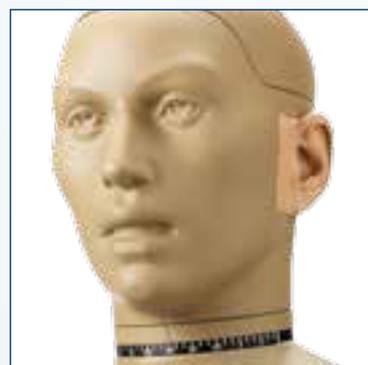
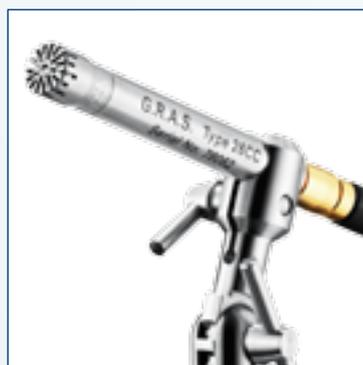
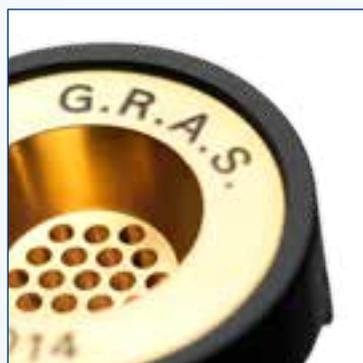


# Product Catalogue

## Measurement Microphones

Standards  
Specials  
Customized



**G.R.A.S.**  
SOUND & VIBRATION



# We make Microphones

Since the company was established in 1994, we have been 100% dedicated to develop and manufacture high-quality measurement microphones and related acoustic equipment.

## **Tradition**

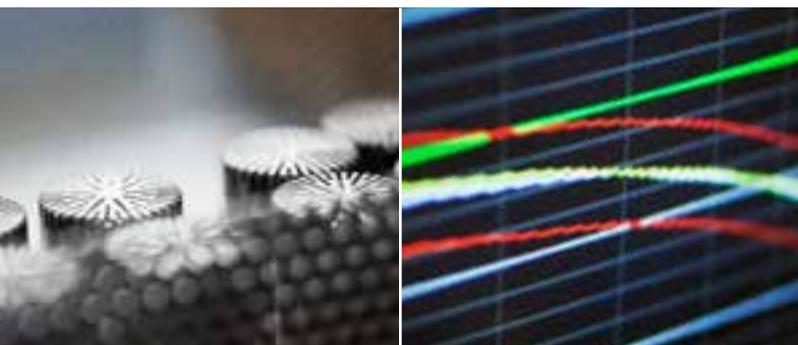
We are located in Denmark and founded by the Danish acoustics pioneer, Gunnar Rasmussen who for more than 60 years has contributed to the world of sound and vibration with his unique ideas and designs. In 1956 Mr. Rasmussen designed the first reproducible 1" condenser measurement microphones. And the commercialization of these measurement microphones enabled quality measurements and instrumentation which could be acoustically calibrated and accredited.

Mr. Rasmussen's ingenuity and understanding of not yet spoken customer needs soon lead to the

world's most popular and probably most copied acoustic sensor: The 1/2" measurement microphone. Then the 1/4" and 1/8" microphones followed with outstanding dynamic and high-frequency capability that brought higher definition and transparency into impulse noise diagnostics. Many variants have been made available over the years; all based on Gunnar Rasmussen's original 1" pressure microphone design.

## **Innovation**

At G.R.A.S., we and our customers benefit daily from Mr. Rasmussen's exceptional understanding of acoustics, physics, electronics and measurement needs. Not only in our R&D department but in the entire house we are proud to develop, produce and offer the broadest range of high-quality measurement microphones and accessories in the industry. And as a family company, now owned and managed by the two sons, Per Rasmussen and Peter Wulf-



Andersen, we safeguard our heritage and knowledge to help create new opportunities with our customers. We work with everybody who has an interest in sound or noise within the fields of aerospace, automotive, audiology, consumer electronics, noise monitoring, building acoustics and tele-communications, metrology, education, consultancy, legislation and system integration.

#### **Quality**

All our microphones are solely produced in stainless steel and in a quality that allows for a 5 year warranty.

#### **Unique repair service**

Should you by mistake damage the diaphragm on a G.R.A.S. microphone, our special technique enables repair at a very reasonable price. A fact often valued not only by the users but also by their purchase

departments who are guaranteed a long term investment with equipment from G.R.A.S. This service applies to both standard, special and customized microphones.

#### **Partners**

G.R.A.S. is represented worldwide in more than 40 countries by subsidiaries and partners. Whether you are searching for a multi-channel solution, a replacement microphone for your sound level meter or a customized sensor design, your local G.R.A.S. partner will in close cooperation with us be able to help solve your measurement needs.

Please visit [gras.dk](http://gras.dk) for your local G.R.A.S. partner.

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# MICROPHONE SELECTION

Measurement microphones are available in many types covering various frequency ranges, dynamic ranges and application situations. The following guide is provided to help select the right microphone for a given application.

Selecting a microphone involves a number of choices, which can be summarized as:

- Externally polarized vs. prepolarized
- Free-field, Pressure or Random incidence
- Dynamic range
- Frequency range

## Externally polarized vs. prepolarized

All G.R.A.S. measurement microphones are of the condenser type. This requires a polarization voltage which can either be supplied from an external power supply or the microphone itself can be polarized by injecting a permanent electrical charge into a thin PTFE layer on the microphone backplate.

### Externally polarized microphones

These microphones are used with standard preamplifiers such as the G.R.A.S. 26AK, which has a 7-pin LEMO connector. The preamplifier must be connected to a power module (for example G.R.A.S. 12AK) or an analyzer input which can supply the preamplifier with power as well as 200 V polarization.

Externally polarized microphones are the most accurate and stable and are to be preferred for very critical measurements.

### Prepolarized microphones

These microphones are used typically with CCP (Constant Current Power\*) preamplifiers such as G.R.A.S. 26CA. Prepolarized microphones must be connected to an input stage for CCP transducers or be powered by a CCP supply, for example the G.R.A.S. 12AL.

CCP preamplifiers use standard coaxial cables, thus reducing costs. On the other hand the long term stability and high temperature stability of prepolarized microphones are not as good as for externally polarized microphones.

\*CCP (Constant Current Power) is the same as IEPE (Integrated Electronic Piezo-Electric) and CCLD (Constant Current Line Drive) and is compatible with many other constant current driven products such as Deltatron® (Brüel & Kjaer), ISOTRON® (Endevco Corp.), ICP® (PCB Group, Inc.).

## Free-field, Pressure or Random incidence

Measurement microphones can be divided into three groups: Free-field, Pressure, and Random incidence. The differences between microphones from group to group are at the higher frequencies, where the size of a microphone becomes comparable with the wavelengths of the sound being measured.

### Free-field microphones

A free-field microphone is designed essentially to measure the sound pressure as it was before the microphone was introduced into the sound field. At higher frequencies the presence of the microphone itself in the sound field will disturb the sound pressure locally. The frequency response of a free-field microphone has been carefully adjusted to compensate for the disturbances to the local sound field. (See also random incidence microphones)

Free-field microphones are recommended for most sound pressure level measurements for example with sound level meters, sound power measurements and sound radiation studies.

### Pressure microphones

A pressure microphone is for measuring the actual sound pressure on the surface of the microphone's diaphragm. A typical application is in the measurement of sound pressure in a closed coupler or, as shown below, the measurement of sound pressure at a boundary or wall; in which case the microphone forms part of the wall and measures the sound pressure on the wall itself.

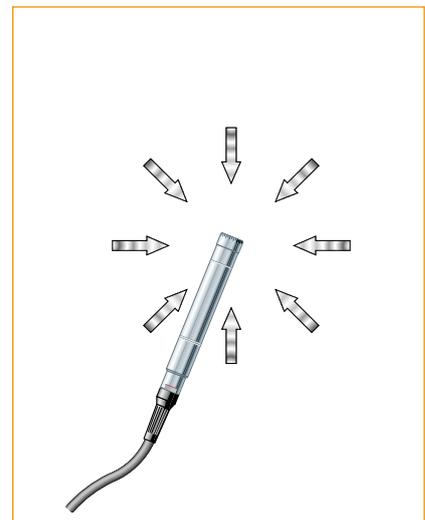
Pressure microphones are recommended for use with couplers like G.R.A.S. RA0045 IEC 60318-4 and RA0038 IEC 60318-5, 2cc coupler and for studies of sound pressures inside closed cavities.

### Random incidence microphones

A random incidence microphone is for measuring in sound fields, where the sound comes from many directions e.g. when measuring in a reverberation chamber or in other highly reflecting surroundings.

The combined influence of sound waves coming from all directions depends on how these sound waves are distributed over the various directions. For measurement microphones, a standard distribution has been defined based on statistical considerations; resulting in a standardized random incidence microphone.

Random incidence is used typically for sound pressure level measurements according to ANSI standards.



## Dynamic range of a microphone

The dynamic range of a microphone can be defined as the range between the lowest level and the highest level that the microphone can handle. This is not only a function of the microphone alone, but also of the preamplifier used with the microphone. The dynamic range of a microphone is, to a large extent, directly linked to its sensitivity.

In general, a microphone with a high sensitivity will be able to measure very low levels, but not very high levels, and a microphone with low sensitivity will be able to measure very high levels, but not very low levels.

The sensitivity of a microphone is determined chiefly by the size of the microphone and the tension of its diaphragm. Generally speaking, a large microphone, with a loose diaphragm, will have a high sensitivity and a small microphone, with a stiff diaphragm, will have a low sensitivity.

### Upper limit of dynamic range

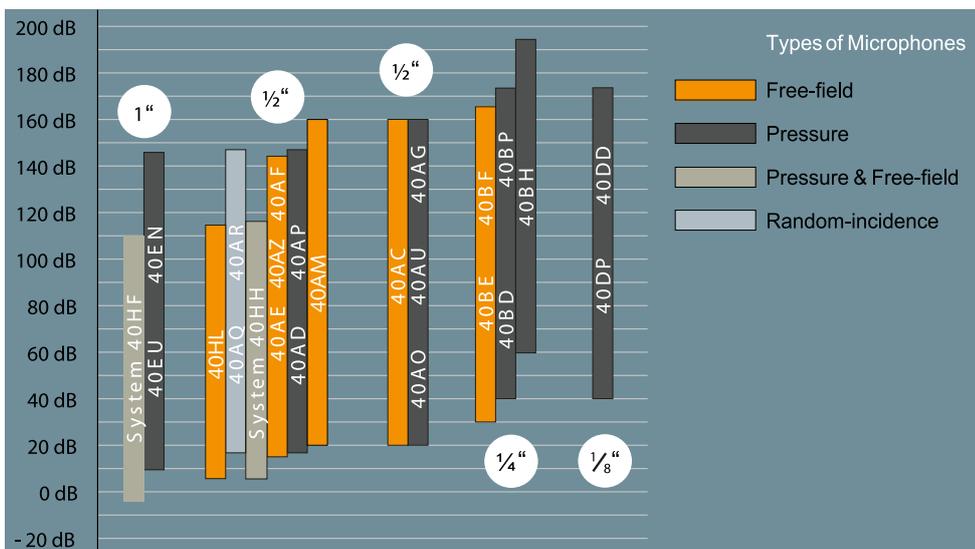
The highest levels that can be measured are limited by the amount of movement allowed for the diaphragm before it comes into contact with the microphone's back plate.

As the level of the sound pressure on a microphone increases, the deflection of the diaphragm will accordingly be greater and greater until, at some point, the diaphragm strikes the back plate inside the body of the microphone. This is ultimately at the highest level the microphone can measure.

### Lower limit of dynamic range

The thermal agitation of air molecules is sufficient for a microphone to generate a very small output signal, even in absolutely quiet conditions. This "thermal noise" lies normally at around 5  $\mu$ V and will be superimposed on any acoustically excited signal detected by the microphone. Because of this, no acoustically excited signal below the level of the thermal noise can be measured.

The dynamic ranges of various G.R.A.S. microphones are shown in the chart below. Different colours are used to distinguish between pressure (dark grey), free-field (orange) and random incidence (light grey) microphones.



The Part or Model number of each microphone is also shown. The microphones are grouped according to size of external diameter, i.e. 1", 1/2", 1/4" and 1/8".

## Frequency range of a microphone

The frequency range of a microphone is defined as the interval between its upper limiting frequency and its lower limiting frequency. With today's microphones it is possible to cover a frequency range starting from around 1Hz and reaching up to 140 kHz.

Low frequency measurements require a microphone with a well controlled static pressure equalization with a very slow venting. Special versions are available for infra-sound measurements.

High frequency measurements are very sensitive to diaphragm stiffness, damping and mass as well as diffraction.

### Upper limiting frequency

The upper limiting frequency is linked to the size of the microphone, or more precisely, the size of the microphone compared with the wavelength of sound. Since wavelength is inversely proportional to frequency, it gets progressively shorter at higher frequencies. Hence, the smaller the diameter of the microphone, the higher are the frequencies it can measure. On the other hand, the sensitivity of a microphone is also related to its size which also affects its dynamic range.

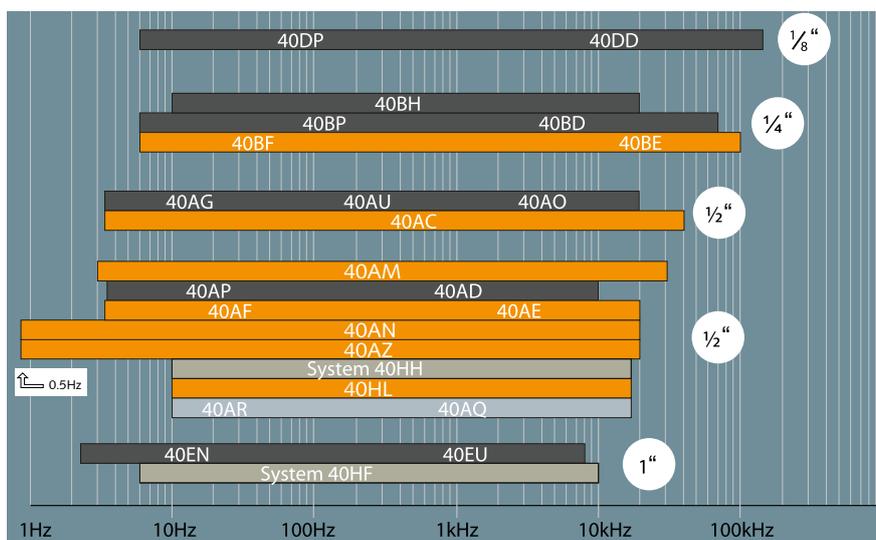
The frequency ranges of various G.R.A.S. microphones are shown in the chart below. Different colours are used to distinguish between pressure (dark grey), free-field (orange) and random incidence (light grey) microphones.

### Lower limiting frequency

The lower limiting frequency of a microphone is determined by its static pressure equalization system. Basically, a microphone measures the difference between its internal pressure and the ambient pressure.

If the microphone was completely airtight, changes in barometric pressure and altitude would result in a static deflection of its diaphragm and, consequently, in a change of frequency response and sensitivity.

To avoid this, the microphone is manufactured with a static pressure equalization channel for equalising the internal pressure with ambient pressure. On the other hand, equalization must be slow enough to avoid affecting the measurement of dynamic signals.



The Part or Model number of each microphone is also shown. The microphones are grouped according to size of external diameter, i.e. 1", 1/2", 1/4" and 1/8".

# MICROPHONE SETS

## **New approach**

With the unique transducer combinations G.R.A.S. is introducing a new approach to measurement microphones and to measurement data safety.

By analyzing the feedback from our multi- as well as 1-channel users we realized that there was a need for a different philosophy when choosing and using acoustic sensors.

Daily situations where you mix up externally polarized and prepolarized microphones and preamplifiers or use wrong calibration data in the system setup are time consuming and often undiscovered until a whole set of measurement data is analyzed and consequently discarded.

## **Pre-assembled sets**

The G.R.A.S. 46 sets of preassembled G.R.A.S. microphones and preamplifiers solves these situations and is a combination carefully selected to obtain the best possible properties and reliability, thus optimizing the

workflow for the user and minimizing typical handling errors.

The sets are assembled in a dust free environment to avoid contamination of the interface between the microphone and preamplifier and have been sealed with a label. The label can be removed and the set dismantled, if desired by the user.

## **Easy selection**

The measurement microphone sets have been combined so they fulfill our users' typical measurement needs. Independently of your measurement system and application you should be able to find a set that suits your needs.

## **Plug & Play**

The microphone sets can be connected directly to all professional measurement systems and as indicated they are available for both CCP and 7-pin LEMO inputs.

If your measurement platform supports intelligent

transducers according to IEEE 1451.4 Transducer Electronic Data Sheet (TEDS) you can simply plug in the microphones and they will identify themselves with their specific properties, types and calibration data. A feature especially appreciated by multi-channel users.

#### **Cables**

The CCP sets use high quality coaxial cables whereas the LEMO sets use a special, soft type of multi-core shielded cable.

Some sets have a 3 m cable included and others have cables as accessories.

It should be noted that longer cables will influence the upper frequency and dynamic ranges.

#### **Calibration data**

All microphone sets are delivered as a unit and are calibrated accordingly. The sets are delivered with calibration charts including sensitivity values and frequency response curves for the complete set. The sensitivity value can therefore be used directly in your system setup.

#### **Verification and annual calibration**

For frequent verification of the measurement chain a sound source will be required. G.R.A.S. supplies a 114 dB sound calibrator for this purpose.

Depending on the use and your internal quality control requirements we recommend that the sets are recalibrated at least every second year.

#### **Warranty**

G.R.A.S. offer a 5 year warranty on the Microphone Sets.

#### **Service**

If you by mistake should damage the diaphragm, cable or connector they can usually all be replaced, which is also the case for the microphone cartridge and preamplifier unit.

# LEMO MICROPHONE SETS

## G.R.A.S. 46AC 1/2" LEMO Free-field Standard Microphone Set, Wide Frequency



46AC is a high-performance 1/2" free-field standard microphone set for measuring medium sound pressure levels at high frequencies; with

built-in TEDS and 7-pin LEMO connector.  
Cables available: AA0008/09/20-CL.

## G.R.A.S. 46AP 1/2" LEMO Pressure Standard Microphone Set, High Sensitivity



46AP is a 1/2" general purpose pressure microphone set with built-in TEDS and 7-pin LEMO connector.

Cables available: AA0008/09/20-CL.

## G.R.A.S. 46AF 1/2" LEMO Free-field Standard Microphone Set



46AF is a 1/2" general purpose high sensitivity free-field microphone set with built-in TEDS and 7-pin LEMO connector.

Cables available: AA0008/09/20-CL.

## G.R.A.S. 46AR 1/2" LEMO Random incidence Standard Microphone Set



46AR is a 1/2" high sensitivity random incidence microphone set optimized to measure sound correctly in random, diffuse and

reverberant sound fields; with built-in TEDS and 7-pin LEMO connector.  
Cables available: AA0008/09/20-CL.

## G.R.A.S. 46AG 1/2" LEMO Pressure Standard Microphone Set



46AG is a 1/2" high precision pressure microphone set for laboratory work and coupler measurements with built-in TEDS and 7-pin LEMO connector.

Cables available: AA0008/09/20-CL.

## G.R.A.S. 46BF 1/4" LEMO Free-field Standard Microphone Set



46BF is a 1/4" high frequency free-field microphone set for high level measurements with built-in TEDS and integrated 3 meter cable with a 7-pin LEMO connector.

G.R.A.S.	Nominal sensitivity	Frequency response	Power supply	Dynamic range	Output impedance	Temperature range	Length	Diameter without protection grid	Diameter with protection grid	Weight
46AC	12.5	3.15 - 40 k	28 - 120	20 dB(A) to 164 dB	75	-30 to +70	101	12.7	13.2	42
46AF	50	3.15 - 20 k	28 - 120	17 dB(A) to 149 dB	75	-30 to +70	101	12.7	13.2	42
46AG	12	3.15 - 20 k	28 - 120	25 dB(A) to 164 dB	75	-30 to +70	101	12.7	13.2	42
46AP	50	3.15 - 10 k	28 - 120	18 dB(A) to 149 dB	75	-30 to +70	101	12.7	13.2	42
46AR	50	3.15 - 16 k*	28 - 120	19 dB(A) to 149 dB	75	-30 to +70	101	12.7	13.2	42
46BF	3.6	4 - 100 k	28 - 120	35 dB(A) to 172 dB	75	-30 to +70	52	6.35	6.9	10
Units	mV/Pa	Hz	V DC	re. 20 µPa	Ω	°C	mm	mm	mm	g

\* ±3 dB. All other ±2 dB.

**G.R.A.S. 46BH**  
**1/4" LEMO Pressure Standard Microphone Set,**  
**High Pressure**



46BH is a 1/4" high pressure microphone set with built-in TEDS and integrated 3 m cable with a 7-pin LEMO connector.

**G.R.A.S. 46DP**  
**1/8" LEMO Pressure Standard Microphone Set**



46DP is a 1/8" pressure microphone set with built-in TEDS and integrated 3 m cable with 7-pin LEMO connector.

**G.R.A.S. 46BP**  
**1/4" LEMO Pressure Standard Microphone Set**



46BP is a 1/4" high frequency pressure microphone set for high level measurements with built-in TEDS and integrated 3 m cable with a 7-pin LEMO connector.

G.R.A.S.	Nominal sensitivity	Frequency response	Power supply	Dynamic range	Output impedance	Temp. range	Length	Diameter without protection grid	Diameter with protection grid	Weight
46BH	0.4	10 - 20 k	28 - 120	54 dB(A) to 193 dB	75	-30 to +70	52	6.35	6.9	10
46BP	1.5	4 - 70 k	28 - 120	39 dB(A) to 169 dB	75	-30 to +70	52	6.35	6.9	10
46DP	0.7	6.5 - 140 k	28 - 120	46 dB(A) to 191 dB	75	-30 to +70	52	3.2	3.5	8
Units	mV/Pa	Hz	mA	re. 20 µPa	Ω	°C	mm	mm	mm	g

# CCP MICROPHONE SETS

## G.R.A.S. 46AD 1/2" CCP Pressure Standard Microphone Set, High Sensitivity



46AD is a 1/2" pressure high sensitivity microphone set with built-in TEDS and BNC connector.

Cables available: AA0035/37/39-CL.

## G.R.A.S. 46AO 1/2" CCP Pressure Standard Microphone Set



46AO is a 1/2" pressure high precision microphone set for laboratory work. Including built-in TEDS and BNC connector.

Cables available: AA0035/37/39-CL.

## G.R.A.S. 46AE 1/2" CCP Free-field Standard Microphone Set



46AE is a 1/2" free-field general purpose high sensitivity microphone set with built-in TEDS and BNC connector.

Cables available: AA0035/37/39-CL.

## G.R.A.S. 46AQ 1/2" CCP Random incidence Standard Microphone Set



46AQ is a 1/2" CCP high sensitivity random incidence microphone set, optimized to measure sound correctly in random, diffuse and reverberant sound fields; with built-in TEDS and BNC connector. Cables available: AA0035/37/39-CL.

## G.R.A.S. 46AM 1/2" CCP Free-field Standard Microphone Set, Wide Frequency



46AM is a 1/2" CCP microphone set for measuring medium sound pressure levels at a wide range of frequencies; with built-in TEDS and a BNC connector.

Cables available: AA0035/37/39-CL.

## G.R.A.S. 46BE 1/4" CCP Free-field Standard Microphone Set



46BE is a 1/4" free-field microphone set with low sensitivity for high level and high frequency measurements; with built-in TEDS and Microdot connector.

Cables available: AA0070/72/73-CL.

