Technical Documentation

Microphone Type 4964
for Hand-held Analyzer
Types 2250, 2250-L and 2270

Supplement to Instruction Manual BE 1712

English BE 1864 – 11

Brüel & Kjær

Microphone Type 4964
for Hand-held Analyzer
Types 2250, 2250-L and 2270

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

Supplement to Instruction Manual BE 1712

BE 1864−11

December 2013

Safety Considerations

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

Safety Symbols

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

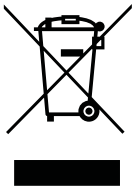
Protective Earth Terminal Hazardous Voltage

Explosion Hazard

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

Warnings

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



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

Chapter 1

Introduction

1.1 About This Supplement

This document is a supplement, to Instruction Manual for Hand-held Analyzer Types 2250, 2250-L and 2270 BE 1712. It provides the information relevant when Hand-held Analyzer Type 2250, 2250-L or 2270 is configured with Low-frequency Free-field ½″ Condenser Microphone Type 4964.

The combination of Low-frequency Free-field ½″ Condenser Microphone Type 4964 and the hand-held analyzer is intended for low frequencies. This combination makes it possible to measure down to 0.4 Hz (–1 dB).

This document also contains the specifications for the frequency analyzer applications when *Low Frequency* is set to *Very Low* and for G-weighting.

The numbering of chapters, sections, figures and tables in this supplement corresponds to Instruction Manual BE 1712. This supplement only contains content that is different from the instruction manual and is specific to this microphone configuration. The other chapters, sections, figures and tables should be read in Instruction Manual BE 1712.

Also see section 1.1 of the Instruction Manual BE 1712.

1.2 System Overview

1.2.4 Hardware Setup

This section provides an overview of the additional hardware components used when the analyzers are configured with one of two microphone configurations based on Microphone Type 4964. The other hardware components can be found in Instruction Manual BE 1712, section 1.2.4.

The microphone configurations are:

- Type 4964 without Adaptor UC-0211 and with *Low Frequency* set to *Normal* or *Extended*
- Type 4964 with Adaptor UC-0211 and with *Low Frequency* set to *Very Low*

Table 1.1
Additional hardware components needed for conformance testing of the analyzers configured with Type 4964

Quantity*	Brüel & Kjær Type/Part Number	Description
1 or 2	Type 4964	Low-frequency Free-field ½″ Condenser Microphone Type 4964
1 or 2	UC-0211	Low-frequency Adaptor

*. Quantity depends on which analyzer is to be tested.

Chapter 2

Information Required by the Standards

2.1 Introduction

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

No additional information is required in Chapter 2 when using Microphone Type 4964 together with the analyzer.

Chapter 3

Conformance Testing

3.1 Introduction

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

3.5 Electrical Substitute for Microphones

3.1.1 Without Low-frequency Adaptor UC-0211

NOTE: Low-frequency Adaptor UC-0211 **should not** be mounted on the preamplifier.

To obtain a BNC-type electrical input, replace the microphone with a **WA-0302-B, 15 pF**, fitted with a 10−32 UNF to BNC adaptor, UA-0245.

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

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

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

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

1) On the **Setup** display (*Full* tab):
   - Set *Input*, *Transd. Used* to the microphone that you intend to substitute
   - Set *Input*, *Input* to *Top Socket*
2) Calibrate the analyzer by typing in the nominal sensitivity as the *Sensitivity* on the **Calibration** display. For Microphone **Type 4964**, the nominal sensitivity is the microphone's Open Circuit Sensitivity (**50.00 mV/Pa**), attenuated by the Microphone Preamplifier ZC-0032's nominal attenuation (**0.25 dB**), which equates to **48.58 mV/Pa**. Do not press the **Start Calibration** button.
3) Connect an electrical sinusoidal signal with a frequency of 1 kHz to the Electrical Substitute for Microphones and adjust the amplitude of this signal until LZF (or LCF) displays 94.00 dB in the **Calibration** display. This electrical amplitude is the 94.00 dB reference for the electrical tests. The amplitude will typically be **52.5 mV**. This is due to the attenuation of the Electrical Substitute for Microphones together with the preamplifier (nominally **0.65 dB**).

3.1.2 With Low-frequency Adaptor UC-0211

NOTE: Low-frequency Adaptor UC-0211 **should** be mounted on the preamplifier.

To obtain a BNC-type electrical input, replace the microphone with a **WA-0302-B, 15 pF**, fitted with a 10−32 UNF to BNC adaptor, UA-0245.

This Electrical Substitute for Microphones has (together with the preamplifier and Low-frequency Adaptor UC-0211) a nominal attenuation of **17.78 dB**.

The electrical input obtained in this way has a maximum input level without overload of typically ±0.67 V_{Peak} and no damage will occur for signals up to ±50 V_{Peak}.

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

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

1) On the **Setup** display (*Full* tab):
   - Set *Input*, *Transd. Used* to the microphone that you intend to substitute
   - Set *Input*, *Input* to *Top Socket*
2) Calibrate the analyzer by typing in the nominal sensitivity as the *Sensitivity* on the **Calibration** display. For Microphone **Type 4964**, the nominal sensitivity is the microphone's Open Circuit Sensitivity (**50.00 mV/Pa**), attenuated by the Microphone Preamplifier ZC-0032's nominal attenuation with UA-0211 mounted (**18.25 dB**), which equates to **6.12 mV/Pa**. Do not press the **Start Calibration** button.
3) Connect an electrical sinusoidal signal with a frequency of 1 kHz to the Electrical Substitute for Microphones and adjust the amplitude of this signal until LZF (or LCF) displays 94.00 dB in the **Calibration** display. This electrical amplitude is the 94.00 dB reference for the electrical tests. The amplitude will typically be **5.81 mV**. This is due to the attenuation of the Electrical Substitute for Microphones together with the preamplifier and UC-0211 (nominally **17.78 dB**).

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

For tests where *Low Frequency* is set to *Normal* or *Extended* follow the procedure in the Instruction Manual BE 1712 Section 3.6.

For tests where *Low Frequency* is set to *Very Low* use the following procedure:

NOTE: These measurements require Frequency Analysis Software and Low Frequency Option to be enabled.

Low-frequency Adaptor UC-0211 must be mounted on preamplifier ZC-0032 and electrical input must be introduced trough the Electrical Substitute for Microphones WA-0302-B mounted on UC-0211.

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

- *Transd. Used* parameter set to *4964+UC-0211* and *Low Frequency* set to *Very Low*
- *Frequency Settings* parameter *Spectrum* set to *Z*

Chapter 4

Specifications

4.1 Specifications

Specifications are given for the configuration detailed in Chapter 1.

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

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

4.5 Microphone

Microphone Type 4964 and Microphone Preamplifier ZC-0032:

Type: Prepolarized Low-frequency Free-field ½″ Condenser Microphone

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

Capacitance: 14 pF (at 250 Hz)

Nominal Preamplifier Attenuation: 0.25 dB without UC-0211, 18.25 dB with UC-0211

Extension Cables between Microphone Preamplifier ZC-0032 and the analyzer: Up to 100 m without degradation of the specifications. **NOTE:** EMC is only tested with a 10 m cable (AO-0441-D-100)

Microphone Reference Point: The centre of the front surface of the microphone protection grid

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

4.6 Frequency Responses

4.6.2 Typical Low-frequency Responses

The typical Low-frequency Responses for Z frequency weighting are given in Fig. 4.2a and Fig. 4.2b. The Electrical Responses are for the rear ‘Input’ socket. The Acoustical Responses include Microphone Type 4964 and Microphone Preamplifier ZC-0032.

Low-frequency Responses depend on the state of the *Low Frequency* parameter on the **Setup** display, under *Frequency Settings*.

Low-frequency Responses are not influenced by the windscreen.

Low-frequency Responses **are** influenced by frequency response compensation.

