



SPECTACOLO SOUND DESIGN COURSE

HOSTED BY MASHIRIKA PERFORMING
ARTS & MEDIA COMPANY

TRAINING

BY

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Introduction to Microphones

Overview:

A microphone is a device that converts sound waves into electrical signals. It is an essential tool in various fields such as music, broadcasting, film production, and communication.

- Importance of Microphones:

- **Recording:** Microphones are crucial in capturing high-quality audio for music, podcasts, and voiceovers.
- **Live Sound:** They are used in concerts, public speaking events, and theater to amplify sound.
- **Broadcasting:** Essential for radio, television, and online streaming to ensure clear audio transmission.
- **Communication:** Used in telephones, video conferencing, and hearing aids to facilitate effective communication.

Brief history of Microphones

- **Early Beginnings:**
 - The concept of the microphone dates back to the 17th century with early acoustic devices like Robert Hooke's "lovers' telephone."
 - The term "microphone" was coined by Sir Charles Wheatstone in 1827.
- **19th Century Innovations:**
 - Alexander Graham Bell and Elisha Gray developed the liquid transmitter in 1876, an early form of the microphone.
 - David Edward Hughes invented the carbon microphone in 1878, which became widely used in telephones and broadcasting.
- **20th Century Advancements:**
 - E.C. Wente invented the condenser microphone in 1916, significantly improving audio quality.
 - Dr. Harry F. Olson patented the dynamic moving coil microphone in 1931.
 - Georg Neumann's development of the condenser microphone in 1932 became a recording studio standard.
- **Modern Developments:**
 - The late 20th century saw digital technology, leading to USB microphones, wireless microphones, and highly sensitive the rise of condenser microphones used in professional settings.

Basic Principles

- **How Microphones Work:**
 - **Transduction:** Microphones function as transducers, converting sound waves (mechanical energy) into electrical signals.
 - **Diaphragm:** The diaphragm is a key component that vibrates in response to sound waves. These vibrations are then converted into electrical signals.
- **Types of Transduction:**
 - **Electromagnetic Induction:** Used in dynamic microphones, where a coil of wire moves within a magnetic field to generate an electrical signal.
 - **Electrostatic Principle:** Used in condenser microphones, where sound waves cause variations in the distance between two charged plates, creating an electrical signal.
- **Key Components:**
 - **Diaphragm:** Captures sound waves and vibrates in response.
 - **Magnet:** Interacts with the diaphragm to generate a magnetic field.
 - **Voice Coil:** Moves within the magnetic field to convert sound vibrations into electrical signals.
- **Signal Processing:**
 - The electrical signal produced by the microphone is often very weak and requires amplification before it can be used in recording or broadcasting.

Types of Microphones

- **Dynamic Microphones:**
 - **How They Work:** Use electromagnetic induction to convert sound into an electrical signal.
 - **Characteristics:** Durable, less sensitive to high frequencies, and can handle high sound pressure levels.
 - **Common Uses:** Live sound, vocals, and instruments like drums and guitar amplifiers.
- **Condenser Microphones:**
 - **How They Work:** Use electrostatic principles with a diaphragm and backplate to create an electrical signal.
 - **Characteristics:** Highly sensitive, captures detailed sound, requires external power (phantom power).
 - **Common Uses:** Studio recording, vocals, acoustic instruments.
- **Ribbon Microphones:**
 - **How They Work:** Use a thin metal ribbon suspended in a magnetic field to generate an electrical signal.
 - **Characteristics:** Warm, vintage sound, very sensitive, and fragile.
 - **Common Uses:** Studio recording, especially for vocals and string instruments.

Types of microphones



Dynamic



Condenser



Ribbon

Types of Microphones

- **USB Microphones:**
 - **How They Work:** Integrate a built-in preamp and analog-to-digital converter, connecting directly to a computer via USB.
 - **Characteristics:** Convenient, plug-and-play, suitable for home recording and podcasting.
 - **Common Uses:** Podcasting, home studios, video conferencing.
- **Shotgun Microphones:**
 - **How They Work:** Use a highly directional polar pattern to capture sound from a specific direction.
 - **Characteristics:** Long, narrow pickup pattern, excellent for isolating sound.
 - **Common Uses:** Film and video production, broadcasting.
- **Lavalier Microphones:**
 - **How They Work:** Small, clip-on microphones that can be wired or wireless.
 - **Characteristics:** Discreet, hands-free, often omnidirectional.
 - **Common Uses:** Public speaking, theater, television