G.R.A.S.	Nominal sensitivity	Frequency response	Power supply	Dynamic range	Output impedance	Max. output peak voltage	Temp. range	Length	Diameter without protection grid	Diameter with protection grid	Weight
46AD	50	3.15 – 10 k	2 - 20	18 dB(A) to 138 dB	< 50	8	-30 to +70	101	12.7	13.2	40
46AE	50	3.15 – 20 k	2 - 20	17 dB(A) to 138 dB	< 50	8	-30 to +70	101	12.7	13.2	40
46AM	14.5	3.15 – 31.5 k	2 - 20	25 dB(A) to 149 dB	< 50	8	-30 to +70	101	12.7	13.2	40
46AO	12	3.15 – 20 k	2 - 20	25 dB(A) to 150 dB	< 50	8	-30 to +70	97	12.7	13.2	39
46AQ	50	3.15 -12.5 k	2 - 20	17 dB(A) to 138 dB	< 50	8	-30 to +70	101	12.7	13.2	40
46BE	4	10 – 80 k	2 - 20	35 dB(A) to 160 dB	< 50	8	-30 to +70	54	6.35	6.9	10
Units	mV/Pa	Hz	mA	re. 20 µPa	Ω	V	°C	mm	mm	mm	g

**G.R.A.S. 46BD**  
**1/4" CCP Pressure Standard Microphone Set**



46BD is a 1/4" pressure microphone set with low sensitivity for high level and high frequency measurements; built-in TEDS and Microdot

connector. Cables available: AA0070/72/73-CL.

**G.R.A.S. 46DD**  
**1/8" CCP Pressure Standard Microphone Set**



46DD is a low sensitivity microphone set for sound measurements at high frequencies. With built-in TEDS and Microdot connector.

Cables available: AA0070/72/73-CL.

**G.R.A.S. 46BG**  
**1/4" CCP Pressure Standard Microphone Set, High Pressure**



46BG is a 1/4" microphone set for high level measurement with built-in TEDS and a Microdot connector. Its low sensitivity and special-

designed diaphragm make it ideal for handling high levels. Cables available: AA0070/72/73-CL.

**G.R.A.S. 46BL**  
**1/4" CCP Pressure Microphone Set, High Sensitivity**



46BL is a 1/4" microphone set for high sensitivity and low noise measurement with built-in TEDS and a Microdot connector.

Cables available: AA0070/72/73-CL.

G.R.A.S.	Nominal sensitivity	Frequency response	Power supply	Dynamic range	Output impedance	Max. output peak voltage	Temp. range	Length	Diameter without protection grid	Diameter with protection grid	Weight
46BD	1.45	4 - 70 k	2 - 20	44 dB(A) to 166 dB	< 50	8	-30 to +70	54	6.35	6.9	10
46BG	0.25	3.15 - 70 k	2 - 20	60 dB(A) to 184 dB	< 50	8	-30 to +70	53	6.35	6.9	8
46BL	18	4 - 20 k	2 - 20	25 dB(A) to 147 dB	< 50	8	-30 to +70	53	6.35	6.9	8
46DD	0.62	6.5 - 70 k	2 - 20	47 dB(A) to 175 dB	< 50	8	-30 to +70	65	3.2	3.5	8
Units	mV/Pa	Hz	mA	re. 20 µPa	Ω	V	°C	mm	mm	mm	g

# EXTERNALLY POLARIZED MEASUREMENT MICROPHONES

## G.R.A.S. 40AF 1/2" Free-field Microphone



General purpose high sensitivity microphone with a frequency range from 3.15 Hz to 20 kHz. Can measure sound pressure levels down to 14 dB(A). For Type 0 and Type 1 measurements.

## G.R.A.S. 40AC 1/2" Free-field Microphone, Wide Frequency



High precision microphone for laboratory work and as a working standard microphone in calibration laboratories. Wide frequency range from 3.15 Hz to 40 kHz. Its size and low sensitivity make it extremely robust and stable and can measure sound levels up to 164 dB.

## G.R.A.S. 40AN 1/2" Free-field Microphone, Low Frequency



High sensitivity microphone ideal for measuring sound at frequencies down to 0.5 Hz. This microphone is the obvious choice for infra-sound measurement.

Use the dedicated 1/4" preamplifier G.R.A.S. 26HG in order to obtain the low frequency response.

## G.R.A.S. 40AR 1/2" Random Incidence Microphone



High sensitivity microphone with a frequency response optimized to measure sound correctly in random, diffuse and reverberant sound fields. It fulfils the requirements of ANSI standard S1.4.

## G.R.A.S. 40BF 1/4" Free-field Microphone



Low sensitivity microphone for high level and high frequency measurements. Its low sensitivity makes it ideal for measuring high sound pressure levels up to 172 dB. Its small size reduces the effects of diffraction and reflections around the microphone, resulting in a frequency range reaching up to 100 kHz.

G.R.A.S.	Size	Application	Sensitivity	Dynamic range	Frequency range	Polarization voltage	IEC 61094 designation
40AF	12.7 (1/2")	Free-field	50	14 - 149	3.15 - 20 k	200	WS2F
40AC	12.7 (1/2")	Free-field	12.5	20 - 164	3.15 - 40 k	200	WS2F
40AN	12.7 (1/2")	Free-field	50	14 - 149	0.5 - 20 k	200	WS2F
40AR	12.7 (1/2")	Random	50	14 - 149	3.15 - 12.5 k	200	WS2P/D
40BF	6.35 (1/4")	Free-field	4	30 - 172	4 - 100 k	200	WS3F
Units	mm (housing)		mV/Pa	dB re. 20 µPa	Hz	V	

**G.R.A.S. 40EN**  
1" Pressure Microphone



High precision microphone for laboratory work. Ideal for measurements in couplers, e.g. the G.R.A.S. RA0075 NBS 9-A 6cc Coupler for testing earphones according to ANSI S3.7 – 1995 and the G.R.A.S. RA0113 which is a 2cc IEC 60318-5 (60126) Coupler. Can also be flush mounted to measure sound pressures on walls and boundaries.

**G.R.A.S. 40AG**  
1/2" Pressure Microphone



High precision microphone for laboratory work and coupler measurements (e.g. in the G.R.A.S. IEC 60318-1 (60318) Ear Simulator RA0039). Has a frequency range from 3.15 Hz to 20 kHz. Its size and low sensitivity makes it extremely robust and stable and can measure sound pressure levels up to 164 dB.

**G.R.A.S. 40EU**  
1" Reference Pressure Microphone



High precision, laboratory-standard microphone with front cavity as specified in IEC 61094-2. Supplied with a protective dust cap.

**G.R.A.S. 40AU**  
1/2" Reference Pressure Microphone



High precision, laboratory-standard microphone with front cavity as specified in IEC 61094-2. Supplied with a protective dust cap.

**G.R.A.S. 40AP**  
1/2" Pressure Microphone, High Sensitivity



High sensitivity microphone with a frequency range from 3.15 Hz to 10 kHz. Can measure sound pressure levels down to 16 dB(A). May also be used as a random incidence microphone.

G.R.A.S.	Size	Application	Sensitivity	Dynamic range	Frequency range	Polarization voltage	IEC 61094 designation
40EN	23.77 (1")	Pressure	50	9.6 - 146	2.6 - 8 k	200	WS1P
40EU	23.77 (1")	Pressure	50	9.6 - 146	2.6 - 8 k	200	LS1P
40AG	12.7 (1/2")	Pressure	12.5	20 - 164	3.15 - 20 k	200	WS2P
40AU	12.7 (1/2")	Pressure	12.5	20 - 164	3.15 - 20 k	200	LS2aP
40AP	12.7 (1/2")	Pressure	50	16 - 149	3.15 - 10 k	200	WS2P
Units	mm (housing)		mV/Pa	dB re. 20 µPa	Hz	V	

**G.R.A.S. 40BP**  
**1/4" Pressure Microphone**



Low sensitivity microphone for sound measurements at high levels and high frequencies. Its low sensitivity makes it ideal for measuring high sound pressure levels of up to 169 dB. Its small size reduces the effects of diffraction and reflections around the microphone, resulting in a frequency range extending up to 70 kHz.

**G.R.A.S. 40DP**  
**1/8" Pressure Microphone**



Low sensitivity microphone for sound measurements at high frequencies and high levels. Its low sensitivity makes it ideal for measuring high sound pressure levels of up to 178 dB. Its very small size reduces the effects of diffraction and reflections around the microphone, resulting in a frequency range extending up to 140 kHz.

**G.R.A.S. 40BH**  
**1/4" Pressure Microphone, High Pressure**



Low sensitivity microphone for sound measurements at very high levels. Its very low sensitivity makes it ideal for measuring very high sound pressure levels of up to 193 dB. Its small size reduces the effects of diffraction and reflections around the microphone, making it ideal for pulse measurements in frequencies of up to 20 kHz.

G.R.A.S.	Size	Application	Sensitivity	Dynamic range	Frequency range	Polarization voltage	IEC 61094 designation
40BP	6.35 (1/4")	Pressure	1.6	34 - 169	4 - 70 k	200	WS3P
40BH	6.35 (1/4")	Pressure	0.4	54 - 193	10 - 20 k	200	WS3P
40DP	3.16 (1/8")	Pressure	1	40 - 178	6.5 - 140 k	200	-
Units	mm (housing)		mV/Pa	dB re. 20 µPa	Hz	V	

**G.R.A.S. 40AE**  
1/2" Free-field Microphone



General purpose high sensitivity microphone with a frequency range from 3.15 Hz to 20 kHz. Requires no external polarization voltage. Ideal with CCP preamplifiers, Type 1 sound level meters and other similar measurement set-ups.

**G.R.A.S. 40AQ**  
1/2" Random Incidence Microphone



High sensitivity microphone with a frequency response optimized to measure sound correctly in random, diffuse and reverberant sound fields. Requires no external polarization voltage. It fulfils the requirements of ANSI standard S1.4.

**G.R.A.S. 40AM**  
1/2" Free-field Microphone, Wide Frequency



High precision microphone for laboratory work. Wide frequency range from 3.15 Hz to 31.5 kHz. Its size and low sensitivity make it extremely robust and stable and can measure sound levels up to 163 dB.

**G.R.A.S. 40AZ**  
1/2" Free-field Microphone, Low Frequency



Low frequency microphone especially designed for infra-sound measurements. Frequency range from 0.5 Hz to 20 kHz. Use the dedicated 1/4" CCP pre-amplifier G.R.A.S. 26CG in order to obtain the low frequency response.

**G.R.A.S. 40BE**  
1/4" Free-field Microphone



Low sensitivity microphone for high level and high frequency measurements. Requires no polarization voltage. Its low sensitivity makes it ideal for measuring high sound-pressure levels of up to 168 dB. Ideal with CCP preamplifiers and for sound measurements at very high frequencies and levels.

G.R.A.S.	Size	Application	Sensitivity	Dynamic range	Frequency range	Polarization voltage	IEC 61094 designation
40AE	12.7 (1/2")	Free-field	50	15 - 148	3.15 - 20 k	0	WS2F
40AM	12.7 (1/2")	Free-field	14.5	20 - 163	3.15 - 31.5 k	0	WS2F
40AQ	12.7 (1/2")	Random	50	16 - 148	3.15 - 12.5 k	0	WS2P/D
40AZ	12.7 (1/2")	Free-field	50	14 - 148	0.5 - 20 k	0	WS2F
40BE	6.35 (1/4")	Free-field	4	30 - 168	4 - 80 k	0	WS3F
Units	mm (housing)		mV/Pa	dB re. 20 µPa	Hz	V	

\* ±3 dB (all other ±2 dB)

# PREPOLARIZED MEASUREMENT MICROPHONES

## G.R.A.S. 40AD 1/2" Pressure Microphone, High Sensitivity



A high sensitivity microphone with a frequency range from 3.15 Hz to 10 kHz. Requires no external polarization voltage. Can measure sound pressure levels down to 16 dB(A). May also be used as a random-incidence microphone.

## G.R.A.S. 40BD 1/4" Pressure Microphone



Low sensitivity microphone for sound measurements at high levels and high frequencies. Requires no external polarization voltage. Its low sensitivity makes it ideal for measuring high sound pressure levels of up to 166 dB. Its small size reduces the effects of diffraction and reflections around the microphone, resulting in a frequency range extending up to 70 kHz.

## G.R.A.S. 40AO 1/2" Pressure Microphone



A high precision microphone for laboratory work. Has a frequency range from 3.15 Hz to 20 kHz. Requires no external polarization voltage. Its size and lower sensitivity make it extremely robust and stable and can measure sound pressure levels up to 163 dB.

## G.R.A.S. 40DD 1/8" Pressure Microphone



Low sensitivity microphone for sound measurements at high frequencies and high levels. Its low sensitivity makes it ideal for measuring high sound pressure levels of up to 175 dB. Its very small size reduces the effects of diffraction and reflections around the microphone, resulting in a frequency range extending up to 80 kHz.



G.R.A.S.	Size	Application	Sensitivity	Dynamic range	Frequency range	Polarization voltage	IEC 61094 designation
40AD	12.7 (1/2")	Pressure	50	16 - 148	3.15 - 10 k	0	WS2P/D
40AO	12.7 (1/2")	Pressure	12.5	20 - 163	3.15 - 20 k	0	WS2P
40BD	6.35 (1/4")	Pressure	1.6	44 - 166	4 - 70 k	0	WS3P
40DD	3.16 (1/8")	Pressure	0.7	40 - 175	6.5 - 80 k	0	-
Units	mm (housing)		mV/Pa	dB re. 20 µPa	Hz	V	

## G.R.A.S. 40AK 1/2" Ext. Polarized Intensity Microphone Kit



Complete kit of the G.R.A.S. 40AI phase-matched 1/2" Intensity Microphone pair, solid spacers and adapters for a pair of G.R.A.S. 26AA 1/4" Preamplifiers.

The microphones have a free-field response optimized for use in face-to-face configuration intensity probes and a high sensitivity to enable low level measurements. As a pair, they fulfil the phase requirements for Class 1 intensity microphones in accordance with IEC International Standard 61043.

The solid spacers are for intensity probe configurations using microphone separations of 12 mm, 25 mm, 50 mm and 100 mm to cover a full frequency range from 50 Hz to 10 kHz, and improve microphone protection even under the most adverse of measurement conditions.

Included are two right-angled adapters and one straight adapter for use with the 1/4" Preamplifier G.R.A.S. 26AA pair.

## G.R.A.S. 40AI 1/2" Ext. Polarized Intensity Microphone Pair

A pair of 1/2" phase-matched Intensity Microphones as used in the G.R.A.S. 40AK, but without spacers and adapters for 1/4" preamplifiers.

## G.R.A.S. 40BI 1/4" Ext. Polarized Intensity Microphone Kit



Complete kit of two phase-matched 1/4" intensity microphones, solid spacers and adapters for a pair of G.R.A.S. 26AA 1/4" Preamplifiers.

Used for measuring very high intensity levels which exceed the dynamic range of 1/2" intensity microphones (i.e. G.R.A.S. 40AI) or in situations where space is limited.

The microphones have a free-field response optimized for use in face-to-face configuration intensity probes. As a pair,

they fulfil the phase requirements for Class 2 intensity microphones in accordance with IEC International Standard 61043.

The solid spacers are for intensity probe configurations using microphone separations of 6 mm, 12 mm and 25 mm. The 6 mm spacer alone will cover a frequency range from 500 Hz to 20 kHz, and improve microphone protection even under the most adverse of measurement conditions.

Included are two right-angled adapters and one straight adapter for use with the 1/4" Preamplifier G.R.A.S. 26AA Set.

## G.R.A.S. 40GK 1/2" Pre-polarized Intensity Microphone Kit



Complete kit of two phase-matched 1/2" pre-polarized intensity microphones, solid spacers and adapters for a pair of G.R.A.S. 26CB 1/4" CCP preamplifiers.

These prepolarized microphones have a free-field response optimized for use in face-to-face optimized intensity probes. As a pair, they fulfil the phase requirements for Class 1 intensity microphones in accordance with IEC 61043.

The solid spacers are for intensity probe configurations covering a full frequency range from 50 Hz to 10 kHz using microphone separations of 12 mm, 25 mm, 50 mm and 100 mm.

Two right-angled adapters and one straight adapter for use with the 1/4" CCP preamplifiers G.R.A.S. 26CB are included.

## G.R.A.S. 40GI 1/2" Pre-polarized Intensity Microphone Pair

A pair of 1/2" prepolarized intensity microphones as used in the G.R.A.S. 40GK, but without spacers and adapters for 1/4" preamplifiers.

Specifications	40AI/40AK	40BI	40GI/GK	Units
Sensitivity	25	4	12.5	mV/Pa
Dynamic range	20 - 157	35 - 172	27 - 163	dB re. 20 µPa
Frequency response	IEC 60651 Type 0	IEC 60651 Type 0	IEC 60651 Type 0	
Phase response	IEC 61043 Class 1	IEC 61043 Class 2	IEC 61043 Class 1	
Polarization voltage	200	200	0	V
Diameter	13.2	6.9	13.2	mm

# SPECIAL MICROPHONES

Special microphones are often required for applications where there are particular requirements surrounding the methods of measurements and configurations as in the following:

**Surface microphones** for general purpose measurements on planar and curved surfaces. Wide useful frequency range reaching up to 70 kHz and a large dynamic range topping at around 174 dB.

**Array microphones** for situations where concurrent measurements are required at several points in an array. For example in the analyses of:

- Sound fields
- Sound power
- Transients

Also of particular value when measurement opportunities are few and far between either because of costs or repeatability.

Close manufacturing tolerances together with the advantages of the TEDS, provide these array microphones with a high degree of interchangeability; a major advantage when used in multiples forming arrays and matrices. All have a coaxial SMB output connector. See also Array Modules PR0001, PR0001-1 and PR0002.

**Probe microphones** for measurements in difficult or inaccessible situations, for example at high temperatures or in conditions of airflow. Its right-angled design makes it particularly well suited for measurements in exhaust systems and machinery in general, as well as for scanning surfaces such as loudspeakers and cabinets.

The small size, low weight and all stainless steel design of the probe's tip make it robust, durable, easy to handle and simple to mount.

## G.R.A.S. 40LA Precision Surface Microphone, High Pressure

The G.R.A.S. 40LA is a high precision surface microphone with a very low sensitivity 0.5 mV/Pa (178 dB).



## G.R.A.S. 40LS Precision Surface Microphone

G.R.A.S. 40LS is a high precision microphone for measurements on airplane surfaces, vehicle surfaces, critical measurements in wind-tunnel as well as general measurements on planar and curved surfaces. It has a wide frequency range reaching up to 70 kHz and a large dynamic range topping at around 167 dB.

G.R.A.S. 40LS is based on high performance measuring microphone technique, which makes the microphone very precise, robust and reliable. The microphone is an integrated unit consisting of the microphone capsule itself and a CCP preamplifier including TEDS for easy access of identification data and calibration data.



Specifications	40LA	40LS
Nominal sensitivity	0.5 mV/Pa	1.8 mV/Pa at 250 Hz
Frequency range	10 Hz - 20 kHz (±1 dB) 5 Hz - 70 kHz (±3 dB)	10 Hz - 20 kHz (±1 dB) 5 Hz - 70 kHz (±3 dB)
Upper Limit of Dynamic Range	Max. without clipping: 178 dB re. 20 µPa	167 dB re. 20 µPa
Output connector	Coaxial microdot	Coaxial microdot
Lower Limit of Dynamic Range	< 56 dB(A) re. 20 µPa (thermal noise)	< 46 dB(A) re. 20 µPa (thermal noise)
Temperature Range	-55 °C to +100 °C	-50 °C to +100 °C
Output impedance	< 50 Ω	< 50 Ω
Diameter (with fairing)	42 mm	42 mm
(without fairing)	16.2 mm	16.2 mm
Thickness	2.5 mm	2.5 mm
Weight	3 g	3 g
Cable length	1.5 m	1.5 m
Cable diameter	1.1 mm	1.1 mm

## G.R.A.S. 40PH Free-field Array Microphone



Cost-effective free-field microphone for general purpose measurements in arrays and matrices with a nominal sensitivity of 50 mV/Pa. It has a wide frequency range up to 20 kHz and a dynamic range from 32 dB(A) to 135 dB. Its integrated CCP preamplifier and built-in TEDS

enables it to be used with TEDS compatible input modules.

## G.R.A.S. 40PL Free-field Array Microphone, High Pressure



Cost-effective microphone for general purpose measurements in arrays and matrices with a nominal sensitivity of 10 mV/Pa. It has a wide frequency range up to 20 kHz and a large dynamic range from 32 dB(A) to 150 dB. Its integrated CCP preamplifier and built-in TEDS

enables it to be used with TEDS compatible input modules.

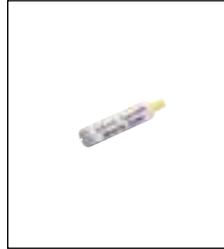


## G.R.A.S. 40PP CCP Free-field QC Microphone



The 40PP is designed for on-line test of products, where the focus is on acoustically correct setup with as little as possible disturbance of the acoustic field and DUT.

## G.R.A.S. 40PK CCP Free-field QC Microphone, Short



The 40PK is designed for on-line test, but in confined spaces, where the focus is not so much on the correct acoustical performance as on the available test space.

40PP and 40PK microphones are CCP supplied and specified for measurements with relatively wide tolerances. They are smart-transducers and thereby allow for fast and easy exchange, provided the test equipment is TEDS compatible. For tighter tolerances, higher transducer linearity and data resolution, we recommend to use our standard high quality measurement microphones. The QC microphones can be sensitivity calibrated and fully repaired.

See Accessories  
for mounting options

Specifications	40PH	40PL
Sensitivity at 250 Hz	50 mV/Pa (nominal)	10 mV/Pa (nominal)
Dynamic range		
Lower limit	< 32 dB(A) re. 20 µPa	< 32 dB(A) re. 20 µPa
Upper limit	135 dB re. 20 µPa	150 dB re. 20 µPa
Frequency range		
± 1 dB	50 Hz - 5 kHz	100 Hz - 5 kHz
± 2 dB	5 kHz - 20 kHz	10 Hz - 20 kHz
± 3 dB	10 Hz - 50 Hz	
Output impedance	< 50 Ω	< 50 Ω

Specifications	40PP	40PK
Sensitivity at 250 Hz	50 mV/Pa (nominal)	18 mV/Pa (nominal)
Dynamic range		
Lower limit	< 30 dB(A) re. 20 µPa	< 25 dB(A) re. 20 µPa
Upper limit	135 dB re. 20 µPa	145 dB re. 20 µPa
Frequency range		
± 1 dB	20 Hz - 10 kHz	
± 2 dB	10 Hz - 20 kHz	10 Hz - 20 kHz
Output impedance	< 50 Ω	< 50 Ω

## G.R.A.S. 47AX 1/2" CCP Flush-Mount Microphone Set



The microphone set 47AX is a low profile 1/2" precision pressure microphone with built-in CCP preamplifier. With a height (to the diaphragm) of only 8 mm, 47AX is suitably designed for flush mounting in plates in ground array applications and other applications with size constraints.

## G.R.A.S. 47BX 1/4" CCP Flush-Mount Microphone Set



The microphone set 47BX is a low profile 1/4" precision pressure microphone with built-in CCP preamplifier. With a height (to the diaphragm) of only 8 mm, 47BX is suitably designed for flush mounting in plates in ground array applications and other applications with size constraints.

## G.R.A.S. 47AD 1/2" CCP Flush-mount Microphone Set High Sensitivity



Identical with 47AX, but specifications differ - see below.

## G.R.A.S. 47DX 1/8" CCP Flush-mount Microphone Set



The microphone set 47DX is a low profile 1/8" precision pressure microphone with built-in CCP preamplifier. With a height (to the diaphragm) of only 9 mm, 47DX is suitably designed for flush mounting in plates in ground array applications and other applications with size constraints.