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

Fig. 4.2a *Typical low-frequency responses without UC-0211*

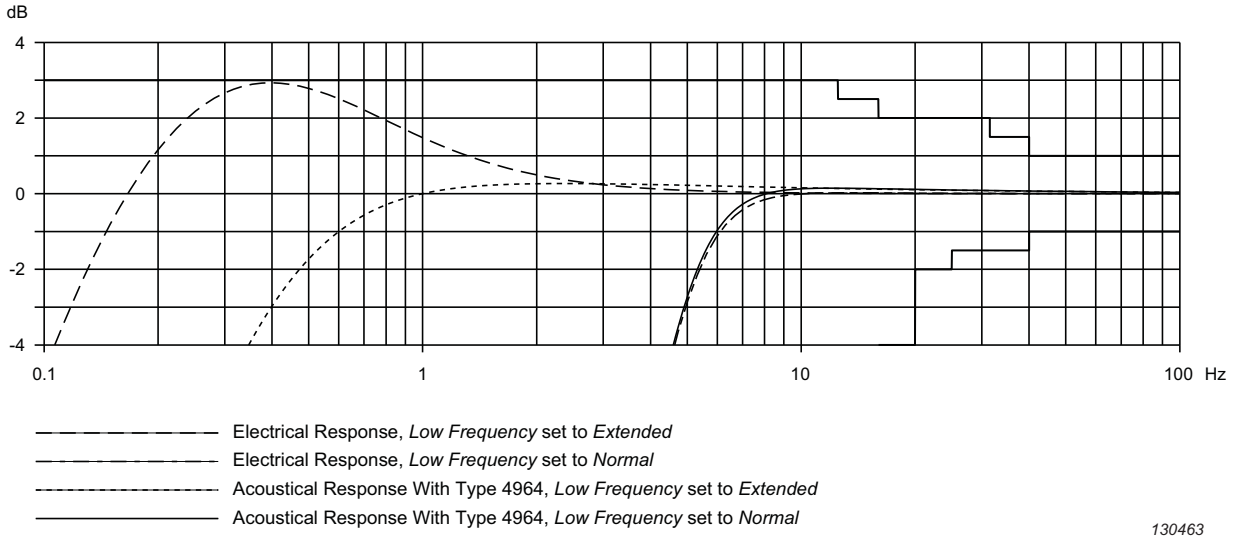
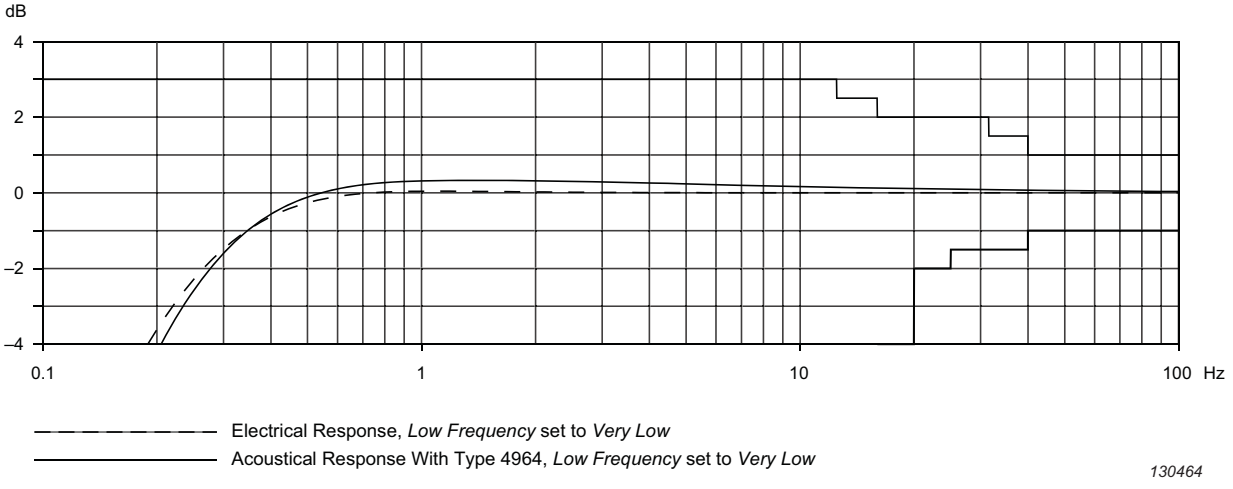


Fig. 4.2b *Typical low-frequency responses with UC-0211*



4.8 Self-generated Noise

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

4.8.1 Maximum Broadband Self-generated Noise

Table 4.1a
Maximum broadband self-generated noise without UC-0211

Maximum Noise	Frequency Weighting				
	A-weighting (dB)	**B-weighting (dB)**	**C-weighting (dB)**	**Z-weighting* Normal (dB)**	**Z-weighting* Extended (dB)**
Single-range					
Microphone	15.6	14.4	14.4	16.2	16.2
Electrical	13.6	12.9	14.4	19.6	28.1
Total	17.7	16.7	17.4	21.2	28.4
High Range					
Microphone	15.6	14.4	14.4	16.2	16.2
Electrical	31.8	30.4	30.4	34.7	35.3
Total	31.9	30.5	30.5	34.8	35.4
Low Range					
Microphone	15.6	14.4	14.4	16.2	16.2
Electrical	13.6	12.9	14.4	19.6	28.1
Total	17.7	16.7	17.4	21.2	28.4

*. minimum 120 seconds L_{Zeq}

Table 4.1b
Maximum broadband self-generated noise with UC-0211

Maximum Noise	Frequency Weighting			
	A-weighting (dB)	**B-weighting (dB)**	**C-weighting (dB)**	**Z-weighting* Very Low (dB)**
Single-range				
Microphone	15.6	14.4	14.5	16.2
Electrical	30.8	29.5	29.6	36.8
Total	30.9	29.6	29.7	36.8
High Range				
Microphone	15.6	14.4	14.5	16.2
Electrical	49.8	48.4	48.4	52.6
Total	49.8	48.4	48.4	52.6
Low Range				
Microphone	15.6	14.4	14.5	16.2
Electrical	30.8	29.5	29.6	36.8
Total	30.9	29.6	29.7	36.8

*. minimum 120 seconds L_{Zeq}

4.8.2 Typical Broadband Self-generated Noise

Table 4.2a
Typical broadband self-generated noise without UC-0211

Typical Noise	Frequency Weighting				
	A-weighting (dB)	B-weighting (dB)	C-weighting (dB)	Z-weighting* Normal (dB)	Z-weighting* Extended (dB)
Single-range					
Microphone	14.6	13.4	13.4	15.2	15.2
Electrical	12.4	11.6	13.0	18.4	27.0
Total	16.6	15.6	16.2	20.1	27.3
High Range					
Microphone	14.6	13.4	13.4	15.2	15.2
Electrical	28.3	26.9	27.0	31.2	32.5
Total	28.5	27.1	27.2	31.3	32.6
Low Range					
Microphone	14.6	13.4	13.4	15.2	15.2
Electrical	12.4	11.6	13.0	18.4	27.0
Total	16.6	15.6	16.2	20.1	27.3

*. minimum 120 seconds L_{Zeq}

Table 4.2b
Typical broadband self-generated noise with UC-0211

Typical Noise	Frequency Weighting			
	A-weighting (dB)	B-weighting (dB)	C-weighting (dB)	Z-weighting* Very Low (dB)
Single-range				
Microphone	14.6	13.4	13.5	15.2
Electrical	29.9	28.5	28.6	34.7
Total	30.0	28.6	28.7	34.7
High Range				
Microphone	14.6	13.4	13.5	15.2
Electrical	46.3	44.9	44.9	49.2
Total	46.3	44.9	44.9	49.2
Low Range				
Microphone	14.6	13.4	13.5	15.2
Electrical	29.9	28.5	28.6	34.7
Total	30.0	28.6	28.7	34.7

