

## BRÜEL & KJÆR® Electroacoustic Solutions

### Anechoic Test Box Type 4232

*Anechoic Test Box Type 4232 produces an exact acoustic replication of an electric input signal and comes in a unit that is so small that you can easily use it on your desk.*

*The test box provides excellent insulation from external noise, even at low frequencies, and well-defined uniform test conditions, important for obtaining accurate and repeatable measurements.*

*The rectangular, table-top design of the test box consists of the bottom section that contains the sound source and the measuring plane, and the hinged lid that is easily opened to give access to the measuring plane on which the test object, coupler or microphone is placed.*



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### Uses and Features

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#### Uses

- Fast and reliable testing of hearing aids and microphones in a uniform sound field
- Investigation of hearing aids, microphones, earphones and telecoils

#### Features

- High insulation against airborne noise
- Wide frequency range: 150 Hz to 2 kHz  $\pm 3$  dB (2 kHz to 10 kHz  $\pm 6$  dB)
- Uniform sound field across the measurement plane
- Total harmonic distortion typically less than 0.1% at 70 dB SPL (125 Hz to 8 kHz)
- Usable for pressure microphones down to 50 Hz and for pressure-gradient microphones down to approximately 500 Hz
- Approximates the free-progressive sound field as specified by IEC 60118-0:2015
- SPL at microphone opening conforms to ANSI S3.22-2003
- Handy, table-top design
- Built-in current loop for testing telecoil function

## Construction of the Test Box

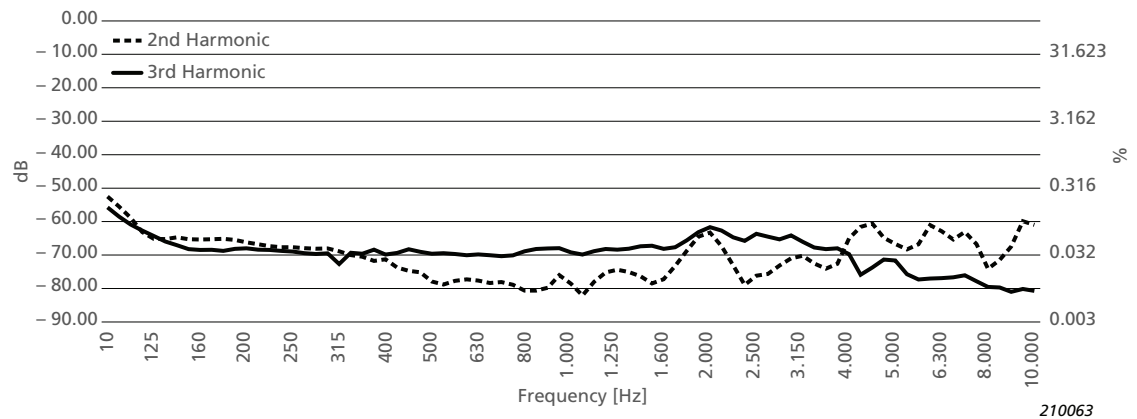
Anechoic Test Box Type 4232 is designed using special materials and construction principles that result in greatly improved low-frequency noise rejection compared to traditional wooden or metal box designs and even to big sand-filled designs. Compared to traditional designs, noise rejection is improved over the entire frequency range.

The heavy lid and the bottom section are constructed similarly in order to obtain the same acoustic performance. The lid is hinged to the back panel of the bottom section and special care has been taken to ensure a good acoustic seal. In daily use, the test box is very easy to handle: the lid is opened or closed by a single movement of the large handle. Gas-filled spring dampers, one on each side, balance the lid and hold it open or closed.

## The Sound Source

The sound source is a high-quality loudspeaker that has been specially selected for very low acoustic distortion (minimal cone break-up and overshoot and a flat frequency response). Contrary to traditional designs, the loudspeaker is mounted firmly, directly on the wall of the test box. This design has been selected to eliminate uncontrolled resonances. The sound source can handle complex test signals at levels exceeding 110 dB SPL.

**Fig. 1**  
Distortion of the test box at 100 dB SPL



## Measuring Plane and Connections

The measuring area is made of foam, which makes it easy to position the reference microphone or coupler with the supplied clips. The centre of the plane is clearly indicated by a round piece of blue foam.

