	**0.02**	-0.07	**0.10**	-0.04	**-0.02**	0.06	**-0.24**
350°	**0.08**	**0.04**	0.06	**-0.02**	0.04	**0.10**	0.15	**0.12**

Angle (degrees)	Nominal frequency / exact frequency (Hz)							
	4500/4466.8	**5000/5011.9**	5600/5623.4	**6300/6309.6**	7100/7079.5	**8000/7943.3**	8500/8414.0	9000/8912.5
0°	0.00	**0.00**	0.00	**0.00**	0.00	**0.00**	0.00	0.00
10°	-0.09	**0.28**	0.03	**-0.20**	-0.07	**-0.04**	-0.07	0.03
20°	-0.09	**0.39**	0.00	**-0.40**	-0.06	**-0.24**	-0.24	-0.13
30°	-0.09	**0.22**	-0.23	**-0.66**	-0.38	**-0.66**	-0.68	-0.57
40°	-0.39	**0.04**	-0.60	**-0.87**	-0.96	**-0.67**	-1.00	-1.28
50°	-0.91	**-0.06**	-1.06	**-1.12**	-1.81	**-1.04**	-1.39	-1.51
60°	-0.76	**-0.49**	-1.05	**-1.53**	-1.28	**-2.35**	-1.84	-2.40
70°	-0.18	**-1.06**	-1.41	**-2.07**	-2.10	**-2.28**	-2.74	-3.34
80°	-0.74	**-1.11**	-1.79	**-2.50**	-2.32	**-2.92**	-2.47	-3.08
90°	-1.35	**-1.25**	-1.68	**-2.85**	-3.04	**-3.93**	-3.83	-4.30
100°	-1.50	**-1.62**	-2.44	**-2.43**	-3.43	**-3.86**	-3.84	-4.80
110°	-1.27	**-2.09**	-3.07	**-3.68**	-3.75	**-5.30**	-4.39	-4.76
120°	-0.96	**-1.45**	-2.43	**-3.97**	-4.45	**-5.69**	-5.92	-6.54
130°	-0.47	**-0.57**	-1.69	**-2.83**	-3.73	**-4.72**	-4.77	-5.75
140°	-0.66	**-2.00**	-1.65	**-2.29**	-3.42	**-4.48**	-4.16	-4.86
150°	-1.04	**-1.68**	-2.34	**-3.04**	-3.73	**-5.18**	-4.85	-5.23
160°	-2.43	**-3.13**	-3.57	**-4.09**	-4.56	**-5.74**	-5.22	-5.99
170°	-1.09	**-1.97**	-2.92	**-3.76**	-4.35	**-6.82**	-6.45	-7.49
180°	-0.43	**-0.95**	-1.88	**-2.42**	-2.88	**-4.66**	-4.51	-5.14
190°	-1.35	**-1.98**	-3.10	**-3.72**	-4.70	**-6.43**	-6.56	-7.60
200°	-2.17	**-2.74**	-3.23	**-3.56**	-4.19	**-5.71**	-5.55	-6.20
210°	-1.09	**-1.45**	-2.28	**-2.75**	-4.01	**-5.08**	-4.97	-5.21
220°	-1.20	**-1.50**	-1.51	**-2.13**	-3.44	**-4.81**	-4.60	-4.90
230°	-0.67	**-0.78**	-1.89	**-2.85**	-4.26	**-4.89**	-5.11	-5.97
240°	-1.19	**-1.47**	-2.53	**-3.76**	-4.63	**-5.62**	-5.94	-6.35
250°	-1.39	**-1.99**	-2.44	**-3.53**	-3.65	**-4.87**	-4.33	-4.73
260°	-1.53	**-1.39**	-2.36	**-2.56**	-3.83	**-3.80**	-4.14	-4.96
270°	-1.17	**-1.19**	-1.68	**-2.69**	-3.41	**-3.99**	-3.92	-3.96
280°	-0.69	**-0.89**	-1.59	**-2.44**	-2.49	**-3.18**	-2.76	-3.27
290°	-0.58	**-0.93**	-1.35	**-1.88**	-2.47	**-2.04**	-2.58	-3.19
300°	-0.68	**-0.51**	-0.77	**-1.69**	-1.50	**-2.26**	-1.89	-2.14
310°	-0.55	**0.07**	-0.84	**-1.05**	-1.37	**-1.10**	-1.29	-1.81
320°	-0.09	**0.14**	-0.85	**-0.88**	-0.88	**-0.84**	-1.13	-1.43
330°	0.01	**0.25**	-0.36	**-0.73**	-0.08	**-0.87**	-0.59	-0.75
340°	0.00	**0.22**	0.06	**-0.39**	0.07	**-0.40**	-0.25	-0.33
350°	-0.05	**0.13**	0.09	**-0.21**	0.07	**0.10**	-0.08	-0.05

Angle (degrees)	Nominal frequency / exact frequency (Hz)					
	9500/9440.6	**10000/10000**	10600/10593	11200/11220	11800/11885	**12500/12589**
0°	0.00	**0.00**	0.00	0.00	0.00	**0.00**
10°	-0.44	**-0.15**	0.13	-0.14	-0.04	**-0.05**
20°	-0.85	**-0.02**	-0.14	-0.71	-0.19	**-0.12**
30°	-1.19	**-0.47**	-0.69	-1.33	-0.74	**-0.57**
40°	-1.87	**-1.23**	-0.95	-1.66	-1.59	**-1.33**
50°	-2.86	**-2.19**	-1.80	-2.52	-2.21	**-2.38**
60°	-2.07	**-2.32**	-3.35	-3.54	-3.20	**-2.89**
70°	-3.35	**-2.98**	-3.78	-4.45	-4.42	**-4.39**
80°	-3.75	**-3.97**	-4.71	-5.26	-5.26	**-4.99**
90°	-3.95	**-3.97**	-5.34	-6.01	-6.06	**-6.82**
100°	-5.31	**-5.03**	-6.07	-6.77	-6.76	**-7.07**
110°	-4.78	**-5.29**	-6.28	-7.03	-7.58	**-8.14**
120°	-6.33	**-6.37**	-6.50	-7.16	-7.29	**-6.83**
130°	-5.68	**-6.23**	-8.00	-8.86	-8.94	**-9.52**
140°	-4.77	**-4.73**	-5.61	-6.41	-6.76	**-7.12**
150°	-4.82	**-5.03**	-6.09	-6.82	-6.91	**-7.00**
160°	-6.31	**-6.27**	-6.81	-7.54	-8.07	**-8.31**
170°	-7.19	**-7.97**	-8.83	-9.26	-8.92	**-9.56**
180°	-5.28	**-5.53**	-6.38	-7.31	-7.36	**-7.00**
190°	-7.65	**-7.55**	-8.48	-8.73	-8.60	**-9.69**
200°	-6.43	**-6.17**	-7.48	-8.10	-7.99	**-8.59**
210°	-5.81	**-5.41**	-5.98	-7.10	-7.62	**-8.07**
220°	-5.19	**-5.23**	-6.06	-7.09	-7.70	**-8.48**
230°	-6.79	**-6.98**	-8.11	-9.18	-9.66	**-9.41**
240°	-6.08	**-5.74**	-6.49	-7.00	-7.43	**-7.80**
250°	-5.21	**-5.25**	-5.92	-7.16	-8.35	**-8.75**
260°	-5.10	**-5.14**	-5.75	-7.04	-7.49	**-7.28**
270°	-4.30	**-4.42**	-5.24	-6.12	-6.98	**-6.70**
280°	-3.98	**-4.19**	-4.90	-5.73	-5.44	**-6.28**
290°	-3.30	**-3.24**	-3.63	-4.85	-5.19	**-4.41**
300°	-2.53	**-2.90**	-3.27	-3.63	-3.34	**-3.37**
310°	-2.40	**-2.06**	-2.12	-2.43	-2.29	**-2.46**
320°	-1.63	**-1.25**	-1.29	-1.76	-1.70	**-1.55**
330°	-1.00	**-0.41**	-0.68	-1.19	-0.97	**-0.47**
340°	-0.63	**-0.16**	-0.34	-0.86	-0.42	**-0.21**
350°	-0.17	**-0.06**	0.01	-0.22	0.02	**-0.04**

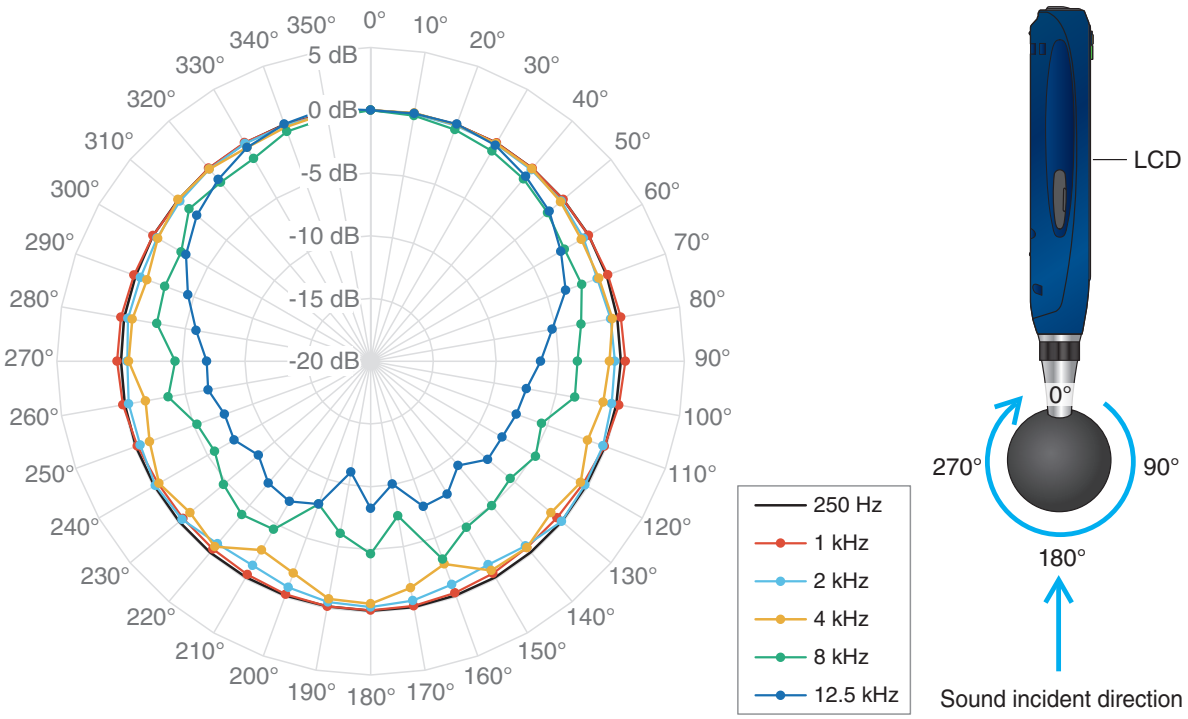


Fig. 15. Directional characteristics of NL-63 with WS-10 attached (vertical direction)

Table 8. Directional characteristics of NL-63 with WS-10 attached (vertical direction)

Angle (degrees)	Nominal frequency / exact frequency (Hz)							
	250/251.19	315/316.23	400/398.11	500/501.19	630/630.96	800/794.33	1000/1000.0	1250/1258.9
0°	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10°	0.05	0.07	0.05	0.03	0.01	0.04	0.05	0.03
20°	0.04	0.08	0.05	0.07	0.02	0.03	0.06	0.05
30°	0.09	0.11	0.09	0.16	0.04	0.08	0.09	0.12
40°	0.06	0.13	0.07	0.14	0.03	0.11	0.07	0.15
50°	0.04	0.08	0.05	0.14	0.04	0.16	0.05	0.12
60°	0.07	0.06	0.02	0.09	0.03	0.21	0.05	0.07
70°	0.01	0.02	-0.05	-0.03	0.00	0.20	0.12	0.07
80°	-0.03	-0.04	-0.11	-0.18	-0.07	0.12	0.24	0.03
90°	-0.06	-0.06	-0.17	-0.23	-0.14	0.01	0.30	-0.03
100°	-0.12	-0.21	-0.27	-0.26	-0.31	-0.14	0.10	0.01
110°	-0.12	-0.23	-0.28	-0.30	-0.37	-0.26	-0.16	0.20
120°	-0.16	-0.23	-0.34	-0.35	-0.42	-0.35	-0.45	0.11
130°	-0.12	-0.28	-0.35	-0.32	-0.43	-0.39	-0.60	-0.29
140°	-0.14	-0.28	-0.39	-0.40	-0.41	-0.41	-0.62	-0.68
150°	-0.12	-0.23	-0.36	-0.42	-0.37	-0.36	-0.49	-0.62
160°	-0.15	-0.24	-0.33	-0.43	-0.31	-0.29	-0.35	-0.36
170°	-0.11	-0.20	-0.32	-0.41	-0.29	-0.21	-0.20	-0.13
180°	-0.12	-0.23	-0.33	-0.40	-0.28	-0.19	-0.15	-0.04
190°	-0.17	-0.22	-0.31	-0.43	-0.30	-0.23	-0.17	-0.12
200°	-0.12	-0.21	-0.34	-0.43	-0.31	-0.26	-0.23	-0.25
210°	-0.12	-0.21	-0.34	-0.43	-0.35	-0.33	-0.37	-0.53
220°	-0.10	-0.20	-0.33	-0.39	-0.40	-0.37	-0.47	-0.73
230°	-0.10	-0.22	-0.32	-0.36	-0.43	-0.39	-0.49	-0.60
240°	-0.10	-0.20	-0.33	-0.36	-0.44	-0.38	-0.47	-0.16
250°	-0.10	-0.18	-0.30	-0.29	-0.39	-0.30	-0.23	0.16
260°	-0.11	-0.18	-0.26	-0.27	-0.34	-0.20	0.04	0.01
270°	-0.11	-0.16	-0.24	-0.22	-0.24	-0.08	0.20	-0.20
280°	-0.06	-0.17	-0.20	-0.27	-0.12	0.05	0.19	-0.10
290°	-0.08	-0.11	-0.16	-0.19	-0.06	0.12	0.07	-0.04
300°	0.02	-0.07	-0.06	-0.08	0.00	0.17	0.02	0.03
310°	0.02	-0.07	-0.03	0.01	0.01	0.14	-0.02	0.07
320°	0.06	0.06	0.04	0.11	0.00	0.16	0.08	0.10
330°	0.07	0.08	0.06	0.14	0.02	0.13	0.10	0.05
340°	0.09	0.05	0.04	0.10	0.00	0.08	0.05	0.01
350°	0.05	0.04	0.05	0.09	0.01	0.07	0.08	0.01