*. minimum 120 seconds L_{Zeq}

4.8.3 Typical Self-generated Noise Spectra

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

Fig.4.24a *Typical self-generated noise, 1/1-octave band, Single-range, without UC-0211*

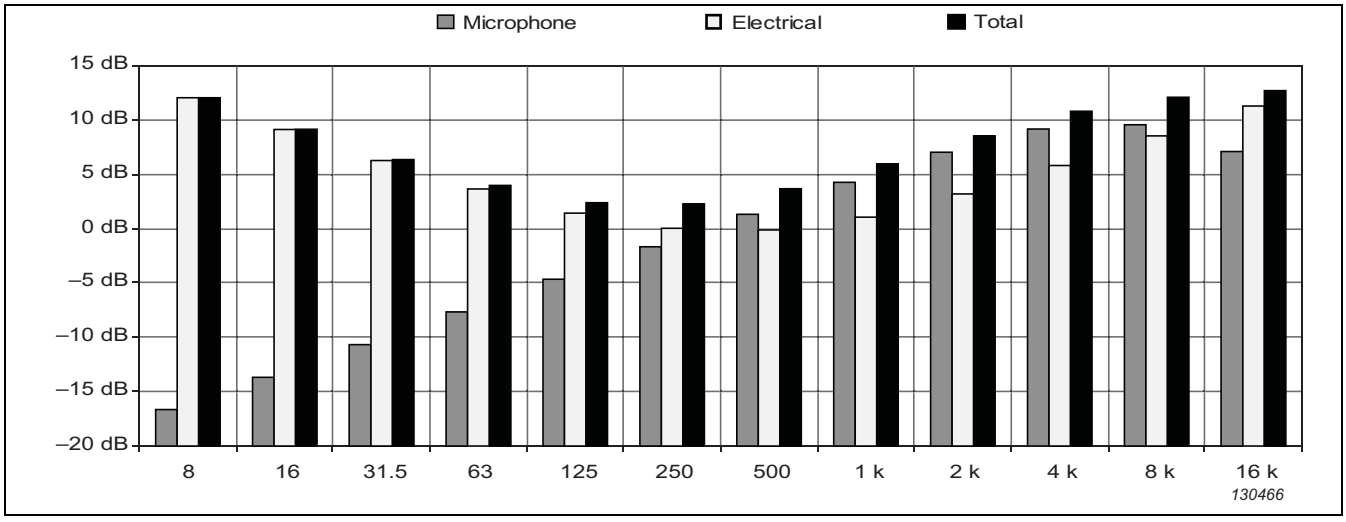


Fig.4.24b *Typical self-generated noise, 1/1-octave band, Single-range, with UC-0211*

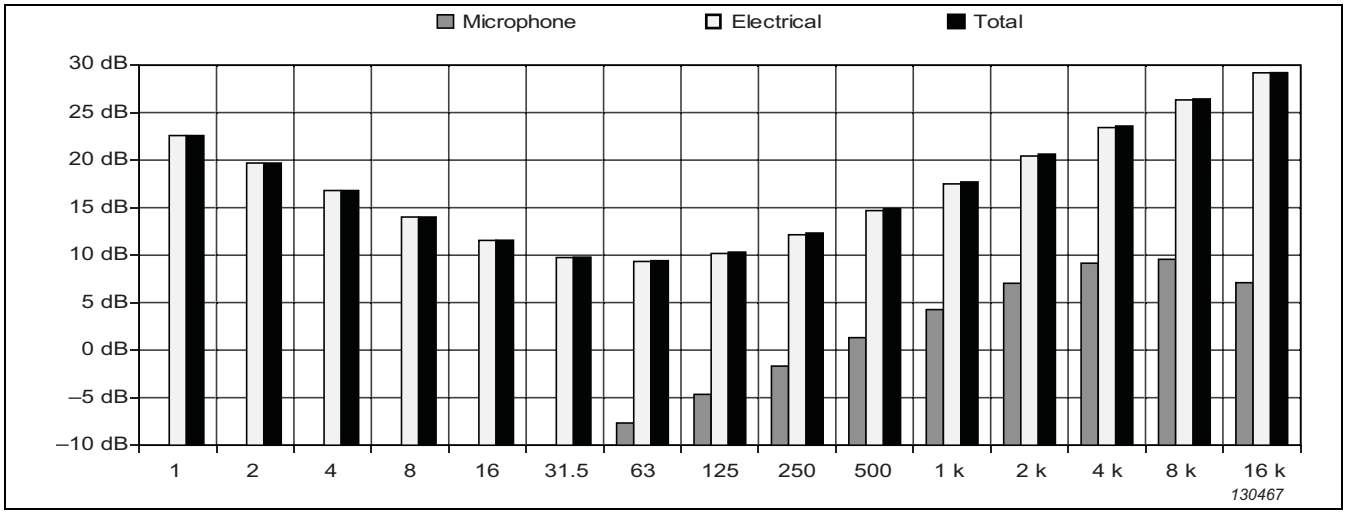


Fig.4.25a *Typical self-generated noise, 1/1-octave band, High Range, without UC-0211*

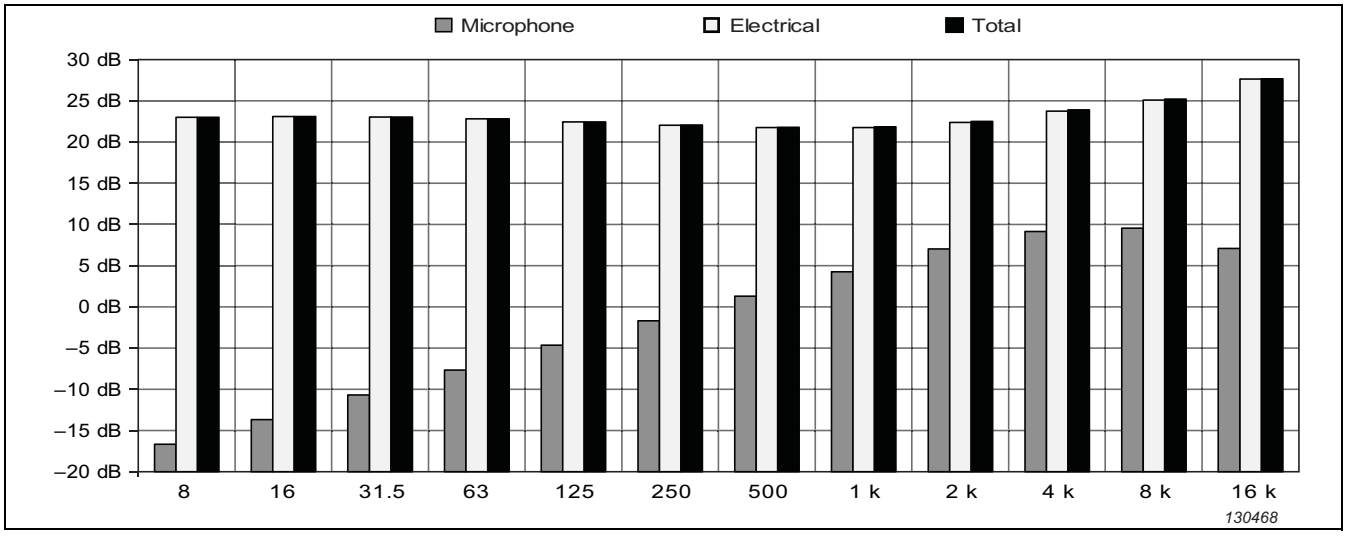


Fig.4.25b *Typical self-generated noise, 1/1-octave band, High Range, with UC-0211*

