Microphones

Microphone characteristics

- Operating principle:

A microphone is an example of a “transducer" a device which convert energy from one form into another in this case from sound energy into electrical energy.

Characteristics of Microphones

- Sensitivity
- Signal to noise ratio
- Frequency response
- Distortion
- Directivity
- Output impedance

Sensitivity

- Output in mill volts for the sound pressure of 1 microbar at 1000Hz. As the normal level of speech provides sound pressure of 1 microbar, the sensitivity based on this criteria is more appropriate.

Signal to noise ratio

- Some noise called self noise is generated inside the microphone due to resistance of the circuit, built in transformer, etc. It is represented in terms of sound pressure level (SPL). Instead of quoting the noise alone, manufactures quote signal to noise ratio. It is defined to be the ratio in dB of the output (with SPL of 1microbar) to the output in the absence of sound.

Frequency response

- Frequency response refers to the way a microphone responds to different frequencies. It is a characteristic of all microphones that some frequencies are exaggerated and others are attenuated (reduced). For example, a frequency response which favours high frequencies means that the resulting audio output will sound more trebly than the original sound.
- Audible frequency range is 16Hz to 20000 Hz.
- A microphone which gives flat response within frequencies 40Hz to 15000Hz is considered as good for high quality sound.

Distortion

- Non linear – distorts amplitude of the signal, which results in production of such harmonics in the output that are not present in the input sound.
- Phase – may cause change of phase relation ship between different components of a complex sound wave. Happens when multiple microphones are used.

Directivity

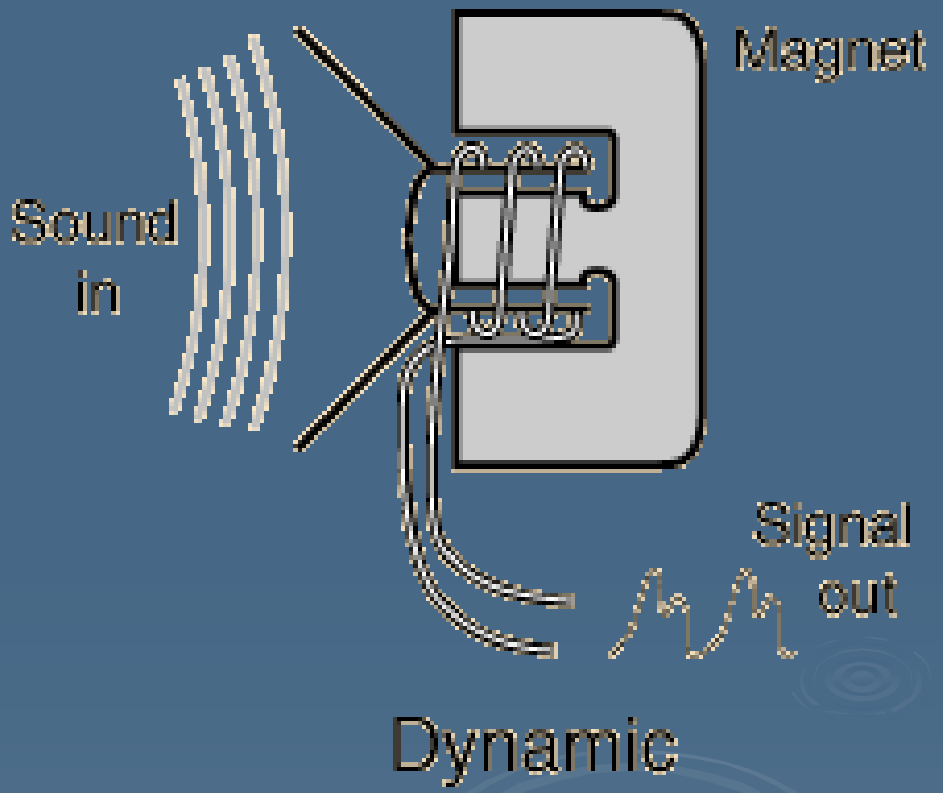
- The direction in which microphone capture the sound or in which axis the microphone capture the most.

