

Microphone Basics

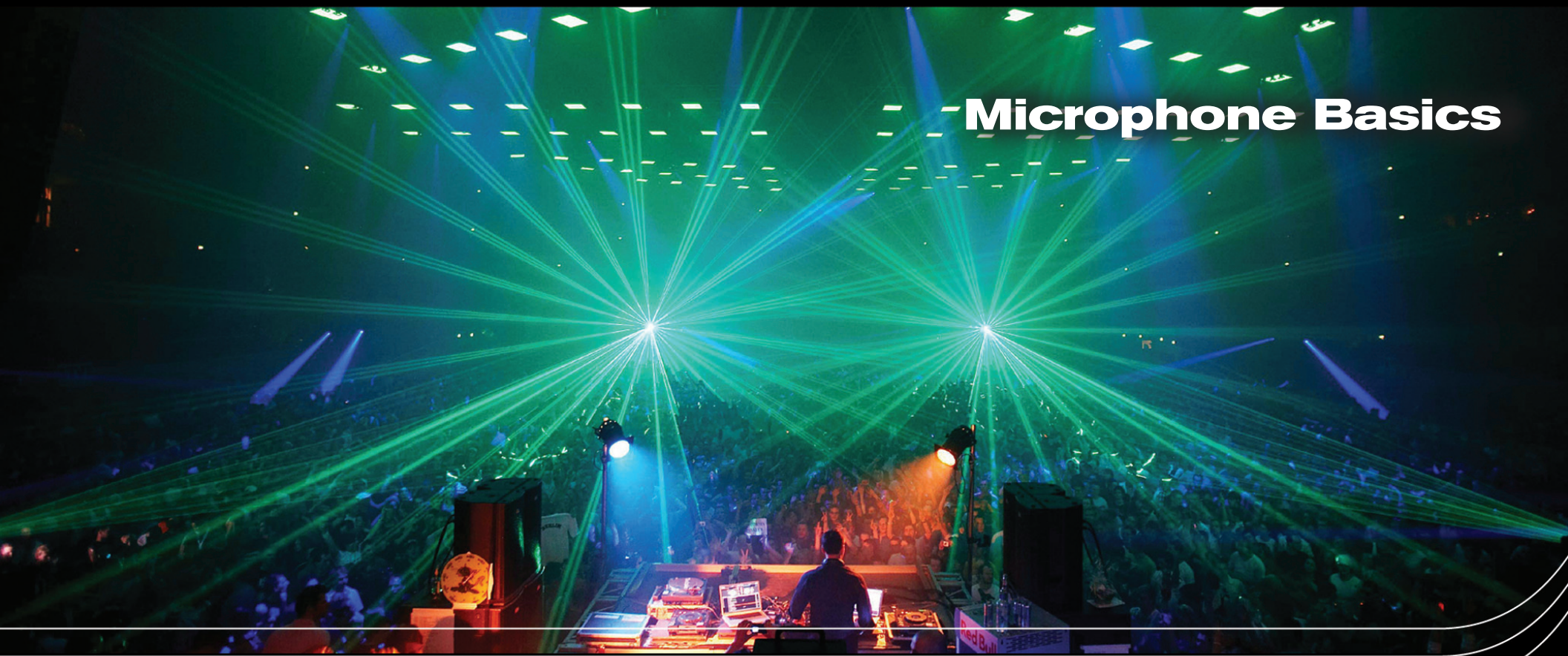


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Introduction

Tell Me About Microphones

Do you need to know the basics of microphones – how they work, what's available, and which is best for your needs? If so, you've come to the right place.

Microphone Basics gives you just enough information about microphones to help you make a smart decision...but not enough of the technical stuff to bore you. You'll learn the difference between microphone types, see how a microphone fits into a complete audio system, figure out the best microphone for your needs, and learn how to get the best possible results from the mic(s) you choose.



What makes EV the expert?

Experience. Dedication. Passion.