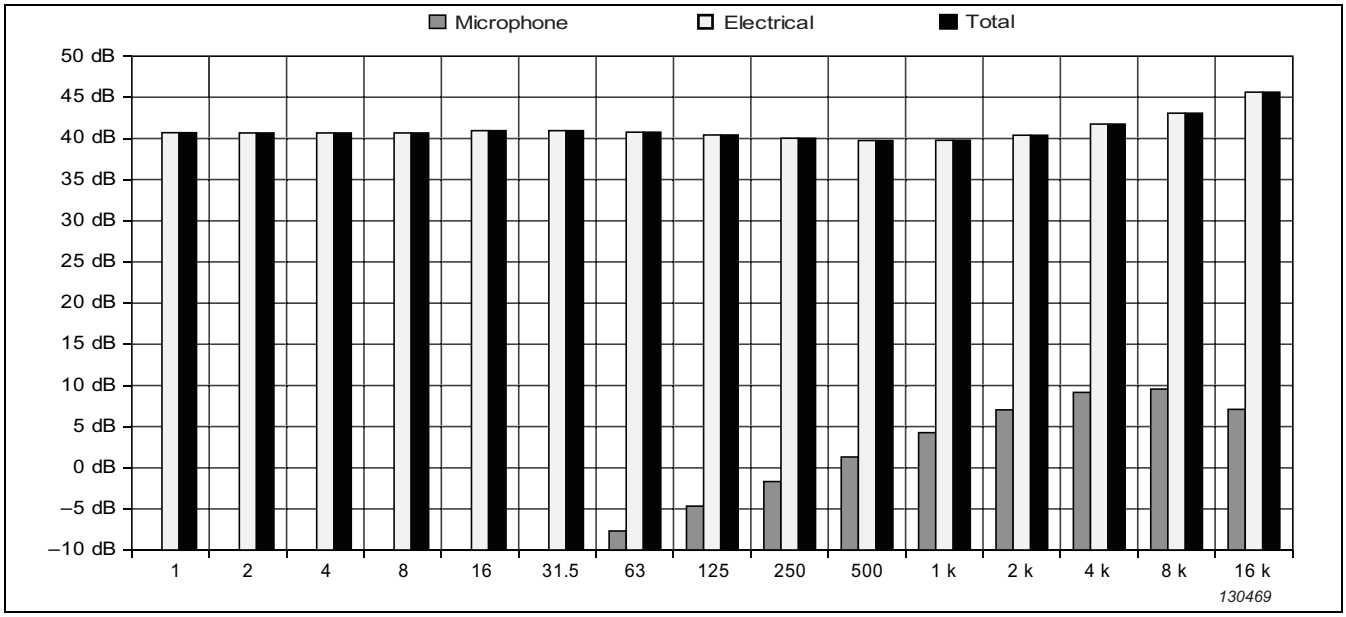


Fig.4.26a *Typical self-generated noise, 1/1-octave band, Low Range, without UC-0211*

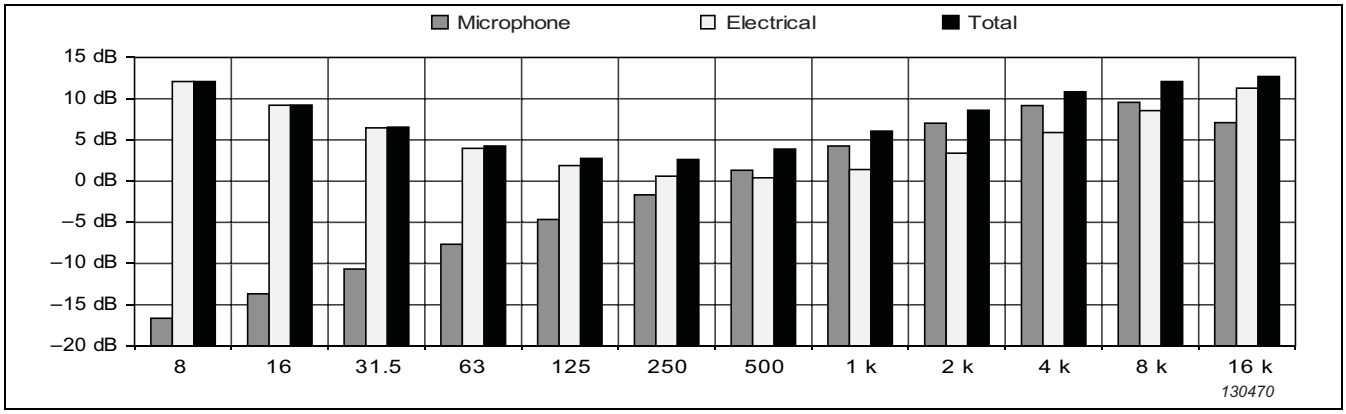


Fig. 4.26b *Typical self-generated noise, 1/1-octave band, Low Range, with UC-0211*

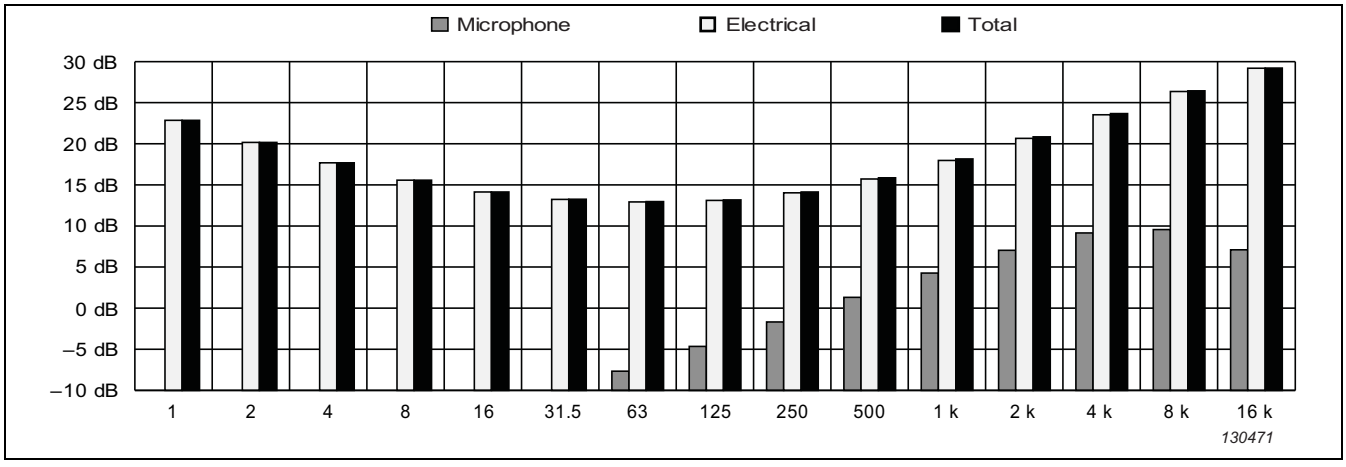


Fig. 4.27a *Typical self-generated noise, 1/3-octave band, Single-range, without UC-0211*

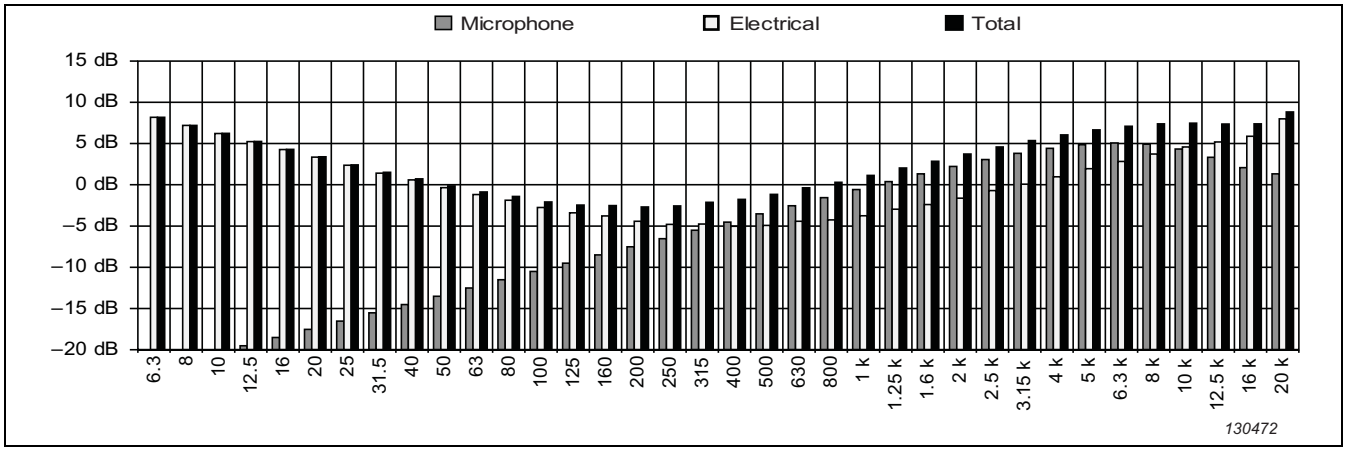


Fig. 4.27b *Typical self-generated noise, 1/3-octave band, Single-range, with UC-0211*