Angle (degrees)	Nominal frequency / exact frequency (Hz)							
	1600/1584.9	**2000/1995.3**	2240/2238.7	**2500/2511.9**	2800/2818.4	**3150/3162.3**	3550/3548.1	**4000/3981.1**
0°	**0.00**	**0.00**	0.00	**0.00**	0.00	**0.00**	0.00	**0.00**
10°	**0.05**	**0.00**	0.05	**-0.08**	0.02	**0.05**	-0.02	**0.08**
20°	**-0.05**	**-0.03**	-0.02	**-0.05**	-0.04	**0.02**	-0.01	**0.05**
30°	**-0.09**	**-0.02**	-0.09	**-0.03**	-0.09	**0.05**	-0.02	**0.02**
40°	**-0.19**	**-0.09**	-0.21	**-0.09**	-0.05	**-0.04**	-0.12	**0.00**
50°	**-0.19**	**-0.16**	-0.22	**-0.24**	-0.05	**-0.12**	-0.19	**-0.24**
60°	**-0.12**	**-0.40**	-0.35	**-0.45**	-0.14	**-0.13**	-0.29	**-0.60**
70°	**-0.02**	**-0.77**	-0.69	**-0.60**	-0.42	**-0.34**	-0.22	**-0.63**
80°	**0.15**	**-0.57**	-1.07	**-0.97**	-0.51	**-0.75**	-0.61	**-0.43**
90°	**0.05**	**-0.53**	-0.79	**-1.11**	-0.76	**-0.77**	-1.24	**-0.96**
100°	**-0.39**	**-0.48**	-0.41	**-0.98**	-1.17	**-1.27**	-0.97	**-1.18**
110°	**-0.29**	**-0.29**	-0.91	**-0.73**	-0.62	**-0.97**	-1.25	**-1.61**
120°	**0.00**	**-0.28**	-0.61	**-0.83**	-0.89	**-0.87**	-0.68	**-0.68**
130°	**-0.19**	**-0.13**	-0.30	**-0.34**	-0.54	**-0.95**	-1.35	**-1.23**
140°	**-0.76**	**-0.79**	-0.90	**-0.62**	-0.37	**-0.40**	-0.16	**-0.61**
150°	**-0.95**	**-1.27**	-1.65	**-1.55**	-1.46	**-1.46**	-1.23	**-0.75**
160°	**-0.82**	**-1.07**	-1.50	**-1.64**	-1.71	**-2.24**	-2.69	**-2.81**
170°	**-0.50**	**-0.64**	-0.95	**-1.01**	-0.97	**-1.24**	-1.27	**-1.67**
180°	**-0.35**	**-0.41**	-0.69	**-0.56**	-0.54	**-0.61**	-0.44	**-0.67**
190°	**-0.40**	**-0.51**	-0.76	**-0.69**	-0.67	**-0.69**	-0.57	**-0.76**
200°	**-0.59**	**-0.82**	-1.12	**-1.20**	-1.22	**-1.35**	-1.40	**-2.03**
210°	**-0.85**	**-1.21**	-1.53	**-1.83**	-1.65	**-1.85**	-1.85	**-2.62**
220°	**-0.82**	**-1.02**	-1.17	**-1.29**	-0.82	**-0.90**	-0.89	**-0.70**
230°	**-0.42**	**-0.40**	-0.41	**-0.63**	-0.49	**-0.64**	-1.12	**-1.23**
240°	**0.03**	**-0.21**	-0.52	**-0.85**	-1.01	**-1.18**	-0.95	**-0.53**
250°	**0.03**	**-0.47**	-0.92	**-1.02**	-0.74	**-0.65**	-0.60	**-1.26**
260°	**-0.45**	**-0.43**	-0.70	**-0.87**	-0.66	**-0.80**	-1.30	**-1.79**
270°	**-0.25**	**-0.62**	-0.43	**-0.72**	-0.78	**-1.11**	-1.42	**-0.72**
280°	**-0.05**	**-0.38**	-0.84	**-0.85**	-0.76	**-1.18**	-0.70	**-0.73**
290°	**-0.13**	**-0.48**	-0.70	**-0.79**	-0.72	**-0.55**	-0.34	**-1.03**
300°	**-0.15**	**-0.35**	-0.55	**-0.74**	-0.22	**-0.14**	-0.49	**-0.43**
310°	**-0.21**	**-0.16**	-0.45	**-0.44**	0.04	**-0.21**	-0.56	**0.04**
320°	**-0.08**	**-0.02**	-0.34	**-0.12**	0.11	**-0.17**	-0.17	**-0.02**
330°	**0.03**	**0.02**	-0.12	**0.09**	0.05	**-0.05**	0.09	**-0.33**
340°	**0.06**	**-0.02**	-0.01	**0.04**	0.00	**0.04**	0.15	**-0.16**
350°	**0.11**	**0.02**	0.07	**-0.02**	0.06	**0.13**	0.16	**0.08**

Angle (degrees)	Nominal frequency / exact frequency (Hz)							
	4500/4466.8	**5000/5011.9**	5600/5623.4	**6300/6309.6**	7100/7079.5	**8000/7943.3**	8500/8414.0	9000/8912.5
0°	0.00	**0.00**	0.00	**0.00**	0.00	**0.00**	0.00	0.00
10°	-0.04	**-0.09**	-0.05	**-0.08**	0.02	**-0.13**	-0.04	-0.03
20°	-0.11	**-0.29**	-0.23	**-0.38**	0.08	**-0.36**	-0.05	-0.46
30°	-0.19	**-0.66**	-0.41	**-0.63**	0.04	**-0.65**	-0.32	-1.09
40°	-0.33	**-0.79**	-0.47	**-0.73**	-0.18	**-1.04**	-0.53	-1.32
50°	-0.43	**-1.02**	-0.72	**-1.26**	-0.90	**-1.59**	-0.83	-1.80
60°	-0.55	**-1.65**	-1.04	**-1.34**	-1.36	**-2.17**	-1.71	-2.15
70°	-1.03	**-1.15**	-1.41	**-1.79**	-1.56	**-2.10**	-2.13	-3.16
80°	-1.27	**-1.76**	-1.63	**-2.31**	-2.01	**-2.96**	-2.79	-3.19
90°	-1.11	**-2.05**	-1.93	**-2.90**	-2.76	**-3.52**	-3.59	-3.79
100°	-1.03	**-1.57**	-2.16	**-3.03**	-4.03	**-3.48**	-3.58	-4.35
110°	-1.68	**-2.04**	-2.21	**-3.11**	-2.98	**-5.50**	-4.76	-5.08
120°	-1.90	**-2.57**	-2.43	**-3.90**	-3.94	**-4.82**	-4.96	-5.35
130°	-0.81	**-1.27**	-2.48	**-3.63**	-4.38	**-5.47**	-5.43	-5.93
140°	-1.28	**-2.26**	-2.08	**-2.49**	-2.71	**-4.97**	-5.50	-6.04
150°	-0.51	**-0.35**	-1.12	**-2.86**	-3.99	**-4.70**	-5.26	-5.47
160°	-2.76	**-2.93**	-2.37	**-2.91**	-2.81	**-3.21**	-3.45	-4.14
170°	-2.08	**-3.17**	-4.01	**-5.12**	-6.16	**-7.49**	-8.26	-8.07
180°	-0.61	**-0.81**	-1.95	**-2.99**	-3.41	**-4.65**	-5.26	-5.97
190°	-0.83	**-1.26**	-2.68	**-3.56**	-4.25	**-6.07**	-6.84	-6.99
200°	-2.98	**-3.84**	-5.39	**-6.22**	-6.31	**-7.88**	-7.41	-7.83
210°	-2.69	**-2.15**	-1.89	**-2.25**	-2.69	**-4.53**	-4.76	-6.04
220°	-0.47	**-2.33**	-2.60	**-3.35**	-3.78	**-4.05**	-4.04	-4.67
230°	-1.85	**-2.18**	-1.15	**-2.71**	-4.73	**-4.71**	-4.63	-6.14
240°	-0.90	**-1.88**	-3.13	**-3.94**	-4.09	**-5.65**	-5.42	-5.96
250°	-2.29	**-2.40**	-3.26	**-2.84**	-3.45	**-5.28**	-4.57	-5.87
260°	-1.71	**-2.90**	-2.27	**-3.26**	-4.09	**-3.62**	-3.67	-5.07
270°	-1.41	**-1.59**	-2.76	**-2.46**	-2.75	**-4.43**	-3.89	-3.89
280°	-1.15	**-1.78**	-1.17	**-2.70**	-2.40	**-2.70**	-2.91	-3.50
290°	-0.79	**-1.80**	-1.85	**-2.23**	-2.07	**-2.56**	-2.65	-3.39
300°	-0.88	**-0.79**	-1.41	**-1.24**	-0.81	**-2.57**	-1.87	-1.88
310°	-0.72	**-0.99**	-0.49	**-1.23**	-1.59	**-1.12**	-0.95	-2.26
320°	-0.14	**-1.26**	-0.57	**-0.46**	-0.78	**-1.40**	-0.95	-1.51
330°	0.15	**-0.99**	-0.65	**-0.85**	0.34	**-1.36**	-0.15	-1.13
340°	0.07	**-0.30**	-0.09	**-0.37**	0.85	**-0.52**	0.35	-0.69
350°	0.10	**-0.12**	0.14	**0.07**	0.49	**-0.29**	0.20	-0.17

Angle (degrees)	Nominal frequency / exact frequency (Hz)					
	9500/9440.6	**10000/10000**	10600/10593	11200/11220	11800/11885	**12500/12589**
0°	0.00	**0.00**	0.00	0.00	0.00	**0.00**
10°	0.07	**0.04**	0.11	-0.24	0.02	**0.05**
20°	-0.15	**-0.09**	-0.17	-0.60	0.03	**0.11**
30°	-0.57	**-0.21**	-0.73	-0.95	-0.76	**-0.13**
40°	-1.41	**-0.73**	-0.95	-1.59	-1.13	**-0.77**
50°	-2.06	**-1.66**	-1.90	-1.93	-2.10	**-1.41**
60°	-2.34	**-2.49**	-2.84	-3.23	-2.73	**-2.50**
70°	-3.23	**-3.02**	-3.37	-4.61	-4.19	**-3.46**
80°	-4.22	**-3.87**	-4.02	-4.95	-5.31	**-5.31**
90°	-4.46	**-4.75**	-5.04	-5.92	-6.24	**-6.46**
100°	-5.26	**-4.62**	-5.02	-6.28	-7.01	**-7.39**
110°	-5.61	**-5.10**	-5.65	-6.75	-7.38	**-7.64**
120°	-6.27	**-5.97**	-6.64	-7.09	-7.91	**-7.89**
130°	-6.74	**-6.11**	-6.44	-7.26	-7.96	**-7.83**
140°	-6.60	**-6.33**	-6.49	-7.99	-8.74	**-9.14**
150°	-6.01	**-5.69**	-5.33	-6.42	-7.14	**-7.77**
160°	-5.37	**-5.25**	-5.52	-6.31	-7.30	**-7.69**
170°	-9.69	**-8.78**	-8.61	-9.61	-9.52	**-10.06**
180°	-7.34	**-6.30**	-5.89	-6.93	-8.59	**-8.27**
190°	-8.39	**-8.33**	-8.43	-9.22	-11.53	**-11.03**
200°	-9.04	**-7.97**	-6.77	-8.15	-7.78	**-7.89**
210°	-7.01	**-6.23**	-6.40	-6.92	-7.32	**-7.10**
220°	-5.35	**-5.94**	-6.17	-7.47	-7.49	**-7.32**
230°	-7.22	**-7.32**	-7.70	-8.22	-7.94	**-8.35**
240°	-5.89	**-6.47**	-7.08	-8.21	-8.04	**-7.45**
250°	-5.30	**-5.20**	-6.25	-7.38	-7.40	**-7.62**
260°	-5.82	**-5.14**	-5.36	-6.76	-7.29	**-6.85**
270°	-4.54	**-4.63**	-4.83	-6.09	-6.09	**-6.94**
280°	-4.32	**-4.40**	-4.91	-4.79	-5.63	**-5.87**
290°	-4.02	**-2.86**	-3.73	-4.61	-4.74	**-4.51**
300°	-2.90	**-2.70**	-2.92	-3.47	-3.61	**-3.01**
310°	-2.19	**-1.77**	-2.12	-2.60	-2.20	**-1.93**
320°	-1.53	**-0.99**	-1.42	-1.54	-1.90	**-1.10**
330°	-0.69	**-0.13**	-0.81	-1.08	-0.94	**-0.33**
340°	-0.51	**0.39**	-0.39	-0.44	-0.47	**0.11**
350°	0.08	**0.32**	-0.13	0.10	0.27	**0.44**

