

Differences in Measurement and Studio Microphones

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Question: What is the difference between a measurement microphone and a studio microphone? Under what circumstances should you use one over the other?

Answer: There are many types of microphones, but this discussion will be limited to condenser microphones. The basic design and the principle of operation of both types of microphones are the same. They consist of a diaphragm and a back plate that act as a capacitor. The diaphragm vibrates in a sound field changing the capacitance of the microphone cartridge and an output signal is generated.

Measurement and studio microphones have common desirable properties, such as low distortion, low internal noise, flat frequency response and a wide dynamic range. The main difference between measurement and studio microphones is that each has been optimized for a different purpose. Measurement microphones are designed to acquire acoustic measurement data, while studio microphones are used for recording and reinforcement of music or speech where the end use is listening.

The following characteristics are of the utmost importance in measurement microphones:

1. Stability over time and under severe environmental conditions
2. Ability to calibrate
3. Documentation and compliance with standards.

These properties are not as critical in studio microphones because studio microphones are used for subjective, not objective, measurements. Essential features in studio microphones include:

1. Subjective sound transduction
2. Directional characteristics, on-axis and off-axis response
3. Electrical compatibility
4. Ruggedness.

It is difficult to precisely define what determines good subjective sound. Much depends on the source. For example, intelligibility is important when reproducing speech and one microphone may be better suited for this than for music. The frequency response indicates the ability of a microphone to accurately transduce a sound. If the frequency response is not flat it may introduce 'coloration' into the sound. Coloration is defined as "a distortion of the tonal quality of the source."¹ A challenge in reproducing music or voice is that the sound can be arriving from many directions. It is desirable to have the same frequency response regard-

less of the direction of the incoming sound. If the frequency response is consistent in all directions, although it may differ in level as a function of frequency, the timbre will remain unaltered even if the angle of incidence changes. This is flat power response.

Studio microphones can be omnidirectional (equally sensitive to sound from all directions) or directional. The directional types have two main response patterns: unidirectional which is referred to as a cardioid response (see Figure 1) or bidirectional which has a figure eight pattern. Omnidirectional microphones sense sound pressure, while directional microphones sense sound pressure gradient.

Directional microphones are most often used in performance situations because they allow separation of sound sources. Another benefit in live performances with sound reinforcement is that they provide better 'rejection' of the sounds from a reverberant sound field. The difficulty with these microphones is that the technique used to sense the pressure gradient can result in a nonuniform frequency response. This can cause resonances in the audio frequency range that may produce a 'ringing' effect.² Microphone manufacturers provide on- and off-axis response curves to aid in choosing the most appropriate microphone for the sound source (see Figure 2).

Studio microphones have built-in preamplifiers, which require power. The most common method for supplying this power is called "Phantom Power." Phantom power is chosen for two reasons. First, it is convenient because most mixing consoles supply phantom power. Second, phantom power is immune to noise. Phantom power utilizes a three-wire system. It requires a balanced circuit where the supply voltage (usually 24 or 48 VDC) is placed on the two signal lines. The third conductor is ground. The signal lines have identical signals, but they are out of phase with each other by 180°. These signals are input to a differential amplifier where the difference between the signals is amplified. Noise on the line is common to both conductors and rejected by the differential amplifier.

While measurement microphones are often used in laboratory environments where great care is taken ensure safe handling, studio microphones can experience rough handling in the course of audio production. Because recording sessions and live performances can be rushed and hectic, ruggedness and simplicity are paramount. The 3-pin XLR connector is

most widely used with studio microphones because it is simple and robust. The ground pin of the XLR connector makes contact first, which bleeds static from the line and eliminates 'popping' noise. It also has a locking mechanism and it is shielded.³

In summary, the main difference between measurement and studio microphones is that measurement microphones are designed for objective scientific measurements and studio microphones are optimized for live or recorded music or voice.

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Next Month's Question: When measuring Frequency Response Functions for the purpose of Modal Analysis; does it matter if a fixed response transducer (impact testing) or a fixed excitation (shaker testing) is aligned with any particular axis or arbitrarily positioned?

1. DPA Microphones A/S, "Pro Audio Dictionary," 1998.
2. David Josephson, "Progress in Microphone Characterization – SC-04-04," Audio Engineering Society Preprint, presented at the 103rd Convention, September 1997.
3. Yamaha, "Sound Reinforcement Handbook," 1987.

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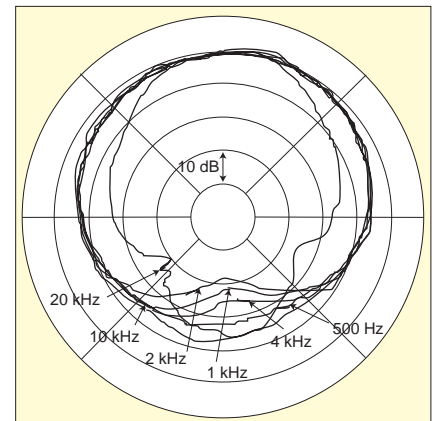


Figure 1. Sample cardioid polar response. Courtesy of DPA Microphones A/S.

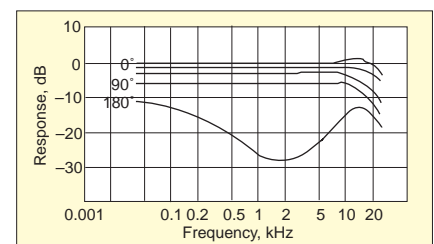


Figure 2. Sample of on- and off-axis frequency response. Courtesy of DPA Microphones A/S.