Specifications	47AX	47BX
Nominal sensitivity	12.5 mV/Pa at 250 Hz	1.6 mV/Pa at 250 Hz
Freq. response	3.15 Hz - 20kHz (±2.0 dB) 5 Hz - 12.5 kHz (±1.0 dB)	4 Hz - 70 kHz (±2.0 dB) 10 Hz - 25 kHz (±1.0 dB)
Dynamic range	Upper Limit; 150 dB re. 20 µPa (3% distortion) Thermal noise; 22 dB(A) re. 20 µPa	Upper Limit; 166 dB re. 20 µPa (3% distortion) Thermal noise; 44 dB(A) re. 20 µPa
Temperature	-30 °C to +70 °C (Operation) -40 °C to +85 °C (Storage)	-30 °C to +70 °C (Operation) -40 °C to +85 °C (Storage)
Static pressure coefficient	-0.008 dB/kPa (250 Hz / 25 °C)	-0.008 dB/kPa (250 Hz / 25 °C)
Dimensions:	Diameter; Microphone: 12 mm - Preamplifier: 18 mm	Diameter; Microphone: 5.9 mm - Preamplifier: 18 mm
Height of Microphone Set:	with grid: 9.2 mm without grid: 8 mm	with grid: 9.2 m without grid: 8 mm
Weight:	9 g	7.5 g

Specifications	47AD	47DX
Nominal sensitivity	50 mV/Pa at 250 Hz	0.9 mV/Pa at 250 Hz
Freq. response	3.15 Hz - 10 kHz (±2.0 dB) 12.5 Hz - 7 kHz (±1.0 dB)	10 Hz - 100 kHz (±3.0 dB)
Dynamic range	Upper Limit; 138 dB re. 20 µPa (3% distortion) Thermal noise; 18 dB(A) re. 20 µPa	Upper Limit; 174 dB re. 20 µPa (3% distortion) Thermal noise; 52 dB(A) re. 20 µPa
Temperature	-30 °C to +70 °C (Operation) -40 °C to +85 °C (Storage)	-30 °C to +70 °C (Operation) -40 °C to +85 °C (Storage)
Static pressure coefficient	-0.008 dB/kPa (250 Hz / 25 °C)	-0.014 dB/kPa (250 Hz / 25 °C)
Dimensions:	Diameter; Microphone: 12 mm - Preamplifier: 18 mm	Diameter; Microphone: 3 mm - Preamplifier: 12 mm
Height of Microphone Set:	with grid: 9.2 mm without grid: 8 mm	with grid: 9.4 m without grid: 9 mm
Weight:	9 g	4 g



The ground array kit is developed for fixed-wing aircraft and rotorcraft flyover measurements in phased arrays, where the noise is mapped for research or approval purposes.

The design offers a practical alternative to the conventional up-side-down microphone setup. It is

**G.R.A.S. 67AX**  
**ø40 cm CCP Ground Array Microphone Kit**

Includes the G.R.A.S. 47AX-S1 1/2" CCP Flush-mount Microphone Set, which is a rear-vented version of 47AX.

See specifications on page 25.

based on a flush-mount G.R.A.S. 47AX-S1 pressure microphone set, integrated into a ø40 cm POM plate, which is easy to position and calibrate in the field.

A variant with higher sensitivity is available for low noise emission aircraft mapping.

**G.R.A.S. 67AD**  
**ø40 cm CCP Ground Array Microphone Kit**

Includes the G.R.A.S. 47AD-S1 1/2" Flush-mount Microphone Set, which is a rear-vented version of 47AD.

See specifications on page 25.

## G.R.A.S. 40SA LEMO Probe Microphone



Small, compact unit for sound pressure measurements in small enclosures, harsh environments and very close to sound sources. The high acoustic input impedance of the probe tip has minimal influence on the acoustic field, and can withstand temperatures of up to 800 °C.

The probe microphone is constructed with a detachable stainless steel probe tip that guides the acoustic signal to a microphone inside the probe housing.

For closed-coupler measurements, the probe microphone uses internal pressure equalization to balance out static pressure differences.

## G.R.A.S. 40SC CCP Probe Microphone



Similar to the Probe Microphone G.R.A.S. 40SA in both size and performance but differs only in the way it is powered. The G.R.A.S. 40SC is built around a prepolarized microphone and CCP preamplifier and requires a constant-current power supply. It has a BNC output socket for making a connection to a constant-current power supply such as the G.R.A.S. 12AL CCP Power Module, or directly to a data-acquisition system that can supply constant current between 2 and 20 mA.

Both probe types are delivered with a selection of probe tips of various lengths that can be customized with the supplied set of pliers.

Specifications	Sensitivity at 250 Hz	Dynamic range	Frequency range ( $\pm 3$ dB)	Electrical output impedance	Noise floor (typical)	Lin (20 Hz – 20 kHz)
40SA	3	40 to >166	2 - 8 k*	55	6 (A-weighted)	2
40SC	3	40 to >160	2 - 8 k*	< 50	6 (A-weighted)	3
Units	mV/Pa (nom.)	dB re. 20 $\mu$ Pa	Hz	$\Omega$	$\mu$ V	$\mu$ V

\*  $\pm 3$  dB

**G.R.A.S. 40AN**  
**1/2" Free-field microphone, low frequencies**



High sensitivity microphone ideal for measuring sound at frequencies down to 0.5 Hz. This microphone is the obvious choice for infra-sound measurement.

**G.R.A.S. 26HG**  
**1/4" Preamplifier, High Impedance**



Similar to G.R.A.S. 26AC but with 40 GΩ input impedance to enable low level and low frequency noise measurements. 3 m cable with a 7-pin LEMO connector included.

**G.R.A.S. 40AZ**  
**1/2" Free-field microphone, prepolarized, low frequency**



Low frequency microphone especially designed for infra-sound measurements. Frequency range from 0.5 Hz to 20 kHz. Use the dedicated G.R.A.S. 26CG 1/4" CCP preamplifier in order to obtain the low frequency response.

**G.R.A.S. 26CG**  
**1/4" CCP preamplifier**



CCP preamplifier with an integrated Microdot connector. For use with 1/4" prepolarized microphones. Especially suitable for infra-sound measurement because of its very low inherent noise level and frequency response from below 1 Hz. It is delivered with

a built-in TEDS (vers. 0.9) and can be programmed as a combined unit with a microphone fitted.

Specifications	40AN	40AZ
Size	12.7 (1/2") mm (housing)	12.7 (1/2") mm (housing)
Application	Free-field	Free-field
Sensitivity	50 mV/Pa	50 mV/Pa
Dynamic range	14 dB(A) - 149 dB re. 20 μPa	14 dB(A) - 148 dB re. 20 μPa
Frequency range	0.5 Hz - 20 kHz	0.5 Hz - 20 kHz
Polarization voltage	200 V	0 V
IEC 61094 designation	WS2F	WS2F

Specifications	G.R.A.S. 26CG	G.R.A.S. 26HG
Frequency range	1 Hz - 200 kHz (±0.2 dB)	1 Hz - 200 kHz (±0.2 dB)
Input impedance	40 GΩ, 0.4 pF	40 GΩ, 0.4 pF
Output impedance	< 55 Ω	75 Ω (typical)
Output connector	Microdot	7-pin LEMO male
Power supply, Single	2 - 20 mA (typically 4 mA)	28 - 120 V
Power supply, Dual		±14 V - ±60 V
Noise A-weighted	≤ 2.5 μV rms	≤ 2.5 μV rms
Noise linear	≤ 6 μV rms	≤ 6 μV rms (20 Hz - 20 kHz)
Gain	-0.35 dB	-0.25 dB (typical)
Operating temperature	-30 °C - +70 °C	-30 °C - +70 °C
Storage temperature	-40 °C - +85 °C	-40 °C - +85 °C

The G.R.A.S. hemisphere kits are optimized for easy sound power testing ensuring acoustically correct and repeatable measurement data. The hemisphere kits are straightforward to assemble and it is simple to position the microphones and access the DUT. The G.R.A.S.

hemispheres are compliant with the ISO 3744, 3745 and 3746 (ANSI S12.54, S12.55, S12.56) standards and accommodate for 4, 10 and 20 positions. The hemisphere kits contain the mechanical structure, microphone sets and cables.

**G.R.A.S. 67HA**  
Hemisphere Kits, 1 m radius

**For LEMO input**

- G.R.A.S. 67HA-01 1 m LEMO Hemisphere Kit, 4-Channel
- G.R.A.S. 67HA-02 1 m LEMO Hemisphere Kit, 10-Channel
- G.R.A.S. 67HA-03 1 m LEMO Hemisphere Kit, 20-Channel

**For CCP input**

- G.R.A.S. 67HA-04 1 m CCP Hemisphere Kit, 4-Channel
- G.R.A.S. 67HA-05 1 m CCP Hemisphere Kit, 10-Channel
- G.R.A.S. 67HA-06 1 m CCP Hemisphere Kit, 10-Channel

**For Lownoise applications**

- G.R.A.S. 67HA-07 1 m LEMO Lownoise Hemisphere Kit, 4-Channel
- G.R.A.S. 67HA-08 1 m LEMO Lownoise Hemisphere Kit, 10-Channel
- G.R.A.S. 67HA-09 1 m LEMO Lownoise Hemisphere Kit, 20-Channel

**G.R.A.S. 67HB**  
Hemisphere Kits, 2 m radius

**For LEMO input**

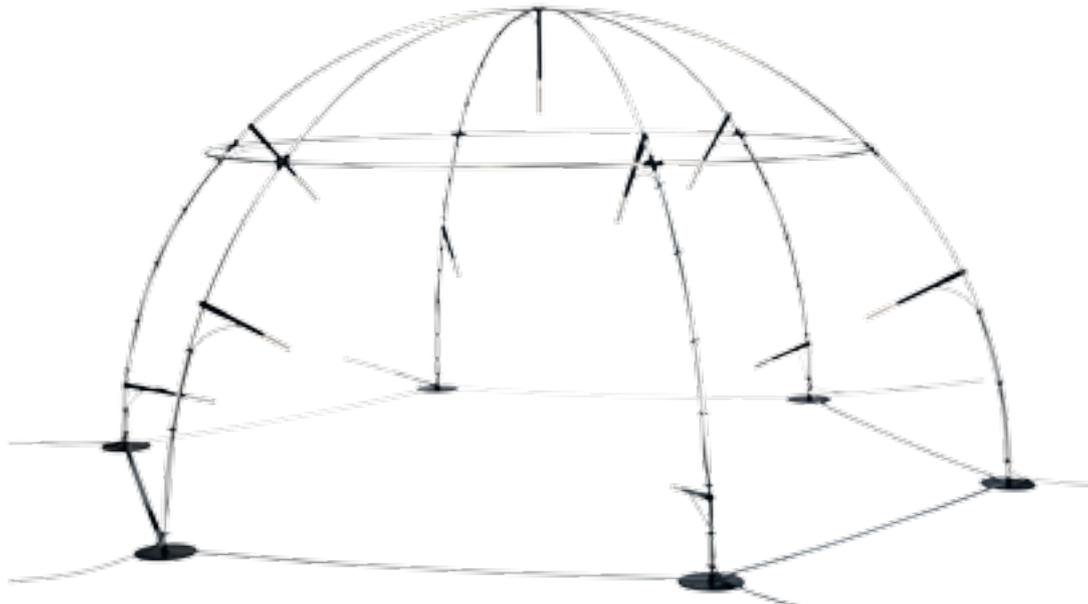
- G.R.A.S. 67HB-01 2 m LEMO Hemisphere Kit, 4-Channel
- G.R.A.S. 67HB-02 2 m LEMO Hemisphere Kit, 10-Channel
- G.R.A.S. 67HB-03 2 m LEMO Hemisphere Kit, 20-Channel

**For CCP input**

- G.R.A.S. 67HB-04 2 m CCP Hemisphere Kit, 4-Channel
- G.R.A.S. 67HB-05 2 m CCP Hemisphere Kit, 10-Channel
- G.R.A.S. 67HB-06 2 m CCP Hemisphere Kit, 10-Channel

**For Lownoise applications**

- G.R.A.S. 67HB-07 2 m LEMO Lownoise Hemisphere Kit, 4-Channel
- G.R.A.S. 67HB-08 2 m LEMO Lownoise Hemisphere Kit, 10-Channel
- G.R.A.S. 67HB-09 2 m LEMO Lownoise Hemisphere Kit, 20-Channel



Configurations	LEMO	CCP	LEMO Lownoise
Frequency Range	3.15 Hz - 20 kHz	3.15 Hz - 20 kHz	10 Hz - 16 kHz
Dynamic Range	17 dB(A) - 149 dB	17 dB(A) - 138 dB	6.5 dB(A) - 110 dB
Sensitivity	50 mV/Pa	50 mV/Pa	850 mV/Pa

Standards	Channel
ISO 3746:2014 ANSI S12.56	4 channels
ISO 3744:2010 ANSI S12.54	10 channels
ISO 3745:2012 ANSI S12.55	20 channels

# PREAMPLIFIERS



The output from a condenser microphone is a very high impedance signal and is therefore very sensitive to the capacitive loads of cables. This makes it necessary to introduce a driver with a high input impedance and a low output impedance. Such a driver is called a preamplifier.

The frequency range of a preamplifier is determined by its electronic circuit and is typically more than 200 kHz at the high end and 1 - 10 Hz at the lower end. The lower end is determined by the input impedance of the preamplifier and the capacitance of the microphone. High microphone capacitance gives a low cut off frequency.

The dynamic range of a preamplifier is defined as the range between the highest level the preamplifier can handle without distortion, and the lowest level it can measure. The highest level is related to the preamplifiers supply voltage, whereas the lowest level is related to the electrical noise generated by the preamplifier itself.

There are today two different preamplifier principles in the world of acoustics.

One is the traditional type for externally polarized microphones often referred to as the "LEMO" type because of its 7-pin connector and has become an industry standard. It is voltage driven and can handle high voltage signals of up to 50 V<sub>peak</sub>.

The other principle uses a Constant Current Power (CCP) supply and was introduced around 1996 to the world of high precision acoustics. Before that, the quality of CCP preamplifiers was not as good as the voltage driven LEMO types, but that is not the case today. A CCP preamplifier uses a Constant Current Power supply, which must lie between 2 mA and 20 mA (nominally 4 mA), to produce a constant nominal voltage level of 12 V DC (referred to as the bias voltage). The output signal from the microphone superimposes fluctuations around this DC level. The great advantage of CCP preamplifiers is that they use a two wire system where the signal is superimposed on



the wire through which the current is kept constant. This means that simple coaxial cables can be used instead of the more complex 7-core cables used with the voltage driven LEMO types. This is traded off by accepting a lower upper limit in dynamic range (due to the lower driving voltage of a constant-current source) which limits the maximum output signal to approximately 8 V<sub>peak</sub>, and the necessity of having to use prepolarized microphones. The range of available prepolarized microphones is still not as wide as for externally polarized microphones, although G.R.A.S. was the first in the world to introduce 1/4" prepolarized microphones, and have just released a 1/8" prepolarized microphone.

G.R.A.S. microphone preamplifiers are all small robust units optimized for acoustical measurements with condenser microphones.

They are all compatible with measurement microphones as defined in the international standard IEC 61094 "Measurement Microphones, Part 4: Specifications for working standard microphones".

All G.R.A.S. preamplifiers are built around a small, thick-film precision amplifier with very high input impedance. The casings are made of stainless steel for maximum strength and durability with minimal sensitivity to vibration and microphonics.

They will work within their specifications up to a temperature of 70 °C. Special versions for use at temperatures up to 120 °C are available on request. The only effect of elevated temperature is a slight increase in inherent noise level. This will change the lower limit of the dynamic range of the microphone/preamplifier combination, thus limiting the ability to measure very low sound pressure levels.

*CCP (Constant Current Power) is the same as IEPE (Integrated Electronic Piezo-Electric) and CCLD (Constant Current Line Drive) and is compatible with many other constant current driven products such as Deltatron® (Brüel & Kjaer), ISOTRON® (Endevco Corp.), ICP® (PCB Group, Inc.).*

# 1/2" LEMO PREAMPLIFIERS

## G.R.A.S. 26AG 1/2" Insert voltage Preamplifier



Preamplifier with an integrated 7-pin LEMO connector. Configured to permit use of the insert volt-

age technique for determining the open-circuit sensitivity of a microphone. Cable (not included) is available in various lengths (see under accessories).

## G.R.A.S. 26AH 1/2" Preamplifier with SysCheck



General purpose preamplifier with an integrated 3 meter cable terminating in a 7-pin LEMO con-

connector. Includes built-in SysCheck facility for enabling easy system checks to be made. Also available as G.R.A.S. 26AL 1/4" preamplifier.

## G.R.A.S. 26AJ 1/2" Preamplifier with SysCheck



General purpose preamplifier with an integrated 7-pin LEMO connector. Includes built-in SysCheck

facility for enabling easy system checks to be made. Cable (not included) is available in various lengths (see under accessories).

## G.R.A.S. 26AK 1/2" Preamplifier



General purpose preamplifier with an integrated 7-pin LEMO connector. Cable (not included) is

available in various lengths (see under accessories).

## G.R.A.S. 26AM 1/2" Preamplifier



General purpose preamplifier with an integrated 3 m cable terminating in a 7-pin LEMO connector.

Specifications	G.R.A.S. 26AH, AM	G.R.A.S. 26AG, AJ, AK	G.R.A.S. 26AL
Frequency range	2.5 Hz – 200 kHz ( $\pm 0.2$ dB)	2.5 Hz – 200 kHz ( $\pm 0.2$ dB)	2.5 - 200 k
Input impedance	20 G $\Omega$ , 0.4 pF	20 G $\Omega$ , 0.4 pF	20 G $\Omega$ , 0.4 pF
Output impedance (typical)	75 $\Omega$	75 $\Omega$	75 $\Omega$
Output connector	7-pin LEMO male	7-pin LEMO male	7-pin LEMO male
Power supply, Single	28 V, 0.7 mA to 120 V, 2.5 mA	28 V, 0.7 mA to 120 V, 2.5 mA	28 V, 0.7 mA to 120 V, 2.5 mA
Power supply, Dual	$\pm 14$ V, 0.7 mA to $\pm 60$ V, 2.5 mA	$\pm 14$ V, 0.7 mA to $\pm 60$ V, 2.5 mA	$\pm 14$ V, 0.7 mA to $\pm 60$ V, 2.5 mA
Noise; A-weighted	$\leq 2.5$ $\mu$ Vrms (typically 1.8 $\mu$ V)	$\leq 2.5$ $\mu$ Vrms (typically 1.8 $\mu$ V)	$\leq 2.5$ $\mu$ Vrms (typically 1.8 $\mu$ V)
Noise; linear (20 Hz – 20 kHz)	$\leq 6$ $\mu$ Vrms (typically 3.5 $\mu$ V)	$\leq 6$ $\mu$ Vrms (typically 3.5 $\mu$ V)	$\leq 6$ $\mu$ Vrms (typically 3.5 $\mu$ V)
Gain	-0.35, -0.25 dB (typical)	-0.25, -0.35, -0.25 dB (typical)	-0.29 dB (typical)
Operating temperature	-30 $^{\circ}$ C to +70 $^{\circ}$ C	-30 $^{\circ}$ C to +70 $^{\circ}$ C	-30 $^{\circ}$ C to +70 $^{\circ}$ C
Storage temperature	-40 $^{\circ}$ C to +85 $^{\circ}$ C	-40 $^{\circ}$ C to +85 $^{\circ}$ C	-40 $^{\circ}$ C to +85 $^{\circ}$ C

## G.R.A.S. 26AB 1/4" Preamplifier



General purpose preamplifier with an integrated 7-pin LEMO connector. A 1/4" to 1/2" adapter, AF0008, is

included, so that it can also be used with G.R.A.S. 1/2" microphones. Cable not included.

## G.R.A.S. 26AN 1/4" Insert voltage Preamplifier



Preamplifier with an integrated 7-pin LEMO connector. Configured to permit use of the insert voltage technique for determining the open-circuit sensitivity of a microphone. A 1/4" to 1/2" adapter, GR0010, is included, so that it can also be used with G.R.A.S. 1/2" microphones. Cable not included.

included, so that it can also be used with G.R.A.S. 1/2" microphones. Cable not included.

## G.R.A.S. 26AR 1/4" Preamplifier, 4-pin mini-LEMO



Preamplifier with integrated 4-pin LEMO mini connector. It is a robust unit, short enough for use in confined spaces and with option for socket mounting in arrays and similar structures, enabling easy calibration and exchange.

included, so that it can also be used with G.R.A.S. 1/2" microphones. Cable not included.

## G.R.A.S. 26AC 1/4" Preamplifier



General purpose preamplifier with an integrated 3 meter lightweight cable terminating in a 7-pin LEMO

connector. A 1/4" to 1/2" adapter, GR0010, is included, so that it can also be used with G.R.A.S. 1/2" microphones.

## G.R.A.S. 26HG 1/4" Preamplifier, High Impedance



Similar to G.R.A.S. 26AC but with 40 GΩ input impedance to enable low level and low frequency

noise measurements.

## G.R.A.S. 26AS 1/4" Preamplifier, very short



Preamplifier with an integrated 3 m lightweight cable terminating in a 7-pin LEMO connector. It is a very

small unit, short enough for use in e.g. anechoic test boxes and with the KEMAR Manikin and Hearing-protector Test Fixture.

## G.R.A.S. 26AS-CL 1/4" Preamplifier, Short version, customized cable length

Specifications	G.R.A.S. 26AR	G.R.A.S. 26AB, AC, AN	G.R.A.S. 26HG	G.R.A.S. 26AS
Frequency range	2.5 Hz - 200 kHz (±0.2 dB)	2 Hz - 200 kHz (±0.2 dB)	1 Hz - 200 kHz (±0.2 dB)	2.5 Hz - 200 kHz (±0.2 dB)
Input impedance	20 GΩ, 0.4 pF	20 GΩ, 0.4 pF	40 GΩ, 0.4 pF	20 GΩ, 0.4 pF
Output impedance (typical)	75 Ω	55 Ω	75 Ω	75 Ω
Output connector	4/7-pin LEMO male	4/7-pin LEMO male	7-pin LEMO male	4/7-pin LEMO male
Power supply, Single	28 V, 0.7 mA to 120 V, 2.5 mA	28 V, 0.7 mA to 120 V, 2.5 mA	28 V, 0.7 mA to 120 V, 2.5 mA	28 V, 0.7 mA to 120 V, 2.5 mA
Power supply, Dual	±14 V, 0.7 mA to ±60 V, 2.5 mA	±14 V, 0.7 mA to ±60 V, 2.5 mA	±14 V, 0.7 mA to ±60 V, 2.5 mA	±14 V, 0.7 mA to ±60 V, 2.5 mA
Noise; A-weighted	6 (typ. 4)	≤ 2.5 μVrms (typically 1.8 μV)	≤ 2.5 μVrms (typically 1.5 μV)	6 (typ 4)
Noise; linear (20 Hz – 20 kHz)	linear 10 (typ 8)	≤ 6 μVrms (typically 3.5 μV)	≤ 6 μVrms (typically 3.2 μV)	10 (typ 8)
Gain	-0.35 dB (typical)	-0.29 dB (typical)	-0.25 dB (typical)	-0.29 dB (typical)
Operating temperature	-30 °C to + 70 °C			
Storage temperature	-40 °C to + 85 °C			

# 1/2" CCP PREAMPLIFIERS

## G.R.A.S. 26CA 1/2" CCP preamplifier



CCP preamplifier with integrated BNC connector. For use with 1/2" prepolarized microphones and standard constant-current input devices. Includes built-in TEDS which enables it to be programmed as a complete unit together with a microphone.

## G.R.A.S. 26CF 1/2" CCP preamplifier with gain and filters



CCP preamplifier with integrated BNC connector. For use with 1/2" prepolarized microphones and standard constant-current input devices.

Has two flush-mounted switches for selecting various combinations of gain and filtering, i.e.:

### Gain switch settings:

- 0 dB - for normal microphone signals.
- +20 dB - for boosting weak microphone signals.