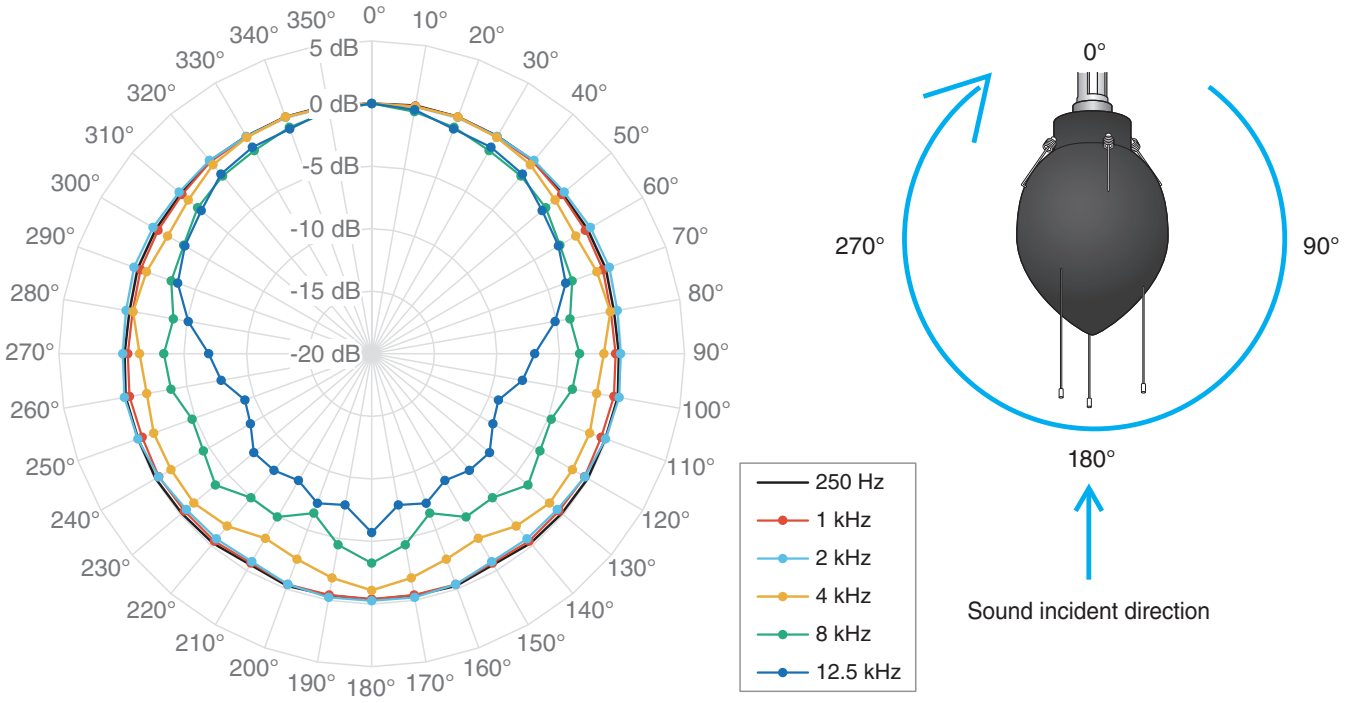


Fig. 16. Directional characteristics of NL-63 with WS-15 attached

Table 9. Directional characteristics of NL-63 with WS-15 attached

Angle (degrees)	Nominal frequency / exact frequency (Hz)							
	250/251.19	315/316.23	400/398.11	500/501.19	630/630.96	800/794.33	1000/1000.0	1250/1258.9
0°	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10°	0.15	0.11	0.11	0.09	0.05	0.09	0.11	0.02
20°	0.15	0.11	0.11	0.13	0.01	0.11	0.14	-0.02
30°	0.09	0.10	0.06	0.09	-0.02	0.06	0.04	-0.06
40°	0.13	0.12	0.11	0.11	0.03	0.10	0.05	-0.05
50°	-0.10	-0.09	-0.11	-0.12	-0.13	-0.13	-0.20	-0.24
60°	-0.07	-0.11	-0.17	-0.15	-0.17	-0.18	-0.28	-0.38
70°	-0.10	-0.13	-0.16	-0.18	-0.18	-0.23	-0.33	-0.53
80°	-0.35	-0.39	-0.43	-0.37	-0.47	-0.51	-0.60	-0.93
90°	-0.25	-0.23	-0.25	-0.23	-0.37	-0.41	-0.51	-0.98
100°	-0.04	-0.04	-0.08	-0.11	-0.15	-0.25	-0.34	-0.88
110°	-0.13	-0.15	-0.19	-0.24	-0.26	-0.37	-0.49	-0.97
120°	-0.06	-0.03	-0.06	-0.17	-0.08	-0.22	-0.35	-0.72
130°	-0.18	-0.19	-0.24	-0.33	-0.24	-0.36	-0.46	-0.74
140°	-0.24	-0.24	-0.28	-0.39	-0.24	-0.36	-0.44	-0.62
150°	-0.56	-0.60	-0.64	-0.70	-0.58	-0.66	-0.69	-0.80
160°	-0.25	-0.29	-0.32	-0.41	-0.28	-0.36	-0.39	-0.47
170°	-0.39	-0.36	-0.37	-0.40	-0.34	-0.45	-0.43	-0.49
180°	-0.36	-0.35	-0.38	-0.38	-0.42	-0.40	-0.39	-0.52
190°	-0.39	-0.36	-0.37	-0.40	-0.34	-0.45	-0.43	-0.49
200°	-0.25	-0.29	-0.32	-0.41	-0.28	-0.36	-0.39	-0.47
210°	-0.56	-0.60	-0.64	-0.70	-0.58	-0.66	-0.69	-0.80
220°	-0.24	-0.24	-0.28	-0.39	-0.24	-0.36	-0.44	-0.62
230°	-0.18	-0.19	-0.24	-0.33	-0.24	-0.36	-0.46	-0.74
240°	-0.06	-0.03	-0.06	-0.17	-0.08	-0.22	-0.35	-0.72
250°	-0.13	-0.15	-0.19	-0.24	-0.26	-0.37	-0.49	-0.97
260°	-0.04	-0.04	-0.08	-0.11	-0.15	-0.25	-0.34	-0.88
270°	-0.25	-0.23	-0.25	-0.23	-0.37	-0.41	-0.51	-0.98
280°	-0.35	-0.39	-0.43	-0.37	-0.47	-0.51	-0.60	-0.93
290°	-0.10	-0.13	-0.16	-0.18	-0.18	-0.23	-0.33	-0.53
300°	-0.07	-0.11	-0.17	-0.15	-0.17	-0.18	-0.28	-0.38
310°	-0.10	-0.09	-0.11	-0.12	-0.13	-0.13	-0.20	-0.24
320°	0.13	0.12	0.11	0.11	0.03	0.10	0.05	-0.05
330°	0.09	0.10	0.06	0.09	-0.02	0.06	0.04	-0.06
340°	0.15	0.11	0.11	0.13	0.01	0.11	0.14	-0.02
350°	0.15	0.11	0.11	0.09	0.05	0.09	0.11	0.02

Angle (degrees)	Nominal frequency / exact frequency (Hz)							
	1600/1584.9	**2000/1995.3**	2240/2238.7	**2500/2511.9**	2800/2818.4	**3150/3162.3**	3550/3548.1	**4000/3981.1**
0°	**0.00**	**0.00**	0.00	**0.00**	0.00	**0.00**	0.00	**0.00**
10°	**0.13**	**0.05**	0.07	**-0.04**	0.06	**0.15**	-0.03	**0.06**
20°	**0.27**	**0.12**	0.04	**-0.07**	0.13	**0.20**	-0.28	**0.14**
30°	**0.25**	**0.07**	-0.11	**-0.27**	-0.02	**0.21**	-0.36	**-0.03**
40°	**0.34**	**0.17**	-0.19	**-0.52**	-0.20	**0.25**	-0.26	**-0.28**
50°	**0.19**	**0.09**	-0.39	**-0.82**	-0.67	**-0.08**	-0.24	**-0.87**
60°	**0.22**	**0.19**	-0.27	**-0.83**	-1.05	**-0.55**	-0.02	**-1.17**
70°	**0.21**	**0.21**	-0.16	**-0.57**	-1.22	**-1.35**	-0.37	**-0.85**
80°	**-0.08**	**-0.07**	-0.27	**-0.34**	-1.03	**-1.86**	-1.56	**-0.64**
90°	**-0.13**	**-0.11**	-0.13	**-0.33**	-0.61	**-0.99**	-2.09	**-1.45**
100°	**-0.22**	**0.08**	-0.13	**-0.57**	-0.74	**-0.60**	-0.95	**-1.75**
110°	**-0.60**	**-0.11**	-0.57	**-0.75**	-1.10	**-1.07**	-0.68	**-1.45**
120°	**-0.66**	**-0.33**	-0.70	**-0.78**	-1.15	**-1.23**	-0.82	**-1.48**
130°	**-0.86**	**-0.65**	-1.15	**-1.20**	-1.48	**-1.72**	-1.41	**-1.45**
140°	**-0.79**	**-0.69**	-1.36	**-1.27**	-1.77	**-2.18**	-2.32	**-2.02**
150°	**-0.81**	**-0.83**	-1.32	**-1.31**	-1.82	**-2.11**	-2.50	**-2.98**
160°	**-0.36**	**-0.39**	-0.79	**-0.77**	-1.15	**-1.28**	-1.49	**-2.54**
170°	**-0.42**	**-0.23**	-0.69	**-0.36**	-0.69	**-0.74**	-0.90	**-1.81**
180°	**-0.09**	**-0.26**	-0.43	**-0.72**	-0.53	**-0.21**	-0.15	**-1.10**
190°	**-0.42**	**-0.23**	-0.69	**-0.36**	-0.69	**-0.74**	-0.90	**-1.81**
200°	**-0.36**	**-0.39**	-0.79	**-0.77**	-1.15	**-1.28**	-1.49	**-2.54**
210°	**-0.81**	**-0.83**	-1.32	**-1.31**	-1.82	**-2.11**	-2.50	**-2.98**
220°	**-0.79**	**-0.69**	-1.36	**-1.27**	-1.77	**-2.18**	-2.32	**-2.02**
230°	**-0.86**	**-0.65**	-1.15	**-1.20**	-1.48	**-1.72**	-1.41	**-1.45**
240°	**-0.66**	**-0.33**	-0.70	**-0.78**	-1.15	**-1.23**	-0.82	**-1.48**
250°	**-0.60**	**-0.11**	-0.57	**-0.75**	-1.10	**-1.07**	-0.68	**-1.45**
260°	**-0.22**	**0.08**	-0.13	**-0.57**	-0.74	**-0.60**	-0.95	**-1.75**
270°	**-0.13**	**-0.11**	-0.13	**-0.33**	-0.61	**-0.99**	-2.09	**-1.45**
280°	**-0.08**	**-0.07**	-0.27	**-0.34**	-1.03	**-1.86**	-1.56	**-0.64**
290°	**0.21**	**0.21**	-0.16	**-0.57**	-1.22	**-1.35**	-0.37	**-0.85**
300°	**0.22**	**0.19**	-0.27	**-0.83**	-1.05	**-0.55**	-0.02	**-1.17**
310°	**0.19**	**0.09**	-0.39	**-0.82**	-0.67	**-0.08**	-0.24	**-0.87**
320°	**0.34**	**0.17**	-0.19	**-0.52**	-0.20	**0.25**	-0.26	**-0.28**
330°	**0.25**	**0.07**	-0.11	**-0.27**	-0.02	**0.21**	-0.36	**-0.03**
340°	**0.27**	**0.12**	0.04	**-0.07**	0.13	**0.20**	-0.28	**0.14**
350°	**0.13**	**0.05**	0.07	**-0.04**	0.06	**0.15**	-0.03	**0.06**