The approximate free-field conditions above 500 Hz, and the positioning of the speaker in the same horizontal plane as the measuring object, allow the performance of directional microphones to be tested.

A built-in current loop makes it possible to test hearing aids with telecoil facility. Typically, a constant current is used to drive the telecoil and to obtain this, a resistor is normally placed in series with the coil. With 100  $\Omega$  series resistance, a field strength of 100 mA/m is obtained with a driving voltage and current of 2.6 V and 25 mA.

For minimum interference with measurements, thin cables are fitted inside the box for connecting a reference microphone and coupler.

A small panel allows hearing aid battery eliminators and auxiliary equipment to be connected

## The Back Panel

All connections to the inside of the test box are mounted on the back panel (Fig. 2). For minimum acoustic interference, the preamplifiers for both the reference microphone and the coupler are placed outside the test box and are screwed directly into the connectors on the back panel.

**Fig. 2**  
All connections to the inside of the test box are made via the connectors on the back panel of Type 4232

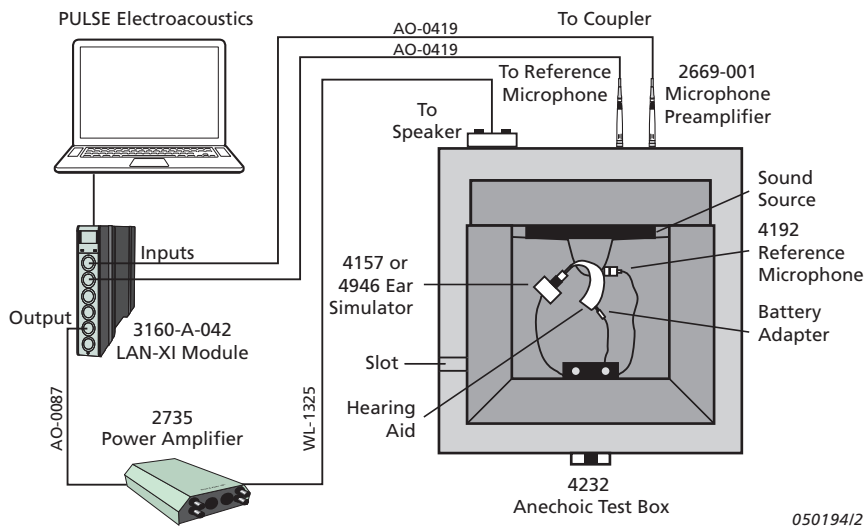


The connection for hearing aid battery eliminators (Batt. Adapter) allows the current consumption for hearing aids to be measured, for example, or the hearing aid response when simulating various voltage conditions of the battery.

The Aux input can be used to connect electrical signals to the hearing aid, for example, for interfacing to the hearing aid according to the Hi-Pro standard. An acoustically sealed slot is provided in the side if you need to use other external cables.

## Use of Anechoic Test Box Type 4232

**Fig. 3**  
Test setup for measurements on hearing aids. The test box is illustrated as a plan view and is not drawn to scale

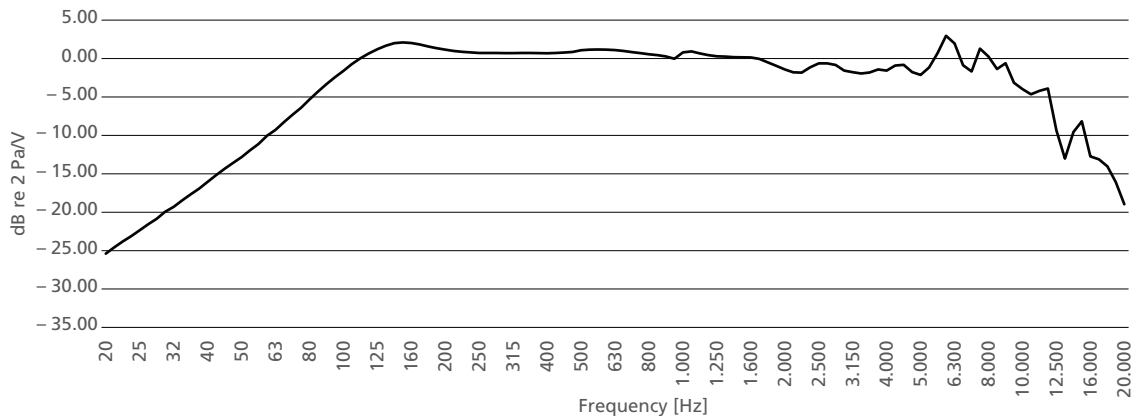


A typical hearing aid measuring system (Fig. 3) consists of two main sections. The first sets up and regulates the sound field while the second analyses the signal from the hearing aid and records the result.