Electro-Voice has been in the audio equipment business since 1930. Recognized the world over as a leader in audio technology, EV is ubiquitous in performing arts centers, sports facilities, houses of worship, cinemas, dance clubs, transportation centers, theaters, and, of course, live music. EV's reputation for providing superior audio products and dedication to innovation continues today. Whether EV microphones, loudspeaker systems, amplifiers, signal processors, the EV solution is always a step up in performance and reliability.

So Many Options, So Little Time



A mic is a mic, right?

Everyone knows what a microphone does: you talk or play into it, and it makes you louder.

But if you've been shopping around, you've probably noticed there are many different types, designs, and specifications. All microphones are not created equal.

Once you know more about microphones, you'll have a better idea of what will work for you.

Dynamic vs. Condenser

Microphones come in many different shapes and sizes, but all do the same thing: convert sound waves into voltage (measured in millivolts). The two types you are most likely to encounter are *dynamic* and *condenser*.

- **Dynamic** microphones are passive—that means they do not require a power source. They're rugged, robust and reliable microphones. Dynamic mics are often used on stage, but they can add depth and value in a recording environment as well. They're perfect for drums and electric guitar cabinets.

Since dynamic microphones have a weaker signal than condenser mics, they must be placed relatively close to the audio source.



Dynamic Microphone: Sturdy enough to survive a mic drop.

- **Condenser** microphones require a power source, which can come from a phantom power supply or a battery. Condenser microphones are generally more sensitive than dynamic microphones and have better high frequency response characteristics. Condenser mics are a good choice for choirs or stage performers who are some distance away from the microphone. They have higher fidelity than dynamic microphones, but they're less durable. They're usually more expensive, too.



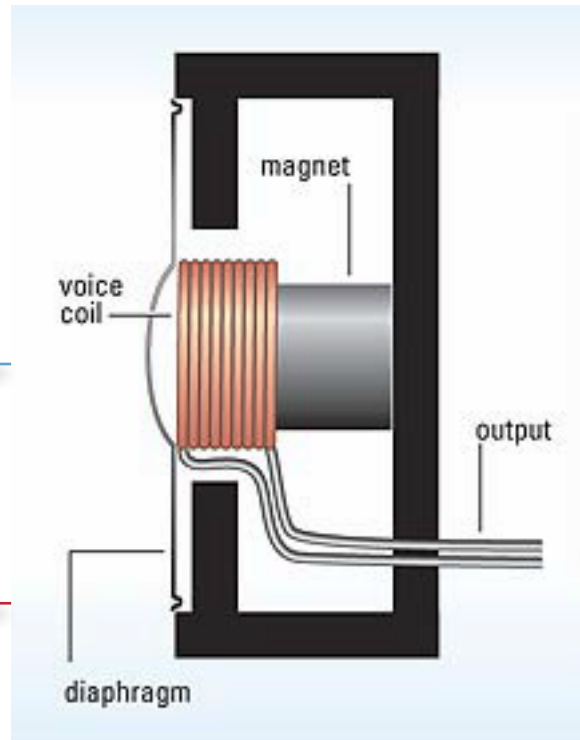
Condenser Microphone: Really responds to those high notes.

How a Dynamic Microphone Works

Let's take a closer look at what's going on inside a dynamic mic.

