

Signal Conditioner Type 1708

Single-channel, battery powered for classical and CCLD input

Type 1708 provides signal conditioning, amplification and gain control for Brüel & Kjær classical microphones as well as CCLD* transducers. It is designed for easy use, both in the field and in the lab, featuring a built-in rechargeable battery optimized for in situ measurements.



Uses and Features

Uses

- Condition signals by applying gains and filters
- Provide reliable power to:
 - Classical microphone assemblies, prepolarized or polarized
 - CCLD transducers

Features

- ± 60 V supply covers the maximum dynamic range of all classical microphones and preamplifiers
- 8 mA supply for compatibility with all CCLD transducers
- Charge injection calibration (CIC) via an external generator

- Built-in Li-Ion battery, provides up to 9 h of operating time for classical microphones (up to 15 h for CCLD)
- 5 V DC adaptor for powering/charging via mains
- Power cable with USB connector for powering/charging via computer
- Wide range of gains ($\times 0.1$, $\times 1$, $\times 10$ and $\times 100$) to amplify analogue signal before external digital conversion, improving noise floor
- Linear, 22.4 Hz to 22.4 kHz, and A-weighting (type 0) filters for removing unwanted frequencies
- Easy-to-use switches for changing settings quickly
- LED displays for quick verification of status

Description

Type 1708 is a single-channel signal conditioner for classical microphone/preamplifier combinations as well as CCLD transducers.

Located on the front panel are the power switch, setting selectors (power supply, filter, and gain) and the LED status displays (battery, overload). The input connectors (LEMO for classical microphones, BNC for CCLD and/or direct), a BNC output connector, an SMB connector for CIC, and a coaxial connector for powering/charging the battery are located on the back panel.

Fig. 1
Left: Front panel
Right: Back panel



* CCLD: Constant current line drive, also known as DeltaTron® (IEPE compatible)

Transducer Power Supply

For powering both classical and CCLD transducers, there are two power supply options: polarization voltage (P_{vol}) or CCLD. Polarization voltage can be set to either 0 or 200 V, and CCLD provides an 8 mA constant current.

CCLD power has many manufacturer specific names such as DeltaTron®, ICP® (Integrated Circuit Piezoelectric), IEPE (Integrate Electronics Piezoelectric) and ISOTRON®. Type 1708 is compatible with transducers using any of the above trade names.

Gain and Filtering

Type 1708 includes analogue gain and filtering. Adding a gain before converting the signal from analogue to digital can improve the system's noise floor. Likewise, selecting a filter can remove unwanted frequencies before conversion.

Type 1708 Gain Settings:

×0.1 (−20 dB), ×1 (0 dB), ×10 (+20 dB), ×100 (+40 dB)

Type 1708 Filters:

Linear, 22.4 Hz to 22.4 kHz, A-weighting (type 0)

Fig. 2

Mains power adaptor ZG-0473 includes plug adaptor set and attached power cable AO-1429 with coaxial to USB connectors



Type 1708 Powering Options

Type 1708 features a DC coaxial (EIAJ-02) connector for powering/charging the built-in battery using either the provided mains power adaptor or a computer's USB port.

The rechargeable battery has at least 500 cycles, each lasting for about 9 hours of operation (depending on the settings), which is more convenient than replacing non-rechargeable batteries and reduces the cost of ownership.





Family of Brüel & Kjær Signal Conditioners

Table 1 Feature comparison of Brüel & Kjær signal conditioners

	1708	1704-A	2690-A	2829	5935-L
Mains (AC) Power	✓	✓	✓	✓	✓
USB Power	✓	✓			
Battery Power	✓	✓	Optional		✓
Number of Channels per Unit	1	1 or 2	1 to 4	4	2
Manual Control	✓	✓	✓		✓
Computer Control			✓		
Read Transducer Electronic Data Sheet (TEDS)			✓	Via external connector	
Uni (Fine) Gain Adjustment			✓		✓
Multiplexer Output			✓	✓	✓
Maximum Frequency (kHz, at filters −5% point)	>350	55	100	–	100
Maximum Gain (dB)	40	40	80	–	50
Minimum Gain (dB)	−20	0	−20	0	0
A-weighting (type 0)	✓	✓	✓		✓
Single and Double Integration Filters			✓	✓	✓
Constant Current Supply (mA)	✓	✓	✓	✓	✓

Compliance with Standards

Type 1708 is designed for use in systems with cable length <30 m.

   	<p>The CE marking is the manufacturer's declaration that the product meets the requirements of the applicable EU directives</p> <p>RCM mark indicates compliance with applicable ACMA technical standards – that is, for telecommunications, radio communications, EMC and EME</p> <p>China RoHS mark indicates compliance with administrative measures on the control of pollution caused by electronic information products according to the Ministry of Information Industries of the People's Republic of China</p> <p>WEEE mark indicates compliance with the EU WEEE Directive</p>
Safety	<p>EN/IEC 61010–1: Safety requirements for electrical equipment for measurement, control and laboratory use</p> <p>ANSI/UL 61010–1: Safety requirements for electrical equipment for measurement, control and laboratory use</p>
EMC Emission	<p>EN/IEC 61000–6–3: Generic emission standard for residential, commercial and light industrial environments</p> <p>EN/IEC 61000–6–4: Generic emission standard for industrial environments</p> <p>CISPR 22: Radio disturbance characteristics of information technology equipment. Class B Limits</p> <p>FCC Rules, Part 15: Complies with the limits for a Class B digital device</p> <p>This ISM device complies with Canadian ICES–001 (standard for interference-causing equipment)</p>
EMC Immunity	<p>EN/IEC 61000–6–1: Generic standards – Immunity for residential, commercial and light industrial environments</p> <p>EN/IEC 61000–6–2: Generic standards – Immunity for industrial environments</p> <p>EN/IEC 61326: Electrical equipment for measurement, control and laboratory use – EMC requirements</p> <p>Note: Effect of radiated RF, 80–1000 MHz 80% AM 1 kHz 10 V/m: <300 µV</p> <p>Note: The above is only guaranteed using accessories listed in this Product Data sheet</p>
Temperature	<p>IEC 60068–2–1 & IEC 60068–2–2: Environmental Testing. Cold and Dry Heat</p> <p>Operating Temperature: –20 to +50 °C (–4 to 122 °F)</p> <p>Storage Temperature: –25 to +70 °C (–13 to +158 °F)</p>
Humidity	IEC 60068–2–78: Damp Heat: 93% RH (non-condensing at 40 °C (104 °F))
Mechanical	<p>Non-operating:</p> <p>IEC 60068–2–6: Vibration: 0.3 mm, 20 m/s², 10 – 500 Hz</p> <p>IEC 60068–2–27: Shock: 1000 m/s²</p> <p>IEC 60068–2–29: Bump: 1000 bumps at 250 m/s²</p>
Enclosure	IEC 60529: Protection provided by enclosures: IP 20

Specifications – Type 1708

CONNECTORS

Input:

- Classical: LEMO
- CCLD: BNC

Output: BNC

External generator: SMB

Battery power supply: Coaxial EIAJ-02

BATTERY

Number of battery charging cycles (down to 80%): 500

Time to charge (in off mode), mains (AC) or USB: 5 hours

PHYSICAL

Dimensions: 110 × 140 × 36 mm (4.33 × 5.51 × 1.42 in)

Weight: 320 g (11.29 oz)

Temperature range:

- Operating: –20 to +50 °C (–4 to +122 °F)
- Charging: 10 to 40 °C (50 to 104 °F)

FILTERING AND GAIN

Filters:

- Linear
- 22.4 Hz to 22.4 kHz
- A-weighting

Gain:

- ×0.1 (–20 dB)
- ×1 (0 dB)
- ×10 (+20 dB)
- ×100 (+40 dB)

		Unit	Gain			
			×0.1 (−20 dB)	×1 (0 dB)	×10 (+20 dB)	×100 (+40 dB)
Amplifier Gain	at 1 kHz	dB	−20 ± 0.05	0 ± 0.05	20 ± 0.05	40 ± 0.05
Gain Tolerance	10 Hz 100 kHz	dB	±0.2	±0.1	±0.1	±0.2
Excitation Voltage	Classical	V	±60	±15	±15	±15
	CCLD	V		25	25	25
Excitation Current	CCLD	mA	8 ± 2			
Maximum Input Voltage (peak)		V	±58	±10	±0.1	±0.010
Input Protection*		V	From ±58	−14.5 to +25	−14.5 to +25	−14.5 to +25
Maximum Non-destructive Input		V	±100	±100	±100	±100
Maximum Output Voltage (peak)		V	6	10	10	10
Overload Level		V	±55	±11	±1.1	±0.11
Output Impedance		Ω	50	50	50	50

		Unit	Gain			
			×0.1 (−20 dB)	×1 (0 dB)	×10 (+20 dB)	×100 (+40 dB)
Cable Fault Voltage Levels	CCLD overload levels		%, CCLD current disconnected	Input voltage below +2.5 V: cable short-circuited Input voltage above +21 V: open circuit		
Total Harmonic Distortion	at 1 kHz 1 V _{rmsout}	dB	>70, Typ.: 80	>80, Typ.: 90	>80, Typ.: 90	>80, Typ.: 90
Output DC Offset		mV	Max.: 3.5, Typ.: 1	Max.: 3.5, Typ.: 1	Max.: 3.5, Typ.: 1	Max.: 3.5, Typ.: 1
Charge Injection Calibration (CIC) [†]			Yes	Yes	Yes	Yes
Frequency Range (−3 dB, max. slew rate 10 V/μs)	Lower Limit	Hz	<1, Typ.: 0.7	<1, Typ.: 0.7	<1, Typ.: 0.7	<1, Typ.: 0.7
	Upper Limit	kHz	>450	>450	>450	>350
Spectral Output Noise, Linear	1 Hz	μV/√Hz	<0.2, Typ.: 0.07	<0.2, Typ.: 0.06	<1.5, Typ.: 0.3	<10, Typ.: 3
	10 Hz		<0.2, Typ.: 0.05	<0.1, Typ.: 0.02	<0.5, Typ.: 0.1	<5, Typ.: 1
	100 Hz		<0.07, Typ.: 0.04	<0.05, Typ.: 0.01	<0.15, Typ.: 0.07	<1.5, Typ.: 0.7
	1 kHz		<0.07, Typ.: 0.035	<0.02, Typ.: 0.01	<0.15, Typ.: 0.07	<1.5, Typ.: 0.7
	10 kHz		<0.02, Typ.: 0.013	<0.02, Typ.: 0.01	<0.15, Typ.: 0.07	<1.5, Typ.: 0.7
	100 kHz		<0.02, Typ.: 0.013	<0.02, Typ.: 0.01	<0.15, Typ.: 0.07	<1.5, Typ.: 0.7
	150 kHz [‡]		<0.02, Typ.: 0.013	<0.02, Typ.: 0.01	<0.15, Typ.: 0.07	<1.5, Typ.: 0.7
Broadband Electrical Output Noise, Linear	1 Hz to 10 kHz	μV _{rms}	<4, Typ.: 2.5	<3, Typ.: 1.2	<8, Typ.: 6.7	<70, Typ.: 63
	1 Hz to 100 kHz		<6, Typ.: 4	<5, Typ.: 3.5	<25, Typ.: 22	<250, Typ.: 200
	1 Hz to 150 kHz [‡]		<7.5, Typ.: 5	<6.5, Typ.: 4.5	<32, Typ.: 28	<320, Typ.: 250
Broadband Output Noise	Acoustic Bandpass, Linear	μV _{rms}	<4, Typ.: 2.6	<3, Typ.: 1.6	<12, Typ.: 10	<100, Typ.: 94
	Acoustic Bandpass, Internal		<8, Typ.: 6.5	<8, Typ.: 6	<15, Typ.: 12	<110, Typ.: 95
	A-weighting, Post-processing		<4, Typ.: 2.4	<3, Typ.: 1.4	<10, Typ.: 7.6	<80, Typ.: 73
	A-weighting, Internal		<10, Typ.: 7	<10, Typ.: 7	<12, Typ.: 10	<80, Typ.: 74
Phase Difference, Device to device (typ. values), Linear weighting (without filters)	100 kHz		±5°	±5°	±10°	±15°
	1 Hz		±2°	±2°	±2.5°	±2.5°
Max. Amplitude Difference, Device to device, Linear weighting (without filters)	100 kHz	dB	±0.4	±0.1	±0.2	±0.5
	1 Hz		±0.15	±0.1	±0.15	±0.11
Battery Life (Typical)	CCLD mode	h	15	15	15	15
	With Preamplifier Type 2669 (±15 V supply)			9.5	9.5	9.5
	With Preamplifier Type 2669 (±60 V supply)		4			
	After low-battery level	min	30	45	45	45