Types of microphones



USB mic



Lavalier mic

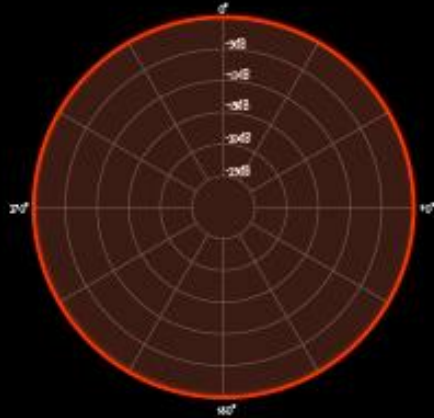


Short gun mic

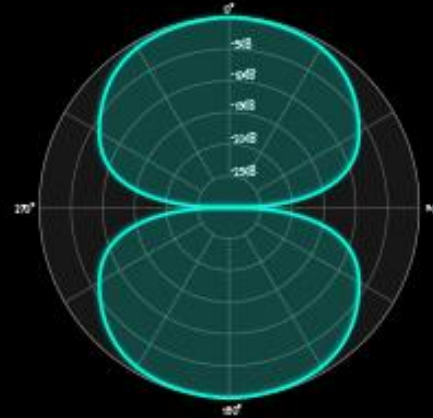
Polar Patterns

- **Cardioid:**
 - **Description:** Picks up sound primarily from the front, with some rejection of sound from the sides and rear.
 - **Applications:** Ideal for live sound and studio recording, especially for vocals and instruments.
- **Omnidirectional:**
 - **Description:** Captures sound equally from all directions.
 - **Applications:** Suitable for capturing ambient sounds, group recordings, and situations where sound from all directions is desired.
- **Bidirectional (Figure-8):**
 - **Description:** Picks up sound from the front and rear while rejecting sound from the sides.
 - **Applications:** Commonly used in studio settings for recording duets or interviews.
- **Shotgun:**
 - **Description:** Highly directional, capturing sound from a narrow area in front of the microphone while rejecting sound from the sides and rear.
 - **Applications:** Perfect for film and video production, where isolating sound from a specific source is crucial.

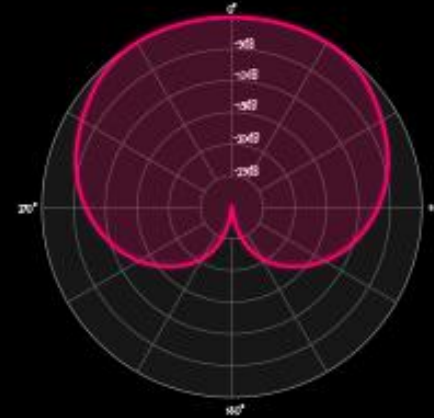
Mic polar patterns



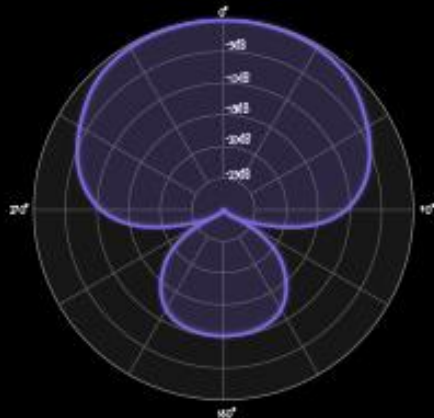
Omni-directional



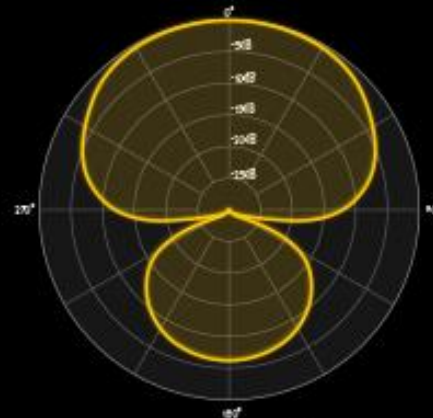
Bi-directional



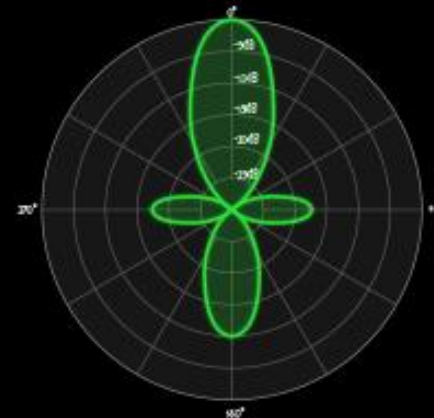
Cardioid



Super-cardioid



Hyper-cardioid



Shotgun

Microphone Components

- **Diaphragm:**

- **Function:** The diaphragm is a thin, flexible membrane that vibrates in response to sound waves.
- **Types:** Can be made from various materials such as mylar, metal, or plastic.
- **Role:** Converts sound waves into mechanical vibrations.

- **Capsule:**

- **Function:** Houses the diaphragm and other components that convert sound into an electrical signal.
- **Types:** Dynamic capsules contain a diaphragm and a coil of wire, while condenser capsules include a diaphragm and a backplate.

Microphone Components

•Voice Coil:

- **Function:** In dynamic microphones, the voice coil moves within a magnetic field to generate an electrical signal.
- **Role:** Converts mechanical vibrations from the diaphragm into electrical signals.

