

Instruction Manual

RA0045 Ear Simulator IEC 60318-4

RA0045-S1 Ear Simulator IEC 60318-4

RA0045-S4 Ear Simulator IEC 60318-4

RA0045-S5 Ear Simulator IEC 60318-4

RA0045-S9 Ear Simulator IEC 60318-4



Revision History

Revision	Date	Description
1	30 September 2017	Extracted from Earbook as separate document. RA0045-S4, -S5 and -S9 added

Any feedback or questions about this document are welcome at gras@gras.dk.

Copyright Notice

© 2005-17 G.R.A.S. Sound & Vibration A/S

<http://www.gras.dk>

Any technical documentation that is made available by G.R.A.S. is the copyrighted work of G.R.A.S. and is owned by G.R.A.S.

The content in this document is subject to change without notice. G.R.A.S. Sound & Vibration A/S is not liable or responsible for any errors or inaccuracies that may appear in this document.

Trademarks

Any other product names mentioned in this document may be trademarks or registered trademarks of their respective companies and are hereby acknowledged.

Contents

Introduction	4
Components.....	4
Calibration	6
Level Calibration	6
Frequency Calibration	7

Introduction

The RA0045 Ear Simulator is for making acoustic measurements on earphones coupled to the human ear by ear inserts such as tubes, ear moulds or ear tips. It is delivered with a built-in 40AG 1/2" pressure microphone and an individual calibration chart for the coupler-microphone combination.

Important! do not extract the microphone housed in the RA0045 since this would invalidate the factory calibration.

The ear simulator complies with the following international requirements:

- IEC 60318-4 Occluded-ear simulator for the measurement of earphones coupled to the ear by ear inserts
- ITU-T Recommendations P.57 Series P: Telephone transmission quality, Objective measuring apparatus: Artificial ears.

The RA0045 comes in a number of variants to meet specific connection and testing needs.

	Polarization	Microphone	Dyn. range, dB	Recommended Preamplifier
RA0045	External	40AG, 1/2"	25 - 164	26AK or 26AC
RA0045-S1	Prepolarized	40AO, 1/2"	25 - 150	26CA or 26CB
RA0045-S4	External	40AP, 1/2"	18 - 149	26AK or 26AC
RA0045-S5	External	40BP, 1/4"	34 - 164	26AC
RA0045-S9	External	40BH, 1/4"	62 - 193	26AC

Apart from different microphones, the different variants are identical, and in this manual the designation RA0045 is used for all variants.

Components

The RA0045 is delivered as shown in Fig. 1, to the left. An exploded view of its user-serviceable components is shown in Fig. 1, to the right.

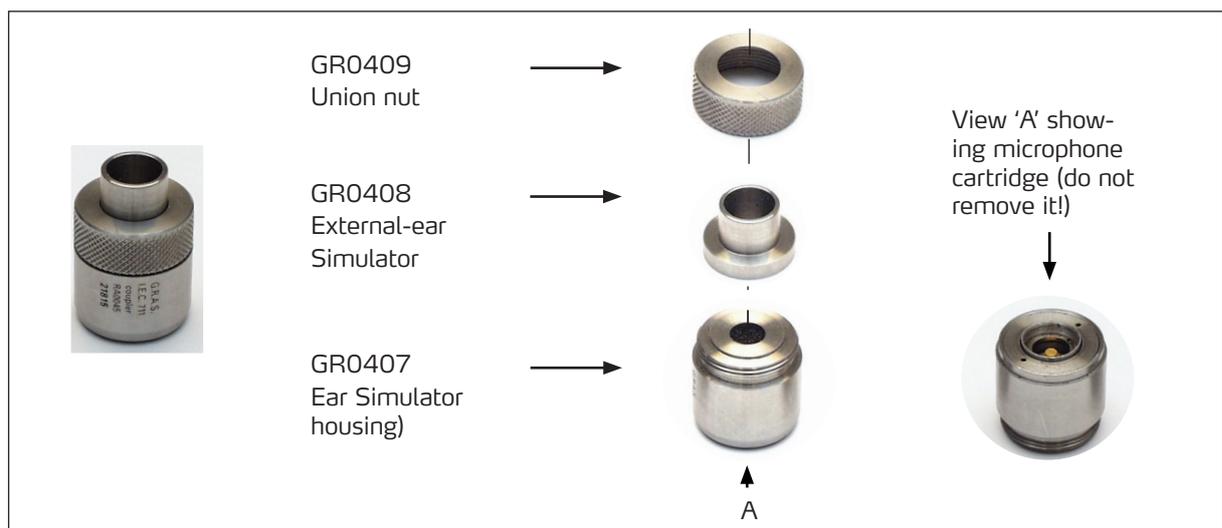


Fig. 1. RA0045 Ear Simulator as delivered (left) and its user serviceable parts (right)

The RA0045 comprises the following user-serviceable components:

- GR0407 Ear Simulator Housing
- GR0408 External-ear Simulator
- GR0409 Union Nut

Characteristics

The acoustic input impedance of the RA0045/RA0045-S1 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.