Output impedance

- **Impedance** is an electronics term, which measures the amount of opposition to an AC current (such as an audio signal) in a circuit. Technically speaking, it is the combined effect of capacitance, inductance, and resistance on a signal.
- Impedance is measured in ohms, shown with the Greek Omega symbol **Ω** or the letter **Z**. A microphone with the specification 600Ω has an impedance of 600 ohms.

Dynamic or moving coil microphone

- In dynamic, microphone, sound waves cause movement of a thin metallic diaphragm and an attached coil of wire.
- A magnet produces a magnetic field which surrounds the coil, and motion of the coil within this field causes current to flow.
- Current is produced by the motion of the diaphragm, and that the amount of current is determined by the speed of that motion. This kind of microphone is known as **velocity sensitive.**



capacitance

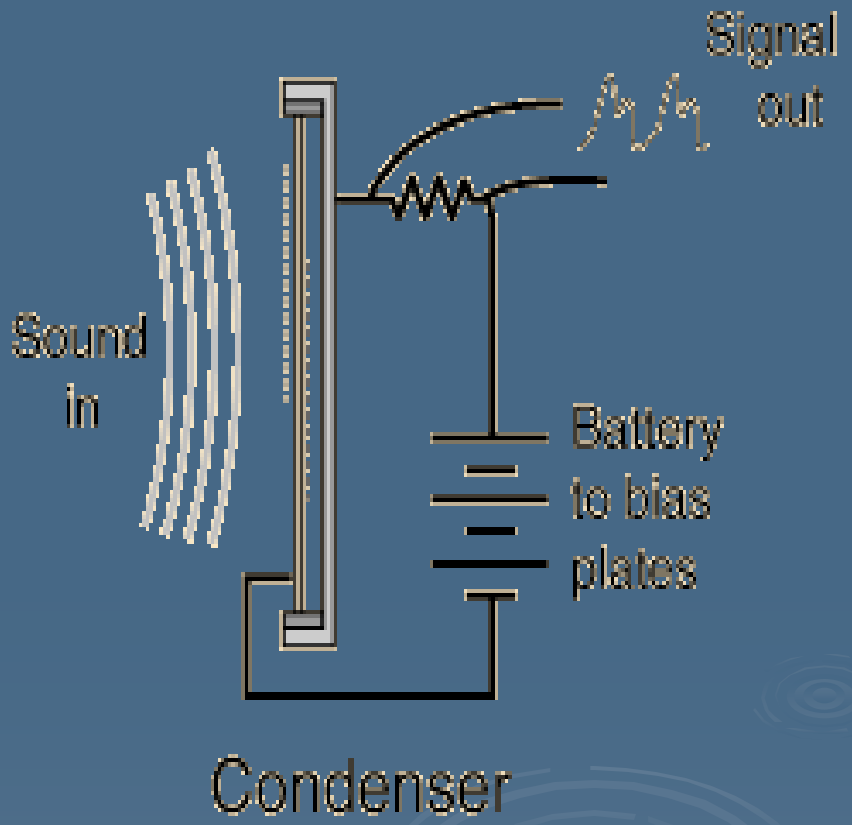
- Capacitance is measure of amount of electric charge.
- A capacitor is an electrical device that can store energy in the electric field between a pair of closely spaced conductors (called 'plates').
- Capacitors are used in electrical circuits as energy-storage devices.