1 A sound wave contacts the **diaphragm**, causing the voice coil to move within the magnetic field.

2 When the **voice coil** moves inside of a magnetic field, a voltage is generated.



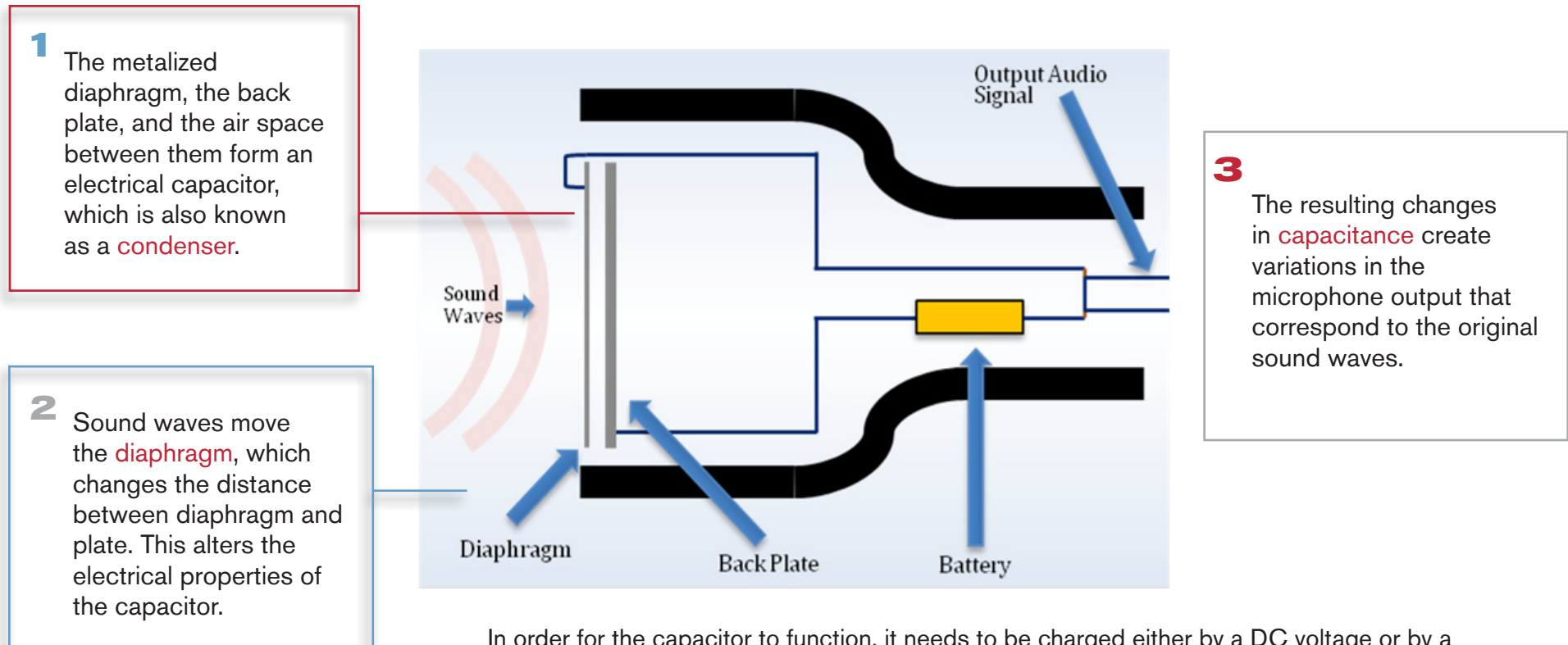
3 The voltage generated is an AC voltage, which means that it has two defining elements: **frequency** and **magnitude**.

Frequency is determined by the pitch it picks up.

Magnitude is determined by how loud the sound is.

How a Condenser Microphone Works

Now let's compare that to the secret inner workings of a condenser mic. In this case, the microphone capsule consists of a metalized diaphragm and back plate, separated by a tiny amount of air. When you connect an electrical voltage across the diaphragm and back plate, these three elements function as an electrical capacitor (which is sometimes also called a condenser – get it?). As the diaphragm moves in response to sound waves, the distance between the diaphragm and plate changes. The resulting changes in electrical capacitance create corresponding changes in the output signal from the microphone.



In order for the capacitor to function, it needs to be charged either by a DC voltage or by a magnetized back plate, and because the output signal from the a condenser microphone is relatively weak, this type of mic always has a built-in amplifier to boost the output. Depending on the mic design, the power for this amplifier can come from an internal battery or from phantom power (supplied through the mic cable by a mixer or mic preamplifier).