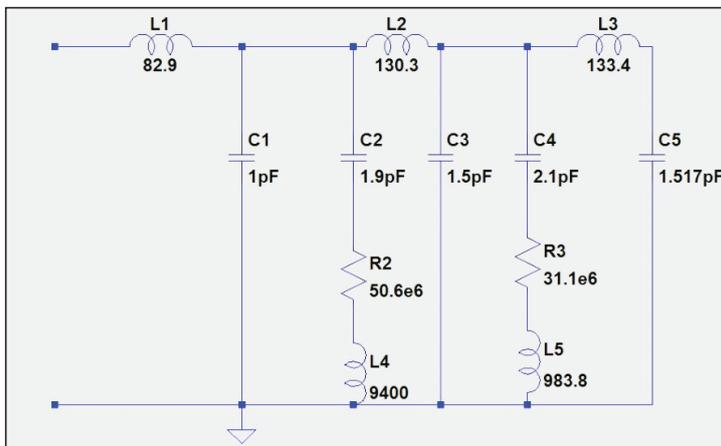


Fig. 2. Electrical equivalent diagram for the RA0045/RA0045S-1. The sound source is not shown in the model.

Fig. 3 shows a typical coupler frequency response of the RA0045/RA0045S-1.

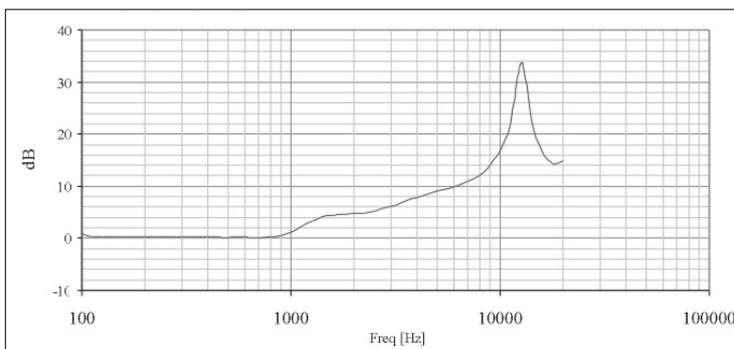


Fig. 3. Typical coupler frequency response re. 500Hz

The input impedance is measured using a special impedance probe as described in ITU-T Recommendations P.57 (08/96). This measures the impedance of the RA0045 as seen from the Ear Reference Point (ERP). The impedance is defined as the ratio of the sound pressure at the ERP to the corresponding particle velocity. The sound pressure is measured with a probe microphone while a constant particle velocity is maintained via a high acoustic impedance sound source.

Calibration

Level Calibration

This paragraph describes level calibration using a pistonphone. This is the kind of calibration you would most often perform prior to measuring. How to perform a frequency calibration is described in "Frequency Calibration" on page 7.

Do not attempt to remove the microphone from the RA0045. You will be calibrating the RA0045 as a whole with a Pistonphone fitted with a ½" coupler. This, in effect, increases the coupler volume such that the signal from the Pistonphone will be reduced by 1.03 dB.

- 1) Snap the spring-loaded clamp (see Fig. 1) to its upright position, or remove it.
- 2) Unscrew the collar of the Pistonphone and remove the O-ring (see Fig. 4).

