18. Technical Data XL2

Sound Level Meter	
Product Configurations Class 1 Type 1	• XL2-TA, M2230 microphone and ASD Cable forms an integrating sound level meter with type approval » Class 1 in accordance with IEC 61672 » Type 1 in accordance with ANSI S1.4 • XL2 with M2230 microphone » Class 1 in accordance with IEC 61672 » Type 1 in accordance with ANSI S1.4 • XL2 with M2211, M2215 microphone » Class 1 frequency response in accordance with IEC 61672 » Type 1 frequency response in accordance with ANSI S1.4 These specifications apply for operation with the microphone detached using the ASD cable. This prevents possible acoustic reflections from the XL2 housing and ensures a high measurement accuracy in accordance with the standards IEC 61672 and ANSI S1.4.
Product Configurations Class 2 Type 2	• XL2 with M4260 microphone » Class 2 in accordance with IEC 61672 » Type 2 in accordance with ANSI S1.4
Conforms with Standards	• IEC 61672, IEC 60651, IEC 60804, IEC 61260, ISO 2969 • China: GB/T 3785:2010, GB/T 3241, GB 3096-2008, GB 50526, GB-T_4959-1995 • Germany: DIN 15905-5, DIN 45645-2, optional: DIN 45645-1 • Japan: JIS C1509-1:2005, JIS C 1513 class 1, JIS C 1514 class 0 • Switzerland: SLV • UK: BS6698, BS5969 • US: ANSI S1.4, ANSI S1.43, ANSI S1.11-2004 class 1 • International IEC standards are adopted as European standards and the letters IEC are replaced by EN. XL2 conforms to these EN standards.
Details	• Measurement bandwidth (-3dB): 4.4 Hz - 23.6 kHz • Level resolution: 0.1 dB • Internal noise: 1.3 µV A-Weighted
Weighting	• Frequency weighting: A, C, Z (simultaneous) • Time weighting: Fast, Slow, optional: Impulse (simultaneous)
Measurement Ranges with different microphones	• XL2+M2230: 17 dB(A) - 138 dB • XL2+M2215: 25 dB(A) - 153 dB • XL2+M2211: 21 dB(A) - 144 dB • XL2+M4260: 29 dB(A) - 144 dB
Linear Measurement Range acc. IEC61672 / ANSI S1.4	• XL2+M2230: 24 dB(A) - 138 dB 27 dB(C) - 138 dB • XL2+M2215: 33 dB(A) - 153 dB • XL2+M2211: 29 dB(A) - 144 dB • XL2+M4260: 35 dB(A) - 144 dB @ typical microphone sensitivity

Stabilization Time	< 10 seconds
Integration Time	• Minimum: 1 second • Maximum: 100 hours minus 1 second
Display Measure-ment Ranges	Three level ranges depending on the microphone sensitivity with manual setting. • M2230 @ sensitivity = 42 mV/Pa » LOW, lower level range: 0 - 100 dBSPL » MID, mid-level range: 20 - 120 dBSPL » HIGH, upper level range: 40 - 140 dBSPL • M2211 @ sensitivity = 20 mV/Pa » LOW, lower level range: 10 - 110 dBSPL » MID, mid-level range: 30 - 130 dBSPL » HIGH, upper level range: 50 - 150 dBSPL • M2215 @ sensitivity = 8 mV/Pa » LOW, lower level range: 20 - 120 dBSPL » MID, mid-level range: 40 - 140 dBSPL » HIGH, upper level range: 60 - 160 dBSPL • M4260 @ sensitivity = 26 mV/Pa » LOW, lower level range: 10 - 110 dBSPL » MID, mid-level range: 30 - 130 dBSPL » HIGH, upper level range: 50 - 150 dBSPL