* If the signal input level exceeds the measuring range significantly, the input will go into protection mode for 0.5 s. Overload will be detected, input impedance will be increased and the signal attenuated. Input signal is cut when it exceeds ±60 V.

† It is possible to calibrate the input of preamplifier using charge injection by connecting an external generator via the SMB connector. During CIC, the CIC switch and the overload diode must be set to 'On'. When not in use, CIC switch must be 'Off'.

‡ Power supply switching frequency: between 170 and 180 kHz

Ordering Information

Type 1708 Signal Conditioner

ACCESSORIES

ZG-0473 Power supply wall adaptor, 5 V

AO-1429 Power cable, DC

CALIBRATION SERVICES

1708-CVI Initial Accredited Calibration, Type 1708 with microphone

1708-CVF Accredited Calibration, Type 1708 with microphone

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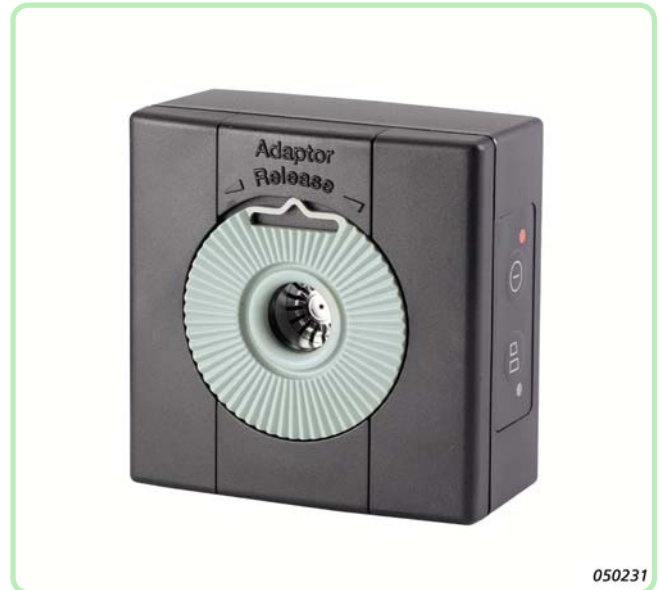
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PRODUCT DATA

Sound Calibrator Type 4231

Sound Calibrator Type 4231 is a handy, portable sound source for calibration of sound level meters and other sound measurement equipment. The calibrator is very robust and stable, and conforms to EN/IEC 60942 (2003) Class LS and Class 1, and ANSI S1.40–2006.



Uses and Features

Uses

- Calibration of sound level meters and other sound measurement equipment

Features

- Conforms to EN/IEC 60942 (2003) Class LS and Class 1, and ANSI S1.40–2006
- Robust, pocket-sized design with highly stable level and frequency
- Calibration accuracy ± 0.2 dB
- 94 dB SPL or 114 dB SPL for calibration in noisy environments
- Extremely small influence of static pressure and temperature
- Sound pressure independent of microphone equivalent volume
- 1 kHz calibration frequency for correct calibration level independent of weighting network
- Fits Brüel & Kjær 1" microphones (1/2", 1/4" and 1/8" microphones with adaptor)
- Switches off automatically when removed from the microphone

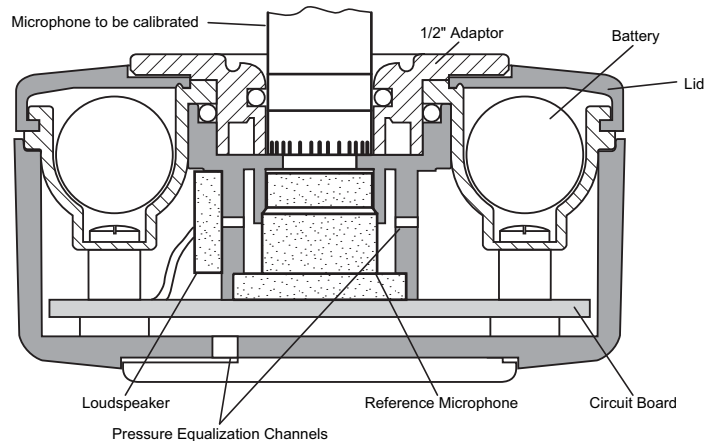
Sound Calibrator Type 4231

Sound Calibrator Type 4231 is a pocket-sized, battery operated sound source for quick and direct calibration of sound level meters and other sound measuring systems. It fits Brüel & Kjær 1" microphones and using the removable adaptor, 1/2" microphones. With optional adaptors, it can be used for 1/4" and 1/8" microphones as well.

The calibration frequency is 1000 Hz (the reference frequency for the standardized international weighting networks), so the same calibration value is obtained for all weighting networks (A, B, C, D and Linear). The calibration pressure of 94 ± 0.2 dB re $20 \mu\text{Pa}$ is equal to 1 Pa or 1 N/m^2 . The +20 dB level step gives 114 dB SPL, which is convenient for calibration in noisy environments, or for checking linearity.

The design of Type 4231 is based on a feed-back arrangement to ensure a highly stable sound pressure level and ease of use. The feed-back loop uses a condenser microphone (see Fig. 1), which is specially developed for this purpose.

Fig. 1
Cross-sectional view of Sound Calibrator Type 4231. The feed-back loop is based on a high-quality condenser microphone to ensure a very stable sound pressure level



This microphone is optimized to have extremely high stability and independence of variations in static pressure and temperature around the 1 kHz calibration frequency. The result of this is a user-friendly calibrator where exact fitting of the microphone is not critical and the effects of changes in temperature and static pressure are negligible.

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Fig. 2
Type 4231 fitted to Hand-held Analyzer Type 2250. The calibrator's centre of gravity is positioned very close to the microphone, giving a stable set-up



The calibrator gives a continuous sound pressure level when fitted on a microphone (see Fig. 2) and activated.





The sensitivity of the sound measuring equipment can then be adjusted until it indicates the correct sound pressure level.

The calibrator is automatically switched off when removed from the microphone.

A leather protection case, which does not need to be removed to use the calibrator, is supplied.

050232

Compliance with Standards

   	<p>The CE marking is the manufacturer's declaration that the product meets the requirements of the applicable EU directives</p> <p>RCM mark indicates compliance with applicable ACMA technical standards – that is, for telecommunications, radio communications, EMC and EME</p> <p>China RoHS mark indicates compliance with administrative measures on the control of pollution caused by electronic information products according to the Ministry of Information Industries of the People's Republic of China</p> <p>WEEE mark indicates compliance with the EU WEEE Directive</p>
Safety	<p>EN/IEC 61010–1: Safety requirements for electrical equipment for measurement, control and laboratory use.</p> <p>ANSI/UL 61010–1: Safety requirements for electrical equipment for measurement, control and laboratory use.</p>
EMC Emission	<p>EN/IEC 61000–6–3: Generic emission standard for residential, commercial and light industrial environments.</p> <p>EN/IEC 61000–6–4: Generic emission standard for industrial environments.</p> <p>CISPR 22: Radio disturbance characteristics of information technology equipment. Class B Limits.</p> <p>FCC Rules, Part 15: Complies with the limits for a Class B digital device.</p> <p>EN/IEC 60942: Instrumentation Standard – Electroacoustics – Sound Calibrators.</p>
EMC Immunity	<p>EN/IEC 61000–6–1: Generic standards – Immunity for residential, commercial and light industrial environments.</p> <p>EN/IEC 61000–6–2: Generic standards – Immunity for industrial environments.</p> <p>EN/IEC 61326: Electrical equipment for measurement, control and laboratory use – EMC requirements.</p> <p>EN/IEC 60942: Instrumentation Standard – Electroacoustics – Sound Calibrators.</p> <p>Note: The above is only guaranteed using accessories listed in this Product Data sheet.</p>
Temperature	<p>IEC 60068–2–1 & IEC 60068–2–2: Environmental Testing. Cold and Dry Heat.</p> <p>Operating Temperature: –10 to +50°C (14 to 122°F)</p> <p>Storage Temperature: –25 to +70°C (–13 to +158°F)</p>
Humidity	IEC 60068–2–78: Damp Heat: 90% RH (non-condensing at 40°C (104°F)).
Mechanical	<p>Non-operating:</p> <p>IEC 60068–2–6: Vibration: 0.3 mm (10 to 58 Hz), 20 m/s² (58–500 Hz)</p> <p>IEC 60068–2–27: Shock: 1000 m/s²</p> <p>IEC 60068–2–29: Bump: 3000 bumps at 400 m/s²</p>
Enclosure	IEC 60529: Protection provided by enclosures: IP 50 with leather protection case.