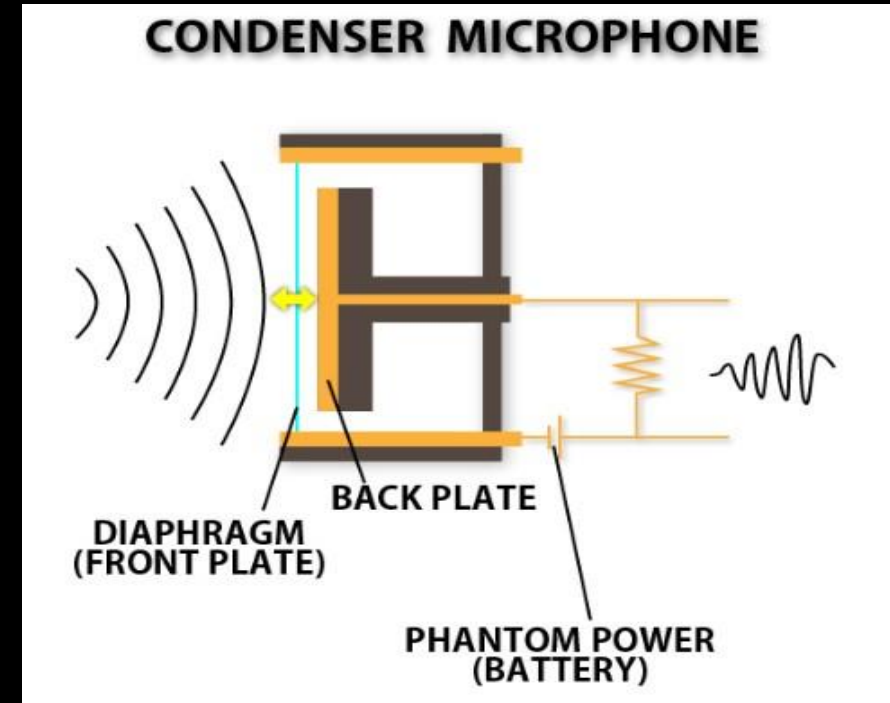
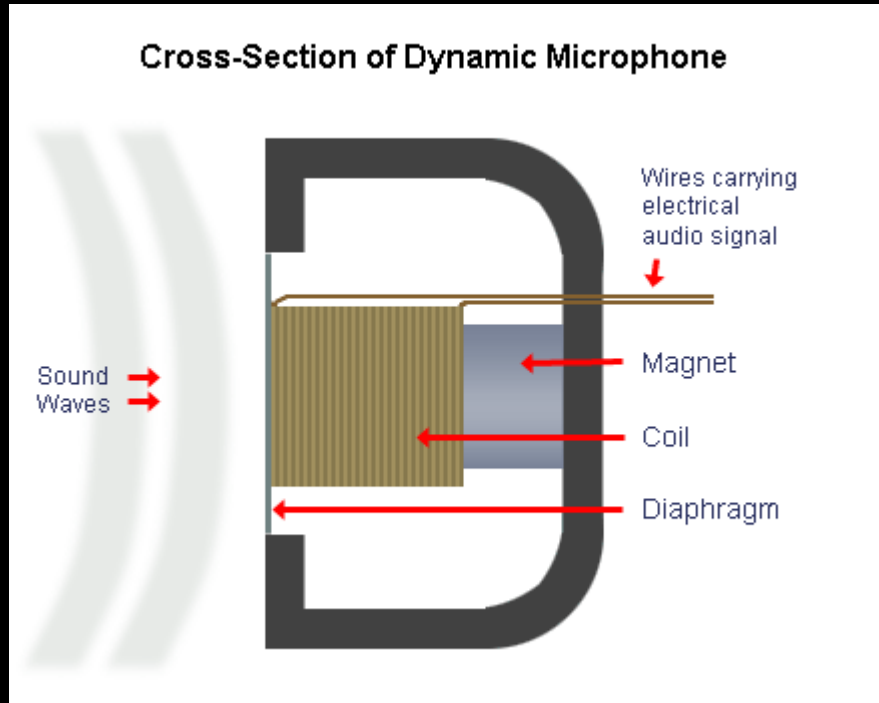
•Magnet:

- **Function:** Creates a magnetic field in which the voice coil moves.
- **Role:** Essential for the electromagnetic induction process in dynamic microphones.

•Preamp:

- **Function:** Amplifies the weak electrical signal generated by the microphone.
- **Types:** Built-in preamps are common in condenser microphones.

Microphone Components



Microphone Components

- **Grille:**

- **Function:** Protects the internal components of the microphone.
- **Role:** Shields the diaphragm and capsule from physical damage and reduces wind noise.

- **Housing/Body:**

- **Function:** Encases and supports all internal components.
- **Role:** Influences the microphone's durability and sound characteristics.

Microphone Accessories

- **Pop Filters:**
 - **Purpose:** Reduces plosive sounds (e.g., "p" and "b" sounds) that can cause distortion.
 - **Types:** Foam filters, fabric screens, and metal screens.
 - **Applications:** Used in recording studios and for podcasting to ensure clear vocal recordings.
- **Shock Mounts:**
 - **Purpose:** Isolates the microphone from mechanical vibrations and handling noise.
 - **Types:** Elastic suspension mounts and integrated shock mounts.
 - **Applications:** Essential for studio recording and live sound to maintain audio clarity.
- **Windscreens:**
 - **Purpose:** Protects the microphone from wind noise and breath sounds.
 - **Types:** Foam covers and furry windscreens (deadcats).
 - **Applications:** Used in outdoor recording, broadcasting, and live sound.