Residual noise in [dB] @ S = 42 mV/Pa of XL2 without measure-ment microphone

• Frequency weighting A

Level range	L_{eq}	L_{peak}
LOW	4	17
MID	18	31
HIGH	43	55

• Frequency weighting C

Level range	L_{eq}	L_{peak}
LOW	3	16
MID	17	30
HIGH	41	55

• Frequency weighting Z

Level range	L_{eq}	L_{peak}
LOW	7	20
MID	21	34
HIGH	46	58

Measure-ments	• SPL actual, Leq, Lmin, Lmax, LCpeak • Gliding L_{Aeq} with selectable time window from five seconds to one hour • All measurement results simultaneously available • Correction value measurement wizard • Noise exposure level LEX with post-processing • Logging all data or subsets in selectable intervals • Recording of wav-files (ADPCM), a new wav-file starts every 12 hours (max. wav-file size 512 MB) • Recording of voice notes • Monitoring of sound levels that exceed limits • Digital I/O interface for external peripherals control
Real-Time Analyzer RTA	• 1/1 octave band display: 8 Hz - 16 kHz sub ranges 8 Hz - 4 kHz or 31.5 Hz - 16 kHz displayed with A/Z broadband levels at one glance • 1/3 octave band display: 6.3 Hz - 20 kHz sub ranges 6.3 Hz - 8 kHz or 20 Hz - 20 kHz displayed with A/Z broadband levels at one glance • Level resolution: 0.1 dB • Measurement Units: Volt, dBu, dBV and dBSPL • Band pass filters (base 2) conform with IEC 61260:2014 class 1 & ANSI S1.11-2004 type 1 for the frequency bands 16 Hz and above • Wide band levels simultaneously • Frequency weighting: X-Curve in accordance with ISO 2969 • Capturing of a single reading into the internal memory for comparative measurements

Remote Measure-ment (optional)	Querying measurement data online via the USB interface of the following functions: • Sound level meter and spectrum analyzer SLMeter/RTA • FFT analyzer • Audio analyzer RMS/THD+N • High resolution spectral analyzer 1/12 Oct + Tol
Data Explorer (optional)	• Enables the import of measurement data into the XL2 Data Explorer software • Powerful data processor for easy and fast analysis of sound level measurement data on PC

Functions of Extended Acoustic Pack (optional)	• SLMeter/RTA function » Recording of linear wav-files (24 bit, 48 kHz) » Percentiles for wide band, 1/1 and 1/3 octave spectrum - Flexible setting from 0.1% to 99.9% - Sampling: every 1.3 ms - Wide band: in 0.1 dB wide classes, based on sampling Lxy (x= A, C or Z, y= F, S or EQ_1") - 1/1 and 1/3 octave spectrum: in 1.0 dB wide classes, based on Lxy (x= A, C or Z, y= F or S) - Dynamic range: 140 dB » Sound Exposure Level LAE » 100ms logging » Event-triggered audio and data recording » Time weighting: Impulse (LxI, LxIeq with x= A, C, Z) » True peak level in 1/1 and 1/3 octave resolution » Clock-Impulse Maximum Level (TaktMax) and values as specified in DIN 45645-1 • FFT function » High-resolution Zoom-FFT with selectable frequency ranges and resolution up to 0.4 Hz in the range of 5 Hz to 20 kHz • RT60 function » Reverberation time RT60 in 1/3 octave resolution

Functions of Spectral Limits Option (optional)	• SLMeter/RTA function » True peak level in 1/1 and 1/3 octave resolution • FFT function » High-resolution Zoom-FFT with selectable frequency ranges and resolution up to 0.4 Hz in the range of 5 Hz to 20 kHz • 1/12 octave function » High resolution RTA function "1/12 Oct + Tol" » Selectable 1/1, 1/3, 1/6 and 1/12 octave spectral resolution » Frequency band listening at rear speaker • FFT and 1/12 octave function » Capturing of multiple readings into the internal memory » Comparing measurement results against captures with relative or absolute curve display » Comprehensive tolerance handling with tolerance masks based on captures for passed/failed measurements » Export and import of tolerance and capture files • Noise Curves » Noise Rating NR in accordance with ISO 1996 » Noise Criteria NC in accordance with ANSI S12.2-2008 and -1995 » Room Noise Criteria RNC in accordance with ANSI S12.2-2008 » Room Criteria RC in accordance with ANSI S12.2-1995 » Preferred Noise Criteria in accordance with ASA 1971