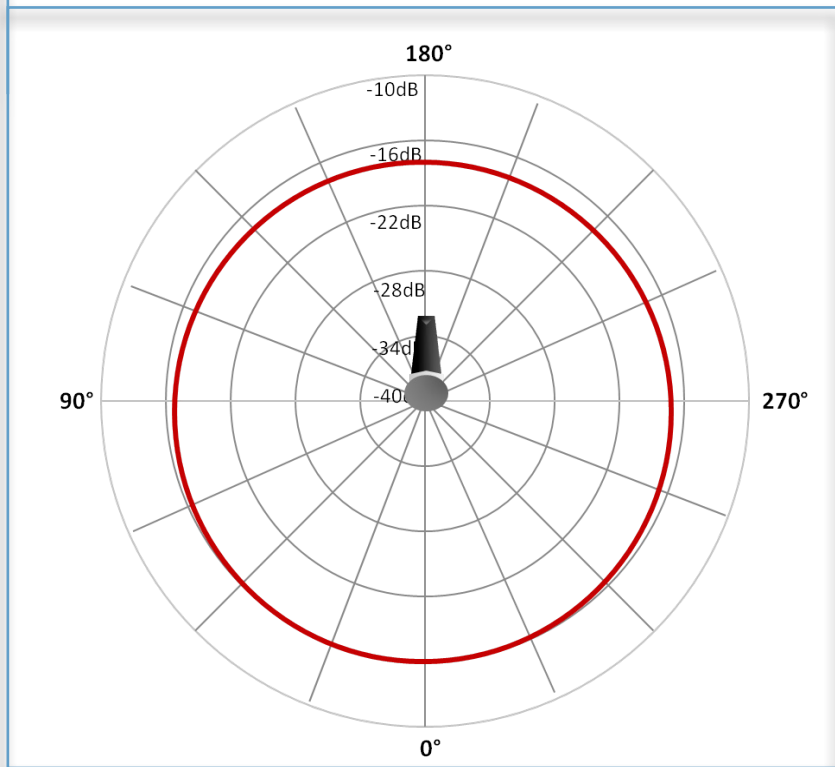
Polar Patterns

Note: This section has nothing to do with ice caps, white bears, or global warming. Carry on.

Every microphone, whether dynamic or condenser, has a specific sensitivity to sounds at various angles. This sensitivity is called a polar, or directional, pattern. The pattern is created by vents that let sound into the microphone in a way that may reject sound from some angles.

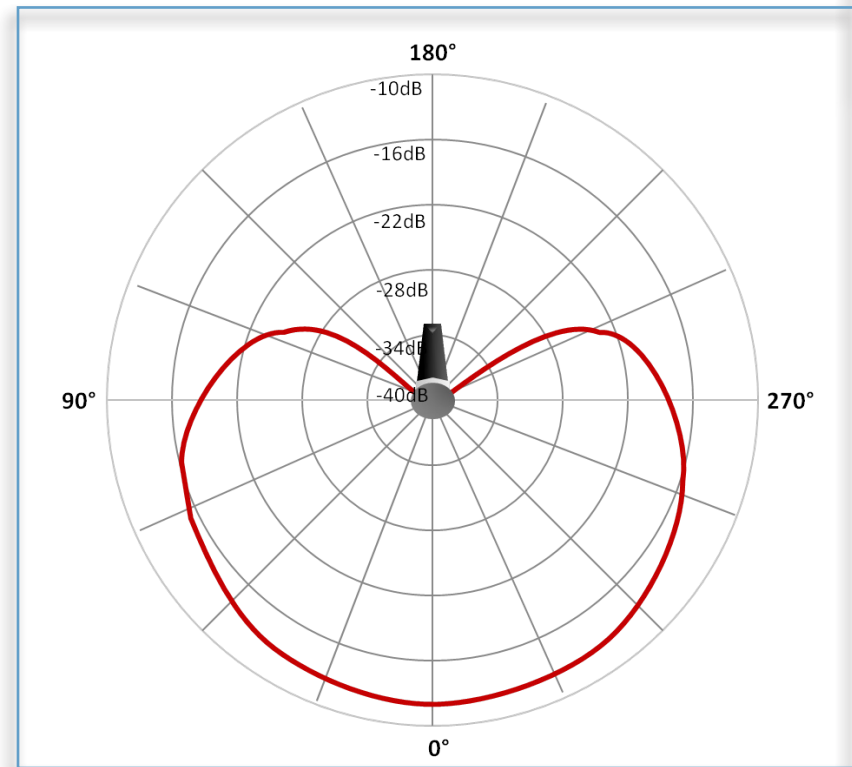
Omnidirectional

Picks up sound equally from all directions.