Microphone Accessories



Shock mounts



Wind screens



Pop Filter

Microphone Accessories

- **Microphone Stands:**
 - **Purpose:** Holds the microphone in place for hands-free operation.
 - **Types:** Boom stands, desktop stands, and floor stands.
 - **Applications:** Used in studios, live performances, and broadcasting.
- **Cables:**
 - **Purpose:** Connects the microphone to audio interfaces, mixers, or recording devices.
 - **Types:** XLR cables, USB cables, and TRS cables.
 - **Applications:** Essential for all types of microphone setups.

Microphone Accessories



SOUND FOR THEATRE Application of Microphones



Application of Microphones

- **Recording Studios:**
 - **Types Used:** Condenser microphones for vocals and acoustic instruments, dynamic microphones for drums and amplifiers.
 - **Purpose:** Capturing high-quality audio for music production, voiceovers, and podcasts.
- **Live Sound:**
 - **Types Used:** Dynamic microphones for vocals and instruments, wireless microphones for mobility.
 - **Purpose:** Amplifying sound for concerts, theater performances, and public speaking events.
- **Broadcasting:**
 - **Types Used:** Condenser microphones for clear and detailed audio.
 - **Purpose:** Ensuring high-quality audio for radio, television, and online streaming.

Application of Microphones

- **Film and Video Production:**
 - **Types Used:** Shotgun microphones for directional sound capture, lavalier microphones for discreet placement.
 - **Purpose:** Capturing dialogue and ambient sounds on set.
- **Communication:**
 - **Types Used:** Headset microphones, built-in microphones in devices.
 - **Purpose:** Facilitating clear communication in telephones, video conferencing, and hearing aids.
- **Field Recording:**
 - **Types Used:** Portable recorders with built-in microphones, shotgun microphones.
 - **Purpose:** Capturing environmental sounds, wildlife, and on-location audio.

Choosing the Right Microphone

- **Factors to Consider:**
 - **Purpose:** Determine what you will be recording (e.g., vocals, instruments, podcasts, field recordings).
 - **Environment:** Consider the recording environment (e.g., studio, live performance, outdoor).
 - **Budget:** Balance your needs with your budget. Higher price doesn't always mean better quality for your specific use.
- **Microphone Types:**
 - **Dynamic Microphones:** Durable and good for live sound and loud sources.
 - **Condenser Microphones:** Sensitive and ideal for studio recordings.
 - **Ribbon Microphones:** Provide a warm, vintage sound but are fragile.
- **Polar Patterns:**
 - **Cardioid:** Good for isolating sound from the front.
 - **Omnidirectional:** Captures sound from all directions.
 - **Bidirectional:** Picks up sound from the front and rear.

Choosing the Right Microphone

- **Frequency Response:**
 - **Flat Response:** Ideal for capturing natural sound.
 - **Tailored Response:** Enhanced for specific applications like vocals or instruments.
- **Additional Features:**
 - **Connectivity:** USB for plug-and-play convenience, XLR for professional setups.
 - **Power Requirements:** Some microphones require phantom power.
 - **Accessories:** Consider necessary accessories like pop filters, shock mounts, and stands.

