Innovation
As a family-owned company, we safeguard our heritage by constantly striving to push the boundaries of what is possible and help our customers improve their products. This is why we have the industry’s most advanced microphones – a broad range of high-quality microphones for general acoustic applications complemented by an even broader range of highly specialized microphones and test solutions developed and fine-tuned to match specific challenges.

This is a reflection of our unique willingness to help solve our customers’ measurement needs and provide solutions for tomorrow. Listening to our customers is at the core of who we are.

Quality
Our measurement microphones are designed to support critical areas in our customers’ R&D, QA and Production Line testing. Using Highly Accelerated Lifetime Tests (HALT) we ensure that our microphones perform optimally in real-life situations and retain the long-term stability that is crucial for trustworthy measurement results. All our microphones are made in Denmark from 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 GRAS microphone, our special technique enables repair at a very reasonable price, ensuring a very low cost of ownership.

Calibration Services
Depending on the use, measurement environment and internal quality control programs, we recommend that microphones are calibrated at a dedicated calibration laboratory at least every second year. We endorse our Accredited Calibration Laboratory in Denmark or the GRAS Microphone Calibration Centers located in Asia, Europe and North America.

Partners
GRAS is located in Denmark and represented worldwide in more than 40 countries. Also, we are the preferred supplier of acoustic sensors to a long list of measurement solution providers. Whether you are searching for a multi-channel solution, a replacement microphone or a customized design, your local GRAS partner will in close cooperation with us be able to help solve your measurement needs.

Please visit gras.dk to find your local GRAS partner.

Tradition
We were founded in 1994 by 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 microphone. Mr. Rasmussen’s ingenuity soon led 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 capabilities that made high-definition diagnostics of impulse noise possible. Many variants have been made available over the years, all based on Gunnar Rasmussen’s original 1” pressure microphone design.
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Choosing a Microphone

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 GRAS 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 GRAS 26AK, which has a 7-pin LEMO connector. The preamplifier must be connected to a power module (for example GRAS 12AK) or an analyzer input that can supply the preamplifier with power as well as 200 V polarization for the microphone capsule.

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 GRAS 26CA. Prepolarized microphones must be connected to an input stage for CCP transducers or be powered by a CCP supply, for example the GRAS 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 to the left, 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 GRAS RA0045 IEC 60318-4 and GRAS RA0038 IEC 60318-5, 2cc coupler and 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 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 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 high sensitivity and a small microphone, with a stiff diaphragm, will have 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 backplate.

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 backplate inside the body of the microphone. This is ultimately 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 µV 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 GRAS microphones are shown in the chart below. Different colors are used to distinguish between pressure (blue), free-field (orange) and random incidence (light grey) microphones.

The microphones are grouped according to size of external diameter, i.e. 1", 1/2", 1/4" and 1/8".
The Part or Model number of each microphone is also shown.
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 1 Hz 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 GRAS microphones are shown in the chart below. Different colors are used to distinguish between pressure (blue), 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 equalizing the internal pressure with ambient pressure. On the other hand, equalization must be slow enough to avoid affecting the measurement of dynamic signals.

The microphones are grouped according to size of external diameter, i.e. 1", 1/2", 1/4" and 1/8".

The Part or Model number of each microphone is also shown.
Microphone Sets – a Safe and Easy Solution

Daily situations where you mix up externally polarized and prepolarized microphones and preamplifiers or use wrong calibration data in your system setup are time-consuming and often not discovered until a whole set of measurement data is analyzed and consequently discarded.

To help you avoid this we offer most of our measurement microphones as microphone sets: Pre-assembled and ready-to-use combinations of microphones and preamplifiers.

Pre-assembled Sets
The GRAS 46XX-series of pre-assembled microphones and preamplifiers offers carefully selected combinations to obtain the best possible properties and reliability, thus optimizing the work-flow 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. They are calibrated together and 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. Whatever 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. This feature is 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. 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. GRAS supplies a number of pistonphones and a multifunction 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
GRAS offers a 5-year warranty on microphone sets.

Service
Should you by mistake damage the diaphragm on a GRAS microphone, our special technique enables repair at a very reasonable price, ensuring a very low cost of ownership. Cable and connector can usually be replaced, which is also the case for the microphone cartridge and preamplifier unit.

Typically a GRAS microphone set is named for the microphone capsule. A 40AE microphone thus becomes a 46AE microphone set when paired with the preamplifier.
GRAS 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.

GRAS 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.

GRAS 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.

GRAS 46BF-1
1/4” LEMO Free-field Standard Microphone Set

46BF-1 is a 1/4” high frequency free-field microphone set for high level measurements with built-in TEDS and a 5-pin LEMO connector. To be used with AA0091 or AA0092-CL 5-pin to 7-pin LEMO cable.

Nominal Sensitivity Frequency Response Power Supply Dynamic Range Temperature Range Length Diameter without Protection Grid Diameter with Protection Grid Weight

<p>| | | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>46AC</td>
<td>12.5</td>
<td>3.15 - 40 k</td>
<td>28 - 120</td>
<td>20 dB(A) to 164 dB</td>
<td>-30 to +70</td>
<td>97</td>
<td>12.7</td>
<td>13.2</td>
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<td>46AF</td>
<td>50</td>
<td>3.15 - 20 k</td>
<td>28 - 120</td>
<td>17 dB(A) to 149 dB</td>
<td>-30 to +70</td>
<td>101</td>
<td>12.7</td>
<td>13.2</td>
</tr>
<tr>
<td>46AR</td>
<td>50</td>
<td>3.15 - 16 k*</td>
<td>28 - 120</td>
<td>19 dB(A) to 149 dB</td>
<td>-30 to +70</td>
<td>101</td>
<td>12.7</td>
<td>13.2</td>
</tr>
<tr>
<td>46BF-1</td>
<td>3.6</td>
<td>4 - 100 k</td>
<td>28 - 120</td>
<td>35 dB(A) to 172 dB</td>
<td>-30 to +70</td>
<td>69</td>
<td>6.35</td>
<td>6.9</td>
</tr>
</tbody>
</table>

Units mV/Pa Hz V DC re. 20 µPa °C mm mm mm g

* ±3 dB. All other ±2 dB.
GRAS 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 5-pin LEMO connector.
To be used with AA0091 or AA0092-CL 5-pin to 7-pin LEMO cable. A front-vented version is available, 46AG-FV.

GRAS 46BP-1
1/4” LEMO Pressure Standard Microphone Set

46BP-1 is a 1/4” LEMO microphone set for pressure measurements for measuring high sound pressure levels at high frequencies, with a 5-pin LEMO connector.
To be used with AA0091 or AA0092-CL 5-pin to 7-pin LEMO cable.

GRAS 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.

GRAS 46DP-1
1/8” LEMO Pressure Standard Microphone Set

46DP-1 is a 1/8” pressure microphone set with built-in TEDS and a 5-pin LEMO connector.
To be used with AA0091 or AA0092-CL 5-pin to 7-pin LEMO cable.

GRAS 46BH-1
1/4” LEMO Pressure Standard Microphone Set, High Pressure

46BH-1 is a 1/4” high pressure microphone set with built-in TEDS and a 5-pin LEMO connector. With a dynamic range topping at 193 dB it is ideal for measuring at very high sound pressure levels.
To be used with AA0091 or AA0092-CL 5-pin to 7-pin LEMO cable.

<table>
<thead>
<tr>
<th>Nominal Sensitivity</th>
<th>Frequency Response</th>
<th>Power Supply</th>
<th>Dynamic Range</th>
<th>Temperature Range</th>
<th>Length</th>
<th>Diameter without Protection Grid</th>
<th>Diameter with Protection Grid</th>
<th>Weight</th>
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<tbody>
<tr>
<td>46AG 12</td>
<td>3.15 - 20 k</td>
<td>28 - 120</td>
<td>25 dB(A) to 164 dB</td>
<td>-30 to +70</td>
<td>101</td>
<td>12.7</td>
<td>13.2</td>
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<tr>
<td>46AP 50</td>
<td>3.15 - 10 k</td>
<td>28 - 120</td>
<td>18 dB(A) to 149 dB</td>
<td>-30 to +70</td>
<td>101</td>
<td>12.7</td>
<td>13.2</td>
<td>42</td>
</tr>
<tr>
<td>46BH-1 0.4</td>
<td>10 - 20 k</td>
<td>28 - 120</td>
<td>54 dB(A) to 193 dB</td>
<td>-30 to +70</td>
<td>69</td>
<td>6.35</td>
<td>6.9</td>
<td>10</td>
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<tr>
<td>46BP-1 1.5</td>
<td>4 - 70 k</td>
<td>28 - 120</td>
<td>39 dB(A) to 172 dB</td>
<td>-30 to +70</td>
<td>69</td>
<td>6.35</td>
<td>6.9</td>
<td>10</td>
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<tr>
<td>46DP-1 0.9</td>
<td>6.5 - 140 k</td>
<td>28 - 120</td>
<td>52 dB(A) to 178 dB</td>
<td>-30 to +70</td>
<td>90</td>
<td>3.2</td>
<td>3.5</td>
<td>8</td>
</tr>
</tbody>
</table>

Units | mV/Pa | Hz | V DC | re. 20 μPa | °C | mm | mm | mm | g

Return to contents  Return to index
146AE is a versatile 1/2” free-field measurement microphone set for the broadest range of noise measurements in challenging environments. It is well protected against vibrations, humidity, dust, oil mists, and temperatures from -40 to 125°C. A comprehensive range of accessories is available, visit www.gras.dk.

147AX is a surface mounted pressure microphone. It comes with a novel magnetic mounting system which provides precise, repeatable and easy mounting. It is well protected against vibrations, humidity, dust, oil mists, and temperatures from -40 to 125°C. A comprehensive range of accessories is available, visit www.gras.dk.

146AE is a 1/2” free-field general purpose high sensitivity microphone set with built-in TEDS and BNC connector.

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.

46BE is a 1/4” Constant Current Power CCP free-field microphone set for measuring high sound pressure levels at high frequencies. It is terminated with a 10/32 UNC Microdot female connector and has TEDS. A high-temperature version is available, 46BE-HT.

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.

---

### CCP Rugged Pressure Microphone

**GRAS 147AX**

### 1/2” CCP Free-field Standard Microphone Set, Wide Frequency

**GRAS 46AM**

### 1/4” CCP Free-field Standard Microphone Set, Wide Frequency

**GRAS 46AQ**

### 1/2” CCP Random Incidence Standard Microphone Set

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#### Specifications

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<td>146AE</td>
<td>50</td>
<td>3.15 - 20 kHz</td>
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<td>8</td>
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<td>-30 to +85</td>
<td>90</td>
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<td>-30 to +85</td>
<td>101</td>
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<td>13.2</td>
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</table>

Units: mV/Pa, Hz, mA, re. 20 μPa, V, °C

* with 5 m integrated cable.
GRAS 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. 
A front-vented version is available, 46AO-FV.

GRAS 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.

GRAS 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, with built-in TEDS and Microdot connector. 
A front-vented version is available, 46BD-FV. 
A version with SMB connector is available, 46BD-S1.

GRAS 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. 
A front-vented version is available, 46BG-FV.

GRAS 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. 
A high-temperature version is available, 46BL-HT.

<table>
<thead>
<tr>
<th>Units</th>
<th>Nominal Sensitivity</th>
<th>Frequency Response</th>
<th>Power Supply</th>
<th>Dynamic Range</th>
<th>Max. Output Peak Voltage</th>
<th>Temperature Range</th>
<th>Length</th>
<th>Diameter without Protection Grid</th>
<th>Diameter with Protection Grid</th>
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<tr>
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<td>12</td>
<td>3.15 - 20 k</td>
<td>2 - 20</td>
<td>25 dB(A) to 150 dB</td>
<td>8</td>
<td>-30 to +85</td>
<td>80</td>
<td>12.7</td>
<td>13.2</td>
<td>39</td>
</tr>
<tr>
<td>mV/Pa</td>
<td>50</td>
<td>3.15 - 10 k</td>
<td>2 - 20</td>
<td>18 dB(A) to 138 dB</td>
<td>8</td>
<td>-30 to +85</td>
<td>94</td>
<td>12.7</td>
<td>13.2</td>
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<tr>
<td>mV/Pa</td>
<td>1.45</td>
<td>4 - 70 k</td>
<td>2 - 20</td>
<td>44 dB(A) to 166 dB</td>
<td>8</td>
<td>-30 to +85</td>
<td>53</td>
<td>6.35</td>
<td>6.9</td>
<td>10</td>
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<tr>
<td>mV/Pa</td>
<td>0.25</td>
<td>3.15 - 70 k</td>
<td>2 - 20</td>
<td>60 dB(A) to 184 dB</td>
<td>8</td>
<td>-30 to +85</td>
<td>53</td>
<td>6.35</td>
<td>6.9</td>
<td>8</td>
</tr>
<tr>
<td>mV/Pa</td>
<td>18</td>
<td>4 - 20 k</td>
<td>2 - 20</td>
<td>25 dB(A) to 147 dB</td>
<td>8</td>
<td>-30 to +85</td>
<td>53</td>
<td>6.35</td>
<td>6.9</td>
<td>8</td>
</tr>
</tbody>
</table>
**CCP MICROPHONE SETS**

### PRESSURE

**GRAS 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. A front-vented version is available, 46DD-FV.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
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<tr>
<td>46DD</td>
<td>0.8</td>
<td>6.5 - 140 kHz*</td>
<td>2 - 20</td>
<td>52 dB(A) to 174 dB</td>
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<td>-30 to +85</td>
<td>64</td>
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<tr>
<td>46DE</td>
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<td>6.5 - 140 kHz*</td>
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<td>52 dB(A) to 174 dB</td>
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<td>-30 to +85</td>
<td>38.2</td>
<td>3.2</td>
<td>3.5</td>
<td>7</td>
</tr>
</tbody>
</table>

* ±3 dB.

### EXTERNALLY POLARIZED MEASUREMENT MICROPHONES

#### FREE-FIELD

**GRAS 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.

**GRAS 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.

<table>
<thead>
<tr>
<th>Designation</th>
<th>Size</th>
<th>Application</th>
<th>Sensitivity</th>
<th>Dynamic Range</th>
<th>Frequency Range</th>
<th>Polarization Voltage</th>
<th>IEC 61094 Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>40AF</td>
<td>12.7 (1/2”)</td>
<td>Free-field</td>
<td>50</td>
<td>14 - 149</td>
<td>3.15 - 20 k</td>
<td>200</td>
<td>WS2F</td>
</tr>
<tr>
<td>40AC</td>
<td>12.7 (1/2”)</td>
<td>Free-field</td>
<td>12.5</td>
<td>20 - 164</td>
<td>3.15 - 40 k</td>
<td>200</td>
<td>WS2F</td>
</tr>
</tbody>
</table>

Units mm (housing) mV/Pa Hz dB re. 20 µPa V
### Externally Polarized Measurement Microphones

#### Free-field, Random Incidence and Pressure

<table>
<thead>
<tr>
<th>Microphone</th>
<th>Description</th>
<th>Application</th>
<th>Sensitivity</th>
<th>Dynamic Range</th>
<th>Frequency Range</th>
<th>Polarization Voltage</th>
<th>IEC 61094 Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>GRAS 40AN</td>
<td>1/2” Free-field Microphone, Low Frequency</td>
<td>Free-field</td>
<td>50</td>
<td>14 - 149</td>
<td>0.5 - 20 k</td>
<td>200</td>
<td>WS2F</td>
</tr>
<tr>
<td>GRAS 40BF</td>
<td>1/4” Free-field Microphone</td>
<td>Free-field</td>
<td>4</td>
<td>30 - 172</td>
<td>4 - 100 k</td>
<td>200</td>
<td>WS3F</td>
</tr>
<tr>
<td>GRAS 40AU-1</td>
<td>1/2” Reference Pressure Microphone</td>
<td>Pressure</td>
<td>12.5</td>
<td>20 - 160</td>
<td>3.15 - 20 k</td>
<td>200</td>
<td>LS2P</td>
</tr>
<tr>
<td>GRAS 40AR</td>
<td>1/2” Random Incidence Microphone</td>
<td>Random</td>
<td>50</td>
<td>14 - 149</td>
<td>3.15 - 12.5 k</td>
<td>200</td>
<td>WS2P/D</td>
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<tr>
<td>GRAS 40EN</td>
<td>1” Pressure Microphone</td>
<td>Pressure</td>
<td>50</td>
<td>9.6 - 146</td>
<td>2.6 - 8 k</td>
<td>200</td>
<td>WS1P</td>
</tr>
</tbody>
</table>

#### Technical Specifications

- **40AN** 12.7 (1/2”) Free-field Microphone

  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 26HG 1/4” preamplifier in order to obtain the low frequency response.

- **40BF** 6.35 (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 of 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.

- **40AU-1** 12.7 (1/2”) Pressure Microphone

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

- **40AR** 12.7 (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 fulfills the requirements of ANSI standard S1.4.

- **40EN** 23.77 (1”) Pressure Microphone

  High precision microphone for laboratory work. Ideal for measurements in couplers, e.g. the RA0075 NBS 9-A 6cc Coupler for testing earphones according to ANSI S3.7 – 1995 and RA0113 which is a 2cc IEC 60318-5 (60126) Coupler. Can also be flush mounted to measure sound pressures on walls and boundaries.
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. A front-vented version is available, 40BP-FV.

GRAS 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 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 up to 20 kHz.

GRAS 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 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.

### Externally Polarized Measurement Microphones

<table>
<thead>
<tr>
<th>Size</th>
<th>Application</th>
<th>Sensitivity</th>
<th>Dynamic Range</th>
<th>Frequency Range</th>
<th>Polarization Voltage</th>
<th>IEC 61094 Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>40AG</td>
<td>Pressure</td>
<td>12.5</td>
<td>25 - 160</td>
<td>3.15 - 20 k</td>
<td>200</td>
<td>WS2P</td>
</tr>
<tr>
<td>40BP</td>
<td>Pressure</td>
<td>1.6</td>
<td>34 - 169</td>
<td>4 - 70 k</td>
<td>200</td>
<td>WS3P</td>
</tr>
<tr>
<td>40AP</td>
<td>Pressure</td>
<td>50</td>
<td>16 - 149</td>
<td>3.15 - 10 k</td>
<td>200</td>
<td>WS2P</td>
</tr>
<tr>
<td>40BH</td>
<td>Pressure</td>
<td>0.4</td>
<td>54 - 193</td>
<td>10 - 20 k</td>
<td>200</td>
<td>WS3P</td>
</tr>
<tr>
<td>40DP</td>
<td>Pressure</td>
<td>1</td>
<td>49 - 178</td>
<td>6.5 - 140 k</td>
<td>200</td>
<td>-</td>
</tr>
</tbody>
</table>

Units: mm (housing) mV/Pa dB re. 20 µPa Hz V

GRAS 40AG
1/2” Pressure Microphone

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

GRAS 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. A front-vented version is available, 40AP-FV.

GRAS 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 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. A front-vented version is available, 40BP-FV.

GRAS 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 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 up to 20 kHz.

GRAS 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 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.
FREE-FIELD AND RANDOM INCIDENCE

**GRAS 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 setups.

**GRAS 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 it can measure sound levels up to 163 dB.

**GRAS 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 fulfills the requirements of ANSI standard S1.4.

**GRAS 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 26CG ¼” CCP preamplifier in order to obtain the low frequency response.

**GRAS 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 up to 168 dB. Ideal with CCP preamplifiers and for sound measurements at very high frequencies and levels. A front-vented version is available, 40BE-FV.

