Product Data

Probe Microphone — Type 4182

USES:

- ❍ Near-field measurement of loudspeakers
- ❍ Investigation of sound distribution inside:
  - Telephone equipment
  - Hi-Fi headphones
  - Musical instruments
- ❍ Measurement of noise radiation from intricate machinery
- ❍ Measurement of attenuation in hearing protectors
- ❍ Acoustic impedance measurements

FEATURES:

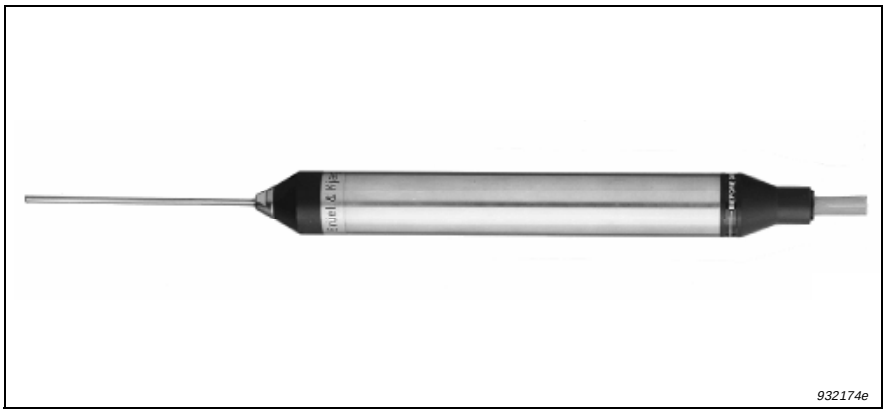
- ❍ Smooth frequency response characteristic between 1 Hz and 20 kHz
- ❍ Small size and lightweight (only 45 g (1.47 oz))
- ❍ Selection of interchangeable stiff and flexible probe tubes
- ❍ Probe-tip can withstand temperatures up to 700°C (1292°F)
- ❍ High acoustic impedance
- ❍ Pressure equalization with the measurement site

Probe Microphone Type 4182 allows sound pressure measurements to be made in small or awkward places or in harsh environments where a conventional microphone would be unsuitable. The probe microphone has a smooth frequency response from 1 Hz to 20 kHz, with a very smooth high-frequency roll-off.

Physically, it is very small and lightweight and has a durable construction. Measurements can be performed extremely close to the sound source due to its small size. Measurement points can be closely spaced when it is necessary to have high spatial resolution.

The high impedance of the narrow probe tip enables measurements in very small volumes – as small as 1 cm^3 with only minor effects due to acoustic loading. Interchangeable stiff and flexible probe tubes, of various lengths, make the probe microphone very adaptable for measurements in awkward places (for safety reasons Probe Microphone Type 4182 is not suitable for measurements on the human body).

The static pressure inside the probe microphone can be equalised to that of the measurement site.



Description

Frequency Response

Probe Microphone Type 4182 is distinguished by a smooth frequency response between 1 Hz and 20 kHz, with a very smooth high-frequency roll-off. This smooth response means you can use equalization or a post-processing correction. Fig. 1 shows four individual frequency response curves for the probe microphone, each measured with a different length of stiff probe tube. The high-frequency roll-off increases for increasing probe tube length. The differences in low frequency responses are dependent on static pressure equalization. The probe microphone is individually calibrated with the 50 mm tube attached.

Using the probe microphone allows you to make measurements in very harsh conditions. The tips of the 100 mm and 200 mm stiff probe tubes can withstand temperatures of up to 700°C.

Response with Flexible Probe Tubes

For very difficult measurement situations, you can fit a flexible probe tube on the probe microphone. The frequency response will, however, be slightly different. 150 cm of the flexible probe tubing is included. Fig. 2 shows the frequency response with flexible probe tubes attached. The more severe high-frequency roll-off is due to the narrower internal diameter of the flexible tubing. You should calibrate the probe microphone when using the flexible tubing.