Specifications – Sound Calibrator Type 4231

STANDARDS SATISFIED

EN/IEC 60942 (2003), Class LS and Class 1, Sound Calibrators
ANSI S1.40 – 2006, Specification for Acoustic Calibrators Class LS and Class 1

SOUND PRESSURE LEVELS

94.0 dB \pm 0.2 dB (Principal SPL) or
114.0 dB \pm 0.2 dB re 20 μ Pa at reference conditions

FREQUENCY

1 kHz \pm 0.1%

SPECIFIED MICROPHONE

Size according to IEC 61094-4:

- 1" without adaptor
- 1/2" with adaptor UC 0210 (supplied)
- 1/4" with adaptor DP 0775 (optional)
- 1/8" with adaptor DP 0774 (optional)

EQUIVALENT FREE-FIELD LEVEL

(0° incidence, re Nominal Sound Pressure Level)
–0.15 dB for 1/2" Brüel & Kjær microphones. See the Type 4231 User Manual for other microphones

EQUIVALENT RANDOM INCIDENCE LEVEL

(re Nominal Sound Pressure Level)
+0.0 dB for 1", 1/2", 1/4" and 1/8" Brüel & Kjær microphones

NOMINAL EFFECTIVE COUPLER VOLUME

> 200 cm³ at reference conditions

DISTORTION

< 1%

LEVEL STABILITY

Short-term: Better than 0.02 dB (as specified in IEC 60942)

One Year: Better than 0.05 dB (σ = 96%)

Stabilization Time: < 5 s

REFERENCE CONDITIONS

Temperature: 23°C \pm 3°C (73° \pm 5°F)

Pressure: 101 \pm 4 kPa

Humidity: 50%, –10% +15% RH

Effective Load Volume: 0.25 cm³

ENVIRONMENTAL CONDITIONS

Pressure: 65 to 108 kPa

Humidity: 10 to 90% RH (non-condensing)

Effective Load Volume: 0 to 1.5 cm³

INFLUENCE OF ENVIRONMENTAL CONDITIONS (Typical)

Temperature Coefficient: \pm 0.0015 dB/°C

Pressure Coefficient: $+8 \times 10^{-4}$ dB/kPa

Humidity Coefficient: 0.001 dB/% RH

POWER SUPPLY

Batteries: 2 \times 1.5 V IEC Type LR6 ("AA" size)

Lifetime: Typically 200 hours continuous operation with alkaline batteries at 23°C (73°F)

Battery Check: When Type 4231 stops working continuously, and only operates when the On/Off button is held in, the batteries should be replaced

DIMENSIONS AND WEIGHT

(Without case)

Height: 40 mm (1.5")

Width: 72 mm (2.8")

Depth: 72 mm (2.8")

Weight: 150 g (0.33 lb), including batteries

Note: All values are typical at 25°C (77°F), unless measurement uncertainty or tolerance field is specified. All uncertainty values are specified at 2 σ (that is, expanded uncertainty using a coverage factor of 2)

Ordering Information

Type 4231 Sound Calibrator

includes the following accessories:

- KE-0317: Leather Case
- 2 × QB-0013: Alkaline Battery Type LR6
- UC-0210: Adaptor for 1/2" microphones

Optional Accessories

DP-0775	Adaptor for 1/4" microphones
DP-0774	Adaptor for 1/8" microphones
DP-0887	Adaptor for Head and Torso Simulator Type 4128

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Brüel & Kjær 



Falcon™ Range 1/2" Microphone Preamplifier — Type 2669

USES:

- Sound measurements with Brüel & Kjær 1/2" (1", 1/4" and 1/8" with adaptor) and compatible microphones
- General-purpose preamplifier and high-impedance input probe for Brüel & Kjær measuring instruments

FEATURES:

- Full electromagnetic compatibility (EMC)
- Detachable, thin cable for easy installation
- Compact LEMO connector at preamplifier
- Patented charge-injection calibration technique for on-site calibration of the whole measuring channel including the microphone
- Wide dynamic range
- Very low inherent noise, high input impedance
- Low output impedance and high output current allows use with long extension cables
- Wide working temperature range
- Falcon™ Range product with a three-year guarantee

1/2" Microphone Preamplifier Type 2669 is a Falcon™ Range product for making precision acoustic measurements with Brüel & Kjær's wide range of condenser microphones. You can connect 1/2" microphones directly and 1", 1/4" and 1/8" types using adaptors.

The preamplifier, cable and its connectors all fulfil EMC requirements.

You can verify the condition of the microphone, preamplifier and cable on-site using its patented charge-injection calibration technique.

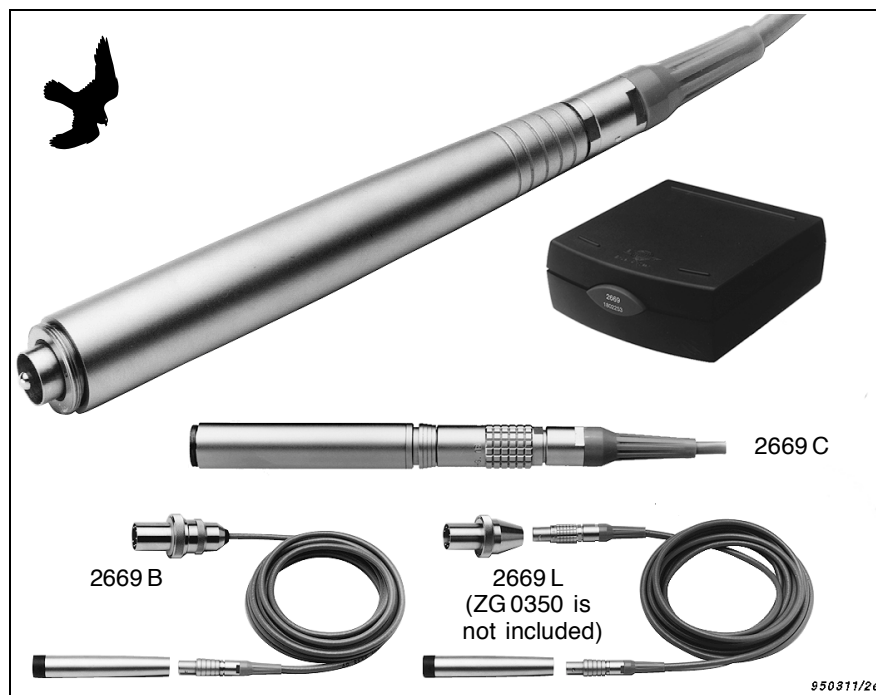
The preamplifier's low output impedance allows the use of long extension cables without problems.

Description

This 1/2" Falcon™ Range microphone preamplifier operates over a wide range of temperature, humidity and other environmental conditions. It is available in three versions: the cylindrical Type 2669 C and the conical Types 2669 L and 2669 B. Apart from the shape of the housing, the only difference is the connectors. The conical form is optimized with respect to acoustical properties, whereas the cylindrical form will fit existing specialized holders.

The preamplifier has a very high input impedance presenting virtually no load to the microphone. The high output voltage together with an extremely low inherent noise level gives a wide dynamic range.

The low output impedance and high output current capability means



that you can use long cables between the preamplifier and your measuring instrument without loss of signal quality. Furthermore, this Falcon™ Range microphone preamplifier comes with an extended guarantee period of three years. It is supplied in an elegant and strong plastic box made from recyclable materials.

EMC Certification

The preamplifier complies with EMC (electromagnetic compatibility) requirements specified in EN 50082-1 (residential, commercial and light in-

dustry) as well as in EN 50082-2 (industrial environment). These are generic European standards for electrical noise immunity, to ensure that instruments do not interfere with each other. To get the full benefit of this certification, the preamplifier must be connected to an instrument which also complies with EMC requirements.

Charge-injection Calibration

This is a patented technique for verifying the entire measurement set-up

including the microphone, preamplifier and connecting cable (see box below).

Microphones and Sockets

You can fit $\frac{1}{2}$ " microphones directly and $1"$, $\frac{1}{4}"$ and $\frac{1}{8}"$ microphones using adaptors DB 0375, UA0035 and UA0036 respectively.

Preamplifier Type 2669 L is delivered with a cable which fits the LEMO preamplifier input socket on new Brüel & Kjær instruments (as well as instruments from Hewlett-Packard and Nortronic). Adaptor ZG 0350 is available for converting it to traditional 7-pin Brüel & Kjær preamplifier sockets. Alternatively, Type 2669 B is available for direct use with traditional Brüel & Kjær instruments. This cable has the same diameter and flexibility, but is equipped with a traditional Brüel & Kjær plug. Both types are fitted with a LEMO 0B connector at the preamplifier.

In contrast the cylindrical Type 2669 C is fitted with a LEMO 1B connector, which means that it can be connected directly to LEMO to LEMO extension cables. Type 2669 C is supplied without a cable.

Power Supply

You can use a dual (plus/minus) or single power supply for the preamplifier. When using a balanced power supply, the offset voltage at the output — and at the preamplifier guard ring — will be almost zero. This protects you against harmless, but unpleasant, electrical shocks if you accidentally mount or remove the microphone with power on, and gives a faster stabilisation time for a measurement set-up.

Detachable Cable (2669L and B)

The 4 mm thick connecting cable is made of silicone and is very flexible. It has a wide working temperature range (-60°C to 150°C). It has a small high-quality connector at the preamplifier end for easy detachment during installation.

Accessories

In addition to the previously mentioned adaptors for $1"$, $\frac{1}{4}"$ and $\frac{1}{8}"$ microphones, other useful accessories are available. The Coaxial Input Adaptor JJ 2617 is used for measuring electrical signals by connecting the preamplifier directly to cables with microplugs (Cables AO 0038, AO 0122). The Flexible Extension Rod UA 0196 gives directional flexi-

bility to the microphone and increases the distance between the microphone and the preamplifier. This allows continuous exposure of the microphone to high temperatures (up to 150°C , 302°F) while avoiding electrical noise otherwise generated by the preamplifier at high temperatures. For short periods the UA 0196 tolerates temperatures up to 300°C (572°F). Microphone Holder UA 1317 is used for mounting the preamplifier on a tripod without compromising the acoustical properties of the preamplifier. It can hold all Brüel & Kjær $\frac{1}{2}"$ preamplifiers. Adaptor DP 0901 is supplied with the preamplifier for use with holders that require a cylindrically shaped preamplifier.

Characteristics

The small and large signal frequency response of the preamplifier depend on the capacitance of the microphone connected to its input and the capacitive load (for example, extension cables) connected to the output.

Small Signal Frequency Response

The curves in Fig. 1 show the low-frequency response of the preamplifier.

Brüel & Kjær's Patented Charge-injection Calibration Technique

The Charge-injection Calibration (CIC) technique is a method for remotely verifying the condition of the entire measurement set-up **including the microphone**. This is a great improvement over the traditional insert-voltage calibration method which virtually ignores the state of the microphone. The CIC technique is very sensitive to any change in the microphone's capacitance which is a reliable

indicator of the microphone's condition.

