

Loudspeaker Basics



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Introduction

Tell Me About Loudspeakers

If you need to know the basics of loudspeakers – how they work, the options available, and what type is best for your needs – you've come to the right place.

Loudspeaker Basics gives you just enough information to help you make smart decisions (or at least *sound* smart)...but not enough of the technical stuff to bore you. You'll learn the difference between loudspeaker types, see how a loudspeaker fits into a complete audio system, figure out the best loudspeaker for your needs, and learn how to get the best possible results from the loudspeakers you choose.



What makes EV the expert?

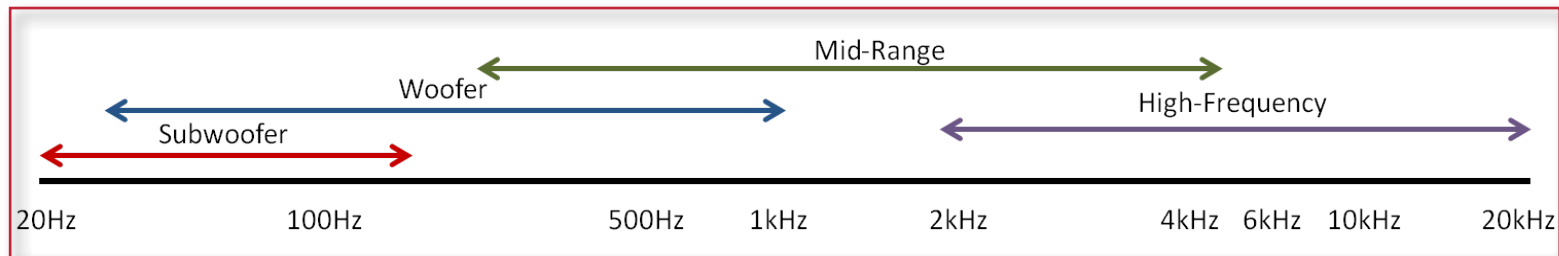
Experience. Dedication. Passion.

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.

Types of Loudspeakers

Loudspeakers come in many different shapes, sizes, and configurations, but they all do the same thing: they convert audio signals into sound waves.

Most audio systems include several loudspeaker drivers to reproduce both low frequencies (LF) and high frequencies (HF). From lowest to highest frequency, the most common types of drivers are **subwoofers, woofers, mid-range, and high frequency**.



Common loudspeaker driver types and the audio frequencies they reproduce

Full- or wide-range drivers, which provide good low and high frequency response, are also available, though some people think they have reduced output at both ends of the frequency range. (In other words, they're not great at either extreme.)

Some loudspeakers, called two-way, three-way, or even four-way systems, include more than one driver in a single speaker cabinet.