---

<table>
<thead>
<tr>
<th>Designation</th>
<th>Size</th>
<th>Application</th>
<th>Sensitivity</th>
<th>Dynamic Range</th>
<th>Frequency Range</th>
<th>Polarization Voltage</th>
<th>IEC 61094 Designation</th>
</tr>
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<tbody>
<tr>
<td>40AE</td>
<td>12.7 (1/2”)</td>
<td>Free-field</td>
<td>50</td>
<td>15 - 148</td>
<td>3.15 - 20 k</td>
<td>0</td>
<td>WS2F</td>
</tr>
<tr>
<td>40AM</td>
<td>12.7 (1/2”)</td>
<td>Free-field</td>
<td>14.5</td>
<td>20 - 163</td>
<td>3.15 - 31.5 k</td>
<td>0</td>
<td>WS2F</td>
</tr>
<tr>
<td>40AQ</td>
<td>12.7 (1/2”)</td>
<td>Random</td>
<td>50</td>
<td>16 - 148</td>
<td>3.15 - 12.5 k</td>
<td>0</td>
<td>WS2P/D</td>
</tr>
<tr>
<td>40AZ</td>
<td>12.7 (1/2”)</td>
<td>Free-field</td>
<td>50</td>
<td>14 - 148</td>
<td>0.5 - 20 k</td>
<td>0</td>
<td>WS2F</td>
</tr>
<tr>
<td>40BE</td>
<td>6.35 (1/4”)</td>
<td>Free-field</td>
<td>4</td>
<td>30 - 168</td>
<td>4 - 80 k</td>
<td>0</td>
<td>WS3F</td>
</tr>
</tbody>
</table>

Units: mm (housing) mV/Pa dB re. 20 µPa Hz V
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 it can measure sound pressure levels up 163 dB. A front-vented version is available, 40AD-FV.

A front-vented version is available, 40AO-FV.

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. A front-vented version is available, 40AD-FV.

A front-vented version is available, 40AO-FV.

A 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 70 kHz.

A front-vented version is available, 40BD-FV.

A 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 70 kHz.

A front-vented version is available, 40BD-FV.

A 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 70 kHz.

A front-vented version is available, 40BD-FV.

A 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 70 kHz.

A front-vented version is available, 40BD-FV.

A 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 70 kHz.

A front-vented version is available, 40BD-FV.

A 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 70 kHz.

A front-vented version is available, 40BD-FV.

A 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 70 kHz.

A front-vented version is available, 40BD-FV.

A 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 70 kHz.

A front-vented version is available, 40BD-FV.

A 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 70 kHz.

A front-vented version is available, 40BD-FV.
**GRAS 40AI**

1/2" Ext. Polarized Intensity Microphone Pair

A pair of 1/2" phase-matched Intensity Microphones as used in 40AK, but without spacers and adapters.

**Specifications**

<table>
<thead>
<tr>
<th>Specifications</th>
<th>40AI/40AK</th>
<th>40BI/40BI-S1</th>
<th>40GI/40GK</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
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<td>25</td>
<td>4</td>
<td>12.5</td>
<td>mV/Pa</td>
</tr>
<tr>
<td>Dynamic Range</td>
<td>20 - 157</td>
<td>35 - 172</td>
<td>27 - 163</td>
<td>dB re. 20 µPa</td>
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<td>Frequency Response</td>
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<td></td>
<td>Class 1</td>
<td>Class 2</td>
<td>Class 1</td>
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<td>Polarization Voltage</td>
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<td>200/0</td>
<td>0</td>
<td>V</td>
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<tr>
<td>Diameter</td>
<td>13.2</td>
<td>6.9</td>
<td>15.2</td>
<td>mm</td>
</tr>
</tbody>
</table>

**GRAS 40GI**

1/2" Prepolarized Intensity Microphone Pair

A pair of 1/2" prepolarized intensity microphones as used in 40GI, but without spacers and adapters.

**GRAS 40AK**

1/2" Ext. Polarized Intensity Microphone Kit

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

The microphones have a free-field response optimized for use in face-to-face configuration and a high sensitivity to enable low level measurements. As a pair, they fulfill 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 26AA 1/4" Preamplifier pair.

**GRAS 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 26AA 1/4" Preamplifiers. Used for measuring very high intensity levels which exceed the dynamic range of 1/2" intensity microphones (i.e. 40AI) or in situations where space is limited. The microphones have a free-field response optimized for use in face-to-face configuration. As a pair, they fulfill the phase requirements for Class 2 intensity microphones in accordance with IEC 61043.

The solid spacers are for 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 improves microphone protection even under the most adverse conditions. Included are two right-angled adapters and one straight adapter for use with the 26AA 1/4" Preamplifier Set. A prepolarized version is available, 40BI-S1.

**GRAS 40GK**

1/2" Prepolarized Intensity Microphone Kit

Complete kit of two phase-matched 1/2" prepolarized intensity microphones, solid spacers and adapters for a pair of 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 fulfill 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 26CB ¼" CCP preamplifiers are included.
Special Microphones

Special microphones are often required for applications where there are particular requirements surrounding the methods of measurements and configurations.

**Surface microphones** are for general purpose measurements on planar and curved surfaces, with a wide useful frequency range reaching up to 70 kHz and a large dynamic range topping at around 178 dB.

**Array microphones** are for situations where concurrent measurements are required at several points in an array.

For example in the analyses of:

- Sound fields
- Sound power
- Transients

Close manufacturing tolerances together with the advantages of TEDS provide GRAS array microphones with a high degree of interchangeability. This is a major advantage when they are used in multiples forming arrays and matrices. All have a coaxial SMB output connector.

**Flush-mount microphones** have very low installation height to fit the sensors into very confined spaces and narrow structures, e.g. in acoustic antennas and beams. With an installation height of less than 10 mm and thin coax wiring, the GRAS flush-mount series can be integrated into literally any design without sacrificing aerodynamic properties.

**Probe microphones** are for measurements in difficult or inaccessible situations, for example at high temperatures or in conditions of airflow. Their right-angled design makes them 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.

**Turbulence Screens** are for aeroacoustic testing in solid-walled wind tunnels. The hydrodynamic component of turbulence is attenuated up to 25 dB. Thereby the acoustic signals of interest can be identified and diagnosed with a reliable resolution.

**Ground array** microphone kits are developed for fixed-wing aircraft and rotorcraft flyover measurements in phased arrays, where the noise is mapped for research or approval purposes. They offer a practical alternative to the conventional upside-down microphone setup.

**Infra-sound microphones** have a very low low-frequency cut-off down to 0.09 Hz. They consist of a special microphone combined with a special pre-amplifier and a low-frequency adapter. To account for pressure variations close to 0 Hz, a special ambient pressure equalization system is used.

**GRAS hemisphere kits** are compliant with the ISO 3744, 3745 and 3746 (ANSI S12.54, S12.55, S12.56) standards for sound power measurements and accommodate for 4, 10 and 20 microphone positions.
**SURFACE MICROPHONES**

**Surface Microphones**

**GRAS 40LS**

**CCP Precision Surface Microphone**

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.

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**

<table>
<thead>
<tr>
<th></th>
<th>40LA</th>
<th>40LS</th>
<th>40PS-1</th>
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<tbody>
<tr>
<td>Nominal Sensitivity</td>
<td>0.5 mV/Pa</td>
<td>1.8 mV/Pa at 250 Hz</td>
<td>15 mV/Pa at 250 Hz</td>
</tr>
<tr>
<td>Frequency Range</td>
<td>10 Hz - 20 kHz (± 1 dB)</td>
<td>10 Hz - 20 kHz (± 1 dB)</td>
<td>10 Hz - 12 kHz (+1, -2 dB)</td>
</tr>
<tr>
<td></td>
<td>5 Hz - 70 kHz (± 3 dB)</td>
<td>5 Hz - 70 kHz (± 3 dB)</td>
<td>10 Hz - 20 kHz (+1, -6 dB)</td>
</tr>
<tr>
<td>Upper Limit of Dynamic Range</td>
<td>178 dB re. 20 µPa</td>
<td>167 dB re. 20 µPa</td>
<td>145 dB re. 20 µPa</td>
</tr>
<tr>
<td>Output connector</td>
<td>Microdot 10/32</td>
<td>Microdot 10/32</td>
<td>Microdot 10/32</td>
</tr>
<tr>
<td>Lower Limit of Dynamic Range</td>
<td>&lt; 56 dB(A) re. 20 µPa (thermal noise)</td>
<td>&lt; 46 dB(A) re. 20 µPa (thermal noise)</td>
<td>&lt; 27 dB(A) re. 20 µPa (thermal noise)</td>
</tr>
<tr>
<td>Temperature Range</td>
<td>-55 °C to +100 °C</td>
<td>-50 °C to +100 °C</td>
<td>-10 °C to +50 °C</td>
</tr>
<tr>
<td>Output Impedance</td>
<td>&lt; 50 Ω</td>
<td>&lt; 50 Ω</td>
<td>&lt; 50 Ω</td>
</tr>
<tr>
<td>Diameter (with fairing)</td>
<td>42 mm</td>
<td>42 mm</td>
<td>40 mm</td>
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<tr>
<td></td>
<td>(without fairing)</td>
<td>16.2 mm</td>
<td>12.5 mm</td>
</tr>
<tr>
<td>Thickness</td>
<td>2.5 mm</td>
<td>2.5 mm</td>
<td>2.8 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>3 g</td>
<td>3 g</td>
<td>1.5 g</td>
</tr>
<tr>
<td>Cable Length</td>
<td>1.5 m</td>
<td>1.5 m</td>
<td>2 m</td>
</tr>
<tr>
<td>Cable Diameter</td>
<td>1.1 mm</td>
<td>1.1 mm</td>
<td>1.1 mm</td>
</tr>
</tbody>
</table>
147EB is a rugged microphone set optimized for wheelhouse brake-noise measurements. It comes with a three-layer protection system that enables it to withstand the conditions in the wheelhouse during prolonged testing on public roads in all types of climate and weather. It is well protected against vibrations, humidity, dust, oil mists, and temperatures from -40 to 125°C.

* Easily replaceable windscreens provide added protection. See page 105. Visit www.gras.dk for further accessories.

<table>
<thead>
<tr>
<th>GRAS 147EB</th>
<th>CCP X-Rugged Microphone Set</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nominal Sensitivity</strong></td>
<td><strong>Frequency Response</strong></td>
</tr>
<tr>
<td>147EB</td>
<td>50</td>
</tr>
<tr>
<td><strong>Units</strong></td>
<td>mV/Pa</td>
</tr>
<tr>
<td>* After correction for the influence of the 1” grid</td>
<td></td>
</tr>
</tbody>
</table>

**PROBE MICROPHONES**

**GRAS 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.

It 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.

**GRAS 40SC**

**CCP Probe Microphone**

Similar to the 40SA in both size and performance but differs in the way it is powered. The GRAS 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 or 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.
### GRAS 47AX

**1/2” CCP Flush-Mount Microphone Set**

- **Nominal Sensitivity**: 12.5 mV/Pa at 250 Hz
- **Frequency Response**: 3.15 Hz - 20 kHz (± 2.0 dB)
- **Temperature**: -30 °C to + 70 °C (operation)
- **Static Pressure Coefficient**: -0.008 dB/kPa (250 Hz / 25 °C)
- **Dimensions**: Diameter: Microphone: 12 mm - Preamplifier: 18 mm
- **Height of Microphone Set**: With grid: 9.2 mm / Without grid: 8 mm
- **Weight**: 9 g

### GRAS 47BX

**1/4” CCP Flush-Mount Microphone Set**

- **Nominal Sensitivity**: 1.6 mV/Pa at 250 Hz
- **Frequency Response**: 4 Hz - 70 kHz (± 1.0 dB)
- **Temperature**: -30 °C to + 70 °C (operation)
- **Static Pressure Coefficient**: -0.008 dB/kPa (250 Hz / 25 °C)
- **Dimensions**: Diameter: Microphone: 3 mm - Preamplifier: 12 mm
- **Height of Microphone Set**: With grid: 9.4 mm / Without grid: 9 mm
- **Weight**: 7.5 g

### GRAS 47AD

**1/2” CCP Flush-mount Microphone Set**

- **Nominal Sensitivity**: 50 mV/Pa at 250 Hz
- **Frequency Response**: 3.15 Hz - 10 kHz (± 2.0 dB)
- **Temperature**: -30 °C to + 70 °C (operation)
- **Static Pressure Coefficient**: -0.008 dB/kPa (250 Hz / 25 °C)
- **Dimensions**: Diameter: Microphone: 12 mm - Preamplifier: 18 mm
- **Height of Microphone Set**: With grid: 9.2 mm / Without grid: 8 mm
- **Weight**: 9 g

### GRAS 47DX

**1/8” CCP Flush-mount Microphone Set**

- **Nominal Sensitivity**: 0.9 mV/Pa at 250 Hz
- **Frequency Response**: 12.5 Hz - 7 kHz (± 1.0 dB)
- **Temperature**: -30 °C to + 70 °C (operation)
- **Static Pressure Coefficient**: -0.008 dB/kPa (250 Hz / 25 °C)
- **Dimensions**: Diameter: Microphone: 3 mm - Preamplifier: 12 mm
- **Height of Microphone Set**: With grid: 9.4 mm / Without grid: 9 mm
- **Weight**: 4 g

---

Identical to 47AX, but with higher sensitivity - see specifications below.
67TS-1-CL Turbulence Screen Kit is designed for aero-acoustic testing in solid-walled wind tunnels. The hydrodynamic component of turbulence is attenuated up to 25 dB. Thereby the acoustic signals of interest can be identified and diagnosed with a reliable resolution. The 47BX-CL 1/4” CCP Flush-mount Microphone Set is included.

67TS Turbulence Screen Kit is identical to the 67TS-1-CL, but without microphone.

The GRAS ground array kits are 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. They are based on customized versions of the 47AX or 47AD flush-mount pressure microphone set, integrated into a Ø40 cm POM plate, which is easy to position and calibrate in the field.

Includes the GRAS 47AX-S1 1/2” CCP Flush-mount Microphone Set, which is a rear-vented version of 47AX.

See specifications for 47AX on page 26.

Includes the GRAS 47AD-S1 1/2” Flush-mount Microphone Set, which is a rear-vented version of 47AD.

See specifications for 47AD on page 26.
GRAS 40PH

CCP 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 150 dB. Its integrated CCP preamplifier and built-in TEDS enables it to be used with TEDS compatible input modules.

GRAS 40PL

CCP 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.

GRAS 40PP

CCP Free-field QC Microphone

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.

GRAS 40PK

CCP Free-field QC Microphone, Short

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.

### Specifications

<table>
<thead>
<tr>
<th>Specifications</th>
<th>40PH</th>
<th>40PL</th>
<th>40PP</th>
<th>40PK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity at 250 Hz</td>
<td>50 mV/Pa (nominal)</td>
<td>10 mV/Pa (nominal)</td>
<td>50 mV/Pa (nominal)</td>
<td>18 mV/Pa (nominal)</td>
</tr>
<tr>
<td>Dynamic Range</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower limit</td>
<td>&lt; 32 dB(A) re. 20 µPa</td>
<td>&lt; 32 dB(A) re. 20 µPa</td>
<td>&lt; 32 dB(A) re. 20 µPa</td>
<td>&lt; 26 dB(A) re. 20 µPa</td>
</tr>
<tr>
<td>Upper limit</td>
<td>135 dB re. 20 µPa</td>
<td>150 dB re. 20 µPa</td>
<td>128 dB re. 20 µPa</td>
<td>145 dB re. 20 µPa</td>
</tr>
<tr>
<td>Frequency Range</td>
<td>± 1 dB</td>
<td>± 2 dB</td>
<td>± 3 dB</td>
<td>± 3 dB</td>
</tr>
<tr>
<td>± 1 dB</td>
<td>50 Hz - 5 kHz</td>
<td>50 Hz - 5 kHz</td>
<td>20 Hz - 10 kHz</td>
<td>-</td>
</tr>
<tr>
<td>± 2 dB</td>
<td>5 kHz - 20 kHz</td>
<td>5 kHz - 20 kHz</td>
<td>10 Hz - 20 Hz, 10 kHz - 20 kHz</td>
<td>10 Hz - 10 kHz</td>
</tr>
<tr>
<td>± 3 dB</td>
<td>10 Hz - 50 Hz</td>
<td>10 Hz - 50 Hz</td>
<td>10 kHz - 20 kHz</td>
<td>10 kHz - 20 kHz</td>
</tr>
<tr>
<td>Output Impedance</td>
<td>&lt; 50 Ω</td>
<td>&lt; 50 Ω</td>
<td>&lt; 50 Ω</td>
<td>&lt; 50 Ω</td>
</tr>
</tbody>
</table>
Low-frequency microphone especially designed for infrasound measurements. Frequency range from 0.5 Hz to 20 kHz. Use the dedicated GRAS 26CG 1/4” CCP preamplifier in order to obtain the low frequency response.

High sensitivity microphone ideal for measuring sound at frequencies down to 0.5 Hz. This microphone is the obvious choice for infra-sound measurement. It has built-in TEDS and a 7-pin LEMO connector.

Low frequency microphone especially designed for infrasound measurements. Frequency range from 0.5 Hz to 20 kHz. Use the dedicated GRAS 26CG 1/4” CCP preamplifier in order to obtain the low frequency response.

47AC is a 1/2” CCP free-field microphone set optimized for infra-sound measurements down to 0.09 Hz.

### Specifications

<table>
<thead>
<tr>
<th>Specifications</th>
<th>46AN</th>
<th>46AZ</th>
<th>47AC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>12.7 (1/2”) mm (housing)</td>
<td>12.7 (1/2”) mm (housing)</td>
<td>12.7 (1/2”) mm (housing)</td>
</tr>
<tr>
<td>Application</td>
<td>Free-field</td>
<td>Free-field</td>
<td>Free-field</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>50 mV/pa</td>
<td>50 mV/pa</td>
<td>8 mV/pa</td>
</tr>
<tr>
<td>Dynamic Range</td>
<td>17 dB(A) - 149 dB re 20 µPa</td>
<td>17 dB(A) - 138 dB re 20 µPa</td>
<td>20 dB(A) - 148 dB re 20 µPa</td>
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<tr>
<td>Frequency Range</td>
<td>0.5 Hz - 20 kHz</td>
<td>0.5 Hz - 20 kHz</td>
<td>0.09 Hz - 20 kHz</td>
</tr>
<tr>
<td>Polarization voltage</td>
<td>200 V</td>
<td>0 V</td>
<td>0 V</td>
</tr>
<tr>
<td>IEC 61094 designation</td>
<td>WS2F</td>
<td>WS2F</td>
<td>WS2F</td>
</tr>
</tbody>
</table>
The GRAS 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 GRAS 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.
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.

Today there are 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 which has become an industry standard. It is voltage driven and can handle high voltage signals up to 50 Vpeak.

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 Vpeak, 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 GRAS was the first in the world to introduce 1/4” and 1/8” prepolarized microphones.

GRAS 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 GRAS 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 effect of elevated temperature is a slight increase in the 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 & Kjær), Isotron® (Endevco Corp.), ICP® (PCB Group, Inc.).
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. Cable (not included) is available in various lengths (see under Accessories).

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).

General purpose preamplifier with an integrated 7-pin LEMO connector. Includes built-in SysCheck facility for enabling easy system checks to be made. Also available in a 1/4" version, 26AL. It looks like 26AN on page 33. Data are listed below.

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

Specifications

<table>
<thead>
<tr>
<th></th>
<th>26AH, AM</th>
<th>26AG, A3, AK</th>
<th>26AL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range</td>
<td>2.5 Hz - 200 kHz (± 0.2 dB)</td>
<td>2.5 Hz - 200 kHz (± 0.2 dB)</td>
<td>2.5 Hz - 200 kHz (± 0.2 dB)</td>
</tr>
<tr>
<td>Input Impedance</td>
<td>20 GΩ, 0.4 pF</td>
<td>20 GΩ, 0.4 pF</td>
<td>20 GΩ, 0.4 pF</td>
</tr>
<tr>
<td>Output Impedance (typical)</td>
<td>75 Ω</td>
<td>75 Ω</td>
<td>75 Ω</td>
</tr>
<tr>
<td>Output Connector</td>
<td>7-pin LEMO male</td>
<td>7-pin LEMO male</td>
<td>7-pin LEMO male</td>
</tr>
<tr>
<td>Power Supply, Single</td>
<td>28 V, 0.7 mA to 120 V, 2.5 mA</td>
<td>28 V, 0.7 mA to 120 V, 2.5 mA</td>
<td>28 V, 0.7 mA to 120 V, 2.5 mA</td>
</tr>
<tr>
<td>Power Supply, Dual</td>
<td>±14 V, 0.7 mA to ± 60 V, 2.5 mA</td>
<td>±14 V, 0.7 mA to ± 60 V, 2.5 mA</td>
<td>±14 V, 0.7 mA to ± 60 V, 2.5 mA</td>
</tr>
<tr>
<td>Noise; A-weighted</td>
<td>≤ 2.5 µVrms (typically 1.8 µV)</td>
<td>≤ 2.5 µVrms (typically 1.8 µV)</td>
<td>≤ 2.5 µVrms (typically 1.8 µV)</td>
</tr>
<tr>
<td>Noise; linear (20 Hz - 20 kHz)</td>
<td>≤ 6 µVrms (typically 3.5 µV)</td>
<td>≤ 6 µVrms (typically 3.5 µV)</td>
<td>≤ 6 µVrms (typically 3.5 µV)</td>
</tr>
<tr>
<td>Gain</td>
<td>-0.25 dB (typical)</td>
<td>-0.35 (typical)</td>
<td>-0.29 dB (typical)</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-30 °C to +70 °C</td>
<td>-30 °C to +70 °C</td>
<td>-30 °C to +70 °C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-40 °C to +85 °C</td>
<td>-40 °C to +85 °C</td>
<td>-40 °C to +85 °C</td>
</tr>
</tbody>
</table>
1/4” LEMO PREAMPLIFIERS

GRAS 26AR
1/4” LEMO Preamplifier, 4-pin mini-LEMO

General purpose 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. To be used with Cable AA0057.

