An Axiometrix Solutions Brand

Handbook

Introduction to Measurement Microphone Setups

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1. INTRODUCTION

The intent of this handbook is to provide an overview of the most basic considerations when deciding on a particular measurement microphone setup. In this handbook you will find a description of the main distinctions and parameters to consider when choosing a microphone. You will also find information about microphones sets as well as a quick overview of availa ble special microphones. Finally, the handbook describes preamplifiers and their most important specifications to be aware of, and how power modules are part of the complete setup.

2. MICROPHONE SELECTION

Measurement microphones are available in many types, covering various frequency ranges, dynamic ranges and application situations. In order to select the right measurement microphone for a given application, there are a number of decisions to make. These are related to the following parameters:

- ✓ Free field, pressure or random incidence
- ✓ Dynamic range
- ✓ Frequency range
- ✓ Externally polarized vs prepolarized

2.1 Free field, pressure or random incidence

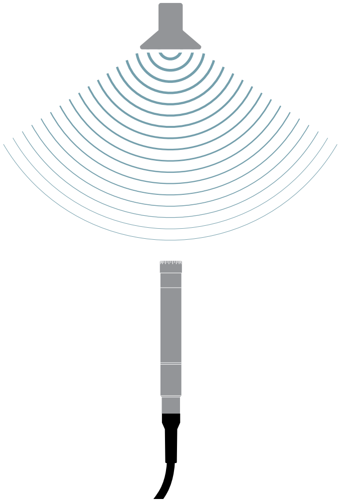
Measurement microphones can be divided into three groups: Free field, pressure and random incidence. The differences between microphones from group to group are at the higher frequencies, where the size of a microphone becomes comparable with the wavelengths of the sound being measured.

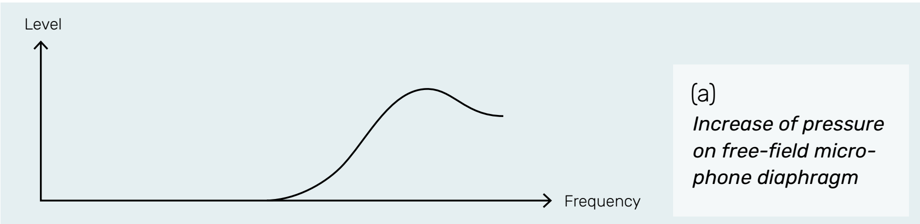
Free-field microphones

A free-field microphone is designed 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.

In general, the sound pressure around a microphone cartridge will increase due to reflections and diffraction.

The frequency characteristics of a free-field microphone are designed to compensate for this increase in pressure; hence, the output of a free-field microphone is a signal proportional to the sound pressure as it existed before the microphone was introduced into the sound field. A free-field microphone should always be pointed towards the sound source (0° incidence) as shown at left. In this situation, the presence of the microphone diaphragm in the sound field will result in a pressure increase in front of the diaphragm depending on the wavelength of the sound and the diameter of the microphone, see curve (a) in the graph below.



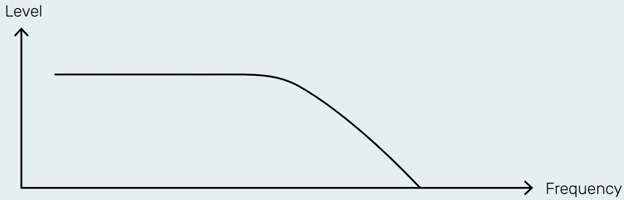


Free-field microphones are recommended for most sound pressure level measurements for example with sound level meters, sound power measurements, and sound radiation studies.