Two-way loudspeaker

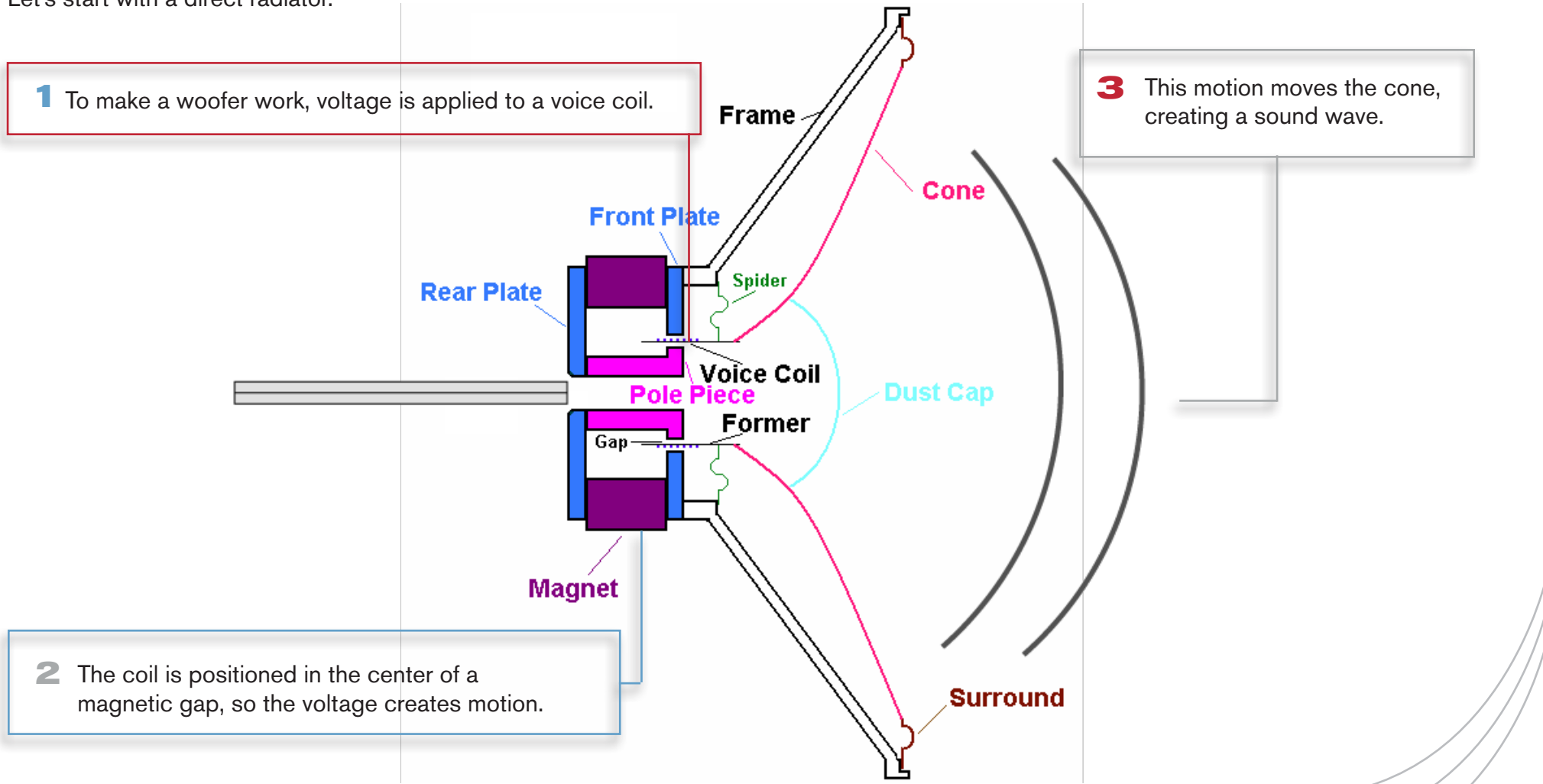


Three-way loudspeaker

How Does a Loudspeaker Work?

Inside a Woofer

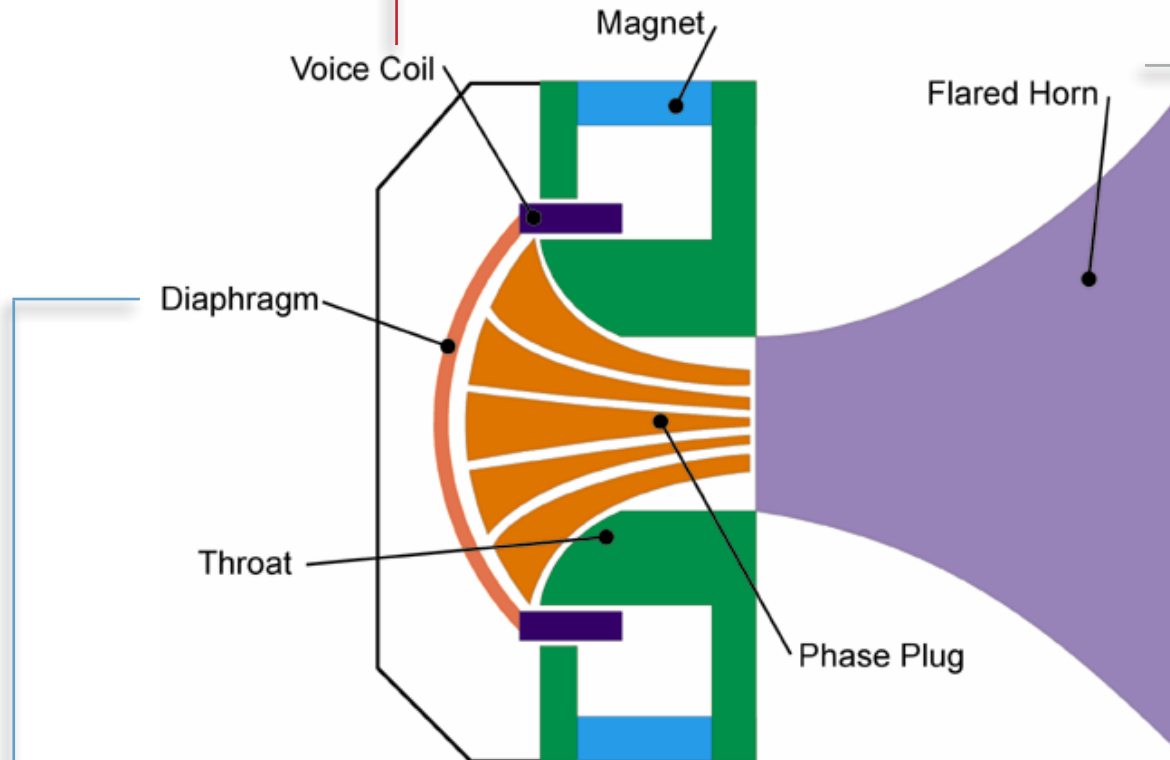
To keep things simple, we're going to focus on two basic driver types: direct radiators and compression drivers. Let's start with a direct radiator.