GRAS 26BR
1/4” LEMO Preamplifier

GRAS 26AN
1/4” LEMO Insert Voltage Preamplifier

Preampifier with 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 GRAS 1/2” microphones. Cable is not included.

GRAS 26AC-1
1/4” LEMO Preamplifier with Integrated 5-pin Miniconnector

GRAS 26AS
1/4” LEMO Preamplifier, Very Short

Preampifier 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.

GRAS 26HG
1/4” LEMO Preamplifier, Low Frequency

Similar to 26AC but with 40 GΩ input impedance to enable low level and low frequency measurements. It has a 3 m integrated cable.

Specifications

<table>
<thead>
<tr>
<th>Specifications</th>
<th>26AR</th>
<th>26AB, 26AN // 26AC-1</th>
<th>26HG</th>
<th>26AS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range</td>
<td>2.5 Hz - 200 kHz (± 0.2 dB)</td>
<td>2 Hz - 200 kHz (± 0.2 dB)</td>
<td>1 Hz - 200 kHz (± 0.2 dB)</td>
<td>2.5 Hz - 200 kHz (± 0.2 dB)</td>
</tr>
<tr>
<td>Input Impedance</td>
<td>20 GΩ, 0.4 pF</td>
<td>20 GΩ, 0.4 pF</td>
<td>40 GΩ, 0.4 pF</td>
<td>20 GΩ, 0.4 pF</td>
</tr>
<tr>
<td>Output Impedance</td>
<td>75 Ω</td>
<td>55 Ω</td>
<td>75 Ω</td>
<td>75 Ω</td>
</tr>
<tr>
<td>Output Connector</td>
<td>4-pin LEMO male mini</td>
<td>7-pin LEMO male // 5-pin LEMO male</td>
<td>7-pin LEMO male</td>
<td>7-pin LEMO male</td>
</tr>
<tr>
<td>Power Supply, Single</td>
<td>28 V, 0.7 mA to 120 V, 2.5 mA</td>
<td>28 V, 0.7 mA to 120 V, 2.5 mA</td>
<td>28 V, 0.7 mA to 120 V, 2.5 mA</td>
<td>28 V, 0.7 mA to 120 V, 2.5 mA</td>
</tr>
<tr>
<td>Power Supply, Dual</td>
<td>±14 V, 0.7 mA to ± 60 V, 2.5 mA</td>
<td>±14 V, 0.7 mA to ± 60 V, 2.5 mA</td>
<td>±14 V, 0.7 mA to ± 60 V, 2.5 mA</td>
<td>±14 V, 0.7 mA to ± 60 V, 2.5 mA</td>
</tr>
<tr>
<td>Noise: A-weighted</td>
<td>0.5 Vrms (typically 1.8 μV)</td>
<td>0.5 Vrms (typically 1.5 μV)</td>
<td>0.5 Vrms (typically 1.5 μV)</td>
<td>0.5 Vrms (typically 1.5 μV)</td>
</tr>
<tr>
<td>Noise: lin. (20 Hz - 20 kHz)</td>
<td>10 (typically 8)</td>
<td>10 (typically 8)</td>
<td>10 (typically 8)</td>
<td>10 (typically 8)</td>
</tr>
<tr>
<td>Gain</td>
<td>-0.5 dB (typical)</td>
<td>-0.29 dB (typical)</td>
<td>-0.5 dB (typical)</td>
<td>-0.29 dB (typical)</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>-30 °C to +70 °C</td>
<td>-30 °C to +70 °C</td>
<td>-30 °C to +70 °C</td>
<td>-30 °C to +70 °C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-40 °C to +85 °C</td>
<td>-40 °C to +85 °C</td>
<td>-40 °C to +85 °C</td>
<td>-40 °C to +85 °C</td>
</tr>
</tbody>
</table>
**Preamplifiers**

**GRAS 26CA**

1" CCP Preamplifier with BNC Connector

- 26CA is a CCP preamplifier with integrated BNC connector. For use with 1" 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.
- A high-temperature version is available, 26CA-HT.

**GRAS 26CK**

1" CCP Preamplifier, Very Short

- 26CK 1" Preamplifier is a very small preamplifier with Microdot connector. The 26CK has a very low inherent noise level, a large dynamic range, and a frequency response from 2.5 Hz to above 200 kHz.

**GRAS 26CF**

1" CCP Preamplifier with Gain and Filters

- 26CF is a CCP preamplifier with integrated BNC connector for use with 1" prepolarized microphones and standard constant-current input devices. It 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.

**GRAS 26CI**

1" CCP Preamplifier with BNC Connector, Low Frequency

- 26CI is optimized for low frequency use with prepolarized condenser microphones. It uses a CCP power supply (ICP ®), e.g. 12AL. It has a very low inherent noise level, a large dynamic range and a frequency response from 1 Hz to above 200 kHz.

---

### Specifications

<table>
<thead>
<tr>
<th>Specifications</th>
<th>26CA</th>
<th>26CA-HT</th>
<th>26CF</th>
<th>26CK</th>
<th>26CI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency Range</strong></td>
<td>2.5 Hz - 200 kHz ± 0.2 dB</td>
<td>2.5 Hz - 200 kHz ± 0.2 dB</td>
<td>2.5 Hz - 200 kHz ± 0.2 dB</td>
<td>2.5 Hz - 200 kHz ± 0.2 dB</td>
<td>1 Hz - 200 kHz ± 0.2 dB</td>
</tr>
<tr>
<td><strong>Input Impedance</strong></td>
<td>20 GΩ, 0.4 pF</td>
<td>20 GΩ, 0.4 pF</td>
<td>20 GΩ, 0.4 pF</td>
<td>20 GΩ, 0.4 pF</td>
<td>40 GΩ, 0.4 pF</td>
</tr>
<tr>
<td><strong>Output Impedance</strong></td>
<td>50 Ω</td>
<td>50 Ω</td>
<td>50 Ω</td>
<td>50 Ω</td>
<td>50 Ω</td>
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<tr>
<td><strong>Output Connector</strong></td>
<td>BNC</td>
<td>BNC</td>
<td>BNC</td>
<td>BNC</td>
<td>BNC</td>
</tr>
<tr>
<td><strong>Power Supply</strong></td>
<td>2 mA to 20 mA (typ. 4 mA)</td>
<td>2 mA to 20 mA (typ. 4 mA)</td>
<td>4 mA to 20 mA (typ. 4 mA)</td>
<td>2 mA to 20 mA (typ. 4 mA)</td>
<td>2 mA to 20 mA (typ. 4 mA)</td>
</tr>
<tr>
<td><strong>Noise A-weighted</strong></td>
<td>≤ 2.5 μVrms (typ. 2.0 μV)</td>
<td>≤ 2.5 μVrms (typ. 2.0 μV)</td>
<td>≤ 2.5 μVrms</td>
<td>≤ 2.5 μVrms</td>
<td>≤ 2.5 μVrms</td>
</tr>
<tr>
<td><strong>Noise Linear</strong></td>
<td>≤ 6 μVrms (typ. 3.5 μV)</td>
<td>≤ 6 μVrms (typ. 3.5 μV)</td>
<td>Typically 8 μVrms (built-in A-weighting)</td>
<td>≤ 6 μVrms</td>
<td>≤ 6 μVrms</td>
</tr>
<tr>
<td><strong>Gain (Typically)</strong></td>
<td>-0.3 dB</td>
<td>-0.3 dB</td>
<td>-0.35 dB</td>
<td>-0.35 dB</td>
<td>-0.35 dB</td>
</tr>
<tr>
<td><strong>Operating Temp.</strong></td>
<td>-30 °C to +85 °C</td>
<td>-30 °C to +120 °C</td>
<td>-30 °C to +85 °C</td>
<td>-30 °C to +85 °C</td>
<td>-30 °C to +85 °C</td>
</tr>
<tr>
<td><strong>Storage Temp.</strong></td>
<td>-40 °C to +85 °C</td>
<td>-40 °C to +85 °C</td>
<td>-40 °C to +85 °C</td>
<td>-40 °C to +85 °C</td>
<td>-40 °C to +85 °C</td>
</tr>
</tbody>
</table>

---

\[\text{Return to contents} \quad \text{Return to index}\]
## GRAS 26CB
### 1/4” CCP Preamplifier

26CB is a CCP preamplifier with integrated Microdot connector for use with 1/4” prepolarized microphones. It includes built-in TEDS which enables it to be programmed as a complete unit together with a microphone. A high-temperature version is available, 26CB-HT.

## GRAS 26CG
### 1/4” CCP Preamplifier

26CG is a CCP preamplifier with integrated Microdot connector for use with 1/4” prepolarized microphones. It includes built-in TEDS which enables it to be programmed as a complete unit together with a microphone.

## GRAS 26CC
### 1/4” CCP Preamplifier

26CC is a CCP preamplifier with integrated SMB connector. For use with 1/4” prepolarized microphones. For direct use on GRAS 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.

## GRAS 26CS
### 1/4” CCP Preamplifier, Very Short

26CS has 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 45CA Hearing-protector Test Fixture.

### Specifications

<table>
<thead>
<tr>
<th>Specifications</th>
<th>26CB</th>
<th>26CB-HT</th>
<th>26CC</th>
<th>26CG</th>
<th>26CS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range</td>
<td>2.5 Hz - 200 kHz (± 0.2 dB)</td>
<td>2.5 Hz - 200 kHz (± 0.2 dB)</td>
<td>2.5 Hz - 200 kHz (± 0.2 dB)</td>
<td>1 Hz - 200 kHz</td>
<td>2 Hz - 200 kHz</td>
</tr>
<tr>
<td>Input Impedance</td>
<td>20 GΩ, 0.4 pF</td>
<td>20 GΩ, 0.4 pF</td>
<td>20 GΩ, 0.4 pF</td>
<td>40 GΩ, 0.4 pF</td>
<td>20 GΩ, 0.4 pF</td>
</tr>
<tr>
<td>Output Impedance</td>
<td>&lt; 50 Ω</td>
<td>&lt; 50 Ω</td>
<td>&lt; 50 Ω</td>
<td>&lt; 55 Ω</td>
<td>&lt; 50 Ω</td>
</tr>
<tr>
<td>Output Connector</td>
<td>Microdot</td>
<td>Microdot</td>
<td>SMB</td>
<td>Microdot</td>
<td>Microdot</td>
</tr>
<tr>
<td>Power Supply</td>
<td>2 mA to 20 mA (typ. 4 mA)</td>
<td>2 mA to 20 mA (typ. 4 mA)</td>
<td>2 mA to 20 mA (typ. 4 mA)</td>
<td>2 mA to 20 mA (typ. 4 mA)</td>
<td>2 mA to 20 mA (typ. 4 mA)</td>
</tr>
<tr>
<td>Noise A-weighted</td>
<td>≤ 2.5 µVrms (typ. 1.8 µV)</td>
<td>≤ 2.5 µVrms (typ. 1.8 µV)</td>
<td>≤ 2.5 µVrms (typ. 2.0 µV)</td>
<td>≤ 2.5 µVrms (typ. 1.5 µV)</td>
<td>≤ 2.5 µVrms</td>
</tr>
<tr>
<td>Noise linear</td>
<td>≤ 6 µVrms (typ. 3.5 µV)</td>
<td>≤ 6 µVrms (typ. 3.5 µV)</td>
<td>≤ 6 µVrms (typ. 3.5 µV)</td>
<td>≤ 6 µVrms (typ. 3.5 µV)</td>
<td>≤ 6 µV</td>
</tr>
<tr>
<td>Gain (Typically)</td>
<td>-0.35 dB</td>
<td>-0.35 dB</td>
<td>-0.35 dB</td>
<td>-0.35 dB</td>
<td>-0.45 dB</td>
</tr>
<tr>
<td>Operating Temp.</td>
<td>-30 °C to +85 °C</td>
<td>-30 °C to +120 °C</td>
<td>-30 °C to +85 °C</td>
<td>-30 °C to +85 °C</td>
<td>-30 °C to +85 °C</td>
</tr>
<tr>
<td>Storage Temp.</td>
<td>-40 °C to +85 °C</td>
<td>-40 °C to +85 °C</td>
<td>-40 °C to +85 °C</td>
<td>-40 °C to +85 °C</td>
<td>-40 °C to +85 °C</td>
</tr>
</tbody>
</table>
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, center prong.

GRAS outdoor microphones are available in the following two versions:

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

GRAS 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.
**GRAS 41AM**

Outdoor Microphone, 0° incidence

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

GRAS 41AM is fitted with a GRAS 41AS 1/2” microphone for measurements at 0° incidence and is optimized for use with its windscreen and rain protection.

**GRAS 41CN**

Outdoor Microphone, 90° incidence

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

GRAS 41CN is fitted with a special GRAS 1/2” microphone for measurements at 90° incidence and is optimized for use with its windscreen and rain protection.

**Included:**
- AM0052 Windscreen incl. birdspike
- AM0052 Transport protection cap
- AM0038 Spanner
- AM0029 Pole adapter
- AM0033 Tripod adapter
- AE0001 LEMO plug

**Accessories available:**
- AC0001 Adapter box
- RA0009 Pistonphone adapter 41AM
- RA0041 Pistonphone adapter 41CN
- AM0009 Set of 5 foam windscreens

**Cables:**
- AA0003 3 m
- AA0002 10 m
- AA0015 100 m on cable drum
- AA0016 200 m on cable drum

### Specifications

<table>
<thead>
<tr>
<th>Specifications</th>
<th>41AM and 41CN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>50 mV/Pa (unified)</td>
</tr>
<tr>
<td>Dynamic Range</td>
<td>20 – 136 dB re. 20 µPa / 38 – 156 dB re. 20 µPa (-20 dB gain)</td>
</tr>
<tr>
<td>Frequency Response</td>
<td>IEC 60651 type 0 / ANSI S1.4 - 1983 type 0 / IEC 61672 Class 1</td>
</tr>
<tr>
<td>Power supply</td>
<td>12 – 18 VDC</td>
</tr>
<tr>
<td>Cal. level of electrostatic actuator</td>
<td>90 dB at 1000 Hz</td>
</tr>
<tr>
<td>Output connector</td>
<td>6-pin LEMO</td>
</tr>
<tr>
<td>Pole adapter</td>
<td>50 mm (1.97”) G 11/2” (ISO 228/1)</td>
</tr>
<tr>
<td>Reference direction 41AM</td>
<td>0° (vertical for airport noise)</td>
</tr>
<tr>
<td>Reference direction 41CN</td>
<td>90° (horizontal for community noise)</td>
</tr>
</tbody>
</table>
The 41AC is a small and handy precision outdoor 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, 41AC is available in three versions.

**41AC Configurations**

**GRAS 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.

**GRAS 41AC-3**  
CCP Outdoor Microphone for Community & Airport Noise. With CCP connection and built-in TEDS for easy identification and system setup.

**GRAS 41AC-4**  
LEMO Outdoor Microphone for Community and Airport Noise (0 V pol.)  
41AC-4 uses a prepolarized microphone with a LEMO type preamplifier.

All three kits include tripod and pole-mount options and are delivered with individual calibration and correction data.

*Additional windscreen, AM0378, is available as a separate item.*

<table>
<thead>
<tr>
<th>Specifications</th>
<th>41AC-2, 41AC-3 &amp; 41AC-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>50 mV/Pa (nominal)</td>
</tr>
<tr>
<td>Dynamic Range</td>
<td>17 - 144 dB re. 20 µPa</td>
</tr>
<tr>
<td>Frequency Range</td>
<td>5 Hz - 10 kHz</td>
</tr>
<tr>
<td>Compliance</td>
<td>IEC 61672 Class 1</td>
</tr>
<tr>
<td>Polarization Voltage</td>
<td>200 V (41AC-2); 0 V (41AC-3 &amp; 4)</td>
</tr>
<tr>
<td>Connector Type</td>
<td>7-pin LEMO (41AC-2 &amp; 4); BNC (41AC-3)</td>
</tr>
<tr>
<td>Microphone Type and Reference Direction</td>
<td>See text above</td>
</tr>
</tbody>
</table>
Low-noise Measuring Systems

Normal measurement microphones have a very wide dynamic range and cover most practical applications. There are however special situations where special microphones are required e.g. the measurements of very low sound pressure levels. Normal measurement microphones have a noise floor around 10 dB(A) re. 20 µPa 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 low-noise 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, and therefore the GRAS 40HH and GRAS 40HF must be used together with the GRAS 12HF low-noise system power supply. To avoid damaging traditional microphone preamplifier supplies, the 7-pin LEMO on the low-noise preamplifier is different from the 7-pin LEMO normally used for microphone preamplifiers.

The very high sensitivity of low-noise 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 GRAS 42AA or GRAS 42AP is available to reduce the level from 114 dB to 94 dB.
**GRAS 40HF**

1” LEMO Low-noise Microphone System

40HF has a wide dynamic range that enables measurements from below -2 dB(A) to 110 dB re. 20 µPa from 10 Hz to 10 kHz.

It comprises the following two specially-designed and matched components:

- High sensitive 1” microphone
- Low-noise 1” microphone preamplifier

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

Accessory: RA0095 Dehumidifier for 1” microphone.

A dedicated power module is required (12HF or 12HM). The specifications given on page 43 are for such a complete system.

**GRAS 40HH**

1/2” LEMO Low-noise Microphone System

40HH has a wide dynamic range that enables measurements from below 6.5 dB(A) to 113 dB re. 20 µPa from 10 Hz to 20 kHz.

It comprises the following two specially-designed and matched components:

- High sensitive 1/2” microphone
- Low-noise 1/2” microphone preamplifier

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

Accessory: RA0095 Dehumidifier for 1” microphone.

A dedicated power module is required (12HF or 12HM). The specifications given on page 43 are for such a complete system.

**GRAS 40HT**

1/2” LEMO Low-noise Microphone System

For use in confined spaces. Otherwise, specifications similar to 40HH.

It comprises the following specially designed and matched components:

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

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

A dedicated power module is required (12HF or 12HM). The specifications given on page 43 are for such a complete system.
47HC 1/2” Low-noise Microphone System measures sound pressure levels down to close to the threshold of human hearing. It is thus generally suitable for sound-power measurements on even very quiet products. Its very wide dynamic range permits measurements down to below 6.5 dB re. 20 μPa (in 1/3-octave bands). 47HC has TEDS.

40HL 1/2” LEMO Low-noise Microphone System

Stand-alone low-noise 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 μPa within 10 Hz to 20 kHz.