Acoustic Analyzer	
FFT Analysis	• Real-time FFT with actual level, L_{eq}, L_{min}, L_{max} • Level resolution: 0.1 dB • Frequency Band Ranges: 7 Hz - 215 Hz, 58 Hz - 1.72 kHz, 484 Hz - 20.5 kHz with 143 frequency bins shown on display • Measurement Units: Volt, dBu, dBV and dBSPL • Optional: High-resolution Zoom-FFT with selectable frequency ranges and resolution up to 0.4 Hz in the range of 5 Hz to 20 kHz • Optional: Capture and tolerance function with multiple readings for comparative measurements and passed/failed analysis
Reverberation Time RT60	• 1/1 octave bands results from 63 Hz - 8 kHz, based on T20 and T30 • Optional: 1/3 octave bands results from 50 Hz - 10 kHz, based on T20 and T30 • Range: 10 ms - 14 seconds • Measurement in accordance with ISO 3382 using Schroeder-method • Test signal: Impulse source or interrupted pink noise generated by the MR-PRO, MR2 or the included NTi Audio Test CD
Delay Time	• Propagation delay between electrical reference signal and acoustic signal using the internal microphone • Range: 0 ms - 1 second (0 m - 344 m) • Resolution: 0.1 ms • Test signal: NTi Audio delay test signal generated by the MR-PRO, MR2 or the included NTi Audio Test CD
Polarity	• Checks polarity of speakers and line signals • Positive/Negative detection of wideband and individual 1/1 octave bands through internal microphone or XLR/RCA connector • Test signal: NTi Audio polarity test signal generated by the MR-PRO, MR2 or the included NTi Audio Test CD
Noise Curves	• Noise Rating NR in accordance with ISO 1996 • Noise Criteria NC in accordance with ANSI S12.2-2008 and -1995 • Room Noise Criteria RNC in accordance with ANSI S12.2-2008 • Room Criteria RC in accordance with ANSI S12.2-1995 • Preferred Noise Criteria in accordance with ASA 1971 • Application range of measurement microphones: » M2230: down to NC15 » M2211: down to NC15 » M4260: down to NC27
1/12 Octave Analysis (optional)	• Actual level, L_{eq}, L_{min}, L_{max} • Selectable 1/1, 1/3, 1/6 and 1/12 octave spectral resolution • Measurement Units: Volt, dBu, dBV and dBSPL • Capturing of multiple readings into the internal memory • Comparing measurement results against captures with relative or absolute curve display • Comprehensive tolerance handling • Creating tolerance masks based on captures for passed/failed measurements

Cinema Meter (optional)	• Measurements in 1/3 octave resolution according SMPTE ST 202:2010 and SMPTE RP 200:2012 • An interactive assistant guides the user through dedicated measurement procedures.
STIPA Speech Intelligibility (optional)	• Single value STI and CIS test result in accordance with IEC 60268-16, ISO 7240-16, ISO 7240-19, DIN VDE 0828-1, DIN VDE 0833-4 • Ambient noise correction • Automated averaging of measurements • Modulation indices and individual band level results with error indicator • Test signal: NTi Audio STIPA signal generated by the MR-PRO, NTi Audio TalkBox or the STIPA Test CD

Audio Analyzer	
Level RMS	• True RMS detection in V, dBu, dBV and dBSPL • Range XLR/RCA input: 2 µV - 25 V (-112 dBu to +30 dBu) • Accuracy: ± 0.5 % @ 1 kHz, • Flatness: ± 0.1 dB @ 12 Hz to 21.3 kHz • Bandwidth (-3 dB): 5 Hz to 23.6 kHz • Resolution: 3 digits (dB scale),5 digits (linear scale) or 6 digits (x1 scale)
Real-Time Analyzer RTA	Following measurement functions offer audio spectrum in Volt, dBu and dBV • Sound Level Meter • FFT • 1/12 Octave (optional)