Construction

An important design feature of Probe Microphone Type 4182 is the internal, impedance matching tube surrounding the preamplifier. This impedance matching tube is used to match the impedance at the exit of

the tiny cavity in front of the microphone diaphragm. This significantly reduces the effects of reflections within the probe tube and provides the microphone with its characteristic smooth response.

Fig. 4 is a simplified drawing showing the continuous passage formed by the probe tube, the cavity in front of the microphone diaphragm and the impedance matching tube.

You can make measurements in high-pressure environments by connecting a tube from the external vent into the measurement environment to equalize the static pressure.

The narrow probe tubes provide the probe microphone with a very high acoustic impedance (approx. 8×10^8 Ns/m^5). Above 50 Hz, there is negligible acoustic loading to volumes of 1 cm^3 or greater.

Noise and Crosstalk

Careful design means that the probe microphone has a low sensitivity to unwanted acoustic signals that could be transmitted through the probe body and tube walls. The curves in Fig. 3 represent the typical sensitivity of the microphone with the probe tip open and closed. Up to 500 Hz, the sensitivity of the microphone with a closed tip decreases by 6 dB/octave due to sound arriving at the pressure equalization vent. The A-weighted inherent noise of the probe microphone is less than 42 dB SPL.

Microphone and Preamplifier

The built-in microphone is similar to a standard Brüel & Kjær $^1/_4$″ condenser microphone. The probe microphone can be connected to the Preamplifier Input of any Brüel & Kjær frequency analyzer or measuring amplifier. The output characteristics of the integral preamplifier are similar to those of Microphone Preamplifier Type 2670. Probe Microphone Type 4182 requires a 200 V polarization voltage.

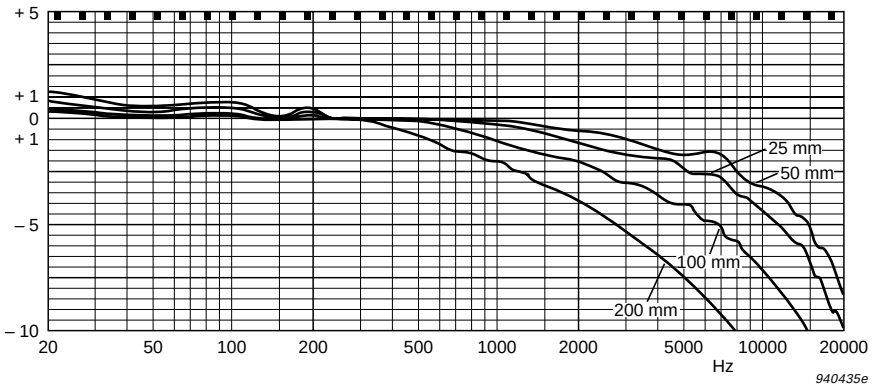


Fig. 1 Typical frequency responses for various stiff probe tube lengths

Accessories

Sensitivity Calibration

Use Adaptor UA 0929 for sensitivity calibration of the probe microphone with Pistonphone Type 4228 or Sound Level Calibrator Type 4231. Type 4182 is supplied with an adaptor ZG 0350 for connection to traditional Brüel & Kjær microphone sockets.

Frequency Response Check and Calibration

Check the frequency response using Calibration Coupler UA 0922 together with Transmitter Adaptor UA 0920. The adaptor uses Condenser Microphone Type 4188 (available separately) as a sound source. You can use Condenser Microphone Type 4136 (available separately) as a reference microphone when you are making a frequency response calibration.