- High sensitivity 1/2” microphone
- Low-noise 1/2” preamplifier with built-in TEDS

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

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**GRAS 47HC**

**1/2” CCP Low-noise Microphone System**

**GRAS 40HL**

**1/2” LEMO Low-noise Microphone System**

---

### Specifications

<table>
<thead>
<tr>
<th>Specifications</th>
<th>40HF</th>
<th>40HH</th>
<th>40HL</th>
<th>40HT</th>
<th>47HC</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal System Sensitivity</td>
<td>1.1</td>
<td>0.8</td>
<td>0.85</td>
<td>0.8</td>
<td>0.45</td>
<td>V/Pa</td>
</tr>
<tr>
<td>Frequency Range</td>
<td>12.5 - 4 k</td>
<td>12.5 - 10 k</td>
<td>12.5 - 10 k</td>
<td>12.5 - 10 k</td>
<td>Hz ± 1 dB</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10 - 10 k</td>
<td>10 - 16 k</td>
<td>10 - 16 k</td>
<td>10 - 16 k</td>
<td>Hz ± 2 dB</td>
<td></td>
</tr>
<tr>
<td>Dynamic Range Lower Limit</td>
<td>-2</td>
<td>6.5</td>
<td>6.5</td>
<td>6.5</td>
<td>6.5</td>
<td>dB(A) re. 20 μPa</td>
</tr>
<tr>
<td>Dynamic Range Upper Limit</td>
<td>110</td>
<td>113</td>
<td>110</td>
<td>113</td>
<td>100</td>
<td>dB peak</td>
</tr>
</tbody>
</table>
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 minimum 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 traveling in the direction from A to B. On the other hand, if it arrives first at microphone B, then it must be traveling in the opposite direction. In the case where it arrives at the two microphones at the same time, then it must be traveling 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 GRAS 40AI and GRAS 40BI intensity microphone pairs have been carefully manufactured and selected to have a 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 GRAS 50AI and GRAS 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 GRAS 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 below.
Intensity Probes

GRAS 50AI-Series Intensity Probes

50AI Intensity Probes comprise:

- GRAS 40AK 1/2" Intensity Microphone Set
- GRAS 26AA 1/4" Preamplifier 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 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.

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 01dB and Neutrix-Cortex. Can be used directly with the 12AB Intensity Power Module, which provides all necessary voltages for the remote-control functions and powering the preamplifiers; also enables direct use with 01dB Sound Intensity systems.

50AI-D is similar to version B, but uses an internal 9V battery (already fitted on delivery) for enabling its remote-control functions, i.e. Müller-BBM.

50AI-C can be connected directly to any analyzer with two standard 7-pin LEMO microphone-preamplifier inputs. Can be used with the following GRAS Power Modules:

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

Different adapter cables are available, see page 103.

<table>
<thead>
<tr>
<th>Specifications</th>
<th>50AI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microphone pair</td>
<td>40AK</td>
</tr>
<tr>
<td>Preamplifiers</td>
<td>2 x 26AA (with 4-pin LEMO FGG OB)</td>
</tr>
<tr>
<td>Frequency response &amp; phase matching</td>
<td>IEC 61043 Class 1</td>
</tr>
</tbody>
</table>

Different adapter cables are available, see page 103.
GRAS 50GI
CCP Intensity Probe

50GI CCP Intensity Probe comprises:

- A 40 GK 1/2" Prepolarized Intensity Microphone Set
- Two 26CB 1/4" CCP Preamplifiers 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.

GRAS 50GI-R
CCP Intensity Probe with Remote Control

50GI-R CCP Intensity Probe comprises

- A 40GK sound Intensity Microphone Pair
- Two 26CB CCP Microphone Preamplifiers
- Four solid spacers of various lengths
- Windscreen
- Probe handle with remote control.

50GI-R is delivered in a carrying case as a ready-to-use kit, complete with all the above accessories. The microphones are ½" 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.

<table>
<thead>
<tr>
<th>Specifications</th>
<th>50GI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microphone pair</td>
<td>40GK</td>
</tr>
<tr>
<td>Preamplifiers</td>
<td>2 x 26CB (with BNC/Microdot)</td>
</tr>
<tr>
<td>Frequency response &amp; phase matching</td>
<td>IEC 61043 Class 1</td>
</tr>
</tbody>
</table>
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.

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.

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

---

**Specifications**

<table>
<thead>
<tr>
<th>50GI-P</th>
<th>50GI-RP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microphone pairs</td>
<td>40GK-S1</td>
</tr>
<tr>
<td>Preamplifiers</td>
<td>26CC set</td>
</tr>
<tr>
<td>Spacers</td>
<td>12, 25 and 50 mm</td>
</tr>
<tr>
<td>Frequency response &amp; phase matching</td>
<td>IEC 61043 Class 1</td>
</tr>
</tbody>
</table>
50VI-1 is a three-dimensional flexible and adjustable sound-intensity probe. It includes the necessary pairs of phase-matched 40AI intensity microphones, 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.

The 12AC 6-Channel Power Module is recommended.

60LK is a 3-D Vector Probe Head with four 1/4” phase-matched measurement microphones arranged in a Ø30mm spherical shell.

The microphones are placed at the vertices of a tetrahedron. They span a three-dimensional space, and therefore appropriate mathematical operations allow the determination of the full sound intensity vector.

The microphones in each particular probe are computer selected from a large population of microphones to have the smallest possible phase and magnitude differences between all possible pairs of combinations.

To be used with AC0025 3 m LEMO 4-pin to 4 x BNC Adapter Cable for 60LK.
Pistonphones and Calibration Equipment

Calibration is an essential step in every precision sound 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 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 method 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 0 dB 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 reasonably 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 ±0.05 dB at reference conditions for the pistonphone.
42AA is a precision sound source for calibrating microphones, sound level meters and other sound measuring equipment.

It is battery-operated and produces a constant nominal sound pressure level of 114 dB re. 20 µPa (equivalent to 10 Pa) at 250 Hz, or 105.4 dB(A) re. 20 µPa. Each 42AA 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.

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.

42AC is a precision sound source for calibrating microphones, sound level meters and other sound measuring equipment at high levels. It is battery-operated and produces a constant nominal sound pressure level of 134 dB re. 20 µPa (equivalent to 100 Pa) at 250 Hz, or 125.4 dB(A) re. 20 µPa. Each 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.

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.

### Specifications

<table>
<thead>
<tr>
<th>Specifications</th>
<th>42AA</th>
<th>42AC</th>
<th>42AP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sound pressure level</td>
<td>114 dB (re. 20 µPa) ±0.08 dB</td>
<td>134 dB (re. 20 µPa) ±0.08 dB</td>
<td>114 dB (re. 20 µPa) ±0.05 dB</td>
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<tr>
<td>Frequency</td>
<td>250 Hz</td>
<td>250 Hz</td>
<td>250 Hz or 251.2 Hz</td>
</tr>
<tr>
<td>Temperature range</td>
<td>-10 °C to +55 °C</td>
<td>-10 °C to +55 °C</td>
<td>-10 °C to +55 °C</td>
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<td>4 x AA alkaline (IEC LR 6)</td>
<td>4 x AA alkaline (IEC LR 6)</td>
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<tr>
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<td>-</td>
<td>-</td>
<td>6V DC 125mA</td>
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<tr>
<td>Weight</td>
<td>325 g</td>
<td>325 g</td>
<td>437 g</td>
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</table>
GRAS 42AP

Intelligent Pistonphone

42AP is a battery-operated precision sound source for calibrating microphones, sound level meters and other sound measuring equipment. It 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 µPa (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.

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
- 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
- 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 part of the delivery.

GRAS 42AG

Multifunction Sound Calibrator

The 42AG Multifunction Sound Calibrator is a portable, battery-operated precision microphone calibrator. The calibrator can be used directly on 1” microphones. Adapters for calibrating 1/2” (factory mounted), 1/4” and 1/8” microphones are included. It can produce a sinusoidal signal of 250 Hz or 1 kHz at 94 dB or 114 dB.

The calibration level is virtually independent of ambient conditions like temperature, atmospheric pressure and humidity within the specified range of operation. For documentation purposes, 42AG provides display of the environmental conditions: ambient air pressure, and temperature.

42AG comes with adapters for all standard microphone sizes from 1” down to 1/8”.

<table>
<thead>
<tr>
<th>Specifications</th>
<th>42AG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sound pressure level</td>
<td>94 dB (± 0.2 dB) or 114 dB (± 0.2 dB)</td>
</tr>
<tr>
<td>Frequency</td>
<td>250 (251.19 ± 0.30 Hz) or 1 kHz (1000 ± 1 Hz)</td>
</tr>
<tr>
<td>Accuracy</td>
<td>IEC 60942 (1998) Class 1</td>
</tr>
<tr>
<td>Temperature range</td>
<td>-10 °C to +50 °C</td>
</tr>
<tr>
<td>Batteries</td>
<td>LR03 (AAA)</td>
</tr>
<tr>
<td>Weight</td>
<td>125 g</td>
</tr>
</tbody>
</table>
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.

42AE is delivered with various types of adapters for calibrating 1/8” to 1” microphones and preamplifiers. A power supply is included.

GRAS 42AE
Low Frequency Calibrator

GRAS 14AA
Electrostatic Actuator Amplifier

42AE

GRAS 14AA

Specifications

<table>
<thead>
<tr>
<th>Specifications</th>
<th>42AE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sound Pressure Level</td>
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</tr>
<tr>
<td>Frequency</td>
<td>&lt; 0.1 - 150 Hz</td>
</tr>
<tr>
<td>Signal Input (max)</td>
<td>0.7 Vrms</td>
</tr>
<tr>
<td>Calibration Signal</td>
<td>1 mV/Pa (140 dB max)</td>
</tr>
<tr>
<td>Weight</td>
<td>1.6 kg</td>
</tr>
</tbody>
</table>

Specifications

<table>
<thead>
<tr>
<th>Specifications</th>
<th>14AA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Signal (max)</td>
<td>3 V peak-to-peak</td>
</tr>
<tr>
<td>Gain</td>
<td>+ 40 dB</td>
</tr>
<tr>
<td>Output Signal (max)</td>
<td>300 V peak-to-peak</td>
</tr>
<tr>
<td>Actuator Polarization Voltage</td>
<td>800 V</td>
</tr>
<tr>
<td>Frequency Response</td>
<td>1 Hz - 200 kHz</td>
</tr>
<tr>
<td>Output Impedance</td>
<td>1 kΩ</td>
</tr>
<tr>
<td>Power Supply</td>
<td>110/130 V AC or 220/240 V AC</td>
</tr>
<tr>
<td>Weight</td>
<td>1.4 kg</td>
</tr>
</tbody>
</table>
Specifications

- **Input Connector**: BNC socket
- **Maximum input signal**: 1 V RMS
- **Frequency Range**: 50 Hz - 6.3 kHz
- **Frequency-intensity index**: >27 dB (nomin. 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

---

**GRAS 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 14AA Electrostatic Actuator Amplifier.

---

**GRAS RA0014–S1**

1/2” Electrostatic Actuator for 40AU-1

As RA0014, but with dimensions fitting 40AU-1.

---

**GRAS RA0015**

1” Electrostatic Actuator

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

---

**GRAS RA0010**

Calibration Stand

**GRAS RA0011**

Calibration Stand for IEC 60318-1 Ear Simulator

**GRAS RA0017**

Pistonphone Calibration Stand (not shown)

**GRAS RA0021**

Microphone Set Calibration Stand (not shown)

---

**Calibration Equipment**

**GRAS RA0014**

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 14AA Electrostatic Actuator Amplifier for driving the setup.

---

**GRAS RA0011**

Provides a convenient platform for calibrating IEC 60318-1 Ear Simulators, e.g. 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.

---

**Calibration Stands**

The GRAS Calibration Stands provide convenient platforms for holding the microphones and accessories used for calibration. They ensure that microphones and accessories are mounted in exactly the same way every time you calibrate.

**AL0010**

Calibration Stand

**AL0011**

Calibration Stand for IEC 60318-1 Ear Simulator

**AL0017**

Pistonphone Calibration Stand (not shown)

**AL0021**

Microphone Set Calibration Stand (not shown)

---

**Calibration Stands**

- **GRAS RA0014**
  - 1/2” Electrostatic Actuator
  - For calibrating 1/2”, 1/4”, and 1/8” standard microphones.
  - Includes adapters for 1/4” and 1/8” microphones.
  - Can be connected to the 14AA Electrostatic Actuator Amplifier.

- **GRAS RA0014–S1**
  - 1/2” Electrostatic Actuator for 40AU-1
  - Same as GRAS RA0014, but with dimensions fitting 40AU-1.

- **GRAS RA0015**
  - 1” Electrostatic Actuator
  - For calibrating 1” standard microphones.
  - Connects directly to the 14AA Electrostatic Actuator Amplifier.

---

**Intensity Calibrator**

**GRAS 51AB**

An electrostatic actuator for testing the frequency response of standard 1” microphones. The RA0014 can be connected directly to the 14AA Electrostatic Actuator Amplifier for driving the setup.

---

**Calibration Equipment**

**GRAS 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 14AA Electrostatic Actuator Amplifier.

---

**GRAS RA0014–S1**

1/2” Electrostatic Actuator for 40AU-1

As RA0014, but with dimensions fitting 40AU-1.

---

**GRAS RA0015**

1” Electrostatic Actuator

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

---

**Calibration Equipment**

**GRAS 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 14AA Electrostatic Actuator Amplifier.

---

**GRAS RA0014–S1**

1/2” Electrostatic Actuator for 40AU-1

As RA0014, but with dimensions fitting 40AU-1.

---

**GRAS RA0015**

1” Electrostatic Actuator

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

---

**Calibration Equipment**

**GRAS 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 14AA Electrostatic Actuator Amplifier.

---

**GRAS RA0014–S1**

1/2” Electrostatic Actuator for 40AU-1

As RA0014, but with dimensions fitting 40AU-1.

---

**GRAS RA0015**

1” Electrostatic Actuator

An electrostatic actuator for testing the frequency response of standard 1” microphones. The RA0015 can be connected directly to the 14AA Electrostatic Actuator Amplifier.
CALIBRATION SYSTEMS

GRAS Audiometer Calibration Systems

The GRAS Audiometer Calibration Systems are configured to meet the requirements of modern audio-meter 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.

GRAS 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 GRAS 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.

GRAS 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 GRAS Audiometer Calibration Analyzer, two complete sets of standardized ear simulators and a coupler platform.

Specifications

<table>
<thead>
<tr>
<th>Ear Simulators conform to:</th>
<th>ANSI 3.6 IEC 60318-1 &amp; -2 &amp; -3 &amp; -4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measured parameters:</td>
<td>Level, frequency and distortion (in one display)</td>
</tr>
</tbody>
</table>

The GRAS 42AG Multifunction Sound Calibrator is also part of the delivery (not shown in the photo)
The GRAS 90CA-S2 Microphone Calibration System is a complete computer-controlled system for calibration of microphones and microphone sets. It 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.

90CA-S2 provides accurate calibration hardware, easily changeable test conditions and a highly reproducible calibration method.

Calibration with the 90CA-S2 is in compliance with
- ANSI S1.10 - 1966 (R1976)
- IEC 61094-1
- IEC 61094-6

Additional software can be purchased for the calibration of preamplifiers.

<table>
<thead>
<tr>
<th>Specifications</th>
<th>90CA-S2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level Calibration:</td>
<td>250 Hz, 114 dB</td>
</tr>
<tr>
<td>Frequency Calibration:</td>
<td>200 Hz to 92 kHz*</td>
</tr>
</tbody>
</table>

*Up to 200 kHz with additional hardware option
Artificial Ears, Ear and 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 standardized human ear, having the same acoustic input impedance as an average human ear.

Another example is IEC 60318-4 (former 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 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 45 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 by Mahlon D. Burkhard.
GRAS 43AA

Ear Simulator Kit According to IEC 60318-1

43AA is a complete test jig for acoustical measurements on telephone handsets and earphones in accordance with:
- IEC 60318-1 (60318) Electroacoustics – Simulators of human head and ear - Part 1: Ear simulator for the calibration of supra-aural and circumaural earphones,

43AA also complies with IEC 60318-2 (1999) (withdrawn and now incorporated into 60318-1).

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

GRAS 43AB

1/2” 2cc Coupler Kit According to IEC 60318-5

43AB is 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.

Included:
- RA0038 IEC 60318-5 (60126) 2cc Coupler
- 40A6 1/2” Pressure Microphone
- 26AC 1/4” Preamplifier
- The RA0052 Test Jig has an adjustable spring-loaded arm to exert a variable force on the test object.
- Studs and moulds for BTE and ITE instruments.

43AA Variants

43AA-S2 Ear Simulator Kit According to IEC 60318-1, CCP. 40AO Prepolarized Pressure Microphone included.

43AA-S3 Ear Simulator Kit According to IEC 60318-1, LEMO, as 43AA, but with 26AB Preamplifier.

<table>
<thead>
<tr>
<th>Specifications</th>
<th>43AA</th>
<th>43AB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standards</td>
<td>IEC 60318-1</td>
<td>IEC 60318-5</td>
</tr>
<tr>
<td></td>
<td>ITU-T Rec. P.57</td>
<td>ANSI S3.7</td>
</tr>
<tr>
<td>Dynamic Range</td>
<td>(ext. pol. mic.) 25 dB(A) - 164 dB</td>
<td>25 dB(A) - 164 dB</td>
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<tr>
<td></td>
<td>(prepol. mic.) 25 dB(A) - 153 dB</td>
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<tr>
<td>Effective Volume</td>
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<td>1550 g</td>
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</table>
GRAS 43AC

Ear Simulator Kit According to IEC 60318-4

43AC is 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 (former 60711) Occluded-ear simulator for the measurement of earphones coupled to the ear by ear inserts.

Included:

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

GRAS 43AF

1" 6cc Coupler Kit According to IEC 60318-3

43AF is a complete test jig for acoustically testing telephone handsets and earphones in accordance with ANSI S3.7 – 1995 and IEC 60318-3.

Included:

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

43AC Variants

43AC-S1 Ear Simulator Kit According to IEC 60318-4, CCP. For more info about the included RA0045-S1, see page 67.

43AC-S4 High-Frequency Ear Simulator Kit LEMO. For more info about the included RA0401, see page 67.

43AC-S5 High-Frequency Ear Simulator Kit CCP. For more info about the included RA0402, see page 67.

43AC-S6 Hi-Res Ear Simulator Kit, LEMO. For more info about the included RA0403, see page 68.

43AC-S7 Hi-Res Ear Simulator Kit, CCP. For more info about the included RA0404, see page 68.

<table>
<thead>
<tr>
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<tbody>
<tr>
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<td>IEC 60318-3, ANSI S3.7</td>
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<tr>
<td>Performance data</td>
<td>RA0045, RA0045-S1</td>
<td>specs on page 67</td>
</tr>
<tr>
<td></td>
<td>RA0401, RA0402</td>
<td>25 dB(A) – 160 dB</td>
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<tr>
<td></td>
<td>RA0403, RA0404</td>
<td></td>
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<tr>
<td>Effective Volume</td>
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</tr>
<tr>
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<td>1650 g</td>
<td>1550 g</td>
</tr>
</tbody>
</table>
GRAS 43AD

Ear Simulator Kit according to ITU-T Rec. P57 Type 1

43AD is a complete assembly for acoustical measurements on acoustical transmitters and loudspeakers in accordance with:

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

Included:
- RA0039 IEC 60318-1 (60318) Ear Simulator
- 40A G 1/2" Pressure Microphone
- 26AK 1/2" Preamplifier
- GR0332 and GR0336 Snap Coupling
- Mounting plate for circum-aural headphones.

GRAS 43AE

Ear Simulator Kit according to ITU-T Rec. P57 Type 3.2

43AE is an IEC 60318-4 (former 60711) Ear Simulator for acoustically testing supra-aural earphones, telephone handsets and loudspeakers in accordance with:
- IEC 60318-4 (former 60711) Occluded-ear simulator for the measurement of earphones coupled to the ear by ear inserts (1/2" Pressure Microphone 40AG included)

Included:
- RA0045 IEC 60318-4 (former 60711) Ear Simulator (40AG 1/2" Microphone built-in)
- 26A C 1/4" Preamplifier
- RA0056 Low-leak simplified Pinna Simulator
- RA0057 High-leak simplified Pinna Simulator.