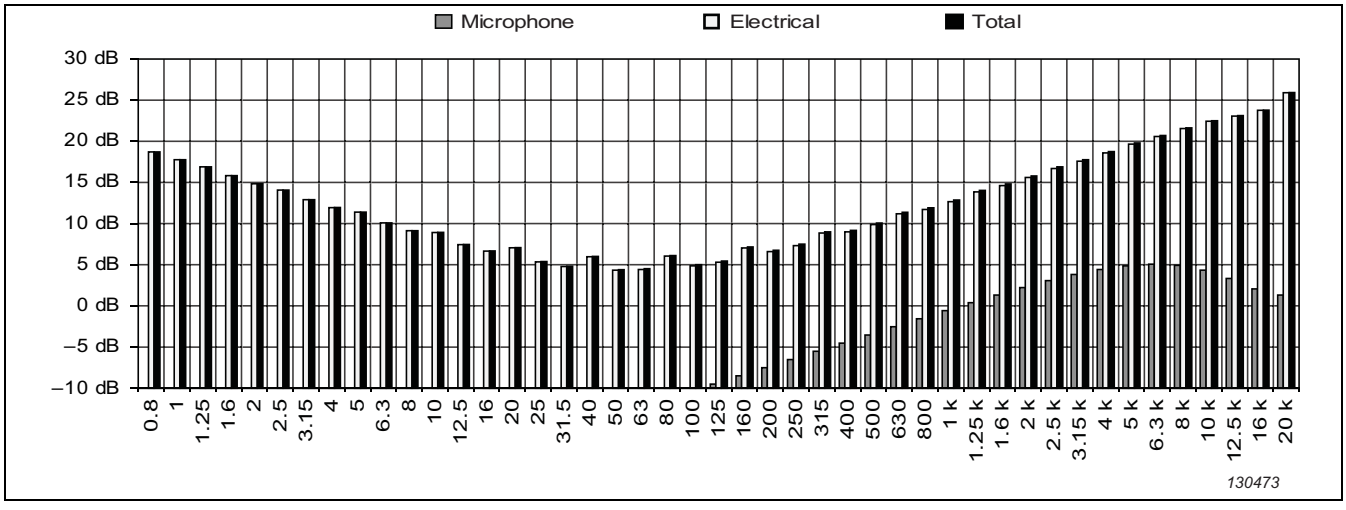


Fig.4.28a *Typical self-generated noise, 1/3-octave band, High Range, without UC-0211*

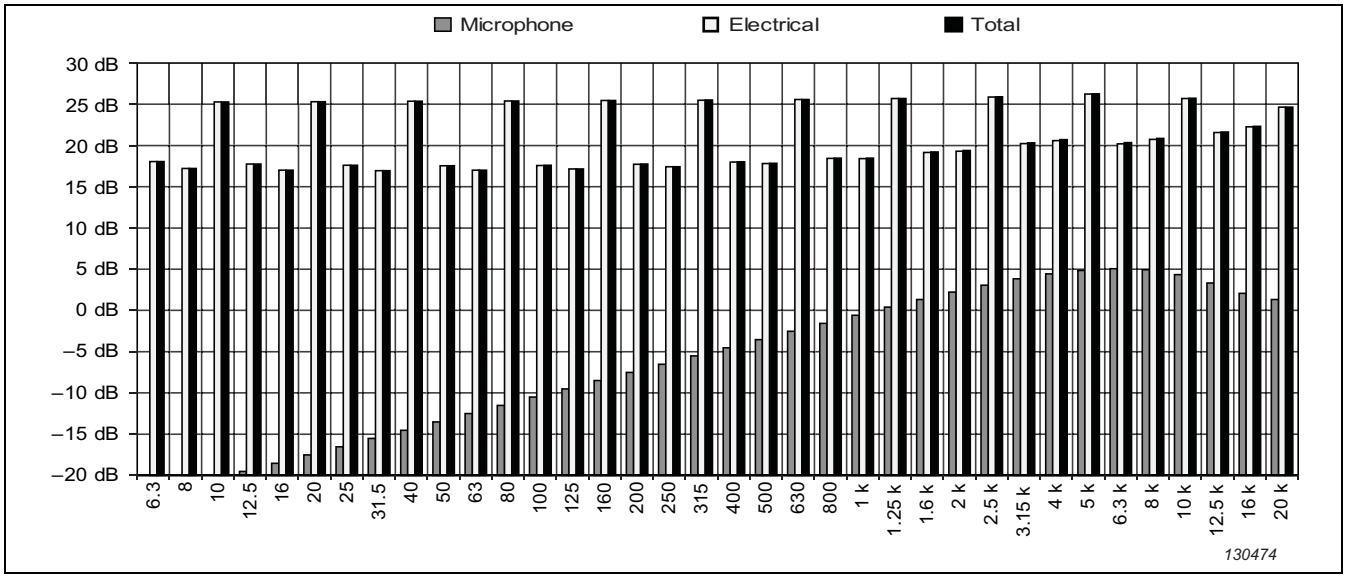


Fig.4.28b *Typical self-generated noise, 1/3-octave band, High Range, with UC-0211*