Examples of Use

Probe Microphone Type 4182 is ideal for measuring very close to a sound source. For example, measurements on loudspeakers, automobile engines, or making in-situ measurements on headphones, hearing protectors, telephones and musical instruments. For safety reasons, measurements on the

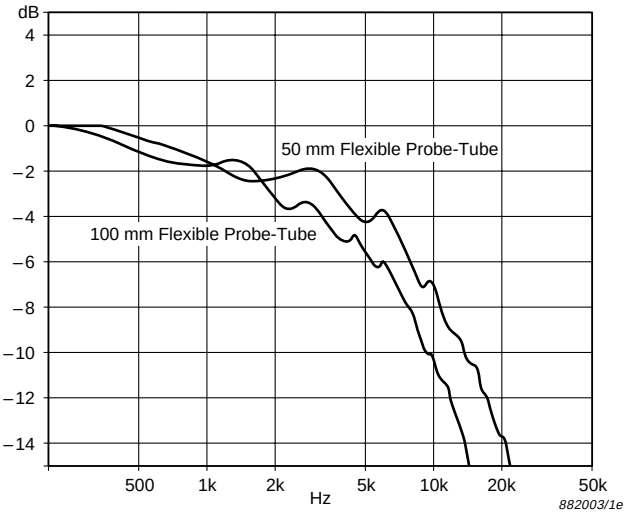


Fig. 2 Typical frequency responses for various flexible probe tube lengths

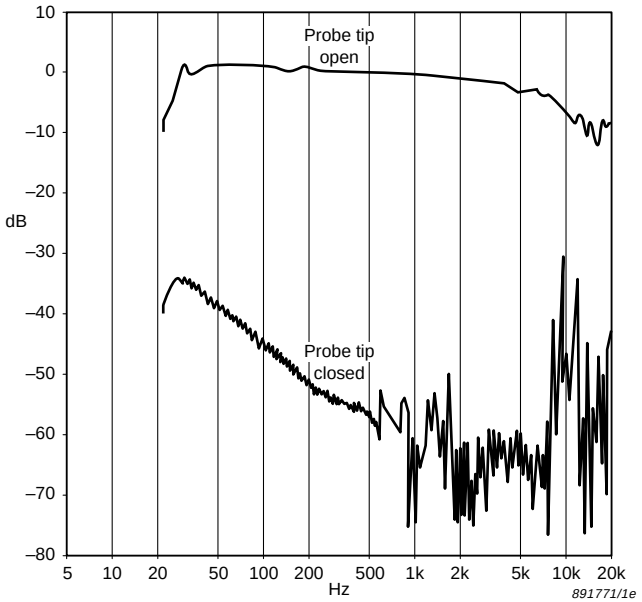


Fig. 3 Comparison of typical sensitivities with probe tip opened (upper curve) and closed in 1 m^3 rigid cavity (lower curve)