Angle (degrees)	Nominal frequency / exact frequency (Hz)							
	4500/4466.8	**5000/5011.9**	5600/5623.4	**6300/6309.6**	7100/7079.5	**8000/7943.3**	8500/8414.0	9000/8912.5
0°	0.00	**0.00**	0.00	**0.00**	0.00	**0.00**	0.00	0.00
10°	0.08	**-0.23**	0.04	**0.27**	0.28	**-0.36**	-0.01	-0.35
20°	0.31	**-0.71**	0.11	**0.22**	0.10	**-0.74**	-0.37	-0.58
30°	0.20	**-1.11**	-0.10	**-0.04**	-0.34	**-1.25**	-0.82	-0.60
40°	0.25	**-1.35**	-0.42	**-0.32**	-0.75	**-1.45**	-1.24	-1.16
50°	0.04	**-1.19**	-1.20	**-0.17**	-1.14	**-1.84**	-1.51	-1.41
60°	-0.09	**-1.11**	-1.41	**-1.29**	-1.41	**-2.64**	-2.19	-1.59
70°	-0.56	**-0.94**	-1.96	**-1.42**	-1.88	**-2.96**	-3.07	-2.71
80°	-0.46	**-1.64**	-2.24	**-2.24**	-1.99	**-3.91**	-3.33	-3.05
90°	0.07	**-1.73**	-2.50	**-2.48**	-2.31	**-3.39**	-3.91	-3.96
100°	-0.63	**-1.86**	-2.67	**-1.88**	-3.27	**-3.70**	-3.85	-4.18
110°	-0.34	**-2.05**	-3.40	**-2.36**	-2.59	**-4.73**	-4.96	-4.41
120°	-0.93	**-1.56**	-1.66	**-2.70**	-3.21	**-4.46**	-4.75	-4.94
130°	-1.21	**-2.43**	-1.98	**-1.69**	-3.68	**-3.69**	-4.35	-5.48
140°	-1.08	**-2.09**	-2.24	**-2.83**	-3.77	**-4.99**	-4.84	-5.16
150°	-2.37	**-3.09**	-2.94	**-3.06**	-3.98	**-4.93**	-4.61	-4.87
160°	-1.79	**-2.88**	-3.36	**-3.78**	-5.27	**-6.45**	-6.90	-6.58
170°	-0.51	**-1.66**	-1.64	**-1.72**	-3.25	**-4.51**	-4.41	-4.20
180°	-0.57	**-1.32**	-0.96	**-1.50**	-2.60	**-3.27**	-3.31	-2.77
190°	-0.51	**-1.66**	-1.64	**-1.72**	-3.25	**-4.51**	-4.41	-4.20
200°	-1.79	**-2.88**	-3.36	**-3.78**	-5.27	**-6.45**	-6.90	-6.58
210°	-2.37	**-3.09**	-2.94	**-3.06**	-3.98	**-4.93**	-4.61	-4.87
220°	-1.08	**-2.09**	-2.24	**-2.83**	-3.77	**-4.99**	-4.84	-5.16
230°	-1.21	**-2.43**	-1.98	**-1.69**	-3.68	**-3.69**	-4.35	-5.48
240°	-0.93	**-1.56**	-1.66	**-2.70**	-3.21	**-4.46**	-4.75	-4.94
250°	-0.34	**-2.05**	-3.40	**-2.36**	-2.59	**-4.73**	-4.96	-4.41
260°	-0.63	**-1.86**	-2.67	**-1.88**	-3.27	**-3.70**	-3.85	-4.18
270°	0.07	**-1.73**	-2.50	**-2.48**	-2.31	**-3.39**	-3.91	-3.96
280°	-0.46	**-1.64**	-2.24	**-2.24**	-1.99	**-3.91**	-3.33	-3.05
290°	-0.56	**-0.94**	-1.96	**-1.42**	-1.88	**-2.96**	-3.07	-2.71
300°	-0.09	**-1.11**	-1.41	**-1.29**	-1.41	**-2.64**	-2.19	-1.59
310°	0.04	**-1.19**	-1.20	**-0.17**	-1.14	**-1.84**	-1.51	-1.41
320°	0.25	**-1.35**	-0.42	**-0.32**	-0.75	**-1.45**	-1.24	-1.16
330°	0.20	**-1.11**	-0.10	**-0.04**	-0.34	**-1.25**	-0.82	-0.60
340°	0.31	**-0.71**	0.11	**0.22**	0.10	**-0.74**	-0.37	-0.58
350°	0.08	**-0.23**	0.04	**0.27**	0.28	**-0.36**	-0.01	-0.35

Angle (degrees)	Nominal frequency / exact frequency (Hz)					
	9500/9440.6	**10000/10000**	10600/10593	11200/11220	11800/11885	**12500/12589**
0°	0.00	**0.00**	0.00	0.00	0.00	**0.00**
10°	0.10	**0.09**	-0.46	-0.04	0.04	**-0.20**
20°	-0.31	**-0.25**	-0.63	-0.52	-0.37	**-0.89**
30°	-1.04	**-0.55**	-1.02	-1.09	-0.88	**-0.94**
40°	-1.03	**-1.36**	-1.25	-1.24	-1.45	**-1.26**
50°	-2.10	**-1.72**	-1.41	-1.83	-2.04	**-2.21**
60°	-2.88	**-2.61**	-2.49	-2.12	-2.29	**-2.77**
70°	-3.27	**-2.77**	-3.09	-2.99	-3.32	**-3.50**
80°	-4.62	**-3.16**	-3.78	-4.04	-5.05	**-5.11**
90°	-4.41	**-4.29**	-4.61	-5.23	-6.41	**-6.97**
100°	-4.95	**-4.82**	-6.64	-6.44	-6.29	**-7.77**
110°	-5.91	**-6.71**	-6.54	-6.51	-7.91	**-9.22**
120°	-5.29	**-6.32**	-7.67	-7.30	-7.43	**-8.80**
130°	-6.57	**-6.39**	-7.02	-7.21	-7.62	**-7.71**
140°	-4.89	**-5.17**	-6.08	-6.13	-6.96	**-7.84**
150°	-5.28	**-6.22**	-7.72	-7.62	-7.48	**-8.30**
160°	-6.84	**-7.26**	-7.78	-7.30	-7.13	**-7.30**
170°	-5.11	**-6.27**	-7.15	-8.45	-7.47	**-7.73**
180°	-3.64	**-4.65**	-4.96	-6.12	-5.37	**-5.71**
190°	-5.11	**-6.27**	-7.15	-8.45	-7.47	**-7.73**
200°	-6.84	**-7.26**	-7.78	-7.30	-7.13	**-7.30**
210°	-5.28	**-6.22**	-7.72	-7.62	-7.48	**-8.30**
220°	-4.89	**-5.17**	-6.08	-6.13	-6.96	**-7.84**
230°	-6.57	**-6.39**	-7.02	-7.21	-7.62	**-7.71**
240°	-5.29	**-6.32**	-7.67	-7.30	-7.43	**-8.80**
250°	-5.91	**-6.71**	-6.54	-6.51	-7.91	**-9.22**
260°	-4.95	**-4.82**	-6.64	-6.44	-6.29	**-7.77**
270°	-4.41	**-4.29**	-4.61	-5.23	-6.41	**-6.97**
280°	-4.62	**-3.16**	-3.78	-4.04	-5.05	**-5.11**
290°	-3.27	**-2.77**	-3.09	-2.99	-3.32	**-3.50**
300°	-2.88	**-2.61**	-2.49	-2.12	-2.29	**-2.77**
310°	-2.10	**-1.72**	-1.41	-1.83	-2.04	**-2.21**
320°	-1.03	**-1.36**	-1.25	-1.24	-1.45	**-1.26**
330°	-1.04	**-0.55**	-1.02	-1.09	-0.88	**-0.94**
340°	-0.31	**-0.25**	-0.63	-0.52	-0.37	**-0.89**
350°	0.10	**0.09**	-0.46	-0.04	0.04	**-0.20**

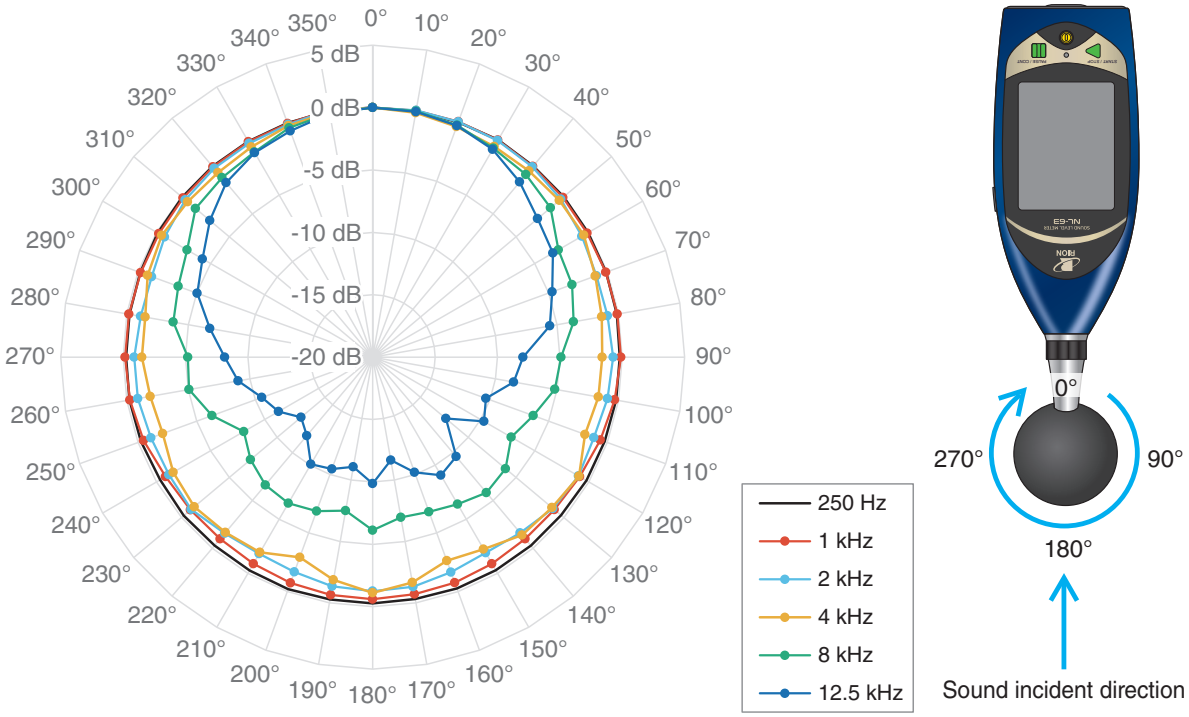


Fig. 17. Directional characteristics of NL-63 with WS-16 attached (horizontal direction)

Table 10. Directional characteristics of NL-63 with WS-16 attached (horizontal direction)

Angle (degrees)	Nominal frequency / exact frequency (Hz)							
	250/251.19	315/316.23	400/398.11	500/501.19	630/630.96	800/794.33	1000/1000.0	1250/1258.9
0°	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10°	0.03	0.04	0.04	0.06	0.01	0.04	0.06	0.00
20°	0.05	0.06	0.07	0.12	0.02	0.07	0.09	0.02
30°	0.10	0.05	0.07	0.15	0.00	0.08	0.08	0.05
40°	0.01	0.01	0.03	0.13	-0.02	0.05	-0.03	0.03
50°	-0.01	-0.02	-0.01	0.12	-0.03	0.06	-0.09	0.01
60°	-0.06	-0.04	-0.08	0.07	-0.07	0.05	-0.14	-0.07
70°	-0.09	-0.11	-0.12	-0.01	-0.14	0.02	-0.11	-0.20
80°	-0.14	-0.18	-0.21	-0.08	-0.21	-0.05	-0.09	-0.32
90°	-0.20	-0.22	-0.26	-0.16	-0.31	-0.18	-0.10	-0.33
100°	-0.19	-0.35	-0.45	-0.43	-0.37	-0.39	-0.30	-0.19
110°	-0.22	-0.35	-0.50	-0.50	-0.45	-0.54	-0.59	-0.11
120°	-0.23	-0.36	-0.53	-0.54	-0.49	-0.64	-0.83	-0.35
130°	-0.29	-0.41	-0.59	-0.59	-0.51	-0.73	-1.00	-0.71
140°	-0.28	-0.37	-0.56	-0.54	-0.49	-0.70	-0.99	-0.86
150°	-0.27	-0.39	-0.55	-0.48	-0.48	-0.65	-0.87	-0.78
160°	-0.27	-0.38	-0.53	-0.45	-0.44	-0.55	-0.76	-0.56
170°	-0.32	-0.40	-0.54	-0.46	-0.41	-0.54	-0.70	-0.41
180°	-0.27	-0.38	-0.50	-0.41	-0.41	-0.47	-0.60	-0.36
190°	-0.28	-0.36	-0.45	-0.42	-0.42	-0.47	-0.66	-0.46
200°	-0.22	-0.35	-0.44	-0.42	-0.44	-0.53	-0.75	-0.59
210°	-0.27	-0.36	-0.47	-0.45	-0.47	-0.60	-0.88	-0.76
220°	-0.29	-0.40	-0.51	-0.56	-0.53	-0.68	-0.99	-0.83
230°	-0.25	-0.39	-0.49	-0.56	-0.54	-0.65	-0.94	-0.59
240°	-0.34	-0.43	-0.57	-0.64	-0.54	-0.64	-0.84	-0.26
250°	-0.24	-0.32	-0.41	-0.48	-0.45	-0.44	-0.46	-0.10
260°	-0.20	-0.30	-0.37	-0.41	-0.39	-0.31	-0.25	-0.19
270°	-0.23	-0.29	-0.35	-0.35	-0.29	-0.19	-0.16	-0.29
280°	-0.20	-0.24	-0.27	-0.22	-0.19	-0.07	-0.16	-0.17
290°	-0.18	-0.20	-0.21	-0.18	-0.11	-0.02	-0.22	-0.05
300°	-0.10	-0.14	-0.14	-0.11	-0.05	0.03	-0.21	0.07
310°	-0.07	-0.09	-0.07	-0.07	-0.03	0.04	-0.17	0.14
320°	-0.04	-0.04	-0.04	-0.03	-0.03	0.04	-0.10	0.14
330°	-0.04	-0.05	-0.03	-0.02	-0.03	0.00	-0.07	0.07
340°	-0.04	-0.03	-0.02	-0.02	-0.02	-0.03	-0.08	0.06
350°	0.04	0.05	0.07	0.09	0.04	0.06	0.11	0.08

