

All you need to know about Microphones

Different types of microphone explained including their connections and the use of VHF, UHF wireless and IR microphones and their frequency allocations.

"A **microphone**, is an acoustic-to-electric transducer or sensor that converts sound into an electrical signal" according to Wikipedia". They are used in many applications such as telephones, recorders, hearing aids, motion picture production, live and recorded audio engineering, in radio and television broadcasting and in computers for recording voice, VoIP, and for non-acoustic purposes such as ultrasonic checking.

The most common designs today use a thin membrane which vibrates in response to sound pressure. This movement is subsequently translated into an electrical signal. Most microphones for audio use electromagnetic generation (dynamic microphones), capacitance change (condenser microphones) or piezoelectric generation to produce the signal from mechanical vibration.



Condenser microphones:

Condenser microphones span the range from inexpensive Karaoke mics to high-fidelity recording mics. They generally produce a high-quality audio signal and are now the popular choice in laboratory and studio recording

applications. They require a power source, provided either from microphone inputs as phantom power or from a small battery. Power is necessary for establishing the capacitor plate voltage, and is also needed for internal amplification of the signal to a useful output level. Condenser microphones are also available with two diaphragms, the signals from which can be electrically connected such as to provide a range of polar patterns (see below), such as cardioid, omnidirectional and figure-eight.

Dynamic microphones:

Dynamic microphones work via electromagnetic induction. They are robust, relatively inexpensive and resistant to moisture, and for this reason they are widely used on-stage by singers. **Moving coil microphones** use the same dynamic principle as in a loudspeaker, only reversed. A small movable induction coil, positioned in the magnetic field of a permanent magnet, is attached to the diaphragm. When sound enters through the windscreen of the microphone, the sound wave moves the diaphragm. When the diaphragm vibrates, the coil moves in the magnetic field, producing a varying current in the coil through electromagnetic induction. A single dynamic membrane will not respond linearly to all audio frequencies. Some microphones for this reason utilize multiple membranes for the different parts of the audio spectrum and then

combine the resulting signals. Combining the multiple signals correctly is difficult and designs that do this are rare and tend to be expensive. There are on the other hand several designs that are more specifically aimed towards isolated parts of the audio spectrum. The AKG D 112, for example, is designed for bass response rather than treble^[2]. In audio engineering several kinds of microphones are often used at the same time to get the best result.

Ribbon microphones

Ribbon microphones use a thin, usually corrugated metal ribbon suspended in a magnetic field. The ribbon is electrically connected to the microphone's output, and its vibration within the magnetic field generates the electrical signal. Ribbon microphones are similar to moving coil microphones in the sense that both produce sound by means of magnetic induction. Basic ribbon microphones detect sound in a bi-directional (also called figure-eight) pattern because the ribbon, which is open to sound both front and back, responds to the pressure gradient rather than the sound pressure. Though the symmetrical front and rear pickup can be a nuisance in normal stereo recording, the high side rejection can be used to advantage by positioning a ribbon microphone horizontally, for example above cymbals, so that the rear lobe picks up only sound from the cymbals. Crossed figure 8, or Blumlein stereo recording is gaining in popularity, and the figure 8 response of a ribbon microphone is ideal for that application.

Other directional patterns are produced by enclosing one side of the ribbon in an acoustic trap or baffle, allowing sound to reach only one side. Older ribbon microphones, some of which still give very high quality sound reproduction, were once valued for

this reason, but a good low-frequency response could only be obtained if the ribbon is suspended very loosely, and this made them fragile. Modern ribbon materials, including new nanomaterials have now been introduced that eliminate those concerns, and even improve the effective dynamic range of ribbon microphones at low frequencies. Protective wind screens can reduce the danger of damaging a vintage ribbon, and also reduce plosive artifacts in the recording. Properly designed wind screens produce negligible treble attenuation. In common with other classes of dynamic microphone, ribbon microphones don't require phantom power; in fact, this voltage can damage some older ribbon microphones. (There are some new modern ribbon microphone designs which incorporate a preamplifier and therefore do require phantom power, also there are new ribbon materials available that are immune to wind blasts and phantom power.)

