# GRAS 45BC-16

## KEMAR with Mouth Simulator and Hi-Res Ear Simulators for Headset Test, 2-Ch CCP



Connection: CCP
Channel(s): 2
Standards: ANSI: S3.36, S3.25
IEC: 60318-4, in accordance with 60318-7
Based on ITU-T Rec. P.57 Type 3.3 and ITU-T Rec. P.58
Special feature: Built-in power amplifier for mouth simulator

The 45BC-16 KEMAR with TEDS is configured with anthropometric pinnae and prepolarized Hi-Res Ear Simulators. Due to its design, realistic measurement in a sound environment as experienced by a human being using a headset is possible. In addition, the 45BC-14 is provided with a mouth simulator for testing of the microphone in the headset. Its LEMO equivalent is GRAS 45BC-15.

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## 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 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 current KEMAR Head and Torso 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 45BC KEMARs consist of the same basic 45BC 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 45BC 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 45BC-16 is a KEMAR with prepolarized hi-res ear simulators and anthropometric pinnae for 2-channel ear and headphone test.

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 45BC-16 are the GRAS RA0404 Hi-Res Ear Simulator and the KB5000/KB50001 Anthropometric Pinnae.

*The 44AA Mouth Simulator according to ITU-T Rec. P51 with built-in power amplifier*
The maximum continuous signal the mouth can produce in 1/3-octave bands is 100dB re. 20µPa in the frequency range of 100Hz to 16kHz. Its loudspeaker accepts an external signal either directly or via its own built-in power amplifier (when power is applied).

*The Hi-Res Ear Simulator*
The acoustic input impedance of the RA0404 Hi-Res Ear Simulator 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 groves.

The RA0404 Hi-Res Ear Simulator 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 20 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 ± 2.2 dB, from 20 kHz to 50 kHz it is within ±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 a number of improvements to the concha and ear canal, combined with increased collapsibility of the helix, and improved mounting of the pinna. 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 over the cylindrically or conically shaped ear canal extensions that are used with the standardized pinna.

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 now possible to mount and dismount DUTs repeatedly without compromising the seal.

Read more about the Anthropometric Pinnae.

## Typical Applications

The anatomical shape of the pinna makes it possible to achieve an excellent 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 means that the low-frequency response is improved. It will allow you to reproduce bass notes, as well as effectively measure (active & passive) attenuation.

With the hi-res ear simulator, it is now possible to make reproducible measurements up to 50 kHz. The 45BC-16 KEMAR is ideal for accurate and repeatable testing of headphones, earphones, and in-ear hearing protectors. In addition to this, the built-in mouth simulator makes it ideal for accurate and repeatable testing of headsets. Read more about the advantages of the hi-res ear simulator here.

## Performance and warranty

KEMAR is made of components from our standard portfolio, all 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 receive our normal five-year warranty. The warranty period for cables is six months.

# Specifications



| | | |
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| Set sensitivity @ 250 Hz (±2 dB) | mV/Pa | 1.6 |
| Theoretical dynamic range lower limit with GRAS preamplifier | dB(A) | 46 |
| Theoretical dynamic range upper limit with GRAS CCP preamplifier | dB | 166 |
| Resonance frequency | kHz | 13.5 |
| Temperature range, operation | °C / °F | -30 to 60 / -22 to 140 |
| Temperature range, storage | °C / °F | -40 to 65 / -40 to 149 |
| Humidity range non condensing | % RH | 0 to 95% |
| ANSI standard | | S3.36, S3.25 |
| IEC standard | | Based on 60318-4 |
| ITU-T recommondations | | P. 58 |
| Weight | g / oz | 11.45 k / 404 |
| MOUTH SIMULATOR | | . |
| Output impedance | Ω | 8 |
| Maximum power, continuous | W | 10 |
| Maximum power, pulsed 2 sec. | W | 50 |
| Input impedance | kΩ | 20 |
| Gain | dB | 10 |
| Input signal, max. | Vrms | 2 |
| Power supply, external | Vdc | 24 |