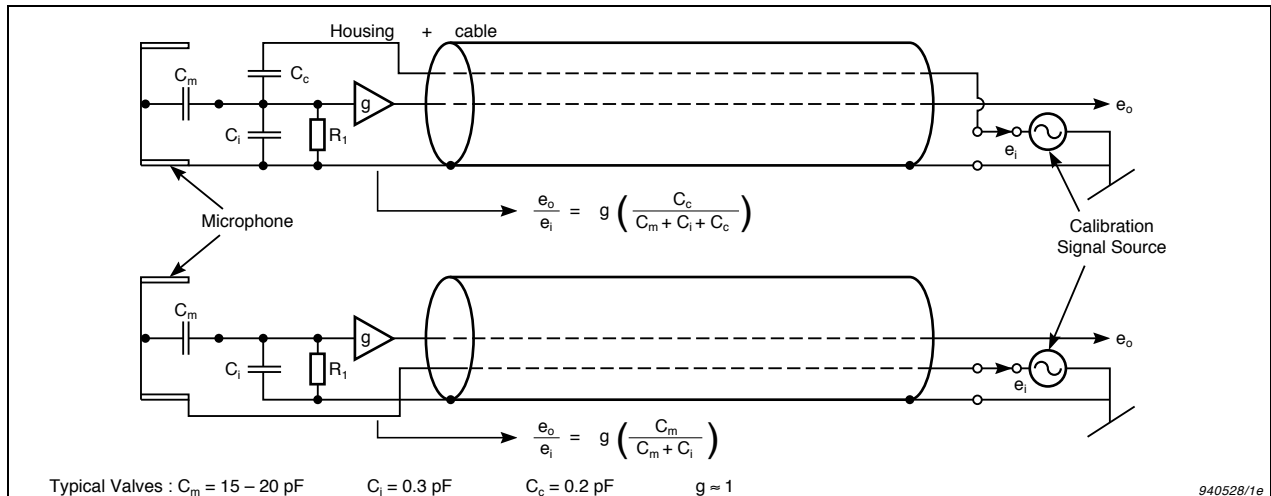
The technique works by introducing a small but accurately defined capacitance C_c (typically 0.2 pF) with a very high leakage resistance (greater than 50 000 G Ω) into the circuit of the preamplifier, see below (upper diagram). C_i and R_i represent the preamplifier's high input impedance and g its gain (≈ 1).

For a given calibration signal e_i , the output e_o of this arrangement will change measurably, even for small changes in the microphone's capacitance C_m . The CIC technique is about 100 times more sensi-

tive than the insert-voltage calibration arrangement shown in the lower diagram.

In the extreme case where there is significant leakage between the microphone's diaphragm and its backplate (C_m becomes very large), the signal output will change by tens of decibels compared with only tenths of a decibel using the insert-voltage method.

Another important CIC feature is that, unlike the insert-voltage technique, it is far less sensitive to external electrical fields.



er for various microphone capacitances. These capacitances (47 pF, 15 pF and 6.2 pF) are typical for 1", 1/2" and 1/4" microphones respectively. Note that they do not show or take into account the lower cut-off frequencies of the microphones. The effects of various capacitive output loads (cable length) on the high-frequency response are also shown. The curves in Fig.1 apply for signal levels within the large signal limits in Table 2.

Large Signal Frequency Response

The capacitive load of extension cables on the output of the preamplifier influences its frequency response and available output voltage. If the specified maximum output current of the preamplifier is exceeded, the signal will be distorted. The curves in Fig.2 show the upper distortion limits (3%) as a function of preamplifier output voltage, frequency and capacitive loading (cable length). The curves are shown for total supply voltages of 120 VDC and 28 VDC (± 60 VDC and ± 14 VDC dual supply voltages respectively).

Noise

Fig.3 shows typical noise frequency spectra when loading the preamplifier with 6.4 pF and 15 pF microphone capacities. The low noise of the preamplifier ensures that the noise floor for a microphone/preamplifier assembly is determined mainly by the associated microphone over most of the frequency range. The preamplifier can work at temperatures up to 150°C, but reduced specifications for noise and output capability will apply.

More information on preamplifiers and other Falcon™ Range products are given in the Microphone Handbook BA5105.

Extension Cables

Extension Cable	AO0414/15 /16	AO0027	AO0028/29
Connectors	LEMO	Brüel & Kjær	
Length	3/10/30 m	3 m	10/30 m
Diameter	4 mm	6 mm	9 mm
Capacitance	290/960 /2900 pF	300 pF	570/ 1700 pF

Table1 Extension cables

All the extension cables with LEMO connectors (see Table 1) are fully EMC certified. The preamplifier can be used with traditional cables with Brüel & Kjær connectors, but EMC compatibility is not guaranteed. The

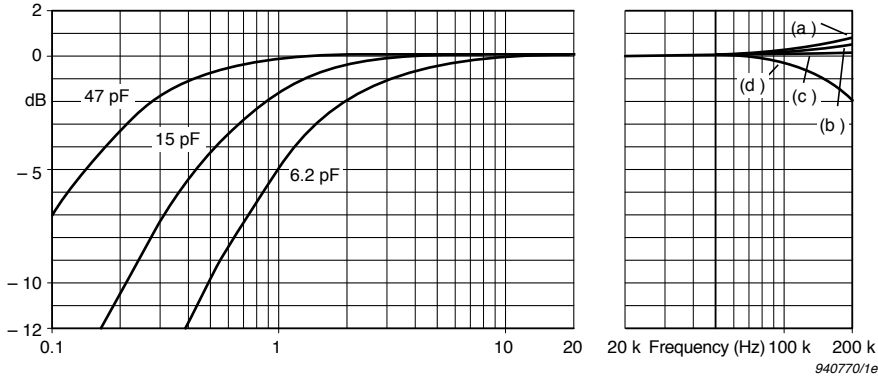


Fig.1 Small signal frequency response of the preamplifier at low frequencies for various microphone capacitances and at high frequencies for various capacitive loads which are (a) 10 nF (b) 3 nF (c) with the 3 m cable supplied (d) 30 nF

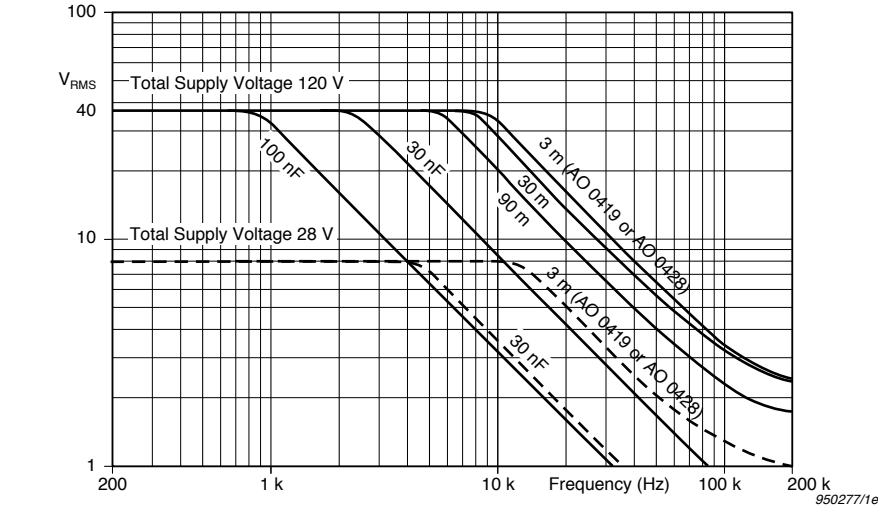


Fig.2 Upper distortion limit (3%) as a function of preamplifier output voltage and frequency for various capacitive loads. The full-drawn curves are valid for a preamplifier powered with 120 VDC (± 60 VDC) and the dotted curves are for 28 VDC (± 14 VDC)

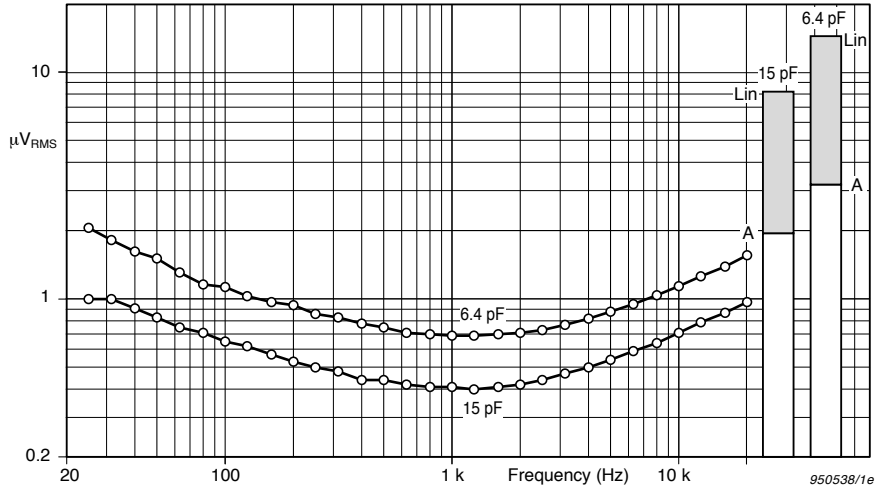


Fig.3 Typical noise frequency spectra in μ V measured with 6.4 pF and 15 pF microphone capacities. The spectra are measured in 1/3-octave bands with levels at centre frequencies indicated by circles. The bar graphs represent broad-band (22.4 Hz to 300 kHz) and A-weighted noise levels for both microphone capacities

cables in Table 1 have a working temperature range from -20 to $+80^\circ\text{C}$. They are very robust, have low capacitance and extremely good shield-

ing so that several of them can be connected in series without loss of signal quality.

Specifications 2669

FREQUENCY RESPONSE (re 1 kHz):

3 Hz to 200 kHz, ± 0.5 dB. See Fig. 1

ATTENUATION: 0.35 dB (max.)

PHASE LINEARITY:

$\leq \pm 3^\circ$ from 20 Hz to 100 kHz

PHASE MATCHING: 0.3° at 50 Hz

INPUT IMPEDANCE: $15\text{ G}\Omega \parallel 0.45\text{ pF}$

OUTPUT IMPEDANCE: $25\text{ }\Omega$ (max.)

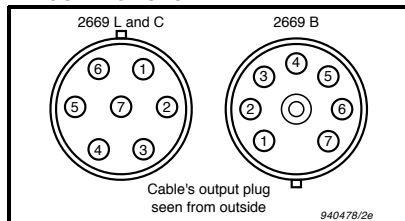
CONNECTOR TYPE:

LEMO type FGJ.OB.307 at preamp. (2669 L & B)

LEMO type FGG.1B.307 (2669 L), or Brüel & Kjær JP 0715 (2669 B) to measuring device

LEMO type FWG.1B.307 at preamp. (2669 C)

PIN CONNECTIONS:



Pin	LEMO (L & C)	Brüel & Kjær (B)
1	Calibration input	Ground
2	Signal ground	Pol. voltage
3	Pol. voltage	Calibration input
4	Signal output	Signal output
5	Not connected	Power supply positive
6	Power supply positive	Not connected
7	Power supply negative/ground	Not connected
Casing	Connected to instrument chassis	

MAX. OUTPUT CURRENT: 20 mA (peak)

Note: The max. output current can be limited by the power supply

CURRENT CONSUMPTION:

3 mA plus output current

MAX. OUTPUT VOLTAGE:

Maximum output voltage V_{p-p} is equal to total

supply voltage minus 10 V

OUTPUT SLEW RATE: $2\text{ V}/\mu\text{s}$

DISTORTION (THD):

Less than -80 dB at 25 V out, 1 kHz

NOISE:

$\leq 8.2\text{ }\mu\text{V}$ Lin. 20 Hz – 300 kHz

$\leq 10.0\text{ }\mu\text{V}$ Lin. 20 Hz – 300 kHz (max.)