Unidirectional

Picks up sound from a designated side.

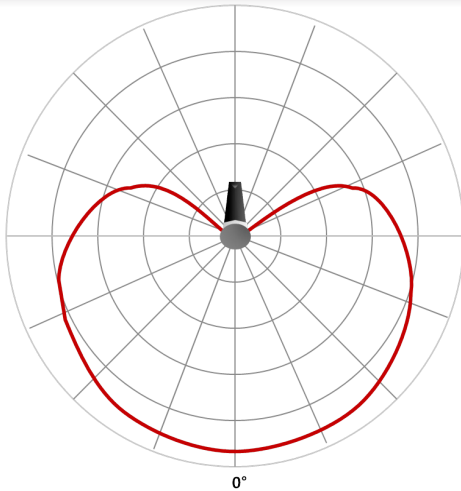


Good to Know:

When you're standing directly in front of the microphone, you're "on axis." Standing to the side or rear puts you "off axis."

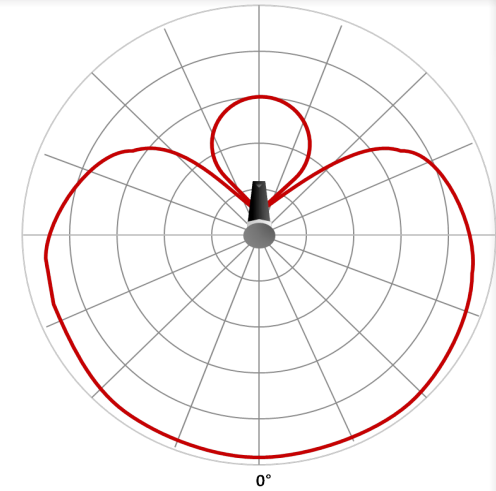
Common Polar Patterns

Cardioid

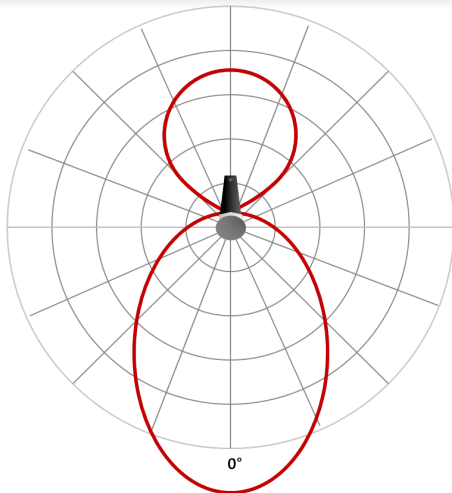


- Good for:
- Lecterns and other stationary sources
 - Outdoor vocal performances
 - Broadcasting
- Not so good for:
- Isolating sound
 - Highly directional recording

Super Cardioid

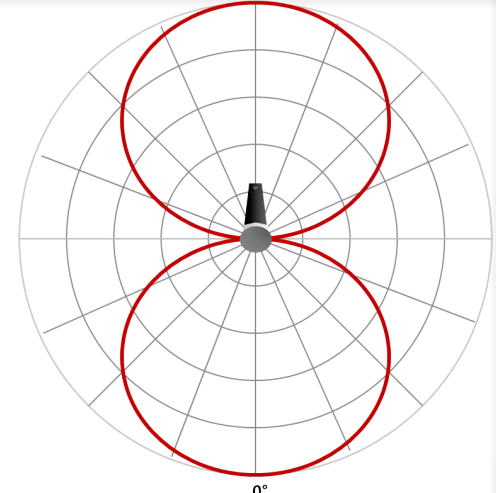


- Good for:
- Capturing a clear, crisp vocal that maintains a broad scope
 - Recording scary animal sounds from a safe distance
- Not so good for:
- Blocking sound from the rear (e.g., rowdy audiences)



- Good for:
- Capturing isolated sound in a noisy environment
 - Picking up one instrument at a time in an ensemble
- Not so good for:
- Picking up a broad scope of sound
 - Capturing an entire ensemble