Inside a Compression Driver

A compression driver works a lot like the woofer on the previous page, with a few notable differences.

1 Voltage is applied to the voice coil. (See? That's the same.)



2 But instead of the voltage moving the cone, the voltage moves the stiff, curved diaphragm to create the sound wave.

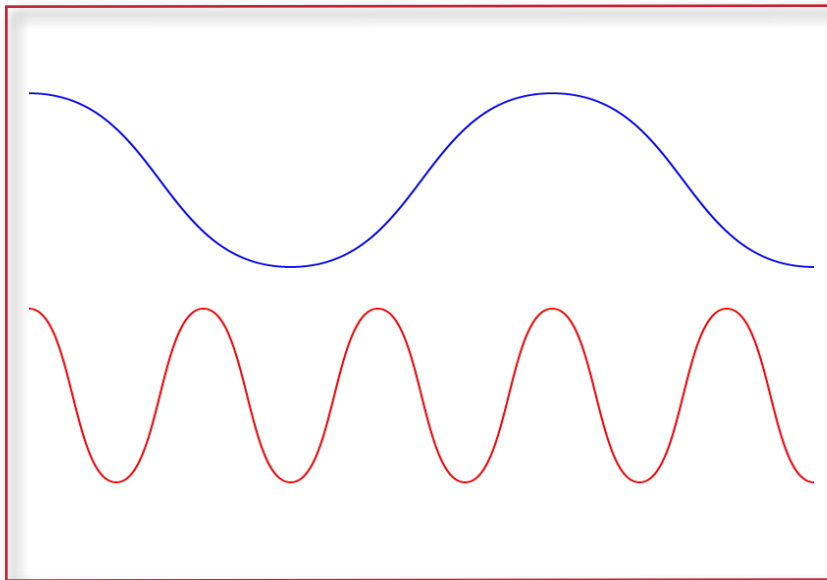
3 A compression driver, on its own, is not loud enough to balance a woofer.

The horn is necessary to focus the output of the compression driver and control the radiation pattern.

