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MUM 2600
Microphone Notes

Microphone – a transducer that converts one type of energy (sound waves) into another corresponding form of energy (electric signal).

The overall sound is only as good as the weakest link in the signal path.

The good rule:
Good musician + good acoustics + good mike + good placement = good sound

DYNAMIC MICS
Dynamic microphone uses electromagnetic induction to generate an output signal.
In theory: whenever an electrically conductive metal cuts across the flux lines of a magnetic field, a current of a specific magnitude and direction will be generated within the metal.

RIBBON MICS
Similar principle to dynamic mic except that the diaphragm is made of extremely thin aluminum.

Because the diaphragm is light (compared to the coil of the dynamic mic), a step-up transformer must be used to bring the output impedance up from 2 ohms to the acceptable range of 150 – 600 Ω.

CONDENSER MICS
Operate on electrostatic instead of electromagnetic principle. The capsule consists of two thin plates, one fixed and one movable. The plates form a capacitor or condenser. A condenser is an electric device capable of storing an electric charge.

Because the diaphragm's output is of extremely high impedance, it is fed through an impedance conversion amplifier which is placed into the circuit at close proximity to the diaphragm in order to prevent hum and noise. This is why condenser microphones require a power supply voltage in order to operate.

Electret-Condenser microphones feature a permanently stored polarizing charge on the microphone's back-plate or diaphragm. Since the capsule still has a very high output impedance, phantom power or n external power supply is still required.

MICROPHONE CHARACTERISTICS

Directional response refers to the mic's output level at various angles of incidence with the respect to the front side of the mic.

Patterns:
Omnidirectional polar response – pressure sensitive device (mic) responsive to sound waves from all directions.
Directional microphones are pressure-gradient. They discern pressure differences coming from different directions.
Bi-directional microphone is one that is purely pressure gradient. Many ribbon mics are bi-directional.
Most commonly known patterns are:

- Cardioid
- Supercardioid
- Hypercardioid
- Omnidirectional
- Bidirectional
- Hemispheric

The cardioid pattern, sometimes called unidirectional, looks like an upside-down heart. These mics pick up sound from the front and reject sound from the rear. Thusly, this pattern is a favorite for live situations.

The supercardioid is similar to the cardioid except that this pattern adds sensitivity to the rear. This microphone is useful for picking up the direct sound and some of the reflections from the rear of the microphone.

The supercardioid picks up a little more than 180° from the front. The supercardioid pattern pick up a very broad picture from the front. From the rear, the microphone picks up a narrow beam of sound waves. This microphone is very useful when recording a large horn section or vocal ensemble.

The omnidirectional pattern picks up sound equally from all directions. This pattern is an excellent choice for a "live" recording feel, acoustic bass and surround sound applications.

The bidirectional microphone pattern picks up form the front and rear equally and eliminates sound from the left or right side. This mic is great when two people are facing each other while performing or in the case of a panel discussion when a performer or lecturer is interacting with the audience.

A PZM zone pressure microphone is the most common example of a hemispheric pattern microphone. The hemispheric pattern picks up sound in the shape of a half-sphere. For this reason, PZM mics are often set on the studio glass at about 5 to 6 feet in height. This enable the hemispheric pattern to capture sound from floor to ceiling in a three-dimensional way.

For an excellent discussion on microphones, connectors and patterns, please visit:
http://www.indiana.edu/~emusic/micropho.htm

FREQUENCY RESPONSE
Response is measured against the standard 20 - 20,000 Hz Frequency range.
Flat response means equal output at all levels.

Low freq. (3 – 25 Hz) can cause rumble. Use a shock mount to eliminate or reduce effect.

Proximity effect is an increased bass response when sound source is closer than 1' to the mic.

Transient response – how quickly does mic react to the sound wave.

Dynamic mics, because they have large diaphragms, have slow responses producing rugged, gutsy and less accurate sound than smaller diaphragm mics.

Ribbon mics have very small diaphragms producing a very fast and accurate response.

OUTPUT CHARACTERISTICS
Sensitivity rating – is the output level in volts that a microphone will produce given a specific and standardized input level (rated in dB). The measurement specifies the amount of amplification needed to raise the mic's signal to line level (-10 or +4).
The higher the mic's sensitivity level, the higher it's output level.

EQUIVALENT NOISE RATING – the device's electrical self-noise.