Frequency	• Range: 9 Hz to 21.3 kHz • Resolution: 6 digits • Accuracy: < ± 0.003%
THD+N (Total Harmonic Distortion + Noise)	• Range: -100 dB to 0 dB (0.001% to 100%) • Minimum level: > -90 dBu • Fundamental frequency range: 10 Hz to 21.3 kHz • Measurement bandwidth: 2 Hz to 23.6 kHz • Resolution: 3 digits (dB scale) or 4 digits (linear scale) • Residual THD+N @ XLR/RCA input: < 2 µV
Scope	Auto ranging, auto scaling
Filter	• Frequency weighting: A, C, Z • Highpass 100Hz, 400 Hz, 19 kHz, • Bandpass 22.4 Hz - 22.4 kHz in accordance with IEC468-4
Remote Measurement (optional)	Querying measurement data online via the USB interface of the following functions: • Sound level meter and spectrum analyzer SLMeter/RTA • FFT analyzer • Audio analyzer RMS/THD+N • High resolution spectral analyzer 1/12 Oct + Tol

Input / Output Interfaces	
Audio Inputs	• XLR balanced with input impedance = 200 kOhm, phantom power: +48 V switchable, automated sensor detection for NTi Audio's ASD measurement microphones and pre-amplifier MA220 • RCA unbalanced with input impedance >30 kOhm • Built-in condenser microphone for polarity testing, delay measurements and voice note recording
Audio Outputs	• Built-in speaker • Headphone connector 3.5 mm Minijack Stereo
USB Interface	USB mini connector for data transfer to PC, XL2 Projector and/or charging of Li-Po battery
Digital I/O	Connection interface to accessories • XL2 Input Keypad • Digital I/O Adapter Box • Digital I/O Adapter PCB
TOSLink	24 bit linear PCM audio signal output (prepared for later firmware extension)

Memory	SD Card included (8 GByte), removable, storing measurement data in ASCII format, screen shots, voice notes and wav-files Data logging every second offers following noise monitoring periods: • Logging default noise levels: > 2 years • Additional logging of 1/3 octave data: > 6 month • Additional » compressed audio recording: > 1 week » linear audio recording: > 15 hours Optional 32 GB SD Cards are available for longer monitoring requirements.
Power Supply	• Rechargeable Li-Po battery included » Type 3.7 V / 2260 mAh » Typical battery lifetime > 4 hours » Range: 3.3 - 4.5 VDC • Dry cell batteries type AA, 4 x 1.5 V » Typical battery lifetime > 4 hours » Range: 3.7 - 6.0 VDC • Linear external power supply 9 VDC » Range: 7.5 - 20.0 VDC @ minimum 6 Watt » Charges Li-Po battery during operation • USB-Power Supply

General	
Clock	Real-time clock with lithium backup battery
Calibration	• Recommended calibration interval: one year • Microphone calibration with external calibrator supported • Optional calibration certificate for new instruments available
Mechanics	• Tripod or microphone stand mount 1/4” • Wire stand mounted on rear side • Display: 160 x 160 pixels grey scale with LED back light • Dimensions (L x W x H) » 180 mm x 90 mm x 45 mm » 7.1” x 3.5” x 1.8” • Weight: 480 g (1 lb) including built-in Li-Po battery
Temperature	-10 °C to +50 °C (14° to 122°F)
Humidity	5% to 90% RH, non-condensing
Susceptibility to radio frequencies	Classification Group X
Electromagnetic Compatibility	CE compliant: EN 61326-1 Class B, EN 55011 class B EN 61000-4-2 to -6 & -11
Protection Rating	IP51
ATEX	• For applications in explosive atmospheres within zone 2 in accordance with IEC 60079 • Conforms to 94/9/EC