$\leq 1.9\text{ }\mu\text{V}$ A weighted

$\leq 2.2\text{ }\mu\text{V}$ A weighted (max.)

POWER SUPPLY, DUAL: $\pm 14\text{ V}$ to $\pm 60\text{ V}$

POWER SUPPLY, SINGLE: 28 V to 120 V

OUTPUT DC OFFSET:

$\approx 1\text{ V}$ for a dual supply, or

$\approx 1/2$ the voltage of a single supply

COMPLIANCE WITH STANDARDS:

	CE-mark indicates compliance with: EMC Directive and Low Voltage Directive.
Safety	EN 61010-1 and IEC 1010-1: Safety requirements for electrical equipment for measurement, control and laboratory use.
EMC Immunity	EN 50082-1: Generic immunity standard. Part 1: Residential, commercial and light industry. EN 50082-2: Generic immunity standard. Part 2: Industrial environment. Note: The above is guaranteed only with extension cables AO 0414, AO 0415 and AO 0416.
Temperature	IEC 68-2-1 & IEC 68-2-2: Environmental Testing. Cold and Dry Heat. Operating Temperature: -20 to $+60^\circ\text{C}$ (-4 to $+140^\circ\text{F}$), (150°C (302°F) with increase in noise) Storage Temperature: -25 to $+70^\circ\text{C}$ (-13 to $+158^\circ\text{F}$)
Humidity	IEC 68-2-3: 95% RH (non-condensing at 40°C (104°F))
Enclosure	IEC 529: IP 20
Mechanical	Non-operating: IEC 68-2-6: Vibration: 0.3 mm , 20 m/s^2 , 10–500 Hz IEC 68-2-27: Shock: 1000 m/s^2 IEC 68-2-29: Bump: 4000 bumps at 400 m/s^2
Reliability	MI-HDBK 217 F, GB (Part-Stress): MTBF >40000 hours (max. 2.5% errors/1000 h)

CALIBRATION INPUT:

Charge insert capacity: 0.2 pF

Max. 10 V RMS, input impedance: 1 nF

DIMENSIONS:

Diameter: 12.7 mm (0.5")

Length: 110 mm (4.3"), (2669 L and B)

120 mm (4.7"), (2669 C)

Weight: 40 g (1.41 oz) (preamplifier only)

Note: All values are typical at 25°C (77°F), unless measurement uncertainty is specified. All uncertainty values are specified at 2σ (i.e. expanded uncertainty using a coverage factor of 2). The above are valid for 15 pF mic. capacitance and a 3 metre cable unless otherwise specified.

Charge Injection Calibration Technique patented according to US Patent No. 5,400,297. The patent includes the measurement method and its implementation.

Ordering Information

Type 2669 L $1/2$ " Microphone Preamplifier (LEMO connector)

Includes the following accessories:

DP 0901: $1/2$ " Cylindrical Adaptor

AO 0419: Microphone Cable 3 m (9.8 ft.)

or as a special order:

EL 4006-AC 0219-x: Microphone Cable length x m (specified by customer)

Type 2669 B $1/2$ " Microphone Preamplifier (Brüel & Kjær connector)

Includes the following accessories:

DP 0901: $1/2$ " Cylindrical Adaptor

AO 0428: Microphone Cable 3 m (9.8 ft.)

or as a special order:

EL 4005-AC 0219-x: Microphone Cable length x m (specified by customer)

Type 2669 C $1/2$ " Microphone Preamplifier (no cable included)

Optional Accessories

ZG 0350: LEMO to 7-pin Brüel & Kjær adaptor

JJ 2617: Input Adaptor (51 pF). Is screwed directly onto a preamplifier for connection to microplug cables

UA 0196: Flexible Extension Rod

DB 0375: $1/2$ " to 1" Adaptor

UA 0035: $1/2$ " to $1/4$ " Adaptor

UA 0036: $1/2$ " to $1/8$ " Adaptor

UA 1317: $1/2$ " Microphone Holder

BA 5105: Microphone Handbook

WB 0850: Insert Junction Adaptor for Type 2669 B/2669 L with Adaptor ZG 0350. For Charge-injection Calibration

Extension Cables

LEMO to LEMO:

AO 0414: 3 m (9.8 ft.)

AO 0415: 10 m (32.8 ft.)

AO 0416: 30 m (98.4 ft.)

EL 4004-AC 0079-x: Length x m (specified by customer)

AR 0014: Flat Cable, 0.5 m (1.64 ft)

Brüel & Kjær reserves the right to change specifications and accessories without notice

Brüel & Kjær

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Local representatives and service organisations worldwide

BP 1422-13

TEDS Microphones

A TEDS (Transducer Electronic Data Sheet) microphone is a cartridge and a preamplifier assembled and sealed in a clean environment. The assembly has one type and serial number. Individual TEDS microphone information is programmed in a data chip inside the preamplifier. TEDS microphones are available with CCLD as well as classical preamplifiers. TEDS is standardized in compliance with IEEE 1454.4.



Uses and Features

Uses

- General sound measurements
- Measurement of dynamic pressure fluctuations

Features

- Plug-and-play
- Frequency: 1 Hz to 180 kHz
- Dynamic Range: 6.5 dB to 192 dB

Brüel & Kjær's TEDS Microphones

TEDS Microphone Benefits

The most important benefit of a TEDS microphone is that the actual identity and loaded sensitivity of the cartridge are programmed in the TEDS and thereby readily available for documentation and application purposes. For many Brüel & Kjær TEDS microphones, the individual frequency response is stored on a mini-CD under the S/N ratio of the microphone. During the manufacturing process the unit is sealed in a clean environment, thus eliminating contamination that could later result in reduced performance.

TEDS Templates

All Brüel & Kjær TEDS microphones, except Types 4957, 4958 and 4959, use a template that complies with IEEE P1454.4 V 0.9. A mapping that complies with IEEE 1454.4 V 1.0 is available free of charge for new TEDS microphones.

Data Transmission

Generally, there are two ways that data from the TEDS chip can be transmitted to the analyzer. The simpler way, class 2, uses a separate wire to transmit the data. For classical, LEMO type TEDS preamplifiers, pin 5 is often used for TEDS data transmission. In single-wire systems, like that used with CCLD, the same conductor is used both for signal and data transmission. This is made possible by using an electronic switch to control the mode of the wire (TEDS data or signal mode).

Selecting the Right TEDS Microphone

Brüel & Kjær offers a wide range of TEDS microphones, most of which are based on combined cartridges and preamplifiers that are available as individual units. The first selection criterion is often determined by the front-end input type: classical or CCLD. The second criterion can be the type of sound field for which the microphone is optimized.

Customer-specific TEDS Microphones

Customer-specific solutions can be made, so if you do not see what you are looking for please ask your local Brüel & Kjær sales office for a quote on a customized solution.

Common Specifications

The following pages contain short-form data for the TEDS microphones offered by Brüel & Kjær. For detailed specifications, please see the individual Product Data. Unless otherwise stated all specifications in this Product Data are valid under the following conditions:

CCLD Input Types	24 V compliance voltage
Classical Input Types	120 V _{DC} supply
Dynamic Range Low Limit	Noise floor dB A
Dynamic Range High Limit	3% distortion limit in dB SPL RMS rounded to nearest integer The undistorted peak level will normally be 3 dB higher
Cartridge Sensitivity	Nominal
TEDS Microphone Sensitivity	Stated as the nominal cartridge sensitivity except for small cartridges where the loaded sensitivity differs considerably from the open-circuit sensitivity

Most microphones come with an individual data CD and a calibration chart that includes the typical frequency response. Any microphones that do not include a CD and/or frequency response graph are noted below under each table.

Temperature Range

The read/write temperature range of the TEDS chip is guaranteed by the chip manufacturer up to 85 °C (185 °F) only, but the TEDS chip will survive the full specified temperature range of the TEDS microphone/preamplifier without any damage.

Standard preamplifier Types 2669, 2670, 2671 and 2699 go to 80 °C (176 °F). High-temperature preamplifier Type 1706 goes to 125 °C (257 °F). Remember also to use cables with the correct temperature range.

Cable Length

TEDS will normally work with cables up to 100 m (328 ft).

Sound Field

In the sections that follow, the microphone specifications are organized by the type of sound field that the microphones are designed to measure.

Free-field TEDS Microphones

Free-field microphones are designed to have a flat frequency response in a free field. At higher frequencies, reflections and diffractions cause a pressure increase in front of the diaphragm. If not corrected for, this would result in an increased output voltage from the microphone. Free-field optimization means that the frequency response of the microphone has been designed in such a way that a flat free-field frequency response at 0° angle of incidence is achieved.

Free-field microphones are commonly used for sound measurement in an anechoic chamber or far away from reflecting buildings, etc. Another application area for free-field microphones is general electroacoustic purposes, like loudspeaker and microphone measurements.

Table 1 Free-field TEDS microphones with Type 4188 ½" cartridge

Input	Microphone	Preamplifier	mV/Pa	dB re 1 V/Pa	±2 dB Frequency Range (Hz)	Dynamic Range (dB)
Classical	Type 4188-C/L-001	Type 2669-C/L	31.6	−30	8 to 12.5 k	15.8 to 146
CCLD	Type 4188-A-021	Type 2671	31.6	−30	20 to 12.5 k	19 to 138

Type 4188 is suited for free-field measurements where an extra-robust prepolarized microphone with medium sensitivity is required
Type 4188 TEDS microphones do not come with a data CD nor with typical frequency response on the calibration chart

Table 2 Free-field TEDS microphones with Type 4189 ½" cartridge

Input	Microphone	Preamplifier	mV/Pa	dB re 1 V/Pa	±2 dB Frequency Range (Hz)	Dynamic Range (dB)
Classical	Type 4189-B/C/L-001	Type 2669-B/C/L	50	−26	6.3 to 20 k	15.2 to 146
CCLD	Type 4189-A-021	Type 2671	50	−26	20 to 20 k	16.5 to 134
CCLD	Type 4189-A-031	Type 2699	50	−26	A-weighted*	18 to 131
CCLD	Type 4189-W-003	Type 2671-W-001	50	−26	6.3 to 20 k	16.5 to 134
CCLD	Type 4189-H-041	Type 1706	50	−26	6.3 to 20 k	16.5 to 134

Type 4189 is suited for free-field measurements where a high-sensitivity prepolarized microphone with full 20 kHz bandwidth is preferred

*For more information on A-weighting, see Type 2699 Product Data [BP2009](#)