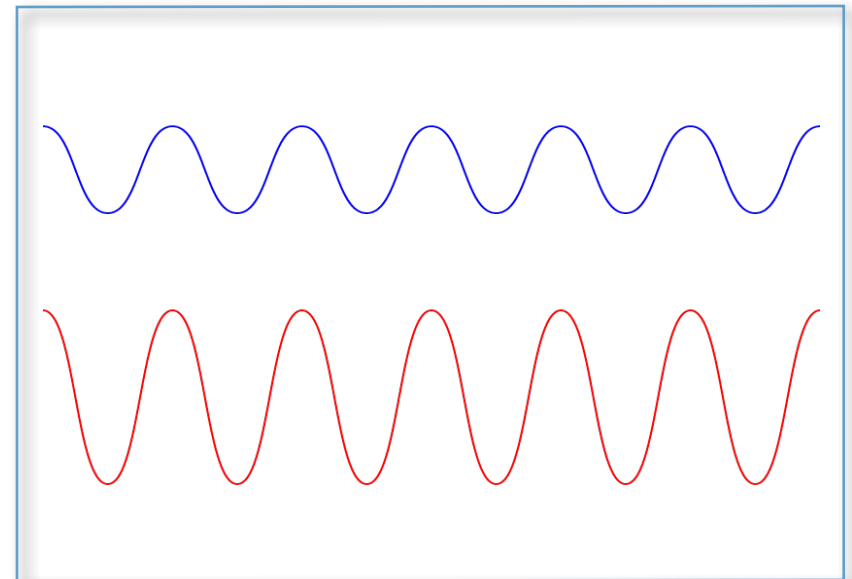
Let's Talk Voltage

The voltage applied to the loudspeaker voice coil is AC voltage, which means it has two defining characteristics: **frequency** and **magnitude**.

The **frequency** fed to the loudspeaker determines the sound wave frequency reproduced. Frequency is the number of times a wave repeats per second, measured in Hertz (Hz). This controls *pitch*.



The **magnitude** of the sound wave is the value of a voltage or waveform. It determines how *loud* the sound will be.

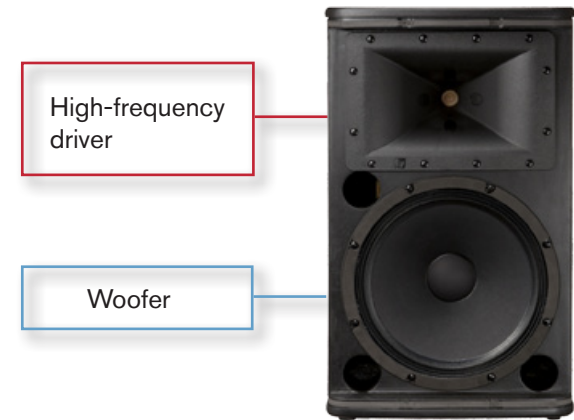


Crossover

A typical two-way loudspeaker has a woofer to reproduce the lower frequencies and a high-frequency driver to reproduce the higher frequencies.

For the woofer and high-frequency driver to work properly, they need to be fed the frequency band that best suits them. The point where the woofer stops and the compression driver takes over is called the “crossover point.” There are two types of crossovers: passive and active.

Passive crossover networks use capacitors, inductors, and resistors to split the audio signal so high frequency information goes to the high-frequency driver and low frequency information goes to the woofer. Passive crossovers are the most cost-effective and allow the loudspeaker to be powered with one amplifier channel. While they work well in most cases, passive crossovers are not as precise as active crossovers.



Active crossovers require external power to operate. They are connected between the output of a mixer (or preamplifier) and a power amplifier. One of the advantages of active crossover is that you can often change characteristics such as crossover frequency and the rate of transition.

An active crossover is normally an extra component that you need to purchase. Make certain that your loudspeaker system has separate inputs to accommodate multiple amplifiers that you'll use with your crossover. One particularly cost-effective way to get an active crossover is to buy a Digital Signal Processor (DSP), which lets you create crossovers, equalizers, and other audio processors.