Specifications

<table>
<thead>
<tr>
<th></th>
<th>43AD</th>
<th>43AE</th>
</tr>
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<tbody>
<tr>
<td>Standards</td>
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<td>IEC 60318-4</td>
</tr>
<tr>
<td></td>
<td>ITU-T Rec. P.57</td>
<td>ITU-T Rec. P.57</td>
</tr>
<tr>
<td>Dynamic Range</td>
<td>25 dB(A) - 164 dB</td>
<td>25 dB(A) - 164 dB</td>
</tr>
<tr>
<td>Effective Volume</td>
<td>–</td>
<td>1260 mm³</td>
</tr>
<tr>
<td>Weight</td>
<td>1650 g</td>
<td>1550 g</td>
</tr>
</tbody>
</table>
Ear & Cheek Simulator Kit IEC 60318-4 & 7

43AG is a table top test 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. It can be used to verify frequency response, distortion, isolation and leakage. Its versatility means that it can be used for testing of both concha and insert types earphones. It can also be used for headphone and headset testing, both circum-aural and supra-aural types. Also, all common types of hearing-aids and telephone handset can be tested with 43AG.

The following configurations are available:

### 43AG Configurations

| 43AG-1 | Ear and Cheek Simulator LEMO is configured with an RA0045 Externally Polarized Ear Simulator According to IEC 60318-4 and a large KEMAR Right Pinna 55 Shore OO. |
| 43AG-2 | Ear and Cheek Simulator CCP is configured with a RA0045-S1 Prepolarized Ear Simulator According to IEC 60318-4 and a large KEMAR Right Pinna 55 Shore OO. |
| 43AG-3 | Ear and Cheek Simulator w Anthropometric Pinna LEMO is configured with an RA0045 Externally Polarized Ear Simulator According to IEC 60318-4 and a KB5000 Large KEMAR Right Anthropometric Pinna 35 Shore OO. |
| 43AG-4 | Ear and Cheek Simulator w Anthropometric Pinna CCP is configured with a RA0045-S1 Prepolarized Ear Simulator According to IEC 60318-4 and a KB5000 Large KEMAR Right Anthropometric Pinna 35 Shore OO. |
| 43AG-5 | Ear and Cheek Simulator, Low-noise is configured with a 43BB low-noise ear simulator system and a large KEMAR Right Anthropometric Pinna 35 Shore OO. |
| 43AG-6 | Ear and Cheek Simulator, High-Frequency, LEMO is configured with an RA0401 Externally Polarized High-Frequency Ear Simulator and a KB5000 Large KEMAR Right Anthropometric Pinna 35 Shore OO. |
| 43AG-7 | Ear and Cheek Simulator, High-Frequency CCP is configured with an RA0402 Prepolarized High-Frequency Ear Simulator and a KB5000 Large KEMAR Right Anthropometric Pinna 35 Shore OO. |
| 43AG-8 | Ear and Cheek Simulator, Hi-Res, LEMO is configured with an RA0403 Externally Polarized Hi-Res Ear Simulator and a KB5000 Large KEMAR Right Anthropometric Pinna 35 Shore OO. |
| 43AG-9 | Ear and Cheek Simulator, Hi-Res, CCP is configured with an RA0404 Prepolarized Hi-Res Ear Simulator and a KB5000 Large KEMAR Right Anthropometric Pinna 35 Shore OO. |

**Specifications**

For specifications for the Ear Simulators, see page 67.
For specifications for 43BB, see page 64.
For more information about the Pinnae, see page 96.
GRAS 43BA

1/4" 0.4cc High-frequency Coupler Kit

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 43BA coupler kit is designed to facilitate the measurement needs described in the IEC TS 62886:2016 "Method for measuring electroacoustic performance up to 16 kHz" 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 versions of the 0.4cc coupler kit are available:

<table>
<thead>
<tr>
<th>43BA Coupler Kits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>43BA-1</strong> 1/4&quot; 0.4cc High Frequency Coupler Kit Includes 40BP 1/4&quot; Ext. Polarized Pressure Microphone, 26AS 1/4&quot; Standard Preamplifier with 3 m Integrated Cable, Very Short and RA0252 1/4&quot; 0.4cc High frequency Coupler as well as cable and adapters.</td>
</tr>
<tr>
<td><strong>43BA-2</strong> 1/4&quot; 0.4cc CCP High Frequency Coupler Kit Includes 40BD 1/4&quot; prepolarized Pressure Microphone, 26CS 1/4&quot; CCP Standard Preamplifier with Microdot Connector, Very Short and RA0252 1/4&quot; 0.4cc High frequency Coupler as well as cable and adapters.</td>
</tr>
<tr>
<td><strong>43BA-3</strong> 1/4&quot; 0.4cc CCP High Frequency Coupler Kit, High Sensitivity Includes a special 1/4&quot; prepolarized high sensitivity microphone, 26CS 1/4&quot; CCP Standard Preamplifier with Microdot Connector, Very Short and RA0252 1/4&quot; 0.4cc High frequency Coupler as well as cable and adapters.</td>
</tr>
</tbody>
</table>

GRAS 43BB

Low-noise Ear Simulator System

43BB is a low-noise, high-sensitive ear simulator system for measurements of sound pressure levels close to or below the threshold of human hearing.

It has a very low noise floor – below 10.5 dB(A) – and can measure sound levels below or close to the threshold of human hearing. For comparison, a standard IEC 60318-4 (711) ear simulator with a 40AG 1/2” microphone has its noise floor at 24.2 dB(A).

It consists of the well known standardized IEC 60318-4 ear simulator and the 40HT Low-noise Microphone System.

**43BB-1** is a variant designed for mounting in KEMAR. It is also part of the KEMAR configurations for low-noise testing. 45BB-11 and -12 and 45BC-11 and -12, see page 70.

<table>
<thead>
<tr>
<th>Specifications</th>
<th>43BB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connector</td>
<td>7-pin LEMO with 3-m cable</td>
</tr>
<tr>
<td>Dynamic range</td>
<td>10.5 dB(A) – 113 dB</td>
</tr>
<tr>
<td>Coupler volume</td>
<td>1260 mm³</td>
</tr>
</tbody>
</table>
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 RA0045-S1 Prepolarized Ear Simulator, the 26CB 1/4” Preamplifier and the RA0056 Low-leak Pinna Simulator 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 42AA/42AP Pistonphone is included.

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

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

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 is used with a 40AG 1/2” microphone and a 26AS preamplifier, which is a 1/4” very short preamplifier with 3 m integrated cable supplied with an adapter for 1/2” microphones. RA0038 is also part of the 43AB 2cc Coupler Kit.

RA0075 is for testing earphones according to ANSI 3.7 – 1995 and IEC 60318-3. It can be used with a 1” pressure microphone like 40EN, a 1/2” preamplifier like 26AK and various adapters, e.g. RA0073.

The coupler used in the 43BA kits is available separately i.e. without microphone, ear mould and tube adapters.
RA0113 is a 2cc IEC 60318-5 (60126) coupler which uses a 1" microphone, like 40EN and a 1/2" preamplifier like 26AK supplied with e.g. RA0073 Adapter.

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

It complies with the following international and national requirements for 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.

RA0039 is 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:


RA0039 is also part of the 43AA and 43AD Ear Simulator kits.

### Specifications

<table>
<thead>
<tr>
<th>Specifications</th>
<th>RA0113</th>
<th>RA0039</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standards</td>
<td>IEC 60318-5</td>
<td>IEC 60318-1 (60318) / ITU-T Rec. P.57 (08/96)</td>
</tr>
<tr>
<td>Frequency Range</td>
<td>-</td>
<td>100 Hz - 8 kHz</td>
</tr>
<tr>
<td>Effective Volume</td>
<td>2 cc</td>
<td>-</td>
</tr>
<tr>
<td>Height</td>
<td>35 mm</td>
<td>19.8 mm</td>
</tr>
<tr>
<td>Diameter</td>
<td>22.4 mm</td>
<td>60 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>50 g</td>
<td>137 g</td>
</tr>
</tbody>
</table>
It is measured and calibrated according to the ITU-T Recommendation P.57 and delivered with a calibration chart specifying its sensitivity and frequency response.

RA0045-S1 is similar to RA0045 but is delivered with a built-in prepolarized microphone GRAS 40AO for use with CCP preamplifiers.

More RA0045 Variants

RA0045-S4 High Sensitivity, 40AP Ext. Pol. Microphone
RA0045-S5 High Pressure, 40BP Ext. Pol. Microphone
RA0045-S6 High Sensitivity, 40AD Prepol. Microphone

Specifications for these RA0045 variants can be found at www.gras.dk

RA0045 variant list:

RA0045
Externally Polarized Ear Simulator IEC 60318-4
RA0045-S1 Prepolarized Ear Simulator IEC 60318-4

RA0401
Externally Polarized High-Frequency Ear Simulator IEC 60318-4
RA0402 Prepolarized High-Frequency Ear Simulator IEC 60318-4

RA0401 is a high-frequency version of the standardized 60318-4 ear simulator (RA0045), which has gained wide acceptance as the preferred tool for measurements with simulation of the acoustic load presented by the human ear. Below 10 kHz, the standardized ear simulator does a good job. However, above 10 kHz, the steep resonance at 13.5 kHz dominates. In RA0401 this resonance is damped and the useful frequency range is extended to 20 kHz.

RA0401 complies with IEC60318-4 and is fully backward compatible as its acoustic transfer impedance is within the tolerance band specified by IEC60318-4. From 10 to 20 kHz the transfer impedance is within ± 2.2 dB, resulting in improved repeatability. Also, realistic THD measurements are now possible.

RA0402 is similar to RA0401 but has a built-in prepolarized microphone for use with CCP preamplifiers.

Specifications

<table>
<thead>
<tr>
<th>Specifications</th>
<th>RA0045/RA0045-S1</th>
<th>RA0401/RA0402</th>
<th>RA0403/RA0404</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic Range</td>
<td>25 dB(A) - 164 dB/25 dB(A) - 150 dB</td>
<td>25 dB(A) - 164 dB/25 dB(A) - 150 dB</td>
<td>44 dB(A) - 169 dB/44dB(A) - 166 dB</td>
</tr>
<tr>
<td>Effective Volume</td>
<td>1260 @ 500 Hz</td>
<td>1260 @ 500 Hz</td>
<td>1260 @ 500 Hz</td>
</tr>
<tr>
<td>Resonant Frequency</td>
<td>13.5 kHz ± 1 kHz</td>
<td>13.5 kHz ± 1 kHz</td>
<td>13.5 kHz ± 1 kHz</td>
</tr>
<tr>
<td>Height</td>
<td>36.5 mm</td>
<td>36.5 mm</td>
<td>36.5 mm</td>
</tr>
<tr>
<td>Diameter</td>
<td>23.8 mm</td>
<td>23.8 mm</td>
<td>23.8 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>71 g</td>
<td>74 g</td>
<td>74 g</td>
</tr>
</tbody>
</table>
ITU-T PINNA SIMULATORS

ITU-T Pinna Simulators

RA0403  Externally Polarized Hi-Res Ear Simulator
RA0404  Prepolarized Hi-Res Ear Simulator

RA0403 is a Hi-Res version of the well-known standardized 60318-4 ear simulator (RA0045), which has gained wide acceptance as the preferred tool for measurements with simulation of the acoustic load presented by the human ear. Below 10 kHz, the standardized ear simulator does a good job. However, above 10 kHz, the steep resonance at 13.5 kHz dominates. In RA0403 this resonance is damped. This, in combination with the use of a 1/4” microphone, extends the useful frequency range to 50 kHz.

RA0403 is compatible with IEC60318-4 and is fully backward compatible as its acoustic transfer impedance is within the tolerance band specified by IEC60318-4. From 10 to 20 kHz the transfer impedance is within ± 2.2 dB, from 20 kHz to 50 kHz it is within ± 3.2 dB, resulting in improved repeatability. Also, realistic THD measurements are now possible in the full audible frequency range.

RA0404 is similar to RA0403 but is delivered with a built-in prepolarized microphone for use with CCP pre-amplifiers.

Specifications on the previous page.

IEC 60318-4 EAR SIMULATORS

A low-leak pinna (outer ear) simulator for use with the RA0045 Ear Simulator 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”.

A high-leak pinna (outer ear) simulator for use with the RA0045 Ear Simulator 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”.

Return to contents  ▲  Return to index
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 µPa 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

<table>
<thead>
<tr>
<th></th>
<th>44AA</th>
<th>44AB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. continuous output level at MRP</td>
<td>110 dB re. 20 µPa (200 Hz – 6 kHz) 100 dB re. 20 µPa (100 Hz – 16 kHz)</td>
<td>110 dB re. 20 µPa (200 Hz – 6 kHz) 100 dB re. 20 µPa (100 Hz – 16 kHz)</td>
</tr>
<tr>
<td>Loudspeaker</td>
<td>8Ω/10 W (max. continuous)</td>
<td>8Ω/10 W (max. continuous)</td>
</tr>
<tr>
<td>Amplifier</td>
<td>Gain: 10 dB / input impedance: 20 kΩ</td>
<td>– / –</td>
</tr>
<tr>
<td>Mouth opening</td>
<td>20 mm diameter</td>
<td>20 mm diameter</td>
</tr>
<tr>
<td>Lip ring: External diameter / Distance from mouth</td>
<td>48 mm / 10 mm</td>
<td>48 mm / 10 mm</td>
</tr>
<tr>
<td>Dimensions: Diameter / Height (with lip ring)</td>
<td>104 mm / 104 mm</td>
<td>104 mm / 104 mm</td>
</tr>
</tbody>
</table>
KEMAR is a head and torso simulator which is factory configured for hearing aid tests, ear- and headphone tests or sound quality recordings. Introduced in 1972 by Knowles Electronics and acquired by GRAS in 2005, it is the origin of all other head and torso simulators and thus the industry standard for in-situ anthropomorphic testing of all kinds of hearing instruments and head- and earphones.

KEMAR is available with and without mouth simulator. It 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 Simulators or various 1/2” and 1/4” pressure microphones for binaural recordings. KEMAR accommodates for LEMO as well as CCP preamplifiers 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. They are delivered fully assembled and tested in one box.

### GRAS 45BB

**45BB KEMAR Head & Torso**  
*A number of rubber pinnae (small and large, soft and hard, anthropometric and wide aperture) are available. 3D-simulation models (step files) of KEMAR with pinnae are also available. See page 96.*

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>45BB-1</td>
<td>KEMAR Head &amp; Torso for Hearing Aid Test, 1-Ch LEMO</td>
</tr>
<tr>
<td>45BB-2</td>
<td>KEMAR Head &amp; Torso for Hearing Aid Test, 1-Ch CCP</td>
</tr>
<tr>
<td>45BB-3</td>
<td>KEMAR Head &amp; Torso for Sound Quality Recording, 2-Ch LEMO</td>
</tr>
<tr>
<td>45BB-4</td>
<td>KEMAR Head &amp; Torso for Sound Quality Recording, 2-Ch CCP</td>
</tr>
<tr>
<td>45BB-5</td>
<td>KEMAR Head &amp; Torso for Ear- and Headphone Test, 2-Ch LEMO</td>
</tr>
<tr>
<td>45BB-6</td>
<td>KEMAR Head &amp; Torso for Ear- and Headphone Test, 2-Ch CCP</td>
</tr>
<tr>
<td>45BB-7</td>
<td>KEMAR Head &amp; Torso for Test of Binaural Hearing Aid, 2-Ch LEMO</td>
</tr>
<tr>
<td>45BB-8</td>
<td>KEMAR Head &amp; Torso for Test of Binaural Hearing Aid, 2-Ch CCP</td>
</tr>
<tr>
<td>45BB-9</td>
<td>KEMAR with Anthropometric Pinnae for Ear- and Headphone Test, 2-Ch LEMO</td>
</tr>
<tr>
<td>45BB-10</td>
<td>KEMAR with Anthropometric Pinnae for Ear- and Headphone Test, 2-Ch CCP</td>
</tr>
<tr>
<td>45BB-11</td>
<td>KEMAR with Anthropometric Pinnae for Low-noise Ear- and Headphone Test, 1-Ch LEMO</td>
</tr>
<tr>
<td>45BB-12</td>
<td>KEMAR with Anthropometric Pinnae for Low-noise Ear- and Headphone Test, 2-Ch LEMO</td>
</tr>
<tr>
<td>45BB-13</td>
<td>KEMAR for High-Frequency Test of Ear- and Headphones, 2-Ch LEMO</td>
</tr>
<tr>
<td>45BB-14</td>
<td>KEMAR for High-Frequency Test of Ear- and Headphones, 2-Ch CCP</td>
</tr>
<tr>
<td>45BB-15</td>
<td>KEMAR for Hi-Res Test of Ear- and Headphones, 2-Ch LEMO</td>
</tr>
<tr>
<td>45BB-16</td>
<td>KEMAR for Hi-Res Test of Ear- and Headphones, 2-Ch CCP</td>
</tr>
</tbody>
</table>

### GRAS 45BC

**45BC KEMAR Head & Torso with Mouth Simulator**

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>45BC-1</td>
<td>KEMAR Head &amp; Torso with Mouth Simulator for Headset Test, 2-Ch LEMO</td>
</tr>
<tr>
<td>45BC-2</td>
<td>KEMAR Head &amp; Torso with Mouth Simulator for Headset Test, 2-Ch CCP</td>
</tr>
<tr>
<td>45BC-3</td>
<td>KEMAR Head &amp; Torso with Mouth Simulator for Telephone Test, 1-Ch LEMO</td>
</tr>
<tr>
<td>45BC-4</td>
<td>KEMAR Head &amp; Torso with Mouth Simulator for Telephone Test, 1-Ch CCP</td>
</tr>
<tr>
<td>45BC-9</td>
<td>KEMAR with Mouth Simulator and Anthropometric Pinnae for Headset Test, 2-Ch LEMO</td>
</tr>
<tr>
<td>45BC-10</td>
<td>KEMAR with Mouth Simulator and Anthropometric Pinnae for Headset Test, 2-Ch CCP</td>
</tr>
<tr>
<td>45BC-11</td>
<td>KEMAR with Mouth Simulator and Anthropometric Pinnae for Low-noise Headset Test, 1-Ch LEMO</td>
</tr>
<tr>
<td>45BC-12</td>
<td>KEMAR with Mouth Simulator and Anthropometric Pinnae for Low-noise Headset Test, 2-Ch LEMO</td>
</tr>
<tr>
<td>45BC-13</td>
<td>KEMAR with Mouth Simulator for High-Frequency Headset Test, 2-Ch LEMO</td>
</tr>
<tr>
<td>45BC-14</td>
<td>KEMAR with Mouth Simulator for High-Frequency Headset Test, 2-Ch CCP</td>
</tr>
<tr>
<td>45BC-15</td>
<td>KEMAR with Mouth Simulator for Hi-Res Test of Headsets, 2-Ch LEMO</td>
</tr>
<tr>
<td>45BC-16</td>
<td>KEMAR with Mouth Simulator for Hi-Res Test of Headsets, 2-Ch CCP</td>
</tr>
</tbody>
</table>
GRAS 45EA
Handset Positioning System for KEMAR

45EA Handset Positioning System is made for the 45BC 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.

GRAS 45EB
Ear-bud Positioning System for KEMAR

45EB Ear-bud Positioning System is made for the 45BB KEMAR Manikin and the 45BC KEMAR Manikin with mouth simulator.

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 secure proper mounting and repeatable measurements.

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

45EB can be retrofitted on all KEMAR versions.
**GRAS 45CA**

**Headphone/Hearing-Protector Test Fixture**

45CA’s robust design makes it ideally suited for binaural testing of active and passive earplugs, as well as circumaural hearing protectors. It is primarily intended for testing the performance of hearing-protection devices but can also be used for testing earphones and headphones. It is fitted with either microphones or ear simulators, depending on the device to test and the standard to comply with. Compliance with ISO 4869-3, IEC 60318-1 and IEC 60318-4 assures technicians, decision makers, and authorities of repeatability and transparent data when developing and verifying hearing protectors.

The pinnae for 45CA are basically the same as the standard KEMAR pinnae, but rounded to fit the large 45CA base plate. This large base plate reduces or eliminates the risk of leakage. 45CA includes two plugs for measuring the acoustic isolation in a closed ear.

The most common configurations can be ordered fully assembled, calibrated. They are listed below.

