

Instruction Manual

50GI-R Sound Intensity Probe



Revision History

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

Revision	Date	Description
1	13 February 2013	First publication
2	19 June 2013	Revision - ordering information for spacers corrected
3	6 June 2014	New part numbers for spacers

Copyright Notice

© 2014 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

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

Contents

Introduction and Description	4
Main Components.....	5
Handling and Assembling the Probe	8
The Microphones	8
Probe Design.....	8
Physical Strength	8
Assembling the Probe	9
Calibration	12
Checking the Sensivity and P-I Index using a Pistonphone.....	12
Checking the Probe's P-I Index using an Intensity Calibrator.....	13
Ordering Information	14
Specifications and Warranty	15
Calibration.....	15
Warranty.....	15
Service and Repairs.....	15

Introduction and Description

The G.R.A.S 50GI-R Sound-intensity Probe is a two-microphone sound intensity probe. It has a pair of G.R.A.S. 40GK phase-matched $\frac{1}{2}$ " microphones, two G.R.A.S. 26CB $\frac{1}{4}$ " phase-matched microphone preamplifiers, solid spacers, remote control handle and connection cable. The probe is adjustable, durable and fully complies with the following requirements:

- IEC 61043, Electroacoustics - Instruments for the Measurement of Sound Intensity – Measurements with Pairs of Pressure Sensing Microphones, 1993 for Class 1 Sound-intensity probes.



Fig. 1. The 50GI-R Sound Intensity Probe

Main Components

The main components of the 50GI-R Sound-intensity Probe are:

- 40GK Sound Intensity Microphone Pair
- Two 26CB Microphone Preamplifiers
- Four solid spacers of various lengths and a spacer cup (see Fig. 6)
- Remote-control handle with (where applicable) up to two push buttons for controlling measurements

The 50GI-R is delivered in a carrying case similar to the one shown in Fig. 2, complete with microphones, preamplifiers, standard accessories and a remote-control handle.



Fig. 2. The type of carrying case delivered with the 50GI-R

Microphones

The microphones are high sensitivity, free-field ½" condenser microphones with a uniquely-designed pressure equalization system that ensures extremely well defined phase characteristics. The microphones and preamplifiers are mounted on the end of the telescopic arm of the Remote-control handle. To cover the full frequency range from 30Hz to 10kHz, the 50GI-R is delivered with four solid interchangeable spacers for spacing the microphones at 12 mm, 25 mm, 50 mm and 100 mm.



Fig. 3. Pairs of phase-matched 1/2" microphone cartridges, with and without spacer.

Preamplifiers

The small 1/4" diameter and 40mm long microphone preamplifiers are housed in robust, stainless steel casings which enable novel probe designs that reduce disturbances to the sound field otherwise brought about by the effects of shadows and diffraction. Symmetry of design enables reliable calibrations as described in the proposed standard (ISO/DIS 9614-2) for sound power measurements using sound-intensity measurements.

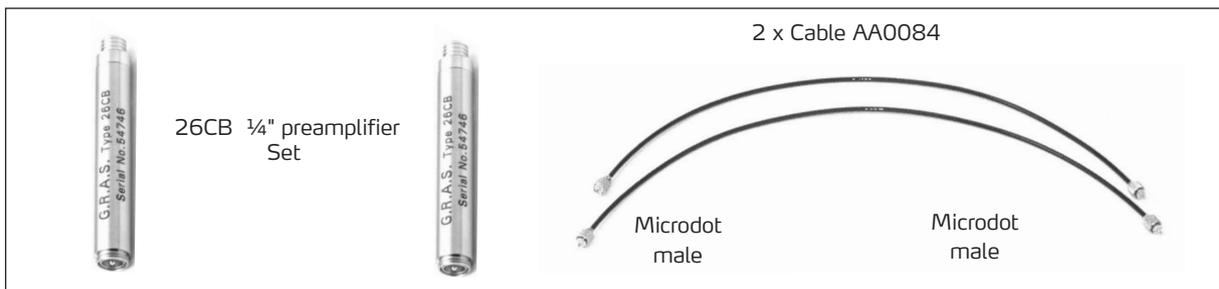


Fig. 4. 26CB 1/4" Preamplifier set supplied with 50GI-R and the 2 microdot cables.