### Filter switch settings:

- A-Weighting - as required in standard measurements.
- Linear - to let the microphone signal pass unfiltered.
- High-pass - to cut off unwanted low frequencies.

## G.R.A.S. 26CK 1/2" CCP Preamplifier, very short



G.R.A.S. 26CK 1/2" Preamplifier is a very small pre-amplifier optimized for use with prepolarized condenser microphones. It is a robust unit that uses a constant current power (CCP) supply. The 26CK has a very low inherent noise level, a large dynamic range, and a frequency response from below 2 Hz to above 200 kHz.

Specifications	26CA	26CF	26CK
Frequency range	2.5 Hz - 200 kHz ( $\pm 0.2$ dB)	2.5 Hz - 200 kHz ( $\pm 0.2$ dB)	2.5 Hz - 200 kHz ( $\pm 0.2$ dB)
Input impedance	20 G $\Omega$ , 0.4 pF	20 G $\Omega$ , 0.4 pF	20 G $\Omega$ , 0.4 pF
Output impedance	< 50 $\Omega$	< 50 $\Omega$	< 50 $\Omega$
Output connector	Coaxial BNC	Coaxial BNC	Microdot
Power supply	2 mA to 20 mA (typically 4 mA)	4 mA to 20 mA (typically 4 mA)	2 mA to 20 mA (typically 4 mA)
Noise A-weighted	$\leq 2.5$ $\mu$ Vrms (typically 2.0 $\mu$ V)	Typically 10 $\mu$ Vrms (built-in A-weighted)	$\leq 2.5$ $\mu$ V rms
Noise linear	$\leq 6$ $\mu$ Vrms (typically 3.5 $\mu$ V)	Typically 8 $\mu$ Vrms	$\leq 6$ $\mu$ V rms
Gain (Typically)	-0.3 dB	-0.35 dB	-0.35 dB
Operating temperature	-30 $^{\circ}$ C to +70 $^{\circ}$ C	-30 $^{\circ}$ C to +70 $^{\circ}$ C	-30 $^{\circ}$ C to +70 $^{\circ}$ C
Storage temperature	-40 $^{\circ}$ C to +85 $^{\circ}$ C	-40 $^{\circ}$ C to +85 $^{\circ}$ C	-40 $^{\circ}$ C to +85 $^{\circ}$ C

**G.R.A.S. 26CB**  
1/4" CCP preamplifier



CCP preamplifier with integrated Microdot connector. For use with 1/4" prepolarized microphones. Delivered with a Microdot connector for constant-current input devices. Includes built-in TEDS which enables it to be programmed as a complete unit together with a microphone.

**G.R.A.S. 26CG**  
1/4" CCP preamplifier



CCP preamplifier with integrated Microdot connector. For use with 1/4" prepolarized microphones. Delivered with a Microdot connector for constant-current input devices. Especially suitable for infra-sound measurement because of its very low inherent noise level and frequency response from below 1 Hz. It is delivered with a built-in TEDS and can be programmed as a combined unit with a microphone fitted.

**G.R.A.S. 26CC**  
1/4" CCP preamplifier



CCP preamplifier with integrated SMB connector. For use with 1/4" prepolarized microphones. For direct use on G.R.A.S. Array Modules PR0001 and PR0002 connected to constant-current input devices. Includes built-in TEDS which enables it to be programmed as a complete unit together with a microphone.

**G.R.A.S. 26CS**  
1/4" CCP preamplifier, very short



CCP preamplifier with integrated Microdot connector. For use with 1/4" prepolarized microphones. Delivered with a Microdot connector for constant-current input devices. It is a very small unit, short enough for use in e.g. anechoic test boxes and with the KEMAR Manikin and Hearing-protector Test Fixture.

Specifications	26CB	26CC	26CG	26CS
Frequency range	2.5 Hz - 200 kHz ( $\pm 0.2$ dB)	2.5 Hz - 200 kHz ( $\pm 0.2$ dB)	1 Hz - 200 kHz	2 Hz - 200 kHz
Input impedance	20 G $\Omega$ , 0.4 pF	20 G $\Omega$ , 0.4 pF	40 G $\Omega$ , 0.4 pF	20 G $\Omega$ , 0.4 pF
Output impedance	< 50 $\Omega$	< 50 $\Omega$	< 55 $\Omega$	< 50 $\Omega$
Output connector	Coaxial microdot	Coaxial SMB	Microdot	Microdot
Power supply	2 mA to 20 mA (typically 4 mA)	2 mA to 20 mA (typically 4 mA)	2 mA to 20 mA (typically 4 mA)	2 mA to 20 mA (typically 4 mA)
Noise A-weighted	$\leq 2.5$ $\mu$ Vrms (typically 2.0 $\mu$ V)	$\leq 2.5$ $\mu$ Vrms (typically 2.0 $\mu$ V)	$\leq 2.5$ $\mu$ Vrms (typically 1.5 $\mu$ V)	$\leq 2.5$ $\mu$ Vrms
Noise linear	$\leq 6$ $\mu$ Vrms (typically 3.5 $\mu$ V)	$\leq 6$ $\mu$ Vrms (typically 3.5 $\mu$ V)	$\leq 6$ $\mu$ Vrms (typically 3.5 $\mu$ V)	$\leq 6$ $\mu$ V
Gain (Typically)	-0.35 dB	-0.35 dB	-0.35 dB	-0.45 dB
Operating temperature	-30 $^{\circ}$ C to +70 $^{\circ}$ C	-30 $^{\circ}$ C to +70 $^{\circ}$ C	-30 $^{\circ}$ C to +70 $^{\circ}$ C	-30 $^{\circ}$ C to +70 $^{\circ}$ C
Storage temperature	-40 $^{\circ}$ C to +85 $^{\circ}$ C	-40 $^{\circ}$ C to +85 $^{\circ}$ C	-40 $^{\circ}$ C to +85 $^{\circ}$ C	-40 $^{\circ}$ C to +85 $^{\circ}$ C

# MICROPHONES FOR OUTDOOR USE

Unprotected measurement microphones are sensitive to environmental factors such as wind, rain and snow. This shortcoming has been eliminated by specially-designed units that protect the microphone and its diaphragm from the effects of outdoor use. Each has a windscreen surmounted by four-pronged anti-bird spikes to prevent birds using it as a perch.

Perching birds and their excreta can seriously distort measurements or even overload the measurement equipment. Smaller birds have actually been known to nest on top of the earlier three-pronged anti-bird spikes. Hence, the introduction of the fourth, centre prong.

#### **Two types are available:**

Outdoor Microphones for permanent outdoor use which are encased stainless steel units that can withstand all weathers year after year e.g. in airport noise monitoring systems.

Environmental Microphones are smaller units meant for temporary outdoor use in terms of days or weeks, such as in time limited consultant work.

#### **Each type is available in the following two versions:**

- For airport noise monitoring, where the measurement direction points upwards (0° incidence).
- For community noise- or traffic noise measurements, where the measurement direction is in the horizontal plane (90° incidence).

G.R.A.S. Sound & Vibration has more than 1500 of these units deployed all over the world, from the arctic cold in Norway to the humid jungles of Malaysia.

## G.R.A.S. 41AM Outdoor Microphone, 0° incidence

For permanent outdoor installation, for example in airport noise monitoring systems. Has built-in A-weighting,  $\pm 20$  dB amplifier (for shifting the dynamic range up or down by 20 dB) and electrostatic actuator for complete check of system functionality.

G.R.A.S. 41AM is fitted with a G.R.A.S. 41AS 1/2" microphone for measurements at 0° incidence and is optimized for use with its windscreen and rain protection.



## G.R.A.S. 41CN Outdoor Microphone, 90° incidence

For permanent outdoor installation, for example in community noise- or traffic noise monitoring systems. Has built-in A-weighting,  $\pm 20$  dB amplifier (for shifting the dynamic range up or down by 20 dB) and electrostatic actuator for complete check of system functionality.

G.R.A.S. 41CN is fitted with a special G.R.A.S. 1/2" microphone for measurements at 90° incidence and is optimized for use with its windscreen and rain protection.

### Accessories included:

Windscreen incl. birdspike ..... AM0052  
 Transport protection cap..... AM0037  
 Spanner ..... AM0038  
 Pole adapter ..... AM0029  
 Tripod adapter ..... AM0033  
 LEMO plug..... AE0001

### Accessories available:

Adapter box ..... AC0001  
 Pistonphone adapter 41AM..... RA0009  
 Pistonphone adapter 41CN ..... RA0041  
 Set of 5 foam windscreens ..... AM0009  
 Cables:  
 3 m ..... AA0003  
 10 m ..... AA0002  
 100 m on cable drum ..... AA0015  
 200 m on cable drum ..... AA0016

Specifications	G.R.A.S. 41AM and 41CN
Sensitivity	50 mV/Pa (unified)
Dynamic range	20 - 136 dB re. 20 $\mu$ Pa 38 - 156 dB re. 20 $\mu$ Pa in -20 dB gainsetting
Frequency response	IEC 60651 type 0 ANSI S1.4-1983 type 0 IEC 61672 Class 1
Power supply	12 - 18 VDC
Cal. level of electro-static actuator	90 dB at 1000 Hz
Output connector	6-pin LEMO
Pole adapter	50 mm (1.97") G 1 1/2" (ISO 228/1)
Reference direction 41AM	0° (vertical for airport noise)
Reference direction 41CN	90° (horizontal for community noise)

## G.R.A.S. 41AC Outdoor Microphone Kit

The 41AC is a small and handy precision environmental microphone kit according to IEC 61672-1 and designed for unattended use in prolonged periods.

41AC can easily be configured for measurement of noise with 90 degrees of incidence, typically community noise, or – with the included correction data – for measurement of noise with 0 degrees of incidence, typically overhead aircraft.

Depending on input type, the 41AC is available in two variants.

**G.R.A.S. 41AC-2 LEMO Outdoor Microphone** with RemoteCheck for Community & Airport Noise  
With the features 7-pin LEMO connection and built-in RemoteCheck technology that makes it possible to remotely check the measurement chain for changes.

**G.R.A.S. 41AC-3 CCP Outdoor Microphone for Community & Airport Noise**  
With the features CCP connection and built-in TEDS for easy identification and system setup.  
Both kits include tripod and pole-mount options and are delivered with individual calibration and correction data.

Additional windscreen G.R.A.S. AM0378 - is available as a single item.

Specifications	G.R.A.S. 41AC-2 & 41AC-3
Sensitivity	50 mV/Pa (nominal)
Dynamic range	17 – 144 dB re. 20 µPa
Frequency range	5 Hz - 10 kHz
Compliance	IEC 61672 Class 1
Polarization voltage	0 V
Connector type	7-pin LEMO
Mic. type and Reference direction	See above



**RA0153  
Weather Protection Kit**

A weather-protection kit for sound level meters with a detachable input stage as well as for other microphone-and-preamplifier combinations.

The kit provides weather protection for the microphone-and-preamplifier combination and is delivered with a windscreen, anti-bird spikes and a carrying case. Can be used with both standard 7-pin LEMO preamplifiers and CCP (Constant Current Power) preamplifiers.



# LOWNOISE MEASURING SYSTEMS

Normal measurement microphones as shown on page 6 have a very wide dynamic range and cover most practical applications. There are however special situations where special microphones are required. One such application is in the measurements of very low sound pressure levels. Normal measurement microphones have a noise floor around 10 dB(A) re. 20  $\mu$ Pa in 1/3 octave bands, while the human ear is able to detect levels down to around 0 dB. In fact the 0 dB level was originally defined as the threshold of the human hearing ability at 1 kHz.

In some applications it is required to measure down to and below the threshold of the human ear. This is possible by using special high sensitive microphones combined with special lownoise preamplifiers.

One of the applications of such microphones may be the measurement of the sound power of high-end personal computers. These are not only used in noisy office environments, but tend to move into living rooms, meeting rooms and hotel rooms. In some hotel rooms the traditional TV set has been replaced by a computer, delivering not only all TV channels, but also pay channels, account status, wake up calls and other services. This requires the computer to be turned on all the time, and to avoid disturbances during sleep the noise level has to be below the threshold of hearing. In turn, this requires that component manufacturers of hard drives, fans, etc. also deliver very low noise devices.



In order to achieve the very low noise floor of the microphone and preamplifier, these have been specially matched and adjusted together. This further enables the microphone/preamplifier combination to be switched to be used for free-field measurements or for pressure measurements.

The special preamplifier and matching circuit require a higher supply current than can be obtained from traditional microphone preamplifier supplies, the G.R.A.S. 40HH and G.R.A.S. 40HF must be used together with the G.R.A.S. 12HF lownoise system power supply. To avoid damaging traditional microphone preamplifier supplies, the 7-pin LEMO on the lownoise preamplifier is different from the 7-pin LEMO normally used for microphone preamplifiers.

The very high sensitivity of lownoise microphones means that the sound pressure level used for calibration should be limited to 94 dB to avoid overloading. A special coupler, RA0090, for the pistonphones G.R.A.S. 42AA or G.R.A.S. 42AP is available to reduce the level from 114 dB to 94 dB.



## **G.R.A.S. 40HF 1" Lownoise Microphone System**

A wide dynamic range enables measurements from below -2 dB(A) to 110 dB re. 20  $\mu$ Pa from 10 Hz to 10 kHz.

Comprises the following two specially-designed and matched components:

- High sensitive 1" microphone
- Lownoise 1" microphone preamplifier

Can be switched to operate either for pressure measurements or free-field measurements.

Accessory available:  
RA0095 Dehumidifier for 1" microphone

Cables available:  
AA0046/47/53-CL

To complete the measuring system, a dedicated power module such as G.R.A.S. 12HF or G.R.A.S. 12HM is required.

## **G.R.A.S. 40HH 1/2" Lownoise Microphone System**

Wide dynamic range enables measurements from below 6.5 dB(A) to 113 dB re. 20  $\mu$ Pa from 10 Hz to 20 kHz.

Comprises the following two specially-designed and matched components:

- High sensitive 1/2" microphone
- Lownoise 1/2" microphone preamplifier

Can be switched to operate either for pressure measurements or free-field measurements.

Cables available:  
AA0046/47/53-CL

To complete the measuring system, a dedicated power module is required (G.R.A.S. 12HF or G.R.A.S. 12HM). The specifications given below are for such a complete system.



## G.R.A.S. 40HL 1/2" LEMO Lownoise Microphone System

Stand-alone Lownoise microphone system for connecting directly to any analyzer input module with 7-pin LEMO. The system is calibrated as a complete unit and has a wide dynamic range that enables measurements from below 6.5 dB(A) to 110 dB re. 20  $\mu$ Pa within 10 Hz to 20 kHz.

- High sensitivity 1/2" microphone
- Lownoise 1/2" preamplifier with built-in TEDS

Cables available:  
AA0008/09/20-CL

40HL is used in the Hemisphere Kits 67HA and 67HB for 4-, 10- and 20 channel lownoise measurements.

## G.R.A.S. 40HT 1/2" Lownoise Microphone System

For use in confined spaces. Otherwise, specifications similar to G.R.A.S. 40HH. Comprises the following specially-designed and matched components:

- High sensitive 1/2" microphone
- Gain and filter unit
- Lownoise 1/4" microphone preamplifier with an adapter (GR0010) for the 1/2" microphone.

Can be switched to operate either for pressure measurements or free-field measurements.

Cables available:  
AA0046/47/53-CL

To complete the measuring system, a dedicated power module is required (G.R.A.S. 12HF or G.R.A.S. 12HM). The specifications given below are for such a complete system.



Specifications	40HF	40HH	40HL	40HT	Units
Nominal sensitivity	System: 1.1	System: 0.8	System: 0.85	System: 0.8	V/Pa
Frequency range	12.5 - 4 k	12.5 - 10 k	12.5 - 10 k	12.5 - 10 k	Hz $\pm$ 1 dB
	10 - 10 k	10 - 16 k	10 - 16 k	10 - 16 k	Hz $\pm$ 2 dB
	6 - 12.5 k	6 - 20 k	6 - 20 k	6 - 20 k	Hz + 2 dB, -3 dB
Dynamic range	-2 to 110	6.5 to 113	6.5 to 110	6.5 to 113	dB(A) re. 20 $\mu$ Pa

# INTENSITY PROBES



The technique of intensity measurements is a powerful tool used for locating sound sources, order ranking them and determining the sound power emitted. The method is based on the simultaneous determination of sound pressure and particle velocity using two closely spaced, face-to-face microphones. A sound-intensity probe must maintain a well-defined acoustical spacing between the microphones with a minimal of disturbance to the sound field.

Generally speaking, the technique of intensity measurements involves determining the direction of a sound wave by detecting differences in arrival time at two closely-spaced microphones.

If the sound wave arrives first at microphone A then, a little later, at microphone B, the sound wave must be travelling in the direction from A to B. On the other hand, if it arrives first at microphone B, then it must be travelling in the opposite direction. In the case where it arrives at the two microphones at the same time, then it must be travelling in a direction perpendicular to the pair of microphones.

The ability of a pair of microphones to determine accurately small differences in arrival times depends on how small the difference is between the phase responses of the two microphones. Therefore, phase-matching is an all-important factor for a pair of intensity microphones. The G.R.A.S. 40AI and G.R.A.S. 40BI intensity micro-

phone pairs have been carefully manufactured and selected to have minimum phase difference.

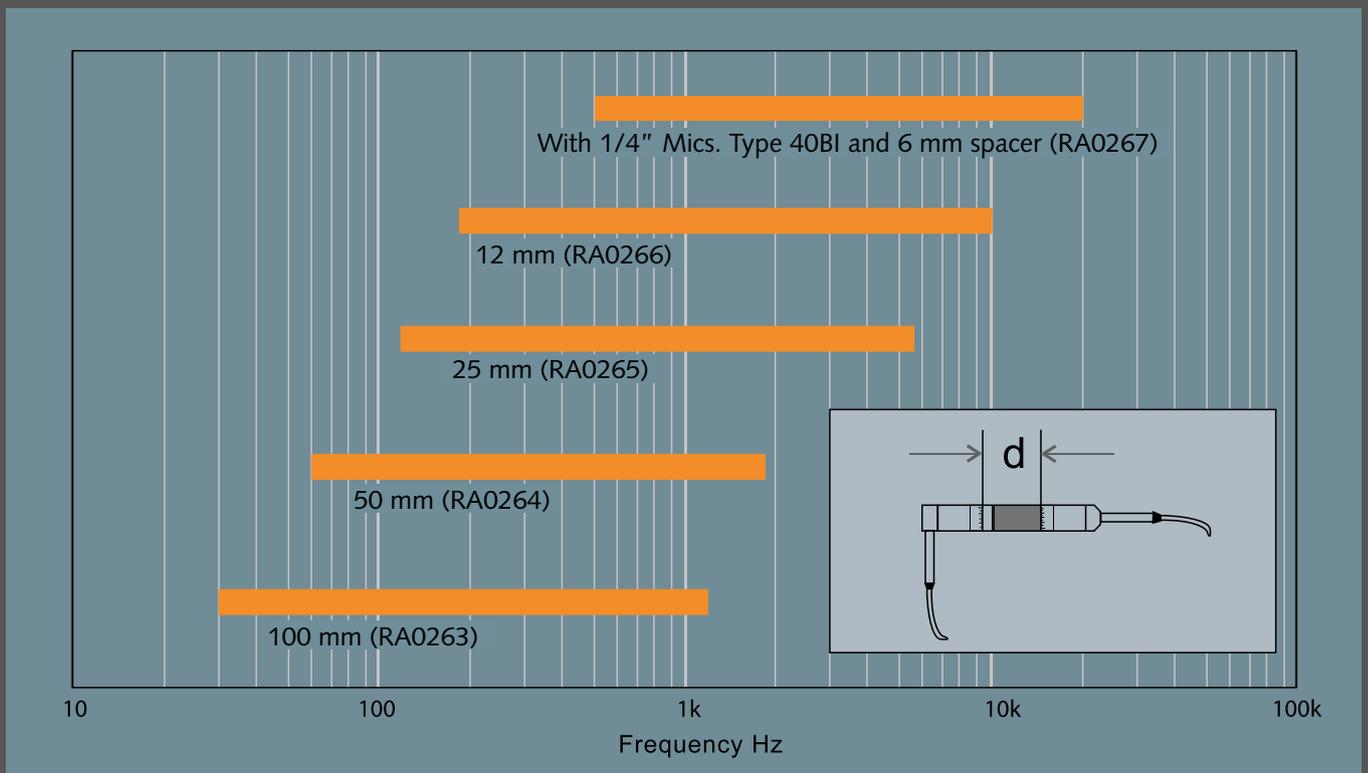
To ensure maximum measurement accuracy, the spacing between the microphones should be optimized for the particular measurement conditions. At low frequencies and in highly reverberant conditions, spacing should be large, whereas at high frequencies, it should be small.

The G.R.A.S. 50AI and G.R.A.S. 50GI Intensity Probes come with a selection of solid spacers for microphone separations ranging from 12 mm to 100 mm. The design of the probe enables spacers to be swapped without dismantling the probe.

The useful frequency range of a sound intensity probe depends on the phase response of the microphones and the distance between the microphones. The G.R.A.S. sound intensity probes have been designed to switch easily between different microphone spacers to cover different frequency ranges. The useful frequency ranges for different microphone spacers are shown on the right.



### Frequency ranges for different microphone spacers



## G.R.A.S. 50AI Intensity Probe

- G.R.A.S. 40AK 1/2" Intensity Microphone Set
- G.R.A.S. 26AA 1/4" Pre-amplifier Set and a remote-control handle

The remote-control functions make it possible to control the process of data acquisition entirely from the handle of the probe.

Various versions of the G.R.A.S. 50AI are available with different remote-control handles for direct use with a wide range of general purpose frequency analyzers as well as specialised sound intensity analyzers. These are described in the following.



### G.R.A.S. 50AI-B

Has remote-control functions for direct connection to, and control of, sound-intensity measuring systems from a wide range of suppliers such as O1dB and Neutrix-Cortex.

Can be used directly with the G.R.A.S. 12AB Intensity Power Module, which provides all necessary voltages for the remote-control functions and powering the preamplifiers; also enables direct use with O1dB Sound Intensity systems.

### G.R.A.S. 50AI-C

Can be connected directly to any analyzer with two standard 7-pin LEMO microphone-pre-amplifier inputs. Can be used with the following G.R.A.S. Power Modules, which provide all necessary voltages for powering the preamplifiers:

- G.R.A.S. 12AB Intensity Power Module
- G.R.A.S. 12AA Power Module (via the included adapter cable AC0003, which splits the output from a 12-pin LEMO socket into two 7-pin LEMO plugs)

The G.R.A.S. 12AA Power Module has two standard BNC output sockets for connecting to analyzers that do not have special microphone-pre-amplifier inputs.



### G.R.A.S. 50AI-D

Similar to version B but uses an internal 9V battery (already fitted on delivery) for enabling its remote-control functions, i.e. Müller-BBM.

For G.R.A.S. 50AI version B, C and D different adapter cables are available.

Specifications	G.R.A.S. 50AI
Microphone pair	G.R.A.S. 40AK
Preamplifiers	2 x G.R.A.S. 26AA (with 4-pin LEMO FGG OB)
Frequency response & phase matching	IEC 61043 Class 1

## G.R.A.S. 50GI CCP Intensity Probe

- 1/2" Prepolarized Intensity Microphone Set G.R.A.S. 40GK
- Two 1/4" CCP preamplifiers G.R.A.S. 26CB and a dedicated handle

This intensity probe can be connected directly to any CCP-compatible input-module with two BNC or Microdot connectors. The prepolarized intensity microphones are phase-matched and fulfill the phase requirements for Class 1 intensity microphones in accordance with IEC 61043.

The intensity probe is designed to have as little acoustic influence as possible and allows for very near-field diagnostics of noise sources. The microphone spacers are easily interchanged without any need for extra tools and enables measurements in the area from 50 Hz to 10 kHz.



