



# THE YAMAHA GUIDE TO CHOOSING A SOUND SYSTEM



**WHAT IS THE BEST SOUND SYSTEM** for your house of worship? The answer depends on different things – there are no one-size-fits-all formulas. Bundled or packaged solutions can be a starting point but the best sound system for your application is the one that's designed specifically for your needs. This guide will give you a good starting point in finding what's right for your congregation.

## SOME THINGS TO CONSIDER

Here are questions you will need to answer when planning out a sound system.

**Will your system be portable or permanent?** congregations can and do meet in many different types of places: community halls, roller rinks, movie theatres, coffee shops and more. If this describes your situation, you probably need a portable sound system. However, if you meet in a dedicated space or established church building, a permanent installed sound system would be the better solution.

**What is the shape of your room?** The sound system's job is to direct sound to where the people are in the room, and away from the walls and ceiling. The speakers need to match the size and geometry of the room. For example, a long narrow room with a high ceiling will require a different approach than a short, wide room with a low ceiling.

**What is your worship style?** Worship style often dictates sound system requirements. If you're just amplifying the pastor as he gives his message, a small system with good vocal intelligibility is all you may need. But if you're also amplifying a large choir or a full worship team with modern electric instruments, your system will be able to reproduce all the instrument and vocal frequencies clearly and evenly. And if you have multiple worship styles, you'll need a scalable solution.

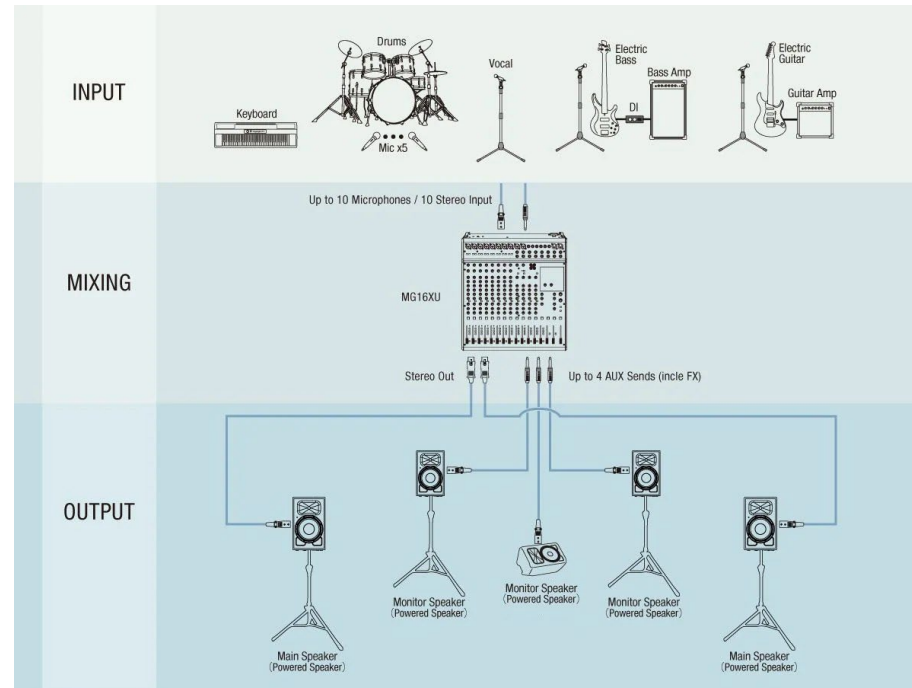
**Who's running the system?** In most cases, you'll have volunteers with different skill levels running sound, so user-friendliness is a necessity. The system should be designed to match the skill level of the team tasked with running it.

**What's in your future?** You should have a plan to future-proof your sound system. When designing a system, keep in mind what your needs may be in one, two and even three years. Try to create a system that can grow with your congregation and all your activities.



## KEY COMPONENTS OF THE SOUND SYSTEM

Your sound system needs to sound great and perform consistently. Regardless of any specific requirements, there are components that are key to every sound system. A good sound system designer can tailor these components for you.



**Mixer:** When searching for a sound system, one of the first things you need to look for is a mixer. And the first consideration for a mixer is the number of inputs and outputs you'll need for all your PA requirements. Write down everything that will go into and out of your sound console: your worship band, vocals and instruments; choirs; announcement microphones; speaker microphones, etc.; audio sends to places like the foyer, cry rooms, hallways, etc. – it's often not just the main sanctuary that requires audio of the service; possible video live stream; video recordings; etc.