Cables



Fig. 5. Cables for control and signal connection to analyzer

Spacers

To cover the wide frequency range (30 Hz - 10 kHz), Type 50GI-R Sound Intensity Probe is delivered with four solid spacers of various lengths and a spacer cup Fig. 6.

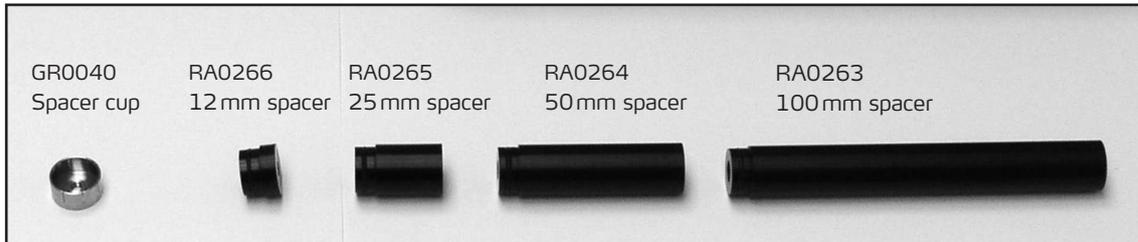


Fig. 6. The various spacers supplied with the 50GI-R.

To select the most appropriate spacer for the actual measurements, refer to Fig. 7.

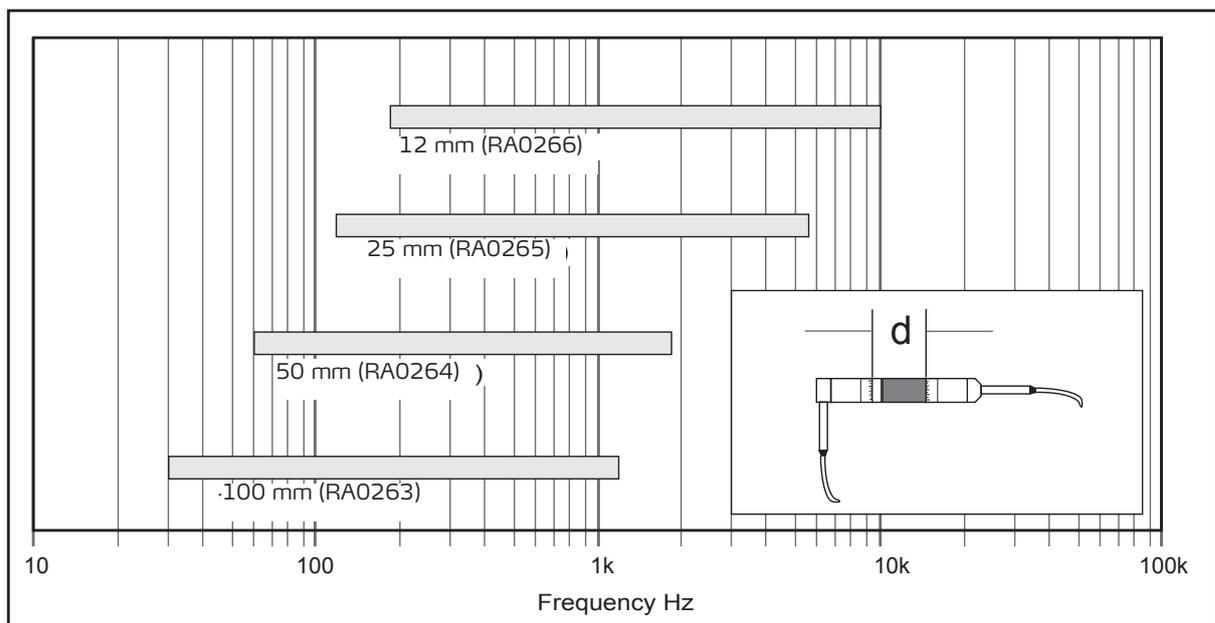


Fig. 7. Frequency ranges covered by the various spacer lengths.