Angle (degrees)	Nominal frequency / exact frequency (Hz)							
	1600/1584.9	**2000/1995.3**	2240/2238.7	**2500/2511.9**	2800/2818.4	**3150/3162.3**	3550/3548.1	**4000/3981.1**
0°	**0.00**	**0.00**	0.00	**0.00**	0.00	**0.00**	0.00	**0.00**
10°	**0.04**	**0.08**	-0.02	**0.10**	0.03	**-0.03**	-0.14	**-0.11**
20°	**0.00**	**0.07**	-0.08	**0.22**	-0.03	**-0.10**	-0.20	**-0.35**
30°	**-0.10**	**0.04**	-0.23	**0.27**	-0.09	**-0.33**	-0.28	**-0.50**
40°	**-0.27**	**-0.09**	-0.44	**0.09**	-0.12	**-0.59**	-0.29	**-0.51**
50°	**-0.34**	**-0.32**	-0.64	**-0.21**	-0.15	**-0.69**	-0.66	**-0.45**
60°	**-0.33**	**-0.63**	-0.85	**-0.56**	-0.42	**-0.61**	-1.00	**-0.45**
70°	**-0.23**	**-0.91**	-1.22	**-0.76**	-0.87	**-0.88**	-1.01	**-1.02**
80°	**-0.28**	**-0.89**	-1.29	**-1.10**	-1.22	**-1.35**	-1.08	**-1.35**
90°	**-0.52**	**-0.73**	-0.99	**-1.19**	-1.50	**-1.77**	-1.49	**-1.60**
100°	**-0.83**	**-0.89**	-0.84	**-0.87**	-1.25	**-1.76**	-1.50	**-1.62**
110°	**-0.71**	**-1.13**	-1.19	**-1.28**	-1.13	**-1.11**	-0.95	**-1.89**
120°	**-0.73**	**-0.96**	-1.21	**-1.50**	-1.52	**-1.36**	-0.59	**-0.91**
130°	**-1.14**	**-1.14**	-1.14	**-1.34**	-1.58	**-1.68**	-0.98	**-1.24**
140°	**-1.44**	**-1.60**	-1.61	**-1.70**	-1.74	**-1.73**	-1.14	**-1.38**
150°	**-1.50**	**-1.90**	-2.00	**-2.23**	-2.36	**-2.37**	-1.75	**-2.22**
160°	**-1.29**	**-1.65**	-1.70	**-1.95**	-2.16	**-2.21**	-1.71	**-2.64**
170°	**-1.17**	**-1.32**	-1.30	**-1.32**	-1.64	**-1.55**	-0.98	**-1.66**
180°	**-0.92**	**-1.24**	-1.14	**-1.23**	-1.33	**-1.17**	-0.61	**-1.11**
190°	**-1.09**	**-1.35**	-1.36	**-1.53**	-1.65	**-1.73**	-1.25	**-1.87**
200°	**-1.32**	**-1.67**	-1.83	**-2.05**	-2.25	**-2.42**	-2.22	**-2.92**
210°	**-1.45**	**-1.82**	-1.99	**-2.02**	-2.19	**-2.17**	-1.81	**-1.94**
220°	**-1.29**	**-1.55**	-1.58	**-1.56**	-1.68	**-1.76**	-1.39	**-1.65**
230°	**-0.89**	**-1.02**	-1.19	**-1.46**	-1.69	**-1.81**	-1.28	**-1.35**
240°	**-0.77**	**-1.14**	-1.46	**-1.67**	-1.60	**-1.32**	-0.63	**-1.54**
250°	**-0.66**	**-1.09**	-1.22	**-1.06**	-1.16	**-1.51**	-1.65	**-2.10**
260°	**-0.73**	**-0.89**	-0.97	**-1.12**	-1.45	**-1.83**	-1.85	**-1.89**
270°	**-0.53**	**-0.89**	-1.19	**-1.55**	-1.56	**-1.63**	-1.43	**-1.50**
280°	**-0.36**	**-1.12**	-1.45	**-1.18**	-1.31	**-1.31**	-0.84	**-1.49**
290°	**-0.39**	**-1.15**	-1.22	**-1.01**	-1.05	**-0.75**	-0.75	**-0.80**
300°	**-0.44**	**-0.74**	-0.83	**-0.73**	-0.52	**-0.57**	-0.77	**-0.49**
310°	**-0.43**	**-0.40**	-0.64	**-0.34**	-0.29	**-0.60**	-0.42	**-0.64**
320°	**-0.33**	**-0.24**	-0.47	**-0.03**	-0.26	**-0.43**	-0.32	**-0.70**
330°	**-0.22**	**-0.22**	-0.32	**0.06**	-0.24	**-0.23**	-0.28	**-0.55**
340°	**-0.16**	**-0.17**	-0.13	**-0.01**	-0.19	**-0.08**	0.03	**-0.26**
350°	**0.09**	**0.11**	0.03	**0.17**	0.09	**0.03**	-0.09	**-0.05**

Angle (degrees)	Nominal frequency / exact frequency (Hz)							
	4500/4466.8	**5000/5011.9**	5600/5623.4	**6300/6309.6**	7100/7079.5	**8000/7943.3**	8500/8414.0	9000/8912.5
0°	0.00	**0.00**	0.00	**0.00**	0.00	**0.00**	0.00	0.00
10°	0.08	**0.03**	0.09	**-0.13**	0.01	**0.03**	-0.20	-0.09
20°	0.07	**0.09**	0.06	**-0.50**	0.06	**-0.22**	-0.23	-0.26
30°	-0.15	**-0.01**	-0.16	**-0.96**	-0.37	**-0.66**	-0.75	-0.54
40°	-0.58	**-0.19**	-0.56	**-1.25**	-0.91	**-0.90**	-1.21	-1.42
50°	-1.05	**-0.41**	-1.19	**-1.46**	-1.89	**-1.39**	-1.65	-2.14
60°	-1.38	**-1.05**	-1.38	**-2.18**	-1.84	**-2.82**	-2.43	-2.80
70°	-1.03	**-1.38**	-1.80	**-2.77**	-2.70	**-2.99**	-3.65	-4.10
80°	-1.50	**-1.42**	-2.33	**-3.21**	-3.16	**-3.65**	-3.65	-4.39
90°	-2.01	**-2.12**	-2.30	**-3.76**	-3.95	**-4.91**	-5.07	-5.56
100°	-2.81	**-2.46**	-3.40	**-3.88**	-4.52	**-5.18**	-5.48	-6.51
110°	-2.72	**-2.70**	-3.93	**-4.91**	-5.18	**-6.31**	-5.99	-6.37
120°	-2.40	**-2.11**	-3.60	**-5.38**	-5.95	**-7.18**	-7.95	-8.78
130°	-2.16	**-1.11**	-2.81	**-4.33**	-5.31	**-6.09**	-7.02	-7.35
140°	-2.30	**-2.17**	-2.60	**-3.40**	-4.63	**-5.82**	-6.23	-6.35
150°	-2.61	**-2.04**	-3.10	**-3.99**	-4.82	**-6.38**	-6.82	-6.80
160°	-3.71	**-3.33**	-4.46	**-5.01**	-5.89	**-6.80**	-6.82	-7.07
170°	-2.45	**-1.98**	-3.72	**-4.72**	-5.60	**-6.97**	-8.46	-7.78
180°	-1.81	**-1.46**	-2.77	**-3.36**	-3.61	**-6.13**	-5.78	-6.60
190°	-2.79	**-2.82**	-4.17	**-5.10**	-6.20	**-7.50**	-7.84	-8.29
200°	-3.58	**-3.18**	-3.88	**-4.50**	-5.06	**-6.87**	-7.11	-7.29
210°	-2.58	**-2.02**	-3.19	**-4.18**	-5.10	**-6.49**	-6.66	-6.54
220°	-2.73	**-2.09**	-2.56	**-3.65**	-4.81	**-6.61**	-6.74	-6.78
230°	-2.02	**-1.56**	-3.21	**-4.53**	-5.81	**-7.23**	-7.81	-8.50
240°	-2.93	**-2.61**	-4.10	**-5.30**	-6.27	**-8.07**	-8.13	-7.77
250°	-2.98	**-3.10**	-3.76	**-5.15**	-4.69	**-6.29**	-5.95	-6.67
260°	-2.60	**-2.33**	-3.54	**-4.03**	-4.94	**-5.05**	-5.73	-6.38
270°	-1.85	**-2.23**	-2.88	**-3.92**	-3.58	**-5.19**	-5.08	-5.09
280°	-1.65	**-1.71**	-2.54	**-2.99**	-3.15	**-3.78**	-3.54	-4.37
290°	-1.63	**-1.35**	-1.78	**-2.75**	-2.62	**-3.43**	-3.53	-3.74
300°	-1.33	**-0.97**	-1.51	**-2.24**	-1.80	**-2.82**	-2.22	-2.66
310°	-0.94	**-0.30**	-1.24	**-1.38**	-1.33	**-1.46**	-1.60	-2.18
320°	-0.57	**-0.15**	-0.99	**-1.26**	-0.72	**-1.23**	-1.23	-1.27
330°	-0.31	**0.05**	-0.33	**-0.76**	-0.05	**-1.02**	-0.52	-0.61
340°	-0.19	**0.05**	-0.13	**-0.41**	0.00	**-0.45**	-0.14	-0.22
350°	0.10	**0.08**	0.10	**-0.21**	0.04	**-0.15**	0.09	0.14

Angle (degrees)	Nominal frequency / exact frequency (Hz)					
	9500/9440.6	**10000/10000**	10600/10593	11200/11220	11800/11885	**12500/12589**
0°	0.00	**0.00**	0.00	0.00	0.00	**0.00**
10°	0.04	**-0.03**	-0.09	-0.22	0.21	**-0.04**
20°	-0.27	**-0.07**	-0.32	-0.60	-0.03	**-0.26**
30°	-0.78	**-0.43**	-0.85	-1.36	-0.72	**-0.77**
40°	-1.25	**-1.03**	-1.23	-1.89	-1.50	**-1.68**
50°	-2.23	**-1.93**	-1.92	-2.64	-2.05	**-2.74**
60°	-2.79	**-2.80**	-3.02	-3.49	-3.10	**-3.32**
70°	-3.75	**-3.51**	-3.82	-4.77	-4.23	**-4.68**
80°	-4.60	**-4.93**	-4.96	-5.88	-5.59	**-5.58**
90°	-5.14	**-5.21**	-6.09	-6.97	-6.71	**-7.96**
100°	-6.69	**-6.38**	-7.51	-8.22	-8.19	**-8.52**
110°	-6.43	**-6.80**	-8.20	-9.19	-9.02	**-10.35**
120°	-8.42	**-8.49**	-9.24	-9.55	-9.39	**-9.70**
130°	-8.52	**-9.11**	-10.40	-11.92	-11.84	**-12.35**
140°	-7.12	**-7.21**	-8.12	-9.23	-9.00	**-9.59**
150°	-7.19	**-7.39**	-8.22	-9.20	-8.86	**-9.07**
160°	-7.95	**-8.14**	-9.06	-9.84	-9.52	**-10.18**
170°	-10.61	**-10.56**	-10.37	-11.45	-10.70	**-11.62**
180°	-7.25	**-7.53**	-8.91	-9.39	-8.84	**-9.86**
190°	-9.39	**-9.28**	-10.39	-11.08	-10.13	**-11.07**
200°	-8.62	**-8.69**	-9.73	-10.39	-10.03	**-10.46**
210°	-8.32	**-8.10**	-8.82	-9.82	-9.70	**-10.08**
220°	-8.18	**-8.06**	-9.32	-10.38	-10.72	**-11.79**
230°	-9.85	**-9.78**	-11.26	-11.82	-11.56	**-12.51**
240°	-7.59	**-7.66**	-8.88	-9.22	-9.28	**-11.29**
250°	-7.04	**-7.23**	-7.84	-9.09	-10.05	**-10.54**
260°	-6.39	**-6.60**	-7.25	-8.14	-8.34	**-9.05**
270°	-5.22	**-5.72**	-6.47	-7.17	-7.65	**-8.14**
280°	-5.12	**-4.93**	-5.53	-6.22	-5.82	**-6.74**
290°	-3.92	**-3.48**	-4.36	-4.95	-4.81	**-5.04**
300°	-3.03	**-2.91**	-3.46	-3.52	-3.19	**-4.26**
310°	-2.29	**-1.96**	-2.37	-2.65	-2.53	**-2.97**
320°	-1.49	**-1.10**	-1.46	-2.02	-1.73	**-1.74**
330°	-1.00	**-0.41**	-0.99	-1.33	-0.74	**-1.09**
340°	-0.30	**-0.14**	-0.48	-0.67	-0.18	**-0.71**
350°	-0.33	**0.04**	-0.17	-0.02	0.00	**-0.16**