**Speakers:** The next part of the sound system to look at is speakers. Quality PA speakers make the difference between a great-sounding system and a one that never seems to sound right. There are different factors to consider when choosing the right PA speakers for your application and building space. Those include powered or passive, portable or permanently installed, and ceiling mounted or floor standing. All these choices will be based on your room configuration and congregation size.

**Stage Monitors:** If you have a worship band and vocals, they'll need to hear themselves. Stage monitors can be an affordable way to have monitoring for the band. However, if stage noise and real estate are a concern, an in-ear monitoring system (IEM) may be the better choice for your situation. In either case, quality stage monitoring is essential. It's important to have a conversation with the audio team and the band to decide what will work best physically and budget-wise.

## THE MIXER

An audio mixer has two primary jobs: it lets you blend and adjust audio signals from microphones, musical instruments and other audio sources; and it sends those mixed and polished signals to its output jacks, which then connect to amplifiers, loudspeakers and/or a recording system. There are three types of audio mixers. Each type has its pros and cons.

- Analog
- Powered Analog
- Digital

**Do you need a mixer for a portable or permanent system?** If you meet outdoors, inside a temporary location, or you have an on-the-go ministry, then you'll most likely need a mixer that can be easily portable. Later in this guide we'll discuss self-contained, self-powered, analog, and digital systems that are designed for different portable applications. We'll also explain and give examples of consoles designed for permanent installation applications, from small to large congregations.

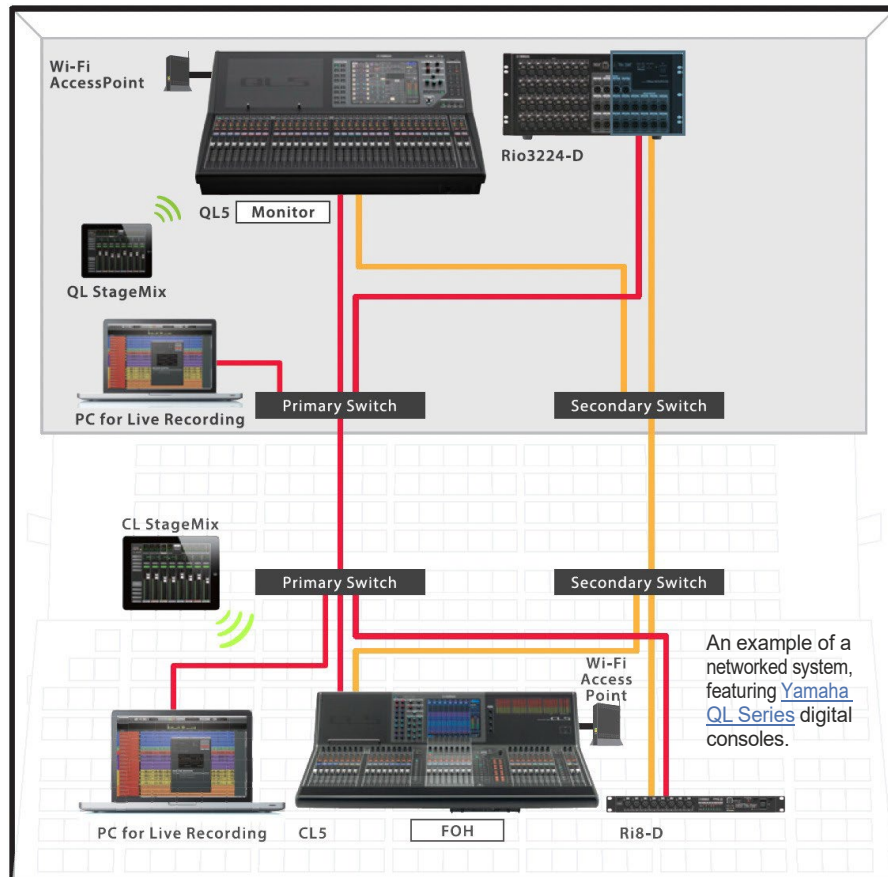
**What is your worship style?** Ranging from traditional to contemporary, you'll have different requirements depending on your worship style. If you're just amplifying the minister's message with maybe one or two acoustic instruments with one or two vocals, a small console may be all you need. But if you have a large choir or a worship team with electric instruments, your mixing needs are going to be more complex. If you have multiple worship styles, different campus locations and the need to interconnect them all, a coordinated networked system will be needed.