Handling and Assembling the Probe

The Microphones

The 40GK Microphones are a pair of special free-field microphones with extremely well-controlled phase characteristics. They are delivered as a matched pair each with individual calibration data as well as data on differences between their phase responses.

These microphones have a unique pressure equalisation system that ensures a well defined lower-limiting frequency and an extremely low sensitivity to sound pressures at the pressure equalisation channels. Therefore, they can be calibrated in single-port phase calibrators such as the G.R.A.S. 51AB Intensity Calibrator.

Probe Design

The design of the Intensity Probe minimizes acoustic reflections and the influence of diffraction. This has been achieved by removing any reflective components from the sound path at 0° incidence. Since sound waves at 0° incidence are the main contributors to the total sound intensity level, it is important that disturbances in this direction be minimized.

The thin preamplifier cables (diameter of 2.5 mm) will have no influence on the sound field since they constitute a highly irregular surface with negligible reflections. The effects of acoustic diffraction and reflections from the physical parts of the Intensity Probe are below 0.15 dB.

The microphones (40GK) are supplied as sets that include spacers and three preamplifier adapters (two right-angled and one straight).

The distances between microphones and preamplifiers have been kept to a minimum in order to avoid problems with stray capacitance and sensitivity to vibration. While amplitude characteristics are little influenced by vibrations in the conductors carrying the raw signals from the microphones, the phase characteristics of an Intensity Probe can be critically affected by even very small vibrations. Therefore, the ¼" preamplifiers are mounted in rigid contact with the ½" microphones via short adapters (right-angled and/or straight). This also eliminates problems with non-matching capacitances between microphones and preamplifiers that could give rise to phase problems.

Physical Strength

From a physical point of view, an Intensity Probe is robust and easy to assemble and dismantle. Typically, two points in an Intensity Probe are critical for its physical strength. These points are the threads on the microphones and preamplifiers as well as the threads on the microphones' protection grids. The connections between microphones and preamplifiers are very delicate. Therefore, the preamplifier threads of the 50GI-R are supported by stainless steel ½" to ¼" adapters. There is also a protective guard within the ¼" housing of each preamplifier. Furthermore, the microphones' protection grids are made of stainless steel that improve their ability to withstand rough physical treatment – a buckled or damaged protection grid will almost invariably damage a microphone's diaphragm beyond repair.

Assembling the Probe

The Intensity Probe can be assembled in either a straight setup or a symmetrical setup:

- The straight setup is for intensity measurements close to surfaces and general source location measurements.
- The symmetrical configuration, is ideal for sound power measurements, for example according to the international standard ISO 9614-2 "Acoustics - Determination of sound power levels of noise sources using sound intensity" where a rotation test is required.

