Making Waves: Microphone Guide

LESGC - WGRL 2015
How Do Microphones Work?

A microphone is an acoustic-to-electric **transducer** that converts **sound** (energy) in air into another form of energy, an **electrical signal**.

Dating back thousands of years, human beings have attempted to amplify their voices: in **600 BC**, oratory masks were invented with special mouths that acoustically augmented the speaker’s voice, and in **1665**, Robert Hooke experimented with the “lover’s telephone” -- two cups attached by a wire.
Types of Microphones: Dynamic

In a **DYNAMIC** microphone, a thin membrane (diaphragm) is vibrated by sound waves. The membrane is attached to a small coil surrounded by a magnet. The small electro-magnetic current generated by the vibrating membrane is sent out of the mic, down the mic cable, into the preamp and through the console.

Because dynamic mics have very few electronic components, they are able to capture loud sounds (like drums & amps) without the risk of distortion.

Dynamic mics have low sensitivity, meaning that they won’t pick up extra sounds (ex: deep breaths, lip smacks, etc)
Types of Mics: Condenser

CONDENSER
Invented by Bell Labs in 1916, condenser mics use internal electronics to increase sensitivity and provide a smoother frequency response. The result is a mic that can capture many more sonic nuances than dynamic mics. Condensers require phantom power, a static voltage that travels from the preamp. Because the electronics are more complicated, they are prone to overload - therefore, one must engage the pad switch (that decreases the input signal level) when recording loud sounds so as not to overdrive the mic.
RIBBON:
Two things set ribbon mics apart from other designs: the method of electromagnetic induction & the SOUND. Ribbons produce induction by placing a conductive metal strip (the ribbon) between the positive and negative poles of a magnet (similar to a dynamic mic). Ribbons are heralded for their “honest” and natural recordings, with a very uncolored frequency response. Ribbon mics come with a fixed figure-8 polar pattern and can be damaged easily - NEVER USE PHANTOM POWER !!! Passive ribbons have low output, so be sure to crank of the gain on your preamp.
**Polar Patterns** are a way of describing how a microphone “hears” or captures sounds around it.

In the graphs below, the units of measurements are decibel (db) points, or how loud a sound is perceived at a certain angle to the microphone.
OMNI-DIRECTIONAL: Microphones record all sound around them in 360 degree radius. These are ideal for natural, ambient recordings and for tie clip microphones - as moving your head to one side will not change the volume. They also make ideal headset microphones, as they sound very natural when close to the mouth.

Omnidirectional microphones are pressure sensitive so they are not as affected by wind noise or by the “proximity” effect (the bass boost when you are close to a directional microphone). They are also less susceptible to popping caused by “plosives” (when you say “P” or “B” close to the microphone). The physical body of the microphone can block some high frequencies, making sound ‘duller’ from the back.
FIGURE-8: Figure of Eight or bi-directional microphones pick up sound from the front and rear while rejecting sound from the sides. They are like omnidirectional microphones which are very neutral sounding.

All ribbon microphones are naturally Figure of Eight.
**CARDIOID**: Named for its heart-like pattern, Cardioid Mics help to reduce feedback and can be used to capture a particular sound in a loud environment.

Downsides: They are affected by wind noise, “proximity” effect and are susceptible to popping caused by “plosives” (esp. popping p’s).
HYPERCARDIOID: Refers to a tightly focused, directional pickup pattern. These work really well in live sound situations, though they don’t reject sound from the rear of the mic as well as cardioids. Hyper-cardioids are even better than cardioid microphones for reducing feedback and therefore are the best choice for a quiet singer, or to capture a particular sound in a loud environment.
The U87 is the best known and most widely used studio microphone in the world. Being incredibly versatile, it is well-known for its warm & well-balanced characteristics and is a perfect choice as a vocal microphone for all types of music & speech, from an orchestra to a spot mic for individual instruments. It has a low cut filter which reduces low frequency interference and a -10db pad which accepts sound pressure levels up to 127 dB without distortion.

**Interactive Diagrams**
Neumann KM184

**Ideal Use:** Announcer mic for broadcasting; overhead spot mic; close miking of strings, wind instruments, percussion, piano, guitar amps

The KM 184 is a classic high-quality miniature cardioid microphone. It is great for universal use, and can be used as an **XY stereo pair**. This mic has a flexible, open sound and responds well to all kinds of changes. It is especially useful for **overhead miking**, and yields great results for **pianos**, **acoustic guitars**, & various **percussion**.