## Included items

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| GRAS 45BC | KEMAR Head & Torso with GRAS 44AA Mouth Simulator, non-configured |
| GRAS KB5000 | KEMAR Large Right Anthropometric Pinna 35 Shore 00 |
| GRAS KB5001 | KEMAR Large Left Anthropometric Pinna 35 Shore 00 |
| GRAS GR0408 | External Ear Canal (for calibration, 2 pcs) |
| GRAS GR0409 | Union Nut (for GR0408, 2 pcs) |
| GRAS GR1874 | Ear Simulator Holder (2 pcs) |
| GRAS RA0404 | Prepolarized High Resolution Ear Simulator, (2 pcs) |
| GRAS 26CS | 1/4" CCP Standard Preamplifier with Microdot Connector, Very Short (2 pcs) |
| GRAS RA0001 | Right Angled Adapter for 1/2" Microphone and 1/4" Preamplifier (2 pcs) |
| GRAS AA0018-S | Microdot-BNC Cable, 35 cm (2 pcs) |
| GRAS AA0035 | 3 m BNC - BNC Cable (2 pcs) |
| GRAS 46BD | 1/4" CCP Pressure Standard Microphone Set |
| GRAS AA0070 | Microdot-BNC Cable, 3 m |

## Optional items

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

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| GRAS 12AL | 1-Channel CCP Power Module with A-weighting filter |
| GRAS 12AQ | 2-Channel Universal Power Module with signal conditioning and PC interface |

### For Ear Simulator Calibration

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| GRAS 42AP | Intelligent Pistonphone (250 Hz or 251.2 Hz, 114 dB +/- 0.05 dB) |
| GRAS 42AA | Pistonphone (250 Hz, 114 dB +/- 0.08 dB) |
| GRAS 42AG | Multifunction Sound Calibrator, Class 1 |

## Pinna Simulators

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| GRAS KB5000 | Large Right Anthropometric Pinna 35 Shore 00 |
| GRAS KB5001 | Large Left Anthropometric Pinnar 35 Shore 00 |
| GRAS KB0060 | KEMAR Small Right Ear 55 Shore 00 |
| GRAS KB0061 | KEMAR Small Left Ear 55 Shore 00 |
| GRAS KB0065 | KEMAR Large Right Ear 55 Shore 00 |
| GRAS KB0066 | KEMAR Large Left Ear 55 Shore 00 |
| GRAS KB1060 | KEMAR Small Right Ear, 35 Shore 00 |
| GRAS KB1061 | KEMAR Small Left Ear 35 Shore 00 |
| GRAS KB1065 | KEMAR Large Right Ear 35 Shore 00 |
| GRAS KB1066 | KEMAR Large Left Ear 35 Shore 00 |
| GRAS KB0090 | KEMAR Large Right Ear (VA-Style/SQ) 55 Shore 00 |
| GRAS KB0091 | KEMAR Large Left Ear (VA-Style/SQ) 55 Shore 00 |
| GRAS KB1090 | KEMAR Large Right Ear (VA-Style) 35 Shore 00 |
| GRAS KB1091 | KEMAR Large Left Ear (VA-Style) 35 Shore 00 |

## Ear Mould Simulators

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| GRAS KB0110 | Ear Mould Simulator for 2 mm inner diameter tubing |
| GRAS KB0111 | Ear Mould Simulator for 3 mm inner diameter tubing |

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

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| GRAS RA0237 | Straight Ear Canal Extension Kit for KEMAR |
| GRAS RA0238 | VA-tapered Ear Canal Extension Kit for KEMAR |

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| GRAS RA0239 | Ear Canal Extension Kit w. silicone lining for KEMAR |
| GRAS RA0240 | Holder for long 1/2" microphone Kit for KEMAR |
| GRAS RA0241 | Holder for short 1/2" microphone Kit for KEMAR |
| GRAS RA0243 | Holder for 1/4" microphone Kit for KEMAR |
| GRAS RA0244 | O-ring kit for KEMAR, 2 pcs. |
| GRAS RA0249 | Straight Ear Canal Extension Kit for KEMAR,made of POM, for binaural hearing aid test |
| GRAS RA0250 | Tapered Ear Canal Extension Kit for KEMAR,made of POM, for binaural hearing aid test |

## KEMAR Retrofit Kit for Binaural Hearing Aid Test

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

## Extension Cables

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| GRAS AA0034 | BNC-BNC Cable, 2 m |
| GRAS AA0035 | BNC-BNC Cable, 3 m |
| GRAS AA0036 | BNC-BNC Cable, 5 m |
| GRAS AA0037 | BNC-BNC Cable, 10 m |

## Flight Case

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| GRAS KM0094 | PELI Case for KEMAR |

## Simulation Model of 45BB KEMAR

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| 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

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

## Miscellaneous (incl. in 45BC)

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| 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

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### 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

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