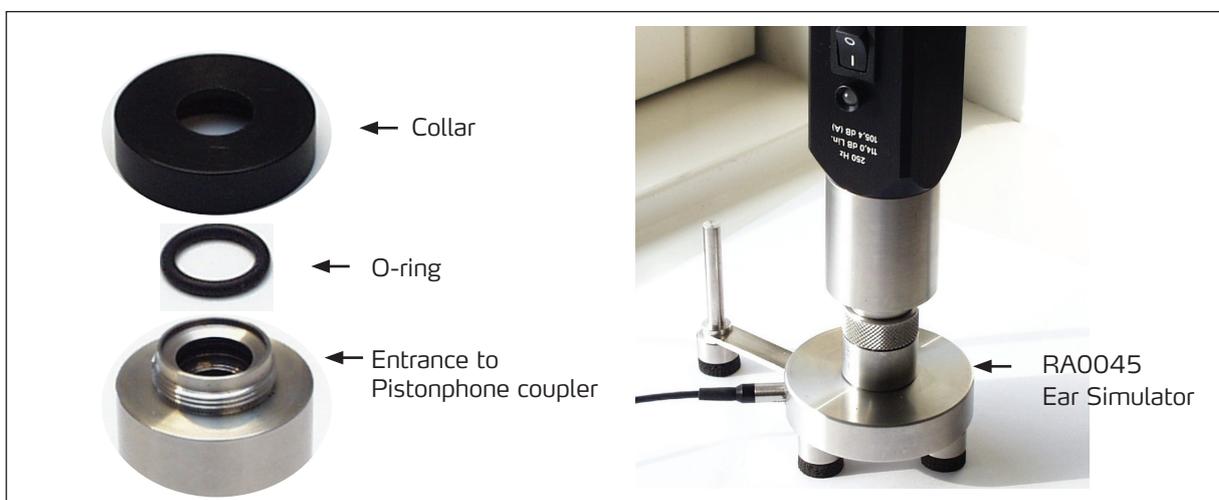


Fig. 4. Calibration using the Pistonphone

- a) Unscrew Pistonphone collar and remove O-ring.
- b) Place coupler over RA0045, push gently down to the stop
- c) Switch on

- 3) Place the coupler of the Pistonphone over the RA0045, push it gently down to the stop and switch on.
- 4) Set the analyser to either wide band or to the ½ octave band whose centre frequency is 250Hz.
- 5) When conditions are stable, adjust the analyser so that it correctly gauges the Pistonphone signal (nominally $114 - 1.03 = 112.97$ dB). See Pistonphone manual for making barometric corrections.
- 6) Switch the Pistonphone off and remove it from the RA0045.
- 7) Re-assemble the pistonphone.

Frequency Calibration

This section describes how to perform a frequency calibration using a 40BP ¼" Microphone as sound source. Fig. 5 shows how to configure the coupler for calibration using the accessories provided, and Fig. 6 shows how these should be used with:

- 40BP ¼" Microphone
- RA0086 Transmitter Adapter



Fig. 5. Assembled and exploded views of the coupler itemising user-serviceable accessories for individual calibration

The ¼" microphone is used as a high-impedance sound source. The complete set-up is shown in Fig. 7. The computer in Fig. 10 is capable of concurrently generating and measuring audio frequency signals. The 14AA Actuator Supply receives a swept tone generated by the computer and sends this, superimposed on a polarisation voltage of 200VDC, to the coupler mounted in the jig, also shown in Fig. 7. The coupler picks up the resulting audio signal and sends this back to the computer which traces out and displays the coupler response. An example of a displayed response is shown in Fig. 8.

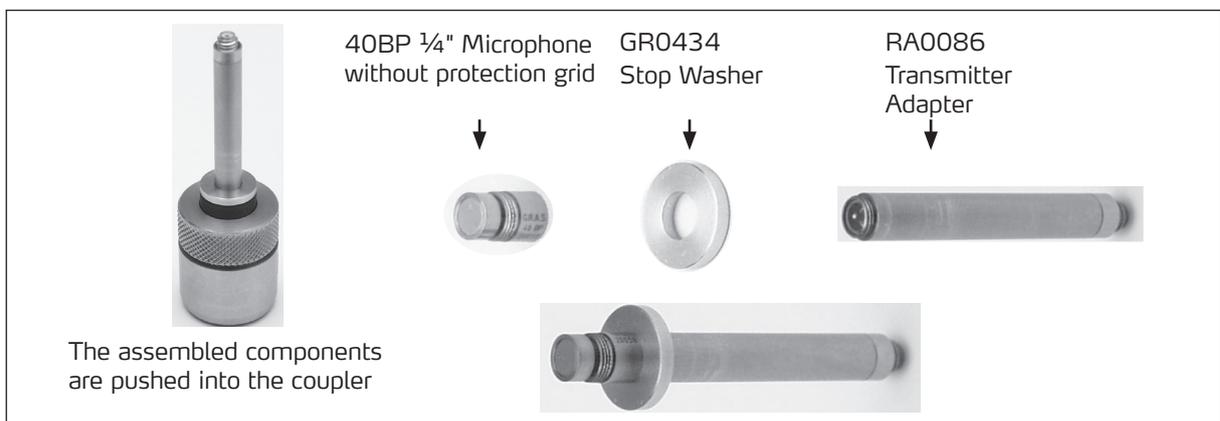


Fig. 6. Assembled and exploded views showing how the GR0434 is used when calibrating the Ear Simulator. 40BP and RA0086 are available from G.R.A.S.