### 45CA Configurations

<table>
<thead>
<tr>
<th>45CA</th>
<th>Headphone/Hearing-Protector Test Fixture, ISO 4869-3 1” Mic., LEMO - for test of ear muffs</th>
</tr>
</thead>
<tbody>
<tr>
<td>45CA-1</td>
<td>Headphone/Hearing-Protector Test Fixture, ISO 4869-3 1/2” Mic., CCP - for test of ear muffs</td>
</tr>
<tr>
<td>45CA-2</td>
<td>Headphone/Hearing-Protector Test Fixture, IEC 60318-1 LEMO - for test of ear muffs and headphones</td>
</tr>
<tr>
<td>45CA-3</td>
<td>Headphone/Hearing-Protector Test Fixture, IEC 60318-1 CCP - for test of ear muffs and headphones</td>
</tr>
<tr>
<td>45CA-4</td>
<td>Headphone/Hearing-Protector Test Fixture, IEC 60318-4 LEMO - test of ear muffs, ear plugs, headphones, ear phones</td>
</tr>
<tr>
<td>45CA-5</td>
<td>Headphone/Hearing-Protector Test Fixture, IEC 60318-4 CCP - test of ear muffs, ear plugs, headphones, ear phones</td>
</tr>
<tr>
<td>45CA-6</td>
<td>Headphone/Hearing-Protector Test Fixture, IEC 60318-4 LEMO, with Anthropometric Pinnae - for test of ear muffs, ear plugs, headphones and ear phones</td>
</tr>
<tr>
<td>45CA-7</td>
<td>Headphone/Hearing-Protector Test Fixture, IEC 60318-4 CCP, with Anthropometric Pinnae - for test of ear muffs, ear plugs, headphones and ear phones</td>
</tr>
<tr>
<td>45CA-8</td>
<td>Headphone/Hearing-Protector Test Fixture, IEC 60318-4 Hi-Res, with Anthropometric Pinnae - for test of ear muffs, ear plugs, headphones and ear phones</td>
</tr>
<tr>
<td>45CA-9</td>
<td>Headphone/Hearing-Protector Test Fixture, IEC 60318-4 Hi-Res, with Anthropometric Pinnae - for test of ear muffs, ear plugs, headphones and ear phones</td>
</tr>
<tr>
<td>45CA-10</td>
<td>Headphone/Hearing-Protector Test Fixture, IEC 60318-4 Hi-Res, with Anthropometric Pinnae - for test of ear muffs, ear plugs, headphones and ear phones</td>
</tr>
<tr>
<td>45CA-11</td>
<td>Headphone/Hearing-Protector Test Fixture, IEC 60318-4 Hi-Res, with Anthropometric Pinnae - for test of ear muffs, ear plugs, headphones and ear phones</td>
</tr>
<tr>
<td>45CA-12</td>
<td>Headphone/Hearing-Protector Test Fixture, IEC 60318-4 Hi-Res, with Anthropometric Pinnae - for test of ear muffs, ear plugs, headphones and ear phones</td>
</tr>
</tbody>
</table>

### Specifications

<table>
<thead>
<tr>
<th>Specifications</th>
<th>45CA</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO standard</td>
<td>ISO 4869-3 (45CA-1 &amp; 2)</td>
</tr>
<tr>
<td>ITU-T Recommendations</td>
<td>P.380</td>
</tr>
<tr>
<td>IEC standard</td>
<td>60318-1 (45CA-3 &amp; 4)</td>
</tr>
<tr>
<td></td>
<td>60318-4 compatible (45CA-11 to 45CA-12)</td>
</tr>
<tr>
<td>Self Insertion Loss, measured with closed ear simulators (45CA-1 and 45CA-2)</td>
<td></td>
</tr>
<tr>
<td>80 - 250 Hz</td>
<td>&gt;50 dB</td>
</tr>
<tr>
<td>350 - 4000 Hz</td>
<td>&gt;65 dB</td>
</tr>
<tr>
<td>5000 - 20,000 Hz</td>
<td>&gt;55 dB</td>
</tr>
<tr>
<td>Weight</td>
<td>11.6 kg</td>
</tr>
</tbody>
</table>

For more specifications, visit GRAS.dk
Acoustic Test Fixture According to ANSI S12.42

GRAS 45CB

45CB is designed for standardized, binaural testing of passive and active earmuffs and earplugs. Besides a robust design made for field testing and high sound pressure levels (blasts), it 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.

45CB directly handles sound pressure levels up to 169 dB and, indirectly (using comparison methods), levels up to 190 dB. It has a self insertion-loss better than 65 dB.

The modified IEC 60318-4 ear simulator with ¼” microphone extends the frequency range as required by the standard. The 14-mm long ear canal extension is designed to let you also test all types of ear plugs.

The silicone-rubber lining of the extension enables leakage-free mounting of both foam plugs and customized molded types. The silicone-rubber lining of the plates ensures leakage-free mounting, as well as high repeatability and reliability.

GRAS 67SB

Blast Probe Microphone

67SB is provided with a 1/4” threaded hole for mounting directly on a tripod, e.g. AL0006.

Specifications

<table>
<thead>
<tr>
<th>Specifications</th>
<th>45CB</th>
<th>67SB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity</td>
<td>1.6 mV</td>
<td>1 mV</td>
</tr>
<tr>
<td>Dynamic range</td>
<td>50 dB(A) - 169 dB</td>
<td>10 - 20 kHz</td>
</tr>
<tr>
<td>Self Insertion Loss</td>
<td>100 Hz - 8 kHz: &gt; 74 dB</td>
<td>52 dB(A) - 174 dB</td>
</tr>
<tr>
<td></td>
<td>80 Hz -12.5 kHz: &gt; 65 dB</td>
<td></td>
</tr>
<tr>
<td>Standard</td>
<td>ANSI S12.42</td>
<td>ANSI S12.42</td>
</tr>
<tr>
<td>Connector</td>
<td>7-pin LEMO</td>
<td>7-pin LEMO</td>
</tr>
<tr>
<td>Weight</td>
<td>14.75 kg</td>
<td>650 g</td>
</tr>
</tbody>
</table>
45CC is a flexible platform for dual-channel testing of headphones and headsets. It can be configured with microphones, IEC 60318-1 ear simulators and ITU-T P.51 mouth simulator. It can be adjusted very precisely to support different headphone/headset designs and sizes for high accuracy and repeatability. It is well suited for research and development, quality control and production line testing.

**45CC Configuration**

- **45CC-1** Headphone Test Fixture with Externally Polarized 1/2” Microphones
- **45CC-2** Headphone Test Fixture with Prepolarized 1/2” Microphones
- **45CC-3** Headphone Test Fixture with IEC 60318-1 Ear Simulators and Ext. Polarized 1/2” Microphones
- **45CC-4** Headphone Test Fixture with IEC 60318-1 Ear Simulators and Prepolarized 1/2” Microphones
- **45CC-5** Headphone Test Fixture with Mouth Simulator and Ext. Polarized 1/2” Microphones
- **45CC-6** Headphone Test Fixture with Mouth Simulator and Prepolarized 1/2” Microphones
- **45CC-7** Headphone Test Fixture with Mouth Simulator, IEC 60318-1 Ear Simulators and Ext. Polarized 1/2” Microphones
- **45CC-8** Headphone Test Fixture with Mouth Simulator, IEC 60318-1 Ear Simulators and Prepolarized 1/2” Microphones
- **45CC-9** Headphone Test Fixture with Externally Polarized 1/4” Microphones
- **45CC-10** Headphone Test Fixture with Prepolarized 1/4” Microphones
- **45CC-11** Headphone Test Fixture with Mouth Simulator and Ext. Polarized 1/4” Microphones
- **45CC-12** Headphone Test Fixture with Mouth Simulator and Prepolarized 1/4” Microphones

### Specifications

<table>
<thead>
<tr>
<th>Specifications</th>
<th>4CC</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEC 61094-4 1/2&quot; WS2P Microphones in the Ear Plate Plane</td>
<td>3.15 Hz - 20 kHz</td>
</tr>
<tr>
<td>Frequency response</td>
<td>25 dB(A) - 164 dB</td>
</tr>
<tr>
<td>40AG dynamic range</td>
<td>25 dB(A) - 150 dB</td>
</tr>
<tr>
<td>IEC 61094-4 1/4&quot; WS3P Microphones in the Ear Plate Plane</td>
<td></td>
</tr>
<tr>
<td>Frequency response</td>
<td>4 Hz - 70 kHz</td>
</tr>
<tr>
<td>40BP dynamic range</td>
<td>39 dB(A) - 169 dB</td>
</tr>
<tr>
<td>40BD dynamic range</td>
<td>44 dB(A) - 166 dB</td>
</tr>
<tr>
<td>Dimensions and weight</td>
<td></td>
</tr>
<tr>
<td>Width between ears adjustable from</td>
<td>130 to 170 mm</td>
</tr>
<tr>
<td>Height of headband holder adjustable</td>
<td>from 75 to 135 mm</td>
</tr>
<tr>
<td>Horizontal position of headband holder</td>
<td>Adjustable, ± 5 mm</td>
</tr>
<tr>
<td>Ear plate angle</td>
<td>4.5° (ISO 4869-3)</td>
</tr>
<tr>
<td>Weight</td>
<td>3 kg</td>
</tr>
</tbody>
</table>

For specifications for the 44AA Mouth Simulator, see page 69
AL0030 Production Line Acoustic Test Chamber is an anechoic test chamber for acoustic production line testing of mobile devices, for example cell phones, tablets, Bluetooth speaker systems and similarly sized portable acoustic devices.

It is designed for quick and qualified acoustic test, including frequency response, THD, Rub & Buzz and microphone test, using optional sound source.

It provides a flexible platform that can be configured to suit specific requirements. It has a broad range of connections for injecting test and control signals to the Device Under Test (DUT).

Main features are:
- Repeatable testing and reliable data
- Easy open/close for quick and safe change of DUT
- Flexible test jig for easy adjustment to new DUT
- Flexible microphone mounting for both front- and backside speakers as well as edge-mounted speakers
- High-quality, high-sensitive 46BL ¼" CCP measurement microphone included
- Individually calibrated frequency response

AL0030 will speed up product development time significantly. It can be deployed almost anywhere and essentially offers a bench-top anechoic chamber providing highly repeatable data.

### Specifications

<table>
<thead>
<tr>
<th>Specifications</th>
<th>AL0030</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency range*</td>
<td>100 Hz - 20kHz</td>
</tr>
<tr>
<td>Noise insulation (SIL)</td>
<td>&gt; 25 dB (3rd octave)</td>
</tr>
<tr>
<td>Patch panel connections**</td>
<td>4 x BNC socket, 2 x USB, 2 x mini DIN 4 pin</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>+5 °C to +40 °C</td>
</tr>
<tr>
<td>Dimensions</td>
<td>Height: 52.8 cm, Width: 42.4 cm, Depth: 63.8 cm</td>
</tr>
<tr>
<td>Max. dimensions of DUT</td>
<td>300 x 200 mm (12&quot; x 8&quot;)</td>
</tr>
<tr>
<td>Weight</td>
<td>39 kg</td>
</tr>
</tbody>
</table>

* The recommended useful frequency range for AL0030 is from 100 Hz to 20 kHz. It can be used down to 50 Hz, however, below 100 Hz phenomena like room gain can make measurements unpredictable, and therefore we recommend 100 Hz as a practical lower limit.

** A customized patch panel can be delivered on request.
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 prepolarized 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 GRAS 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 GRAS power modules that maintain a constant level of current for driving CCP transducers such as GRAS 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 GRAS low-noise measurement systems. They provide polarization and supply voltages for powering the special low-noise 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 realized by using multi-channel power modules. Most GRAS power modules will fit into the optional GRAS 19” standard rack kit.

A combined power module and power amplifier is also available for electro-acoustic tests of smaller devices like receivers and mini speakers.
12AD is a 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.

12AR is a 2-channel, battery-operated, microphone power module. It has 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

<table>
<thead>
<tr>
<th>Specifications</th>
<th>12AD</th>
<th>12AR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Channels</td>
<td>7-pin LEMO 1B connectors</td>
<td>2 x 7-pin LEMO 1B connectors</td>
</tr>
<tr>
<td>Output Channels</td>
<td>BNC socket</td>
<td>2 x BNC sockets</td>
</tr>
<tr>
<td>Preamplifier Supply</td>
<td>± 15 V</td>
<td>± 15 V</td>
</tr>
<tr>
<td>Output Impedance</td>
<td>Depends on preamplifier</td>
<td>Depends on preamplifier</td>
</tr>
<tr>
<td>Polarization Voltage</td>
<td>0 V or 200 V</td>
<td>0 V or 200 V</td>
</tr>
<tr>
<td>Frequency Response</td>
<td>0.05 Hz - 200 kHz</td>
<td>0.05 Hz - 200 kHz</td>
</tr>
<tr>
<td>Power Supply</td>
<td>4 x AA alkaline batteries (included) or 4.5 - 24 V DC mains adapter 115/230VAC (not included)</td>
<td>4 x AA alkaline batteries (included) or 4.5 - 24 V DC mains adapter 115/230 VAC (not included)</td>
</tr>
</tbody>
</table>
12AK is a 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 fulfills 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 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 AK0040 Standard 19” Rack Kit.

12AA is a 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 fulfills 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 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 AK0040 Standard 19” Rack Kit.

### Specifications

<table>
<thead>
<tr>
<th>12AK</th>
<th>12AA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Input Channel</strong></td>
<td>7-pin LEMO 1B connectors</td>
</tr>
<tr>
<td><strong>Output Channel</strong></td>
<td>BNC socket</td>
</tr>
<tr>
<td><strong>Gain Settings</strong></td>
<td>0 dB, +10 dB, +20 dB, +30 dB, +40 dB, +50 dB</td>
</tr>
<tr>
<td><strong>Preamplifier Supply</strong></td>
<td>28 V or 120 V</td>
</tr>
<tr>
<td><strong>Output Impedance</strong></td>
<td>30 Ω</td>
</tr>
<tr>
<td><strong>Polarization Voltage</strong></td>
<td>0 V or 200 V</td>
</tr>
<tr>
<td><strong>Frequency Response</strong></td>
<td>3.5 Hz - 200 kHz</td>
</tr>
<tr>
<td><strong>A-weighting Network</strong></td>
<td>IEC 60651 Type 0 and IEC 61672 Class 1</td>
</tr>
<tr>
<td><strong>Power Supply</strong></td>
<td>10 x AA alkaline batteries (included) or 12 - 18 V DC mains/line adapter for 115/230 VAC (included)</td>
</tr>
</tbody>
</table>
12AG is an 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 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 -1dB 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 the AK0040 Standard 19” Rack Kit.

 Specifications | 12AG
---|---
Input Channels | 8 x 7-pin LEMO 1B connectors
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 115/230 VAC (included)

12AB is a 2-channel, battery-operated, microphone power module for use with the GRAS 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 GRAS 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 the AK0040 Standard 19” Rack Kit.

 Specifications | 12AB
---|---
Input Channels | 2 via 12-pin LEMO 1B connectors
Output Channels | 2 x BNC sockets and 9-pin D-sub socket
Preamplifier Supply | 28 V or 120 V
Polarization Voltage | 0 V or 200 V
Frequency Response | 0.05 Hz – 200 kHz
Power Supply | 10 x AA alkaline batteries (included) or 12 – 18 V DC mains/line adapter for 115/230 VAC (included)
12AQ is a 2-channel power module for powering microphone preamplifiers requiring a constant-current or constant voltage power supply. 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 12AQ is prepared with slots for extra filters.

12AL is a 1-channel CCP Power Module for powering microphone preamplifiers requiring a constant-current power supply, e.g. 26CB and 26CA. It can also power the 40SC Probe Microphone as well as the 40PH and 40PL Array Microphones.

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

<table>
<thead>
<tr>
<th>GRAS 12AQ</th>
<th>12AL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Traditional preamp. input:</strong></td>
<td><strong>Input Channel</strong></td>
</tr>
<tr>
<td>Connector</td>
<td>BNC coaxial</td>
</tr>
<tr>
<td>Power Supply</td>
<td>±15 V or ±60 V</td>
</tr>
<tr>
<td>Polarization</td>
<td>0 V or 200 V</td>
</tr>
<tr>
<td><strong>CCP Preamp. input:</strong></td>
<td><strong>Output Channel</strong></td>
</tr>
<tr>
<td>Connector</td>
<td>BNC coaxial connector</td>
</tr>
<tr>
<td>Power Supply</td>
<td>4 mA sourced from 28 V</td>
</tr>
<tr>
<td><strong>Signal Output</strong></td>
<td><strong>Frequency Range</strong></td>
</tr>
<tr>
<td>Gain</td>
<td>Adjusted, steps of 10 dB from -20 dB to +70 dB</td>
</tr>
<tr>
<td><strong>Frequency Range</strong></td>
<td><strong>Filters</strong></td>
</tr>
<tr>
<td><strong>Filters</strong></td>
<td></td>
</tr>
<tr>
<td>Control Interface to host</td>
<td>Smart RS-232, MSG line</td>
</tr>
<tr>
<td><strong>Power Supply</strong></td>
<td></td>
</tr>
</tbody>
</table>

6 x LR14 alkaline batteries (included) or 8 - 18 V DC mains adapter for 115/230 VAC (included)

2 x AA alkaline batteries (included) or 3 - 6 V DC mains adapter for 115/230 VAC (not included)
**GRAS 12AN**

4-Channel Power Module

12AN is a 4-channel power module for general use. It is a cost-effective solution with direct coupling (no filters), and is therefore ideally suited for infra-sound measurements. It can be used with all standard LEMO microphone sets and standard front-ends or acquisition units.

**GRAS 12AZ**

4-Channel CCP Power Module

12AZ is a 4-channel power module for production line testing. It has three gain settings for optimization of the signal-to-noise performance. It can be used with all standard CCP microphone sets and standard front-ends or acquisition units.

<table>
<thead>
<tr>
<th>Specifications</th>
<th>12AN</th>
<th>12AZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Channels</td>
<td>4 x 7-pin LEMO 1B connector</td>
<td>4 x BNC sockets</td>
</tr>
<tr>
<td>Output Channels</td>
<td>4 x BNC sockets</td>
<td>4 x BNC sockets</td>
</tr>
<tr>
<td>Gain</td>
<td>-</td>
<td>0 dB, +20 dB, +40 dB</td>
</tr>
<tr>
<td>Preamplifier Supply</td>
<td>+/- 15 V</td>
<td>5 mA @ 28 V</td>
</tr>
<tr>
<td>Polarization</td>
<td>0 V / 200 V (remote controlled)</td>
<td>0 V</td>
</tr>
<tr>
<td>Frequency Response</td>
<td>0.05 Hz - 200 kHz +/- 0.2 dB</td>
<td>1 to 300 kHz (+1/-3 dB @ Gain = 0 dB)</td>
</tr>
<tr>
<td>Power Supply (included)</td>
<td>4 x AA batteries or 6 - 20 V DC mains adapter for 115/230 V AC</td>
<td>6 - 20 V DC mains/line adapter for 115/230 V AC</td>
</tr>
</tbody>
</table>

**GRAS 12AU**

1-Channel Universal Power Module with Signal Conditioning and Power Amplifier

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, it 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®. It can be mounted in a 19" rack.

<table>
<thead>
<tr>
<th>Specifications</th>
<th>12AU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional input</td>
<td>Connector 7-pin LEMO 1B series</td>
</tr>
<tr>
<td></td>
<td>Power Supply ± 15 V</td>
</tr>
<tr>
<td>CCP Input</td>
<td>Connector BNC</td>
</tr>
<tr>
<td></td>
<td>Power Supply 2-20 mA</td>
</tr>
<tr>
<td>Polarization</td>
<td>0 V / 200 V (remote controlled)</td>
</tr>
<tr>
<td>Output</td>
<td>BNC floating (2 kHz/100 nF to power ground)</td>
</tr>
<tr>
<td>Gain</td>
<td>0 - 50 dB in 10 dB steps (± 0.2 dB) (remote controlled)</td>
</tr>
<tr>
<td>Bandwidth (-3dB)</td>
<td>1 Hz to 100 kHz</td>
</tr>
<tr>
<td>Noise (relative to input</td>
<td>&lt; 1.5 µVrms (20 Hz - 20 kHz)</td>
</tr>
<tr>
<td>Input shorted (≥ 20 dB</td>
<td>&lt;5 µVrms (20 Hz - 20 kHz)</td>
</tr>
<tr>
<td>gain)</td>
<td></td>
</tr>
<tr>
<td>Input loaded with 20pF</td>
<td></td>
</tr>
<tr>
<td>dummy mic.</td>
<td></td>
</tr>
<tr>
<td>High Pass Filter (remote</td>
<td>1 Hz (1. order) or 20 Hz (3. order Butterworth)</td>
</tr>
<tr>
<td>controlled)</td>
<td></td>
</tr>
<tr>
<td>Max Output Current</td>
<td>+/- 1.4 A</td>
</tr>
<tr>
<td>Overload Detection</td>
<td>LED indicators (remote controlled reading and reset)</td>
</tr>
<tr>
<td>(voltage &amp; current)</td>
<td></td>
</tr>
<tr>
<td>Current Output</td>
<td>1 V DC/1 A or 10 V DC/1 A</td>
</tr>
<tr>
<td>(voltage/current ratio)</td>
<td></td>
</tr>
<tr>
<td>Power Supply</td>
<td>115/230 VAC</td>
</tr>
</tbody>
</table>
12HF is a power module for single-channel, low-noise measurements using the matched, low-noise preamplifiers and high sensitive microphones of GRAS 40HF, 40HH and 40HT Low-noise Microphone Systems.