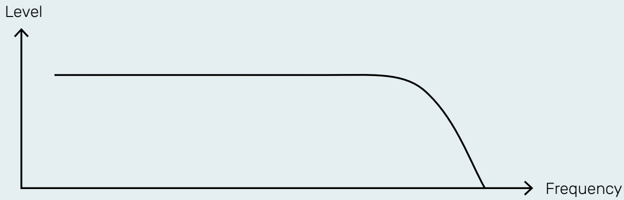
For a typical 1/2" microphone, the maximum pressure increase will occur at 26.9 kHz, where the wavelength of the sound (λ) coincides with the diameter of the microphone; i.e.:

$$\lambda = \frac{342 \text{ m/s}}{26.9 \text{ kHz}} \approx 12.7\text{mm} = ½"$$

The result is an output from the microphone cartridge that is proportional to the sound pressure as it existed before the microphone was introduced into the sound field, see curve (c) below. Curve (a)—also called the free-field correction curve—must be added to the pressure response of the microphone shown in curve (b) in order to obtain the characteristics of a free-field microphone shown in curve (c).



(b)
Pressure response of free-field micro-phone

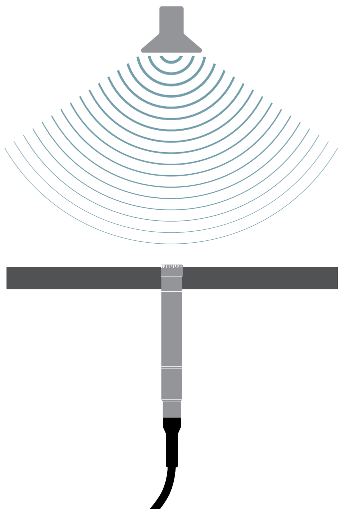


(c)
Free-field response of free-field micro-phone

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.

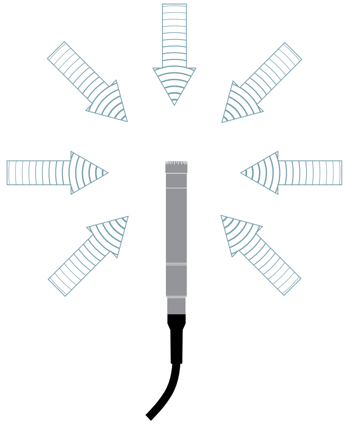
Pressure microphones are recommended for use with couplers like GRAS RA0045 IEC 60318-4 and GRAS RA0038 IEC 60318-5 with 2cc couplers and for studies of sound pressures inside closed cavities.



Random-incidence microphones

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



Typically, random incidence is used for sound pressure level measurements according to ANSI standards.

2.2 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.

Dynamic range upper limit

The **dynamic range upper limit** is established by exposing a microphone to a pure 1KHz sinusoidal tone that stepwise increases in amplitude until a 3% THD is measured at the microphone output. The result is expressed as peak level in dB SPL.

When exposed to higher sound pressure, the microphone does not act as a linear transducer anymore and the accuracy of the measured output can not be guaranteed.

Lower limit of dynamic range:

The Lower limit of dynamic range is defined by the inherent noise of the microphone caused to a great extent by limitations in the electronics and Brownian movements of the microphone diaphragm.

The **dynamic range lower limit** is established by placing the microphone in a soundproof acoustical chamber and measuring the microphone signal output.

The result is an equivalent noise level expressed in dB(A). Please note that to guarantee a minimum inherent noise, GRAS microphones must be used along with GRAS power modules.

This inherent noise is normally 5 μV and is equivalent to a sound pressure level that can be calculated from the sensitivity of the microphone. For a microphone with a sensitivity of 50 mV/Pa, this would correspond to an apparent sound pressure of:

$$\frac{5\ \mu V}{50\ mV/Pa} = 0.0001\ Pa;$$ in other words around 14 dB re. 20 μPa

Similarly, for a microphone with a sensitivity of 4 mV/Pa, this would correspond to an apparent sound pressure of:

$$\frac{5\ \mu V}{4\ mV/Pa} = 0.00125\ Pa;$$ in other words around 36 dB re. 20 μPa