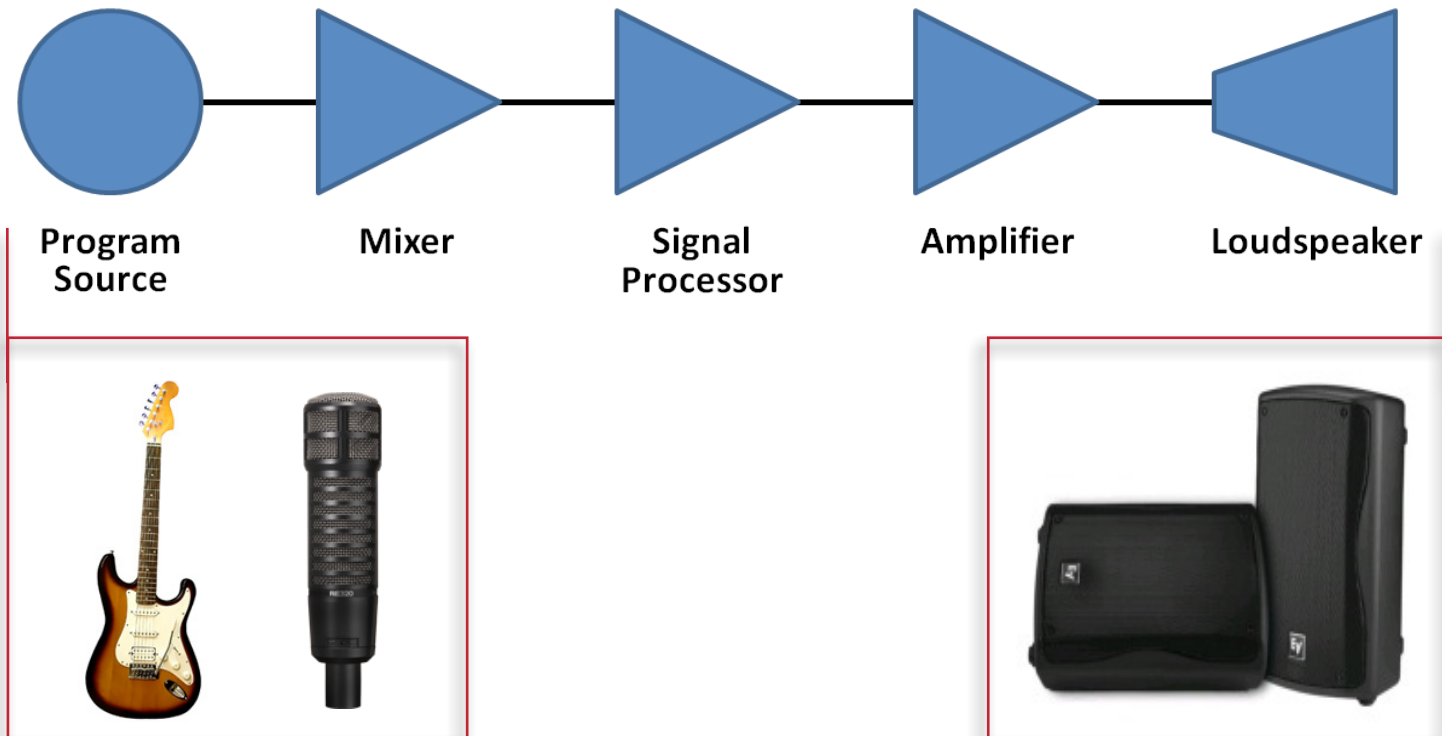


How Does a Loudspeaker Fit into an Audio System?

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.