It has exceptionally low inherent self-noise and exceptionally high overload capacity.

**Type:** Cardioid Condenser  
**Polar Patterns:** omnidirectional, cardioid, hypercardioid  
**Connector:** XLR

Interactive Diagrams
Ideal Use: vocal mic; spot mic for all instruments, especially strings & winds

The M147 Tube is a fixed-cardioid valve microphone with a large-diaphragm K47 capsule, that is accompanied by a separate power-supply unit, the N149A. It has a high dynamic range, and provides a warm yet transparent sound, making it ideal for voiceover work. The mic’s output is transformerless, which helps keep the mic’s self noise very low. At higher frequencies, the pattern becomes more directional. When close miking, use a pop filter!!

**Type:** Vacuum Tube Condenser

**Polar Pattern:** super-cardioid

**Connector:** supplied 10-metre cable with screw-locking eight-pin DIN connectors

Interactive Diagrams
Royer R-121

Ideal Use: electric & acoustic guitar, brass, percussion overhead

The R-121 is an exceptionally sturdy ribbon microphone with a realistic warm sound and a flat frequency response. Unlike most ribbon mics, it can handle loud sounds very well!

At distances of 3 feet and closer, the back of the R-121 records slightly brighter than the front side, which is extremely useful when recording acoustic guitars, vocals and other sounds that could use a brighter response. Use a pop filter when recording vocals!

Type: Ribbon Microphone
Polar Patterns: Figure-8
Connector: XLR cable
AKG D112 (aka “the egg”)

Ideal Use: bass drum, bass guitar, trombone, tuba

Type: Large Diaphragm Dynamic Microphone

Polar Pattern: Cardioid

Connector: XLR cable

The D112 is considered the best kick drum microphone ever made! The large diaphragm dynamic mic delivers accurate ultradeep frequencies with a unique, punchy sound. The mic has been designed with a low resonance frequency and can handle very high transient signals with virtually unmeasurable distortion.
AKG C414B/XLS-Stereo

Ideal Use: EVERYTHING

Type: Large Diaphragm Condenser Microphone
Polar Patterns: 9 options: cardioid, figure-8, hypercardioid, omnidirectional, wide cardioid
Connector: balanced XLR

This is an incredibly versatile microphone, with 9 polar patterns, three attenuation levels and three different switchable bass-cut filters. It also includes an LED light that signals overload warning due to audio peaks. This mic is great for distant miking applications in classical music settings and drum ambiance. The stereo set-up provides three-dimensional recordings!
Ideal Use: EVERYTHING!

This rugged microphone can withstand extremely high sound pressure levels (SPL), has low self-noise and an extended frequency response, making it ideal for recording musical instruments. It has three switchable pad positions for handling high SPLs and three switchable low-frequency filters to reduce background noise. It yields great responses when used on acoustic string instruments, winds, as an overhead mic for percussion, or for room ambiance.

Type: Condenser Microphone
Polar Patterns: Omnidirectional, Cardioid
Phantom Power: Yes
The SM58 is a live vocal microphone known for its rugged reliability on tour. The SM58's cuts out low-end rumble and adds a noticeable rise in the upper-mid frequencies. It also lets you get the most out of a wide range of sources, including guitar cabinets, brass, and many other instruments.

**Ideal Use:**
Live Vocals and EVERYTHING!

**Type:** Dynamic Guitar Microphone
**Polar Patterns:** Supercardioid
**Connector:** XLR cable
The 57 and 58 microphones are based on the same cartridge design. The main difference is in the grille, or the top of the mic. The SM58 was designed for vocals, and uses a ball grille with built in pop filter to eliminate plosives (like popping p’s). The SM57 is designed as an instrument microphone, where a smaller grille size is more practical and plosives are less of a concern. So the SM57 does not use a ball grille with pop filtering and instead uses an integral resonator/grille assembly, where the grille is actually part of the cartridge.

**Shure SM57**

**Type:** Dynamic Microphone

**Polar Patterns:** Cardioid

**Connector:** XLR cable

**Ideal Use:** recording drums, guitar, and woodwinds.
The Shure SM81 has a unidirectional design which captures a precise and detailed sound. It has a flat response curve, meaning it is equally sensitive to all frequencies. The SM81 has low noise and high output clipping level, low distortion, and provides maximum rejection of off-axis sounds.