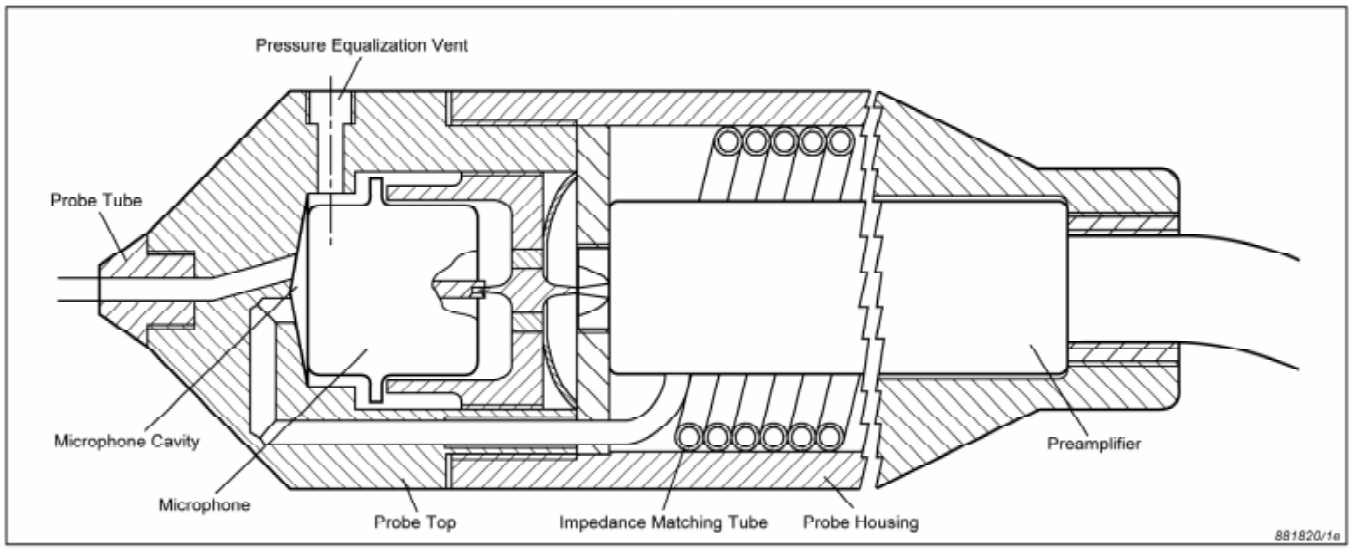


Fig.4 Schematic representation of the internal construction of Probe Microphone Type 4182 showing the microphone cavity, equalization vent and impedance matching tube

human body must not be made with Probe Microphone Type 4182.

The probe microphone can also be used as a reference microphone with the Brüel & Kjær Spatial Transformation of Sound Fields (STSF) System. This uses near-field sound measurements to predict far-field behaviour. With its small size, it is easy to get close to the near-field using the probe microphone.

Measurements on Exhaust Systems

Usually you have to make these measurements at the source. For measurements in smaller systems such as car exhausts, the tip of the probe tube can be inserted directly into the exhaust channel. You can expose the tip of the probe tube to temperatures up to 700°C, however you must make sure that temperature of the microphone body is not greater that 50°C.

When you are using the probe microphone for exhaust system measurements, water may condense inside the probe tube system. To avoid damage to the built-in microphone use the 200 mm probe tube and make sure the pressure at the measurement point is not greater than 10000 Pa (0.1 bar).

In large systems, a metal waveguide tube is inserted through the wall of the exhaust channel (see Fig. 5). The waveguide uses a long flexible hose to provide proper acoustic termination. The end of the hose is sealed to prevent exhaust gas flow in the waveguide. If the attenuation in the waveguide is taken into account, the sound pressure in the waveguide is equal to the sound pressure in the exhaust channel. The probe microphone can then be used to measure in the waveguide. For good results, the internal area of the waveguide should be greater than 13.25 mm^2 (dia. 4.1 mm).

The waveguide's internal area should also be 25 times smaller that the exhaust channel's internal area. An equalisation tube connects the microphone pressure equalization vent to the tube. You can also measure the attenuation across filters in the exhaust channel.

Acoustic Impedance Measurements

Acoustic impedance measurements help determine the loading and efficiency of transmission paths and transducers. Because of its small size and high impedance, the probe microphone is ideal for in-situ measurements of acoustic impedance in ducts or on telephones and earphones, as well as helmets and masks equipped with communication devices.