Specifications	G.R.A.S. 50GI
Microphone pair	G.R.A.S. 40GK
Preamplifiers	2x G.R.A.S. 26CB (with BNC/Microdot)
Frequency response & phase matching	IEC 61043 Class 1

## G.R.A.S. 50GI-R CCP Intensity Probe with Remote Control

The G.R.A.S. 50GI-R CCP Intensity Probe comprises a 40GK sound Intensity Microphone Pair, two 26CB CCP Microphone Preamplifiers, four solid spacers of various lengths, windscreen, and probe handle with remote control.

The 50GI-R is delivered in a carrying case as a ready-to-use kit, complete with all the above accessories. The microphones are 1/2" free-field prepolarized microphones with a uniquely-designed pressure equalization system, which ensures extremely well defined phase characteristics.

The microphones and preamplifiers are mounted on a swivel head on the telescopic arm of the Remote control handle. To cover the full frequency range from 50 Hz to 10 kHz, the 50GI-R probe is delivered with four solid spacers for spacing the microphones at 12 mm, 25 mm, 50 mm and 100 mm. These spacers can be easily interchanged without dismantling the probe.



## G.R.A.S 50GI-P CCP Rugged Intensity Probe

The 50GI-P CCP Intensity Probe comprises a 40GK Sound Intensity Microphone Pair, two 26CB CCP Microphone Preamplifiers, three solid spacers of various lengths, windscreen and a probe handle.

The probe head is symmetrical which enables reliable calibrations as described in the proposed standard (ISO/DIS 9614-2) for sound power measurements.

The 50GI-P is delivered in a carrying case as a ready-to-use kit, complete with all the above accessories.

The microphones are 1/2" intensity prepolarized microphones with a uniquely-designed pressure equalization system, which ensures extremely well defined phase characteristics.

## G.R.A.S 50GI-RP CCP Rugged Intensity Probe with Remote Control

This intensity probe is identical to 50GI-P but with remote control buttons for start/stop of the intensity analyzer.



Specifications	G.R.A.S. 50GI-P
Microphone pairs	G.R.A.S. 40GK-S1
Preamplifiers	26CC set
Spacers	12, 25 and 50 mm



Specifications	G.R.A.S. 50GI-RP
Microphone pairs	G.R.A.S. 40GK-S1
Preamplifiers	26CC set
Spacers	12, 25 and 50 mm

### G.R.A.S. 50VI-1 Vector-intensity Probe 3D

Three-dimensional flexible and adjustable sound-intensity probe. It includes the necessary pairs of phase-matched intensity microphones G.R.A.S. 40AI, G.R.A.S. 26AA Preamplifier Sets, 25 mm and 50 mm spacers, 6-channel probe handle and a 10 m cable with LEMO connectors.

The probe handle has inputs for 6 preamplifiers and a pair of LEDs for indicating two states as well as a push button for interactive use with a remote-control system. For example, the output socket for remote control can be connected to the RS-232 interface of a computer which controls the process of data acquisition.

G.R.A.S. 12AC is the recommended power module.



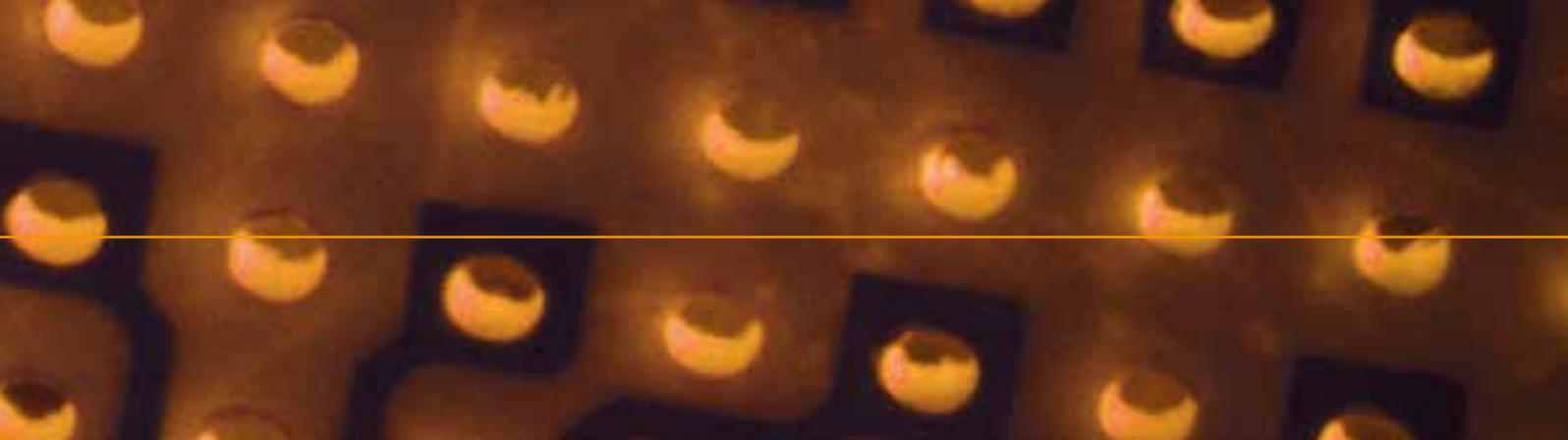
Specifications	G.R.A.S. 50VI-1
Microphone pairs	3 x G.R.A.S. 40AI
Preamplifiers	6 x G.R.A.S. 26AA (with 4-pole LEMO FGG OB)
Spacers	3-D 25 mm and 50 mm
Frequency response & phase matching	IEC 61043 Class 1

# PISTONPHONES AND CALIBRATION EQUIPMENT

Calibration is an essential step in every precision noise measurement. It establishes the relationship between the sound pressure acting on a microphone and the resulting electrical output of the microphone. There are basically two properties of a measurement microphone requiring calibration, these are: level calibration and a frequency-response calibration.

Level calibration determines the absolute sensitivity of the measurement microphone. Various methods can be used, e.g. reciprocity, comparison, pistonphone or calibrator.

- a) Reciprocity is normally considered the most accurate of methods but is elaborate and expensive.
- b) Comparison is where the sensitivity of the microphone under test is compared with the known sensitivity of a reference microphone. It is simple and can be done with commonly-available equipment and requires minor investment.
- c) A pistonphone, with a precision barometer for applying static pressure corrections, is a robust and highly reliable method of level calibration at 250 Hz.
  - At 250 Hz, the frequency response of most microphones is flat and will give a more accurate result.
- d) A calibrator is a convenient way of calibrating a microphone at 1000 Hz but does not have the same precision as a pistonphone. Neither does it require static-pressure corrections.
  - At 1000 Hz, weighting filters have 0dB attenuation and will therefore not affect the calibration. In these cases it might be an advantage to use a 1000 Hz calibration tone.



A frequency-response calibration describes the response of the microphone over a range of frequencies. Frequency-response measurements can be presented in various ways, i.e. pressure response, free-field response and diffuse-field response.

Generally, pressure response is determined by using an electrostatic actuator which simulates purely an oscillating pressure exerted on the microphone's diaphragm. Free-field and diffuse-field responses can then be arrived at by adding predetermined correction values to the measured actuator (pressure) response of the microphone.

Electrostatic actuators require no special acoustic laboratory facilities since background noise is not too critical a factor.

An electrostatic actuator consists of an electrically conductive rigid plate mounted close to, and parallel with, the microphone's diaphragm. When an oscillating voltage is applied between the microphone's housing and the electrostatic actuator, an oscillating force will be exerted on the diaphragm. This oscillating force simulates an oscillating sound pressure, thus making it possible to determine the response of the microphone to pressure alone. This means that the frequency response

of microphones can be measured under normal circumstances, not requiring special sound insulated test chambers, as long as the background noise levels are reasonable low.

The pistonphone works on the principle of a pair of similar opposing, reciprocating pistons actuated by a precision-machined cam disc with a sinusoidal profile. The profile of the cam disc is such that the pistons follow a sinusoidal movement at a frequency equal to four times the speed of rotation. This results in a corresponding sinusoidal variation in the effective volume of the closed coupler and, consequently, an acoustic signal within it.

The mechanical structure of the pistonphone makes this generated acoustic pressure signal very reliable and stable. By careful control of the atmospheric pressure conditions and the calibration temperature, the calibration far exceeds the requirements for class LS calibrators. Absolute calibration accuracy has been determined to be within  $\pm 0.05$  dB at reference conditions for the pistonphone.



## G.R.A.S. 42AA Pistonphone

Precision sound source for calibrating microphones, sound level meters and other sound measuring equipment. Battery operated and produces a constant nominal sound pressure level of 114 dB re. 20  $\mu$ Pa (equivalent to 10 Pa) at 250 Hz, or 105.4 dB(A) re. 20  $\mu$ Pa. Each G.R.A.S. 42AA is within 0.1dB of the nominal value and is delivered with an individual calibration chart and a barometer for Class 1 static pressure corrections. For Class 0 static pressure corrections, a precision barometer is required. G.R.A.S. 42AA can be used both for field checks of complete measurement systems as well as for laboratory calibrations of measurement microphones. It complies with the requirements of IEC 60942 (1988) Class 1 and is PTB approved.



### Included accessories:

#### RA0049

Adapter for 1/4" microphones

#### RA0069

Adapter for 1/8" microphones

### Available accessories:

#### RA0023

Coupler for 1" microphones

#### RA0024

Two-port calibration coupler

#### RA0072

Octopus coupler for calibrating up to eight 1/2" microphones

#### RA0090

94 dB coupler

## G.R.A.S. 42AC High Pressure Pistonphone

Precision sound source for calibrating microphones, sound level meters and other sound measuring equipment at high levels. Battery operated and produces a constant nominal sound pressure level of 134 dB re. 20  $\mu$ Pa (equivalent to 100 Pa) at 250 Hz, or 125.4 dB(A) re. 20  $\mu$ Pa. Each G.R.A.S. 42AC is within 0.1 dB of the nominal value and is delivered with an individual calibration chart and a barometer for Class 1 static pressure corrections. For Class 0 static pressure corrections, a precision barometer is required. The G.R.A.S. 42AC can be used both for field checks of complete measurement systems as well as for laboratory calibrations of measurement microphones. It complies with the requirements of IEC 60942 (1988) Class 1. An adapter (GR0398) is included for use with hydrophone couplers.



### Included accessories:

#### RA0049

Adapter for 1/4" microphones

#### RA0069

Adapter for 1/8" microphones

### Available accessories:

#### RA0023

Coupler for 1" microphones

#### RA0042

Two-port high pressure calibration coupler

#### RA0072

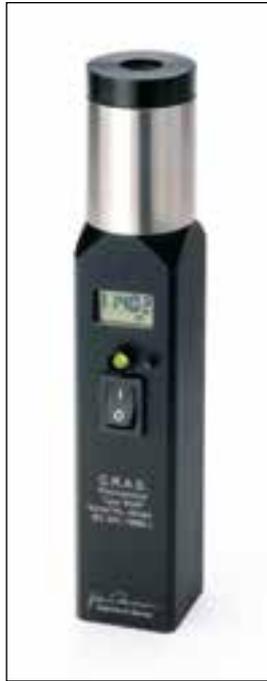
Octopus coupler for calibrating up to eight 1/2" microphones

Specifications	42AA	42AC	42AP
Sound pressure level	114 dB (re. 20 $\mu$ Pa) $\pm$ 0.08 dB	134 dB (re. 20 $\mu$ Pa) $\pm$ 0.08 dB	114 dB (re. 20 $\mu$ Pa) $\pm$ 0.05 dB
Frequency	250 Hz	250 Hz	250 Hz or 251.2 Hz
Accuracy	IEC 60942 (1988) Class 1	IEC 60942 (1988) Class 1	IEC 60942 (ed.3/FDIS)LS
Temperature range	-10 °C to +55 °C	-10 °C to +55 °C	-10 °C to +55 °C
Batteries	4 x AA alkaline (IEC LR 6)	4 x AA alkaline (IEC LR 6)	4 x AA alkaline (IEC LR 6)
External power	-	-	6V DC 125mA
Weight (with batteries)	325 g	325 g	437 g

## G.R.A.S. 42AP Intelligent Pistonphone

Battery-operated, precision sound source for calibrating microphones, sound level meters and other sound measuring equipment. Has built-in precision barometer and thermometer. Via its display and RS-232 interface, the user can read the actual corrected sound pressure level, as well as the calibration temperature and ambient static pressure.

It produces a constant nominal sound pressure level of 114 dB re. 20  $\mu$ Pa (equivalent to 10 Pa) at either 250 Hz or 251.2 Hz (true centre frequency of a 250 Hz, 1/3-octave band filter). The actual sound pressure level, corrected for static ambient pressure, is shown on its display which can also show the A-weighted sound pressure level after correcting it for using an A-weighting filter.



- Calibration temperature in °C
- Calibration temperature in °F
- The pistonphone frequency can be programmed, via its RS-232 interface, to be either 250 Hz or 251.2 Hz
- G.R.A.S. 42AP is an extremely stable laboratory standard sound source which can also be used for field calibrations - it retains its high accuracy even under hostile environmental conditions. It complies with all the requirements of IEC Standard 60942 (2003) LS
- An individual calibration chart is delivered with each pistonphone

### Included accessories:

#### RA0023

Coupler for 1" microphones

#### RA0049

Adapter for 1/4" microphones

#### RA0069

Adapter for 1/8" microphones

#### AA0050

RS-232 interface cable

### Available accessories:

#### RA0024

Two-port calibration coupler

#### RA0072

Octopus coupler for calibrating up to eight 1/2" microphones

#### RA0090

94 dB coupler

#### AB0005

Power Supply SMPS regulated  
110-220 V AC – 6 V DC 10 W

### The display can be switched to show any of the following:

- Actual corrected sound pressure level in decibels
- Actual corrected sound pressure level in decibels if measured with an A-weighting filter
- Static air pressure in hPa

## G.R.A.S. 42AB Sound Calibrator



Pocket-sized, battery operated calibrator for microphones, sound level meters and other sound measuring equipment. Produces a constant nominal sound pressure level of 114 dB re. 20  $\mu$ Pa (equivalent to 10 Pa) at 1 kHz. Easy to use and requires no corrections for ambient pressure changes or microphone equivalent volume. Includes adapters for calibrating 1", 1/2", 1/4" and 1/8" microphones. The G.R.A.S. 42AB complies with the requirements of IEC 60942 (1988) Class 1.

Specifications	G.R.A.S. 42AB
Sound pressure level	114 dB (re. 20 $\mu$ Pa) $\pm$ 0.2 dB
Frequency	1 kHz
Temperature range	-10 °C to + 50 °C
Batteries	6LR61, 9 V
Accuracy	IEC 60942 (1988) Class 1
Weight	220 g

## G.R.A.S. 42AE Low Frequency Calibrator



G.R.A.S. 42AE permits microphone calibration at frequencies down to 0.01 Hz for both front and rear-vented microphones.

The two-port configuration allows the actual sound pressure in the coupler to be monitored by a reference microphone simultaneously with the microphone under test. The sound pressure can alternatively be monitored using the voltage output proportional to the pressure in the coupler. The built-in, DC-coupled power amplifier enables the calibrator to be used for swept-sine, broadband and step function investigations.

G.R.A.S. 42AE is delivered with various types of adapters for calibrating 1/8" to 1" microphones and preamplifiers.

A power supply is included.

Specifications	G.R.A.S. 42AE
Sound pressure level	140 dB (re. 20 µPa)
Frequency	< 0.1 – 250 Hz
Signal input (max)	0.7 Vrms
Calibration signal	1 mV/Pa (140 dB max)
Weight	1.6 kg

## G.R.A.S. 14AA Electrostatic Actuator Amplifier



High voltage, high gain amplifier and voltage supply for driving electrostatic actuators. The high voltage output can also be used to drive standard microphones as sound sources. The G.R.A.S. 14AA can drive an electrostatic actuator with a 300 V peak-to-peak signal superimposed on 800 V DC. Its wide frequency range makes it possible to determine the pressure frequency response of condenser microphones from 1 Hz to 200 kHz (note: care should be taken below 200 Hz because of the influence of pressure equalization in the rear volume of the microphone). The G.R.A.S. 14AA can be connected directly to an external signal generator or the generator output of any standard signal analyzer.

Specifications	G.R.A.S. 14AA
Input signal (max)	3 V peak-to-peak
Gain	+ 40 dB
Output signal (max)	300 V peak-to-peak
Actuator Polarization Voltage	800 V
Frequency response	1 Hz – 200 kHz
Output impedance	1 kΩ
Power supply	110 /130 V AC or 220/240 V AC
Weight	1.4 kg

## G.R.A.S. AL0010 Calibration Stand



Provides a convenient platform for testing condenser microphones. It has a fixture for holding a 1/2" pre-amplifier (e.g. G.R.A.S. 26AK) securely in place as well as recesses and a column for safely parking electrostatic actuators (i.e. RA0014 and RA0015) and microphone protection grids when not in use. It can be set up for both 1/2" and 1" microphones. The AL0010 is a useful addition to a set-up (which includes the G.R.A.S. 14AA Electrostatic Actuator Amplifier) for routinely calibrating condenser microphones.

## G.R.A.S. AL0011 Calibration Stand for IEC 60318-1 Ear Simulator



AL0011 provides a convenient platform for calibrating IEC 60318-1 Ear Simulators, e.g. G.R.A.S. RA0039. The stand and the adapters are designed for standardized frequency calibration using a transmitter setup with a microphone as sound source (not included) and the 14AA Electrostatic Actuator Amplifier for driving the setup.

## RA0014 1/2" Electrostatic Actuator



An electrostatic actuator for testing the frequency response of standard 1/2", 1/4" and 1/8" microphones. Adapters are included for testing 1/4" and 1/8" microphones. The RA0014 can be connected directly to the G.R.A.S. 14AA Electrostatic Actuator Amplifier.

## RA0014-S1 1/2" Electrostatic Actuator for 40AU

## RA0015 1" Electrostatic Actuator



An electrostatic actuator for testing the frequency response of standard 1" microphones. The RA0015 can be connected directly to the G.R.A.S. 14AA Electrostatic Actuator Amplifier.

## G.R.A.S. 51AB Intensity Calibrator



For calibrating the phase response of a pair of microphones used for measuring sound intensity, e.g. G.R.A.S. 40AI and G.R.A.S. 40BI. It includes a calibrated acoustic resistance to enable the computation of particle velocity and intensity levels.

Complies with IEC International Standard 61043.

**Accessories included:**  
2 x 1/4" microphone adapters

Specifications	G.R.A.S. 51AB
Input connector	BNC socket
Maximum input signal	1 V RMS
Frequency range	50 Hz - 6.3 kHz
Frequency-intensity index	>27 dB (nominal mic. spacing 25 mm)
SPL difference between channels	< 0.1 dB
Operating temperature range	+ 5 °C to + 40 °C
Dimensions	Height: 42.2 mm Width: 50.3 mm Depth: 60.0 mm
Weight	515 g

# ARTIFICIAL EARS, EAR & MOUTH SIMULATORS, AND KEMAR

The human ear is acoustically a complicated structure with volumes, channels and damping resulting in a complex acoustical impedance. Also, at higher frequencies, the diffraction around the outer ear will change the acoustic field and result in a unique response at the inner ear.

In order to be able to compare and quantify measurements related to the human ear, a number of international standards and recommendations have defined some "ideal" or average ears. These can be simulated by more or less complicated mechanical and acoustical systems.

The IEC 60318-1 & -2 (60318) coupler is an example of a standardised human ear, having the same acoustic input impedance as an average human ear.

Another example is IEC 60318-4 (60711) Occluded-ear simulator for the measurement of earphones coupled to the ear by ear inserts.

- IEC 60318-4 (60711) Occluded-ear simulator for the measurement of earphones coupled to the ear by ear inserts.



Mouth Simulators are sound sources for simulating the sound field around the human mouth at close quarters and are used for testing telephone mouthpieces as well as other microphones similarly used in vocal-communication networks. They are built around a loudspeaker and deliver sound signals at a "Mouth Reference Point" in accordance with International Standards IEEE 269, 661 and ITU-T Rec. P51.

The Ear and Mouth simulators can be incorporated into a wide range of measuring setups for testing a wide range of products such as telephones, hearing aids, headphones, headsets etc.

The ear simulators can also be incorporated into a Head and Torso Simulator (HATS) like KEMAR, which lends more realism to in-situ anthropomorphic testing. KEMAR is a model of a human head and torso, and has been extensively used for the last 35 years for studying the interaction between the human head and torso and sound fields.

KEMAR was developed by KNOWLES Inc. in 1972 and is thoroughly documented in numerous studies, some of which have been collected in the book *Manikin Measurement - Mahlon D. Burkhard*.



## G.R.A.S. 43AA Ear Simulator Kit according to IEC 60318-1 & -2

### Included:

- IEC 60318-1 & -2 (60318) Ear Simulator RA0039
- 1/2" Pressure Microphone G.R.A.S. 40AG
- 1/4" Preamplifier G.R.A.S. 26AC
- Mounting plate for circum-aural headphones
- The Test Jig RA0052 has an adjustable spring-loaded arm to exert a variable force on the test object

A complete test jig for acoustical measurements on telephone handsets and earphones in accordance with:

- IEC 60318-1 & -2 (60318) Electroacoustics – Simulators of human head and ear - Part 1: Ear simulator for the calibration of supra-aural earphones, 1998-07
- ITU-T Recommendation P.57 (08/96) Series P: Telephone transmission quality, Objective measuring apparatus: Artificial ears

### Alternative versions available:

G.R.A.S. 43AA-S2 Artificial Ear, Prepolarized

G.R.A.S. 43AA-S3 Artificial Ear incl. 26AB preamplifier



## G.R.A.S. 43AB 1/2" 2cc Coupler Kit according to IEC 60318-5

### Included:

- IEC 60318-5 (60126) 2cc Coupler RA0038
- 1/2" Pressure Microphone G.R.A.S. 40AG
- 1/4" Preamplifier G.R.A.S. 26AC
- The Test Jig RA0052 has an adjustable spring-loaded arm to exert a variable force on the test object
- Studs and moulds for BTE and ITE instruments

A complete test jig for acoustical measurements on hearing aids in accordance with IEC 60318-5 (60126) and ANSI S3.7-1995 on insert type hearing aids in accordance with:

- IEC 60318-5 (60126) IEC reference coupler for the measurement of hearing aids using earphones coupled to the ear by means of ear inserts
- ANSI S3.7-1995 American National Standard for Coupler Calibration of Earphones



## G.R.A.S. 43AC Ear Simulator Kit according to IEC 60318-4

### Included:

- IEC 60318-4 (60711) Ear Simulator RA0045
- 1/2" Pressure Microphone G.R.A.S. 40AG
- 1/4" Preamplifier G.R.A.S. 26AC
- The Test Jig RA0052 has an adjustable spring-loaded arm to exert a variable force on the test object

A complete test jig for acoustical measurements on earphones coupled to the ear by inserts such as tubes and ear moulds in accordance with:

- IEC 60318-4 (60711) Occluded-ear simulator for the measurement of earphones coupled to the ear by ear inserts
- ITU-T Recommendations P.57 (08/96) Series P: Telephone transmission quality, Objective measuring apparatus: Artificial ears

### Alternative version available:

G.R.A.S. 43AC-S1 Artificial Ear with IEC60711 Coupler, Prepolarized



## G.R.A.S. 43AF 1" 6cc Coupler Kit according to IEC 60318-3

### Included:

- NBS 9-A 6cc Coupler RA0075
- Thread Adapter RA0076
- 1" Pressure Microphone G.R.A.S. 40EN (in WE 640AA configuration)
- 1/4" Preamplifier G.R.A.S. 26AC
- The Test Jig RA0052 has an adjustable spring-loaded arm to exert a variable force on the test object

A complete test jig for acoustically testing telephone handsets and earphones in accordance with ANSI S3.7 – 1995 and IEC 60318-3.