**Shure SM81 LC**

**Ideal Use:** Choirs, acoustic string instruments, piano/organ & overhead cymbals

**Type:** Small-Diaphragm Condenser Mic

**Polar Patterns:** Cardioid

**Connector:** XLR

**Phantom Power:** YES
Designed for the Kick Drum, the Shure BETA52A is great for bass tones, such as a the bass guitar.

Ideal Use:
Kick drum and
Bass guitar

**Type:** Dynamic Microphone
**Polar Patterns:** Supercardioid
**Connector:** ¼ Cable
The Shure BETA57A is based on the Shure 57, like its predecessor it is designed for recording instruments, specifically miking drums (mainly toms), amplifiers and brass/woodwind.

**Type:** Dynamic Microphone

**Polar Patterns:** Supercardioid

**Connector:** XLR

**Ideal Use:** snare mic
Shure 520DX “Green Bullet”

Ideal Use: Harmonica

This famous harmonica microphone is the perfect tool for live performers. The Shure 520 DX "Green Bullet" has volume control knob at the base of the microphone so it's easy to adjust your levels mid-performance.

Type: Dynamic Microphone

Polar Patterns: Omnidirectional

Connector: ¼ Cable
The Shure SM7B is great for large vocals and broadcasting. You've heard the SM7 hundreds of times... Aside from being a very widely-used mic for broadcast, the SM7 was used in Michael Jackson's, "Thriller." It's recommend that the SM7B be paired with a pre-amp to turn up the gain when recording.

Ideal Use: recording vocals, podcasting.

Type: Dynamic Microphone
Polar Patterns: Supercardioid
Connector: cable

No phantom power needed
The electro-voice RE20 is a cardioid moving-coil dynamic microphone with LF rolloff. Its mostly known these days as the "standard" microphone for radio broadcast, though it is also a versatile studio microphone - vocals, electric bass, kick drum, guitar amps, snare, and toms all benefit from its smooth sound and flat frequency response. When the RE20 is being used for recording vocals it should be paired with a pre amp to turn up the gain.

Ideal Use: recording vocals, podcasting.

Type: Dynamic Microphone
Polar Patterns: Cardioid
Connector: XLR cable
The MD421-II is an incredibly versatile mic: Its ability to handle high pressure levels makes it a natural for **guitars** and **drums**. The MD 421-II's full-bodied cardioid pattern and five-position bass control means it's an excellent choice for most instruments, as well as group **vocals**, or **radio broadcast** announcers. The cardioid pattern offers outstanding **feedback rejection** in situations where bleed from other instruments might be an issue. It is great for close-miking because it provides a clean, clear response with no unnatural bass boost. It is very directional and has really good dynamic range.

**Sennheiser MD421-II**

**Ideal Use:** EVERYTHING - especially tom tom drums & horns

- **Type:** Dynamic Microphone
- **Polar Patterns:** cardioid
- **Connector:** XLR cable
Sennheiser MD441U

Ideal Use: Vocals & Instruments

The MD 441 is acknowledged as the most accurate and versatile mic available because it combines the best qualities of both dynamic & condenser mic technologies. It boasts a textbook perfect super-cardioid pattern and is equipped with a 5-position low frequency contour switch AND a two-position high frequency switch [boosting the treble]. It has excellent feedback/ noise rejection, has amazing sound quality, and handles high sound pressure levels exceptionally well.

Type: Dynamic Microphone
Polar Patterns: Supercardioid
Connector: XLR cable
Sennheiser E906

The e 906 is custom-made for demanding instrumental use. It has a very fast transient response, which makes it ideal for guitar leads and percussive sounds. In addition, the e 906's frequency response of 40Hz-18kHz can handle instruments from toms and congas to triangles and cuicas.

Ideal Use: Lead guitar

Type: Dynamic Guitar Microphone
Polar Patterns: Supercardioid
Connector: XLR cable

Phantom Power Needed - Plug in with XLR cable THEN turn on Phantom Power.
One of the C 451 B's most common applications is for drum overheads, and many engineers say there's nothing quite like it for miking cymbals. The C451B is also an excellent tool for accurately capturing signals rich in transients such as instruments with a percussive sound, acoustic guitar, or for overhead miking.

Ideal Use: Cymbals & Percussion

**Type:** Condenser,  
**Polar Patterns:** Cardioid  
**Connector:** XLR cable
Blue baby bottle is recommended for recording **vocals**, room mixing for drums, electric **guitar amps**, and difficult **brass** instrument sources like saxophones and horns.

Requires phantom power.

**Ideal Use:** Vocals & Instruments

**Type:** Condenser, Pressure Gradient

**Polar Patterns:** Cardioid

**Connector:** XLR cable