High Resolution Ear Simulator

Reliable measurements of headphones and earphones up to 20 kHz

GRAS RA0401/RA0402 High Resolution Ear Simulator

GRAS Sound & vibration

Next Generation of ear simulators

High Resolution Ear Simulator for headphone testing

High resolution audio is quickly becoming an important market driver in personal audio. Objective measurement methods have until now not kept up with this trend.

This is why we have developed the new High Resolution Ear Simulator. It offers a precise method for measuring up to 20 kHz.

With repeatable measurement results and a humanlike loading of the headphone it narrows the gap between objective measurements and humans with "golden ears".

The challenge
The standardized IEC 60318-4 ear simulator (e.g. the GRAS RA0045) is a good tool for ear simulation up to 10 kHz. However, its high Q resonance makes it unsuitable for analysing high resolution audio performance.

The solution
The new High Resolution Ear Simulator mitigates this limitation. The resonance is dampened by approximately 14 dB and the damping does not change with varying lengths of the ear canal caused by changes in placement of the Device Under Test (DUT). Therefore both frequency response and distortion measurements up to 20 kHz can now be made with confidence and full backwards compability to historical measurements. The GRAS High Resolution Ear Simulator is therefore well suited for testing of wideband headphones.

Compatible with GRAS test fixtures
R & D
For R&D testing, a 45BB KEMAR configured with a High Resolution Ear Simulator and an Anthropometric Pinna includes the effects of head, torso, pinna, ear canal and ear simulator in the test. This allows for realistic testing of the effects of variations of insertion depth, acoustic sealing and leakage – effects that end users will also experience.

Production testing
For production testing, the 45CA Headphone/ Hearing-protector Test Fixture offers mounting accuracy and repeatability.

Verification
For verification, the 43AG Ear and Cheek Simulator offers a fast and reliable test setup to identify divergences between R&D and production samples.

Key features

- From 10 to 20 kHz the response is within ± 2.2 dB
- The 13.5 kHz resonance dampened by approximately 14 dB
- Upgraded IEC60318-4 ear simulator - same form factor
- Full backwards compatible with standard IEC 60318-4 (711) ear simulator

Benefits

- Improved repeatability above 10 kHz
- Measurements below and above 10 kHz both in the same measurement setup
- The dampened resonance means better distortion measurements, even from as low as 3-5 kHz

GRAS test fixtures for headphone testing

	KEMAR Head and Torso	R & D
	45CA Headphone/ Hearing-protector Test Fixture	Production
	43AG Ear and Cheek Simulator	Verification

These test platforms can be individually configured to suit your specific needs. Contact your local GRAS partner for further information.

Two versions are available

Externally polarized and prepolarized

RA0401 Externally Polarized
High Resolution Ear Simulator

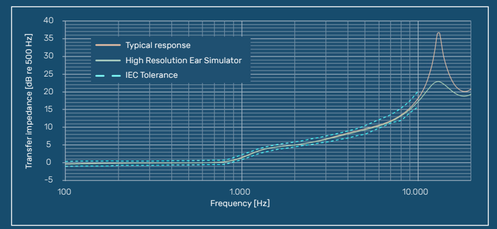
RA0402 Prepolarized
High Resolution Ear Simulator

Specifications

GRAS High Resolution Ear Simulator

RA0401 Externally Polarized High Resolution Ear Simulator
RA0402 Prepolarized High Resolution Ear Simulator

Theoretical dynamic range lower limit with GRAS preamplifier	dB(A)	25
Theoretical dynamic range upper limit, RA0401 Externally Polarized Ear Simulator	dB	164
Theoretical dynamic range upper limit, RA0402 Prepolarized Ear Simulator	dB	153
Resonance frequency	kHz	13,5
Coupler volume	mm^3	1260 @ 500 Hz
Temperature range, operation	°C /°F	-30 to 60 /-22 to 140
Temperature coefficient @250 Hz	dB/ °C/ dB/ °F/	0,05
Humidity range non condensing	% RH	0 to 75
IEC standard		60318-4
ITU-T recommendations		P.57
CE/RoHS compliant/WEEE registered		Yes/Yes/Yes
Weight	g /oz	52 / 1.8

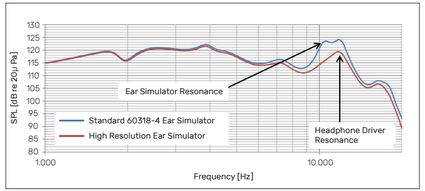


The resonance of the High Resolution Ear Simulator is attenuated by about 14 dB

Reliable and repeatable high frequency data

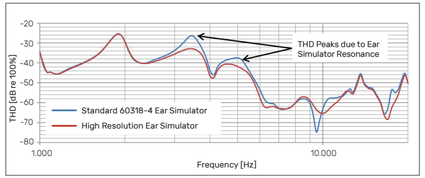
With the new High Resolution Ear Simulator it is possible to make objective and quantifiable assesments of the performance of headphones/personal audio devices up to 20 kHz. Total Harmonic Distortion (THD), frequency response and driver resonance related phenomena can now be investigated, and an objective and actionable supplement to the "golden ear" approach is now available for concept validation, R&D, and production testing – all based on a "humanlike" in-situ test method.

Comparative measurements of an In-Ear headphone in the standard Ear Simulator and the High Resolution Ear Simulator



In the standard Ear Simulator the resonance of the headphone driver and the resonance of the Ear Simulator will often almost coincide. This makes it difficult to interpret measurement results. In the High Resolution Ear Simulator the Ear Simulator resonance is dampened and the resulting frequency response is much clearer. Also, due to the distance from the headphone driver the Ear Simulator resonance has moved from 13.5 kHz to 10.5 kHz and the headphone driver resonance is at 12 kHz. In the standard Ear Simulator it would be an easy mistake to swap the driver and Ear Simulator resonance.

THD measurements in the standard Ear Simulator and the High Resolution Ear Simulator



When examining THD it is clear that the standard Ear Simulator overestimates the distortion due to the gain imposed by the resonance. The differences in the peaks are 6.5 dB at 3.3 kHz and 4.5 dB at 6 kHz.

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