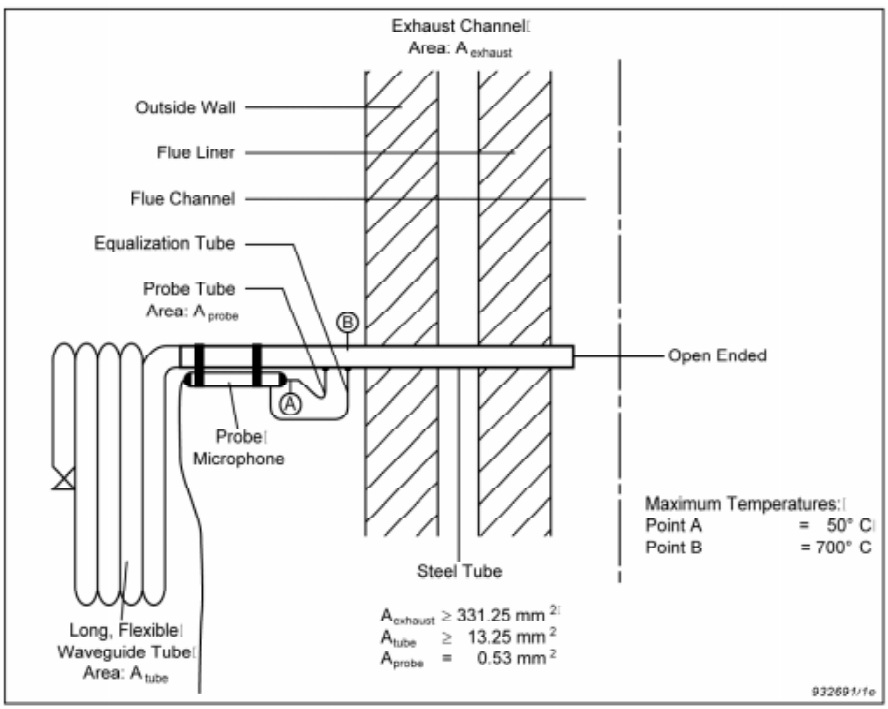


Fig.5 Diagram showing application of the probe microphone for noise measurements on exhaust systems or chimneys

Specifications 4182

SENSITIVITY (250 Hz):
–50 dB ±3 dB re 1 V/Pa (nom. 3.16 mV/Pa) (individually calibrated)
PRESSURE RESPONSE:
2 Hz : +1.5 dB (no SPL at vent)
5 Hz : +1.0 dB (no SPL at vent)
10 Hz : +0.8 dB
20 Hz : +0.5 dB ±0.5 dB
100 Hz : +0.2 dB ±0.5 dB
250 Hz : 0 dB
1 kHz : –0.3 dB ±0.5 dB
2 kHz : –1.0 dB ±0.7 dB
5 kHz : –2.5 dB ±1.0 dB
10 kHz : –5.0 dB ±1.5 dB
20 kHz : –11.0 dB ±3.0 dB
(50 mm probe, 23°C (73.4°F), ref. 250 Hz)
The high-frequency roll-off is due to probe tube loss
ACOUSTICAL INPUT IMPEDANCE:
8×10^8 Ns/m^5 (approx.)
ELECTRICAL OUTPUT IMPEDANCE:
25 Ω (max.)
DISTORTION: <3% below 164 dB SPL (100 Hz)
EQUIVALENT INHERENT NOISE:
<42 dB SPL (A)
<50 dB SPL (lin. 20 Hz to 20 kHz)
CONNECTOR TYPE:
LEMO type FGG.1B.307

Environmental

TEMPERATURE RANGE:
Probe Tip:
Up to 700°C (1292°F) with 100 mm probe tube. Temperature calibration needed, see Instruction Manual.
TEMPERATURE COEFFICIENT (250 Hz):
–0.005 dB/°C
VIBRATION SENSITIVITY (f <300 Hz):
68 dB SPL at 1 ms^{-2}
Worst Case: axial direction
MAGNETIC FIELD SENSITIVITY:
45 dB SPL at 50 Hz, 80 A/m
PRESSURE EQUALIZATION MODES:
Vented to the ambient pressure at the housing, or to the static pressure at the measurement site via an external tube.
Time Constant = 0.05 s to 0.53 s

MAXIMUM STATIC PRESSURE BETWEEN PROBE SYSTEM AND ENVIRONMENT:
10 000 Pa (0.1 bar) recommended
MAXIMUM STATIC PRESSURE BETWEEN TIP AND VENT:
300 Pa, (1% sensitivity change)
10 000 Pa (0.1 bar), (damage risk limit)
AMBIENT PRESSURE COEFFICIENT (250 Hz):
–0.0007 dB/mbar

Dimensions and Weight

Probe Tube Lengths: 1 × 25 mm (0.99″)
1 × 50 mm (1.97″)
2 × 100 mm (3.94″)
1 × 200 mm (3.94″)

Probe Tube Diameter: 1.24 mm (0.05″)
Probe Housing Diameter: 13.5 mm (0.53″)
Probe Housing Length: 118.5 mm (4.67″)
Probe Weight: (excl. cable)**:** 45 g (1.47 oz)
Cable Length: 2 m (6.6 ft)
Cable Weight: 20 g/m (0.65 oz/yd)