Anechoic Test Box Type 4232 provides repeatable, constant sound pressure level conditions, with very low acoustic distortion, over the measuring plane inside the chamber. It is possible to perform measurements in most environments, even at low acoustical levels (35 to 50 dB SPL).

Fig. 4 shows a typical uncorrected frequency characteristic for the test box at 100 dB excitation level. The smooth shape of the curve makes it very simple to equalize.

**Fig. 4**  
Frequency response for the test box measured at 100 dB excitation level



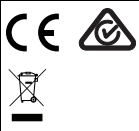
As well as providing a suitable test environment internally, the chamber must also attenuate external noise. Outside noise that is not sufficiently suppressed at the measuring plane will affect the measurements. With Type 4232, any normal office or quality control department will provide a suitable acoustic environment for tests to be performed.

## Associated Products

Ear Simulator Type 4157 (IEC 60318-4 coupler) is delivered fully assembled and calibrated and has its own ½" microphone built in. A wide range of adapters are supplied, which permit easy coupling of all types of insert earphones and hearing aids.

Instead of the ear simulator, 2 cc Click-on Coupler Type 4946 can be used. The coupler is made to IEC and ANSI requirements, and fits 1" and ½" microphones.

## Compliance with Standards

	<p>The CE marking is the manufacturer's declaration that the product meets the requirements of the applicable EU directives. RCM mark indicates compliance with applicable ACMA technical standards – that is, for telecommunications, radio communications, EMC and EME. WEEE mark indicates compliance with the EU WEEE Directive.</p>
<b>Safety</b>	<p>EN/IEC 61010-1: Safety requirements for electrical equipment for measurement, control and laboratory use. ANSI/UL 61010-1: Safety requirements for electrical equipment for measurement, control and laboratory use.</p>
<b>EMC Emission</b>	<p>EN/IEC 61000-6-3: Generic emission standard for residential, commercial and light industrial environments. CISPR 32: Electromagnetic compatibility of multimedia equipment – Emission requirements. Class B Limits. FCC Rules, Part 15: Complies with the limits for a Class B digital device.</p>
<b>EMC Immunity</b>	<p>EN/IEC 61000-6-1: Generic standards – Immunity for residential, commercial and light industrial environments. EN/IEC 61326: Electrical equipment for measurement, control and laboratory use – EMC requirements. <b>Note:</b> The above is only guaranteed using accessories listed in this document.</p>
<b>Temperature</b>	<p>IEC 60068-2-1 &amp; IEC 60068-2-2: Environmental Testing. Cold and Dry Heat. Operating Temperature: 15 to 35 °C (59 to 95 °F). Storage Temperature: 0 to 50 °C (32 to 122 °F).</p>

## Specifications – Anechoic Test Box Type 4232

### Acoustical

#### DYNAMIC RANGE

From below 35 dB to above 110 dB SPL (re 20 µPa)

#### UNIFORMITY OF THE SOUND FIELD

The measuring area is equivalent to the area occupied by the blue foam. The free-field sound level within the measuring area is equal to the regulated SPL within ±1 dB from 20 Hz to 10 kHz

#### INSULATION AGAINST AIRBORNE NOISE

40 dB, 20 Hz to 300 Hz  
45 to 55 dB above 300 Hz

#### SENSITIVITY (FOR 1 W INPUT)

110 dB SPL at the test point. The test point is defined as the centre of the measuring area