FIG. 10 SHURE SM81

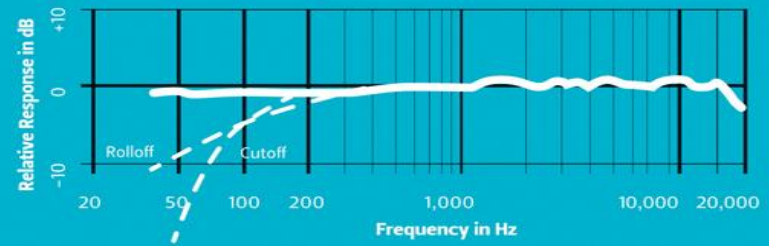


FIG. 11 AUDIX ADX51

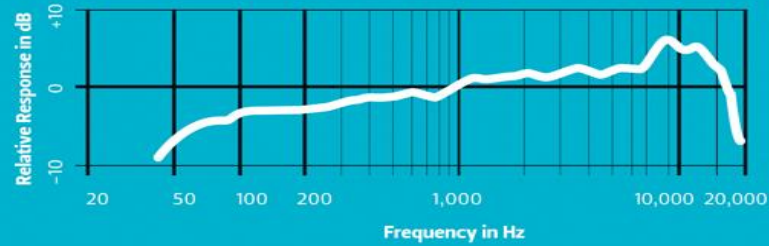


FIG. 12 AKG C 451 B

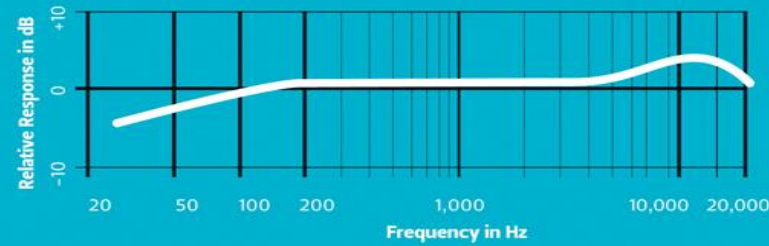
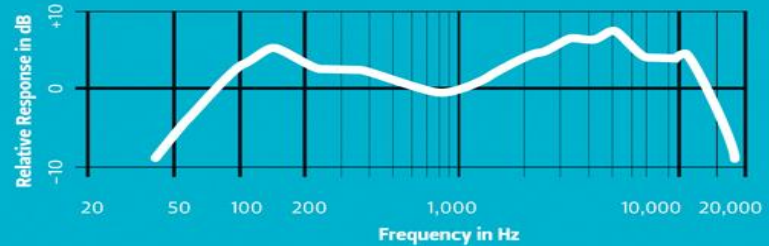


FIG. 13 AUDIX D2



Setting Up a Microphone

- **Placement:**
 - **Optimal Positioning:** Place the microphone at an appropriate distance and angle to capture the best sound quality. For vocals, position the microphone about 6-12 inches away from the mouth.
 - **Environment:** Consider the acoustics of the room. Use soundproofing materials if necessary to reduce unwanted noise.
- **Connection:**
 - **Wired Microphones:** Connect the microphone to an audio interface, mixer, or recording device using an XLR or TRS cable.
 - **USB Microphones:** Plug directly into a computer's USB port. Ensure the necessary drivers are installed.
- **Testing:**
 - **Sound Check:** Perform a sound check to ensure the microphone is working correctly. Speak or sing into the microphone and adjust the levels on your audio interface or mixer.
 - **Troubleshooting:** If the microphone isn't working, check the connections, ensure the device is selected as the input source, and update drivers if necessary.