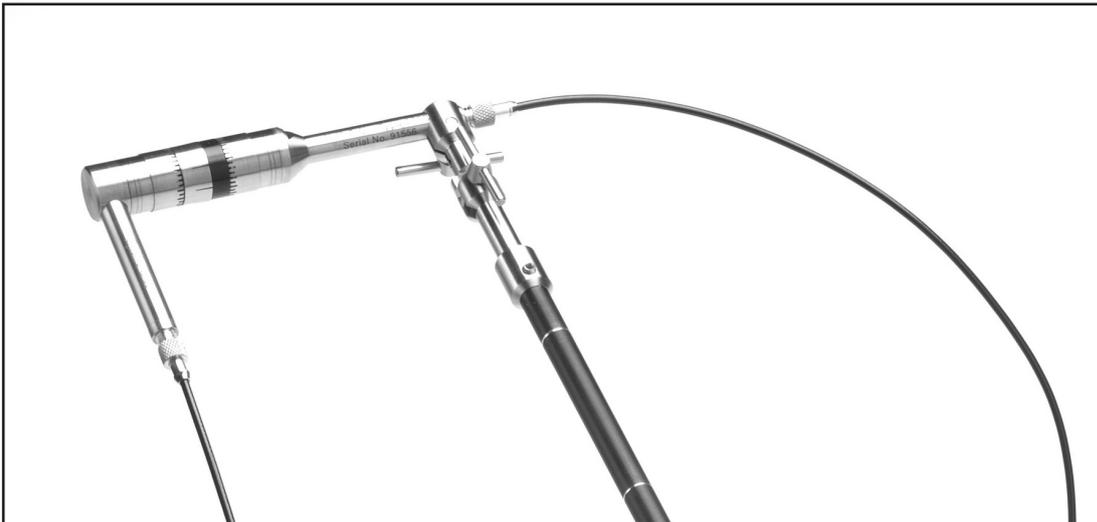


Fig. 8. Straight setup using the 25-mm spacer.



Fig. 9. Symmetrical setup using the 12-mm spacer.