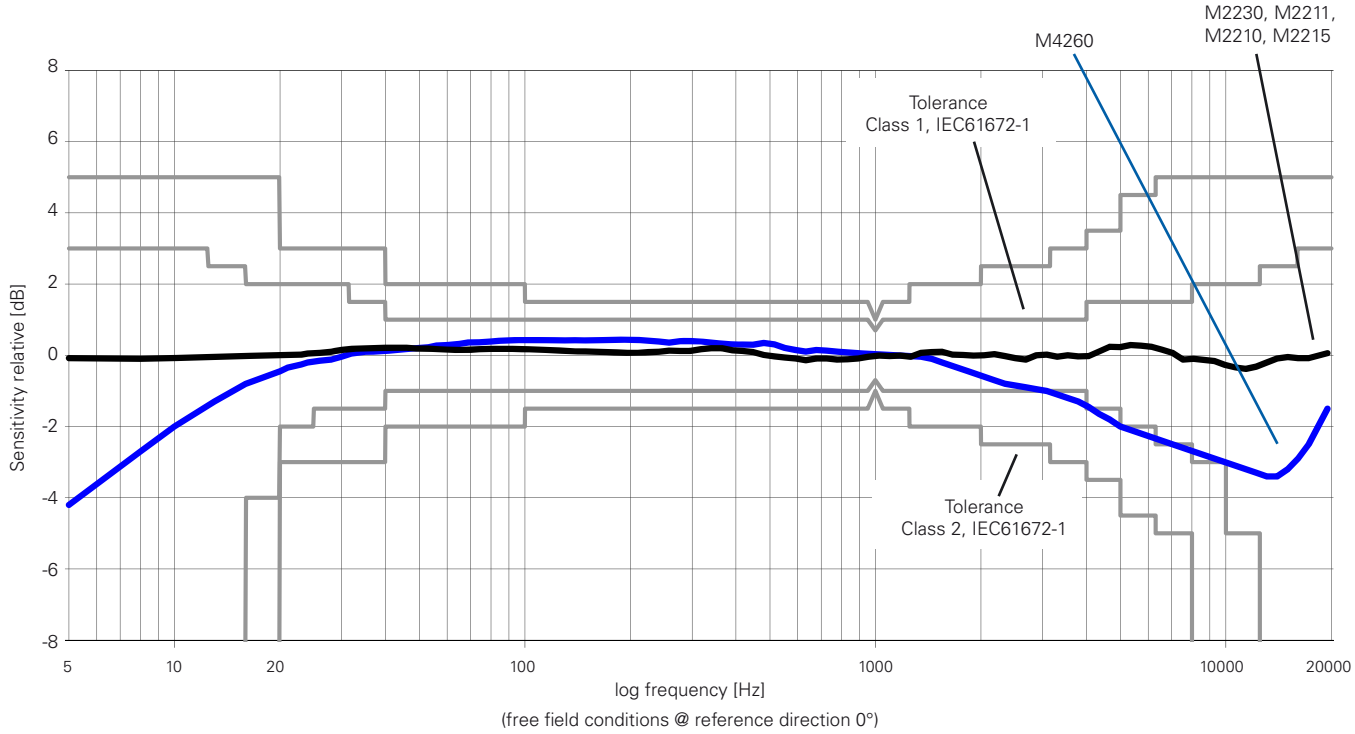
All specifications are according the standard IEC61672. Other applicable standards are listed the corresponding specification position.

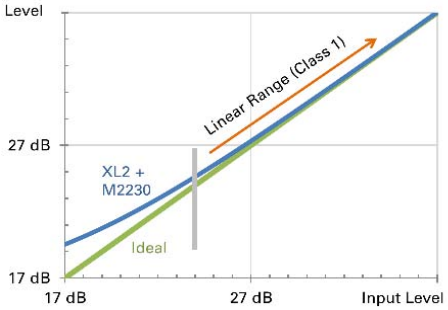
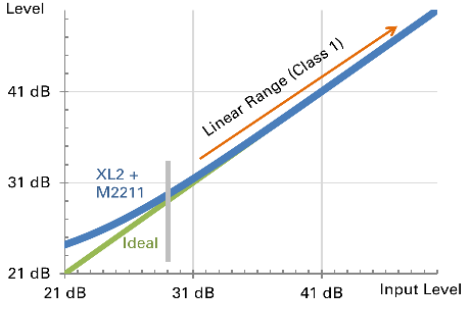
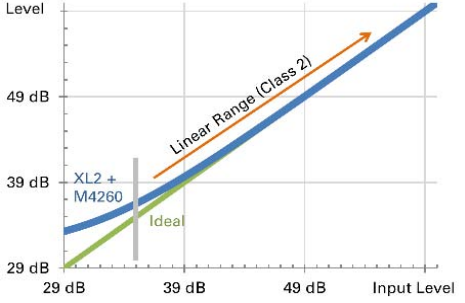
19. Technical Data Microphones