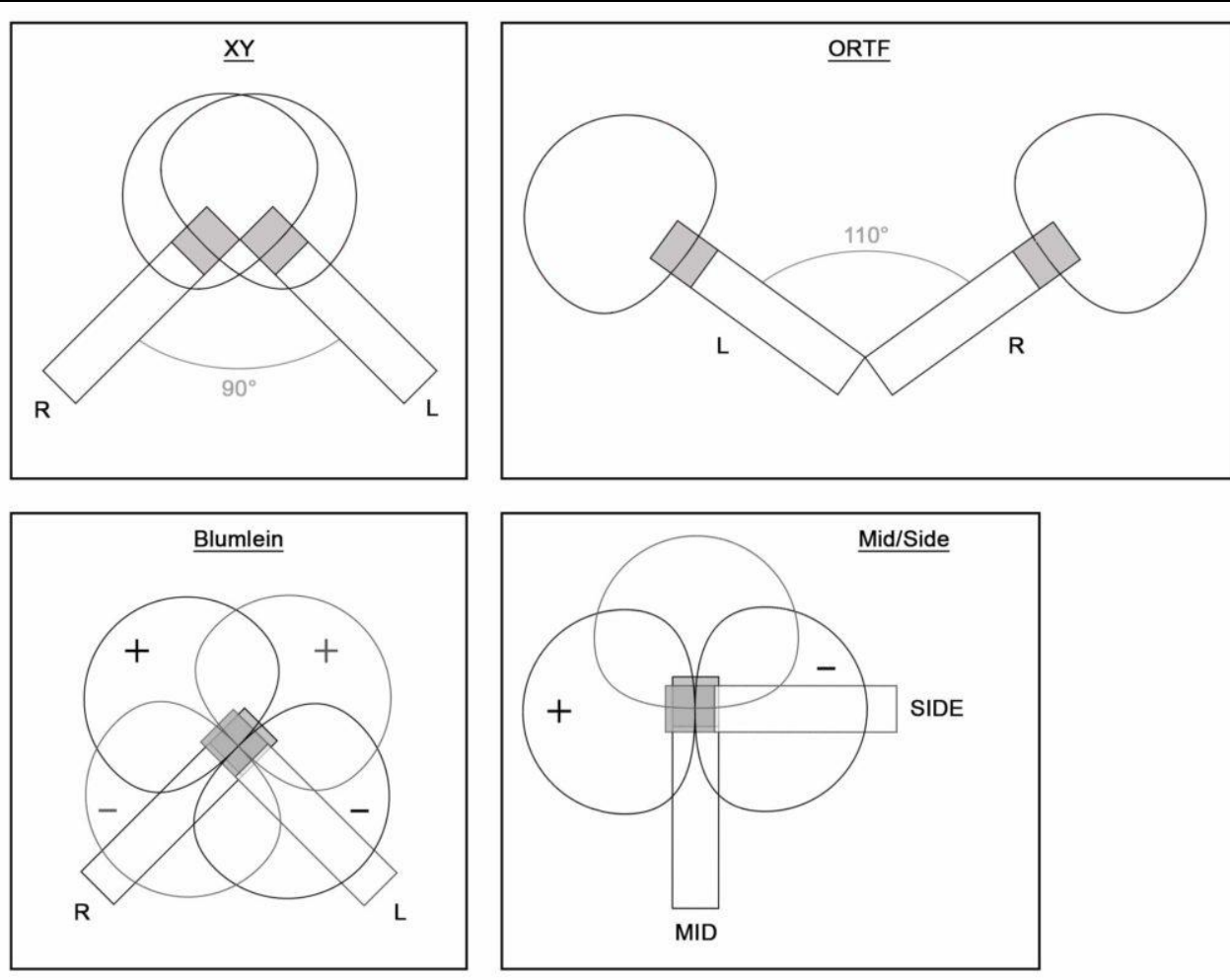
Setting Up a Microphone

- **Adjusting Settings:**
 - **Gain and Volume:** Adjust the gain and volume settings to avoid distortion and ensure a clear signal.
 - **Equalization (EQ):** Use EQ settings to enhance the sound quality by adjusting frequencies.
- **Additional Tips:**
 - **Pop Filters and Windscreens:** Use pop filters to reduce plosive sounds and windscreens to minimize wind noise.
 - **Shock Mounts:** Use shock mounts to isolate the microphone from vibrations and handling noise.

Advanced Techniques

- **Multi-Microphone Setups:**
 - **Techniques:** Using multiple microphones to capture different aspects of a sound source.
 - **Benefits:** Provides a richer, more detailed sound by capturing various perspectives.
 - **Examples:** Drum kits often use separate microphones for each drum and cymbal.
- **Stereo Recording:**
 - **Techniques:** Various methods like X-Y, A-B, Mid-Side (M-S), and Blumlein Pair.
 - **Benefits:** Creates a more immersive and realistic sound field.
 - **Examples:** X-Y technique uses two cardioid microphones placed at a 90-degree angle to each other.
- **Noise Reduction:**
 - **Techniques:** Using noise gates, filters, and software to reduce unwanted noise.
 - **Benefits:** Enhances the clarity and quality of the recorded sound.
 - **Examples:** Applying a high-pass filter to remove low-frequency rumble.