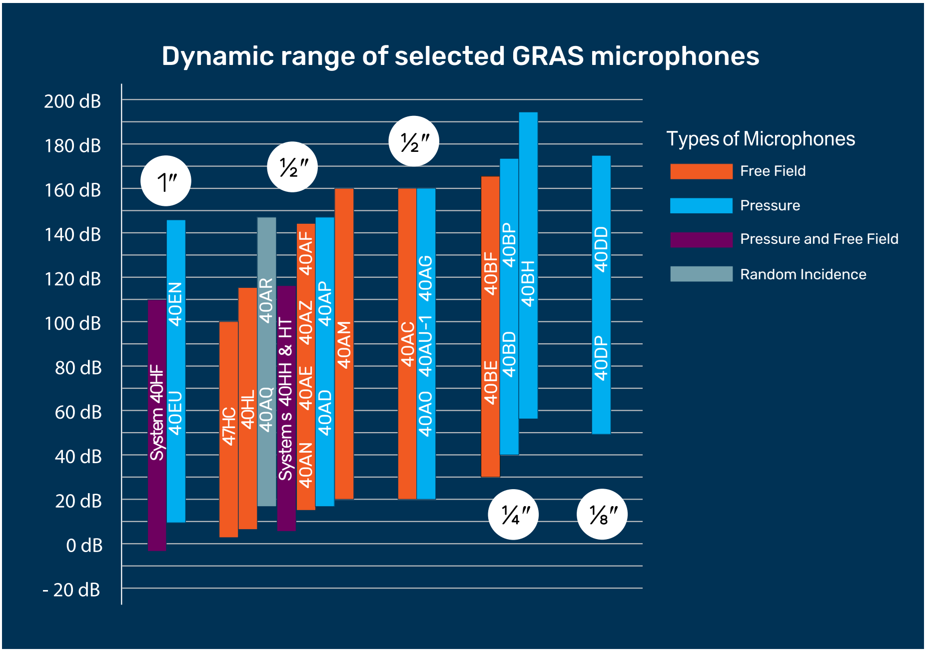
Hence, a microphone with a sensitivity of 50 mV/Pa can measure down to about 14 dB whereas a microphone with a sensitivity of 4 mV/Pa can only measure down to about 36 dB.

In practice, a microphone needs to be connected to a high-impedance preamplifier in order to handle the very weak output signal from the microphone. A preamplifier also has a certain amount of noise that will be added to the thermal noise generated by the microphone.

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.

2.3 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.



The microphones are grouped according to size of external diameter—i.e., 1″, ½″, ¼″ and ⅛″. The Part or Model number of each microphone is also shown.

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.

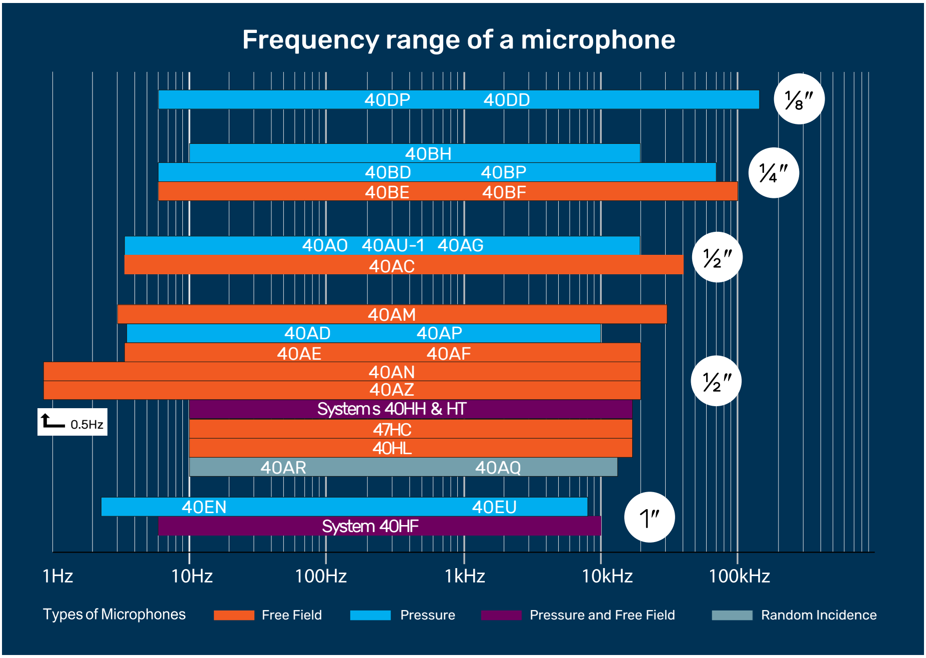
Upper limiting frequency

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.