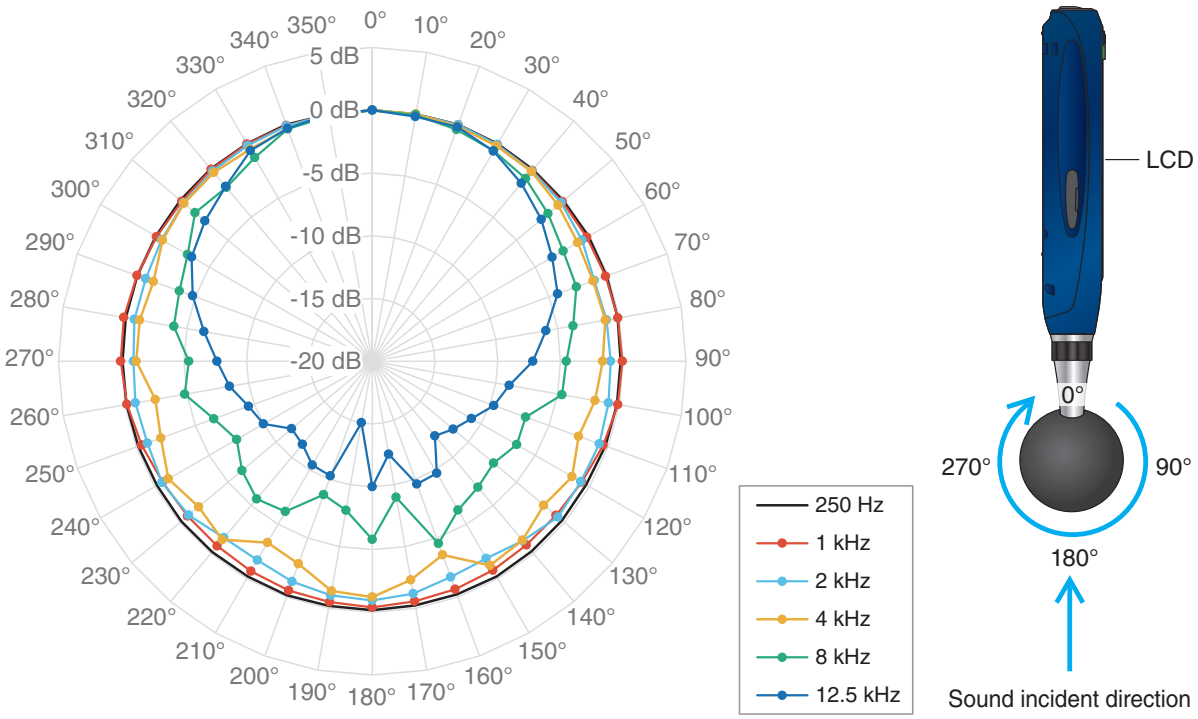


Fig. 18. Directional characteristics of NL-63 with WS-16 attached (vertical direction)

Table 11. Directional characteristics of NL-63 with WS-16 attached (vertical direction)

Angle (degrees)	Nominal frequency / exact frequency (Hz)							
	250/251.19	315/316.23	400/398.11	500/501.19	630/630.96	800/794.33	1000/1000.0	1250/1258.9
0°	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10°	-0.01	-0.01	-0.02	-0.04	-0.02	-0.01	-0.04	0.00
20°	0.06	0.03	0.05	0.02	0.01	0.06	0.04	0.08
30°	-0.01	-0.04	-0.02	-0.06	0.00	0.01	-0.08	0.12
40°	-0.08	-0.09	-0.08	-0.16	0.03	-0.01	-0.17	0.14
50°	-0.12	-0.14	-0.13	-0.20	0.01	0.00	-0.23	0.10
60°	-0.10	-0.15	-0.17	-0.24	-0.05	0.02	-0.26	0.00
70°	-0.13	-0.17	-0.20	-0.24	-0.09	0.02	-0.21	-0.08
80°	-0.15	-0.23	-0.24	-0.28	-0.17	-0.06	-0.12	-0.15
90°	-0.20	-0.26	-0.31	-0.35	-0.27	-0.17	-0.07	-0.25
100°	-0.20	-0.29	-0.34	-0.34	-0.37	-0.27	-0.12	-0.22
110°	-0.23	-0.32	-0.39	-0.35	-0.46	-0.42	-0.42	-0.08
120°	-0.31	-0.31	-0.40	-0.37	-0.52	-0.52	-0.72	-0.16
130°	-0.25	-0.31	-0.42	-0.38	-0.54	-0.56	-0.88	-0.59
140°	-0.24	-0.33	-0.41	-0.36	-0.56	-0.57	-0.89	-1.01
150°	-0.19	-0.28	-0.39	-0.35	-0.53	-0.52	-0.77	-1.01
160°	-0.24	-0.31	-0.39	-0.36	-0.46	-0.48	-0.67	-0.77
170°	-0.24	-0.30	-0.46	-0.37	-0.42	-0.44	-0.57	-0.48
180°	-0.16	-0.25	-0.33	-0.34	-0.41	-0.34	-0.39	-0.37
190°	-0.19	-0.26	-0.41	-0.31	-0.40	-0.40	-0.51	-0.40
200°	-0.15	-0.33	-0.45	-0.47	-0.44	-0.47	-0.56	-0.51
210°	-0.19	-0.33	-0.45	-0.51	-0.48	-0.53	-0.68	-0.77
220°	-0.15	-0.32	-0.46	-0.52	-0.51	-0.57	-0.78	-0.94
230°	-0.15	-0.32	-0.43	-0.51	-0.52	-0.57	-0.79	-0.82
240°	-0.20	-0.28	-0.42	-0.48	-0.51	-0.53	-0.71	-0.34
250°	-0.16	-0.27	-0.40	-0.46	-0.45	-0.45	-0.45	-0.01
260°	-0.12	-0.28	-0.37	-0.40	-0.41	-0.34	-0.15	-0.15
270°	-0.10	-0.21	-0.31	-0.34	-0.31	-0.16	0.04	-0.36
280°	-0.07	-0.15	-0.19	-0.20	-0.23	-0.03	0.10	-0.39
290°	-0.07	-0.14	-0.15	-0.14	-0.15	0.04	-0.06	-0.29
300°	-0.09	-0.11	-0.12	-0.09	-0.12	0.04	-0.15	-0.22
310°	-0.03	-0.08	-0.08	-0.04	-0.07	0.05	-0.19	-0.09
320°	0.02	-0.05	-0.01	0.03	-0.04	0.05	-0.05	-0.02
330°	0.00	-0.05	-0.01	0.00	-0.03	0.00	-0.03	0.00
340°	0.07	-0.04	0.01	-0.02	0.01	0.00	-0.01	0.02
350°	-0.03	0.00	0.02	-0.02	-0.01	0.02	0.01	0.00

Angle (degrees)	Nominal frequency / exact frequency (Hz)							
	1600/1584.9	**2000/1995.3**	2240/2238.7	**2500/2511.9**	2800/2818.4	**3150/3162.3**	3550/3548.1	**4000/3981.1**
0°	**0.00**	**0.00**	0.00	**0.00**	0.00	**0.00**	0.00	**0.00**
10°	**-0.07**	**-0.02**	0.00	**-0.02**	-0.04	**-0.05**	-0.07	**0.00**
20°	**-0.03**	**0.05**	-0.05	**0.03**	-0.03	**-0.06**	-0.15	**-0.09**
30°	**-0.28**	**-0.07**	-0.24	**-0.01**	-0.18	**-0.22**	-0.16	**-0.19**
40°	**-0.45**	**-0.22**	-0.43	**-0.14**	-0.23	**-0.43**	-0.32	**-0.27**
50°	**-0.54**	**-0.35**	-0.53	**-0.33**	-0.31	**-0.63**	-0.49	**-0.65**
60°	**-0.55**	**-0.69**	-0.75	**-0.60**	-0.47	**-0.74**	-0.64	**-1.11**
70°	**-0.43**	**-1.16**	-1.14	**-0.79**	-0.82	**-0.94**	-0.68	**-1.27**
80°	**-0.31**	**-1.04**	-1.56	**-1.20**	-0.99	**-1.36**	-1.06	**-1.14**
90°	**-0.39**	**-1.00**	-1.40	**-1.40**	-1.27	**-1.42**	-1.65	**-1.63**
100°	**-0.81**	**-0.87**	-0.90	**-1.43**	-1.76	**-1.92**	-1.54	**-1.96**
110°	**-0.79**	**-0.74**	-1.47	**-1.16**	-1.27	**-1.84**	-2.27	**-2.49**
120°	**-0.44**	**-0.80**	-1.18	**-1.29**	-1.55	**-1.70**	-1.46	**-1.60**
130°	**-0.64**	**-0.68**	-0.88	**-0.86**	-1.16	**-1.71**	-2.16	**-2.15**
140°	**-1.13**	**-1.34**	-1.35	**-1.20**	-0.99	**-0.97**	-0.75	**-1.38**
150°	**-1.33**	**-1.85**	-2.10	**-2.14**	-2.04	**-1.87**	-1.52	**-1.20**
160°	**-1.29**	**-1.70**	-2.05	**-2.26**	-2.46	**-2.84**	-3.31	**-3.58**
170°	**-0.99**	**-1.20**	-1.48	**-1.35**	-1.58	**-1.88**	-1.87	**-2.31**
180°	**-0.75**	**-0.94**	-1.09	**-1.14**	-1.16	**-1.11**	-0.84	**-1.21**
190°	**-0.87**	**-1.05**	-1.27	**-1.07**	-1.27	**-1.28**	-1.07	**-1.41**
200°	**-1.12**	**-1.32**	-1.71	**-1.52**	-1.82	**-2.07**	-2.03	**-2.82**
210°	**-1.37**	**-1.70**	-2.11	**-2.10**	-2.23	**-2.56**	-2.47	**-3.32**
220°	**-1.35**	**-1.63**	-1.74	**-1.71**	-1.51	**-1.66**	-1.58	**-1.43**
230°	**-0.93**	**-0.91**	-0.95	**-1.05**	-1.14	**-1.38**	-1.69	**-1.95**
240°	**-0.43**	**-0.66**	-1.05	**-1.26**	-1.60	**-1.86**	-1.51	**-1.25**
250°	**-0.41**	**-0.93**	-1.45	**-1.43**	-1.31	**-1.33**	-1.24	**-2.08**
260°	**-0.88**	**-0.84**	-1.16	**-1.30**	-1.22	**-1.48**	-1.89	**-2.45**
270°	**-0.59**	**-0.97**	-0.81	**-1.10**	-1.25	**-1.61**	-1.86	**-1.20**
280°	**-0.25**	**-0.75**	-1.16	**-1.26**	-1.16	**-1.50**	-1.03	**-1.18**
290°	**-0.39**	**-0.80**	-0.99	**-1.09**	-1.04	**-0.82**	-0.83	**-1.44**
300°	**-0.44**	**-0.62**	-0.83	**-0.94**	-0.48	**-0.46**	-0.85	**-0.70**
310°	**-0.40**	**-0.38**	-0.67	**-0.58**	-0.20	**-0.50**	-0.78	**-0.43**
320°	**-0.25**	**-0.21**	-0.51	**-0.31**	-0.12	**-0.37**	-0.32	**-0.36**
330°	**-0.17**	**-0.15**	-0.27	**-0.04**	-0.14	**-0.27**	0.10	**-0.51**
340°	**-0.06**	**-0.07**	-0.11	**-0.03**	-0.09	**-0.13**	0.11	**-0.28**
350°	**0.02**	**0.00**	-0.01	**-0.04**	-0.02	**0.01**	0.03	**-0.03**

Angle (degrees)	Nominal frequency / exact frequency (Hz)							
	4500/4466.8	**5000/5011.9**	5600/5623.4	**6300/6309.6**	7100/7079.5	**8000/7943.3**	8500/8414.0	9000/8912.5
0°	0.00	**0.00**	0.00	**0.00**	0.00	**0.00**	0.00	0.00
10°	-0.07	**-0.02**	-0.11	**-0.06**	0.00	**-0.07**	-0.02	0.00
20°	0.00	**-0.21**	-0.22	**-0.39**	0.12	**-0.36**	-0.08	-0.37
30°	-0.37	**-0.33**	-0.52	**-0.78**	-0.16	**-0.63**	-0.49	-0.83
40°	-0.68	**-0.34**	-0.68	**-1.07**	-0.54	**-0.99**	-0.92	-1.14
50°	-0.90	**-0.60**	-1.07	**-1.80**	-1.38	**-1.71**	-1.38	-1.81
60°	-1.12	**-1.31**	-1.50	**-2.03**	-1.98	**-2.42**	-2.39	-2.36
70°	-1.55	**-1.22**	-1.95	**-2.59**	-2.34	**-2.69**	-3.06	-3.77
80°	-1.87	**-2.06**	-2.38	**-3.19**	-2.88	**-3.74**	-3.81	-4.20
90°	-1.72	**-2.67**	-3.05	**-3.49**	-3.39	**-4.53**	-4.59	-4.49
100°	-1.65	**-2.31**	-3.04	**-4.37**	-4.97	**-4.64**	-4.83	-5.77
110°	-2.47	**-2.96**	-3.25	**-4.55**	-4.41	**-7.00**	-6.25	-6.53
120°	-2.74	**-3.50**	-3.61	**-5.50**	-5.32	**-6.70**	-6.97	-7.55
130°	-1.70	**-2.26**	-3.67	**-5.24**	-5.92	**-7.36**	-7.73	-8.34
140°	-2.16	**-3.21**	-3.11	**-3.76**	-4.11	**-6.89**	-7.69	-8.14
150°	-1.21	**-1.33**	-2.24	**-4.02**	-5.07	**-6.31**	-6.89	-6.99
160°	-3.54	**-3.78**	-3.33	**-3.80**	-3.63	**-4.53**	-4.90	-5.67
170°	-2.65	**-4.03**	-4.91	**-6.26**	-6.75	**-8.99**	-8.85	-10.31
180°	-1.26	**-1.64**	-2.75	**-3.77**	-4.06	**-5.79**	-6.76	-7.11
190°	-1.60	**-2.08**	-3.72	**-4.81**	-5.08	**-7.95**	-8.70	-9.18
200°	-3.60	**-4.45**	-6.08	**-7.74**	-7.27	**-8.68**	-9.18	-9.19
210°	-3.14	**-2.59**	-2.85	**-3.61**	-3.77	**-6.17**	-6.19	-7.61
220°	-0.95	**-2.66**	-3.53	**-4.95**	-5.08	**-5.67**	-6.06	-6.69
230°	-2.64	**-2.71**	-2.16	**-4.37**	-6.39	**-6.45**	-7.22	-8.45
240°	-1.67	**-2.53**	-4.26	**-5.75**	-5.53	**-7.54**	-7.64	-7.89
250°	-3.04	**-2.99**	-4.20	**-4.44**	-5.03	**-6.56**	-6.51	-7.39
260°	-2.38	**-3.40**	-3.27	**-4.87**	-5.20	**-4.82**	-5.30	-6.53
270°	-1.93	**-2.18**	-3.30	**-3.47**	-3.73	**-5.39**	-4.78	-4.74
280°	-1.54	**-2.55**	-1.74	**-3.43**	-3.12	**-3.95**	-4.15	-4.70
290°	-1.14	**-2.15**	-2.48	**-2.79**	-2.65	**-3.65**	-3.67	-4.38
300°	-1.13	**-1.15**	-1.78	**-1.95**	-1.24	**-3.01**	-2.48	-2.78
310°	-0.84	**-1.20**	-0.85	**-1.69**	-1.99	**-1.57**	-1.83	-2.61
320°	-0.36	**-1.23**	-0.99	**-0.96**	-0.91	**-1.92**	-1.25	-1.65
330°	-0.17	**-0.68**	-0.79	**-1.18**	0.19	**-1.27**	-0.48	-1.23
340°	-0.13	**0.02**	-0.22	**-0.51**	0.53	**-0.31**	-0.08	-0.60
350°	-0.04	**0.17**	0.05	**-0.10**	0.29	**-0.19**	-0.06	-0.21