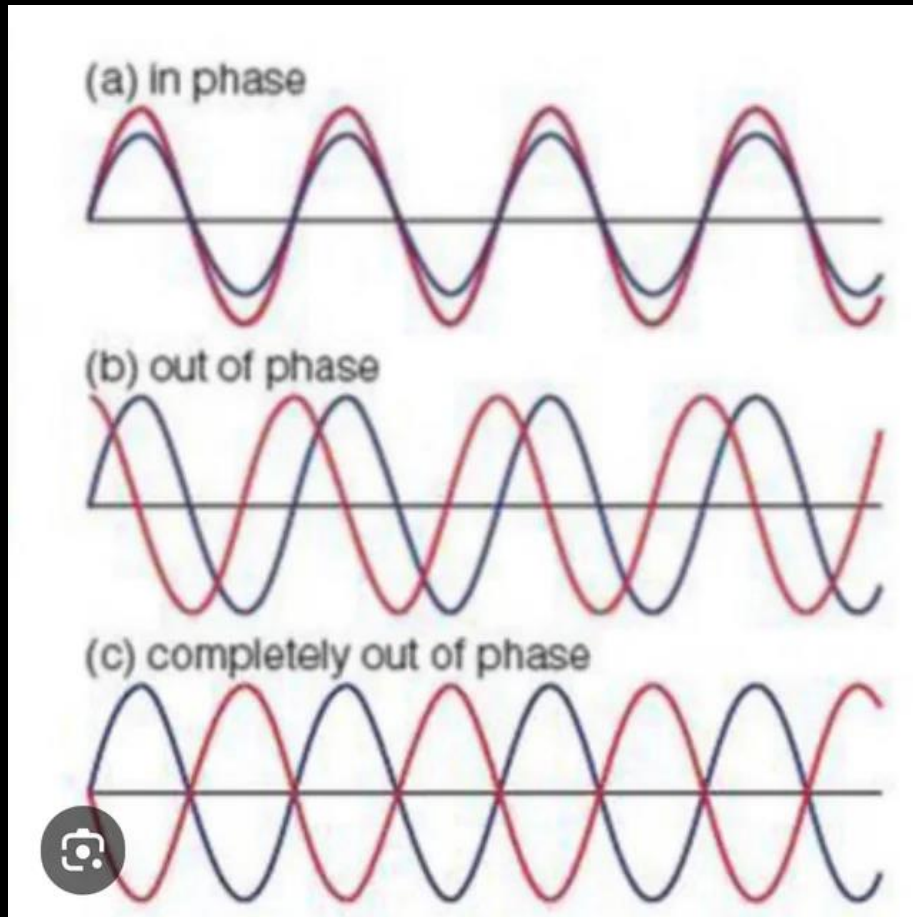
Stereo Mic Configurations



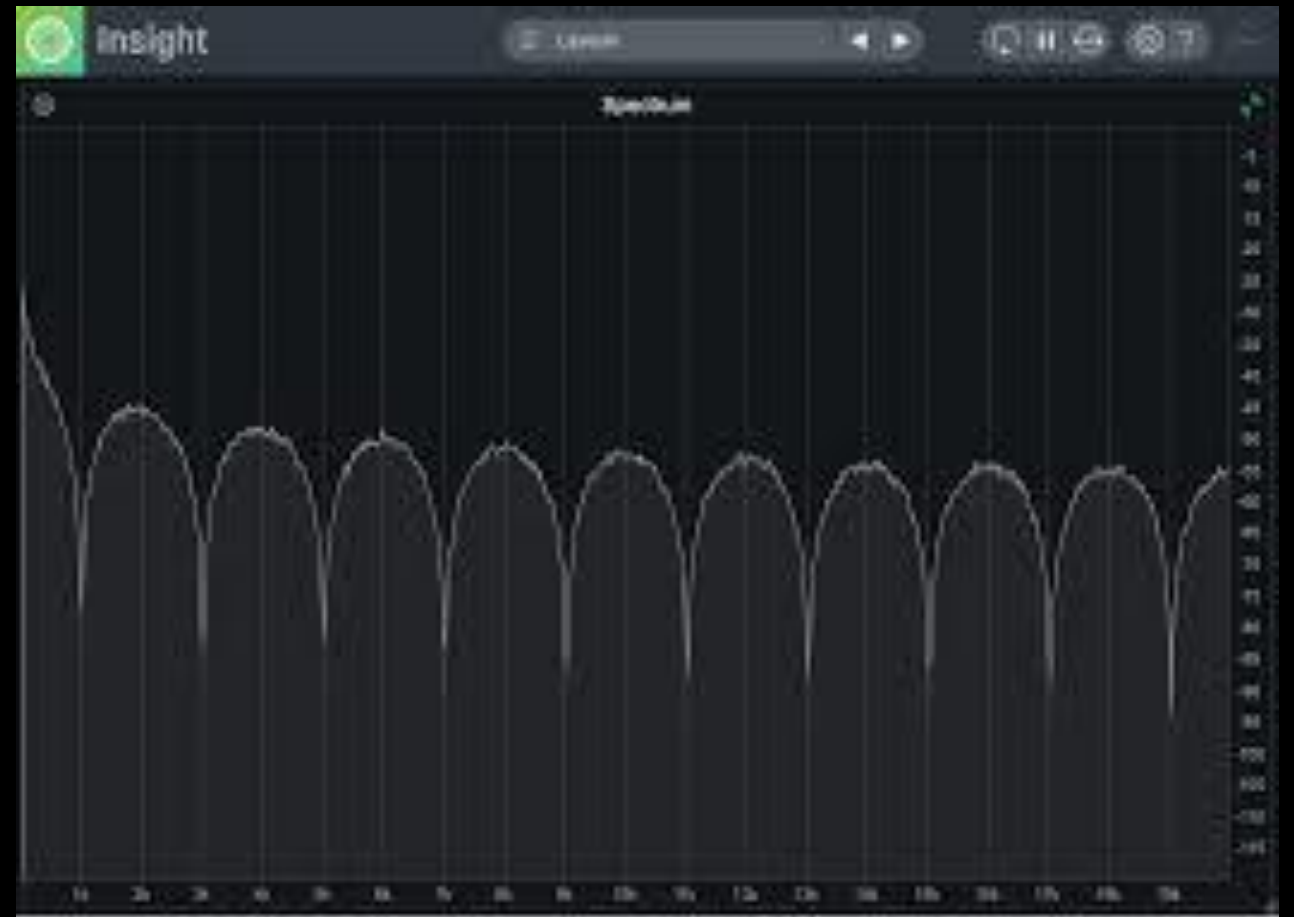
Advanced Techniques

- **Phase Alignment:**
 - **Techniques:** Ensuring that multiple microphones are in phase to avoid phase cancellation.
 - **Benefits:** Maintains the integrity of the sound and prevents thin or hollow audio.
 - **Examples:** Aligning the phase of microphones on a drum kit to ensure a full sound.
- **Creative Effects:**
 - **Techniques:** Using reverb, delay, and other effects to enhance the sound.
 - **Benefits:** Adds depth and character to the recording.
 - **Examples:** Adding reverb to vocals to create a sense of space.

