Microphone Characteristics, Types and Properties

A microphone is a device known as a type of transducer that converts an audio signal into an electrical voltage. The sensitivity of the microphone and the way this process happens differentiates between different microphone types.

When choosing a microphone you should consider the characteristics and the properties of a microphone to get the best possible recording. Some microphones are built for a purpose while others are built for a more general use; this is why care should be taken when opting for a microphone.

Cross-Section of Dynamic Microphone

![Diagram of a dynamic microphone]

Fig.1. Mic-Dynamic

Dynamic microphones consist of a magnet, coil and diaphragm. Sound waves vibrate the diaphragm that moves the coil making an electromagnetic induction; this changes the electric charge sent down the wire which is then converted to audio using Analogue to digital converters (DC’s).

Dynamic microphones are also very robust, resistant to moisture and are rarely expensive which makes them the most common choice for live performances. Unlike condenser microphones, dynamic’s don’t require their own power supply.
The sound quality of a dynamic is generally not as accurate as a condenser but they do have the ability to withstand a lot more high sound pressure levels without any occurring distortion. This makes them very useful when recording a sound reasonably close or loud.

Unlike condenser microphones the frequency response of a dynamic microphone is tailored to a specific quality. Dynamics commonly have a limited frequency response, “the result of this curtailed upper response for dynamic mics is that most of them don’t do justice to very high-frequency sounds such as cymbals, bells, or the upper harmonics of the acoustic guitar or piano [Sound on sound 1998].”

Dynamic microphones are generally used to record drums, bass, snares and any close miking, this is due to the sensitivity of a dynamic mic. A dynamic lacks sensitivity to quiet sounds, this means the microphone has to be turned up considerably to make the sound audible which will introduce more noise into the signal path.

“In practical terms, this means that dynamic mics are fine for loud sounds, such as drums and electric guitar, and they’re good for medium-level sounds at close range, such as vocals, but they can fall down badly when you try to record quiet or distant sounds [Sound on Sound, 1998].”
A condenser microphone has a two-plated diaphragm that acts as one, “one that can move, which acts as a diaphragm, and one that is fixed, called a back plate. This is, in effect, a capacitor (or “condenser”) with a positively and negatively charged electrode and an air space in between. Sound depresses the diaphragm, causing a change in the spacing between it and the back plate” (Owsinski, 2005). The charge between the diaphragms sends signals down the wire to generate sound.

The diaphragms are thin which requires less energy to vibrate them in turn makes condenser mics very sensitive to quite sounds and are capable of capturing the higher frequencies. A condenser microphone requires a constant charge that is taken from a battery or phantom power (48 Volts). There are two types of condensers a small diaphragm and a large diaphragm.

The small diaphragm mics are commonly used on vocals and live instruments and tends to be more accurate than the large diaphragms having a wider frequency response. Generally speaking small diaphragms tend to be good at capturing high frequency’s and ambience due to its ability to capture sounds from all types of angles with a low time delay. “Small-diaphragm mics are usually less expensive and can be used onstage as handhelds, or to record instruments” (Kirn 2005).
Large diaphragm mics are also commonly used to record vocals. Out of both the large and small diaphragm microphones the large diaphragm is generally a more "deep" toned microphone that tends to warm up the sound. “The larger, more flexible diaphragm gives a richer, more detailed sound with a higher sensitivity, and so is generally preferable for primary announcing duties” (Herrington 2005).

The main negative of large diaphragms is their expense. Due to there expense the large diaphragm is looked upon as a luxury microphone in a home studio. However, a large diaphragm microphone will greatly improve the standard of all recordings.

Condensers posses a “flat” frequency response that gives them the ability to reproduce an instrument or voice a lot more accurately than dynamics. Condenser mics are however much more sensitive to loud sounds and can be expensive to repair if broken. Condenser microphones are generally used to record vocals, guitars, cellos, cymbals and any ambience.

Ribbon Microphone

![Ribbon Microphone - Front View](image)

**Fig.4. Ribbon Mic**

Ribbon mics work off the same principal has a dynamic microphone except one main factor; unlike a dynamic mic, a ribbon microphone uses a very thin plate of corrugated aluminium that is suspended in a magnetic field.
The vibration of the ribbon vibrates in a magnetic field and it is this vibration that generates sound. “The thin strip of metal moves very much like a sail, due to the action of the sound waves. This motion induces a voltage in the coil around the magnet” (Dyer 2011). Also be aware if the ribbon microphone may or may not be “active”. Generally just like dynamic microphones, ribbons do not use a power supply. If phantom power is used this can have a profound effect damaging the ribbons.

The known quality’s of a ribbon microphone is its high response to the mid range frequencies and the low range frequencies. The extremely thin plate within the ribbon microphone is very sensitive and is able to pick up sound pressure waves more freely. A ribbon microphone will pick up a much more detailed recording than both a condenser and dynamic microphone.

However, this sensitivity has to be treated very carefully, something as small as a blow can fracture the ribbon. Its recommended if used for vocals to always use a pop shield and this can be tricky due to the ribbon microphone polar pattern (Figure of eight). Ribbon mics also generally need a low noise pre-amp to increase the microphones output volume as the ribbons lacks gain. “Passive ribbon mics require more gain than dynamics and condensers to achieve optimum performance—70dB or more is ideal. Typically, the preamps in inexpensive digital interfaces offer less than 60dB of gain. So if you use one of these, you’ll want to invest in an external preamp for your ribbon” (Robair 2011). This can be problematic as the more gain added the more noise that will be introduced to the recording signal.

<table>
<thead>
<tr>
<th>Microphone Type</th>
<th>Output</th>
<th>Ruggedness</th>
<th>Sound Quality</th>
<th>Throw</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ribbon</td>
<td>Poorest</td>
<td>Poorest</td>
<td>Best</td>
<td>2nd Best</td>
</tr>
<tr>
<td>Dynamic</td>
<td>2nd Best</td>
<td>Best</td>
<td>Poorest</td>
<td>Best</td>
</tr>
<tr>
<td>Condenser</td>
<td>Best</td>
<td>Poor 2nd</td>
<td>Close 2nd</td>
<td>Poorest</td>
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</tbody>
</table>
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