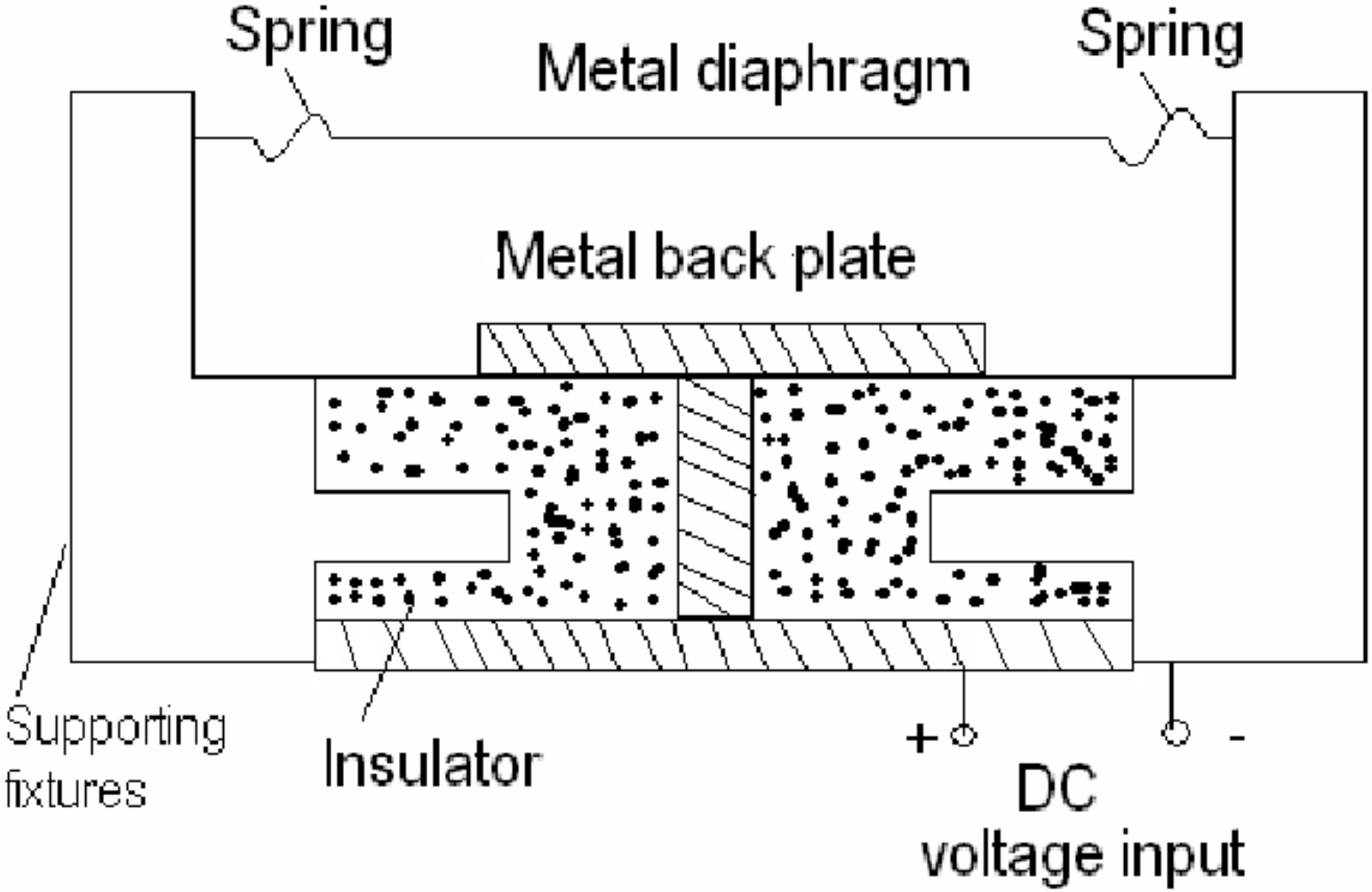
Capacitor/Electrostatic or Condenser microphone

- In this a conducting diaphragm (plastic coated with metal deposit) positioned near to a rigid metal piece so that two of them form a capacitor.
- The combination of diaphragm and the back plate is known as the capsule.
- Capacitance changes occur as a result of the diaphragm moving in the presence of sound waves.
- The plate has to be charged