Carbon microphones:

A carbon microphone, formerly used in telephone handsets, is a capsule containing carbon granules pressed between two metal plates. A voltage is applied across the metal plates, causing a small current to flow through the carbon. One of the plates, the diaphragm, vibrates in sympathy with incident sound waves, applying a varying pressure to the carbon. The changing pressure deforms the granules, causing the contact area between each pair of adjacent granules to change, and this causes the electrical resistance of the mass of granules to change. The changes in resistance cause a corresponding change in the voltage across the two plates, and hence in the current flowing through the microphone, producing the electrical signal. Carbon microphones were once commonly used in telephones; they have extremely low-quality sound

reproduction and a very limited frequency response range, but are very robust devices.

Crystal microphones:

A crystal microphone uses the phenomenon of piezoelectricity—the ability of some materials to produce a voltage when subjected to pressure—to convert vibrations into an electrical signal. An example of this is Rochelle salt (potassium sodium tartrate), which is a piezoelectric crystal that works as a transducer, both as a microphone and as a slimline loudspeaker component. Crystal microphones used to be commonly supplied with vacuum tube (valve) equipment, such as domestic tape recorders. Their high output impedance matched the high input impedance (typically about 10 megohms) of the vacuum tube input stage well. They were difficult to match to early transistor equipment, and were quickly supplanted by dynamic microphones for a time, and later small electret condenser devices. The high impedance of the crystal microphone made it very susceptible to handling noise, both from the microphone itself and from the connecting cable.

Piezo transducers are often used as contact microphones to amplify sound from acoustic musical instruments, to sense drum hits for triggering electronic samples and to record sound in challenging environments, such as underwater under high pressure. Saddle-mounted pickups **on acoustic guitars** are generally piezos that contact the strings passing over the saddle. This type of microphone is different from magnetic coil pickups commonly visible on typical electric guitars, which use magnetic induction rather than mechanical coupling to pick up vibration.

Wireless Microphones

There are many different standards, frequencies and transmission technologies used to replace the microphone's cable connection and make it into a wireless microphone. They can transmit, for example, in radiowaves using UHF or VHF frequencies, FM, AM, or various digital modulation schemes. Some low cost models use infrared light. Infrared microphones require a direct line of sight between the microphone and the receiver, while costlier radio frequency models do not. The advantage of Infrared being the avoidance of most interference problems

VHF models usually operate on a single fixed frequency, but the more advanced UHF models operate on a user selectable frequency to avoid interference, and allow the use of several microphones at the same time.

Almost all wireless microphone systems use wideband FM modulation, which requires approximately 200 kHz of bandwidth to operate in. Because of the relatively large bandwidth requirements, wireless microphone use is effectively restricted to VHF and above.

Many older wireless microphone systems operate in the VHF part of the electromagnetic spectrum. Systems operating in this range are often crystal-controlled, and therefore operate on a single frequency. However, if this frequency is chosen properly, the system will be able to operate for years without any problems.

Most modern wireless microphone products operate in the UHF television band, however. In the United States, this band extends from 470 MHz to 806 MHz. Other countries have similar band limits; for example, Great

Britain's UHF TV band extends from 470 MHz to 854 MHz. Typically, wireless microphones operate on unused TV channels, with room for one to two microphones per MHz of spectrum available. Starting in January of 2009 UHF channels for wireless microphones will be limited to below 695MHz, due to the FCC auctioning the "white space" frequencies between 695-806MHz for other uses.

Intermodulation (IM) is a major problem when operating multiple systems in one location. IM occurs when two or more RF signals mix in a non-linear circuit, such as an oscillator or mixer. When this occurs, predictable combinations of these frequencies can occur. For example, the combinations 2A-B, 2B-A, and A+B-C might occur, where A, B, and C are the frequencies in operation. If one of these combinations is close to the operating frequency of another system (or one of the original frequencies A, B, or C), then interference will result on that channel. The solution to this problem is to manually calculate all of the possible products, or use a computer program that does this calculation automatically.

Digital Wireless microphones

There are two commonly-used digital transmission schemes in use today: Digital Hybrid and Pure Digital.

Digital Hybrid systems use an analog FM audio signal in combination with digital signal processing (DSP) to enhance the system's audio. Using DSP, it is easier to achieve a flat frequency response in the audio spectrum and to reduce noise and other undesirable effects. Since the audio is transmitted via FM, these systems use 200-500 kHz of bandwidth.