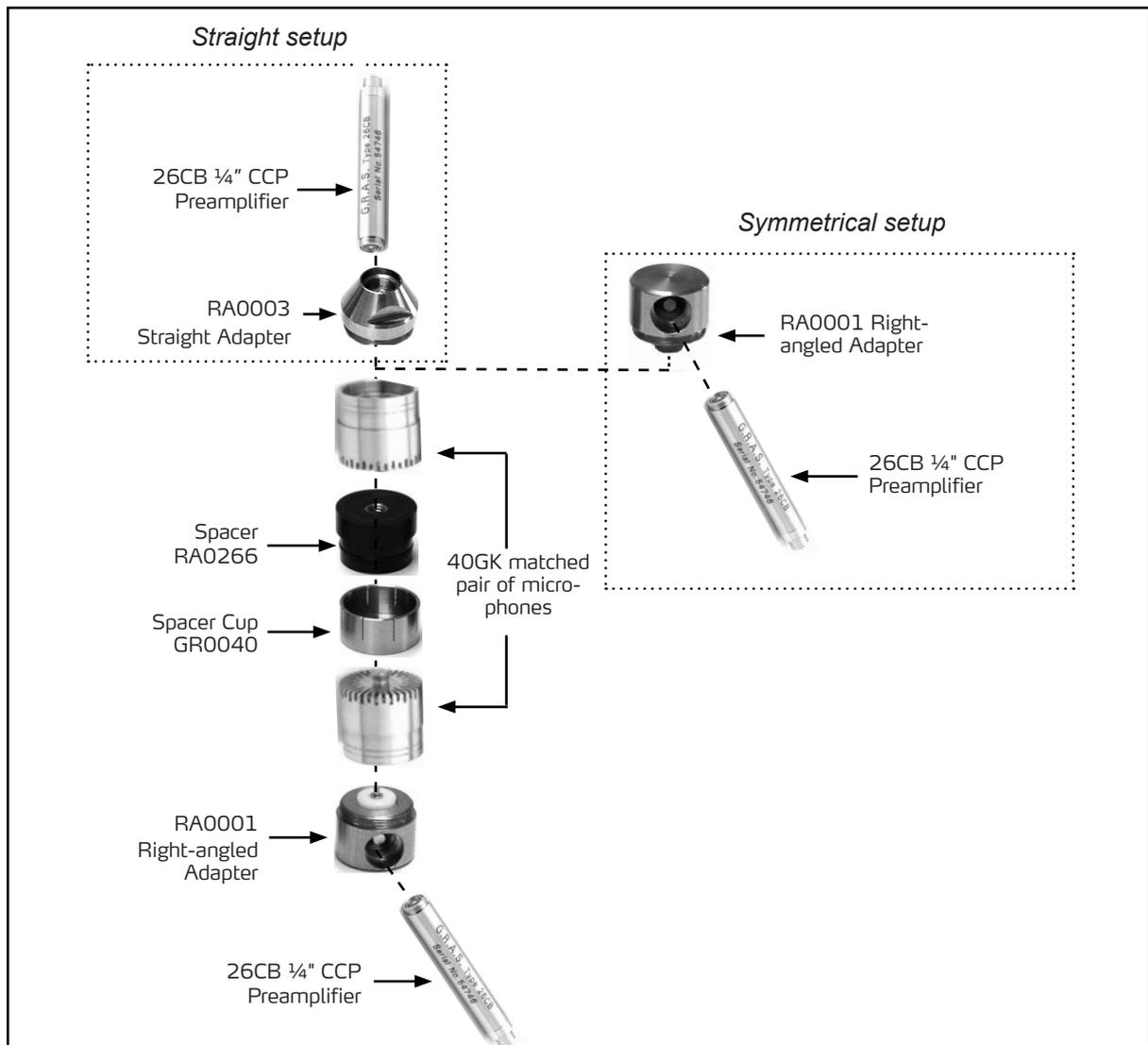


Fig. 10. Exploded view of probe assembly for both straight and symmetrical setup.

Assemble as follows:

1. Mount one microphones onto one RA0001 Right-angled Adapter and the other microphone onto the other Right-angled Adapter RA0001 (symmetrical configuration) or onto the RA0003 Straight Adapter (straight configuration).
2. Unscrew the black protection caps from the two CCP Preamplifiers.
3. Mount the microphone-adapter assemblies onto the preamplifiers.
4. Screw the GR0040 Spacer Cup onto the protection grid of one of the microphones.
5. Select the most appropriate spacer for the frequency range you wish to measure. Refer to "Spacers" on page 7 to select the spacer needed for the actual application.
6. Screw the spacer onto the protection grid of the other microphone.

7. Assemble the probe head by pressing the free end of the spacer (mounted on the one microphone) into the spacer cup mounted on the other microphone:

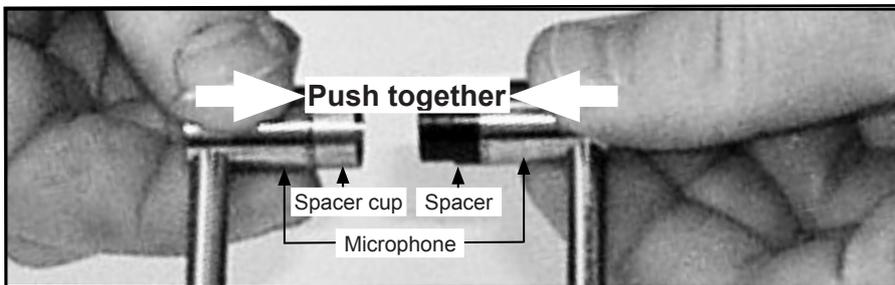


Fig. 11. Assembling the probe head (shown for the symmetrical setup).

8. Mount the probe head by sliding either of the preamplifiers into the clamp (can be locked at angles of 0°, 45°, 90°, 135° and 180° at the top of the telescopic arm, and tighten the finger screw).
9. Connect the Cable AA0084 to the preamplifiers and mount the cables into the cable guides of the probe handle

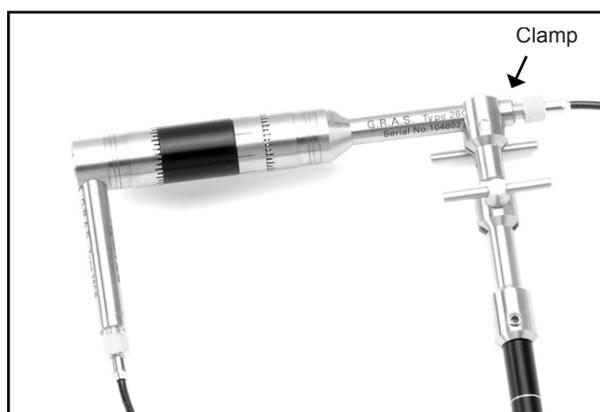


Fig. 12. Probe head mounted on the probe (straight setup).