	M2230 Class 1 Certified	M2230-WP Class 1 Outdoor Microphone (M2230+WP30)	M2211 Frequency Response Class 1	M2215 High SPL Frequency Response Class 1	M4260 Class 2
Microphone Type	Omnidirectional, pre-polarized condenser, free field microphone				
Classification according IEC 61672 and ANSI S1.4	Class 1 / Type 1 Certified	Class 1 / Type 1	Frequency Response Class 1 / Type 1		Class 2 / Type 2
Capsule / Transducer	1/2" detachable with 60UNS2 thread, type WS2F according IEC 61094-4				1/4" permanently installed
PreAmplifier Type	MA220				-
Flatness tolerance bands typical	±1 dB @ 5 Hz - 20 Hz ±1 dB @ >20 Hz - 4 kHz ±1.5 dB @ >4 kHz - 10 kHz ±2 dB @ >10 kHz - 16 kHz ±3 dB @ >16 kHz - 20 kHz				+1/-4.5 dB @ 5 Hz - 20 Hz ±1.5 dB @ >20 Hz - 4 kHz ±3 dB @ >4 kHz - 10 kHz ±4.5 dB @ >10 kHz - 16 kHz ±5 dB @ >16 kHz - 20 kHz
Frequency Range	5 Hz - 20 kHz				
Residual Noise Floor typical	16 dB(A)		21 dB(A)	25 dB(A)	29 dB(A)
Maximum SPL @ THD 3%, 1 kHz	139 dBSPL		144 dBSPL	153 dBSPL	144 dBSPL
Sensitivity typical @ 1 kHz	-27.5 dBV/Pa ±2 dB (42 mV/Pa)		-34 dBV/Pa ±3 dB (20 mV/Pa)	-42 dBV/Pa ±3 dB (8 mV/Pa)	-31.7 dBV/Pa ±3 dB (26 mV/Pa)
Temperature Coefficient	< -0.01 dB / °C		< ±0.015 dB / °C		< ±0.02 dB / °C

	M2230 Class 1 Certified	M2230-WP Class 1 Outdoor Microphone (M2230+WP30)	M2211 Frequency Response Class 1	M2215 High SPL Frequency Response Class 1	M4260 Class 2
Temperature Range	-10°C to +50°C (14°F to 122°F)				0°C to +40°C (32°F to 104°F)
Pressure Coefficient	-0.005 dB / kPa		-0.02 dB / kPa		-0.04 dB / kPa
Influence of Humidity (non-condensing)	< ±0.05 dB				< ±0.4 dB
Humidity	5% to 90% RH, non-condensing				
Long Term Stability	> 250 years / dB				-
Electronic Data Sheet	NTi Audio ASD in accordance with IEEE P1451.4 V1.0, Class 2, Template 27				
Output Impedance	100 Ohm balanced				
Power Supply	48 VDC phantom power, 3 mA typical				
Connector	Balanced 3-pole XLR				
Diameter Dimensions	20.5 mm (0.8")	36 mm (1.4")	20.5 mm (0.8")		
Length Dimensions	154 mm (6.1")	378 mm (14.9")	150 mm (5.9")		
Weight	100 g, 3.53 oz	430 g, 15.17 oz	100 g, 3.53 oz		83 g, 2.93 oz
Environmental protection	IP51	IP54 in vertical position	IP51		
NTi Audio #	600 040 050	600 040 055	600 040 022	600 040 045	600 040 025

Typical Frequency Response of Measurement Microphones



Linear Measurement Range acc. IEC61672 / ANSI S1.4 (typ. microphone sensitivity)	**XL2 + M2230:** 24 dB(A) - 138 dB	
		
	XL2 + M2211: 29 dB(A) - 144 dB	**XL2 + M4260:** 35 dB(A) - 144 dB
		

Free Field - Pressure Correction Factors

If a measurement microphone is held in a free-field environment, then the measurement microphone acts at high frequencies like a reflector. The sound pressure increases in front of the microphone capsule membrane. M2230, M2211 and M2215 are free-field equalized measurement microphones, they compensate for the increased pressure internally.

