

Certificate of Calibration for Brüel & Kjær 1/2" Free-field Microphone

This calibration is performed by comparison with measurement reference standard microphone:

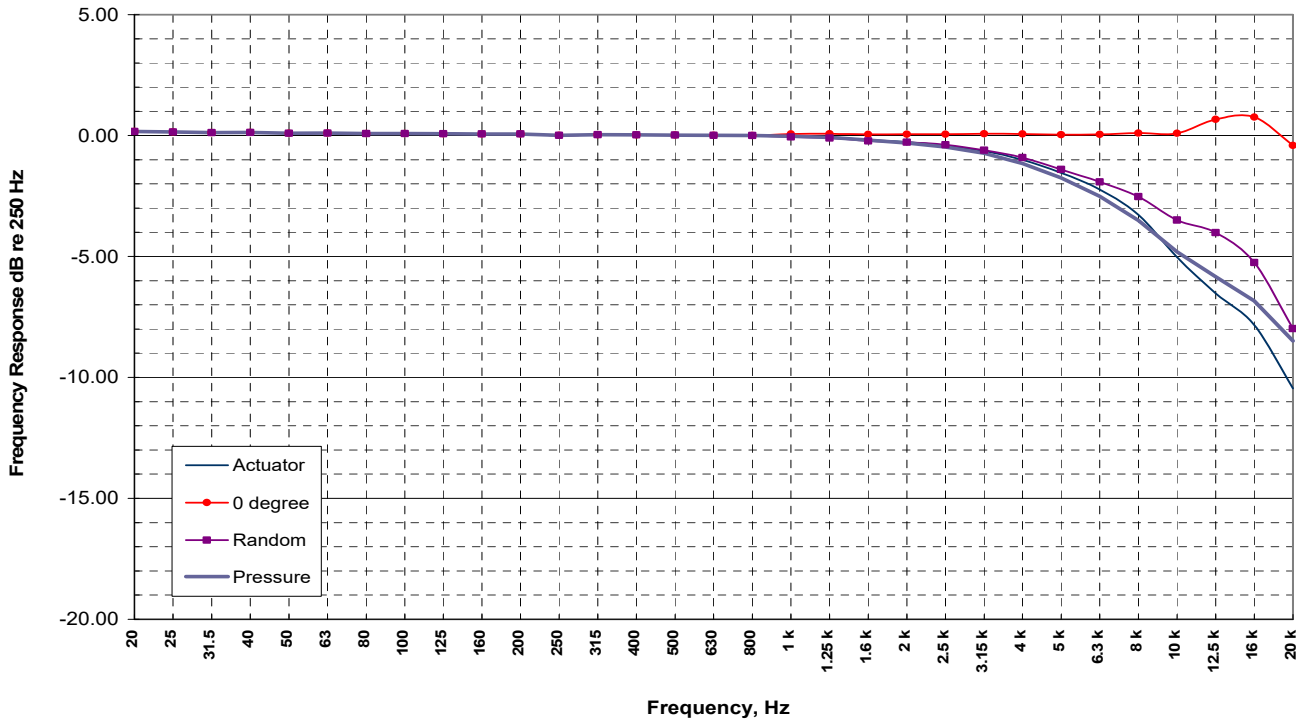
Type no. **4189**
 Serial no. **2866277**
 With preamplifier type no. **N/A**
 Preamplifier Serial no. **N/A**
 Submitted by **Odin Metrology, Inc.**
Thousand Oaks, CA 91320
 Purchase order no. **N/A**
 Asset no. **N/A**

REFERENCE STANDARDS	
Type No.	4134/UA0825
Serial No.	1866523
Calibrated by	DANAK
Cal Date	28 OCT 2020
Due Date	28 OCT 2022

- a) Estimated uncertainty of comparison: ± 0.06 dB
- b) Estimated uncertainty of reference microphone: ± 0.04 dB
- c) Total uncertainty: $\sqrt{a^2 + b^2} = \pm 0.07$ dB
- d) Expanded uncertainty (coverage factor $k = 2$ for 95% confidence level): ± 0.14 dB

PERFORMANCE DATA		
Open circuit sensitivity at 1,013 hPa, 23°C, 50% RH, 251.2 Hz	-25.79	dB re 1 V/Pa
	51.35	mV/Pa
System sensitivity (with preamplifier) at 251.2 Hz	N/A	dB re 1 V/Pa
	N/A	mV/Pa

Microphone Frequency Response Type 4189 S/N 2866277 : Measured 14 Jun 2021



Calibration performed by

Harold Lynch, Service Manager

CONDITION OF TEST		
Ambient Pressure	986.17	hPa
Temperature	23	°C
Relative Humidity	37	%
Polarization Voltage	0	V
Frequency	251.2	Hz
Date of Calibration	14 JUN 2021	
Re-calibration due on	14 JUN 2022	

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The calibration data is both "as found" and "as final." At the time of calibration this microphone was found to be **within** the manufacturer's specifications. Calibration Procedure: **OM-P-1008-Microphone Rev. 1.2 20130618.**

This calibration is traceable to DANAK/DPLA No. **M2.10-1423-3.1** and through inter-laboratory comparisons to NIST Test Number: **683/289533-17.** *See page 2 Traceability.