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

COMPLIANCE WITH STANDARDS:

CE	CE-mark indicates compliance with: EMC Directive.
Safety	EN 61010–1 and IEC 1010–1: Safety requirements for electrical equipment for measurement, control and laboratory use.
EMC Emission	EN 50081–1: Generic emission standard. Part 1: Residential, commercial and light industry. EN 50081–2: Generic emission standard. Part 2: Industrial environment. CISPR 22: Radio disturbance characteristics of information technology equipment. Class B Limits. FCC Rules, Part 15: Complies with the limits for a Class B digital device.
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.
Temperature	IEC 68–2–1 & IEC 68–2–2: Environmental Testing. Cold and Dry Heat. Operating Temperature: –10 to +50°C (14 to 122°F) Storage Temperature: –25 to +70°C (–13 to 158°F) IEC 68–2–14: Change of Temperature: –10 to +50°C (2 cycles, 1°C/min.)
Humidity	IEC 68–2–3: Damp Heat: 90% RH (non-condensing at 40°C (104°F)). The absolute value of humidity (46 g/m^3) must not exceed the value for 90% relative humidity at 40°C (104°F)

Ordering Information

Type 4182 Probe Microphone
Includes the following accessories:
UA 0926: Set of probe tubes with impedance matching tubes
AF 0555: Flexible Probe Tube (1.5 m)
UA 1066: Flexible Probe Tube Stud
DB 2930: Venting-tube Stud
2 × DH 0549: Cleaning Needle
QA 0159: Wrench
UA 0922: Calibration Coupler
2 × UA 0939: Calibration Stop
UA 0929: Pistonphone Adaptor
UA 0920: Transmitter Adaptor
JP 0169: Short-circuit Plug
DP 0651: Plug (spare)
DP 0652: Plug (spare)
ZG 0350: LEMO to 7-pin Brüel & Kjær adaptor

Optional Accessories

General:
Type 4231: Sound Level Calibrator
Type 4228: Pistonphone
Type 4136: 1/4″ Condenser Microphone
Type 4188: 1/2″ Condenser Microphone
UA 0801: Tripod
UA 0588: Tripod Adaptor

B & K to B & K Extension Cables:
AO 0027: Extension cable 3 m
AO 0028: Extension cable 10 m
AO 0029: Extension cable 30 m

LEMO to LEMO Extension Cables:
AO 0414: Extension cable 3 m
AO 0415: Extension cable 10 m
AO 0416: Extension cable 30 m

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

Brüel & Kjær

WORLD HEADQUARTERS:
DK-2850 Naerum · Denmark · Telephone: +45 45 80 05 00 · Fax: +45 45 80 14 05 · Internet: http://www.bk.dk · e-mail: info@bk.dk
Australia (02) 9450-2066 · Austria 00 43-1-865 74 00 · Belgium 016/44 92 25 · Brazil (011) 246-8166 · Canada: (514) 695-8225 · China 10 6841 9625 / 10 6843 7426
Czech Republic 02-67 021100 · Finland 90-229 3021 · France (01) 69 90 69 00 · Germany 0610 3/908-5 · Holland (0)30 6039994 · Hong Kong 254 8 7486
Hungary (1) 215 83 05 · Italy (02) 57 60 4141 · Japan 03-3779-8671 · Republic of Korea (02) 3473-0605 · Norway 66 90 4410 · Poland (0-22) 40 93 92 · Portugal (1) 47114 53
Singapore (65) 275-8816 · Slovak Republic 07-37 6181 · Spain (91) 36810 00 · Sweden (08) 71127 30 · Switzerland 01/94 0 09 09 · Taiwan (02) 713 9303
United Kingdom and Ireland (0181) 954-236 6 · USA 1 - 800 - 332 - 2040
Local representatives and service organisations worldwide

BP 0659 – 15