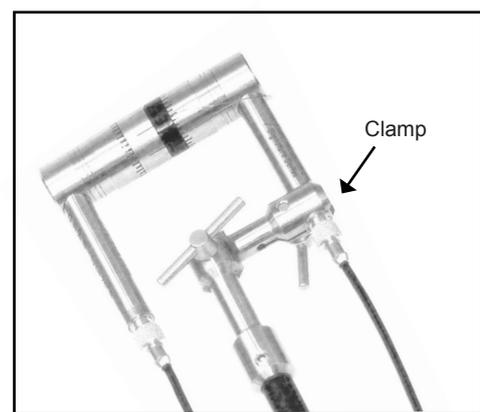
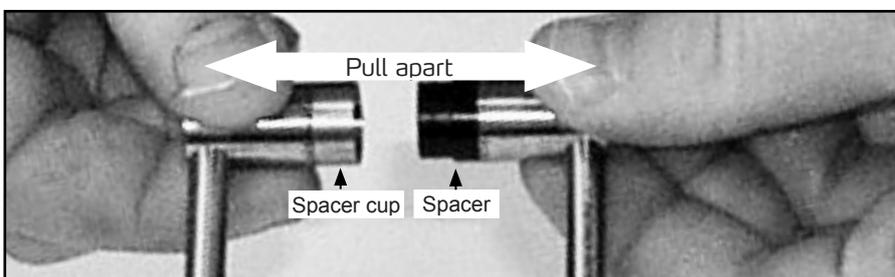


Fig. 13. Probe head mounted on the probe (symmetrical setup).

Changing the Spacer (to cover a different frequency range)



1. Dismantle the probe head by pulling the spacer out of the spacer cup.
2. Unscrew the spacer and replace it with the one covering the desired frequency range (See "Spacers" on page 7).

Calibration

Checking the Sensivity and P-I Index using a Pistonphone

Checking the Sensitivity

Check the sensitivity of the microphones using a 42AP (recommended) or 42AA Pistonphone. Refer to the manual supplied with the pistonphone for instructions on using the pistonphone.

Checking the P-I Index (Pressure Intensity)

Check the P-I index using the RA0024 Two-port Calibration Coupler and a pistonphone, either the 42AP (recommended) or the 42AA.

1. Dismount the standard ½" coupler.
2. Mount the Two-port Calibration Coupler RA0024, and insert the two microphones into its ports. *The two microphones will be subjected to the same pressure level.*