Angle (degrees)	Nominal frequency / exact frequency (Hz)					
	9500/9440.6	**10000/10000**	10600/10593	11200/11220	11800/11885	**12500/12589**
0°	0.00	**0.00**	0.00	0.00	0.00	**0.00**
10°	-0.05	**-0.06**	0.11	-0.14	-0.04	**-0.21**
20°	-0.14	**-0.19**	-0.17	-0.50	-0.16	**-0.14**
30°	-0.73	**-0.50**	-0.65	-0.89	-0.86	**-0.67**
40°	-1.80	**-1.04**	-0.85	-1.63	-1.51	**-1.50**
50°	-2.60	**-2.08**	-1.64	-2.13	-2.61	**-2.42**
60°	-3.22	**-3.14**	-2.51	-3.16	-3.07	**-3.44**
70°	-4.00	**-3.70**	-3.68	-4.68	-4.46	**-4.28**
80°	-5.18	**-4.81**	-4.80	-5.66	-5.67	**-5.94**
90°	-5.74	**-5.45**	-5.59	-6.59	-6.70	**-7.21**
100°	-6.34	**-5.94**	-6.70	-7.70	-7.71	**-8.91**
110°	-6.65	**-6.93**	-7.52	-8.61	-8.57	**-9.68**
120°	-7.82	**-8.18**	-9.06	-9.46	-9.59	**-10.87**
130°	-8.99	**-8.82**	-9.12	-10.05	-10.46	**-11.59**
140°	-8.85	**-8.86**	-8.99	-11.41	-11.47	**-12.23**
150°	-7.60	**-7.41**	-7.20	-8.92	-9.08	**-9.70**
160°	-6.59	**-6.71**	-7.12	-8.40	-8.84	**-9.58**
170°	-10.90	**-10.25**	-10.37	-11.24	-11.50	**-12.48**
180°	-9.00	**-8.04**	-7.32	-9.05	-9.90	**-9.99**
190°	-10.86	**-11.62**	-11.62	-12.92	-13.21	**-15.02**
200°	-10.83	**-9.44**	-8.76	-9.27	-10.00	**-10.27**
210°	-8.95	**-8.59**	-8.74	-9.05	-9.71	**-10.44**
220°	-7.70	**-8.13**	-8.73	-9.81	-10.78	**-11.35**
230°	-10.41	**-10.22**	-9.99	-10.77	-11.02	**-11.62**
240°	-8.78	**-8.95**	-8.93	-10.25	-10.34	**-10.00**
250°	-7.37	**-7.28**	-7.76	-9.12	-9.39	**-9.52**
260°	-7.50	**-6.67**	-6.86	-8.06	-8.79	**-8.46**
270°	-5.90	**-5.69**	-5.90	-7.11	-7.34	**-7.63**
280°	-4.44	**-5.02**	-6.02	-5.94	-5.80	**-6.40**
290°	-3.57	**-3.47**	-4.61	-5.26	-4.58	**-4.77**
300°	-2.99	**-3.31**	-3.26	-3.82	-3.56	**-3.38**
310°	-2.07	**-1.93**	-2.27	-2.96	-2.25	**-2.59**
320°	-1.39	**-1.19**	-1.58	-2.03	-1.87	**-1.83**
330°	-0.73	**-0.31**	-0.99	-1.41	-0.73	**-0.61**
340°	-0.66	**0.04**	-0.44	-0.57	-0.28	**-0.25**
350°	-0.15	**0.05**	-0.24	-0.18	0.19	**0.01**

9.12 Random incidence response

The random incidence response represents the random incidence sensitivity level in a diffuse field minus the free field sensitivity level in the free field.
The high-frequency response is lower in a diffuse field than in a free field. This can be corrected using the diffuse sound field correction function.

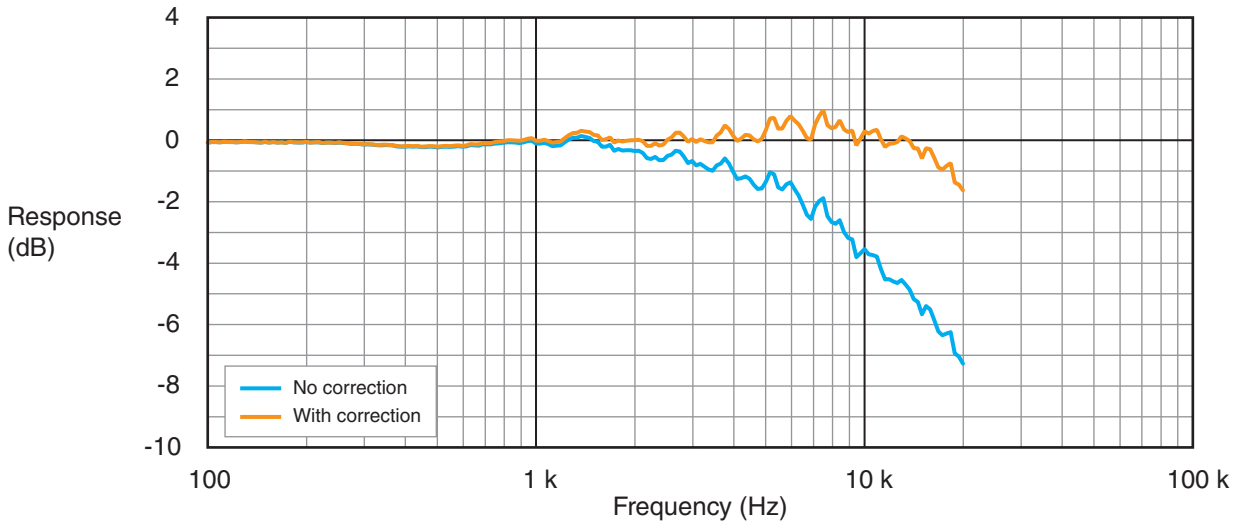


Fig. 19. NL-63 random incidence response

Table 12. NL-63 random incidence response

Nominal frequency (Hz)	Exact frequency (Hz)	NL-63 Random incidence response (dB)	Diffuse sound field correction amount
63	**63.096**	**-0.1**	**0.0**
80	**79.433**	**-0.1**	**0.0**
100	**100.00**	**-0.1**	**0.0**
125	**125.89**	**-0.1**	**0.0**
160	**158.49**	**-0.1**	**0.0**
200	**199.53**	**-0.1**	**0.0**
250	**251.19**	**-0.1**	**0.0**
315	**316.23**	**-0.1**	**0.0**
400	**398.11**	**-0.2**	**0.0**
500	**501.19**	**-0.2**	**0.0**
630	**630.96**	**-0.2**	**0.0**
800	**794.33**	**-0.1**	**0.1**
1000	**1000.0**	**-0.1**	**0.1**
1060	1059.3	-0.1	0.1
1120	1122.0	-0.2	0.1
1180	1188.5	-0.2	0.1
1250	**1258.9**	**0.0**	**0.1**
1320	1333.5	0.1	0.2
1400	1412.5	0.1	0.2
1500	1496.2	0.0	0.2
1600	**1584.9**	**-0.2**	**0.2**

Nominal frequency (Hz)	Exact frequency (Hz)	NL-63 Random incidence response (dB)	Diffuse sound field correction amount
1700	1678.8	-0.1	0.2
1800	1778.3	-0.3	0.3
1900	1883.6	-0.3	0.3
2000	**1995.3**	**-0.3**	**0.3**
2120	2113.5	-0.4	0.4
2240	2238.7	-0.6	0.4
2360	2371.4	-0.6	0.5
2500	**2511.9**	**-0.5**	**0.5**
2650	2660.7	-0.3	0.6
2800	2818.4	-0.5	0.7
3000	2985.4	-0.7	0.7
3150	**3162.3**	**-0.8**	**0.8**
3350	3349.7	-0.9	0.9
3550	3548.1	-0.8	1.0
3750	3758.4	-0.6	1.1
4000	**3981.1**	**-1.0**	**1.2**
4250	4217.0	-1.2	1.3
4500	4466.8	-1.2	1.4
4750	4731.5	-1.6	1.5
5000	**5011.9**	**-1.4**	**1.7**
5300	5308.8	-1.1	1.8
5600	5623.4	-1.6	2.0
6000	5956.6	-1.4	2.2
6300	**6309.6**	**-1.8**	**2.3**
6700	6683.4	-2.4	2.5
7100	7079.5	-2.2	2.7
7500	7498.9	-1.9	2.9
8000	**7943.3**	**-2.7**	**3.1**
8500	8414.0	-2.6	3.3
9000	8912.5	-3.2	3.4
9500	9440.6	-3.8	3.6
10000	**10000**	**-3.5**	**3.8**
10600	10593	-3.7	4.0
11200	11220	-4.2	4.2
11800	11885	-4.5	4.4
12500	**12589**	**-4.6**	**4.6**
13200	13335	-4.7	4.8
14000	14125	-5.2	4.9
15000	14962	-5.7	5.1
16000	**15849**	**-5.5**	**5.2**

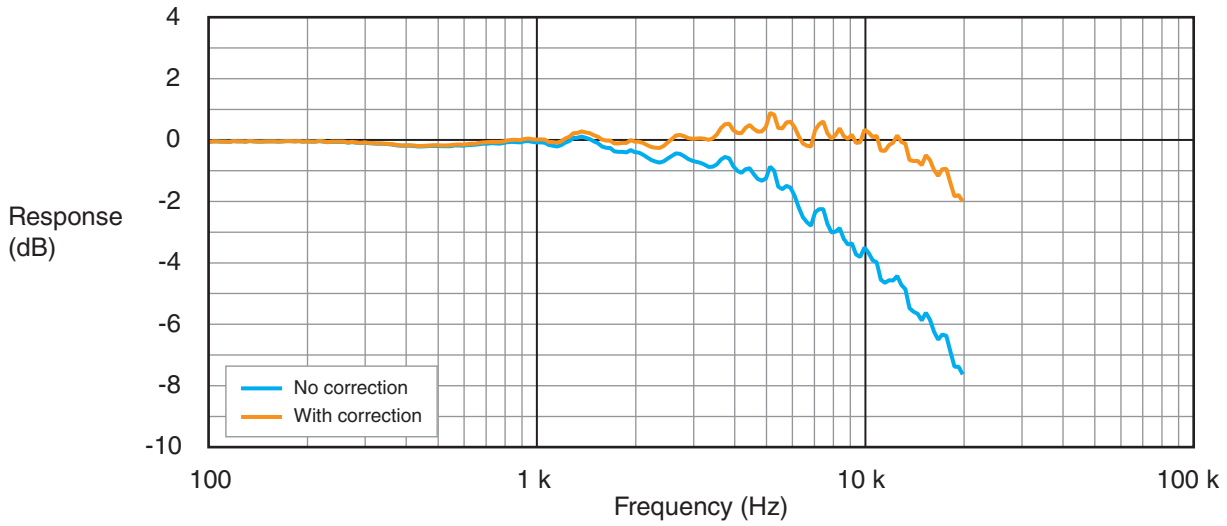


Fig. 20. Random incidence response of NL-63 with WS-10 attached

Table 13. Random incidence response of NL-63 with WS-10 attached

Nominal frequency (Hz)	Exact frequency (Hz)	Random incidence response of NL-63 with WS-10 attached (dB)	Diffuse sound field correction amount
63	**63.096**	**-0.1**	**0.0**
80	**79.433**	**-0.1**	**0.0**
100	**100.00**	**-0.1**	**0.0**
125	**125.89**	**-0.1**	**0.0**
160	**158.49**	**-0.1**	**0.0**
200	**199.53**	**-0.1**	**0.0**
250	**251.19**	**-0.1**	**0.0**
315	**316.23**	**-0.1**	**0.0**
400	**398.11**	**-0.2**	**0.0**
500	**501.19**	**-0.2**	**0.0**
630	**630.96**	**-0.2**	**0.0**
800	**794.33**	**-0.1**	**0.1**
1000	**1000.0**	**-0.1**	**0.1**
1060	1059.3	-0.1	0.1
1120	1122.0	-0.2	0.1
1180	1188.5	-0.2	0.1
1250	**1258.9**	**0.0**	**0.1**
1320	1333.5	0.1	0.2
1400	1412.5	0.1	0.2
1500	1496.2	-0.1	0.2
1600	**1584.9**	**-0.2**	**0.2**
1700	1678.8	-0.3	0.2
1800	1778.3	-0.4	0.3
1900	1883.6	-0.4	0.3
2000	**1995.3**	**-0.4**	**0.3**
2120	2113.5	-0.5	0.4
2240	2238.7	-0.7	0.4
2360	2371.4	-0.7	0.5