Instrumentation used for calibration of microphones

<u>Instrument Type</u>	<u>Type no.</u>	<u>Serial no.</u>	<u>Cal. Date</u>	<u>Cal. Due</u>	<u>Cal. by</u>
Precision Barometer	Druck 141	299/95-10	07 DEC 2020	07 DEC 2021	CMI
B&K Sine/Random Generator	1049	1464545	04 JUN 2021	04 JUN 2022	HL
Measuring Amplifier	2636	1324114	28 MAY 2021	28 MAY 2022	HL
Preamplifier	2639	1595652	17 JUN 2020	17 JUN 2021	HL
Preamplifier	2669	2145792	02 DEC 2020	02 DEC 2021	HL
Preamplifier	26AG	201377	03 SEP 2020	03 SEP 2021	HL
Multimeter	34401A	MY45001930	07 NOV 2020	07 NOV 2021	PMI
Multimeter	34401A	US36009807	10 SEP 2020	10 SEP 2021	PMI
Microphone	4134/JA0825	1866523	28 OCT 2020	28 OCT 2022	DANAK
Pistonphone	4220	1404269	24 NOV 2020	24 NOV 2021	TE
Multitone Calibrator	4226	3274134	30 NOV 2020	30 NOV 2021	HL
Precision Attenuator	5936	1637820	07 SEP 2020	07 SEP 2021	HL
Polarization Voltmeter	WB0781	21	03 SEP 2020	03 SEP 2021	HL

Calibration of reference microphones 4160 serial numbers 991820 and 991821, and standard pistonphones 4220 serial numbers 1048473, 1510240, 4228 serial number 1048747 with 40 cm³ volume are calibrated traceable to NIST with NIST test number **683/289533-17**.

The verification/calibration listed on page 1 of this document was performed on a test system which conforms to and operates under the requirements of **ANSI/NCSL Z540-1** which also covers the requirements for **MIL STD 45662A**, **ISO 17025**, and ISO 9001:2015 NQA certification no.: **11252**.

*Traceability to NIST by NIST calibration of Transfer Standard Microphone is used to verify consistency between DANAK/DPLA and NIST calibrations.

This page revised: Rev. 27.3, 20210604

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Calibration of Brüel & Kjær Instruments
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Certificate #. OM2021-5 for 4189 serial # 2866277

Tabulation for Electrostatic Actuator Response with Free Field Corrections for 4189 Microphone

For: Odin Metrology, Inc.
Purchase Order# N/A Measurements Performed on 14-Jun-2021
Environmental Conditions: Temp 23 deg C, Relative Humidity: 37%, Ambient Press: 986.17 hPa
Performed by: HL

Indicated Plot Frequency	Frequency Response				Actual 1/3 Octave Test Frequency
	Actuator	0 degree	Random	Pressure	
20	0.17	0.17	0.17	0.17	19.95
25	0.15	0.15	0.15	0.15	25.12
31.5	0.12	0.12	0.12	0.12	31.62
40	0.13	0.13	0.13	0.13	39.81
50	0.09	0.09	0.09	0.09	50.12
63	0.10	0.10	0.10	0.10	63.10
80	0.09	0.09	0.09	0.09	79.43
100	0.09	0.09	0.09	0.09	100.00
125	0.07	0.07	0.07	0.07	125.89
160	0.06	0.06	0.06	0.06	158.49
200	0.06	0.06	0.06	0.06	199.53
250	0.01	0.01	0.01	0.01	251.19
315	0.04	0.04	0.04	0.04	316.23
400	0.03	0.03	0.03	0.03	398.11
500	0.02	0.02	0.02	0.02	501.19
630	0.01	0.01	0.01	0.01	630.96
800	0.00	0.00	0.00	0.00	794.33
1 k	-0.03	0.07	-0.05	-0.03	1000.00
1.25 k	-0.07	0.08	-0.11	-0.08	1258.93
1.6 k	-0.17	0.05	-0.23	-0.18	1584.89
2 k	-0.27	0.05	-0.28	-0.31	1995.26
2.5 k	-0.42	0.06	-0.38	-0.48	2511.89
3.15 k	-0.64	0.08	-0.60	-0.74	3162.28
4 k	-1.00	0.06	-0.91	-1.15	3981.07
5 k	-1.54	0.03	-1.40	-1.75	5011.87
6.3 k	-2.23	0.05	-1.92	-2.51	6309.57
8 k	-3.28	0.10	-2.53	-3.51	7943.28
10 k	-5.03	0.09	-3.49	-4.80	10000.00
12.5 k	-6.52	0.67	-4.01	-5.84	12589.25
16 k	-7.83	0.76	-5.25	-6.84	15848.93
20 k	-10.46	-0.41	-7.98	-8.50	19952.62