

# GRAS 45BB-16

KEMAR with Hi-Res Simulators for Test of Ear- and Headphones, 2-Ch CCP



Connection: Constant Current Power (0 V/CCP)

Channel(s): 2

ANSI: S3.36, S3.25

IEC: 60318-7

ITU-T Rec. P.57 Type 3.3

based on ITU-T Rec. P.58

The 45BB-16 KEMAR with TEDS is a manikin configured with pre-polarized hi-res ear simulators and anthropometric pinnae for dual-channel ear- and headphone test up to 50 kHz. Its corresponding LEMO equivalent is the [GRAS 45BB-15 KEMAR](#).

## Introduction

The KEMAR head and torso simulator was introduced by Knowles in 1972 and quickly became the industry standard for hearing-aid manufacturers and research audiologists (visit [KEMAR.us](https://www.kemar.us) to read the full story). It is based on worldwide average human male and female head and torso dimensions. It meets the requirements of ANSI S3.36/ASA58-2012 and IEC 60318-7:2017.

The GRAS 45BB KEMAR has the same dimensions and acoustical properties as the original KEMAR but has been developed further by GRAS to meet the industry's demand for realistic measurements of hearing aids, headphones, and headsets. It provides acoustic diffraction similar to that encountered around the median human head and torso, both in the proximity and in the far-field.

As all the preconfigured 45BB KEMARs consist of the same basic 45BB KEMAR Non-configured, plus a set of application-specific accessories, the full information about a given KEMAR configuration is obtained by combining the information about the 45BB KEMAR Non-configured and the information for a given configured version as found in the present text. Read about the non-configured KEMAR [here](#).

## TEDS Compatibility

All CCP-based KEMAR configurations are IEEE 1451.4 TEDS v. 1.0 compliant. If your measurement platform supports Transducer Electronic Data Sheets (TEDS), you will be able to read and write data like properties and calibration data.

## Design

The 45BB-16 is a KEMAR head and torso for 2-channel ear and headphone test, with prepolarized hi-res ear simulators and anthropometric pinnae.

It is delivered fully configured, individually calibrated and ready for use. In addition to a system calibration certificate, a USB flash memory with simulation data is included.

The main configuration-specific components of the 45BB-16 are the GRAS RA0404 Prepolarized Hi-Res Audio Ear Simulator and the KB5000/KB50001 Anthropometric Pinnae.

### *The Hi-Res Ear Simulator*

The acoustic input impedance of the RA0404 closely resembles that of the human ear and, as a result, loads a sound source in very much the same way. It embodies a number of carefully designed volumes connected via well-defined and precisely tuned resistive grooves. In an equivalent electrical circuit, capacitors would represent the volumes, and inductance and resistance would represent respectively air mass and air flow within the resistive grooves.

The RA0404 mitigates the limited usefulness of the standard IEC60318-4 ear simulator above 10 kHz. The steep resonance at 13.5 kHz has been replaced by a much-damped resonance and the useful frequency range is now extended to 50 kHz within a narrow tolerance band. It complies with IEC60318-4 and its acoustic transfer impedance is within the tolerance band specified by IEC60318-4. From 10 to 20 kHz the transfer impedance is within  $\pm 2.2$  dB, from 20 kHz to 50 kHz it is within  $\pm 3.2$  dB, resulting in much-improved repeatability. Also, realistic THD measurements are now possible.

It is measured and calibrated according to IEC60318-4 and ITU-T Recommendation P.57 and delivered with a calibration chart specifying its sensitivity and frequency response.

It is delivered with a built-in [GRAS 40BD](#) 1/4" prepolarized pressure microphone.

Read [more about RA0404 here](#).

### *The Anthropometric Pinna*

Compared to the standardized pinna, the anthropometric pinna embodies several improvements to the concha and ear canal, combined with increased collapsibility of the helix, and improved mounting. It is made of soft silicone, 35 Shore 00 hardness.

The external shape of the pinna is identical to that of the standardized KEMAR pinna, but concha and ear canal have been modified so that they closely mimic the properties of a real human ear. The ear canal has been extended and is now an integral part of the pinna which seals directly against the ear simulator. Like the human ear, the ear canal has the 1st and 2nd bend, and the interface with the concha is oval. Fit and insertion consistency are much improved compared to the cylindrically or conically shaped ear canal extensions that are used with the standard pinnae.

The flexibility of the outer ear has been improved, and when mounting supra-aural and circum-aural headphones the pinna now collapses against the head very much like a human ear.

In addition to the traditional push mounting from the outside, the pinna is secured with two screws from the inside of KEMAR's head. These two screws ensure that the pinna is held firmly in place. Therefore, it seals perfectly against the ear simulator and the head, and it is possible to mount and dismount DUTs repeatedly without compromising the seal.

Read [more about the Anthropometric Pinnae here](#).