Hyper Cardioid



- Good for:
- Duets
 - Blocking sound from the sides
- Not so good for:
- Blocking ambient sounds
 - Focusing on a single source

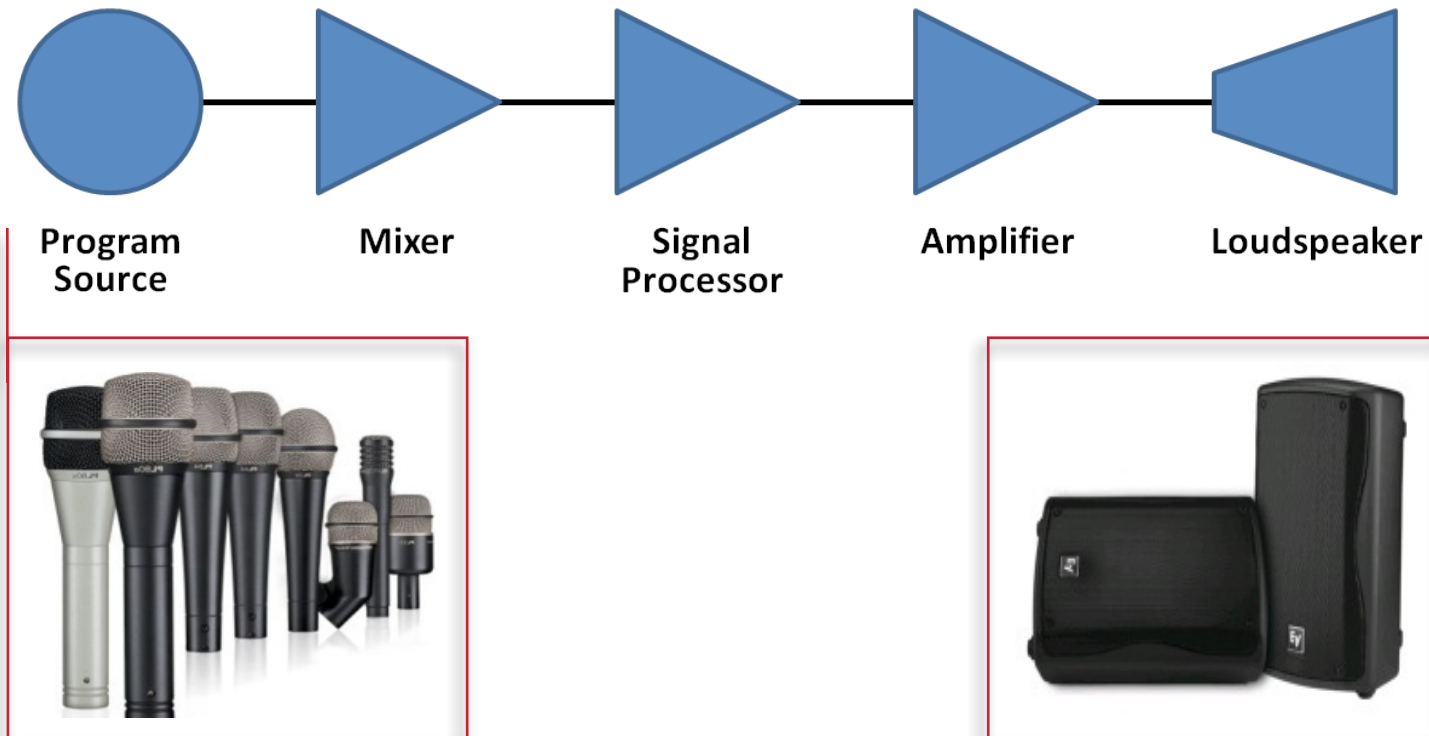
Bidirectional/Figure Eight

How Does a Mic Fit into an Audio System?

The Signal Chain

In a sound system, an audio signal travels from its source through system components that balance, process, and amplify the signal, and comes out a loudspeaker or headphones. The audio signal's path is called the **signal chain**.

Some signal chains are complex, with many components and divergences, and some are pretty simple. The diagram below represents a basic, stripped-down signal chain.