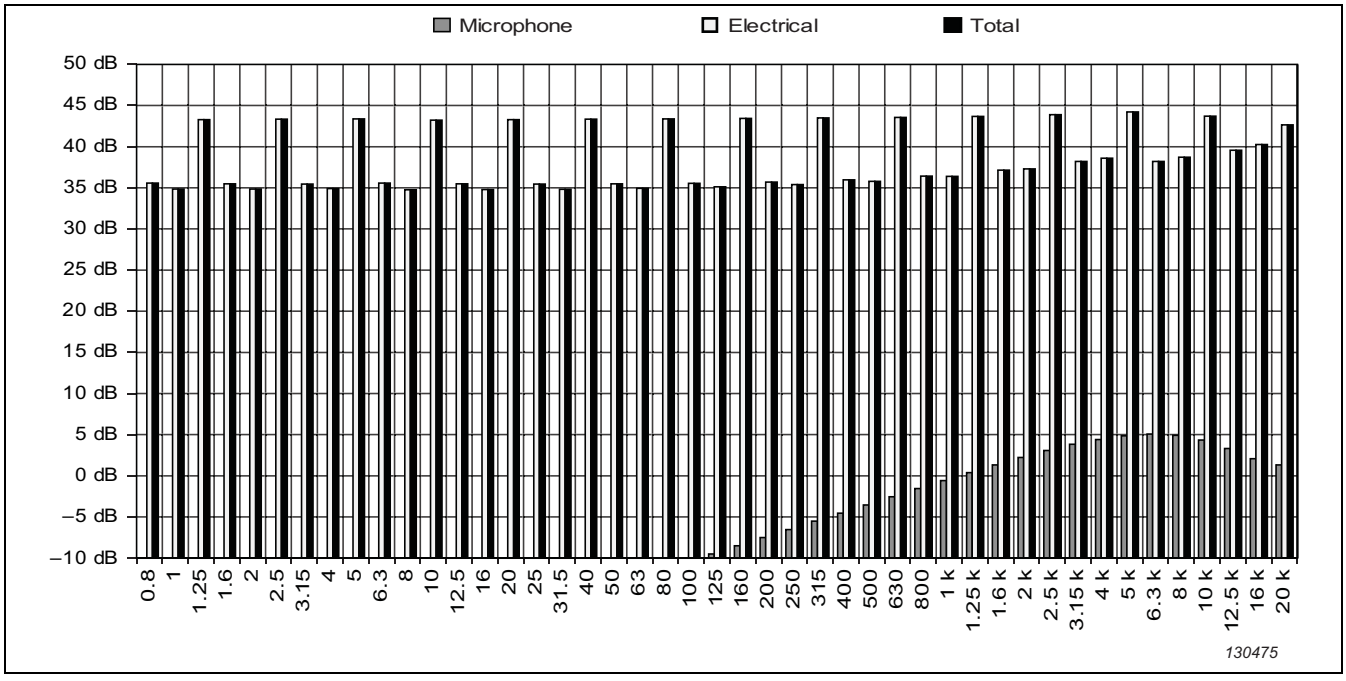


Fig. 4.29a *Typical self-generated noise, 1/3-octave band, Low Range, without UC-0211*

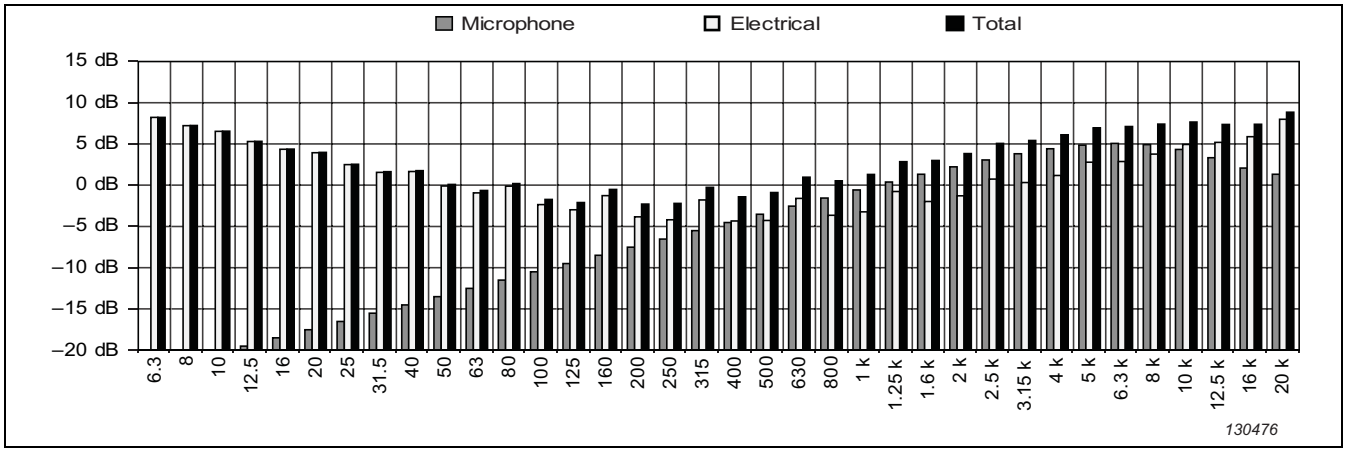
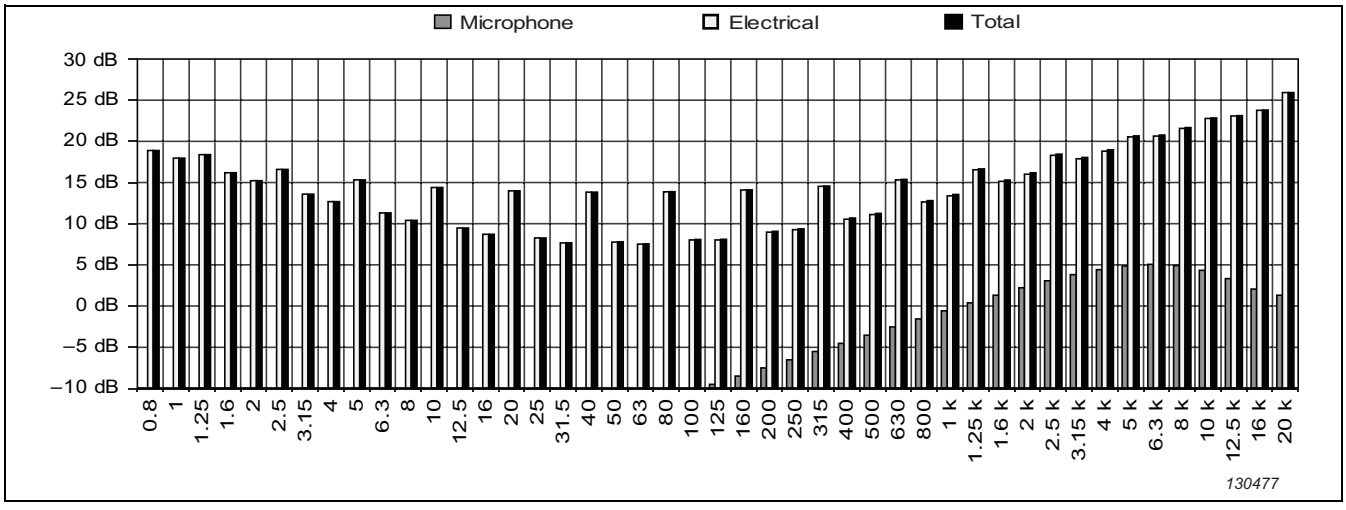


Fig. 4.29b *Typical self-generated noise, 1/3-octave band, Low Range, with UC-0211*



4.9 Measuring Ranges

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

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

4.9.1 Maximum Sound Level

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

4.9.2 Total Range

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

Table 4.3a
Total range without UC-0211

Frequency Weighting				
A-weighting (dB)	**B-weighting (dB)**	**C-weighting (dB)**	**Z-weighting Normal (dB)**	**Z-weighting Extended (dB)**
139.7 – 24.8	139.7 – 24.1	139.7 – 25.6	139.7 – 30.8	139.7 – 39.3

Table 4.3b
Total range with UC-0211

Frequency Weighting			
A-weighting (dB)	**B-weighting (dB)**	**C-weighting (dB)**	**Z-weighting Very Lowl (dB)**
129.9 – 42.0	129.9 – 40.7	129.9 – 40.8	129.9 – 48.0

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

4.9.3 Primary Indicator Range

Primary Indicator Range according to the International Standard IEC 60651:

Table 4.4a
Primary Indicator Range without UC-0211

Range	**Upper Limit (dB)**	**Lower Limit**				
		A-weighting (dB)	**B-weighting (dB)**	**C-weighting (dB)**	**Z-weighting Normal (dB)**	**Z-weighting Extended (dB)**
Single	122.3	23.5	22.8	24.3	29.5	38.0
High	122.3	41.7	40.3	40.3	44.6	45.2
Low	92.3	23.5	22.8	24.3	29.5	38.0

Table 4.4b
Primary Indicator Range with UC-0211

Range	**Upper Limit (dB)**	**Lower Limit**			
		A-weighting (dB)	**B-weighting (dB)**	**C-weighting (dB)**	**Z-weighting Very Low (dB)**
Single	112.5	40.7	39.4	39.5	46.7
High	112.5	59.7	58.3	58.3	62.5
Low	110.5	40.7	39.4	39.5	46.7

4.9.4 Indicator Range

Indicator Range according to the International Standard IEC 60804:

Table 4.5a
Indicator Range without UC-0211

Range	Upper Limit (dB)	Lower Limit				
		A-weighting (dB)	B-weighting (dB)	C-weighting (dB)	Z-weighting Normal (dB)	Z-weighting Extended Low Frequency (dB)
Single	139.3	23.5	22.8	24.3	29.5	38.0
High	139.3	41.7	40.3	40.3	44.6	45.2
Low	109.3	23.5	22.8	24.3	29.5	38.0

Table 4.5b
Indicator Range with UC-0211

Range	Upper Limit (dB)	Lower Limit			
		A-weighting (dB)	B-weighting (dB)	C-weighting (dB)	Z-weighting Normal (dB)
Single	129.5	40.7	39.4	39.5	46.7
High	129.5	59.7	58.3	58.3	62.5
Low	127.5	40.7	39.4	39.5	46.7

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

4.9.5 Linearity Range

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

Table 4.6a
Linearity Range without UC-0211

Range	Upper Limit (dB)	Lower Limit				
		A-weighting (dB)	B-weighting (dB)	C-weighting (dB)	Z-weighting Normal (dB)	Z-weighting Extended (dB)
Single	140.8	21.4	20.7	22.2	27.4	35.9
High	140.8	39.6	38.2	38.2	42.5	43.1
Low	110.8	21.4	20.7	22.2	27.4	35.9

Table 4.6b
Linearity Range with UC-0211

Range	Upper Limit (dB)	Lower Limit			
		A-weighting (dB)	B-weighting (dB)	C-weighting (dB)	Z-weighting Very Low (dB)
Single	131.0	38.6	37.3	37.4	44.6
High	131.0	57.6	56.2	56.2	60.4
Low	129.0	38.6	37.3	37.4	44.6

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

4.9.6 Pulse Range

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

Table 4.7a
Pulse Range

Range	Upper Limit (dB)	Lower Limit				
		A-weighting (dB)	B-weighting (dB)	C-weighting (dB)	Z-weighting Normal (dB)	Z-weighting Extended (dB)
Single	143.8	21.4	20.7	22.2	27.4	35.9
High	143.8	39.6	38.2	38.2	42.5	43.1
Low	113.8	21.4	20.7	22.2	27.4	35.9

Table 4.7b
Pulse Range

Range	Upper Limit (dB)	Lower Limit			
		A-weighting (dB)	B-weighting (dB)	C-weighting (dB)	Z-weighting Very Low (dB)
Single	134.0	38.6	37.3	37.4	44.6
High	134.0	57.6	56.2	56.2	60.4
Low	132.0	38.6	37.3	37.4	44.6

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

4.9.7 Linear Operating Range

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

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

Table 4.8a
Linear Operating Range without UC-0211

Frequency-Weighting	Upper Limit					Lower Limit
	31.5 Hz (dB)	**1 kHz (dB)**	**4 kHz (dB)**	**8 kHz (dB)**	**12.5 kHz (dB)**	**All (dB)**
Single-range						
A-weighting	100.6	139.7	140.8	138.9	135.3	24.8
B-weighting	122.9	139.7	139.1	137.1	133.4	24.1
C-weighting	137.0	139.7	139.0	137.0	133.3	25.6
Z-weighting Normal	140.0	139.7	139.8	140.0	139.6	30.8
Z-weighting Extended	140.0	139.7	139.8	140.0	139.6	39.3
High Range						
A-weighting	100.6	139.7	140.8	138.9	135.3	43.0
B-weighting	122.9	139.7	139.1	137.1	133.4	41.6
C-weighting	137.0	139.7	139.0	137.0	133.3	41.6
Z-weighting Normal	140.0	139.7	139.8	140.0	139.6	45.9
Z-weighting Extended	140.0	139.7	139.8	140.0	139.6	46.5
Low Range						
A-weighting	70.6	109.7	110.8	108.9	105.3	24.8
B-weighting	92.9	109.7	109.1	107.1	103.4	24.1
C-weighting	107.0	109.7	109.0	107.0	103.3	25.6
Z-weighting Normal	110.0	109.7	109.8	110.0	109.6	30.8
Z-weighting Extended	110.0	109.7	109.8	110.0	109.6	39.3

Table 4.8b
Linear Operating Range with UC-0211

Frequency-Weighting	Upper Limit					Lower Limit
	31.5 Hz (dB)	1 kHz (dB)	4 kHz (dB)	8 kHz (dB)	12.5 kHz (dB)	All (dB)
Single-range						
A-weighting	90.8	129.9	131.0	129.2	125.5	42.0
B-weighting	113.2	129.9	129.3	127.4	123.7	40.7
C-weighting	127.2	129.9	129.2	127.3	123.6	40.8
Z-weighting Very Low	130.3	129.9	130.0	130.3	129.8	48.0
High Range						
A-weighting	90.8	129.9	131.0	129.2	125.5	61.0
B-weighting	113.2	129.9	129.3	127.4	123.7	59.6
C-weighting	127.2	129.9	129.2	127.3	123.6	59.6
Z-weighting Very Low	130.3	129.9	130.0	130.3	129.8	63.8
Low Range						
A-weighting	88.8	127.9	129.0	127.2	123.5	42.0
B-weighting	111.2	127.9	127.3	125.4	121.7	40.7
C-weighting	125.2	127.9	127.2	125.3	121.6	40.8
Z-weighting Very Low	128.3	127.9	128.0	128.3	127.8	48.0

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

4.9.8 Peak C Range

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

Table 4.9a
Peak C Range without UC-0211

Range	Upper Limit					Lower Limit
	31.5 Hz (dB)	1 kHz (dB)	4 kHz (dB)	8 kHz (dB)	12.5 kHz (dB)	All (dB)
Single	140.0	142.7	142.0	140.0	136.3	42.4
High	140.0	142.7	142.0	140.0	136.3	58.4
Low	110.0	112.7	112.0	110.0	106.3	42.4

Table 4.9b
Peak C Range with UC-0211
Table 4.9b

Range	Upper Limit					Lower Limit
	31.5 Hz (dB) *Table4.9b*	1 kHz (dB)	4 kHz (dB)	8 kHz (dB)	12.5 kHz (dB)	All (dB)
Single	130.2	132.9	132.2	130.3	126.6	57.6
High	130.2	132.9	132.2	130.3	126.6	76.4
Low	128.2	130.9	130.2	128.3	124.6	57.6

4.11 Spectrum Analysis

4.11.1 1/1- octave Band Centre Frequencies

See Instruction Manual BE 1712. Additional filters when *Low Frequency* is set to *Very Low*:

Nominal: 1 Hz, 2 Hz, 4 Hz

Exact (5 digits): 0.97656 Hz, 1.9531 Hz, 3.9063 Hz

Real-time Frequency Range: 1 Hz to 16 kHz centre frequencies.

4.11.2 1/3-octave Band Centre Frequencies

See Instruction Manual BE 1712. Additional filters when *Low Frequency* is set to *Very Low*:

Nominal: 0.8 Hz, 1 Hz, 1.25 Hz, 1.6 Hz, 2 Hz, 2.5 Hz, 3.15 Hz, 4 Hz, 5 Hz

Exact (5 digits): 0.77510 Hz, 0.97656 Hz, 1.2304 Hz, 1.5502 Hz, 1.9531 Hz, 2.4608 Hz, 3.1004 Hz, 3.9063 Hz, 4.9216 Hz

Real-time Frequency Range: 0.8 Hz to 20 kHz centre frequencies.