  one way is by using electrets

  other way is using 48v dc supply

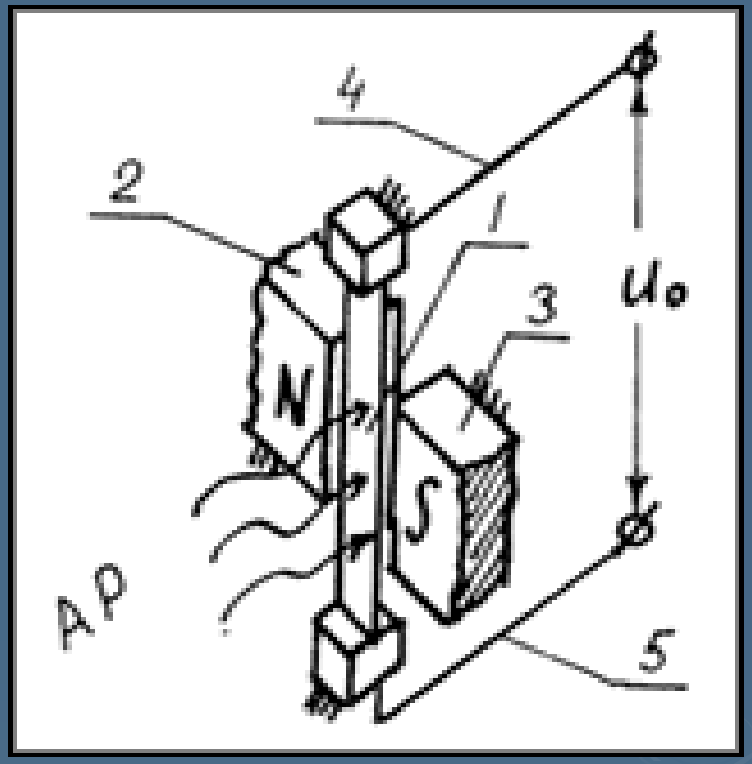



Spring
Metal diaphragm
Spring
Metal back plate
Supporting fixtures
Insulator
+
-
DC voltage input

- An electrets is a substance that almost permanently retains electrical charge.
- Giving 48V dc supply is called T-Powering.

Ribbon microphone

- In a ribbon microphone, the sound field acts on a light metal ribbon placed between the poles of a magnet. A vibratory motion of the ribbon induces a voltage along the ribbon. The voltage is proportional to the difference between the acoustic pressures at both sides of the ribbon.
- AP = acoustic pressure, Uo = output voltage, 1 = light metal ribbon, 2 and 3 = poles of magnet, 4 and 5 = electrical leads.



Crystal or Piezo electric Microphones

- Certain crystals change their electrical properties as they change shape (Barium, titanate and quartz). By attaching a diaphragm to a crystal, the crystal will create a signal when sound waves hit the diaphragm.
- Quartz when compressed or bent, it generates a charge or voltage on its surface. This is a fairly common phenomenon called the **Piezoelectric effect**.

Carbon Granules or Carbon microphones

- Carbon granules are loosely packed in contact with the diaphragm in such a way that when the diaphragm moves it moves the granules.
- As sound waves hit the diaphragm, they compress the carbon dust, which changes its resistance. By running a current through the carbon, the changing resistance changes the amount of current that flows.

Pick –up or directivity pattern

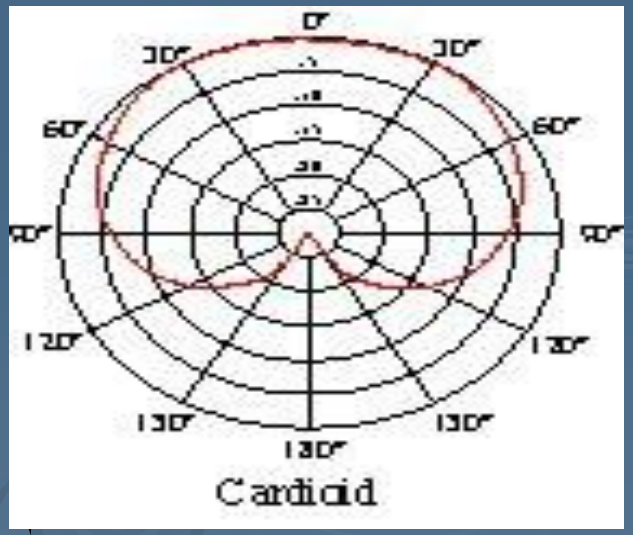
- An important characteristics of a microphone is its response to sound arriving from different direction. This is called Polar Pattern.
- microphone pickup patterns:
    1. Omni
    2. Cardioid
        a. Cardioid
        b. Super-Cardioid
        c. Hyper-Cardioid
    3. Figure-of-eight or bi directional

Omni directional

- Microphones has equal response at all angles. it's coverage or pickup angle is a full 360 degrees.
- This type of microphones are used if more room ambience is desired.