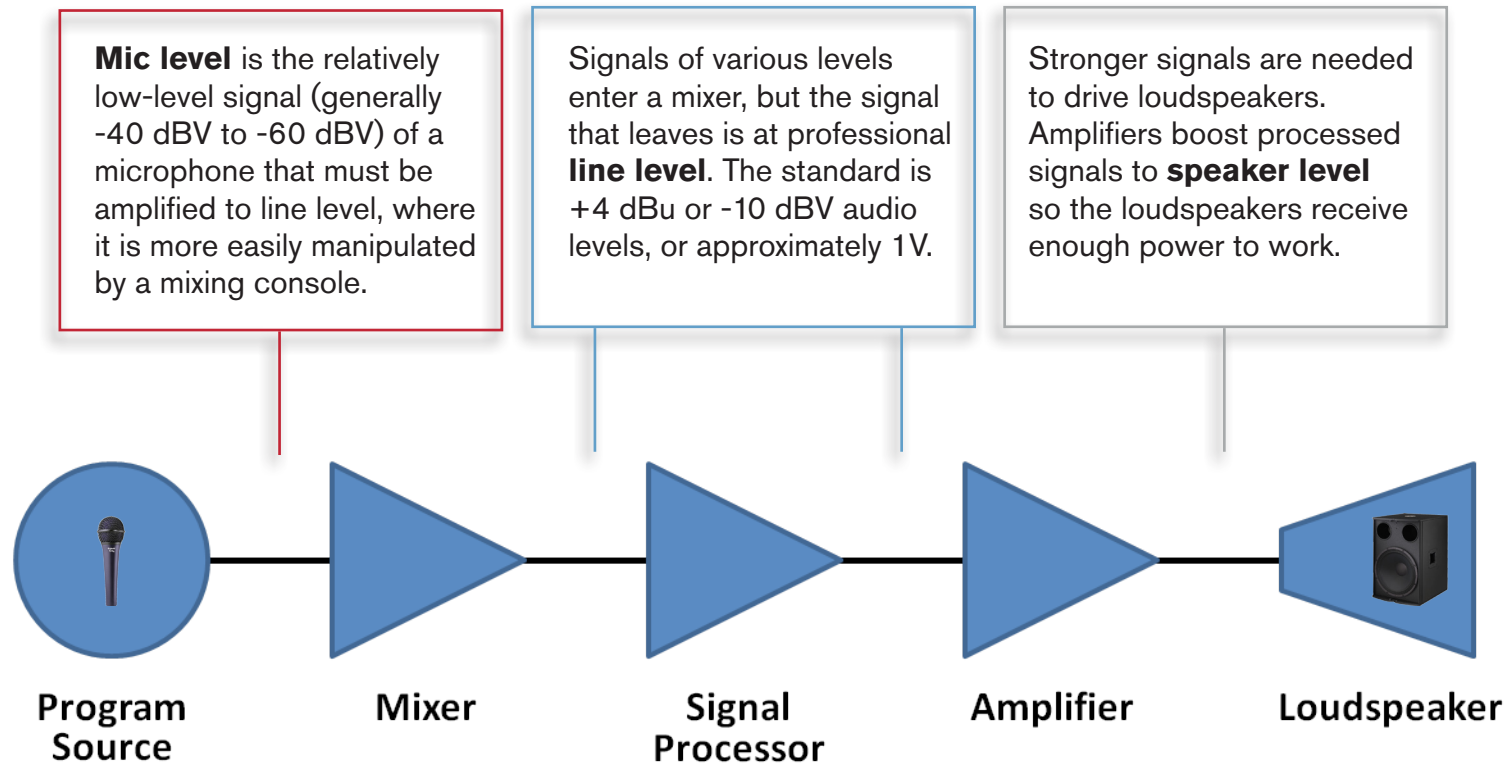


One way to get your audio signal into the signal chain is through a microphone.

The signal comes out through a loudspeaker...or two or three.

Signal Voltage and Why it Matters

Signal voltage is the value of the signal that leaves or feeds an audio device. We generally talk about the value in decibel volts (dBV). Every microphone, amp, pickup, and program source has a unique signal voltage level, but the signals can't be mixed together until they are all brought up to professional "line level."