Table 3 Free-field TEDS microphones with Type 4190 ½" cartridge

Input	Microphone	Preamplifier	mV/Pa	dB re 1 V/Pa	±2 dB Frequency Range (Hz)	Dynamic Range (dB)
Classical	Type 4190-B/C/L-001	Type 2669-B/C/L	50	−26	3.15 to 20 k	15 to 148

Type 4190 is designed for free-field measurements where a high-sensitivity externally polarized microphone with full 20 kHz bandwidth is preferred

Table 4 Free-field TEDS microphones with Type 4191 ½" cartridge

Input	Microphone	Preamplifier	mV/Pa	dB re 1 V/Pa	±2 dB Frequency Range (Hz)	Dynamic Range (dB)
Classical	Type 4191-B/C/L-001	Type 2669-B/C/L	12.5	−38	3.15 to 40 k	21.4 to 162

Type 4191 is designed for free-field measurements where a wideband externally polarized microphone is required

Table 5 Free-field TEDS microphones with Type 4939 ¼" cartridge

Input	Microphone	Preamplifier	mV/Pa	dB re 1 V/Pa	±2 dB Frequency Range (Hz)	Dynamic Range (dB)
Classical	Type 4939-A-011	Type 2670	4	−48	4 to 100 k	35 to 164
Classical	Type 4939-C/L-002	Type 2669-C/L with UA-0035	3.5	−49	4 to 100 k	35 to 164

Type 4939 is designed for free-field measurements where a high-frequency, high-level externally polarized microphone is required

Table 6 Free-field TEDS microphones with Type 4954 ¼" cartridge

Input	Microphone	Preamplifier	mV/Pa	dB re 1 V/Pa	±2 dB Frequency Range (Hz)	Dynamic Range (dB)
Classical	Type 4954-A-011	Type 2670	2.8	–51	3 to 80 k	34 to 164
CCLD	Type 4954-A	Integral with SMB	2.8	–51	16 to 80 k	40 to 159
CCLD	Type 4954-B	Integral with 10–32 UNF	2.8	–51	16 to 80 k	40 to 159

Type 4954 is designed for free-field measurements where a high-frequency, high-level prepolarized microphone is required

Table 7 Free-field TEDS microphones with Type 4966 ½" cartridge

Input	Microphone	Preamplifier	mV/Pa	dB re 1 V/Pa	±2 dB Frequency Range (Hz)	Dynamic Range (dB)
CCLD	Type 4966-H-041	Type 1706	50	–26	6.3 to 20 k	16.5 to 134

Type 4966 is suited for free-field measurements where a high-sensitivity prepolarized microphone with full 20 kHz bandwidth is preferred

Pressure-field TEDS Microphones

Pressure-field microphones are optimized to have a flat frequency response in a pressure field. They are used for measurements in small, closed couplers or close to hard, reflective surfaces.

Table 8 Pressure-field TEDS microphones with Type 4192 ½" cartridge

Input	Microphone	Preamplifier	mV/Pa	dB re 1 V/Pa	±2 dB Frequency Range (Hz)	Dynamic Range (dB)
Classical	Type 4192-B/C/L-001	Type 2669-B/C/L	12.5	–38	3.15 to 20 k	20.7 to 162

Type 4192 is designed for pressure-field measurements where a high-sensitivity externally polarized microphone with full 20 kHz bandwidth is preferred

Table 9 Prepolarized pressure-field TEDS microphones with Type 4956 ½" cartridge

Input	Microphone	Preamplifier	mV/Pa	dB re 1 V/Pa	±2 dB Frequency Range (Hz)	Dynamic Range (dB)
CCLD	Type 4956-W-001	Type 2671-W-001	12.5	–38	3.5 to 20 k	26.5 to 135

Type 4956 is designed for pressure-field measurements where a high-frequency, high-level externally polarized microphone is required

Table 10 Pressure-field TEDS microphones with Type 4938 ¼" cartridge

Input	Microphone	Preamplifier	mV/Pa	dB re 1 V/Pa	±2 dB Frequency Range (Hz)	Dynamic Range (dB)
Classical	Type 4938-A-011	Type 2670	1.4	–57	4 to 70 k	42 to 172
Classical	Type 4938-B/C/L-002	Type 2669-B/C/L with UA-0035	1.4	–57	4 to 70 k	42 to 172

Type 4938 is designed for pressure-field measurements where a high-frequency, high-level externally polarized microphone is required

Table 11 Pressure-field TEDS microphones with Type 4944 ¼" cartridge

Input	Microphone	Preamplifier	mV/Pa	dB re 1 V/Pa	±2 dB Frequency Range (Hz)	Dynamic Range (dB)
Classical	Type 4944-A	Integral with SMB	0.9	–61	16 to 70 k	48 to 169
Classical	Type 4944-B	Integral with 10–32 UNF	0.9	–61	16 to 70 k	48 to 169

Type 4944 is designed for pressure-field measurements where a high-frequency, high-level prepolarized microphone is required

Table 12 Pressure-field TEDS microphones with Type 4138 1/8" cartridge

Input	Microphone	Preamplifier	mV/Pa	dB re 1 V/Pa	±2 dB Frequency Range (Hz)	Dynamic Range (dB)
Classical	Type 4138-A-015	Type 2670 with UA-0160	0.56	–65	6.5 to 140 k	52.2 to 168
Classical	Type 4138-B/C/L-006	Type 2669-B/C/L with UA-0036	0.8	–62	6.5 to 140 k	52.2 to 168

Type 4138 is designed for pressure-field measurements where an absolute maximal frequency range is required. This microphone is externally polarized. Type 4138 TEDS microphones do not come with a data CD nor with typical frequency response on the calibration chart.

Diffuse-field TEDS Microphones

Diffuse-field microphones, also called random-incidence microphones, are designed to have a flat response to signals arriving simultaneously from all directions – that is, a random or diffuse field. They should be used in all situations where the sound field is diffuse, and where several sources contribute to the sound pressure at the measurement position. Applications include indoor measurements where the sound is reflected by walls, ceilings and objects in the room, including in reverberation chambers, and in-cabin measurements.

Table 13 Diffuse-field TEDS microphones with Type 4942 ½" cartridge

Input	Microphone	Preamplifier	mV/Pa	dB re 1 V/Pa	±2 dB Frequency Range (Hz)	Dynamic Range (dB)
Classical	Type 4942-B/C/L-001	Type 2669-B/C/L	50	–26	6.3 to 16 k	15.2 to 146
CCLD	Type 4942-A-021	Type 2671	50	–26	20 to 16 k	18 to 134
CCLD	Type 4942-A-031	Type 2699	50	–26	A-weighted	18 to 131
CCLD	Type 4942-H-041	Type 1706	50	–26	6.3 to 20 k	18 to 134

Type 4942 is designed for diffuse-field measurements where a high-sensitivity prepolarized microphone with wide bandwidth is preferred.

Table 14 Diffuse-field TEDS microphones with Type 4943 ½" cartridge

Input	Microphone	Preamplifier	mV/Pa	dB re 1 V/Pa	±2 dB Frequency Range (Hz)	Dynamic Range (dB)
Classical	Type 4943-B/C/L-001	Type 2669-B/C/L	50	–26	3.15 to 10 k	15.9 to 148

Type 4943 is designed for diffuse-field measurements where a high-sensitivity externally polarized microphone is preferred.

Special TEDS Microphones

A number of special TEDS microphones are available:

- Infrasound Microphone Type 4193
- High-intensity Pressure-field Microphones Type 4941
- Aerospace Surface Microphone Type 4948
- Automotive Surface Microphone Type 4949
- Low-noise Free-field Microphone Type 4955
- Low-noise Free-field Microphone Type 4955-A, for hand-held analyzers such as Type 2250/2270
- 10 kHz Array Microphone Type 4957
- 20 kHz Array Microphone Type 4958
- Short 20 kHz Array Microphone Type 4959
- Multi-field Microphone Type 4961

Table 15 *Special TEDS Microphones*

Input	Microphone	Preamplifier	mV/Pa	dB re 1 V/Pa	±2 dB Frequency Range (Hz)	Dynamic Range (dB)
Classical	Type 4193-B/C/L-004	Type 2669-B/C/L with UC-0211	2	−54	0.1 to 20 k	29 to 148
Classical	Type 4941-A-011	Type 2670	0.08	−82	4 to 20 k	73.5 to 184
Classical	Type 4941-C-002	Type 2669-C with UA-0035	0.08	−82	4 to 20 k	75.8 to 184
Classical	Type 4955	Integral	1100	0.8	10 to 16 k	6.5 to 110
Classical	Type 4955-A	Integral	1100	0.8	10 to 16 k	6.5 to 110
CCLD	Type 4948	Integral	1.4	−57	5 to 20 k *	55 to 160
CCLD	Type 4949	Integral	11.2	−39	5 to 20 k *	30 to 140
CCLD	Type 4957	Integral	11.2	−39	50 to 10 k	32 to 134
CCLD	Type 4958	Integral	11.2	−39	10 to 20 k	28 to 140
CCLD	Type 4959	Integral	11.2	−39	50 to 20 k	32 to 134
CCLD	Type 4961	Integral	60	−24.5	12 to 20 k	20 to 130

* ±3 dB pressure response limits

Types 4941, 4957, 4958 and 4959 microphones do not come with an individual data CD nor with typical frequency response on the calibration chart

Ordering Information

If you do not see what you are looking for, please ask your local Brüel & Kjær sales office for a quote on a customized solution.