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.



The microphones are grouped according to size of external diameter—i.e., 1″, ½″, ¼″ and ⅛″. The Part or Model number of each microphone is also shown.

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 frequency ranges of various GRAS microphones are shown above. Different colors are used to distinguish between pressure (blue), free-field (orange) and random-incidence (light grey) microphones.

2.4 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 preferred for very critical measurements.

Prepolarized microphones

Typically these microphones are used with constant current power* (CCP) preamplifiers such as GRAS 26CA. Prepolarized microphones must be connected to an input stage for CCP transducers or be powered by a CCP supply like the GRAS 12AL.

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

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

3. MICROPHONE SETS

3.1 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. This optimizes the work-flow for the user and minimizes 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.

3.2 Easy selection

The measurement microphone sets from GRAS have been combined so they fulfill typical measurement needs. Whatever your measurement system and application, you should be able to find a set that suits your needs.

3.3 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.

3.4 Cables

The CCP sets use high-quality coaxial cables; whereas, the LEMO sets use a special, soft type of multicore shielded cable. It should be noted that longer cables will influence the upper frequency and dynamic ranges.

3.5 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.

3.6 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.

3.7 Warranty

GRAS offers a five-year warranty on microphone sets.

3.8 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 after the microphone capsule. A 40AE microphone thus becomes a 46AE microphone set when paired with the preamplifier.

4. SPECIAL MICROPHONES

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

4.1 Ultra-thin Precision (UTP) Microphones

UTP micropones are suitable for aeroacoustic testing where minimal disturbance to the sound field is important.

These microphones combine the advantages of precision measurement microphones with a small form factor (a very low profile—just 1 mm) and provide the ability to quantify and understand boundary layer and turbulent noise.

4.2 Microphones with SysCheck2™ functionality

SysCheck2™ is a new technology recently introduced by GRAS. SysCheck2™ is a GRAS-patented technology allowing remote-controlled, fast and precise verification of the entire measurement chain (microphones, channel gain and cable integrity) with a single click.

Microphone sets with built-in SysCheck2™ functionality are equipped with a high-precision built-in microprocessor able to generate a reference signal that enables remote verification of the entire measurement chain.

SysCheck2™ requires no physical interaction. It is easy to set up with standard cables making it adaptable for any testing setups and is highly recommendable for both production line and distributed measurement setups.

In production line setups, SysCheck2™ can help reduce downtime as well as increase efficiency and data reliability. It is also essential for test setups when microphones are placed in dangerous or hard-to-reach locations as well as for distributed measurement setups where many microphones need to be validated in a short period of time.

The verifications are easily made on each SysCheck2-enabled microphone connected to a CCP/IEPE/ICP/CCLD power module with TEDS read-write support and measurement software. SysCheck2™ functionality also provides on-demand environmental data: Temperature, barometric pressure and humidity.

4.3 Surface microphones

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.

4.4 Array microphones

Array microphones can be useful in situations where concurrent measurements are required at several points in an array.

For example in the analyses of:

- ✓ **Sound fields**
- ✓ **Sound power**

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.

4.5 Flush-mount microphones

Flush-mounted 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 without sacrificing aerodynamic properties.

4.6 Probe microphones

When measuring in difficult or inaccessible cavities, at high temperatures or in conditions of airflow, probe microphones can be very useful. 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.

4.7 Turbulence screens

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.

4.8 Ground array microphone kits

Ground array microphones 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 s etup.

4.9 Infra-sound microphones

When measuring very low frequencies, infra-sound microphones are the optimal microphones to choose. They have a very low low-frequency cut-off down to 0.09 Hz. They consist of a special microphone combined with a special preamplifier and a low-frequency adapter. To account for pressure variations close to 0 Hz, a special ambient pressure equalization system is used.

4.10 Hemisphere kits

Hemisphere kits are ideal for sound power measurements. They 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.