Considerations for Choosing a Mic

Now that you know the technical basics of microphones, let's talk about choosing the best mic design for your needs.



Handheld mics (wired or wireless) are most commonly used because they offer the most flexibility. You can move around the stage with it, hand it off to another presenter or performer, or set it in a stand. It also offers the user a lot of control in how close he or she holds it when speaking or singing.



Lapel mics can be convenient for presenters who want to move around without holding a mic, but they can pick up extra noise from the presenter's clothes if they're not angled just right. It's also important to remember to turn off a lapel mic when you're off stage to prevent embarrassing mishaps.



Headworn mics are excellent for presenters or performers who move around a lot because they help keep the mic the optimal distance from the performer's mouth. They also come in handy when a performer's hands are full and a mic stand isn't practical.



Stationary microphones, such as microphones attached to a lectern or choir mics suspended over a stage, are designed for specific uses, but they aren't easy to adjust during a performance, and they usually can't do double duty.

Pro Tip:

Make sure the mics you choose let the audience hear everything they're supposed to hear and not too much of the stuff they're not supposed to hear. For example, if your drummer insists on singing, you don't want his mic picking up the drum kit instead of his vocals, so this is why you pay attention to the polar pattern when you choose a microphone.

Quick Review

- 1** *I'm a singer. I generally perform on small stages, so I don't move around too much, but I want control over mic placement from song to song. What kind of microphone is best for me?*



- **Dynamic**
You don't need to spend a lot to get the sound you need.
- **Unidirectional, cardioid polar pattern**
It won't pick up noise from the nearby audience.
- **Handheld, with cord**
It provides control without the potential complication of a wireless system.

- 2** *I'm a motivational public speaker. I'm on and off the stage several times a day, and a headworn mic is inconvenient for me. I just want a small mic I can switch on and off. What kind of mic is best for me?*



- **Unidirectional, hypercardioid polar pattern**
It provides a more directed pickup, so you can avoid rustling noises from clothing.
- **Lapel, cordless**
Since he doesn't like headsets, this is the next best way to get the microphone close to his voice, and it keeps his hands free.

- 3** *I'm a singer/songwriter. I perform on large stages, and I often play multiple instruments while I sing. I move all over the stage from one song to the next. What kind of microphone is best for me?*



- **Condenser**
Most headset mics are condensers.
- **Unidirectional, supercardioid polar pattern**
It picks up a broad scope, plus crisp tones from all the instruments you're playing.
- **Headworn, cordless**
When your hands are full, you need a headset, and a corded mic would just trip you up.

- 4** *I need a microphone presenters can use when they speak in our auditorium. I don't want to worry about anyone accidentally wandering off with it. What kind of microphone is best for me?*



- **Unidirectional, cardioid**
It won't pick up noise from the audience.
- **Stationary**
The microphone will always be connected to the lectern. It will not need to be adjusted during a presentation.

Words of Wisdom

There's a right way and a wrong way to do everything...and then there's the way that works in real life. We've collected some tips and best practices from professional audio technicians who are willing to let you to learn from them. (Of course, if you're one of those "have to learn everything the hard way" people, feel free to skip ahead.)

"Microphone placement in any application is critical. Before you start EQ'ing the channel strip, try moving the microphone instead."



"For live performance, stage monitor placement will depend on the pickup pattern of the microphone. For a cardioid microphone, the stage monitor should go directly behind the microphone for maximum gain before feedback. For a hyper-cardioid microphone, the stage monitor should be at a 45 degree angle to the microphone for maximum gain before feedback."



"Use the three-to-one rule when using multiple microphones: place each microphone three times farther away from other microphones as it is from the desired sound source. For example, if the microphone is 1 foot away from a sound source, it should be 3 feet away from the next closest microphone."

Wrap-Up

That's All for Now

Hopefully, we just gave you enough information about microphones to make an educated decision about what you need.

If you need more information or guidance, visit Electro-Voice online at <http://www.electrovoice.com>.