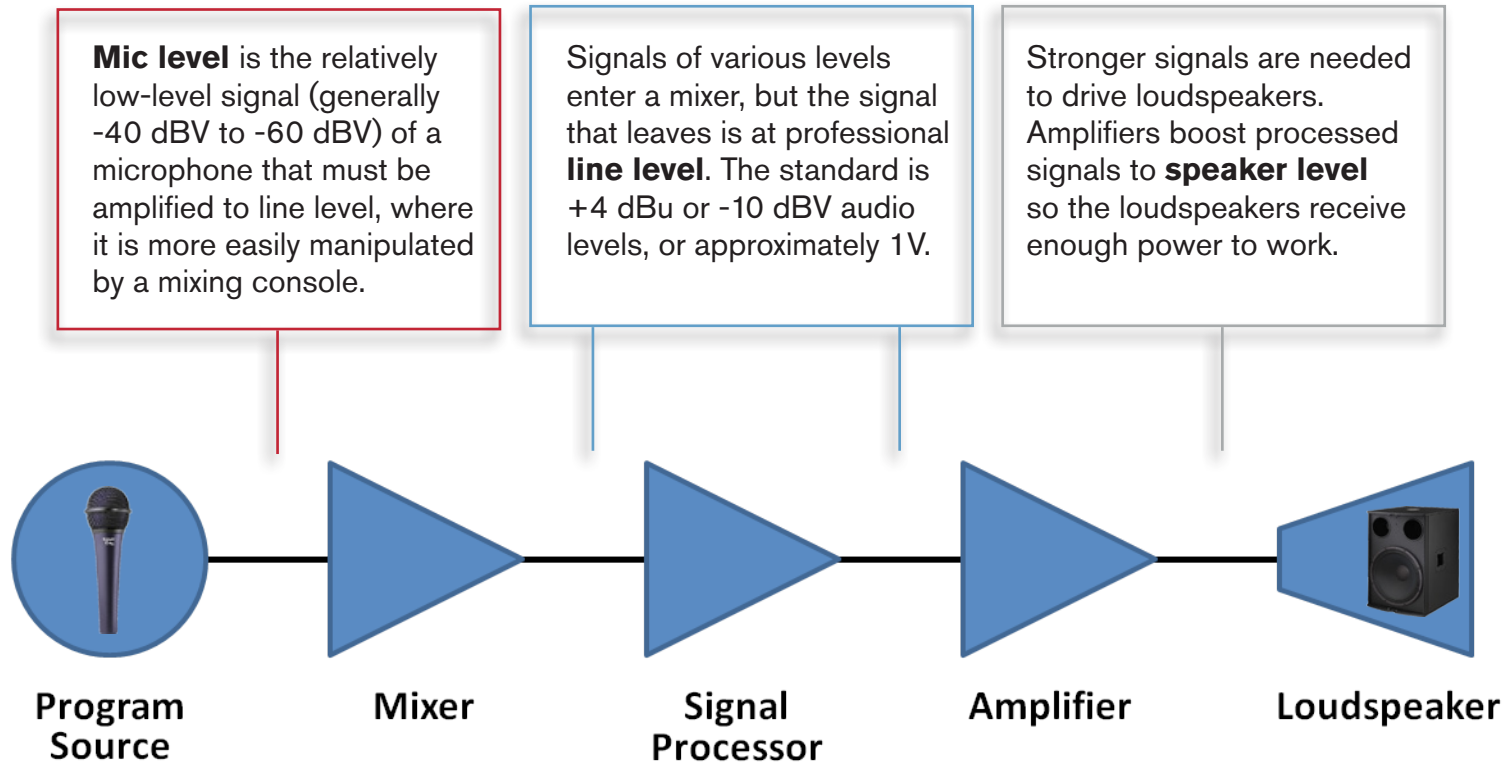


The audio signal in the signal chain can come from an instrument or a microphone.

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 Loudspeaker

A Few Helpful Terms

When you start exploring your loudspeaker options, you're going to see a lot of fancy-shmancy audio terms like *impedance*, *frequency response*, *power rating*, and *SPL*. Incidentally, they're kind of important. Here's a quick primer.

Coverage Pattern: A loudspeaker system's directional pattern, which can vary by frequency and tone. For example, one loudspeaker's output might cover a wide and short section of a room, while another's might cover a comparatively tall and narrow section.

Pro Tip:

Be sure the coverage pattern of your loudspeakers includes your entire audience. Remember, people who can't hear you well are more likely to throw things at the stage.

Enclosure: A cabinet in which loudspeaker drivers and associated electronic hardware, such as crossover circuits, are mounted. An enclosure can be a simple wooden box or a complex cabinet that contains internal baffles, ports and acoustic insulation. The enclosure prevents the front and rear sound waves from interfering with each other, helps manage vibration, and reduces heat generated by driver coils. It also shapes the low frequency response. The enclosure design has to be matched to the driver characteristics to do this successfully. Electro-Voice was one of the companies that pioneered the idea of systematically matching enclosure designs to drivers in order to optimally extend the low end.

Frequency Response: A measurement that indicates how evenly a speaker or electronic component reproduces sound. A frequency response specification includes the frequency range and the amount that the specification deviates from perfectly flat response. Frequency response curves are often used to indicate the accuracy of sound systems.

Frequency Range: The lower and upper limit of the system's usable output. A loudspeaker should not be expected to reproduce anything below or above its rated frequency range, *so don't even try it, Buddy*.