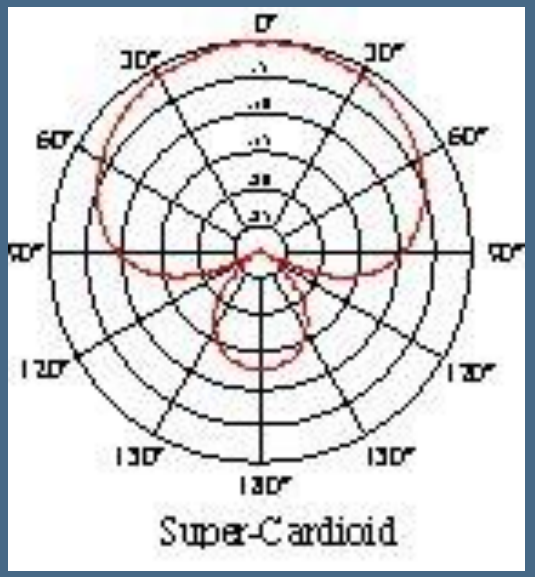
Cardioid

- This has full sensitivity at 0 degrees (on-axis) and is least sensitive at 180 degree (off-axis).
- Cardioid microphone picks up only about one-third as much ambient sound as an omni.



SuperCardioid

- This pattern offer narrow front pickup angles than the cardioid and also greater rejection of ambient sound.
- The least sensitive direction is 125 degrees.



HyperCardioid

- This pattern also offer narrow pickup angles than the cardioid and also greater rejection of ambient.
- The least sensitive direction is at 110 degrees.

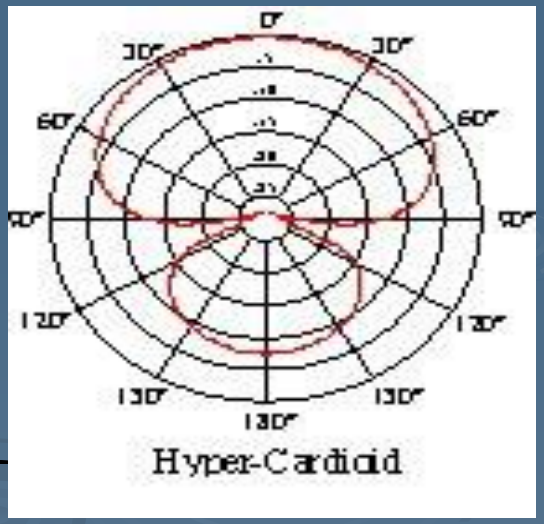
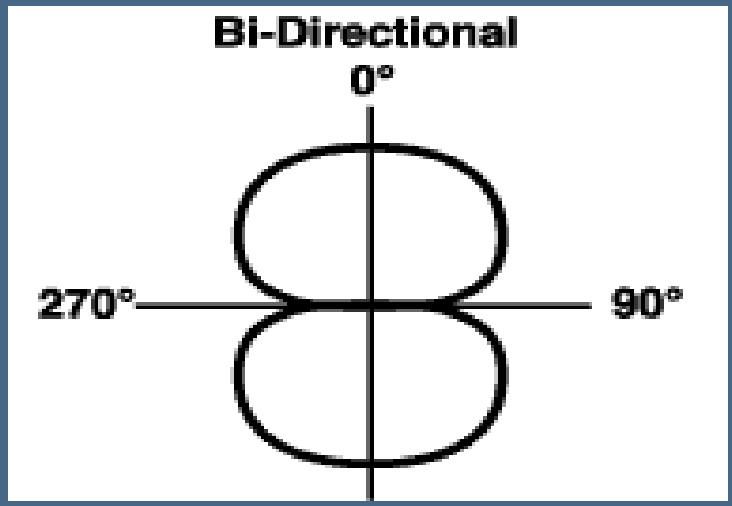


Figure- of eight or bi directional microphones

- This type of microphone has full response at both 0 degree (front) and at 180 degrees back.
- It has least response at the sides.