4.11.3 Linear Operating Range

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

Table 4.11a
Linear Operating Range without UC-0211

Range	Upper Limit (dB)	Lower Limit 1/1-octave (dB)	Lower Limit 1/3-octave (dB)
Single	140.0	24.8	20.9
High	140.0	42.8	39.6
Low	110.0	24.8	20.9

Table 4.11b
Linear Operating Range with UC-0211

Range	Upper Limit (dB)	Lower Limit 1/1-octave (dB)	Lower Limit 1/3-octave (dB)
Single	130.3	41.8	38.5
High	130.3	60.8	57.6
Low	128.3	41.8	38.5

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

4.11.4 Measurement Range

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

Table 4.12 *Measurement Range*

	1/1-octave (dB)	**1/3-octave (dB)**
Without UC-0211	140.0 – 24.8	140.0 – 20.9
With UC-0211	130.3 – 41.8	130.3 – 38.5

4.11.5 Octave Band Time Constants

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

Table 4.13 *Octave band Fast Time Constants*

1/1-octave Centre Frequency (Hz)	**1/3-octave Centre Frequency (Hz)**	**Time Constant (ms)**	**Averaging Time (ms)**
≥63	≥100	125 (Fast)	250 (Fast)
31.5	80, 63, 50	250	500
16	40, 31.5, 25	500	1000
8	20, 16, 12.5	1000	2000
4	10, 8, 6.3	2000	4000
2	5, 4, 3.15	4000	8000
1	2.5, 2, 1.6	8000	16000
-	1.25, 1, 0.8	16000	32000

Table 4.14 *Octave band Slow Time Constants*

1/1-octave Centre Frequency (Hz)	**1/3-octave Centre Frequency (Hz)**	**Time Constant (ms)**	**Averaging Time (ms)**
≥8	≥12.5	1000 (Slow)	2000 (Slow)
4	10, 8, 6.3	2000	4000
2	5, 4, 3.15	4000	8000
1	2.5, 2, 1.6	8000	16000
-	1.25, 1, 0.8	16000	32000

For a white Gaussian signal and for 1/1-octave centre frequencies from 1 Hz to 63 Hz, these time constants give a maximum relative standard deviation of approximately 1.5 dB. For 1/3-octave centre frequencies from 0.8 Hz to 160 Hz, these time constants give a maximum relative standard deviation of approximately 2 dB.

4.12 Influence from the Operating Environment

4.12.4 Vibration

Vibration Sensitivity (20 – 1000 Hz) for 1 ms^{-2}: A-weighted max. 76 dB, Z-weighted max. 86 dB without UC-0211, A-weighted max 93 dB, Z-weighted max 103 dB with UC-0211.

Appendix E

G-weighting

E.1 Introduction

G-weighting is not specified in the Sound Level Meter standard IEC 61672–1 (2002–05), but it states in paragraph 5.4.12:

"If a sound level meter provides one or more optional frequency responses, the instruction manual shall state the design-goal frequency response and the tolerance limits that are maintained around the design goal(s). If an optional frequency response is specified in an International Standard, the design-goal frequency response shall be as specified in that International Standard...."

Concerning Level Linearity, the standard states in paragraph 5.5.7:

"The specifications in 5.5.5 and 5.5.6 apply over the total range for any frequency within the frequency range of the sound level meter and for any frequency weighting or frequency response provided."

G-weighting covers a substantially different frequency range from that of the Sound Level Meter standard IEC 61672–1; therefore, it is neither possible nor relevant to fulfil the above completely, but in the specification below we have tried to be as loyal to it as possible.

E.2 Frequency Weighting

Both broadband and spectrum measurements can be frequency weighted with G-weighting.

The G-weightings conform to the requirements in ISO 7196:1995 and ANSI S1.42–2001 (R2011).

Table 2.1 states the design goal frequency responses for the frequency weighting and the typical acoustical responses for the two microphone configurations:

- Type 4964 without UC-0211 and *Low Frequency* is set to *Extended*
- Type 4964 with UC-0211 and *Low Frequency* is set to *Very Low*

At these low frequencies there are no significant influences from windscreens and sound fields.

Table E.1
Frequency weighting design goal and typical acoustical responses

Nominal 1/3-octave Frequency (Hz)	Exact Frequency (6 digits) (Hz)	ISO 7196 Relative Response (dB)	ISO 7196 Tolerance Range (informative) (dB)	Type 4964 without UC-0211 Typical Acoustical Responses (dB)	Type 4964 with UC-0211 Typical Acoustical Responses (dB)
0.25	0.251189	–88.01	–∞ to +1	–95.12	–87.71
0.315	0.316228	–80.04	–∞ to +1	–84.83	–79.76
0.4	0.398107	–72.10	–∞ to +1	–75.11	–71.84
0.5	0.501187	–64.26	–∞ to +1	–65.98	–64.02
0.63	0.630957	–56.64	–∞ to +1	–57.49	–56.43
0.8	0.794328	–49.45	–∞ to +1	–49.76	–49.26
1.00	1	–43.01	–∞ to +1	–43.02	–42.85
1.25	1.25893	–37.45	± 1	–37.29	–37.31
1.6	1.58489	–32.64	± 1	–32.41	–32.52
2.0	1.99526	–28.26	± 1	–28.00	–28.15
2.5	2.51189	–24.11	± 1	–23.84	–24.02
3.15	3.16228	–20.04	± 1	–19.78	–19.96
4.0	3.98107	–16.02	± 1	–15.78	–15.95
5.0	5.01187	–12.01	± 1	–11.79	–11.95
6.3	6.30957	–8.00	± 1	–7.80	–8.00
8.0	7.94328	–4.00	± 1	–3.82	–4.00
10.0	10	0.00	± 1	0.16	0.00
12.5	12.5893	3.99	± 1	4.13	3.99
16.0	15.8489	7.74	± 1	7.86	7.74
20.0	19.9526	8.99	± 1	9.10	8.99
25.0	25.1189	3.73	–∞ to +1	3.82	3.73
31.5	31.6228	–4.02	–∞ to +1	–3.94	–4.02
40	39.8107	–12.00	–∞ to +1	–11.93	–12.00
50	50.1187	–20.00	–∞ to +1	–19.94	–20.00
63	63.0957	–28.00	–∞ to +1	–28.00	–28.00
80	79.4328	–36.00	–∞ to +1	–36.00	–36.00
100	100	–44.00	–∞ to +1	–44.00	–44.00
125	125.893	–52.00	–∞ to +1	–52.00	–52.00
160	158.489	–60.00	–∞ to +1	–60.00	–60.00
200	199.526	–68.00	–∞ to +1	–68.00	–68.00
250	251.189	–76.00	–∞ to +1	–76.00	–76.00
315	316.228	–84.00	–∞ to +1	–84.00	–84.00

E.3 G-weighted Self-generated Noise

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

Table E.2
G-weighted self-generated noise

	Type 4964 without UC-0211		Type 4964 with UC-0211	
	Maximum Noise (dB)	**Typical Noise (dB)**	**Maximum Noise (dB)**	**Typical Noise (dB)**
Single Range				
Microphone	–3.8	–4.8	–3.8	–4.8
Electrical	18.4	17.3	21.4	19.5
Total	18.4	17.3	21.4	19.5
High Range				
Microphone	–3.8	–4.8	–3.8	–4.8
Electrical	19.1	17.6	30.5	28.0
Total	19.1	17.6	30.5	28.0
Low Range				
Microphone	–3.8	–4.8	–3.8	–4.8
Electrical	18.4	17.3	21.4	19.5
Total	18.4	17.3	21.4	19.5

E.4 G-weighted Linear Operating Range

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

Linear Operating Range according to the International Standard IEC 61672-1, but at the G-weighting reference frequency, 10 Hz:

Table E.3
Linear Operating Range

	Type 4964 without UC-0211		Type 4964 with UC-0211	
	Upper Limit (dB)	**Lower Limit (dB)**	**Upper Limit (dB)**	**Lower Limit (dB)**
Single Range	149.0	29.6	139.3	32.6
High Range	149.0	30.3	139.3	41.7
Low Range	119.0	29.6	137.3	32.6

E.4.1 Exponential Averaging

Fast and Slow are not relevant at the low frequencies that G-weighting covers, therefore, the exponential time constant is 10 s when G-weighting is selected. This corresponds to an averaging time of 20 s.

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

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