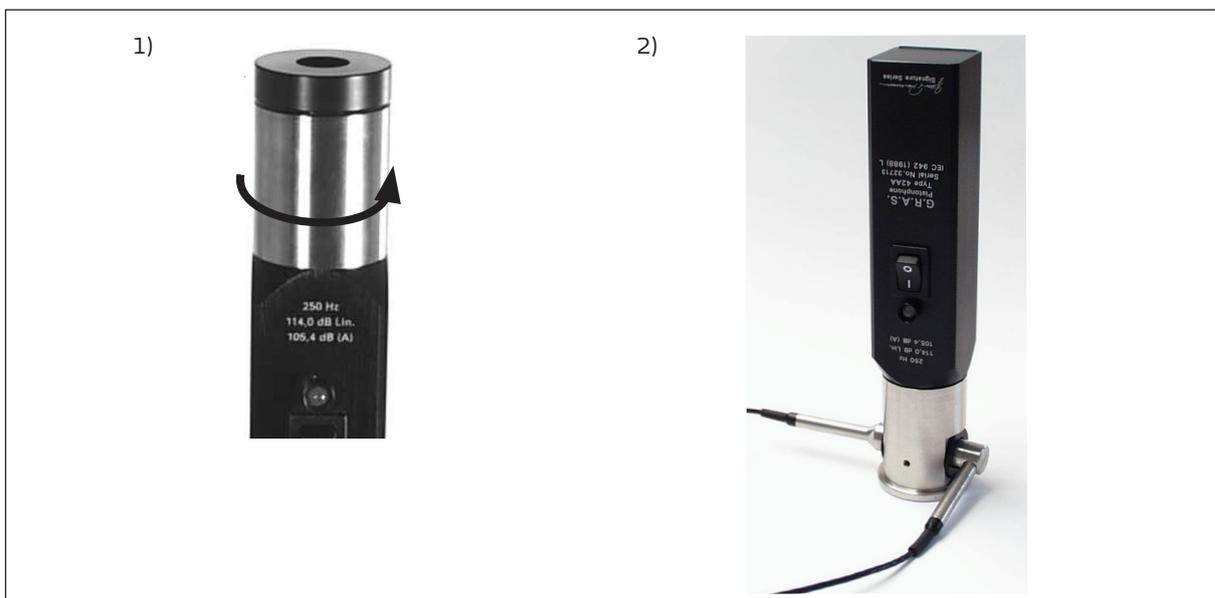


Fig. 14. Mounting the RA0024 two port calibration coupler.

You will have to add the two-port correction factor for the RA0024 to the calibration value given for the pistonphone. The sound pressure level L_{2P} obtained in the two-port adapter is then:

$$L_{2P} = L_P + L_C$$

L_P : normal pistonphone level corrected for the barometric pressure
 L_C : two-port correction factor (nominal 8.0 dB)

If the pistonphone is used an ambient temperature different from that ambient static pressure (1013 hPa), the sound pressure level must be corrected accordingly.

Two-port correction factor (nominal):	8.0 dB
Nominal Frequency	250 Hz

Checking the Probe's P-I Index using an Intensity Calibrator

The P-I (Pressure Intensity) index of the sound intensity microphone pair and preamplifiers can be checked using the Intensity Calibrator Type 51AB – proceed as follows:

1. Mount the intensity microphones on their preamplifiers.
2. Connect the preamplifier outputs to the sound-intensity analyzer¹.
3. Insert the microphones into the holes at the ends of the Intensity Calibrator, making sure to push them all the way in.
4. Set the intensity analyzer to measure intensity corresponding to a 25 mm microphone spacing.
5. Apply a signal² to the BNC input of the Intensity Calibrator (signal must not exceed 1V RMS).
6. Set the analyzer to mean pressure mode, and measure the result in decibels re. 20 μPa.
7. Set the analyzer to intensity mode and measure the result in decibels re. 10⁻¹² W/m².

The P-I index of the intensity probe is then the difference, in decibels, of these two results. For frequencies above 300 Hz, this should be at least 29 dB.