Overload Characteristics – at what point does the input level cause distortion. Condenser mics are very sensitive and therefore usually have a built in pad.

MIC IMPEDANCE
Dynamic mics are low impedance devices that use a built-in step-up transformer. These mics cables often pickup electrostatic noise. They use unbalanced lines.

High-impedance mics.

MICROPHONE PREAMPS
Used because most mics can't put enough signal for line level. A mic preamp is used to boost the signal (30 – 60 dB) to an acceptable level.

Most preamps today are very inexpensive and sound great. Most offer features such as: Input gain, high-pass filtering and phantom power.

Phantom Power
Phantom power supplies a positive DC supply voltage of 48+ V to both conductors (pins 2 and 3) of a balanced mic line. Most condenser mics need phantom power in order to work correctly.

MICROPHONE TECHNIQUES

All mics have a distinctive sound based on their design.

MIC PLACEMENT

Distant placement – more than 3' from source.

1. Picks up a large portion of the sound from an individual instrument or ensemble. This technique helps to preserve overall tonal balance. A natural balance can often be achieved by placing the mic at a distance that's roughly equal to the size of the instrument or sound source. Used for vocal ensembles, string ensembles and large groups.
2. This technique allows the "room sound" to be picked up and incorporated into the overall sound.

Close placement – 1' – 3' from source.

1. Creates, tight, present sound quality.
2. Effectively excludes the acoustic environment (room sound).

Leakage is defined as when sound from one instrument is picked up by a nearby microphone. Happens often with horn sessions and live rhythm section recordings.
Techniques used in avoiding leakage:

1. Bring mics closer to respective instruments.
2. Place an acoustic barrier between instruments. (Baffle, gobo, flat, divider, etc.)
3. Use directional mics.
4. Spread the instruments farther apart.

Whenever individual instruments are being recorded close or semi-close, it's generally wise to follow the 3:1 distance rule. The rule states that in order to maintain phase integrity … for every unit of distance between a mic and its source, a nearby mic (or mics) should be separated by at least three times that distance.

Accent Placement
Accent mic – a mic placed by an instrument or section, inside of a larger ensemble, in a close but not so close position as to record an unnatural sound. Used to add presence to those instruments without changing the balance or spatial relationship of the overall recording.
Ex. Placing a mic close to the double-reed section in an orchestra.

Ambient Placement
Ambient mic is placed at a distance so that the room sound is more prominent than the source sound.
Reasons for use of ambient mics:

1. In a live concert, to restore natural reverberation and room sound lost by close mic techniques.
2. In live recordings, ambient mics pick up audience sound.
3. In studios, used to add a sense of natural acoustics back into the sound. This is particularly useful when recording a "section" such as horns, strings or vocals.

Stereo Techniques

The use of two microphones in one of three ways:

1. Spaced pair – *Uses time and amplitude cues to create a stereo image*. Two mics of the same manufacturer, type and model can be placed from 3' to 30' in front of an ensemble in left to right fashion in order to achieve an overall stereo image. The primary drawback of this technique is the possibility of phase discrepancies due to the difference in arrival time of the sound between the two mics.

2. XY coincident pair technique – *Uses only amplitude cues to create a stereo image*. Two directional mics of the exact same type, manufacturer and model are placed with their grills as close together as possible without touching. The should face between 90° and 135°. The midpoint between the the mics is faced toward the source and the mic outputs are equally panned left and right. The stereo imaging in this case is excellent and often better than the spaced pair. The generally accepted polar pattern is cardiod. The Blumlein technique uses two crossed bi-directional mics. (See page 119 for drawing.)

3. M-S method – Mid-side technique. M/S classic technique uses one mic to be the mid-positioned pickup, generally oriented towards the sound source and using a cardioid pick-up pattern. The S (side) capsule is generally chosen to be a figure-8 pattern that's oriented sideways (with the 90° null side facing the cardioid's main axis). "M" picks up direct sound and "S" picks up the ambient sound.

<u>DIRECT RECORDING</u>

D.I. (direct injection) box serves to interface in the following ways:

1. Reduces an instrument's line-level output to mic level for direct insertion into console.
2. Changes an instrument's unbalanced, high-source impedance line to a balanced, low-impedance signal.
3. Electrically isolates audio signal paths reducing ground loop hum.

It is common to use both the direct sound and a mic sound in combination in recording. Especially used in recordings of bass.