## Typical Applications

The anatomical shape of the pinna makes it possible to achieve a very good fit and sealing with

anatomically shaped in-ear transducers. Controlling the insertion depth is easy, leading to good insertion consistency and highly improved repeatability and accuracy of measurements. The improved fit and seal also mean that the low-frequency response is improved. It will allow you to reproduce base notes, as well as effectively measure (active & passive) attenuation.

With the hi-res audio ear simulator, it is now possible to make reproducible measurements up to 50 kHz. The 45BB-16 KEMAR is ideal for accurate and repeatable testing of hearing aids, headphones, earphones, and in-ear hearing protectors. Read more about [the advantages of the high-resolution ear simulator here](#).

## Performance and warranty

KEMAR is made of components from our standard portfolio and is manufactured of high-quality material and branded parts chosen and processed to ensure life-long stability and robustness. This enables us to offer a two-year warranty against defective materials and workmanship.

Exceptions: Microphones included in KEMAR as for these our normal five-year warranty applies. The warranty period for cables is six months.

Connector type		BNC
Set sensitivity @ 250 Hz ( $\pm 2$ dB)	mV/Pa	1.6
Theoretical dynamic range lower limit with GRAS preamplifier	dB(A)	44
Theoretical dynamic range upper limit with GRAS CCP preamplifier	dB	166
Resonance frequency	kHz	13.5
Temperature range, operation	$^{\circ}\text{C} / ^{\circ}\text{F}$	-30 to 60 / -22 to 140
Temperature range, storage	$^{\circ}\text{C} / ^{\circ}\text{F}$	-40 to 65 / -40 to 149
Humidity range non condensing	% RH	0 to 95%
ANSI standard		S3.36, S3.25
IEC standard		60318-7
ITU-T recommendations		P. 58
Weight	g / oz	11.45 k / 404

## Included items

<a href="#">GRAS 45BB</a>	KEMAR Head & Torso, Non-configured
<a href="#">GRAS KB5000</a>	Large Right Anthropometric Pinna 35 Shore 00
<a href="#">GRAS KB5001</a>	Large Left Anthropometric Pinnar 35 Shore 00
<a href="#">GRAS RA0404</a>	Prepolarized Hi-Res Audio Ear Simulator ( 2 pcs)
GRAS GR1874	Ear Simulator Holder
GRAS GR0408	External Ear Canal
GRAS GR0409	Union Nut
<a href="#">GRAS 26CS</a>	1/4" CCP Short Preamplifier (2 pcs)
<a href="#">GRAS AA0018-S</a>	Microdot-BNC Cable, 35 cm (2 pcs)
<a href="#">GRAS AA0035</a>	BNC-BNC Cable, 3 m (2 pcs)

## Optional items

### Power Modules for Pre-polarized Ear Simulators and Microphones

<a href="#">GRAS 12AL</a>	1-Channel CCP Power Module with A-weighting filter
<a href="#">GRAS 12AQ</a>	2-Channel Universal Power Module with signal conditioning and PC interface

### For Ear Simulator Calibration

<a href="#">GRAS 42AP</a>	Intelligent Pistonphone (250 Hz or 251.2 Hz, 114 dB +/- 0.05 dB)
<a href="#">GRAS 42AA</a>	Pistonphone (250 Hz, 114 dB +/- 0.08 dB)

### Pinna Simulators

<a href="#">GRAS KB5000</a>	Large Right Anthropometric Pinna 35 Shore 00
<a href="#">GRAS KB5001</a>	Large Left Anthropometric Pinnar 35 Shore 00
<a href="#">GRAS KB0060</a>	KEMAR Small Right Straight Pinna 55 Shore 00
<a href="#">GRAS KB0061</a>	KEMAR Small Straight Pinna 55 Shore 00
<a href="#">GRAS KB0065</a>	KEMAR Large Straight Pinna 55 Shore 00

<a href="#">GRAS KB0066</a>	KEMAR Large Left Straight Pinna 55 Shore 00
<a href="#">GRAS KB1060</a>	KEMAR Small Right Straight Pinna 35 Shore 00
<a href="#">GRAS KB1061</a>	KEMAR Small Left Straight Pinna 35 Shore 00
<a href="#">GRAS KB1065</a>	KEMAR Large Right Straight Pinna 35 Shore 00
<a href="#">GRAS KB1066</a>	KEMAR Large Left Straight Pinna 35 Shore 00
<a href="#">GRAS KB0090</a>	KEMAR Large Right Tapered Pinna (VA-Style/SQ) 55 Shore 00
<a href="#">GRAS KB0091</a>	KEMAR Large Left Tapered Pinna (VA-Style/SQ) 55 Shore 00
<a href="#">GRAS KB1090</a>	KEMAR Large Right Tapered Pinna (VA-Style) 35 Shore 00
<a href="#">GRAS KB1091</a>	KEMAR Large Left Tapered Pinna (VA-Style) 35 Shore 00

## Ear Mould Simulators

<a href="#">GRAS KB0110</a>	Ear Mould Simulator for 2 mm Inner diameter tubing
<a href="#">GRAS KB0111</a>	Ear Mould Simulator for 3 mm Inner diameter tubing