The calibrator offers no longer free-field conditions. Therefore, the free-field equalization of the microphone must be compensated. This needs to be considered prior the calibration. The correction value needs to be added to the pressure response of the microphone.

Example:

- During the calibration, the XL2 measures the sound level in the calibrator. If the B&K4226 calibrator is used and it is set to 16 kHz, then the XL2+M2230 reads just 86.7 dBA.
- The free-field sound level is calculated by summing the XL2 measurement value and the correction value (= 86.7 dB + 7.3 dB = 94.0 dB).

The following corrections apply with the B&K4226 calibrator:

Nominal Frequency [Hz]	M2230 Measurement Microphone [dB]	M2211 Measurement Microphone [dB]	M2215 Measurement Microphone [dB]	Measurement Uncertainty U [dB]
31.5	0.0	0.0	0.0	0.3
63	0.0	0.0	0.0	0.3
125	0.0	0.0	0.0	0.3
250	0.0	0.0	0.0	0.3
500	0.0	0.1	0.0	0.3
1000	0.0	0.1	0.0	0.3
2000	0.3	0.6	0.2	0.3
4000	0.7	1.7	1.2	0.3
8000	2.6	4.2	3.9	0.4
12500	6.0	7.3	6.7	0.7
16000	7.3	9.2	9.0	0.8

Correction values for other calibrators for M2230:

Type	Correction Value	Calibration Frequency	Calibration Level
NTi Audio CAL200	0.1	1 kHz	114 dB
B&K 4231	0.2	1 kHz	114 dB
Norsonic Nor-1251	0.2	1 kHz	114 dB

Diffuse Field Correction Factors

A diffuse sound field is characterized that the sound arrives at the receiver from all directions with more or less equal probability. The M2230 is a free-field equalized measurement microphone. The default frequency response refers to a 0° sound incidence. The diffuse-field frequency response is calculated by averaging the M2230-directional characteristics; this results in a reduction at the high frequencies. The individual third-octave band correction values for diffuse-field conditions are documented in the following table. The directional response of the M2230 is described in the appendix.

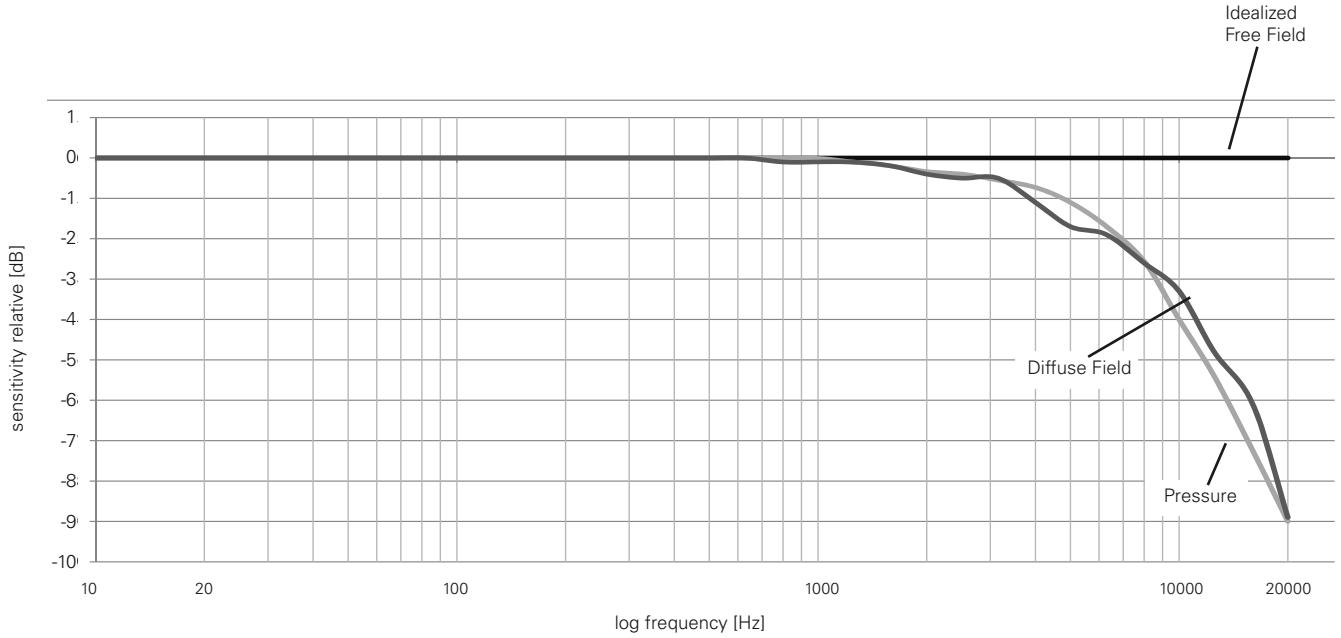
Example:

- The sound pressure level in a diffuse sound field shall be determined. The display of the XL2 with the M2230 reads 80.0 dBA for the 20 kHz third-octave band.
- The diffuse sound level is now calculated from the sum of the XL2 measurement value and the correction value (= 80.0 dB + 8.9 dB = 88.9 dB).

This correction is not necessary using a diffuse field equalized measurement microphone.

Nominal Frequency [Hz]	M2230 Microphone [dB]
50	0.0
63	0.0
80	0.0
100	0.0
125	0.0
160	0.0
200	0.0
250	0.0
315	0.0
400	0.0
500	0.0
630	0.0
800	0.1
1000	0.1
1250	0.1
1600	0.2
2000	0.4
2500	0.5
3150	0.5
4000	1.1
5000	1.7
6300	1.9
8000	2.6
10000	3.3
12500	4.8
16000	6.1
20000	8.9

M2230 Frequency Response for Free Field, Diffuse Field and Pressure



Spectral Correction for horizontal Sound Incidents using the Outdoor Microphone

The outdoor microphone M2230-WP fulfills IEC 61672 Class 1 as well as the ANSI S1.4 Type 1 requirements for vertical sound incidence. For compliance with horizontal sound incidence a spectral correction is employed in the associated XL2 Sound Level Meter.

Nominal Frequency [Hz]	Spectral Correction for horizontal Sound Incidents [dB]	
	1/3 Octave	1/1 Octave
<400	0.0	0.0
400 500 630	-0.1 -0.1 -0.1	-0.1
800 1000 1250	-0.1 -0.2 -0.2	-0.2
1600 2000 2500	-0.2 -0.1 0.2	0.0
3150 4000 5000	0.9 1.9 2.6	1.8
6300 8000 10000	2.6 3.3 4.2	3.4
12500 16000 20000	5.2 5.2 5.2	5.2

20. Technical Data PreAmplifier

	MA220 PreAmplifier
Microphone PreAmplifier	Compatible with 1/2" microphone capsules type WS2F in accordance with IEC61094-4
Frequency Range	4 Hz - 100 kHz
Residual Noise Floor typical	1.6 µV(A) at C_in 18pF ≙ 12 dBA @ 20 mV/Pa
Frequency Response Flatness	±0.2 dB
Phase Linearity	< 1° @ 20 Hz - 20 kHz
Maximum Output Voltage	21 Vpp ≙ 7.4 Vrms ≙ 145 dBSPL @ 20 mV/Pa, THD 3%, 1 kHz
Electronic Data Sheet	• Containing user calibration data • Default factory sensitivity = 4.9 V/Pa • Read/write by XL2 Audio and Acoustic Analyzer • NTi Audio ASD in accordance with IEEE P1451.4 V1.0, Class 2, Template 27
Impedance	Input: 20 GOhm // 0.26 pF, Output: 100 Ohm balanced
Power Supply	48 VDC phantom power, 3 mA typical
Attenuation	< 0.17 dB (Rphantom 2x 6.8 kOhm)
Connector	Balanced 3-pole XLR
Thread for Capsule	60 UNS2
Weight	90 g, 3.17 oz
Dimensions	Length 142.5 mm (5.6"), diameter 20.5 mm (0.8")
Temperature Range	-10°C to +50°C (14°F to 122°F)
Humidity	5% to 90% RH, non-condensing
NTi Audio #	600 040 040

The product specifications may vary based on the mounted microphone capsule type.