Proximity Effect

- For most unidirectional types bass response increases as the microphone is moved closer to the sound source.

- Omni directional-

- Cardioid-

- Supercardioid-

Requisites of a good microphone

- High Sensitivity
- High Signal to noise ratio
- Flat frequency response
- Natural resonant frequency outside audible range
- Low distortion
- Out put impedance should match line impedance
- Directivity should meet the requirement of application

Microphone techniques

- Proper micking technique comes down to choose the right mic and positioning it properly.
- Microphone placement is broken into two broad categories:

  1. Mono micking
  2. Stereo micking

- Mono micking: the basic idea of mono micking is the collection of various mono sources of sound for combination in a mix for a simulated stereo effect. Often mono and stereo mix together

Mono Microphone technique

Distant microphone placement:

- The positioning of one or two microphones at 3 ft from the sound source.
- Such a distance picks up tonally balanced sound from the instrument and also picks up the acoustic environment ie reflected sound.
- Distant microphone is often used for choirs or orchestras. Mic placement depends on size of sound and the reverberant characteristics of the room.

Close microphone placement:

- The mic placed 1” or 3” from the source. Only direct, on-axis sound is captured.
- Creates a tight present sound quality which effectively exclude the acoustic environment.

Accent micking:

- A not too close micking technique used to highlight an instrument in an ensemble which is being picked by distant mikes.
- The accent micking will add more volume and presence to the highlighted instrument when mixed together with the main mic.

Ambient micking:

- An ambient mic is placed in such a way that the reverberant or room sound is more prominent than the direct signals.
- The ambient microphone will enhance the recorded sound in a number of ways :

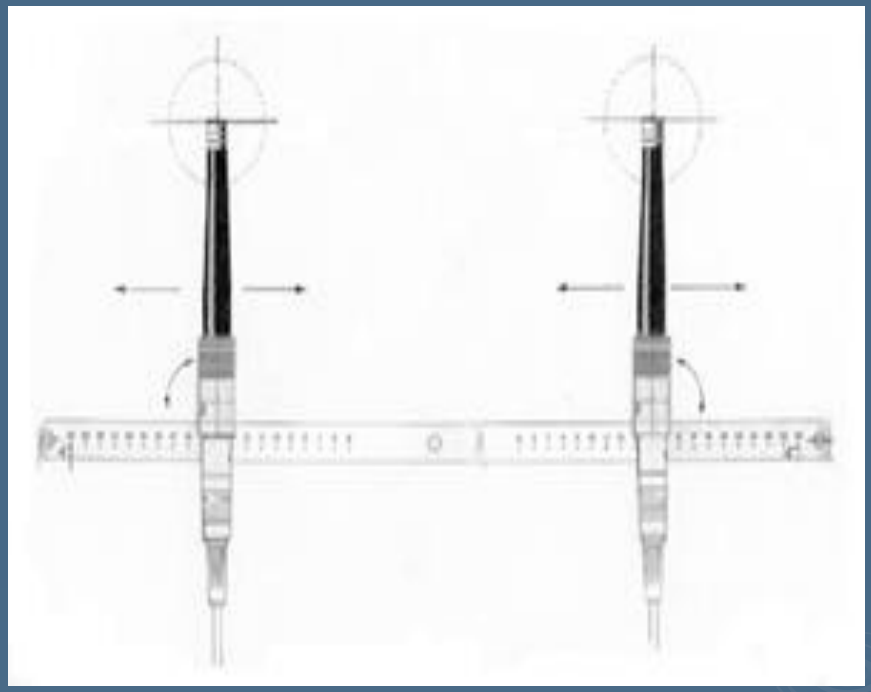
a. Restore natural reverb to alive sound.
b. Used to pick up the audience reaction in alive concert.
c. In a studio used to add the studio rooms acoustic back in to a close micked recording.

Stereo micking technique

- The use of two identical microphone to obtain a stereo image.