Order No.	Mini CD Incl.	Description
Type 4101-A	No	Binaural Microphone
Type 4138-A-015	No	Pressure-field 1/8" Mic. Type 4138, Preamp. Type 2670, Adaptor UA-0160
Type 4138-B-006*	No	Pressure-field 1/8" Mic. Type 4138, Preamp. Type 2669-B, Adaptor UA-0036
Type 4138-C-006	No	Pressure-field 1/8" Mic. Type 4138, Preamp. Type 2669-C, Adaptor UA-0036
Type 4138-L-006	No	Pressure-field 1/8" Mic. Type 4138, Preamp. Type 2669-L, Adaptor UA-0036
Type 4188-C-001	No	Prepolarized Free-field 1/2" Mic. Type 4188, Preamp. Type 2669-C
Type 4188-L-001	No	Prepolarized Free-field 1/2" Mic. Type 4188, Preamp. Type 2669-L
Type 4188-A-021	No	Prepolarized Free-field 1/2" Mic. Type 4188, Preamp. Type 2671
Type 4189-B-001*	Yes	Prepolarized Free-field 1/2" Mic. Type 4189, Preamp. Type 2669-B
Type 4189-C-001	Yes	Prepolarized Free-field 1/2" Mic. Type 4189, Preamp. Type 2669-C
Type 4189-L-001*	Yes	Prepolarized Free-field 1/2" Mic. Type 4189, Preamp. Type 2669-L
Type 4189-A-021	Yes	Prepolarized Free-field 1/2" Mic. Type 4189, Preamp. Type 2671
Type 4189-A-031	Yes	Prepolarized Free-field 1/2" Mic. Type 4189, Preamp. Type 2699
Type 4189-H-041	Yes	Prepolarized Free-field 1/2" Mic. Type 4189, Preamp. Type 1706
Type 4189-W-003	Yes	Prepolarized Free-field 1/2" Mic. Type 4189, Preamp. Type 2671-W-001
Type 4190-B-001*	Yes	Free-field 1/2" Mic. Type 4190, Preamp. Type 2669-B
Type 4190-C-001	Yes	Free-field 1/2" Mic. Type 4190, Preamp. Type 2669-C
Type 4190-L-001	Yes	Free-field 1/2" Mic. Type 4190, Preamp. Type 2669-L
Type 4190-L-002	Yes	Free-field 1/2" Mic. Type 4190, Preamp. Type 2669-L, Adaptor UA-1260
Type 4191-B-001*	Yes	Free-field 1/2" Mic. Type 4191, Preamp. Type 2669-B
Type 4191-C-001	Yes	Free-field 1/2" Mic. Type 4191, Preamp. Type 2669-C
Type 4191-L-001	Yes	Free-field 1/2" Mic. Type 4191, Preamp. Type 2669-L
Type 4192-B-001*	Yes	Pressure-field 1/2" Mic. Type 4192, Preamp. Type 2669-B
Type 4192-C-001	Yes	Pressure-field 1/2" Mic. Type 4192, Preamp. Type 2669-C
Type 4192-L-001	Yes	Pressure-field 1/2" Mic. Type 4192, Preamp. Type 2669-L
Type 4193-B-004*	Yes	Pressure-field 1/2" Mic. Type 4193, Preamp. Type 2669-B, Adaptor UC-0211
Type 4193-C-004	Yes	Pressure-field 1/2" Mic. Type 4193, Preamp. Type 2669-C, Adaptor UC-0211
Type 4193-L-004	Yes	Pressure-field 1/2" Mic. Type 4193, Preamp. Type 2669-L, Adaptor UC-0211
Type 4938-A-011	Yes	Pressure-field 1/4" Mic. Type 4938, Preamp. Type 2670
Type 4938-C-002	Yes	Pressure-field 1/4" Mic. Type 4938, Preamp. Type 2669-C, Adaptor UA-0035
Type 4938-L-002	Yes	Pressure-field 1/4" Mic. Type 4938, Preamp. Type 2669-L, Adaptor UA-0035
Type 4939-A-011	Yes	Free-field 1/4" Mic. Type 4939, Preamp. Type 2670
Type 4939-C-002	Yes	Free-field 1/4" Mic. Type 4939, Preamp. Type 2669-C, Adaptor UA-0035
Type 4939-L-002	Yes	Free-field 1/4" Mic. Type 4939, Preamp. Type 2669-L, Adaptor UA-0035
Type 4941-A-011	No	High-level Pressure-field 1/4" Mic. Type 4941, Preamp. Type 2670
Type 4941-C-002	No	High-level Pressure-field 1/4" Mic. Type 4941, Preamp. Type 2669-C, Adaptor UA-0035
Type 4942-B-001*	Yes	Prepolarized Diffuse-field 1/2" Mic. Type 4942, Preamp. Type 2669-B
Type 4942-C-001	Yes	Prepolarized Diffuse-field 1/2" Mic. Type 4942, Preamp. Type 2669-C
Type 4942-L-001	Yes	Prepolarized Diffuse-field 1/2" Mic. Type 4942, Preamp. Type 2669-L
Type 4942-A-021	Yes	Prepolarized Diffuse-field 1/2" Mic. Type 4942, Preamp. Type 2671
Type 4942-A-031	Yes	Prepolarized Diffuse-field 1/2" Mic. Type 4942, Preamp. Type 2699
Type 4942-H-041	Yes	Prepolarized Diffuse-field 1/2" Mic. Type 4942, Preamp. 1706

Order No.	Mini CD Incl.	Description
Type 4943-B-001*	Yes	Diffuse-field 1/2" Mic. Type 4943, Preamp. Type 2669-B
Type 4943-C-001	Yes	Diffuse-field 1/2" Mic. Type 4943, Preamp. Type 2669-C
Type 4943-L-001	Yes	Diffuse-field 1/2" Mic. Type 4943, Preamp. Type 2669-L
Type 4944-A	No	Pressure-field 1/4" Mic. Type 4944 with SMB socket
Type 4944-B	No	Pressure-field 1/4" Mic. Type 4944 with 10–32 UNF socket
Type 4948	No	Aerospace Surface Microphone
Type 4949	No	Automotive Surface Microphone
Type 4954-A	No	Free-field 1/4" Mic. Type 4954 with SMB socket
Type 4954-B	No	Free-field 1/4" Mic. Type 4954 with 10–32 UNF socket
Type 4954-A-011	Yes	1/4" Prepolarized Free-field Mic. Type 4954, Preamp. Type 2670
Type 4955	Yes	1/2" Low-noise Free-field Microphone
Type 4955-A	Yes	1/2" Low-noise Free-field Microphone for hand-held analyzers such as Type 2250/2270
Type 4956-W-001	Yes	Prepolarized Pressure-field 1/2" Mic. Type 4956 with Preamp. Type 2671-W-001
Type 4957†	No	10 kHz Array Microphone
Type 4958‡	No	20 kHz Precision Array Microphone
Type 4959	No	Short 20 kHz Array Microphone
Type 4966-H-041	Yes	Prepolarized Free-field 1/2" Mic. Type 4966 with Preamp. Type 1706
Other TEDS Related Equipment		
BZ-5294	–	TEDS Editor Kit
ZZ-0245	–	In-line TEDS Adaptor for CCLD Transducer without TEDS
Type 2467-A	–	1 mV/pC Charge to CCLD Converter with TEDS
Type 2647-B	–	10 mV/pC Charge to CCLD Converter with TEDS
Type 2647-C	–	0.1 mV/pC Charge to CCLD Converter with TEDS

* These types are delivered with a LEMO to Brüel & Kjær cable AO-0428. This cable does **NOT** support TEDS

† TEDS to IEEE 1454.4, V1.0, UDID No. 127–0–0–0U

‡ TEDS to IEEE 1454.4, V1.0, UDID No. 127–0–0–1 U with complex transfer function

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Brüel & Kjær 



PRODUCT DATA

½" Prepolarized Infrasound Microphone Type 4964

Type 4964 is designed for high-precision, acoustic measurements where an infrasound microphone with high sensitivity is required. Being prepolarized, Type 4964 can be used with both CCLD and classical preamplifiers.

Uses

- General noise measurements
- Wind turbine measurements
- Sonic boom measurements

Features

- Sensitivity: 50 mV/Pa
- Frequency: 0.02 Hz – 20 kHz (± 3 dB)
- Dynamic Range: 14.6 – 146 dB
- Temperature: -30 to $+150^{\circ}\text{C}$ (-22 to $+302^{\circ}\text{F}$)
- Polarization: Pre-polarized



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Use of Free-field Microphones

Free-field means that the frequency response at 0 degrees incidence is flat. Free-field microphones are commonly used, for example, for recording sound measurements in anechoic chambers and far away from reflecting buildings. Another area for free-field microphones is for general electroacoustic measurement purposes like loudspeaker and microphone measurements.

At infrasound and frequencies below a few kHz, the pressure and free-field response are the same. At higher frequencies, reflections and diffractions cause pressure to increase in front of a microphone's diaphragm. Type 4964 has been optimized for free-field, and designed for use with the protection grid in place.

Type 4964 is also suited for use in class 1 sound level meters and for all high-precision acoustic measurements where a robust and stable free-field microphone with an upper frequency of 20 kHz is required.

Manufacturing and Stability

A press-fitted, stainless-steel diaphragm ensures superior long-term stability and mechanical robustness – Type 4964 will withstand the 1 m drop test of IEC 60068–2–32.

All Brüel & Kjær measuring microphones are assembled in a clean room. This ensures that the microphones maintain their inherent low noise floor and high stability, even when used in environments with a combination of high humidity and high temperature.

Polarization Voltage

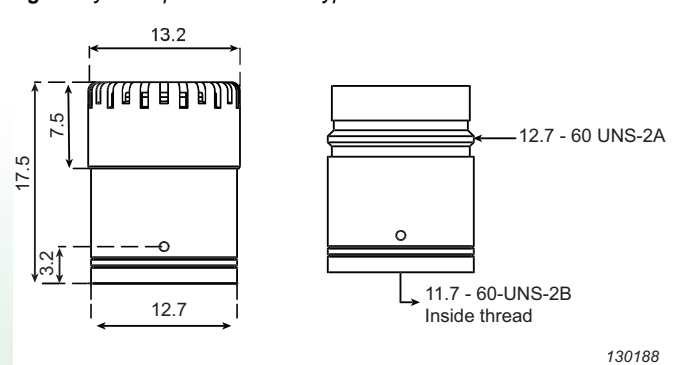
Being prepolarized, Type 4964 is especially well-suited for battery operated equipment and operation in environments with high humidity.

Individual Calibration Data

Each Type 4964 comes with an individual calibration chart including information about the open-circuit sensitivity, the frequency response in a free field as well as the electrostatic actuator response.

An enclosed mini-CD contains the individual calibration data at 1/12-octave frequencies plus a wealth of technical information, such as the influence of different accessories, response in different sound fields and much more. Using the CD data and the REq-X feature of PULSE™, a real-time correction for different measurement situations, can increase measurement accuracy.

Fig. 1 Physical specifications of Type 4964



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Specifications – Prepolarized Infrasound Microphone Type 4964 (valid for serial number 2495 387)

Specification	Value
IEC 61094–4 Type Designation	WS2F
Polarization Voltage (external)	0 V (prepolarized)
Open-circuit Sensitivity (250 Hz) [*]	50 mV/Pa, –26 dB ± 1.5 dB re 1 V/Pa
0° Incidence Free-field Response [*]	0.04 Hz to 8 kHz: ± 1 dB 0.03 Hz to 20 kHz: ± 2 dB
Lower Limiting Frequency (–3 dB) [*]	0.01 to 0.05 Hz
Pressure Equalization Vent	Rear vented
Diaphragm Resonance Frequency	14 kHz (90° phase shift)
Cartridge Capacitance (Polarized) [*]	14 pF at 250 Hz
Equivalent Air Volume	46 mm ³ (250 Hz)
Pistonphone Correction	0.00 dB (with Type 4228 and DP-0776)
Cartridge Thermal Noise	14.6 dB(A), 15.3 dB(Lin)
Upper Limit of Dynamic Range [†]	3% Distortion: >148 dB SPL Max. SPL: 158 dB (peak)
Environmental	
Operating Temperature Range	–30 to +150°C (–22 to +302°F)
Storage Temperature (in Microphone Box)	–30 to +70°C (–22 to +158°F) With mini-CD: +5 to +150°C (+41 to 122°F)
Temperature Coefficient (250 Hz)	–0.006 dB/K (–10 to +50°C/+14 to 122°F)
Pressure Coefficient	–0.01 dB/kPa
Operating Humidity Range	0 to 100% RH (without condensation)
Influence of Humidity	<0.1 dB in the absence of condensation
Vibration Sensitivity (<1000 Hz)	62.5 dB, ≈ SPL for 1 m/s ² axial vibration
Magnetic Field Sensitivity	6 dB SPL for 80 A/m, 50 Hz field
Estimated Long-term Stability	>1 dB/1000 years in dry air at 20°C (68°F) >2 hours/ dB in dry air at 150°C (302°F) >40 years/ dB in air at 20°C (68°F), 90% RH >1 dB/year in air at 50°C (122°F), 90% RH
Physical	
Thread for Preamplifier Mounting	11.7 mm–60 UNS
Diameter with Grid	13.2 mm (0.52")
Diameter without Grid	12.7 mm (0.50")
Height with Grid	17.6 mm (0.69")
Height without Grid	16.3 mm (0.64")