#### DISTORTION (100 HZ TO 8 KHZ)

**100 dB SPL:**  
<0.5% 2nd harmonic  
<0.3% 3rd harmonic

#### FREQUENCY RANGE (WITHOUT ELECTRICAL EQUALIZATION)

150 Hz to 2 kHz (±3 dB)  
2 kHz to 10 kHz (±6 dB)  
12 dB/octave attenuation slope below 117 Hz  
24 dB/octave attenuation slope above 10 kHz

#### EXCITATION LEVELS

**Upper Limit:** Maximum 110 dB SPL  
**Lower Limit:** Determined by ambient noise level and noise rejection

#### FREE-FIELD PROPERTIES OF SOUND FIELD

Approximates free-field conditions above 500 Hz. Sound radiation is in the horizontal plane

### Electrical

#### LOUDSPEAKER

**Maximum Continuous Input Power:** 4.5 W  
**Maximum Peak Input Power:** 40 W  
**Nominal Impedance:** 8 Ω (maximum 25 Ω)

#### TELECOIL

**Resistance:** 1 Ω  
**Inductance:** 9 µH

#### Connectors

##### REFERENCE MICROPHONE

11.7 mm – UNF thread for fitting an external ½" microphone preamplifier

##### MEASURING MICROPHONE

11.7 mm – UNF thread for fitting an external ½" microphone preamplifier

##### BATTERY ADAPTER

Three-pole mini jack socket

##### TELECOIL LOOP

Standard jack socket

##### SPEAKER

Spring-loaded terminals for stripped cable ends

##### AUXILIARY

5-pole mini DIN socket (Hi-Pro standard)

### Dimensions and Weight

**Height:** 260 mm (10.2")  
**Width:** 365 mm (14.4")  
**Depth:** 400 mm (15.7")  
**Weight:** 22 kg (48.5 lb)  
**Dimensions of Measurement Chamber:**  
60 × 165 × 200 mm (2.4 × 6.4 × 7.8")

#### Note 1:

½" Microphone Preamplifier Type 2669-001 was used to obtain these specifications

#### Note 2:

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

## Ordering Information

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### Type 4232 Anechoic Test Box

includes the following accessories:

- 2 × UA-1375: Clip for holding IEC 711 or 2 cc Coupler
- UA-1376: Clip for holding reference microphone
- UA-1370: Protection bracket for external microphone preamplifier

### Required Accessories

Type 2669-001\* ½" Microphone Preamplifier for use with Type 4232

### Accessories Available

DB-0962 Adapter, to mount 1" Microphone on ½" Preamplifier

### Additional Instrumentation

#### MICROPHONES

Type 4144 1" Pressure-field Microphone  
Type 4192 ½" Pressure-field Microphone  
Type 4947 ½" Prepolarized Pressure-field Microphone

#### COUPLERS

Type 4157-X Ear Simulator, IEC 60318-4, without preamplifier  
Type 4946 2 cc Click-on Coupler (excluding microphone)

### Preamplifier

Type 2695 ½" CCLD Microphone Preamplifier  
(short preamplifier to be used inside Type 4232)

### CONDITIONING

Type 2735 2 × 35W Measurement Power Amplifier  
Type 2829 4-channel Microphone Power Supply  
Type 2690-A-0S2 NEXUS™ 2-channel Microphone Conditioning Amplifier  
Type 2693-A-0S4 NEXUS 4-channel CCLD Conditioning Amplifier with filters

### ANALYSIS

Type 3160-A-042 LAN-XI Generator, 4/2-ch. Input/Output Module 51.2 kHz  
BZ-5548-N PULSE™ SSR Analysis – Harmonic Distortion, node-locked licence  
BZ-5549-N PULSE SSR Analysis – Intermodulation Distortion, node-locked licence

### CABLES

AO-0087-D-030 BNC to BNC cable, 3 m (10 ft)  
AO-0419-D-030 Cable with LEMO Connector for ½" Microphone Preamplifier Type 2669-001, 3 m (10 ft)  
AO-0531-D-030 10–32 UNF to BNC Connector for ½" CCLD Microphone Preamplifier Type 2695, 3 m (10 ft)  
WL-1325-D-050 2-way Banana to Speakon® Cable, 5 m (16.7 ft)

### CALIBRATION

Type 4231 Sound Calibrator

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\* Preamplifier Type 2669-001 must be used with Type 4232.



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