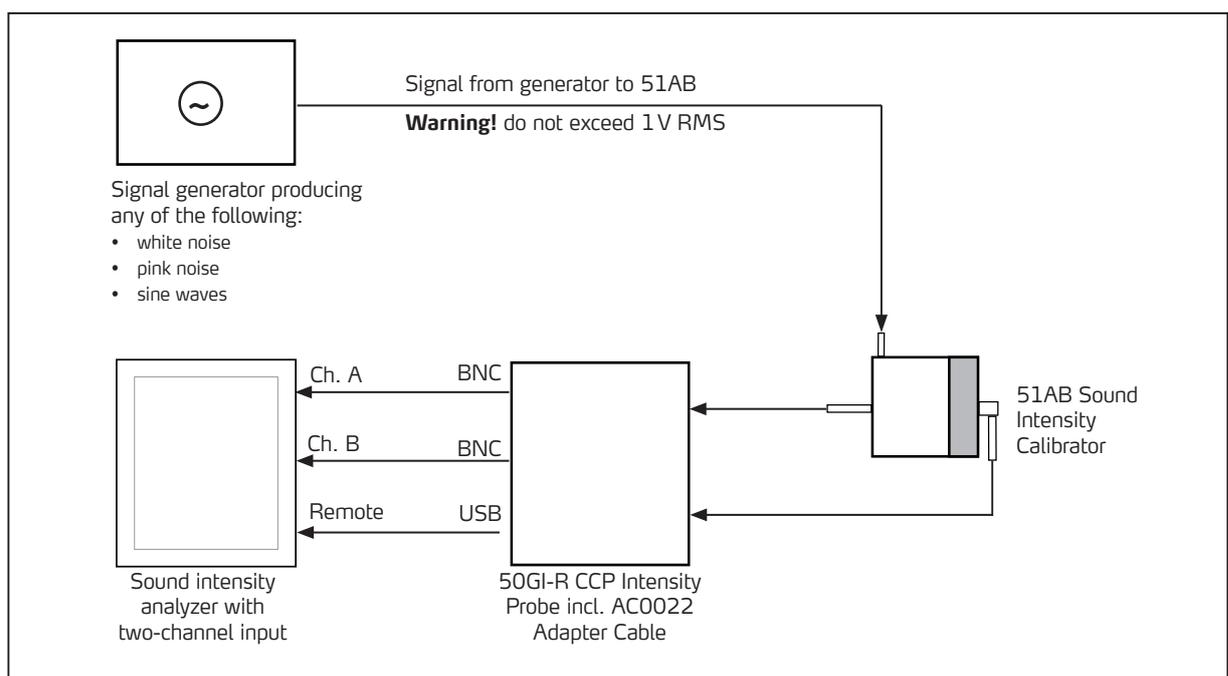


Fig. 15. Setup with signal generator and sound intensity analyzer.

¹ Via a preamplifier power module (e.g. the GRAS 2-channel Power Module Type 12AQ) if the sound-intensity analyzer does not provide power for preamplifiers.

² White-noise, pink-noise or a sine wave.

Ordering Information

Included Items	Part Number
½" Free-field Sound Intensity Microphone set	40GK
¼" CCP Preamplifier set	26CB
Spacers:	
Spacer, 100 mm	RA0263
Spacer, 50 mm	RA0264
Spacer, 25 mm	RA0265
Spacer, 12 mm	RA0266
Straight adapter	RA0003
Angled adapter	RA0001
12-pin LEMO Extension Cable, 5 m (male-male)	AA0021
Adapter, 12-pin LEMO (female) to 2 x BNC + RS232 (male)	AC0024
2 x Cable Microdot 30 cm (male-male)	AA0084
Serial to USB Adapter	KE0132
Probe Handle	AI0048S
Windscreen	AI0001
Optional Accessories	
Microphone Adapter (microdot-microdot, female)	AE0046
For calibration:	
Intensity calibrator	51AB
Pistonphone with built-in barometer and thermometer (recommended)	42AP
Pistonphone	42AA
Two-port Calibration Coupler (for 42AP and 42AA Pistonphones)	RA0024
Adapter cable	AC0022

Specifications and Warranty

Specifications

Sound-intensity microphone pair 40GK, phase-matched	½" Free-field
Preamplifiers 26CB	Phase-matched
Frequency response and phase-matching	IEC 61043 class 1
Weight	0.4 kg (0.9 lbs)
Frequency range: with 100 mm spacer with 50 mm spacer with 25 mm spacer with 12-mm spacer	30 Hz – 1 kHz 80 Hz – 1.5 kHz 120 Hz – 5 kHz 200 Hz – 10 kHz

Calibration

Before leaving the factory, all G.R.A.S. products are calibrated in a controlled laboratory environment using traceable calibration equipment.

We recommend a yearly recalibration at minimum, depending on the use, measurement environment, and internal quality control programs.

We recommend calibration prior to each use to ensure the accuracy of your measurements.

Warranty

All G.R.A.S. products are made of high-quality materials that will ensure life-long stability and robustness. The 50GI-R is delivered with a 2-year warranty.

Damaged diaphragms in microphones can be replaced.

The warranty does not cover products that are damaged due to negligent use, an incorrect power supply, or an incorrect connection to the equipment.

Service and Repairs

All repairs are made at G.R.A.S. International Support Center located in Denmark. Our Support Center is equipped with the newest test equipment and staffed with dedicated and highly skilled engineers. Upon request, we make cost estimates based on fixed repair categories. If a product covered by warranty is sent for service, it is repaired free of charge, unless the damage is the result of negligent use or other violations of the warranty. All repairs are delivered with a service report, as well as an updated calibration chart.