## G.R.A.S. 43AG Ear & Cheek Simulator Kit IEC 60711-4 & -7

A device for measurements on earphones of various types. It simulates the ear and cheek of a human head as well as approximates the acoustic impedance of an average human ear.

The Ear and Cheek Simulator can be used for measurements on insert hearing aids, earphones, supra-aural earphones as well as circum-aural earphones and telephones.

It includes an IEC 60318-4 (60711) Ear Simulator RA0045, 1/4" Preamplifier G.R.A.S. 26AC and a Test Jig RA0052 with an adjustable force clamp. It is delivered with a right KEMAR pinna KB0065 with a hardness of shore 00-55, which is easily interchangeable with other optionally-available KEMAR pinnae.

### Alternative version available:

G.R.A.S. 43AG-S1 CCP Ear & Cheek Simulator



## G.R.A.S. 43AD Ear Simulator Kit according to ITU-T Rec. P57 Type 1

### Included:

- IEC 60318-1 & -2 (60318) Ear Simulator RA0039
- 1/2" Pressure Microphone G.R.A.S. 40AG
- 1/2" Preamplifier G.R.A.S. 26AK
- Snap coupling GR0332 and GR0336
- Mounting plate for circum-aural headphones

A complete assembly for acoustical measurements on acoustical transmitters and loudspeakers in accordance with:

- IEC 60318-1 & -2 (60318) Electroacoustics – Simulators of human head and ear – Part 1: Ear simulator for the calibration of supra-aural earphones, 1998-07
- ITU-T Recommendation P.57 (08/96) Series P: Telephone transmission quality, Objective measuring apparatus: Artificial ears

It can be integrated with a telephone test head or permanently installed on a production test line

### Alternative version available:

G.R.A.S. 43AD-S1 Artificial Ear for Telephone Test Head, prepolarized



## G.R.A.S. 43AE Ear Simulator Kit according to ITU-T Rec. P57 Type 3.2

### Included:

- IEC 60318-4 (60711) Ear Simulator RA0045 (1/2" Microphone 40AG built-in)
- 1/4" Preamplifier G.R.A.S. 26AC
- Low-leak simplified Pinna Simulator RA0056
- High-leak simplified Pinna Simulator RA0057

An IEC 60318-4 (60711) Ear Simulator for acoustically testing supra-aural earphones, telephone handsets and loudspeakers in accordance with:

- IEC 60318-4 (60711) Occluded-ear simulator for the measurement of earphones coupled to the ear by ear inserts (1/2" Pressure Microphone 40AG included)
- ITU-T Recommendations P.57 (08/96) Series P: Telephone transmission quality, Objective measuring apparatus: Artificial ears

### Alternative versions available:

G.R.A.S. 43AE-S1 Ear Simulator  
according to ITU-T Rec. P57 Type 3.2, Prepolarized

G.R.A.S. 43AE-S2 Ear Simulator  
according to ITU-T Rec. P57 Type 3.2 with 26AB Preamplifier



**G.R.A.S. 43BA**  
**1/4" 0.4cc High-frequency Coupler**

The G.R.A.S. 43BA is a high frequency 1/4" 0.4cc coupler for test of hearing aids at frequencies up to 16 kHz. It is a complete kit with a 1/4" pressure microphone, a 1/4" preamplifier and the same adapters known from the reference 2cc coupler. It is designed for repetitive use and is equally suited for research, quality assurance and production test applications.

The coupler kit 43BA is designed to facilitate the measurement needs described in the IEC 60118 Technical Specification "Electroacoustics - Hearing Aids - Measurement of the performance characteristics of hearing aids" (2013) and meets the need for an accurate and repeatable measurement method that can be used by designers of hearing aids and hearing aids receivers, and by fitters of hearing aids.

Three variants of the 0.4cc coupler kit are available.



**G.R.A.S. 43BA-1**  
**1/4" 0.4cc High Frequency Coupler Kit**

Includes G.R.A.S. 40BP 1/4" Ext. Polarized Pressure Microphone, G.R.A.S. 26AS 1/4" Standard Preamplifier with 3 m Integrated Cable, Very Short and G.R.A.S. RA0252 1/4" 0.4cc High frequency Coupler as well as cable and adapters.

**G.R.A.S. 43BA-2**  
**1/4" 0.4cc CCP High Frequency Coupler Kit**

Includes G.R.A.S. 40BD 1/4" Prepolarized Pressure Microphone, G.R.A.S. 26CS 1/4" CCP Standard Preamplifier with Microdot Connector, Very Short and G.R.A.S. RA0252 1/4" 0.4cc High frequency Coupler as well as cable and adapters.

**G.R.A.S. 43BA-3**  
**1/4" 0.4cc High Frequency Coupler Kit, High Sensitivity**

Includes a special G.R.A.S. 1/4" prepolarized high sensitivity microphone, G.R.A.S. 26CS 1/4" CCP Standard Preamplifier with Microdot Connector, Very Short and G.R.A.S. RA0252 1/4" 0.4cc High frequency Coupler as well as cable and adapters.

## G.R.A.S. 43AH CCP Ear Simulator for Production Testing ITU-T P57 3.2 LL



This ear simulator consists of the ITU-T Rec. P.57 Type 2 Ear Simulator and Type 3.2 Simplified Low-leak Pinna Simulator and is designed for making ITU-T standardized tests of telephone handsets, receivers and receiver/loudspeaker-modules on the production

line. Besides the ear and pinna simulators G.R.A.S. 43AH includes a detachable front-plate that can be machined to make well-defined testing on various receiver related items. A calibration adapter to be used with Pistonphone G.R.A.S. 42AA/42AP is included.



G.R.A.S. 43AH can also be delivered with customized front plates that will enable leakage-controlled testing according to your specific needs.

G.R.A.S. 43AH is available for either BNC or LEMO connectors.

## G.R.A.S. 43AI CCP Ear Simulator for Production Testing ITU-T P57 3.2 LL



This ear simulator is similar to G.R.A.S. 43AH but comprises a Type 3.2 Simplified High-leak Pinna Simulator for testing leak tolerant receivers.

## G.R.A.S. RA0038 1/2" 2cc Coupler IEC 60318-5



An IEC 60318-5 (60126) 2cc coupler which complies with the requirements of:

- IEC 60318-5 (60126) IEC reference coupler for the measurement of hearing aids using earphones coupled to the ear by means of ear inserts
- ANSI S3.7-1995 American National Standard for Coupler Calibration of Earphones

It uses a 1/2" microphone with protection grid, e.g. G.R.A.S. 40AG and a suitable preamplifier, like G.R.A.S. 26AS, which is a 1/4" very short standard preamplifier with 3 m integrated cable supplied with an adapter for 1/2" microphones.

The RA0038 is also part of the G.R.A.S. Artificial Ear G.R.A.S. 43AB.

## G.R.A.S. RA0075 NBS 9-A 6cc Coupler



For testing earphones according to ANSI 3.7 – 1995 and IEC 60318-3. It can be used with a 1" pressure microphone like G.R.A.S. 40EN, a 1/2" preamplifier like G.R.A.S. 26AK and various adapters. E.g. G.R.A.S. RA0073.

## G.R.A.S. RA0252 1/4" 0.4cc High frequency Coupler



The coupler used in the 43BA kits is available separately i.e. without microphone, ear mould and tube adapters.

Specifications	RA0038	RA0075	RA0113
Standards	IEC 60318-5 (60126) ANSI S3.7-1995	ANSI S3.7-1995, Coupler calibration of earphones	IEC 60318-5 (60126) ANSI S3.7-1995

## G.R.A.S. RA0113 1" 2cc Coupler IEC 60318-5



A 2cc IEC 60318-5 (60126) coupler which uses a 1" microphone, like G.R.A.S. 40EN and a 1/2" preamplifier like G.R.A.S. 26AK supplied with e.g. G.R.A.S. RA0073 Adapter..

The microphone, without its grid, screws into the base of the RA0113. In all other respects, this coupler is equivalent to the RA0038.

It complies with the following international and national requirements for acoustically testing insert type hearing aids:

- IEC 60318-5 (60126) IEC reference Coupler for the measurement of hearing aids using earphones coupled to the ear by means of ear inserts
- ANSI S3.7-1995 American National Standard for Coupler Calibration of Earphones

## G.R.A.S. RA0039 Ear Simulator IEC 60318-1



An IEC 60318-1 (60318) Ear Simulator with an input impedance closely resembling that of an average human ear. When

coupled to a sound source, its impedance will load the sound source similar to the loading caused by the human ear. It complies with the requirements of:

- IEC 60318-1 (60318) Electroacoustics – Simulators of human head and ear – Part 1: Ear simulator for the calibration of supra-aural earphones, 1998-07
- ITU-T Recommendation P.57 (08/96) Series P: Telephone transmission quality, Objective measuring apparatus: Artificial ears

The RA0039 is also part of the G.R.A.S. 43AA and G.R.A.S. 43AD Ear Simulator kits.

Specifications	RA0039
Standards	IEC 60318-1 (60318) ITU-T Recommendations P.57 (08/96)
Frequency range	100 Hz - 4 kHz
Height	19.8 mm
Diameter	60 mm
Weight	137 g

## G.R.A.S. RA0045 Externally Polarized Ear Simulator IEC 60318-4



An IEC 60318-4 (60711) Ear Simulator for making acoustic measurements on earphones coupled to the human ear by ear inserts such as tubes, ear moulds or ear tips in accordance with:

- IEC 60318-4 (60711) Occluded-ear simulator for the measurement of earphones coupled to the ear by ear inserts
- ITU-T Recommendations P.57 (08/96) Series P: Telephone transmission quality, Objective measuring apparatus: Artificial ears

It is delivered with a built-in 1/2" microphone G.R.A.S. 40AG and an individual calibration chart for the coupler-microphone combination. Can be used with either of the Pinna Simulators RA0056 and RA0057 to simulate a complete ear for testing telephones and loudspeakers. The RA0045 is also part of the G.R.A.S. 43AC and G.R.A.S.43AE Ear Simulator kits.

### Alternative version available:

## G.R.A.S. RA0045-S1 Prepolarized Ear Simulator IEC 60318-4

Similar to RA0045 but is delivered with a built-in prepolarized microphone G.R.A.S. 40AO for use with CCP preamplifiers.

Specifications	RA0045/RA0045-S1
Standards	IEC 60318-4 (60711) ITU-T Recommendations P.57 (08/96)
Effective volume	1.26 ± 0,04 ccm @ 500 Hz
Resonant frequency	13.5 kHz ± 1 kHz
Height	36.5 mm
Diameter	23.8 mm
Weight	71 g

## RA0056 Low-leak Pinna Simulator

A low-leak, pinna (outer ear) simulator for use with the Ear Simulator RA0045 to simulate a complete ear for testing telephones and loudspeakers. The RA0056 meets the specifications in the ITU-T Recommendation P.57 (08/96) "Series P: Telephone transmission quality, Objective measuring apparatus: Artificial ears".



## RA0057 High-leak Pinna Simulator

A high-leak, pinna (outer ear) simulator for use with the Ear Simulator RA0045 to simulate a complete ear for testing telephones and loudspeakers. The RA0057 meets the specifications in the ITU-T Recommendation P.57 (08/96) "Series P: Telephone transmission quality, Objective measuring apparatus: Artificial ears".



## G.R.A.S. 44AA & 44AB Mouth Simulators

A sound source, which simulates the acoustic field close to the human mouth and complies with the standards IEEE 269, 661 and ITU-T Rec. P51.

For testing telephone mouthpieces as well as other microphones. At the mouth reference point (MRP), which is 25 mm from the detachable lip ring, the minimum-continuous signal it can produce in 1/3-octave bands is 100 dB re. 20  $\mu$ Pa in the frequency range 100 Hz to 10 kHz.

44AA's loudspeaker accepts an external signal either directly or via its own built-in power amplifier.

44AB's loudspeaker accepts a signal from an external power amplifier directly via the BNC input.

The jigs RA0104 and RA0105 are included for calibration according to ITU-T Rec. P51 and IEEE 269. These are for use with 1/4" or 1/2" microphones on 1/4" preamplifiers.

RA0104 holds the microphone at 0° incidence (1/4" only) to the sound source, RA0105 at 90° incidence (1/4" or 1/2").



Specifications	44AA	44AB
Min. continuous output level at MRP	110 dB re. 20 $\mu$ Pa (200 Hz – 6 kHz) 100 dB re. 20 $\mu$ Pa (100 Hz – 10 kHz)	110 dB re. 20 $\mu$ Pa (200 Hz – 6 kHz) 100 dB re. 20 $\mu$ Pa (100 Hz – 10 kHz)
Loudspeaker	8 $\Omega$ / 20 W (max. continuous)	8 $\Omega$ / 20 W (max. continuous)
Amplifier	Gain: 10 dB / Input impedance: 20 k $\Omega$	- / -
Mouth opening	20 mm diameter	20 mm diameter
Lip ring: External diameter / Distance from mouth	48 mm / 10 mm	48 mm / 10 mm
Dimensions: Diameter / Height (with lip ring)	104 mm / 104 mm	104 mm / 104 mm
Power Supply	24 V DC	
Weight	1.3 kg	0.93 kg

## G.R.A.S. 45AA Telephone Test Head

Laboratory stand for testing the acoustic performance of telephone handsets in accordance with international standards and recommendations.

Combines precision with a robust construction to ensure stability and reproducible test results with a minimum of acoustic interference.

When used with G.R.A.S. 43AD or G.R.A.S. 43AE Ear Simulators and G.R.A.S. 44AA/44AB Mouth Simulator, the Telephone Test Head can be set up for testing telephone handsets and mobile/cell telephones in accordance with ITU-T recommendations.

Four different, detachable precision brackets are provided for mounting the mouth simulator according to the standardised positions shown below for speaking into a telephone.

Speaking Position	Recommendation
LRGP	ITU-T Rec. P76
AEN	ITU-T Rec. P76
HATS	ITU-T Rec. P58
REF	OREM A

The Telephone Test Head stands on four anti-vibration mounts to isolate it from extraneous vibrations which could otherwise lead to spurious measurement results.

Graduated guides and stops are provided for aligning a telephone handset correctly in position over the ear simulator. Lateral guides are independently adjustable to cater for asymmetrical handsets.

### Accessories included:

Two types of adjustable detachable clamps Spring loaded for laboratory testing, adjustable from 0 to 8N and for production testing, heavy duty. Four detachable brackets for speaking positions: LRGP, AEN, HATS, and REF.

### Accessories available:

Mouth Simulators, IEC 60318-1 (60318) Ear Simulator, IEC 60318-4 (60711) Ear Simulator, Pinna Simulators, Pistonphone, Sound Calibrator, Power Module and Reference Gauge RA0141.



### RA0141 Reference Gauge



For checking the AEN and REF speaking positions on the Telephone Test Head G.R.A.S. 45AA.

Specifications	G.R.A.S. 45AA
Handset alignment	Four lateral guides independently adjustable over 35 mm to cater for asymmetrical handsets. Longitudinal stop adjustable over 35 mm. All adjustments relative to centre of coupler aperture.

## G.R.A.S. 45EA Handset Positioning System for KEMAR

The Handset Positioning System G.R.A.S. 45EA is made for the G.R.A.S. head and torso simulator, KEMAR Manikin with Mouth Simulator configured for telephone testing. The system is designed with maximum flexibility and acoustic performance in mind for laboratories & development environments that focus on the acoustic quality of their telephone handsets.

The finger grip is provided with adjustable positioning and scales which may be noted down for reproducible mounting and positioning.

The system is mounted on the KEMAR with no use of additional tools and can switch from right to left side setup with minimum alterations.

The Ear Reference Point of the preferred pinna type is determined by the supplied ERP-gauge and the applied handset pressure-force measured by use of the included force gauge RA0184.



## G.R.A.S. 45EB Ear-bud Positioning System for KEMAR

The Ear-bud Positioning System G.R.A.S. 45EB is made for the G.R.A.S. head and torso simulator, KEMAR Manikin G.R.A.S. 45BB and KEMAR Manikin with mouth simulator G.R.A.S. 45BC.

This system is designed for positioning and holding ear-buds or ear-borne devices in the concha of the pinna simulator. The pressure force and position is adjustable and will with the preferred pinna (see page 84) secure proper mounting and repeatable measurements.

The applied pressure-force is measured by use of the included force gauge RA0184.

G.R.A.S. 45EB can be retrofitted on all KEMAR versions.



## G.R.A.S 45BB & 45BC KEMAR Manikins

KEMAR is a head and torso simulator which is factory configured for hearing aid tests, ear- and head-phone tests and sound quality recordings. Introduced in 1972 by Knowles Electronics and acquired by G.R.A.S. in 2005, it is the origin of all other head and torso simulators thus the industry standard for in-situ anthropomorphic testing of all kinds of hearing instruments and head- and earphones.

Introduced in 2013, the new generation KEMAR is available with and without mouth simulator and fully backwards acoustically compatible with earlier KEMAR models.

KEMAR meets the requirements of ANSI S3.36 and IEC 60318-7 and can be configured with more sizes of standardized pinna simulators, the IEC 60318-4 Ear Simulator (711-coupler) or various 1/2" and 1/4" pressure microphones for binaural recordings.

KEMAR accommodates for LEMO as well as CCP pre-amplifiers which are all electrically accessible from the connector panel on the back.

The preconfigured KEMAR models include ear simulators, microphones, preamplifiers and pinnae for specific applications. It is delivered fully assembled and tested in one box.

## Available preconfigurations

45BB-1 KEMAR Head & Torso for hearing aid test, 1-Channel LEMO

45BB-2 KEMAR Head & Torso for hearing aid test, 1-Channel CCP

45BB-7 KEMAR Head & Torso test of binaural HA, 2-Ch LEMO

45BB-8 KEMAR Head & Torso for test of binaural HA, 2-Ch CCP

45BB-5 KEMAR Head & Torso for ear- and head-phone test, 2-Channel LEMO

45BB-6 KEMAR Head & Torso for ear- and head-phone test, 2-Channel CCP

45BC-1 KEMAR Head & Torso with Mouth Simulator for headset test, 2-Channel LEMO.

45BC-2 KEMAR Head & Torso with Mouth Simulator for headset test, 2-Channel CCP

45BC-3 KEMAR Head & Torso with Mouth Simulator for telephone test, 1-Channel LEMO.

45BC-4 KEMAR Head & Torso with Mouth Simulator for telephone test, 1-Channel CCP

45BB-3 KEMAR Head & Torso for sound quality recording, 2-Channel LEMO

45BB-4 KEMAR Head & Torso for sound quality recording, 2-Channel CCP



**G.R.A.S. 45CB**  
**Acoustic Test Fixture according to ANSI S12.42**

The 45CB is developed for standardized, binaural testing of passive and active earmuffs and ear-plugs. Besides a robust design made for field testing and high sound pressure levels (blasts), the ATF has a very high self-insertion loss, body temperature regulated ear-canals with silicone lining and a huge pinna surround – all to provide the most realistic and repeatable fit.



**G.R.A.S. 67SB Blast Probe Microphone**



The 67SB Blast Probe is designed as a reference microphone for impulse measurements according to the ANSI S12.42 standard.

The 1/8" reference microphone inside it is ideally suited for capturing impulsive signals with a very fine time resolution. This microphone has an upper limit of 174 dB in the dynamic range.

An adapter is included with the 67SB, so you can perform a verification of the microphone before each use.

**G.R.A.S. 45CA**  
**Hearing-protector Test Fixture**

G.R.A.S. 45CA is a multi-purpose acoustic test fixture designed in accordance with ISO 4869-3 using 1" or 1/2" microphones for testing insertion-loss of circum-aural hearing-protectors (ear muffs).

Alternatively, G.R.A.S. 45CA can be configured for testing insertion-loss of ear plugs using the IEC 60318-7 KEMAR Pinna Simulators and IEC 60318-4 Ear Simulators (711 coupler – G.R.A.S. RA0045).

As above or with the IEC 60318-1 Ear Simulators (318 coupler – G.R.A.S. RA0039) the test fixture can also be used for testing the performance of earphones as well as headphones (e.g. like audiometric earphones).

The test fixture can in all configurations be set up for one or two channels.

G.R.A.S. 45CA is delivered with a test stand and an acoustic cup for determining the self insertion loss of the system. Microphones, ear simulators and preamplifiers must be configured separately according to your specific application.



## G.R.A.S. Audiometer Calibration Systems

The G.R.A.S. Audiometer Calibration Systems are configured to meet the requirements of modern audiometer calibration. They are easy and fast to set up and control, and can be upgraded as your calibration needs change. Two standard packages are available and several options can be added depending on the type and features of the audiometer and connected earphones.

### G.R.A.S. 90AA Audiometer Calibration System

This system has been configured for the calibration technician on the move. It is portable and includes everything you need for calibrating supra- and circum-aural audiometric earphones like TDH-39 and HDA-200. The system includes a G.R.A.S. Audiometer Calibration Analyzer, two complete sets of standardized ear simulators on two coupler platforms, and a sound level calibrator and force gauge for verification of the system. All instrumentation is packed into a rugged suitcase that also allows space for options like free-field and insert-earphone calibration.

### G.R.A.S. 90AB Basic Audiometer Calibration System

This system is configured for the stationary calibration lab and will also calibrate supra- and circum-aural audiometric earphones like TDH-39 and HDA-200. This configuration includes a G.R.A.S. Audiometer Calibration Analyzer, two complete sets of standardized ear simulators and a coupler platform.

Specifications	G.R.A.S. 90AA & 90AB
Ear Simulators conform to:	ANSI 3.6 IEC 60318-1 & -2 & -3 & -4
Measured parameters:	Level, frequency and distortion (in one display)



## G.R.A.S. 90CA Microphone Calibration Systems

The G.R.A.S. 90CA Microphone Calibration System provides you with a computer-controlled level and frequency-response calibration of measurement microphones and microphone sets. This highly automated process is convenient with its ready-to-use software and hardware, and auto-generated customizable documentation.

Additional software can be purchased for the calibration of preamplifiers.

Calibration with the 90CA is in compliance with

- ANSI S1.10 – 1966 (R1976)
- IEC Norm 61094-1
- IEC 61094-6

The 90CA provides accurate calibration hardware, easily changeable test conditions and a highly reproducible calibration method.

The picture is not showing the system control and monitor, which are included with 90CA.

## G.R.A.S. 90CA-S2 Microphone Calibration Systems based on NI-PXI

Specifications:	G.R.A.S. 90CA
Level Calibration:	250 Hz, 114 dB
Frequency Calibration:	200 Hz to 92 kHz*

*\*Up to 200 kHz with additional hardware option*





# POWER MODULES

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Measurement microphones and preamplifiers require special voltages for supply and polarization. There are two different supply principles. One is for the traditional voltage-driven preamplifiers, and one is for CCP (Constant Current Power) preamplifiers. Acoustic measurements also often require special signal conditioning such as A-weighting or high-pass filtering. Amplification or attenuation of the signal may also be necessary.

Standard externally polarized condenser microphones require a stable polarization voltage of 200 V DC for proper operation. This polarization voltage may be turned off in the power modules for use with pre-polarized microphones too.

A-weighting is the most commonly used form of frequency weighting in acoustic measurements. It approximates the sensitivity of the human ear, which results in a more subjective measurement of noise.

Low frequency acoustic signals generated, for example, by wind flow may overload the input section of the analyzer and subsequent measurement chain. This can be avoided by removing frequencies below 20 Hz with the high-pass filter of a power module.

The wide range of G.R.A.S. power modules can fulfil these requirements. Some are simple supplies that give only the special voltages required, whereas others also include signal conditioning.



CCP stands for “Constant Current Power” and describes G.R.A.S. power modules that maintain a constant level of current for driving CCP transducers such as G.R.A.S. CCP Preamplifiers standard CCP microphone sets and special CCP microphones. Since the current is constant, the only thing that can vary with a CCP transducer under excitation is the supply voltage, which is analogous to its output signal.