Pro Tip:

Not all speaker manufacturers use the same standard, so read the footnotes supplied by the manufacturer to make a fair speaker comparison. A frequency range determined by -10 dB values will typically be wider than one measured at the -3 dB points, but it's not a fair comparison.

A Few (More) Helpful Terms

Impedance (Z): The amount of resistance offered by an electronic circuit or device to the (AC) current that flows through it. It is commonly represented by the mathematical symbol “Z” and is measured in Ohms. Impedance describes how difficult a speaker is to drive and its compatibility with various amplifiers.

Pro Tip:

Check your amplifiers and other equipment for compatibility requirements *before* you buy your loudspeakers. Trust us.

Power Rating: Continuous and peak power ratings are measured separately. **Continuous** tells you how much power the loudspeaker can handle over time. **Peak** tells you how much power it can handle in short bursts. (In other words, don't expect to be able to melt faces at the peak rating for long.) Most manufacturers also do a “life test” to determine just how long a loudspeaker can stand abuse. At EV, we do a 100-hour test on every loudspeaker to verify the continuous power-handling measurement.

Sound Pressure Level (SPL): The loudness of an acoustic wave stated in decibels (dB). The maximum SPL is the highest sound pressure level a loudspeaker can handle before distortion sets in.



How Many Loudspeakers Do I Need?

The most basic sound system you can find will use one single loudspeaker. And sure, that's just fine for some folks. If your venue is cozy (for example, if you're playing a didgeridoo concert at a coffee shop), one loudspeaker may be all you need.



But if you have multiple instruments and vocals on stage or your venue is on the large side, you're going to want a few more loudspeakers to achieve decent sound reproduction and coverage. Otherwise, what's the point? You want to sound as good as you are.

In general, the bigger your venue gets, the more loudspeakers you need.

To achieve massive coverage, loudspeakers can be hooked together to form impressive arrays, hung from the ceiling, mounted to scaffolding, and so on. But designing speaker arrays for a large venue is not a DIY project.



When you're playing a show this big, it's time to call in the pros.

Quick Review

- 1** *I'm a singer/songwriter, and I play acoustic guitar. I play solo shows in coffee shops all over town, and I carry all my own equipment with me. What should I look for in a loudspeaker?*



- **Two-Way**
Save space—and your back—with a 12" two-way loudspeaker. You might even want two, depending on the size/shape of your venues.
- **Coverage Pattern**
Make sure your loudspeakers can cover the largest space you're likely to play in.

- 2** *Our band is going on the road. We're playing shows in different-sized venues across the country, but our loudspeakers aren't designed for large spaces. What should we look for in new loudspeakers?*



- **Coverage Pattern**
You want everyone to be able to hear you, no matter what size venue you're playing. Be sure your loudspeakers can cover your largest venue.
- **Power Rating**
How loud do you need to be in your largest venue? Make sure your loudspeakers can handle your peak volume.

- 3** *I'm a cellist. I mostly play weddings and other events, so I never know what my performance space will look like—or if I'll need a loudspeaker. I use public transportation most of the time. What should I look for?*



- **Two-Way**
A cello has a wide frequency range, so a 12" or 15" two-way loudspeaker would be a good choice—and it won't be too big to bring on the bus!
- **Compatibility**
Make sure the loudspeaker you choose is compatible with your amp. Look at impedance and sensitivity, or choose a powered speaker with mic-level input.

- 4** *I'm in charge of installing a new audio system in our huge church—it serves over 1,000 people weekly. All the loudspeakers need to be permanently installed throughout the building. What do I need?*



- **Professional Help**
Always work with a professional sound engineer when installing permanent loudspeakers that are part of a complex system. In addition to liability concerns when hanging heavy objects, making the best choices about components, placement, and performance will ensure adequate coverage and excellent sound reproduction.

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.)

"Point the loud part of the speaker at the people. Yeah, it sounds like a no-brainer, but it's worth the reminder."

"When using multiple loudspeaker systems, splay the systems so that the horn patterns don't overlap."



"Make sure you have enough 'rig for the gig' — over-driving loudspeakers to get enough output usually ends in high repair bills."

Wrap-Up

That's All for Now

Hopefully, you now know enough about loudspeakers to figure out what you need.

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