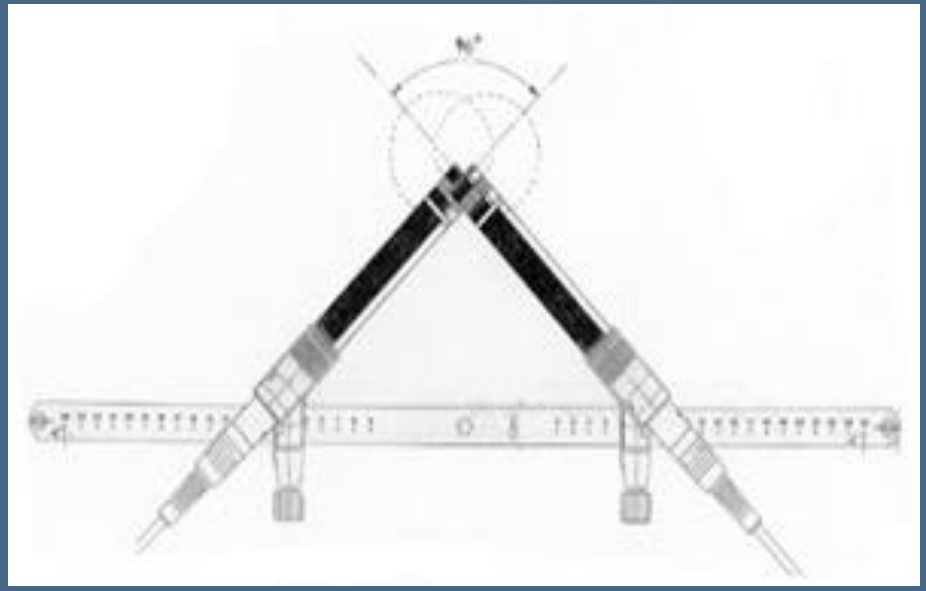
AB or Spaced pair:

- The two (omni or cardioid) are placed quite far from each other to preserve a stereo image of the sound.



XY pair:

- Two cardioid microphone set at an angle of between 90 and 135 degrees



Wireless microphone

- Invented by Hung C. Lin, the first wireless microphone went into production in 1962, called the "transistophone" and put out by the German equipment manufacturer beyerdynamic.
- There are many standards and frequencies in wireless microphones. They can transmit, for example, in radiowaves UHF, VHF, FM, AM, and some cheap models, in infrared light.

Cordless Microphone

Rifle Microphone

- This is usually known as a shotgun mic because of its similarity in appearance to a gun barrel.

Microphone manufactures

- AKG, Shure, Rode, Audio-Technica, Neumann, Beyerdynamic, crown, DPA, dbx, Sennheiser

Condenser microphone

- AKG C414

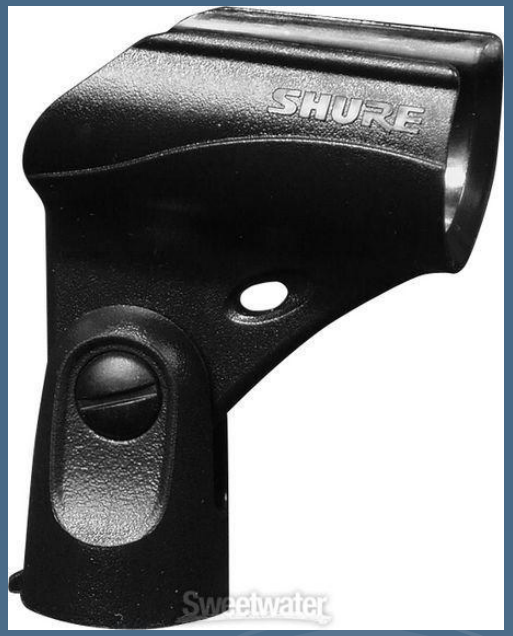
- AKG C1000s

- Rode NT1-A

- Shure KSM 44

Dynamic Microphone

- Shure SM58



- Sennheiser e 609 Silver

- AKG D 112

- Neumann BCM 705

Ribbon Microphone

- Beyerdynamic M130 & M160 Bundle

- Pop filter

Boom Microphone

Lavalier (lapel or lap) microphone

Microphone with headphone

Guitar amps are micked very closely.

Snare drum mics need to be close to the skin