12HF provides:
- Polarization voltage (200 V) for the condenser microphone
- Voltage supplies (±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 12HF supports the specifications of GRAS Low-noise Microphone Systems.

12HM is a 10-channel power supply for multi-channel low-noise measurements with GRAS 40HF, 40HH and 40HT Low-noise Microphone Systems. With these, the 12HM can be used in sound-power measurements of low-noise products, such as disk drives, under anechoic and/or semi-anechoic conditions.

12HM provides:
- Polarization voltages (200 V) for up to 10 condenser microphones
- Voltage supplies (±15 V) for powering up to 10 microphone preamplifiers
- Individual response setting, pressure or free-field, for each channel
- Individual gain adjustment of ±3 dB for each channel.

When connected to the above matched preamplifiers and microphones, each channel supports the specifications of GRAS Low-noise Microphone Systems.

### Specifications

<table>
<thead>
<tr>
<th>Specifications</th>
<th>12HF</th>
<th>12HM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Channel</td>
<td>7-pin LEMO EGA 1B</td>
<td>10 x 7-pin LEMO EGA 1B</td>
</tr>
<tr>
<td>Output Channel</td>
<td>BNC coaxial</td>
<td>10 x BNC coaxial</td>
</tr>
<tr>
<td>Output Impedance</td>
<td>30 Ω</td>
<td>30 Ω</td>
</tr>
<tr>
<td>Polarization Voltage</td>
<td>200 V</td>
<td>200 V</td>
</tr>
<tr>
<td>Gain Adjustment/Channel</td>
<td>-</td>
<td>± 3 dB</td>
</tr>
<tr>
<td>Channel Separation</td>
<td>-</td>
<td>&gt; 90 dB</td>
</tr>
<tr>
<td>Power Supply</td>
<td>4 x LR14 (C) batteries or [included]</td>
<td>Mains adapter for 115 or 230 VAC - max. 35 VA [included]</td>
</tr>
<tr>
<td>Dimensions</td>
<td>Height: 132.6 mm (5 1/4&quot;)</td>
<td>Height: 132.6 mm (5 1/4&quot;)</td>
</tr>
<tr>
<td></td>
<td>Width: 34.6 mm (1.3&quot;)</td>
<td>Width: 420 mm (16 1/2&quot;)</td>
</tr>
<tr>
<td></td>
<td>Depth: 196 mm (7.7&quot;)</td>
<td>Depth: 196 mm (7.7&quot;)</td>
</tr>
<tr>
<td>Weight</td>
<td>620 g (1.3 lbs)</td>
<td>5.5 KG (12 lbs)</td>
</tr>
</tbody>
</table>
GRAS Sound & Vibration offers a wide range of standard accessories in the form of cables, adapters, wind-screens and tripods for use in measuring setups.

These can be broadly divided into 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 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.
ASSEMBLING MICROPHONES AND PREAMPLIFIERS

1/2" Microphone to 1/4" Preamplifier

<table>
<thead>
<tr>
<th>Adapter Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AF0008</td>
<td>Adapter for 1/2&quot; Mic. and 1/4&quot; Preamplifier.</td>
</tr>
<tr>
<td>GR0010</td>
<td>Adapter for 1/2&quot; Mic. and 1/4&quot; Preamplifier.</td>
</tr>
<tr>
<td>RA0003</td>
<td>Adapter for 1/2&quot; Mic. and 1/4&quot; Preamplifier.</td>
</tr>
</tbody>
</table>

For any standard 1/2" microphone and 1/4" preamplifier. AF0008, included with 26AB. GR0010, included with 26AC, 26AL, 26AR and 26CB. RA0003 for any standard 1/2" mic. of other brand and a GRAS 1/4" preamplifier.

1/4" Microphone to 1/2" Preamplifier Adapter

<table>
<thead>
<tr>
<th>Adapter Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA0019</td>
<td>Adapter for 1/4&quot; Mic. and 1/2&quot; Preamplifier.</td>
</tr>
</tbody>
</table>

Inline stub adapter for connecting 1/4" microphone to 1/2" preamplifier.

1" Microphone to 1/2" Preamplifier Adapter

<table>
<thead>
<tr>
<th>Adapter Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA0017</td>
<td>Adapter for 1&quot; Mic. and 1/2&quot; Preamplifier.</td>
</tr>
<tr>
<td>RA0073</td>
<td>Adapter for 1&quot; Mic. and 1/2&quot; Preamplifier.</td>
</tr>
</tbody>
</table>

RA0017. Head adapter for any standard 1" microphone and 1/2" preamplifier. RA0073. For 1" mic. with 1/2" preamp. The influence of RA0073 on the acoustic field is minimal.

1/4" Mic. to 1/4" Preamp., for intensity Probe

<table>
<thead>
<tr>
<th>Adapter Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA0007</td>
<td>Adapter for 1/4&quot; Mic. and 1/4&quot; Preamplifier.</td>
</tr>
</tbody>
</table>

7.5 mm straight adapter for placing between a 1/4" microphone and a 1/4" preamplifier. Included with GRAS 40BI 1/4" Intensity Microphone set.

1/8" Microphone to 1/4" Preamplifier

<table>
<thead>
<tr>
<th>Adapter Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA0063</td>
<td>Adapter for 1/8&quot; Mic. and 1/4&quot; Preamplifier.</td>
</tr>
<tr>
<td>RA0082</td>
<td>Adapter for 1/8&quot; Mic. and 1/4&quot; Preamplifier, long</td>
</tr>
</tbody>
</table>

Adapters for using a 1/8" microphone with a 1/4" preamplifier. Can be used with any standard 1/8" microphone and 1/4" preamplifier such as 26AC.

RA0063. To reduce attenuation of the microphone signal, the guard ring of the preamplifier is extended through RA0063.

RA0082. its extended length improves high frequency performance by reducing diffraction effects.

Right-angled Adapters (90°)

<table>
<thead>
<tr>
<th>Adapter Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA0001</td>
<td>1/2&quot; microphone to 1/4&quot; preamplifier</td>
</tr>
<tr>
<td>RA0190</td>
<td>1/2&quot; microphone to 1/2&quot; preamplifier</td>
</tr>
<tr>
<td>RA0006</td>
<td>1/4&quot; microphone to 1/4&quot; preamplifier</td>
</tr>
</tbody>
</table>

Right-angled adapters. Can be used with all standard microphones and preamplifiers.

Tools for Gripping Microphones

<table>
<thead>
<tr>
<th>Adapter Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA0161</td>
<td>Tool for gripping 1&quot; Microphone</td>
</tr>
<tr>
<td>RA0081</td>
<td>Tool for gripping 1/2&quot; Microphone</td>
</tr>
<tr>
<td>RA0200</td>
<td>Tool for gripping 1/4&quot; Microphone</td>
</tr>
<tr>
<td>RA0210</td>
<td>Tool for gripping 1/8&quot; Microphone</td>
</tr>
</tbody>
</table>

With soft jaws for safely holding the microphone when unscrewing the protection grid or preamplifier.
**Accessories for Microphones - Rain and Wind**

### Rain Protection Caps
- **RA0131** Rain-protection cap for 1/2" microphone
- **RA0127** Rain-protection cap for 1/4" microphone
- **RA0092** Rain-protection cap for array microphone

**RA0131** includes a protection grid which has a central matching threaded stud.

**RA0127** includes a protection grid which has a central matching threaded stud.

**RA0092** is for use with GRAS array microphones 40PH and 40PL.

### Nosecones
- **RA0020** 1/2" Nosecone
- **RA0020-A** 1/2" Nosecone, aluminum for lightness
- **RA0022** 1/4" Nosecone
- **RA0173** 1/8" Nosecone

Nosecones for replacing the standard protection grid of a microphone when making acoustic measurements in high-speed laminar airflow. The tip should be pointed upstream in the laminar flow to reduce turbulence created by the microphone itself.

### Rain-resistant Grids
- **RA0262** Rain-resistant grid for 1/2" microphone
- **RA0336** Rain-resistant grid for 1/4" microphone
- **RA0312** Rain-resistant grid for 1/8" microphone

**RA0262** and **RA0336** have a central threaded stud that can be used for mounting a Rain Protection Cap.

### GRAS RA0132
**Dehumidifier for 1/2" Microphones**

For use at high humidity levels, only with rear-vented 1/2" microphones. An indicator on the side of the dehumidifier shows when it needs to be dried out.
**ACCESSORIES FOR MICROPHONES - MOUNTING**

### Microphone Tripods with 1/4” UNC-20 Threads

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL0004</td>
<td>Small Lightweight Microphone Tripod</td>
</tr>
<tr>
<td>AL0006</td>
<td>Microphone Tripod</td>
</tr>
</tbody>
</table>

- Standard mounting thread (1/4” UNC-20)
- Crank-adjusted centre column
- Rubber feet
- Adjustable tripod legs with locks

**AL0004.** Compact, light-weight tripod.
- Max. height 123 cm
- Retracted 24 cm

**AL0006.** A versatile and robust tripod. As AL0004, but stronger and more stable.
- Max. height 166 cm
- Retracted 66 cm

### Microphone Holders – Stainless Steel, Adjustable

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA0093</td>
<td>1/2” microphone holder, 5-click</td>
</tr>
<tr>
<td>RA0096</td>
<td>1/4” microphone holder, 5-click</td>
</tr>
<tr>
<td>RA0094</td>
<td>7 mm array microphone holder, 5-click</td>
</tr>
</tbody>
</table>

Adjustable, high quality, stainless steel tripod adapters with 180° angular adjustment in steps of 45°.

### Microphone Holders – Stainless Steel, Fixed

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL0012</td>
<td>1/2” Microphone Holder</td>
</tr>
<tr>
<td>AL0013</td>
<td>1/4” Microphone Holder</td>
</tr>
</tbody>
</table>

For mounting microphone sets on tripods with a standard 1/4” UNC-20 thread. Can be used with the swivel head AL0005.

### Microphone Holders – POM, Fixed

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL0008</td>
<td>1/2” Microphone Holder, POM</td>
</tr>
<tr>
<td>AL0028</td>
<td>7 mm Microphone Holder, POM</td>
</tr>
<tr>
<td>AL0029</td>
<td>1/4” Microphone Holder, POM</td>
</tr>
<tr>
<td>AL0035</td>
<td>1/8” Microphone Holder, POM (not shown)</td>
</tr>
</tbody>
</table>

### GRAS AL0005

**Swivel Head**

Lightweight swivel head for microphone holders, with a standard 1/4” UNC-20 thread.
**GRAS AL0003**  
**Tripod Adapter for Microphones**

AL0003 is an adapter with a swivel head for mounting 1/2" or 1/4" microphone sets on tripods with a standard 1/4" UNC-20 thread. Designed to minimize diffraction.

**GRAS RA0504**  
**1/2" GoPro Adapter**

A specially-designed adapter that makes it possible to use the whole range of GoPro mounting accessories for mounting 1/2" microphone sets.

**MagMount™ Discs for 147AX**

- RA0392-1 Pack of mounting discs, 5 pcs
- RA0392-10 Pack of mounting discs, 10 pcs

Discs for magnetic mounting of the 147AX. They can be screw-mounted or attached with glue or double-sided adhesive tape. The center tap ensures precise mounting of the 147AX.

**3/8" UNC-16 to 1/4" UNC-20**

- SK0017 Tripod Thread Insert
- SK0057 Tripod Conversion Screw

SK0017. For adapting a female 3/8" UNC-16 thread to a male 1/4" UNC-20 thread.  
SK0057. For adapting the 3/8" UNC-16 thread of a tripod to 1/4" UNC-20 thread.

**GRAS AL0007**  
**Clips for 1/4” Intensity Microphones**

Set with microphone clips 12 mm and 25 mm for side-by-side mounting of a pair of 1/4" intensity microphones.
**GRAS RA0077**

**NBS 9-A Coupler Adapter for 1/2” Microphone**

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

**GRAS RA0011**

**Gooseneck**

RA0011 is a 20 cm flexible gooseneck with 7-pin LEMO connectors for use with preamplifiers with integrated 7-pin LEM0 connectors such as 26AJ, 26AK and 26AB. For example, it can be mounted between the preamplifier and a sound level meter in order to reduce reflections.

**GRAS RA0117**

**Coupler Adapter for 1/2” to 1/4” Microphone**

RA0117 is an adapter for mounting a ¼” microphone in couplers designed for 1/2” microphones.

**Random Incidence Correctors**

- **RA0122** For 1/2” free-field microphones
- **RA0357** For 146AE 1/2” Free-field Rugged Microphone set

**RA0016 and RA0018** are 20 dB attenuators for inserting between a 1/2” microphone and preamplifier. They attenuate the output signal of the microphone by 20 dB in order to avoid overloading the preamplifier or input module.

**RA0016** For externally polarized microphones
**RA0018** For prepolarized microphones

**Transmitter Adapters**

- **RA0067** For 1/2” prepolarized microphones
- **RA0086** For 1/4” ext. polarized microphones

RA0067 and RA0086 enable microphones (typically a 40BP 1/4” ext.pol. or 40AD 1/2 prepol.) to be used as high impedance sound sources. They take 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 used as a microphone. The RA0067 can also be used with externally polarized microphones when used with 14AA Actuator Amplifier, which superimposes +200 VDC polarization on the calibration signal.

RA0067 has a BNC connector
RA0086 has a microdot connector.

**RA0067 RA0086 RA0016 RA0018**

**20 dB Attenuators**

- **RA0016** For externally polarized microphones
- **RA0018** For prepolarized microphones

RA0016 and RA0018 are 20 dB attenuators for inserting between a 1/2” microphone and preamplifier. They attenuate the output signal of the microphone by 20 dB in order to avoid overloading the preamplifier or input module.
**GRAS RA0091**

**Insulated 1/2” Microphone Protection Grid**

For avoiding ground loops, e.g. with RA0085 in telephone testing set-ups using 43AD Ear Simulator Kit.

---

**GRAS RA0140**

**Dummy 1” Microphone**

For checking the inherent noise level of a preamplifier loaded purely by the capacitance of a 1” microphone.
### Capacitive Input Adapters

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA0062</td>
<td>20 pF Input Adapter for 1/2 preamplifier</td>
</tr>
<tr>
<td>RA0062-S1</td>
<td>50 pF Input Adapter for 1/2 preamplifier</td>
</tr>
<tr>
<td>RA0080</td>
<td>6 pF Input Adapter for 1/4&quot; preamplifier</td>
</tr>
</tbody>
</table>

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.

RA0062-S1 is a 50pF 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 50pF dummy load when short circuiting the BNC input.

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.

### Inline Input Adapters

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AG0001</td>
<td>7-pin LEMO to B&amp;K</td>
</tr>
<tr>
<td>AG0002</td>
<td>CCP Input Adapter</td>
</tr>
<tr>
<td>AG0003</td>
<td>CCP to XLR Adapter</td>
</tr>
<tr>
<td>RA0083</td>
<td>BNC to 7-pin LEMO</td>
</tr>
<tr>
<td>RA0125</td>
<td>Microdot input to 1/2&quot; Preamplifier</td>
</tr>
</tbody>
</table>

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

AG0002 is an inline adapter for using a CCP preamplifier with a (constant-voltage) GRAS 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. CCP preamplifiers 26CB, 26CC (1/4") and 26CA, 26CF (1/2").

AG0003 is an adapter for connecting a CCP compatible preamplifier to an input module with XLR connector and Phantom Supply (CCP) supply. AG0003 is provided with a BNC input connector.

RA0083 is for utilising the signal and signal-ground pins only of the 7-pin LEMO input of a preamplifier power supply.

RA0125 is an adapter for using a Microdot (UNF 10-32) input to a standard 1/2" preamplifier such as the 26AK. Useful when a high input impedance is required for transducers such as hydrophones and accelerometers. Including GR0010, it can be used with 1/4" preamplifiers as well, f.ex. 26AC.
### Accessories for Outdoor Microphones

**GRAS AC0001**  
Calibration Control Box for 41AM/41CN  
AC0001 is a control box with local and remote facilities for switching on/off the actuator calibration of 41AM and 41CN Outdoor Microphone Systems. 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 41AM and 41CN.

**GRAS AM0033**  
Tripod Adapter  
For mounting 41AM/41CN Outdoor Microphones (fitted with Pole Adapter AM0029) on a tripod. Has 1 1/2" RG (ISO 228/1) male thread on top and 3/8" UNC-16 female thread at the bottom.

**GRAS RA0087**  
Special Key  
Used when dismantling the microphone assembly of the GRAS 41AM and 41CN Outdoor Microphone Systems.

**GRAS AM0007**  
Transport Protection Cap  
For protecting the microphone assembly in GRAS 41AM/41CN Outdoor Microphones.

**GRAS AM0029**  
Pole Adapter  
For mounting 41AM/41CN Outdoor Microphones 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.

**GRAS AM0038**  
Multi Spanner/Wrench  
For dismantling the microphone assembly of 41AM/41CN Outdoor Microphones.

---

**Cables for Outdoor Microphones**  
- Visit [www.gras.dk](http://www.gras.dk)
<table>
<thead>
<tr>
<th><strong>GRAS AM0009</strong></th>
<th><strong>GRAS RA0009</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Windscreen/Birdspike for 41AM/41CN</strong></td>
<td><strong>Adapter for Pistonphone calibration</strong></td>
</tr>
<tr>
<td><img src="example-image1" alt="Image" /></td>
<td><img src="example-image2" alt="Image" /></td>
</tr>
<tr>
<td>AM0009 is a set of five open-cell-structure foam windscreen for mounting on 41AM and 41CN Outdoor Microphone Systems.</td>
<td>RA0009 is an adapter for calibrating 41AM Outdoor Microphone System. It fits over the rain protection cap for 41AM and permits in-situ calibration using a pistonphone such as 42AA.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>GRAS AM0052</strong></th>
<th><strong>GRAS RA0041</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Complete Windscreen/Birdspike for 41AM/41CN</strong></td>
<td><strong>Adapter for Pistonphone Calibration</strong></td>
</tr>
<tr>
<td><img src="example-image3" alt="Image" /></td>
<td><img src="example-image4" alt="Image" /></td>
</tr>
<tr>
<td>AM0052 is a windscreen, complete with anti-bird spikes, for mounting on the 41AM and 41CN Outdoor Microphone Systems.</td>
<td>RA0041 is an adapter for calibrating the 41CN Outdoor Microphone. It fits over the rain protection cap for 41CN and permits in-situ calibration using a pistonphone such as 42AA.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>GRAS AM0089</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Large Windscreen for 41AM/41CN</strong></td>
</tr>
<tr>
<td><img src="example-image5" alt="Image" /></td>
</tr>
<tr>
<td>Spherical windscreen for 41AM and 41CN Outdoor Microphone Systems. Fits directly over the existing windscreen, accommodating the anti-bird spikes. Open-cell foam structure, 150 mm diameter.</td>
</tr>
</tbody>
</table>
### IEC60318-4 Ear Simulator – Accessories for Testing of ITE Hearing Aids

<table>
<thead>
<tr>
<th>Item Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GR0435</td>
<td>In-ear Adapter</td>
</tr>
<tr>
<td>GR0436</td>
<td>Tube Stud</td>
</tr>
</tbody>
</table>

For testing of ITE hearing aids with an IEC60318-4 Ear Simulator, GR0435 or GR0436 are needed. The illustration to the right shows the context in which they are needed.