4.11 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 (0° incidence).
- For community-noise or traffic-noise measurements, where the measurement direction is in the horizontal plane (90° 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.

4.12 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 16 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-sensitivity microphones combined with special low-noise preamplifiers.

One application of such a microphone is 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, they 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; therefore, 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.

4.13 Intensity probes

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

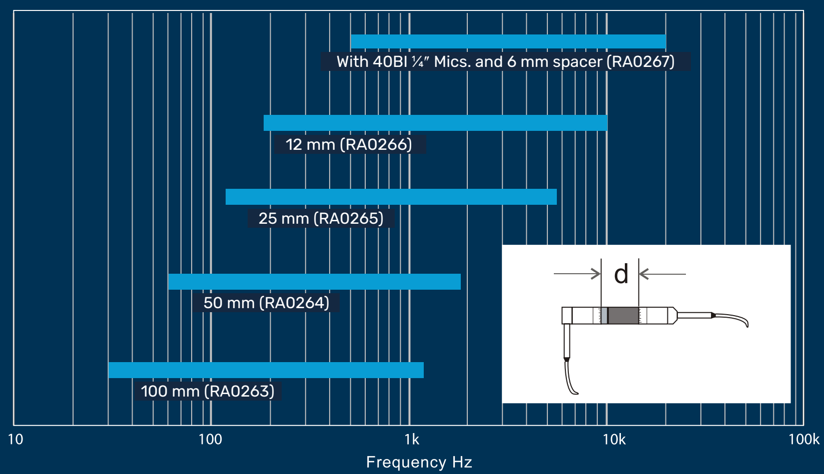
The GRAS 40AI and GRAS 40BI intensity microphone pairs have been carefully manufactured and selected to have a minimum phase difference.

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. 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.

Overview of different intensity probes



To ensure maximum measurement accuracy, the spacing (d) between the microphones should be optimized depending on measurement conditions.

5. PREAMPLIFIERS

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

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

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

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 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 seven-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 ¼" and ⅛" 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.

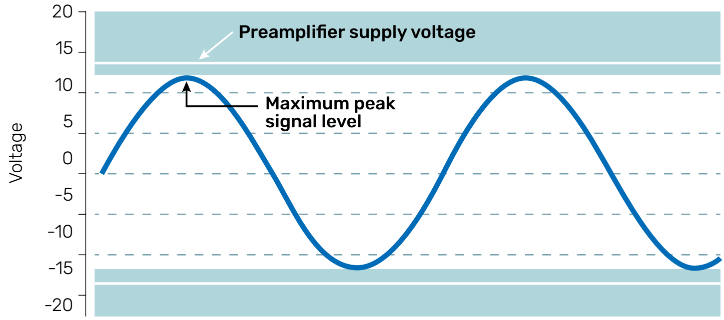
They will work within their specifications up to a temperature of 70 °C/158 °F. Special versions for use at temperatures up to 120 °C/248 °F are available on request. The effect of elevated temperature is a slight increase in the inherent noise level. This will change the lower limit of the dynamic range of the microphone/preamplifier combination, thus limiting the ability to measure very low sound pressure levels.

5.1 Preamplifier dynamic range

The dynamic range of a preamplifier can be defined as the range between the highest level the preamplifier can handle and the lowest level it can measure. The highest level is related to the voltage supplied to the preamplifier, whereas the lowest level is related to the noise generated by the preamplifier itself.

5.2 Upper limit of dynamic range

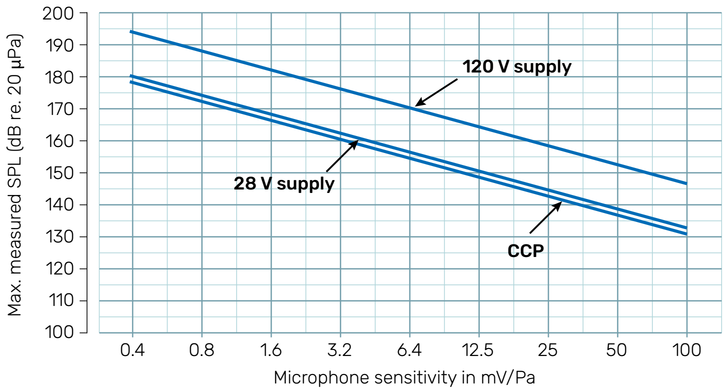
The highest level is related to the voltage supplied to the preamplifier so that the peak-to-peak variation in signal levels that can be handled by the preamplifier is slightly less than the voltage supplied. For example, for a supply voltage of ±14 V DC, the preamplifier can handle peak signals up to 12 V or peak-to-peak signals up to 24 V. See diagram below.