Phase demonstration



Phase



Comb Filtering

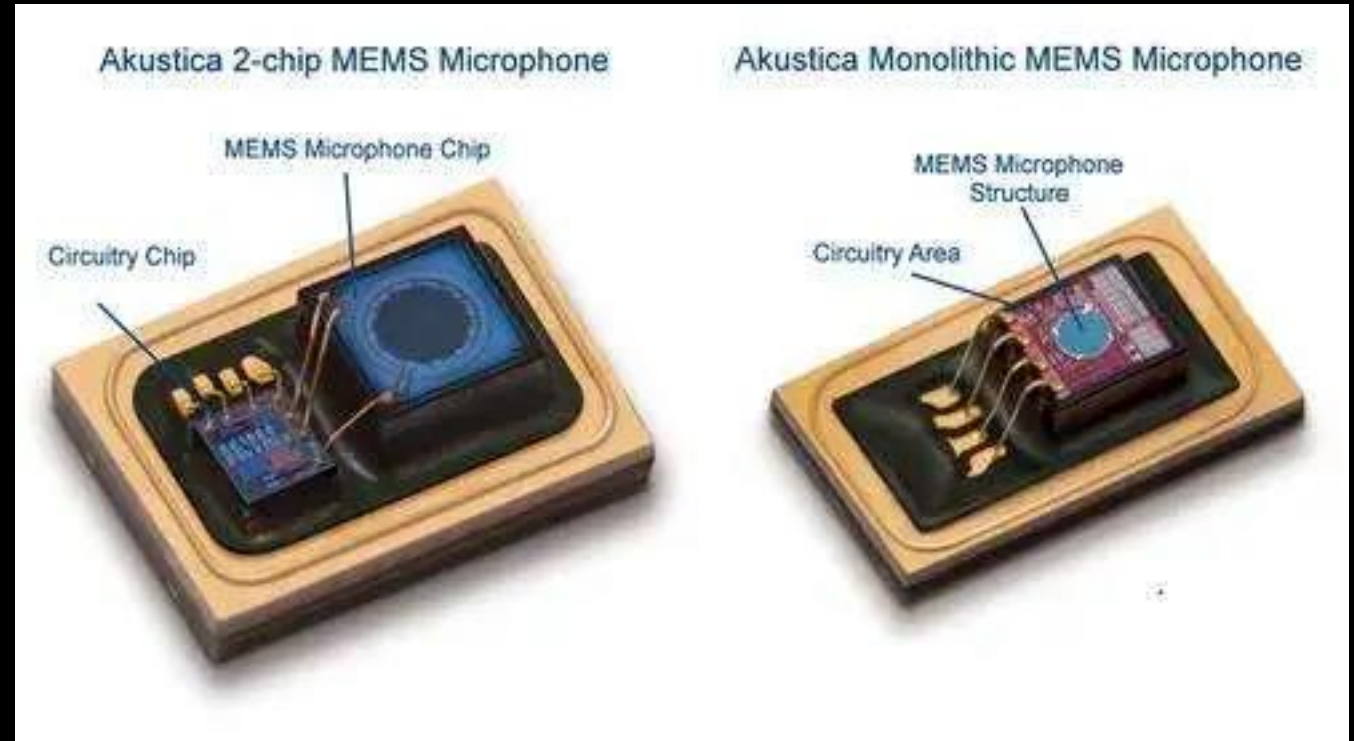
Future of Microphone technology

- **MEMS Microphones:**
 - **Description:** Micro-Electro-Mechanical Systems (MEMS) microphones are tiny, highly sensitive, and power-efficient.
 - **Applications:** Widely used in smartphones, hearing aids, and IoT devices.
 - **Benefits:** Their small size and low power consumption make them ideal for compact devices without compromising audio quality.
- **Spatial Audio Capture:**
 - **Description:** Techniques that capture sound in a way that mimics human hearing, creating immersive audio experiences.
 - **Applications:** Virtual reality (VR), augmented reality (AR), and gaming.
 - **Benefits:** Enhances the realism and immersion of audio environments.
- **Biomimicry in Microphone Design:**
 - **Description:** Inspired by natural systems, such as spider silk, to create more sensitive and compact microphones.
 - **Applications:** Advanced sound detection and environmental monitoring.
 - **Benefits:** Increased sensitivity and the ability to capture a wider range of frequencies.

Future of Microphones



iphone 16 pro mics



MEMS microphone

Future of Microphone technology

- **Wireless Technology:**
 - **Description:** Advances in wireless transmission technology, including new frequency bands and improved reliability. (5ghz)
 - **Applications:** Live performances, broadcasting, and conferencing.
 - **Benefits:** Greater flexibility and mobility for users.
- **Artificial Intelligence (AI) Integration:**
 - **Description:** AI algorithms that enhance microphone performance by reducing noise and improving sound quality.
 - **Applications:** Smart assistants, voice recognition systems, and automated transcription.(iphone 16 pro, waves Clarity vx, Izotope Rx, Adobe Podcast Ai, DxRevive Pro, etc
 - **Benefits:** Improved accuracy and efficiency in audio processing.

Summary of Key Points:

- **Types of Microphones:** Dynamic, condenser, ribbon, USB, shotgun, and lavalier microphones each have unique characteristics and applications.
- **Polar Patterns:** Understanding cardioid, omnidirectional, bidirectional, and shotgun patterns helps in selecting the right microphone for specific needs.
- **Components and Accessories:** Diaphragms, capsules, preamps, pop filters, shock mounts, and windscreens are essential for optimal microphone performance.
- **Applications:** Microphones are used in recording studios, live sound, broadcasting, film production, and communication.
- **Advanced Techniques:** Multi-microphone setups, stereo recording, noise reduction, and phase alignment enhance audio quality.
- **Future Trends:** Innovations like MEMS microphones, spatial audio capture, biomimicry, wireless technology, and AI integration are shaping the future of microphones.

Have a blessed week