Pure digital systems may take various forms, but many systems use frequency-hopping spread spectrum technology, similar to that used for cordless phones. As this requires more bandwidth than an FM signal, these microphones operate in the 900 MHz or 2.4 GHz unlicensed bands. Unfortunately, this results in interference to and from wireless computer networks, Bluetooth devices, cordless phones, amateur radio operators, and many other things.

Some of the digital wireless microphone systems use encryption technology to prevent eavesdropping.

Licensing of Wireless Microphones

In the UK, use of wireless microphone systems requires a license, except for the license free bands of 173.8 MHz - 175.0 MHz and 863 MHz - 865 MHz (N.B. This is emphatically **NOT** TV Channel 69. Channel 69 is from 854 - 862 MHz. In the UK Channel 69 frequencies **do** require a license from JFMG Ltd.

The UK communications regulator, Ofcom, has said it will auction part of the spectrum currently reserved for wireless microphones, to which objections have been raised by Andrew Lloyd Webber.

Licenses are required to use wireless microphones on vacant TV channels in the United States as they are a part of the Broadcast Auxiliary Service (BAS). However, this requirement is often overlooked and rarely enforced by the FCC.

In many other countries wireless microphone use requires a license. Some governments regard all radio frequencies as military assets and the use of unlicensed radio transmitters, even wireless microphones, may be severely punished.

Microphone connections

The most common connectors used by microphones are:

- Male XLR connector on professional microphones



- 6.3mm (1/4 inch) mono phone plug on less expensive consumer microphones



- 3.5 mm (1/8 inch) mini stereo jack (wired as mono) mini phone plug on very inexpensive and computer microphones



A 6.3mm (1/4 inch) stereo phone plug or TRS connector (also called an audio jack, phone plug, jack plug, stereo plug, mini-jack, or mini-stereo), 5-pin XLR, or 3.5mm stereo mini phone plug (1/8 inch TRS) are used on some

stereo microphones. Some lavalier microphones use a proprietary connector for connection to a wireless transmitter. Since 2005, professional-quality microphones with [USB](#) connections have begun to appear, designed for direct recording into computer-based software.

Impedance-matching

Microphones have an electrical characteristic called impedance, measured in ohms (Ω), that depends on the design. Typically, the *rated impedance* is stated. Low impedance is considered under 600 Ω . Medium impedance is considered between 600 Ω and 10 k Ω . High impedance is above 10 k Ω .

Most professional microphones are low impedance, about 200 Ω or lower. Low-impedance microphones are preferred over high impedance for two reasons: one is that using a high-impedance microphone with a long cable will result in loss of high frequency signal due to the capacitance of the cable; the other is that long high-impedance cables tend to pick up more hum (and possibly radio-frequency interference RFI as well). However, some devices, such as vacuum tube guitar amplifiers, have an input impedance that is inherently high, requiring the use of a high impedance microphone or a matching transformer. Nothing will be damaged if the impedance between microphone and other equipment is mismatched; the worst that will happen is a reduction in signal or change in frequency response.

To get the best sound, the impedance of the microphone must be distinctly lower (by a factor of at least five) than that of the equipment to which it is connected. Most microphones are designed not to have their impedance "matched" by the load to which they are connected; doing so can alter their

frequency response and cause distortion, especially at high sound pressure levels. There are transformers (confusingly called **matching transformers**) that adapt impedances for special cases such as connecting microphones to DI units or connecting low-impedance microphones to the high-impedance inputs of certain amplifiers, but microphone connections generally follow the principle of bridging (voltage transfer), not matching (power transfer). In general, any XLR microphone can usually be connected

to any mixer with XLR microphone inputs, and any plug microphone can usually be connected to any jack that is marked as a microphone input, but not to a line input. This is because the signal level of a microphone is typically 40 to 60 dB lower (a factor of 100 to 1000) than a line input. Microphone inputs include the necessary amplification to handle these very low level signals. Certain ribbon and dynamic microphones, which are most linear when operated into a load of known impedance, are exceptions

About the Author

Compiled from a number of sources including Wikipedia

[More.... Tips and Articles from Edis Trading](#)