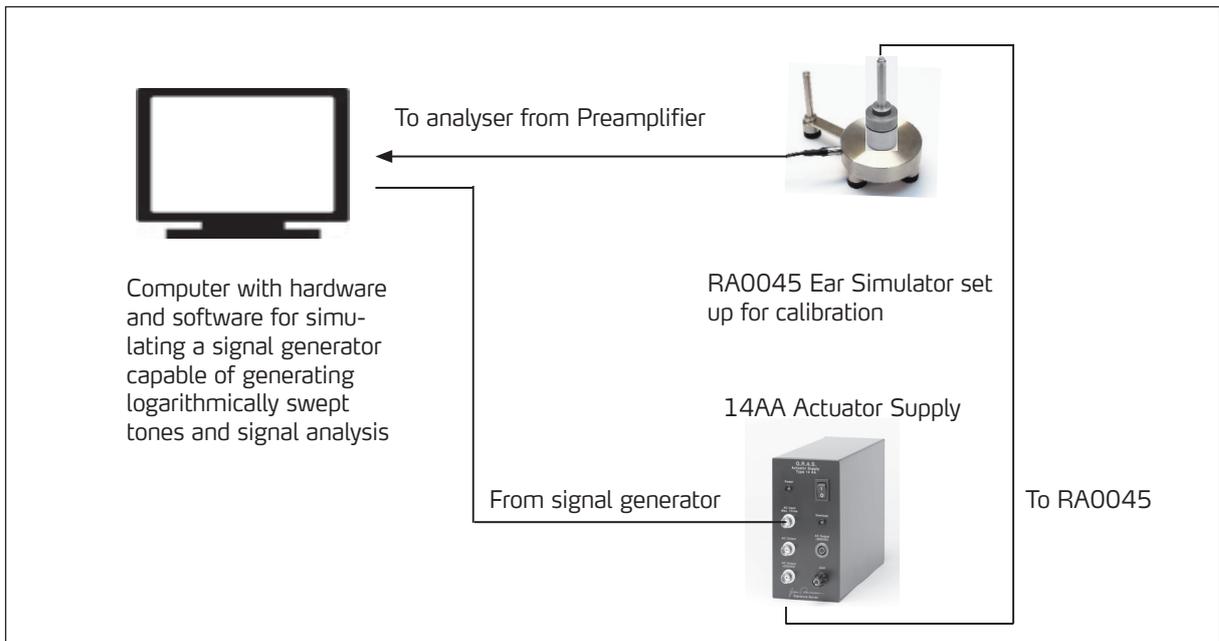


Fig. 7. Block diagram of a complete set-up for calibration.

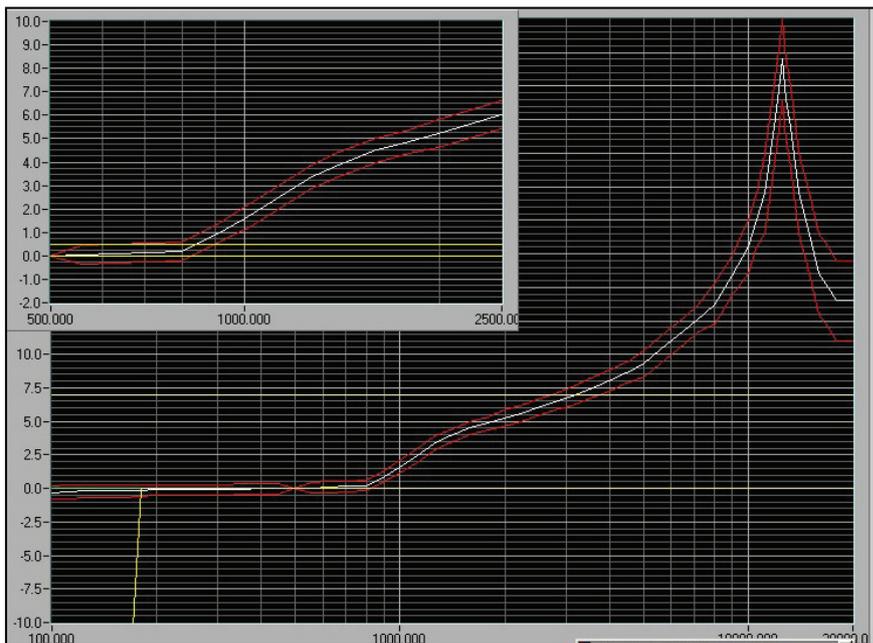


Fig. 8. Example of a calibration result using a swept tone