### IEC60318-4 Ear Simulator – Accessories for Testing of BTE Hearing Aids

<table>
<thead>
<tr>
<th>Item Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GR0437</td>
<td>Ear-mould Simulator</td>
</tr>
<tr>
<td>GR0438</td>
<td>Union nut</td>
</tr>
<tr>
<td>GR0440</td>
<td>Tube stud</td>
</tr>
<tr>
<td>GR1176</td>
<td>Gasket</td>
</tr>
</tbody>
</table>

For testing of BTE hearing aids with an IEC60318-4 Ear Simulator, the items shown above are needed. The illustration to the right shows the context in which they are used.

### IEC60318-5 1/2” 2cc Coupler – Accessories for Testing of ITE Hearing Aids

<table>
<thead>
<tr>
<th>Item Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GR0315</td>
<td>Gasket</td>
</tr>
<tr>
<td>GR0317</td>
<td>Ear-mould Adapter</td>
</tr>
<tr>
<td>GR0318</td>
<td>Tube Adapter</td>
</tr>
<tr>
<td>GR0319</td>
<td>Tube Adapter</td>
</tr>
<tr>
<td>GR0320</td>
<td>Union nut</td>
</tr>
<tr>
<td>GR0321</td>
<td>In-ear Adapter</td>
</tr>
</tbody>
</table>

For testing of ITE hearing aids with a RA0038 1/2” IEC60318-5 Ear Simulator, the items shown above are needed. The illustration to the right shows the context in which they are used.
ACCESSORIES FOR ARTIFICIAL EARS & MOUTHS

**IEC60318-5 1" 2cc Coupler – Accessories for Testing of ITE Hearing Aids**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GR0316</td>
<td>Union nut</td>
</tr>
<tr>
<td>GR0723</td>
<td>Tube Adapter</td>
</tr>
<tr>
<td>OR5003</td>
<td>O-ring</td>
</tr>
<tr>
<td>OR5389</td>
<td>O-ring</td>
</tr>
<tr>
<td>RA0017</td>
<td>½” to 1” Adapter</td>
</tr>
<tr>
<td>RA0114</td>
<td>⅛”-button Adapter</td>
</tr>
<tr>
<td>RA0115</td>
<td>In-ear Adapter</td>
</tr>
</tbody>
</table>

For testing of ITE hearing aids with an RA0113 1" IEC60318-5 Ear Simulator, the items shown above are needed. The illustration to the right shows the context in which they are needed.

**GRAS RA0052**

Test Jig

For use with GRAS couplers and ear simulators. It has an adjustable spring-loaded arm to exert a variable force on the test object.

**GRAS RA0070**

Test Base for Ear Simulators

Test base for GRAS ear simulators and couplers.

**GRAS RA0058**

1/2” to 1” Microphone Adapter

Converts a 1/2” microphone (with grid removed) into a 1” microphone’s dimensions (with grid). Allows mounting of 1” microphone protection grid. Typically used with 45CA Hearing-protector Test Fixture.

**GRAS RA0076**

Adapter for NBS 9-A Coupler RA0075

RA0076 is a thread adapter exclusively for use in connection with RA0052 Test Jig. It can also be used when upgrading the 43XX Series Ear Simulator Kits, except 43AF, where it is included.
GRAS RA0085
Insulated Coupling for Artificial Ear

Can be used as a substitute for the snap coupler GR0336 in the 43AD Ear Simulator Kit to avoid ground loops.

GRAS RA0088
In Ear Adapter

Moulding cup used to fit in-ear hearing aids to the RA0045 IEC60318-4 (former 60711) Ear Simulator.

GRAS RA0116
Adapter for 1/2” Microphone

For use with RA0113 2cc Coupler.

GRAS 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.

GRAS RA0172
Pinna Holder Kit for 45CA

Used for 45CA when configured with IEC 60318-4 Ear Simulator and KEMAR pinna.

GRAS RA0307
Retrofit Kit with Anthropometric Pinna for 43AG and Knowles KEMAR

The items needed for retrofitting an anthropometric pinna on a GRAS 43AG (produced before April 2016) and on a Knowles KEMAR (produced before 2005).
### PINNAE FOR KEMAR, 45CA AND 45CB

#### KEMAR Pinnae for GRAS 45BB, 45BC and 43AG

<table>
<thead>
<tr>
<th>Pinna Type</th>
<th>KEMAR Pinnae Code</th>
<th>Shore Value</th>
<th>Pinna Type</th>
<th>KEMAR Pinnae Code</th>
<th>Shore Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard KEMAR Pinnae, Soft</td>
<td>KB1060</td>
<td>35 Shore OO</td>
<td>Standard KEMAR Pinnae, Hard</td>
<td>KB0060</td>
<td>55 Shore OO</td>
</tr>
<tr>
<td>KB1061</td>
<td>Small Left Pinna, 35 Shore OO</td>
<td>KB0061</td>
<td>Small Left Pinna, 55 Shore OO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KB1065</td>
<td>Large Right Pinna, 35 Shore OO</td>
<td>KB0065</td>
<td>Large Right Pinna, 55 Shore OO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KB1066</td>
<td>Large Left Pinna 35, Shore OO</td>
<td>KB0066</td>
<td>Large Left Pinna, 55 Shore OO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sound Quality/Wide Aperture KEMAR Pinnae, Soft</td>
<td>KB1068</td>
<td>Small Right Pinna 35, Shore OO</td>
<td>Sound Quality/Wide Aperture KEMAR Pinnae, Hard</td>
<td>KB0068</td>
<td>Small Right Pinna, 55 Shore OO</td>
</tr>
<tr>
<td>KB1069</td>
<td>Small Left Pinna 35, Shore OO</td>
<td>KB0069</td>
<td>Small Left Pinna 55, Shore OO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KB1090</td>
<td>Large Right Pinna, 35 Shore OO</td>
<td>KB0090</td>
<td>Large Right Pinna, 55 Shore OO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KB1091</td>
<td>Large Left Pinna, 35 Shore OO</td>
<td>KB0091</td>
<td>Large Left Pinna, 55 Shore OO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Anthropometric Pinnae for KEMAR</td>
<td>KB5000</td>
<td>Large Right Anthropometric Pinna, 35 Shore OO</td>
<td>3-D Simulation of KEMAR with Pinnae</td>
<td>KB3000</td>
<td>45BB with Large Pinna, step file</td>
</tr>
<tr>
<td>KB5001</td>
<td>Large Left Anthropometric Pinna, 35 Shore OO</td>
<td>KB3001</td>
<td>45BB with Small Pinna, step file</td>
<td></td>
<td></td>
</tr>
<tr>
<td>KB5002</td>
<td>Large Right (mirrored left) Anthro. Pinna, 35 Shore OO</td>
<td>KB3002</td>
<td>45BB with Anthropometric Pinna, step file</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Pinnae for GRAS 45CA

<table>
<thead>
<tr>
<th>Pinna Type</th>
<th>KEMAR Pinnae Code</th>
<th>Shore Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pinna for 45CA, Soft and Anthro Pinna</td>
<td>KB1070</td>
<td>Large Right Pinna, 35 Shore OO</td>
</tr>
<tr>
<td>KB1071</td>
<td>Large Left Pinna, 35 Shore OO</td>
<td>KB0071</td>
</tr>
<tr>
<td>KB5010</td>
<td>Right Anthropometric Pinna for 45CA, 35 Shore OO</td>
<td>KB0072</td>
</tr>
<tr>
<td>KB5011</td>
<td>Left Anthropometric Pinna for 45CA, 35 Shore OO</td>
<td>KB0073</td>
</tr>
</tbody>
</table>

#### Pinnae for GRAS 45CB

<table>
<thead>
<tr>
<th>Pinna Type</th>
<th>KEMAR Pinnae Code</th>
<th>Shore Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pinna for 45CB Ansi Head</td>
<td>KB0077</td>
<td>Large Right Pinna, 55 Shore OO</td>
</tr>
<tr>
<td>KB0078</td>
<td>Large Left Pinna, 55 Shore OO</td>
<td></td>
</tr>
</tbody>
</table>
**Anthropometric Pinna Upgrade Kits for KEMAR**

RA0308   Anthropometric Pinna Upgrade Kit for KEMAR 2005 - 2013  
RA0311   Anthropometric Pinna Upgrade Kit for KEMAR 2013 - present

**GRAS RA0143**

*Ear Simulator Holder Kit for KEMAR*

This retrofit kit enables mounting of the IEC 60318-4 (former 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.

<table>
<thead>
<tr>
<th>Pinnae for 45CB ANSI Head</th>
</tr>
</thead>
<tbody>
<tr>
<td>GR0917</td>
</tr>
<tr>
<td>GR0924</td>
</tr>
<tr>
<td>GR0958</td>
</tr>
<tr>
<td>GR1153</td>
</tr>
</tbody>
</table>

**GRAS RA0251**

*GRAS 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. These are included.

<table>
<thead>
<tr>
<th>Ear Canal Extensions (POM versions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA0249</td>
</tr>
<tr>
<td>RA0250</td>
</tr>
</tbody>
</table>
ACCESSORIES FOR PISTONPHONES

Couplers for Pistonphones

RA0023  1” coupler for pistonphone
RA0048  1/2” coupler for pistonphone

Adapters for Pistonphones

RA0049  1/2” adapter for 1/4” microphone
RA0069  1/2” adapter for 1/8” microphone

Calibration Adapters for 146AE and 147AX

RA0341  Calibration adapter for 146AE
RA0391  Calibration adapter for 147AX

Couplers for Two-port Calibration

RA0024  Coupler for two-port Calibration
RA0042  Coupler for two-port Calibration, high pressure

GRAS RA0090
94 dB Pistonphone Coupler

RA0049 is for use with 42AA and 42AP Pistonphones.
RA0069 is a high-pressure version for use with the 42AC Pistonphone.

RA0024 is for use with 42AA and 42AP Pistonphones.
RA0042 is a high-pressure version for use with the 42AC Pistonphone.

A large-volume Coupler for enabling 42AA and 42AP Pistonphones to produce a sound pressure level of 94 dB instead of 114 dB re. 20 μPa. Essential when calibrating highly sensitive low-noise measuring systems, which would otherwise be overloaded by 114 dB.

A pistonphone adapter for calibration checking the GRAS 43AE Ear Simulator when a pinna simulator is mounted on the RA0045 Ear Simulator.

For calibration of 146AE and 147AX respectively.

Two-port high couplers for comparison calibrations between two 1/2” microphones; one of which is a reference microphone. Can also be used in measuring the P-I (Pressure-Intensity) Index of intensity probes at 250 Hz.

Couplers for GRAS pistonphones.

Adapters for calibrating 1/4” and 1/8” microphones with a GRAS pistonphone fitted with a 1/2” Coupler.
ACCESSORIES FOR ARRAY MODULES

**GRAS PR0001**
Module for Array Microphones, wired

- PR0001 is a mounting rail for GRAS 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**
- AC0015  Split cable from rail to 6 BNC connectors
- AA0016  Split cable from rail to 6 SMB connectors

**GRAS GR0625**
End Piece Array Modules

- For Array Module GRAS PR0001/PR0001-1 and PR0002.

**GRAS GR0630**
Connecting Piece for Array Modules

- Used to extend Array Module GRAS PR0001/PR0001-1 in the horizontal direction.

**GRAS GR0707**
Spacer for Array

- The 50 mm spacer is used to extend PR0001/PR0001-1 Array Module in the vertical direction.

**GRAS PR0002**
Module for Array Microphones, variable

- PR0002 has 23 positions for microphones, spaced at 25 mm intervals. The microphones can also be spaced with intervals of 50 mm, 75 mm or 100 mm. CCP cable is used. The holder RA0185 is available for mounting array microphones with SMB connector, and a special holder RA0245 is available for mounting 1/4” microphone sets with Microdot connector. To be mounted on the AL0006 Tripod and the stainless-steel RA0094 Tripod Adapter (for 8 microphones). These are standard solutions, but GRAS also offers alternative sizes and shapes of array modules.

**GRAS GR0107**
Spacer Set for Array Modules

- A set of 6 (50 mm) for PR0001/PR0001-1 Array Module.

**GRAS AC0016**
Cable for 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

**GRAS AC0015**
1-6 Split Cables for Array Modules

- For use with PR0001 Array Module. One end has a LEMO connector, which plugs into the array module and splits into six BNC outputs on the ends of short cables.
GRAS AK0040
Standard 19” Rack Kit

AK0040 is a shelf for mounting instrument cabinets, e.g. GRAS 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 up to a total width of 430 mm.

GRAS AB0002
Mains Adapter EU

Regulated 230 V AC - 15 V DC 7.5 W.
Connector for European Union.

GRAS AK0096
Mounting Plate

For mounting two GRAS Power Modules (12AA/12AK) side-by-side.

GRAS AB0003
Mains Adapter USA

Regulated 110 V AC - 15 V DC 7.5 W.
Connector for United States.

GRAS AB0005
Mains Adapter, EU/UK/USA

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
Mains Adapter UK

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-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-Microdot

- AA0064 3 m
- AA0087-CL Customized length

CCP Coaxial Cable, SMB-Microdot

- AA0076-CL Customized length

CCP Coaxial Cables, SMB-BNC
CCP Coaxial Cables, SMB-BNC for Array and
QC microphones

- AA0027 3 m
- AA0028 10 m
- AA0082-CL Customized length
CCP Cables – Watertight and Heat Resistant

High Temperature Cable, BNC-BNC

for high-temperature applications

AA0095-CL Customized length

CCP High Temperature Cable, Microdot-Microdot

CCP Coaxial Cable, max temperature 150°C

AA0064 3 m

CCP High Temperature Cable, Microdot-BNC

CCP Coaxial Cables, Microdot-BNC for 1/4” and 1/8” Microphone Sets, max temperature 150°C

AA0018 3 m
AA0061-CL Customized length

CCP High Temperature, Microdot-SMB

CCP Coaxial Cables, Microdot-SMB, max temperature 150°C

AA0049 10 m

Watertight and Heat Resistant CCP Cables

AA0107 1 m BNC - BNC
AA0108 3 m BNC - BNC
AA0121 5 m BNC - BNC w rubber sleeve
AA0109 10 m BNC - BNC
AA0110 30 m BNC - BNC

These cables are watertight and can be used at temperatures up to 125°C, for example with the 146AE 1/2” CCP Free-field Microphone Set.

AA0121 has a rubber sleeve at one end.

Cable Replacement Kits for 147AX

RA0393 5 m
RA0394 10 m
RA0395 20 m
RA0396 Custom length

The repair kits comprise a key for screw-mounting one end of the cable to the 147AX’ housing.
LEMO CABLES – ADAPTER CABLES FOR 50AI INTENSITY PROBE

**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**
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 Low-noise Systems**
LEMO Cables for Low-noise Systems

- AA0046 3 m
- AA0047 10 m
- AA0053-CL Customized length

**LEMO Cables for Intensity Probes**
LEMO Cables for Intensity Probes

- AA0006 2 m - 4-pin
- AA0021 5 m - 12-pin

**Adapter Cables for 50AI and 60LK**

- AC0002 Adapter Cable for GRAS 50AI-B for use with 01dB Symphonie
- AC0003 Adapter cable 12-pin LEMO to 2 x 7-pin LEMO for GRAS 50AI-C.
- AC0005 Adapter Cable for GRAS 50AI-D for Use with Müller BBM and OROS analyzers
- AC0008 Adapter Cable for GRAS 50AI-D for Use with 01dB Harmonie and Soundbook
- AC0010 Adapter Cable 18-pin LEMO to 2 x 7-pin LEMO
- AC0025 3 m LEMO 4-pin to 4 x BNC Adapter Cable for 60LK
CABLE ACCESSORIES

GRAS AE0001
Male Plug for 41AM/41CN
- 6-pin LEMO FFA.2S.306 male plug as supplied with 41AM/41CN

GRAS AE0003
Male plug for LEMO for Preamplifier Cable
- 7-pin LEMO FGG.1B.307 male plug for preamplifier cables

GRAS AE0046
BNC male - Microdot Female Adapter
- Used for a cable terminated with a Microdot connector to connect to a BNC female (e.g. Power Module/Input Module)

GRAS AE0074
BNC Female-female Adapter
- This adapter is used for interconnecting two cables which are terminated with BNC male connectors

GRAS AE1002
7-pin LEMO 1B Series Female Connector
- 7-pin LEMO 1B series female connector for panel mounting

GRAS AE1003
7-pin LEMO 1B series female connector
- 7-pin LEMO 1B series female connector for cable mounting

GRAS PA0017
Drum for 100 m cable
- The PA0017 is a cable drum for approximately 100 m microphone cable

GRAS PA0018
Drum for 200 m cable
- The PA0018 is a cable drum for approximately 200 m microphone cable
Gras 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.

Large pressure fluctuations caused by turbulence can be attenuated by up to 20 dB.

Windscreens for outdoor microphones can be found on page 92.

**Spherical Windscreens**

- **AM0363** For 1" microphone
- **AM0069** For 1/2" microphone
- **AM0071** For 1/4" microphone
- **AM0364** For array microphones

**Elliptical Windscreen for Rugged CCP Intensity Probes**

- **GRAS AI0001** 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.

**Windscreen for 147EB - High Temperature**

- **AM0387-1** Windscreen, 1 pc
- **AM0387-4** Windscreens, 20 pcs.

**Windscreen for 147AX - High Temperature**

- **AM0388-1** Windscreen, 1 pc
- **AM0388-2** Windscreens, 5 pcs.

**GRAS AM0376**

- **Elliptical Windscreen for Rugged CCP Intensity Probes**
  - Fits the rugged CCP Intensity Probe 50Gi-P and 50Gi-RP.

**Windscreen for 146AE - High Temperature**

- **AM0391-1** Windscreen, 1 pc
- **AM0391-2** Windscreens, 20 pcs.

**High-temperature windscreen especially designed for 146AE. It has a plastic ring inside that locks it to 146AE.**
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| 12AD | 77 | 41CN | 38 | 67SB | 73 |
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| 12BL | 80 | 43AF | 61 | AA0006 | 103 |
| 12BN | 81 | 43AG | 63 | AA0008 | 103 |
| 12BP | 80 | 43AH | 65 | AA0009 | 103 |
| 12BQ | 81 | 43AI-1 | 66 | AA0010 | 103 |
| 12BR | 80 | 43BI | 66 | AA0014 | 103 |
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| 26AN | 33 | 46AB | 14 | AA0046 | 103 |
| 26AO | 33 | 46AC | 14 | AA0047 | 103 |
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| 26AQ | 33 | 46AE | 12 | AA0053-CL | 103 |
| 26AR | 33 | 46AF | 12 | AA0056-CL | 101 |
| 26AS | 33 | 46AG | 13 | AA0057 | 103 |
| 26AT | 33 | 46AH | 14 | AA0061-CL | 102 |
| 26AU | 33 | 46AI | 29 | AA0064 | 101 |
| 26AV | 33 | 46AM | 15 | AA0070 | 101 |
| 26AW | 33 | 46AN | 13 | AA0071 | 101 |
| 26AX | 33 | 46AO | 14 | AA0072 | 101 |
| 26AY | 33 | 46AP | 12 | AA0073-CL | 101 |
| 26AZ | 33 | 46AQ | 29 | AA0076-CL | 101 |
| 26B | 34 | 46AR | 15 | AA0078 | 101 |
| 26C | 34 | 46AS | 15 | AA0080 | 101 |
| 26D | 34 | 46AT | 13 | AA0081-CL | 101 |
| 26E | 34 | 46AU | 13 | AA0082-CL | 101 |
| 26F | 34 | 46AV | 13 | AA0083-CL | 101 |
| 26G | 34 | 46AW | 16 | AA0087-CL | 101 |
| 26H | 34 | 46AX | 16 | AA0089-CL | 103 |
| 26I | 34 | 46AY | 16 | AA0090-CL | 103 |
| 26J | 34 | 46AZ | 13 | AA0091 | 103 |
| 26K | 34 | 46BD | 13 | AA0092-CL | 103 |
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| 26O | 34 | 46BH | 13 | AA0109 | 102 |
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