Nominal frequency (Hz)	Exact frequency (Hz)	Random incidence response of NL-63 with WS-10 attached (dB)	Diffuse sound field correction amount
2500	**2511.9**	**-0.6**	**0.5**
2650	2660.7	-0.5	0.6
2800	2818.4	-0.5	0.7
3000	2985.4	-0.7	0.7
3150	**3162.3**	**-0.8**	**0.8**
3350	3349.7	-0.9	0.9
3550	3548.1	-0.8	1.0
3750	3758.4	-0.6	1.1
4000	**3981.1**	**-0.9**	**1.2**
4250	4217.0	-1.1	1.3
4500	4466.8	-0.9	1.4
4750	4731.5	-1.3	1.5
5000	**5011.9**	**-1.3**	**1.7**
5300	5308.8	-1.0	1.8
5600	5623.4	-1.6	2.0
6000	5956.6	-1.6	2.2
6300	**6309.6**	**-2.2**	**2.3**
6700	6683.4	-2.7	2.5
7100	7079.5	-2.4	2.7
7500	7498.9	-2.3	2.9
8000	**7943.3**	**-3.0**	**3.1**
8500	8414.0	-2.9	3.3
9000	8912.5	-3.4	3.4
9500	9440.6	-3.8	3.6
10000	**10000**	**-3.5**	**3.8**
10600	10593	-3.9	4.0
11200	11220	-4.6	4.2
11800	11885	-4.6	4.4
12500	**12589**	**-4.5**	**4.6**
13200	13335	-4.9	4.8
14000	14125	-5.6	4.9
15000	14962	-5.9	5.1
16000	**15849**	**-5.9**	**5.2**

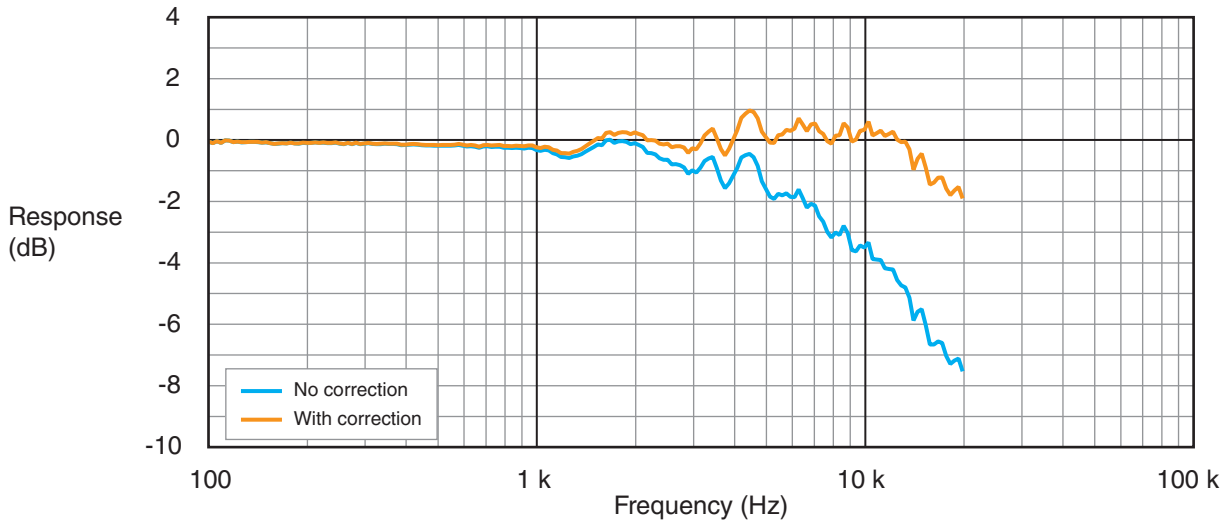


Fig. 21. Random incidence response of NL-63 with WS-15 attached

Table 14. Random incidence response of NL-63 with WS-15 attached

Nominal frequency (Hz)	Exact frequency (Hz)	Random incidence response of NL-63 with WS-15 attached (dB)	Diffuse sound field correction amount
63	**63.096**	**-0.1**	**0.0**
80	**79.433**	**-0.1**	**0.0**
100	**100.00**	**-0.1**	**0.0**
125	**125.89**	**-0.1**	**0.0**
160	**158.49**	**-0.1**	**0.0**
200	**199.53**	**-0.1**	**0.0**
250	**251.19**	**-0.1**	**0.0**
315	**316.23**	**-0.1**	**0.0**
400	**398.11**	**-0.2**	**0.0**
500	**501.19**	**-0.2**	**0.0**
630	**630.96**	**-0.2**	**0.0**
800	**794.33**	**-0.3**	**0.1**
1000	**1000.0**	**-0.3**	**0.1**
1060	1059.3	-0.3	0.1
1120	1122.0	-0.4	0.1
1180	1188.5	-0.6	0.1
1250	**1258.9**	**-0.6**	**0.1**
1320	1333.5	-0.5	0.2
1400	1412.5	-0.4	0.2
1500	1496.2	-0.2	0.2
1600	**1584.9**	**-0.2**	**0.2**
1700	1678.8	0.0	0.2
1800	1778.3	-0.1	0.3
1900	1883.6	-0.1	0.3
2000	**1995.3**	**-0.1**	**0.3**
2120	2113.5	-0.2	0.4
2240	2238.7	-0.4	0.4
2360	2371.4	-0.6	0.5

Nominal frequency (Hz)	Exact frequency (Hz)	Random incidence response of NL-63 with WS-15 attached (dB)	Diffuse sound field correction amount
2500	**2511.9**	**-0.7**	**0.5**
2650	2660.7	-0.8	0.6
2800	2818.4	-0.9	0.7
3000	2985.4	-1.0	0.7
3150	**3162.3**	**-0.9**	**0.8**
3350	3349.7	-0.6	0.9
3550	3548.1	-0.9	1.0
3750	3758.4	-1.6	1.1
4000	**3981.1**	**-1.2**	**1.2**
4250	4217.0	-0.6	1.3
4500	4466.8	-0.5	1.4
4750	4731.5	-0.9	1.5
5000	**5011.9**	**-1.6**	**1.7**
5300	5308.8	-1.9	1.8
5600	5623.4	-1.8	2.0
6000	5956.6	-1.9	2.2
6300	**6309.6**	**-1.6**	**2.3**
6700	6683.4	-2.2	2.5
7100	7079.5	-2.2	2.7
7500	7498.9	-2.7	2.9
8000	**7943.3**	**-3.2**	**3.1**
8500	8414.0	-3.1	3.3
9000	8912.5	-3.1	3.4
9500	9440.6	-3.6	3.6
10000	**10000**	**-3.5**	**3.8**
10600	10593	-3.9	4.0
11200	11220	-3.9	4.2
11800	11885	-4.2	4.4
12500	**12589**	**-4.6**	**4.6**
13200	13335	-4.8	4.8
14000	14125	-5.9	4.9
15000	14962	-5.5	5.1
16000	**15849**	**-6.7**	**5.2**

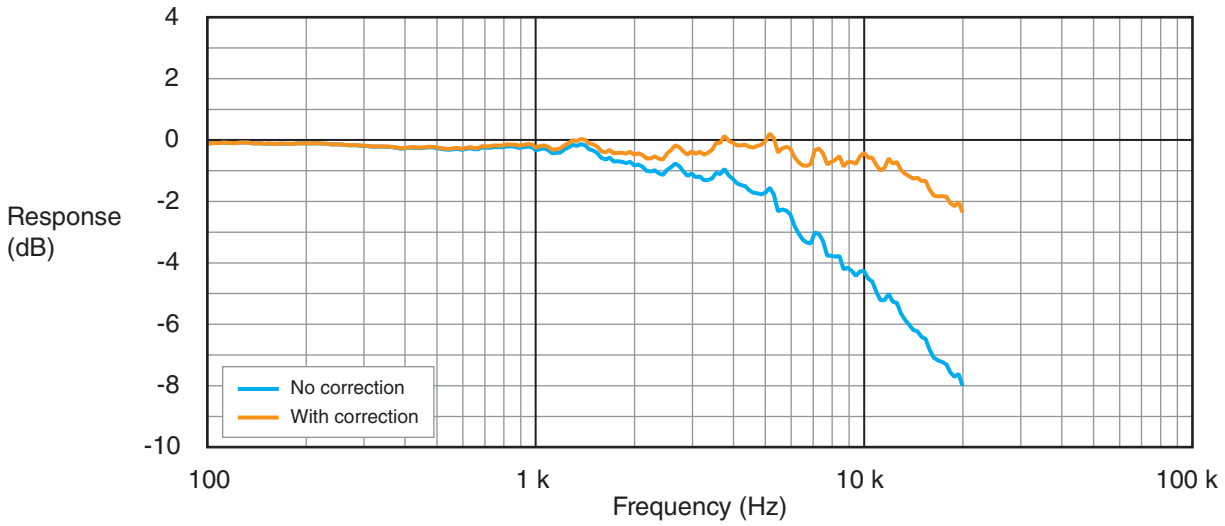


Fig. 22. Random incidence response of NL-63 with WS-16 attached

Table 15. Random incidence response of NL-63 with WS-16 attached

Nominal frequency (Hz)	Exact frequency (Hz)	Random incidence response of NL-63 with WS-16 attached (dB)	Diffuse sound field correction amount
63	**63.096**	**-0.1**	**0.0**
80	**79.433**	**-0.1**	**0.0**
100	**100.00**	**-0.1**	**0.0**
125	**125.89**	**-0.1**	**0.0**
160	**158.49**	**-0.1**	**0.0**
200	**199.53**	**-0.1**	**0.0**
250	**251.19**	**-0.1**	**0.0**
315	**316.23**	**-0.2**	**0.0**
400	**398.11**	**-0.3**	**0.0**
500	**501.19**	**-0.3**	**0.0**
630	**630.96**	**-0.3**	**0.0**
800	**794.33**	**-0.2**	**0.1**
1000	**1000.0**	**-0.3**	**0.1**
1060	1059.3	-0.3	0.1
1120	1122.0	-0.4	0.1
1180	1188.5	-0.4	0.1
1250	**1258.9**	**-0.2**	**0.1**
1320	1333.5	-0.2	0.2
1400	1412.5	-0.2	0.2
1500	1496.2	-0.3	0.2
1600	**1584.9**	**-0.6**	**0.2**
1700	1678.8	-0.6	0.2
1800	1778.3	-0.7	0.3
1900	1883.6	-0.8	0.3
2000	**1995.3**	**-0.8**	**0.3**
2120	2113.5	-0.9	0.4
2240	2238.7	-1.0	0.4
2360	2371.4	-1.1	0.5

Nominal frequency (Hz)	Exact frequency (Hz)	Random incidence response of NL-63 with WS-16 attached (dB)	Diffuse sound field correction amount
2500	**2511.9**	**-1.0**	**0.5**
2650	2660.7	-0.8	0.6
2800	2818.4	-1.0	0.7
3000	2985.4	-1.1	0.7
3150	**3162.3**	**-1.2**	**0.8**
3350	3349.7	-1.3	0.9
3550	3548.1	-1.1	1.0
3750	3758.4	-0.9	1.1
4000	**3981.1**	**-1.3**	**1.2**
4250	4217.0	-1.5	1.3
4500	4466.8	-1.6	1.4
4750	4731.5	-1.7	1.5
5000	**5011.9**	**-1.7**	**1.7**
5300	5308.8	-1.8	1.8
5600	5623.4	-2.3	2.0
6000	5956.6	-2.4	2.2
6300	**6309.6**	**-3.0**	**2.3**
6700	6683.4	-3.3	2.5
7100	7079.5	-3.0	2.7
7500	7498.9	-3.3	2.9
8000	**7943.3**	**-3.8**	**3.1**
8500	8414.0	-3.8	3.3
9000	8912.5	-4.2	3.4
9500	9440.6	-4.4	3.6
10000	**10000**	**-4.3**	**3.8**
10600	10593	-4.6	4.0
11200	11220	-5.2	4.2
11800	11885	-5.0	4.4
12500	**12589**	**-5.3**	**4.6**
13200	13335	-5.9	4.8
14000	14125	-6.2	4.9
15000	14962	-6.4	5.1
16000	**15849**	**-6.8**	**5.2**

Trademarks

- QR code is a registered trademark of DENSO WAVE Incorporated.
- All company names and product names mentioned in this manual are trademarks or registered trademarks of their respective owners.

RION CO., LTD.

https://www.rion.co.jp/english/

3-20-41 Higashimotomachi, Kokubunji, Tokyo 185-8533, Japan

No. 66202 24-11