Furthermore, since power is supplied via the same line as that used by the signal, only a coaxial cable is needed for connecting the transducer to the power module and subsequent analyzer.

There are also dedicated power modules for use only with G.R.A.S. Lownoise measurements systems. They provide polarization and supply voltages for powering the special Lownoise microphones and preamplifiers. The power modules are provided with a switch for selecting a response setting of either pressure or free-field.

Large systems for multi-channel acoustic measurements involving eight channels or more are most economically realised by using multi-channel power modules. Most G.R.A.S. power modules will fit into the optional G.R.A.S. 19” standard rack kit.

Combined power modules and power amplifiers are also available for electro-acoustic test of smaller devices like receivers and mini speakers.



## G.R.A.S. 12AD 1-Channel Power Module

1-channel, battery-operated, microphone power module. It has a 7-pin LEMO 1B input connector for a microphone preamplifier and one BNC output socket. It can provide a polarization of 200 V for externally polarized or 0 V for prepolarized microphone cartridges.

A battery indicator is included to monitor battery condition as well as an input socket for an external power supply.

## G.R.A.S. 12AR 2-Channel Power Module

2-channel, battery-operated, microphone power module. It has a two 7-pin LEMO 1B input connectors for microphone preamplifiers and two BNC output sockets. It can provide a polarization of 200 V for externally polarized or 0 V for prepolarized microphone cartridges.

A battery indicator is included to monitor battery condition as well as an input socket for an external power supply.



Specifications	G.R.A.S. 12AD
Input channel	7-pin LEMO 1B connectors
Output channel	BNC socket
Preamplifier supply	$\pm 15$ V
Output impedance	Depends on preamplifier
Polarization voltage	0 V or 200 V
Frequency response	0.05 Hz – 200 kHz
Power supply (not included)	4 x AA alkaline batteries or 4.5 – 24 V DC

Specifications	G.R.A.S. 12AR
Input channels	2 x 7-pin LEMO 1B connectors
Output channels	2 x BNC sockets
Preamplifier supply	$\pm 15$ V
Output impedance	Depends on preamplifier
Polarization voltage	0 V or 200 V
Frequency range	0.05 Hz – 200 kHz
Power supply (not included)	4 x AA alkaline batteries or 4.5 – 24 V DC

**G.R.A.S. 12AK**  
**1-Channel Power Module with gain, filters and SysCheck generator**

1-channel, battery-operated, microphone power module, amplifier and filter unit. It has a 7-pin LEMO 1B input connector for a microphone preamplifier and a BNC output socket. It has both instantaneous and latched overload indicators and a gain that can be set to 0dB, +10dB, +20dB, +30dB, +40dB or +50dB.

The A-weighting network fulfils the requirements of IEC 60651 for Type 0 and IEC 61672 Class 1 Sound Level Meters. The high pass filter is a 3-pole Butterworth filter with a cut-off frequency at 20 Hz.

A battery indicator is included to monitor battery condition as well as an input socket for an external power supply. It also has a built-in 1 kHz precision calibration generator with adjustable level for activating the SysCheck function in the G.R.A.S. 26AJ and 26AL preamplifiers. The generator can be activated either via a front-panel button or remotely via an input on the back of the module.

12 of these Power Modules can be mounted in the G.R.A.S. AK0040 Standard 19" Rack Kit.



Specifications	G.R.A.S. 12AK
Input channel	7-pin LEMO 1B connector
Output channel	BNC socket
Gain settings	0 dB, +10 dB, +20 dB, +30 dB, +40 dB, +50 dB
Preamplifier supply	28 V or 120 V
Polarization voltage	0 V or 200 V
Frequency response	3.5 Hz – 200 kHz
A-weighting network	IEC 60651 Type 0 and IEC 61672 Class 1
Output impedance	30 Ω
Power supply (included)	10 x AA alkaline batteries or 12 – 18 V DC mains/line adapter for 220/115 V

**G.R.A.S. 12AA**  
**2-Channel Power Module with gain, filters and SysCheck generator**

2-channel, battery-operated, microphone power module, amplifier and filter unit. It has two 7-pin LEMO 1B input connectors for microphone preamplifiers as well as two BNC output sockets. Both channels have an overload indicator and a gain that can be set to -20dB, 0dB, +20dB or +40dB.

The A-weighting network fulfils the requirements of IEC 60651 for Type 0 and IEC 61672 Class 1 Sound Level Meters. The high pass filters are 3-pole Butterworth filters with a cut-off frequency at 20 Hz.

A battery indicator is included to monitor battery condition as well as an input socket for an external power supply. It also has a built-in 1 kHz precision calibration generator with adjustable levels for both channels for activating the SysCheck function in the G.R.A.S. 26AJ and 26AL preamplifiers. The generator can be activated either via a front-panel button or remotely via an input on the back of the module.

12 of these Power Modules can be mounted in the G.R.A.S. AK0040 Standard 19" Rack Kit.



Specifications	G.R.A.S. 12AA
Input channels	2 x 7-pin LEMO 1B connectors
Output channels	2 x BNC sockets
Gain settings	-20 dB, 0 dB, +20 dB, +40 dB
Preamplifier supply	28 V or 120 V
Polarization voltage	200 V or 0 V
Frequency response	3.5 Hz – 200 kHz
A-weighting network	IEC 60651 Type 0 and IEC 61672 Class 1
Output impedance	30 Ω
Power supply (included)	10 x AA alkaline batteries or 12 – 18 V DC mains/line adapter for 220/115 V

## G.R.A.S. 12AG 8-Channel Power Module with gain, filters and SysCheck generator

8-channel mains/line operated power module, but can also be powered by an external DC supply. It is built for multi-channel acoustic measurements, using preamplifiers and condenser microphones.

Each channel offers a choice of linear response, A-weighting and high pass filters, and has a built-in 1000 Hz oscillator, which enables a complete channel check when used in conjunction with preamplifiers having a SysCheck or similar facility. The polarization voltage can be set to either 200 V or 0 V allowing the use of either externally polarized and prepolarized microphone cartridges. The preamplifier supply voltage can be selected internally to either 28 V or 120 V.

Each channel has a 7-pin LEMO 1B input connector for a microphone preamplifier, as well as indicators for instantaneous and latched overloads.

The gain in each channel can be selected individually in steps of 10 dB from 0 dB up to +50 dB. The high-pass filters are 3-pole Butterworth filters with a -1 dB cut-off frequency at 20 Hz to remove unwanted low frequency signals, for example caused by wind-induced noise around the microphones.

Two of these Power Modules can be mounted in a G.R.A.S. AK0040 Standard 19" Rack Kit.



Specifications	G.R.A.S. 12AG
Input channels	8 x 7-pin LEMO 1B connector
Output channels	8 x BNC sockets
Gain settings	0 dB, +10 dB, +20 dB, +30 dB, +40 dB, +50 dB
Preamplifier supply	28 V or 120 V
Polarization voltage	0 V or 200 V
Frequency response	3.5 Hz – 200 kHz
A-weighting network	IEC 60651 Type 0 and IEC 61672 Class 1
Output impedance	30 Ω
Power supply	12 – 18 V DC mains/line adapter for 220/115 V

## G.R.A.S. 12AB 2-Channel Power Module for G.R.A.S. Intensity Probes

2-channel, battery-operated, microphone power module for use with the G.R.A.S. 50AI-B/-C/-D Sound Intensity Probe.

It has a 12-pin LEMO 1B input connector for direct connection with the intensity probe and two BNC output sockets for the microphone signals. It also has a 9-pin D-sub socket for connecting to the RS-232 port of a computer for software control of the remote control facilities of the G.R.A.S. 50AI Sound Intensity Probe.

A battery indicator is included to monitor battery condition as well as an input socket for an external power supply.

12 of these Power Modules can be mounted in a G.R.A.S. AK0040 Standard 19" Rack Kit.



Specifications	G.R.A.S. 12AB
Input channels	2 via a 12-pin LEMO 1B connector
Outputs channels	2 x BNC sockets and one 9-pin D-sub socket
Preamplifier supply	28 V or 120 V
Polarization voltage	0 V or 200 V
Frequency response	0 Hz – 200 kHz
Power supply	10 x AA alkaline batteries or 12 – 18 V DC mains/line adapter for 220/115 V

**G.R.A.S. 12AQ**  
**2-Channel Universal Power Module**  
**with signal conditioning and PC interface**

2-channel power module for powering microphone preamplifiers requiring a constant-current or constant voltage power supply. G.R.A.S. 12AQ is for general use in acoustic measurements as well as for intensity measurements, both in the laboratory and in the field. It has facilities for both manual control and remote control. Manual control is via front-panel switches and push buttons. Remote control is via RS-232 interface.

If a special filter function such as a HP-filter, LP-filter or BP-filter is required, it can easily be implemented in the module, as G.R.A.S. 12AQ is prepared with slots for extra filters.



Specifications	G.R.A.S. 12AQ
Traditional preamplifier input:	
Connector	7-pin LEMO
Power Supply	$\pm 15V$ or $\pm 60 V$
Polarization	0 V or 200 V
CCP preamplifier input:	
Connector	BNC coaxial
Power supply	4 mA sourced at 28 V DC
Signal output	BNC coaxial connector
Gain	Adjusted in steps of 10 dB from -20 dB to +70 dB
Frequency range	2 Hz to 200 kHz $\pm 0.2$ dB
Filters	HP filter 20 Hz A-weighting IEC 61651 type 0
Control interface to host	Smart RS-232, MSG line
Power supplies	6 x LR14 alkaline batteries or 8 – 18 V DC

**G.R.A.S. 12AL**  
**1-Channel CCP Power Module**  
**with A-weighting filter**

1-channel CCP Power Module for powering microphone preamplifiers requiring a constant-current power supply, e.g. G.R.A.S. 26CB and 26CA. It can also power the G.R.A.S. 40SC Probe Microphone as well as the G.R.A.S. 40PH and 40PL Array Microphones.

The G.R.A.S. 12AL covers the frequency range from 1 Hz to 200 kHz and has a switchable A-weighting network and overload indicator. It is powered either by two internal batteries (LR6-AA) or by an external 3 - 6 V DC supply.



Specifications	G.R.A.S. 12AL
Input channel	BNC socket
Output channel	BNC socket
Transducer supply current	4 mA sourced from 28 V
Frequency response	1 Hz – 200 kHz
A-weighting network	IEC 60651 Type 0 and IEC 61672 Class 1
Power supply	2 x AA alkaline batteries or 3 – 6 V DC

## G.R.A.S. 12AN 4-Channel Power Module

12AN is a 4-channel battery-operated power module, which is suitable for general use. It is a cost-effective solution with direct coupling (no filters), and is therefore ideally suited for infra-sound measurements.

The 12AN Power Module can be used with all standard, LEMO microphone sets and standard front-ends or acquisition units.



Specifications	G.R.A.S. 12AN
Input channels	4 x 7-pin LEMO 1B connector
Output channels	4 x BNC sockets
Preamplifier supply	+/- 15 V
Polarization	0 V or 200 V
Frequency response	0.05 Hz – 200 kHz +/- 0.2 dB
Power supply	2 x AA alkaline batteries or 6 – 20 V DC mains/line adapter for 230/120 V

## G.R.A.S. 12AU 1-Channel Universal Power Module with signal conditioning and power amplifier

G.R.A.S. 12AU is a combined power module and power amplifier, optimized for production line testing of micro-speakers and receivers. It will supply a CCP or a LEMO microphone set and condition the measured signal. In addition, the 12AU will drive a loudspeaker and continuously monitor the current and voltage for easy derivation of typical loudspeaker test parameters.

It is remotely controlled via its USB interface and, for this purpose, is delivered with a control program for Microsoft Windows®.

G.R.A.S. 12AU can be mounted in a 19" rack.



Specifications	G.R.A.S. 12AU
Traditional Input:	Connector 7 pin LEMO 1B series Power Supply ±15 V Polarization 0 V / 200 V
CCP Input:	Connector BNC Power Supply 2-20 mA Input impedance 100 kΩ
Output	BNC floating (2 kΩ//100 nF to power ground)
Output impedance	100 Ω
Gain	0 - 50 dB in 10 dB steps (±0.2 dB) (remote controlled)
Bandwidth (-3dB)	1 Hz to 100 kHz
Noise floor (relative to input) Input shorted (≥20dB gain) Input loaded with 20pF dummy mic.	<1.5 μVrms (20 Hz - 20 kHz) <5 μVrms (20 Hz - 20 kHz)
High pass filter (remote controlled) 1.order Butterworth 3. order	1 Hz 20 Hz
Overload detection	LED indicators (remote controlled)
Max output current	+/-1.4 A
Voltage and current overload detection	LED indicator (remote controlled reading and reset)
Current output (voltage/current ratio)	1 V DC/1 A or 10 V DC/1 A

## G.R.A.S. 12HF 1-Channel Power Module for Lownoise Systems

Power Module for single-channel, lownoise measurements using the matched, lownoise preamplifiers and high sensitive microphones of G.R.A.S. 40HF, 40HH and 40HT Lownoise Microphone Systems.

### The G.R.A.S. 12HF provides:

- Polarization voltage (200 V) for the condenser microphone
- Voltage supplies ( $\pm 15$  V) for powering the microphone preamplifier
- A response setting of pressure or free-field

When fitted with the above matched preamplifiers and microphones, the G.R.A.S. 12HF supports the specifications of a G.R.A.S. Lownoise Microphone Systems.



## G.R.A.S. 12HM 10-Channel Power Module for Lownoise Systems

The G.R.A.S. Power Module G.R.A.S. 12HM is a 10-channel power supply for multi-channel lownoise measurements using the matched, lownoise preamplifiers and high sensitive microphones of G.R.A.S. 40HF, 40HH and 40HT Lownoise Microphone Systems.

When fitted with these matched preamplifiers and microphones, the G.R.A.S. 12HM can be used in sound-power measurements of lownoise products, such as disk drives, under anechoic and/or semi-anechoic conditions.

### The G.R.A.S. 12HM provides:

- Polarization voltages (200 V) for up to 10 condenser microphones
- Voltage supplies ( $\pm 15$  V) for powering up to 10 microphone preamplifiers
- Individual response setting, pressure or free-field, for each channel
- Individual gain adjustment of  $\pm 3$  dB for each channel.

When connected to the above matched preamplifiers and microphones, each channel supports the specifications of a G.R.A.S. Lownoise Microphone Systems.



Specifications	G.R.A.S. 12HF	G.R.A.S. 12HM
Input channel	7-pin LEMO EGA 1B	10 x 7-pin LEMO EGA 1B
Output channel	BNC coaxial	10 x BNC coaxial
Output impedance	30 $\Omega$	30 $\Omega$
Polarization voltage	200 V	200 V
Gain adjustment/channel	-	$\pm 3$ dB
Channel separation	-	> 90 dB
Power supply	4 x LR14 (C) internal cells or an external supply of 6 – 20V DC	115 or 230V AC max. 35 VA
Dimensions	height: 132.6 mm (5 1/4") width: 34.6 mm (1.3") depth: 196 mm (7.7")	height: 132.6 mm (5 1/4") width: 420 mm (16 1/2") depth: 196 mm (7.7")
Weight	620 g (1.3 lbs)	5.5 kg (12 lbs)



# ACCESSORIES

G.R.A.S. Sound & Vibration offers a wide range of standard accessories in the form of cables, adapters, windscreens and tripods for use in measuring setups. These can be broadly split up under accessories for microphones, preamplifiers and outdoor microphones. Some are included with certain products, some are

available as extras. All can be ordered individually. The brief description given here as well as the information available on [www.gras.dk](http://www.gras.dk) will help you select what you need for your particular setup. At all events, feel free to contact your local partner if you need advice or further information.



**AF0008**  
**Adapter for 1/2" microphone and 1/4" preamplifier**



An inline barrel adapter for using 1/4" preamplifiers with 1/2" microphones. Included with Preamplifier G.R.A.S. 26AB.

**RA0006**  
**Right-angled (90°) adapter for 1/4" microphone and 1/4" preamplifier**



The RA0006 is a right-angled adapter for using a 1/4" microphone with a 1/4" preamplifier. It can be used with any standard 1/4" microphone and 1/4" preamplifier such as the G.R.A.S. 26AC.

**GR0010**  
**Adapter for 1/2" microphone and 1/4" preamplifier**



An inline stub adapter for using 1/4" preamplifiers with 1/2" microphones. Included with G.R.A.S. 26AC, 26AL, 26AR and 26CB. Designed for G.R.A.S. microphones and 1/4" preamplifiers (see also RA0003).

**RA0007**  
**Straight adapter for 1/4" preamplifiers**



7,5 mm straight adapter for placing between a 1/4" microphone and a 1/4" preamplifier. Included with G.R.A.S. 40BI 1/4" Intensity Microphone set.

**RA0001**  
**Right-angled (90°) adapter for 1/2" microphone and 1/4" preamplifier**



The RA0001 is a right-angled adapter for using a 1/2" microphone with a 1/4" preamplifier. It can be used with any standard 1/2" microphone and 1/4" preamplifier such as the G.R.A.S. 26AC. The RA0001 could

be useful in situations where the microphone has to be flush mounted on a wall.

**RA0016**  
**20 dB Attenuator for externally polarized 1/2" microphones**



The RA0016 is a 20 dB attenuator for inserting between a 1/2" microphone and preamplifier. It will attenuate the output signal of the microphone by 20 dB in order to avoid overloading the preamplifier or following analyzer.

The RA0016 will work properly only with externally polarized microphones. For prepolarized microphones, use the RA0018.

**RA0003**  
**Adapter for 1/2" microphone and 1/4" preamplifier**



The RA0003 is an adapter for using a 1/2" microphone with a 1/4" preamplifier. It can be used with any standard 1/2" microphone and 1/4" preamplifier such as the G.R.A.S. 26AC.

**RA0017**  
**Adapter for 1" microphone and 1/2" preamplifier**



The RA0017 is a head adapter for using a 1" microphone with a 1/2" preamplifier. It can be used with any standard 1" microphone and 1/2" preamplifier such as the G.R.A.S. 26AK.

**RA0018**  
20 dB Attenuator for prepolarized 1/2" microphones



RA0018 is a 20 dB attenuator for inserting between a 1/2" pre-polarized microphone and preamplifier. It will attenuate the output signal of the microphone by 20 dB in order to avoid overloading the preamplifier.

The RA0018 is useful when measuring very high sound pressure levels using a preamplifier with limited dynamic range such as a Constant Current powered preamplifier. The RA0018 will work properly only with prepolarized microphones. For externally polarized microphones, use the RA0016.

**RA0019**  
Adapter for 1/4" microphone and 1/2" preamplifier



The RA0019 is an adapter for using a 1/4" microphone with a 1/2" preamplifier. Its influence on the acoustic field is minimal. To reduce attenuation of the microphone signal, the guard ring of the preamplifier is extended through the RA0019.

**RA0020 1/2" Nosecone**



The RA0020 is a 1/2" nosecone for replacing the standard protection grid of a 1/2" microphone when making acoustic measurements in laminar airflow. The tip should be pointed upstream in a laminar

flow to reduce turbulence created by the microphone itself in the airflow.

**RA0020-A 1/2" Nosecone**



Similar to RA0020 but made of aluminium for lightness.

**RA0022 1/4" Nosecone**



The RA0022 is a 1/4" nosecone for replacing standard protection grid of a 1/4" microphone when making acoustic measurements in laminar airflow. The tip should be pointed upstream in a laminar flow to reduce

turbulence created by the microphone itself in the airflow.

**RA0173 1/8" Nosecone**



The RA0173 is a 1/8" nosecone for replacing the standard protection grid of a 1/8" microphone when making acoustic measurements in laminar airflow. The tip should be pointed upstream in a laminar

flow to reduce turbulence created by the microphone itself in the airflow.

**RA0063**  
Adapter for 1/8" microphone and 1/4" preamplifier



The RA0063 is an adapter for using a 1/8" microphone with a 1/4" preamplifier. It can be used with any standard 1/8" microphone and 1/4" preamplifier such as the G.R.A.S. 26AC. To reduce attenuation of the micro-

phone signal, the guard ring of the preamplifier is extended through the RA0063.

**RA0067**  
**Transmitter adapter for 1/2" prepolarized microphones**



The RA0067 enables a prepolarized 1/2" microphone (typically a G.R.A.S. 40AD) to be used as a high impedance sound source. It takes a calibration signal directly from a signal generator.

This makes the microphone behave like an electrostatic loudspeaker which, in a coupler, has a frequency response as good as when operated as a microphone. It can also be used with externally polarized microphones, when used with G.R.A.S. 14AA Actuator Amplifier which superimposes + 200 VDC polarization on the calibration signal. The RA0067 has a BNC connector.

**RA0073**  
**Adapter for 1" microphone and 1/2" preamplifier**



The RA0073 is an adapter for using a 1" microphone with a 1/2" preamplifier. The influence of the RA0073 on the acoustic field is minimal.

**RA0077**  
**NBS 9-A Coupler adapter for 1/2" microphone**



The RA0077 is an adapter for using a 1/2" microphone in the NBS 9-A Coupler RA0075.

**RA0081**  
**Tool for gripping 1/2" microphones**



The RA0081 has a pair of soft, semi-circular jaws for gripping a 1/2" microphone safely when unscrewing its protection grid or unscrewing it from a preamplifier.

**RA0082**  
**Adapter for 1/8" microphone and 1/4" preamplifier (long version)**



The RA0082 is an adapter for using a 1/8" microphone with a 1/4" preamplifier. It can be used with any standard 1/8" microphone and 1/4" preamplifier such as the G.R.A.S. 26AC. Its extended length improves high frequency performance by reducing diffraction effects. To reduce attenuation (see RA0063).

**RA0086**  
**Transmitter adapter for 1/4" microphones**



The RA0086 is similar to the RA0067 but is used with a 1/4" externally polarized microphone (typically a G.R.A.S. 40BP) which can then be used as a high impedance sound source, e.g. when calibrating an acoustic coupler such as the G.R.A.S. RA0045. The RA0086 has a microdot connector.

**RA0091**  
Insulated 1/2" microphone protection grid



For avoiding ground loops, e.g. with RA0085 in telephone testing set-ups using the Artificial Ear G.R.A.S. 43AD.

**RA0096**  
Stainless steel tripod adapter



Adjustable, high quality, stainless steel tripod adapter for 1/4" microphones/preamplifiers. Angular adjustment: 180° in steps of 45°.

**RA0092**  
Rain-protection cap for array microphones



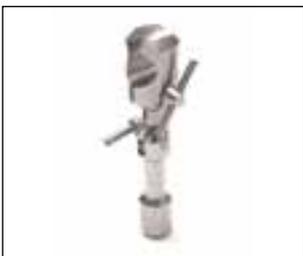
The RA0092 is for use with G.R.A.S. array microphones G.R.A.S. 40PH and 40PL.

**RA0117**  
Coupler adapter for 1/2" to 1/4" microphone



The RA0117 is an adapter for mounting a 1/4" microphone in couplers designed for 1/2" microphones.

**RA0093**  
Stainless steel tripod adapter



Adjustable, high quality, stainless steel tripod adapter for 1/2" microphones/preamplifiers. Angular adjustment: 180° in steps of 45°.

**RA0094**  
Stainless steel tripod adapter



Adjustable, high quality, stainless steel tripod adapter for microphone arrays PR0001 and PR0002. Angular adjustment: 180° in steps of 45°.

**RA0118**  
Attenuator for 1/4" microphones



The RA0118 is an attenuator for inserting between a 1/4" microphone and preamplifier. It will attenuate the output signal of the microphone by approximately 16 dB in order to avoid overloading the preamplifier or

following analyzer. The RA0118 is useful when measuring very high sound pressure levels using a preamplifier or analyzer with limited dynamic range.

**RA0122**  
Random incidence corrector



For use with 1/2" Free-field microphones when measuring noise according to ANSI requirements.