The relation between maximum signal level and the preamplifier

For a CCP preamplifier, the supply voltage is limited to 24 V which gives a maximum peak-to-peak output signal of 22 V.

The sound pressure levels that can be measured with a particular preamplifier depend on the sensitivity of the microphone used for the measurements, such that a microphone with a low sensitivity can measure higher levels than a microphone with a high sensitivity, see diagram below.

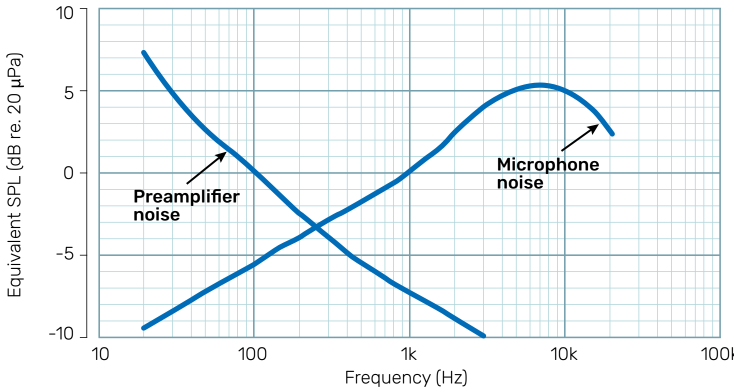


The importance of microphone sensitivity

5.3 Lower limit of dynamic range

The lower limit of a preamplifier's dynamic range is determined by the noise floor of the preamplifier. A typical preamplifier generates a broadband noise signal of around 3 μV and will mask the microphone's signal if it lies below this.

The noise spectrum of the preamplifier is dominated by low frequencies as shown in the graph above.



The relation between lower limit of dynamic range and the preamplifier

When a microphone is mounted on a preamplifier, the inherent noise of the microphone will be added to the preamplifier noise, and the noise floor of the system will be determined by the combined microphone and preamplifier noise.

As the graph above shows, the lower limit of the dynamic range is determined by preamplifier noise at the low frequencies and by microphone noise at the high frequencies.

CCP is the same as integrated electronic piezoelectric (IEPE) and constant current line drive (CCLD) and is compatible with many other constant current driven products such as Isotron® (Endevco Corp.), ICP® (PCB Group, Inc.).

6. POWER MODULES

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 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 measurement. 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 units that give only the special voltages required, but other units provide more features, such as signal conditioning.

Power modules with TEDS support

CCP Power Modules: GRAS 12BA I GRAS 12BE I GRAS 12BB

GRAS CCP power modules 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.

LEMO Power Modules: GRAS 12BC I GRAS 12BF I GRAS 12BD

GRAS WORLDWIDE

Subsidiaries and distributors in more than 40 countries

About GRAS Sound & Vibration

GRAS is a worldwide leader in the sound and vibration industry. We develop and manufacture state-of-the-art measurement microphones and related equipment for industries where acoustic measuring accuracy and repeatability are of the utmost importance. This includes applications and solutions for customers within the fields of aerospace, automotive, audiology, consumer electronics and other highly demanding industries. GRAS microphones are designed to live up to the high quality, durability and accuracy that our customers have come to expect and trust.

GRAS Sound & Vibration is represented through subsidiaries and distributors in more than 40 countries and is part of Axiometrix Solutions, a leading test solutions provider comprised of globally recognized measurement brands.

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Please contact Support@GRASacoustics.com to help find the most appropriate measurement setup for your needs.

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