## Ear Canal Extension and Microphone Holder Kits (kits with 2 pcs and O-rings)

<a href="#">GRAS RA0237</a>	Straight Ear Canal Extension Kit for KEMAR
<a href="#">GRAS RA0238</a>	VA-tapered Ear Canal Extension Kit for KEMAR
<a href="#">GRAS RA0239</a>	Ear Canal Extension Kit w. silicone lining for KEMAR
<a href="#">GRAS RA0240</a>	Holder for long 1/2" Microphone Kit for KEMAR
<a href="#">GRAS RA0241</a>	Holder for short 1/2" Microphone Kit for KEMAR
<a href="#">GRAS RA0243</a>	Holder for 1/4" Microphone Kit for KEMAR
<a href="#">GRAS RA0244</a>	O-ring kit for KEMAR
<a href="#">GRAS RA0249</a>	Straight Ear Canal Extension Kit for KEMAR, made of POM, for binaural hearing aid test
<a href="#">GRAS RA0250</a>	Tapered Ear Canal Extension Kit for KEMAR, made of POM, for binaural hearing aid test

## KEMAR Retrofit Kit for Binaural Hearing Aid Test

<a href="#">GRAS RA0251</a>	KEMAR Retrofit Kit for Binaural Hearing Aid Test. The Kit includes Ear Holder Plates, mounting bolts and the RA0249 and RA0250 Ear Canal Extension Kits. Included items are made of POM, Nylon and Teflon.
-----------------------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

## Extension Cables

GRAS AA0034	BNC-BNC Cable, 2 m
<a href="#">GRAS AA0035</a>	BNC-BNC Cable, 3 m
GRAS AA0036	BNC-BNC Cable, 5 m
GRAS AA0037	BNC-BNC Cable, 10 m

## Flight Case

GRAS KM0094	PELI Case for KEMAR
-------------	---------------------

## Simulation Model of KEMAR

GRAS KB3000	3D Simulation Model of KEMAR with large pinnae, stp file
GRAS KB3001	3D Simulation Model of KEMAR with small pinnae, stp file
GRAS KB3002	3D Simulation Model of KEMAR with anthropometric pinnae, stp file

## Stand for KEMAR

GRAS AL0026	Stand for KEMAR, Ø 35 mm
-------------	--------------------------

## Miscellaneous (incl. in 45BB)

GRAS KB0000	KEMAR Handbook
GRAS KB0010	T-Shirt for KEMAR

GRAS Sound & Vibration reserves the right to change specifications and accessories without notice.

# GRAS Worldwide

Subsidiaries and distributors in more than 40 countries

**HEAD OFFICE, DENMARK**  
**GRAS SOUND & VIBRATION**  
Skovlytoften 33  
2840 Holte  
Denmark  
Tel: +45 4566 4046  
[www.GRASacoustics.com](http://www.GRASacoustics.com)  
[gras@grasacoustics.com](mailto:gras@grasacoustics.com)

**USA**  
**GRAS SOUND & VIBRATION**  
9290 SW Nimbus Avenue  
Beaverton, OR 97008  
Tel: 503-627-0832  
Toll Free: 800-231-7350  
[www.GRASacoustics.com](http://www.GRASacoustics.com)  
[sales-usa@grasacoustics.com](mailto:sales-usa@grasacoustics.com)

**UK**  
**GRAS SOUND & VIBRATION**  
Unit 115, Gibson House,  
Ermine Business Park, Huntingdon,  
Cambridgeshire, PE29 6XU  
Tel: +44 (0) 7762 584 202  
[www.GRASacoustics.com](http://www.GRASacoustics.com)  
[sales-uk@grasacoustics.com](mailto:sales-uk@grasacoustics.com)

**CHINA**  
**GRAS SOUND & VIBRATION**  
Room 315, RuiBo Center(T1)  
Lane683, Shenhong Rd,  
Minhang District,  
Shanghai, China, 201107  
Tel: +86 21 64203370  
[www.GRASacoustics.cn](http://www.GRASacoustics.cn)  
[cnsales@grasacoustics.com](mailto:cnsales@grasacoustics.com)



## About GRAS Sound & Vibration

GRAS is a worldwide leader in the sound and vibration industry. We develop and manufacture state-of-the-art measurement microphones and related equipment for industries where acoustic measuring accuracy and repeatability are of the utmost importance. This includes applications and solutions for customers within the fields of aerospace, automotive, audiology, consumer electronics and other highly demanding industries. GRAS microphones are designed to live up to the high quality, durability and accuracy that our customers have come to expect, trust and require.

GRAS Sound & Vibration is represented through subsidiaries and distributors in more than 40 countries and is part of Axiometrix Solutions, a leading test solutions provider comprised of globally recognized measurement brands. Read more at [www.grasacoustics.com](http://www.grasacoustics.com)

[grasacoustics.com](http://grasacoustics.com)

**GRAS**  
An Axiometrix Solutions Brand