**RA0127**  
Rain-protection cap for 1/4" microphones



The RA0127 is for use with 1/4" microphones fitted with the protection grid provided which has a central matching threaded stud.

**RA0131**  
Rain-protection cap for 1/2" microphones



The RA0131 is for use with 1/2" microphones fitted with the protection grid provided which has a central matching threaded stud.

**RA0132**  
Dehumidifier for 1/2" microphones



For use when humidity levels are high and only with a rear-vented 1/2" microphone.

An indicator placed on the side of the dehumidifier shows when it needs to be dried out before further use.

**AL0003**  
Tripod adapter for microphones



The AL0003 is an adapter with a swivel head for mounting 1/2" or 1/4" preamplifiers with microphones on tripods with a standard 1/4" UNC-20 thread.

**AL0004**  
Small light weight microphone tripod



Compact, light-weight tripod for use with the Environmental Microphone G.R.A.S. 41AL and microphone preamplifier combinations.

Its main features are:

- Standard mounting thread (1/4" UNC-20)
- Crank-adjusted centre column
- Rubber feet
- Adjustable tripod legs with locks
- Max. height 123 cm
- Retracted 24 cm
- Weight 650 g

**AL0005**  
Swivel head



For tripods with a standard 1/4" UNC-20 thread.

**AL0013**  
Tripod adapter for 1/4" microphones/preamplifiers



The AL0013 is an adapter for using 1/4" preamplifiers with microphones on tripods with a standard 1/4" UNC-20 thread. It is recommended for use with the swivel head AL0005.

**AL0006**  
Microphone Tripod



A versatile and robust tripod for measurement set-ups. Its main features are the same as AL0004, but it is stronger and more stable.

**SK0017**  
Tripod thread insert



For adapting a female 3/8" UNC-16 thread to a female 1/4" UNC-20 thread.

**AL0007**  
Clips for 1/4" Intensity Microphones



Microphone clips 12 mm and 25 mm for side-by-side mounting of a pair of 1/4" intensity microphones.

**SK0057**  
Tripod conversion screw



For adapting the 3/8" UNC-16 thread of a tripod to 1/4" UNC-20 thread.

**AL0012**  
Tripod adapter for 1/2" microphones/preamplifiers



The AL0012 is an adapter for mounting 1/2" preamplifiers with microphones on tripods with a standard 1/4" UNC-20 thread. It is recommended for use with the swivel head AL0005.

**RA0011**  
Gooseneck



The RA0011 is a 20 cm flexible gooseneck with 7-pin LEMO connectors for use with preamplifiers with integrated 7-pin LEMO connectors such as G.R.A.S. 26AJ, 26AK and 26AB. For example, it can be mounted between

the preamplifier and a sound level meter in order to reduce reflections.

**RA0062**  
**20 pF Input adapter for 1/2" preamplifiers**



The RA0062 is a 20pF input adapter for 1/2" preamplifiers. One end screws on to a 1/2" preamplifier and the other end has a BNC input connector. This enables connecting a signal generator to the input of

the preamplifier. RA0062 can be used as a 20pF dummy load when short circuiting the BNC input.

**RA0125**  
**Adapter for microdot input to a 1/2" preamplifier**



The RA0125 is an adapter for using a Microdot (UNF 10-32) input to a standard 1/2" preamplifier such as the G.R.A.S. 26AK. Useful when a high input impedance is required for transducers such as hydrophones and

accelerometers. Including the GR0010, it can be used with 1/4" preamplifiers as well; f.ex. G.R.A.S. 26AC.

**RA0080**  
**6 pF Input adapter for 1/4" preamplifiers**



The RA0080 is a 6pF input adapter for 1/4" preamplifiers. One end screws on to a 1/4" preamplifier and the other end has a Microdot (UNF 10-32) input connector. This enables connecting a signal generator to the input of

the preamplifier. RA0080 can be used as a 6pF dummy load when short circuiting the Microdot input.

**AG0001**  
**Adapter for 7-pin LEMO to B&K**



The AG0001 is an adapter for a 7-pin LEMO connector and a traditional 7-Pin B&K microphone input connector.

**AG0002**  
**CCP Input Adapter**



An inline adapter for using a CCP preamplifier with a (constant-voltage) G.R.A.S. Power Module. One end plugs straight into the Power Module's input LEMO connector and the other end has a BNC socket for making

a connection with a CCP preamplifier, e.g. G.R.A.S. CCP preamplifiers G.R.A.S. 26CB, 26CC (1/4") and G.R.A.S. 26CA, 26CF (1/2")

**RA0083**  
**BNC to 7-pin LEMO Adapter**



For utilising the signal and signal-ground pins only of the 7-pin LEMO input of a preamplifier power supply.

**RA0140**  
**Dummy 1" microphone**

For checking the inherent noise level of a preamplifier loaded purely by the capacitance of a 1" microphone.

**AG0003**  
**Adapter for CCP preamplifier to XLR**



The AG0003 is an adapter for an XLR connector and a CCP compatible preamplifier. AG0003 is provided with a BNC connector.

**AC0001**  
**Calibration Control Box for G.R.A.S. 41AM/41CN**

The AC0001 is a control box with local and remote facilities for switching on/off the Actuator Calibration of the Outdoor Microphone Systems G.R.A.S. 41AM and 41CN. It also has a BNC output for analyzing the signals from these Outdoor Microphone Systems. It can be connected to a 12 – 18 V DC mains/line adapter for powering the G.R.A.S. 41AM and 41CN.

**AM0033**  
**Tripod adapter**



For mounting Outdoor Microphones G.R.A.S. 41AM/41CN (fitted with Pole Adapter AM0029) on a tripod. Has 1/2" RG (ISO 228/1) male thread on top and 3/8" UNC-16 female thread at the bottom.

**RA0087**  
**Special key**



Used when dismantling the microphone assembly of Outdoor Microphone Systems G.R.A.S. 41AM and 41CN.

**AM0037**  
**Transport protection cap**



For protecting the microphone assembly in Outdoor Microphones G.R.A.S. 41AM/41CN.

**AM0029**  
**Pole adapter**



For mounting Outdoor Microphones G.R.A.S. 41AM/41CN on a pole. Has 1 1/2" RG (ISO 228/1) female thread. Also used with the Tripod Adapter AM0033 for mounting an Outdoor Microphone on a tripod.

**AM0038**  
**Multi spanner/wrench**



For dismantling the microphone assembly of Outdoor Microphones G.R.A.S. 41AM/41CN.

Cables for outdoor microphones  
– see [www.gras.dk](http://www.gras.dk)

## AM0009 Windscreens for G.R.A.S. 41AM/41CN



The AM0009 is a set of five open-cell-structure foam windscreens for mounting on the Outdoor Microphone Systems G.R.A.S. 41AM and 41CN.

## RA0009 Adapter for Pistonphone calibration



The RA0009 is an adapter for calibrating the Outdoor Microphone System G.R.A.S. 41AM. It fits over the rain protection cap for G.R.A.S. 41AM and permits in-situ calibration using a pistonphone such as the G.R.A.S. 42AA.

## AM0052 Complete windscreen/birdspike for G.R.A.S. 41AM/41CN



The AM0052 is a windscreen, complete with anti-bird spikes, for mounting on the Outdoor Microphone Systems G.R.A.S. 41AM and 41CN.

## RA0041 Adapter for Pistonphone calibration



The RA0041 is an adapter for calibrating the Outdoor Microphone G.R.A.S. 41CN. It fits over the rain protection cap for G.R.A.S. 41CN and permits in-situ calibration using a pistonphone such as G.R.A.S. 42AA.

## AM0089 Large wind screen for G.R.A.S. 41AM/41CN



Spherical windscreen for Outdoor Microphone Systems G.R.A.S. 41AM and 41CN . Fits directly over the existing wind-screen, accommodating the anti-bird spikes. Open-cell foam structure, 150 mm diameter.

**RA0052**  
Test Jig



For use with G.R.A.S. couplers and artificial ears. It has an adjustable spring-loaded arm to exert a variable force on the test object.

**RA0088**  
In Ear Adapter



Moulding cup used to fit in-ear hearing aids to IEC 60318-5 (60126) 2cc coupler RA0113.

**RA0058**  
1/2" to 1" Microphone Adapter  
(with thread for 1" grid)



Converts a 1/2" microphone (with grid removed) into a 1" microphone's dimensions (with grid). Allows for mounting of 1" microphone protection grid.

**RA0076**  
Adapter for NBS 9-A Coupler RA0075



RA0076 is a thread adapter exclusively for use in connection with RA0052 Test Jig. Can also be used when upgrading the G.R.A.S. ear couplers, except G.R.A.S. 43AF, where it is included.

Typical use with Hearing-protector Test Fixture G.R.A.S. 45CA.

**RA0070**  
Test base for artificial ears



Test base for G.R.A.S. artificial ears and couplers.

**RA0114**  
Adapter for 1/4" button type hearing aids



For use with 2cc Coupler RA0113.

**RA0115**  
Moulding adapter for ITE hearing aids



For use with 2cc Coupler RA0113.

**RA0085**



**Insulated coupling for artificial ear**

Can be used as a substitute for the snap coupler GR0336 in the G.R.A.S. Artificial Ear 43AD to avoid ground loops.

**RA0116**  
Adapter for 1/2" microphone



For use with 2cc Coupler RA0113.

## RA0143

### Ear Simulator Holder Kit for KEMAR

This retrofit kit enables mounting of the IEC 60318-4 (60711) Ear Simulator on KEMAR models earlier than 2005. It is delivered for one side with two types of ear canal extensions and microphone holders.



## RA0251

### G.R.A.S. KEMAR Retrofit Kit for Binaural Hearing Aid Test

For testing of binaural hearing aids using RF communication, POM versions of the straight and the tapered ear canal extensions are available. To obtain the desired effect of non-interference with RF communication inside the head, KEMAR must also be fitted with POM ear holder plates.



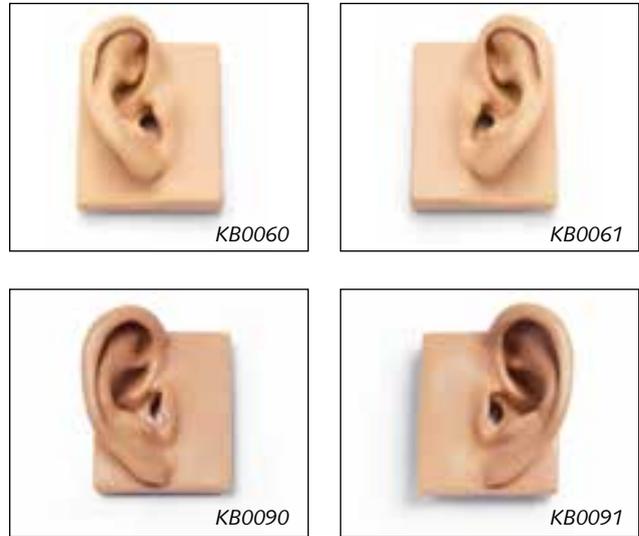
## RA0249

Straight POM Ear Canal kit for KEMAR, Ø 7.5 mm, 8.3 mm long. Standardized according to IEC60318-7.

## RA0250

Tapered POM Ear Canal Kit for KEMAR. Ø 9.85 tapering down to Ø 7.5 mm, 7.4 mm long.

## KEMAR Pinnae for G.R.A.S. 45BB, 45BC and 43AG



Ear No.	Description
KB0060	Small Right Ear 55 Shore-OO
KB0061	Small Left Ear 55 Shore-OO
KB0065	Large Right Ear 55 Shore-OO
KB0066	Large Left Ear 55 Shore-OO
KB0090	Large Right Ear (VA-style) 55 Shore-OO
KB0091	Large Left Ear (VA-style) 55 Shore-OO
KB1060	Small Right Ear 35 Shore-OO
KB1061	Small Left Ear 35 Shore-OO
KB1065	Large Right Ear 35 Shore-OO
KB1066	Large Left Ear 35 Shore-OO
KB1090	Large Right Ear (VA-style) 35 Shore-OO
KB1091	Large Left Ear (VA-style) 35 Shore-OO

## KB0110 & KB0111 Ear-mould simulators



Ear-mould simulator for connecting a coupler holder to a BTE hearing aid via 2 mm (KB0110) or 3 mm (KB0111) plastic tubing.

## KEMAR Pinnae for G.R.A.S. 45CA



KB0070



KB0071



KB0072



KB0073

Ear No.	Description
KB0070	Large Right Ear 55 Shore-OO
KB0071	Large Left Ear 55 Shore-OO
KB0072	Small Right Ear 55 Shore-OO
KB0073	Small Left Ear 55 Shore-OO

## KEMAR Pinnae for G.R.A.S. 45CB



KB0078



KB0077

Ear No.	Description
KB0077	ANSI Pinna Left 55 Shore-OO
KB0078	ANSI Pinna Right 55 Shore-OO

## RA0172

### Pinna Holder Kit for G.R.A.S. 45CA



Used for G.R.A.S. 45CA when configured with IEC 60318-4 Ear Simulator and KEMAR pinna.

## RA0042

### Coupler for two-port Calibration



Two-port high pressure coupler for 1/2" microphones. Used in comparison calibrations between two 1/2" microphones; one of which is a reference microphone. It can also be used in measuring the P-I (Pressure-Intensity) Index of intensity probes at 250 Hz. For use with Pistonphone G.R.A.S. 42AC.

## RA0024

### Coupler for two-port Calibration

Two-port coupler for 1/2" microphones. Used in comparison calibrations between two 1/2" microphones; one of which is a reference microphone. It can also be used in measuring the P-I (Pressure-Intensity) Index of intensity probes at 250 Hz. For use with Pistonphone G.R.A.S. 42AA and 42AP.

**RA0023**  
**Coupler for 1" microphones**



Coupler for 1" microphones. For use with G.R.A.S. pistonphones.

**RA0090**  
**94 dB Pistonphone Coupler**



A larger-volume Coupler for enabling Pistonphone G.R.A.S. 42AA and 42AP to produce a sound pressure level of 94 dB instead of 114 dB re. 20  $\mu$ Pa. Essential when calibrating highly sensitive, G.R.A.S. Lownoise Measuring

Systems which would otherwise be overloaded by 114 dB.

**RA0048**  
**Coupler for 1/2" microphones**



Coupler for 1/2" microphones. For use with G.R.A.S. pistonphones.

**RA0119**  
**Pistonphone Adapter**

A Pistonphone adapter for calibration checking the Ear Simulator G.R.A.S. 43AE when a pinna simulator is mounted on the IEC 60711 Ear Simulator RA0045.

**RA0049**  
**1/2" adapter for 1/4" microphones**



1/2" adapter for 1/4" microphones. For use with G.R.A.S. pistonphones.

**RA0069**  
**1/2" adapter for 1/8" microphones**



1/2" adapter for 1/8" microphones. For use with G.R.A.S. pistonphones.

**RA0060**  
**Coupler for 1/2" nosecone**



For use when calibrating a microphone fitted with a 1/2" nosecone RA0020 using a G.R.A.S. pistonphone like 42AA.

**PR0001**  
**Module for Array Microphones, wired**

PR0001 is a mounting rail for G.R.A.S. CCP array microphones, e.g. 40PH or 40PL. The rail has a single 3 m cable which terminates in a 7-pin male LEMO connector. Adapter cables are available for splitting the signals to BNC or SMB connectors.

The design allows multiple-array configurations to suit various measurement requirements. In all cases, the fixed distance is 50 mm, resulting in an upper frequency of 3.4 kHz.

**Adapter cables available:**

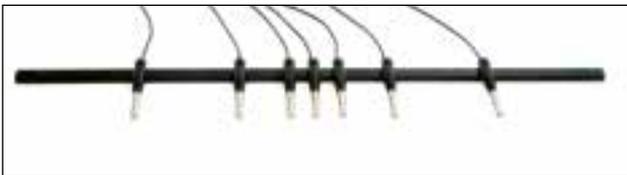
**AC0015:** Split cable from rail to 6 BNC connectors

**AA0016:** Split cable from rail to 6 SMB connectors



*PR0001-1 Alternative version with lateral cable connection*

**PR0002**  
**Module for Array Microphones, variable**



The PR0002 rail has 23 positions for microphones, spaced at 25 mm intervals. However, it is possible to space the microphones with intervals of 50 mm, 75 mm or 100 mm.

For each microphone a CCP cable is used with this module.



The holder RA0185 is available for mounting array microphones with SMB connector on the rail, and a special holder RA0245 is available for mounting 1/4" microphone sets with Microdot connector.



To be mounted on the tripod AL0006 and the stainless-steel tripod adapter RA0094 (for 8 microphones). These are standard solutions, but G.R.A.S. also offers alternative sizes and shapes of array modules.

**GR0625**  
**End piece Array Modules**



For Array Module G.R.A.S. PR0001/ PR0001-1 and PR0002.

**GR0630**  
**Connecting piece for Array Modules**



Used to extend Array Module G.R.A.S. PR0001/ PR0001-1 in the horizontal direction.

**GR0707**  
**Spacer for Array**



The 50 mm spacer is used to extend Array Module G.R.A.S. PR0001/ PR0001-1 in the vertical direction.

**RA0107 Spacer Set for Array Modules**

A set of 6 (50 mm) spacers for Array Modules PR0001 and PR0001-1.

**AC0015**  
**1-6 Split cables for Array Modules**



The AC0015 is for use with the Array Module PR0001. One end has a LEMO connector which plugs into the array module and splits into six BNC outputs on the ends of short cables.

## AK0040 Standard 19" Rack Kit



A shelf for mounting instrument cabinets, e.g. G.R.A.S. Power Modules, and can itself be mounted in a standard 19" instrumentation rack via its flanges. It can house instruments 133 mm high and is wide enough to contain instruments amounting up to a total width of 430 mm.

## AK0096 Mounting Plate



For mounting two G.R.A.S. Power Modules (G.R.A.S. 12AA/12AK) side-by-side.



**AB0002**  
Regulated 230 V AC  
- 15 V DC 7.5 W.  
Connector for European Union.



**AB0003**  
Regulated 110 V AC  
- 15 V DC 7.5 W.  
Connector for United States.



**AB0005**  
SMPS regulated 100–240 V AC - 6 V DC 10 W.  
Connector for European Union, United Kingdom, and United States.  
Specify connector when ordering.



**AB0006**  
Regulated 230 V AC - 15 V DC 7.5 W  
Connector for United Kingdom.

**CCP Coaxial Cables, BNC-BNC  
for 1/2" microphone sets**



AA0035 3 m  
AA0037 10 m  
AA0039-CL  
Customized length  
AA0056-CL (RG174)  
Customized length

**CCP Coaxial Cables, SMB angled-BNC  
for Array and QC microphones**



AA0078 3 m  
AA0080 10 m  
AA0081-CL  
Customized length

**CCP Coaxial Cables, Microdot-BNC  
for 1/4" and 1/8" microphone sets  
Max. temperature 70°C**



AA0070 3 m  
AA0071 5 m  
AA0072 10 m  
AA0073-CL  
Customized length

**CCP Coaxial Cables, SMB-SMB  
for Array and QC microphones**



AA0043 3 m  
AA0044 10 m  
AA0083-CL  
Customized length

**CCP Coaxial Cables, Microdot-BNC  
for 1/4" and 1/8" microphone sets  
Max temperature 150°C**



AA0018 3 m  
AA0062 10 m  
AA0061-CL  
Customized length

**CCP Coaxial Cable, SMB-Microdot**



AA0049 10 m cable  
AA0076-CL  
Customized length

**CCP Coaxial Cables, SMB-BNC  
for Array and QC microphones**



AA0027 3 m  
AA0028 10 m  
AA0082-CL  
Customized length

**CCP Coaxial Cables, Microdot-Microdot**



AA0064 3 m  
AA0087-CL  
Customized length

## LEMO Cables - standard

Standard cables 1B 7-pin LEMO to 1B 7-pin LEMO.



- AA0008** 3 m
- AA0009** 10 m
- AA0020-CL** Customized length
- AA0089-CL** Customized length for panel mounting

## LEMO Cables for Outdoor microphones



- AA0003** 3 m
- AA0002** 10 m
- AA0015** 100 m  
- on cable drum
- AA0016** 200 m  
- on cable drum

## LEMO Cables for Lownoise Systems



- AA0046** 3 m
- AA0047** 10 m
- AA0053-CL**  
Customized length

## LEMO Cables for Intensity Probes



- AA0006** 2 m  
- 4-pin
- AA0021** 5 m  
- 12-pin

**Adapter cables  
for Intensity Probe G.R.A.S. 50AI**



**AC0002**  
Adapter cable for G.R.A.S. 50AI-B for use with 01dB Symphonie.



**AC0003**  
Adapter cable 12-pin LEMO to 2 x 7-pin LEMO for G.R.A.S. 50AI-C.



**AC0005**  
Adapter cable for G.R.A.S. 50AI-D for use with Müller BBM and OROS analyzers.

**AC0008**  
Adapter cable for G.R.A.S. 50AI-D for use with 01dB Harmonie and Soundbook.

**AC0010**  
Adapter cable 18-pin LEMO to 2 x 7-pin LEMO.

**AC0016**  
The AC0016 is for use with the Array Module PR0001. One end has a LEMO connector which plugs into the array module and splits into six SMB outputs on the ends of short cables.

**Cable Accessories**

**AE0001**  
6-pin LEMO FFA.2S.306 male plug as supplied with G.R.A.S. 41AM/41CN.

**AE0003**  
7-pin LEMO FGG.1B.307 male plug for preamplifier cables.

**AE0046**  
**BNC male - Microdot female Adapter**  
Is typically used when you have a cable which is terminated with a Microdot connector and wish to connect to a BNC female e.g. on a Power Module/ Input Module.

**AE0074**  
**BNC female-female Adapter**  
This adapter is used for interconnecting two cables which are terminated with BNC male connectors.

**AE1002**  
7-pin LEMO 1B series female connector for panel mounting.

**AE1003**  
7-pin LEMO 1B series female connector for cable mounting.

**Raw Cables**

**EW0006**  
4.8 mm diameter high quality, screened/shielded 7-core preamplifier cable, PUR jacket.

**EW0009**  
2.5 mm diameter screened/shielded 4 x AWG 30 EFTE cable, PUR jacket.

**EW0011**  
2.8 mm diameter screened/shielded 5 x AWG 30 EFTE cable, PUR jacket.

**EW0035**  
7.8 mm diameter combined 2 coaxial and 16-core screened/shielded cable, PUR jacket.

**EW0061**  
2 mm diameter high quality coax cable.

**EW0062**  
7 mm diameter combined coaxial and 8-core screened/shielded cable, PUR jacket.



**PA0017 Cable drum**

The PA0017 is a cable drum for approximately 100 m microphone cable.

**PA0018 Cable drum**

The PA0018 is a cable drum for approximately 200 m microphone cable.

## Spherical windscreens

The G.R.A.S. windscreens are all size optimized and their special, open-cell foam structure is designed to resist a humid environment and not influence the sound pressure measurement result significantly. Frequency-dependent attenuation is to be expected, if the windscreen gets wet. Therefore windscreens are not intended as rain protection.

### AM0069 Spherical windscreen for 1/2" microphones



### AM0071 Spherical windscreen for 1/4" microphones



### AM0363 Spherical windscreen for 1" microphones



### AI0001 Elliptical Windscreen for Intensity Probes



Provides good protection at wind speeds of more than 0.5 m/s and is able to reduce pressure fluctuations caused by turbulence by up to 20 dB.

### AM0364 Spherical windscreens for array microphones



The G.R.A.S. windscreens are all size optimized and their special, open-cell foam structure is designed to resist a humid environment and not influence the sound pressure measurement result significantly.

Frequency-dependent attenuation is to be expected, if the windscreen gets wet. Therefore windscreens are not intended as rain protection.

### AM0376 Elliptical windscreen for rugged CCP Intensity Probes



Fits the rugged CCP Intensity Probe 50GI-P and 50GI-RP.



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