^{*} Individually calibrated

[†] 137 dB (peak) with CCLD preamplifier and 24 V supply and 140 (peak) with ±15 V supply

Ordering Information

Type 4964 ½" Prepolarized Infrasound Microphone Type 4964

Includes the following accessories:

- BC-0224: Calibration Chart[‡]
- BC-5002: Microphone Mini-CD[‡]

Optional Accessories	
Type 1706	½" CCLD High Temperature Preamplifier
Type 2669	½" Microphone Preamplifier
2671-W-001	½" CCLD Preamplifier (version with LLF <1.2 Hz)
Type 2699	½" CCLD Preamplifier, A-weighted
Type 4231	Sound Calibrator
Type 4228	Pistonphone
Type 4226	Multifunction Acoustic Calibrator
DP-0776	Calibration Adapter for ½" Microphones
UA-0033	Electrostatic Actuator
UA-1260	½" Angle Adaptor (approx. 80°)
UA-0386	Nose Cone for ½" Microphone
UA-0237	Windscreen for ½" microphone, 90 mm diameter
UA-0459	Windscreen for ½" Microphone, 65 mm diameter
Calibration Services	
4964-CAI	Accredited Initial Calibration
4964-CAF	Accredited Calibration
4964-CFF	Factory Standard Calibration



Compliance with EMC Directive and Low Voltage Directive of the EU
Compliance with the EMC requirements of Australia and New Zealand

[‡] State microphone serial number if re-ordering calibration data

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Brüel & Kjær



½" Prepolarized Free-field Microphone Type 4966

Type 4966 is designed for high-precision, free-field measurements where a microphone with high sensitivity is required. Being prepolarized, Type 4966 can be used with both CCLD[‡] and classical Brüel & Kjær preamplifiers.



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Uses

- Precision sound-measurements
- General purpose sound-measurements
- Electroacoustic measurements

Features

- Sensitivity: 50 mV/Pa
- Frequency: 5 Hz to 20 kHz
- Dynamic Range: 14.6 to 144 dB
- Temperature: –30 to +150 °C (–22 to +302 °F)

Description

Type 4966 is a robust and stable free-field microphone cartridge designed for high-precision acoustic measurements. It is developed and refined for measurements where a high sensitivity microphone with a full 20 kHz bandwidth is preferred and is optimized for use with the protection grid in place. Type 4966 is prepolarized, so it is well suited for use in battery-operated equipment and environments with high humidity.

Because this microphone is optimized for free-field environments, it has a flat free-field response at 0° incidence. This makes Type 4966 ideal for use in anechoic chambers or far away from reflective surfaces, such as buildings, and for general electroacoustic measurement purposes, such as loudspeaker and microphone measurements.

Manufacturing and Stability

The press-fitted, stainless-steel diaphragm of Type 4966 ensures superior long-term stability and mechanical robustness, withstanding the 1 m drop test according to IEC 60068–2–32.

All Brüel & Kjær measuring microphones are assembled in a clean room. This ensures that the microphones maintain their low noise floor and high stability even in environments with a combination of high humidity and high temperature.

TEDS Microphone

Type 4966-H-041 is a transducer electric data sheet (TEDS) combination of Type 4966 and High-temperature CCLD Microphone Preamplifier Type 1706. The TEDS template is based on IEEE P1451.4 and programmed with the loaded sensitivity of the actual cartridge. This combination can be used for measurements up to 125 °C (257 °F) making it suitable for

use in a broad range of applications. Brüel & Kjær offers a selection of cables, including cables for use at higher temperatures.

TEDS microphones are considered one unit because the cartridge is sealed to the preamplifier in production.

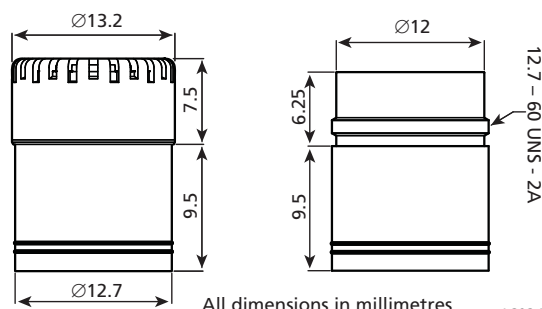
Individual Calibration Data

All calibration data for Brüel & Kjær transducers is now available electronically. Find calibration charts and correction factors at bksv.com/calibrationdata and select Search Calibrations.

Calibration charts include information about the open-circuit sensitivity, the frequency response in a free field and the electrostatic actuator response.

Correction factors contain individual calibration data at 1/12-octave frequencies and technical information, such as the influence of different accessories and the microphone's response in different sound fields. For example, use data and the REq-X feature of PULSE™ for a real-time correction under different measurement situations to increase measurement accuracy.

Fig. 1 Dimensions of Type 4966

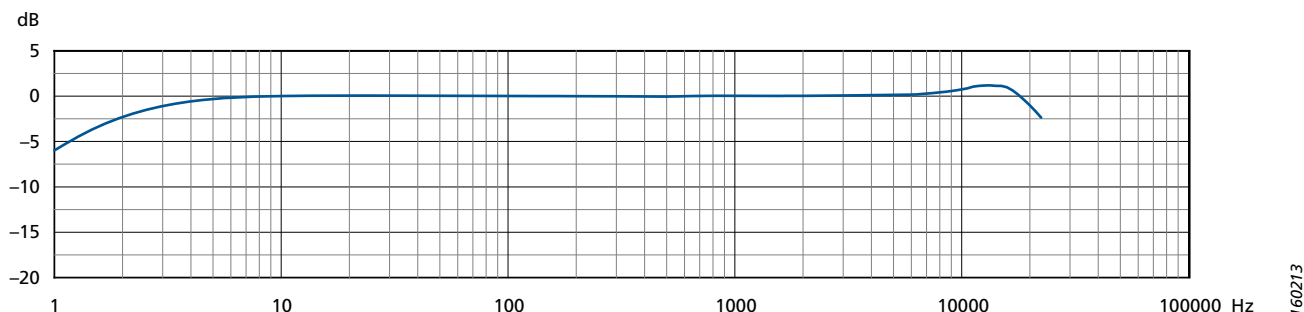


All dimensions in millimetres

160249

‡ CCLD: Constant current line drive, also known as DeltaTron® (IEPE compatible)

Fig. 2 Typical free-field response of the microphone cartridge with protection grid. The low-frequency response is valid when the vent is exposed to the sound field



Specifications – III " Free-field Microphone Type 4966

Type No.	4966
General	
IEC 61094–4 Type Designation	WS2F
Polarization Voltage	0 V (prepolarized)
Open-circuit Sensitivity (250 Hz)*	50 mV/Pa, -26 ± 1.5 dB re 1 V/Pa
0° Incidence Free-field Response*	10 Hz to 8 kHz: ± 1 dB 5 Hz to 20 kHz: ± 2 dB
Lower Limiting Frequency (LLF)(–3 dB)*	1 to 3 Hz
Pressure Equalization Vent	Rear vented
Cartridge Capacitance*	14 pF at 250 Hz
Pistonphone Correction (Type 4228 with DP-0776)	0.00 dB
Cartridge Thermal Noise	14.9 dB(A), 15.4 dB(Lin)
Upper Limit of Dynamic Range (3% Distortion)	>144 dB SPL†
Max. Sound Pressure Level	158 dB (peak)
Environmental	
Operating Temperature Range	-30 to $+150$ °C (-22 to $+302$ °F)
Storage Temperature In Microphone Box	-30 to $+70$ °C (-22 to $+158$ °F)
With Mini-CD	5 to 50 °C (41 to 122 °F)
Temperature Coefficient (250 Hz)	$+0.003$ dB/K (-10 to $+50$ °C, 14 to 122 °F)
Pressure Coefficient	-0.012 dB/kPa
Operating Humidity Range	0 to 100% RH (without condensation)
Influence of Humidity	<0.1 dB in the absence of condensation
Vibration Sensitivity (<1000 Hz)	62.5 dB equivalent SPL for 1 m/s^2 axial vibration
Magnetic Field Sensitivity	6 dB SPL for 80 A/m, 50 Hz field
Estimated Long-term Stability	<1 dB/1000 years in dry air at 20 °C (68 °F)
	<1 dB/2 hours in dry air at 150 °C (302 °F)
	<1 dB/40 years in 90% RH at 20 °C (68 °F)
	<1 dB/1 year in 90% RH at 50 °C (122 °F)

* Individually calibrated

† 137 dB (peak) with DeltaTron preamplifier and 24 V supply and 140 dB (peak) with ± 15 V supply

All values are typical at 23 °C (73.4 °F), 101.3 kPa and 50% RH unless otherwise specified

Ordering Information

Type 4966 $\frac{1}{2}$ " Prepolarized Free-field Microphone‡

TEDS COMBINATION

Type 4966-H-041 Type 4966 with Type 1706‡

OPTIONAL ACCESSORIES

Type 2669 $\frac{1}{2}$ " Microphone Preamplifier
Type 1706 $\frac{1}{2}$ " CCLD Microphone Preamplifier (LLF: <3 Hz)

Type 2671-W-001 $\frac{1}{2}$ " CCLD Microphone Preamplifier (LLF: <1.2 Hz)

Type 2699 $\frac{1}{2}$ " CCLD Microphone Preamplifier, A-weighted

Type 4231 Sound Calibrator

Type 4228 Pistonphone

Type 4226 Multifunction Acoustic Calibrator

DP-0776 Calibration Adaptor for $\frac{1}{2}$ " Microphones

UA-0033 Electrostatic Actuator

UA-1260 $\frac{1}{2}$ " Angle Adaptor (approx. 80°)

UA-0386 Nose Cone, $\frac{1}{2}$ " microphone

UA-0237 Windscreen, $\frac{1}{2}$ " microphone, $\varnothing 90$ mm

UA-0459 Windscreen, $\frac{1}{2}$ " microphone, $\varnothing 65$ mm

CALIBRATION SERVICES

4966-CAI Accredited Initial Calibration

4966-CAF Accredited Calibration

4966-CFF Factory Standard Calibration

COMPLIANCE WITH STANDARDS



‡ Calibration data can be found at bksv.com

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