**Who is your tech staff?** From the beginning, it's important to know the experience level of the people who will be running the sound system. Houses of worship tech staff can range from having experienced techs who know the system inside and out, to volunteers who may only be capable of moving three faders and nothing more, so experience level is a big part of the decision. The group experience level of your operators will decide what interface will work best; is the console laid out in such a way that it's easy to use – or can be easily learned – and allows for intuitive access to settings? A good mixer is one that allows you to adjust a large quantity of variables and parameters, allows the operator to see what they need to see without getting overloaded, and then can interact quickly with all those parameters.

**Figure out the inputs and outputs will you need?** One of the first criteria to think about is the number of inputs and outputs you currently need, and then look at what you may need in the next two to three years. You may only need 16 or 24 channels now, but what if the music ministry expands, requiring more input and output channels, especially for more monitors. What if your building grows and you need to send more audio feeds to different rooms, or you decide to live stream. All these circumstances will certainly increase your I/O requirements.

## CONNECTION ABILITY

Will the main sound board be needed to communicate with ancillary consoles? You need to consider how well the console will work with another mixer – from the same manufacturer or a different one. If you need more consoles for broadcast or monitors, for example, will you need to buy the same board as the front of house (FOH), or can a smaller, less expensive board work for those positions? As well as considering your Input/Output (I/O) needs for the future, it is important to consider the overall possible “network” expansion of your system. You may eventually get to a place where not everything can be done from the FOH board alone and you’ll need to add more consoles.



## CONNECTING TO THE STAGE

While an analog “snake” will work for analog and digital boards, a digital console should be paired with the digital snake designed for it. Digital snakes use a CAT5E or CAT6 cable to send all the FOH I/O to the stage – or any other networked console or device in the system. The greatest advantage of a digital snake: it’s a single cable that replaces the large, heavy and cumbersome analog snake and has the ability to communicate with other devices on your audio network. It also greatly reduces your chances of having a faulty cable among all those other cables.

## SINGLE BRAND CHOICE

If growth is in your future, whether that means your worship team and/or your campus, it's important to think about how your tech team will perform rotating from one console to another. Houses of worship can have multiple rooms running at the same time on service days, all in need of sound engineers, and those engineers are often rotated among the rooms. If you have consoles from different manufacturers, that often entails multiple training sessions to make sure the entire staff is competent on the different platforms. Churches today opt for "brand family" consoles so that the training is on same operating platform no matter the sizes or models. For example, Yamaha [QL](#) and [CL](#) mixing consoles use the same workflow, making it easy for a tech to mix on a CL5 this week and a QL1 next week. Brand family also works great when using a Dante network – all the consoles use the same protocol and are easily recognized by the network.

## TAKE TIME TO TRAIN

If you're upgrading your console, set up the new one next to the old one if possible. A great deal of the preliminary work in setting up a new console can be done by using the old one as a reference, for tasks such as connection routing and labeling. This also gives the tech team a chance to get inside the workflow of the new console as compared to the workflow of the old console.

Don't underestimate the amount of time required for the audio techs to learn not only how to use new consoles, but also how to improve their mixing skills on them. Even if the board is considered easy to use, there will still be a learning curve. Each operator needs a reasonable amount of time to push buttons, move faders, and discover what the console is capable of, and then get comfortable with how it works. While there may be more capability and flexibility built in, there are going to be more variables and parameters they can use.

## ANALOG MIXERS

Analog mixers are divided into channel strips with rotatory knobs that control gain, EQ, effects, compression, and AUX sends and returns. All the controls needed to run the board are physically found on the mixer. This type of configuration decides the physical size of the console. A mixer with 16 channels or less will have a relatively small footprint, but when more channels are required, the footprint will get significantly larger as more channel strips are added.

For the most part, analog mixers usually have a shorter learning curve and are often a good choice for teams that have limited audio mixing experience.



Many analog consoles include built-in effects and compression, like the Yamaha [MG Series](#) and [MGP Series](#). These consoles offer 6-32 input channels and, for the most part, don't require external effects generators or compressors. However, you may want to consider an external sound processor to help balance the overall room sound.

If you're budget conscious, analog mixers usually cost less than digital models, but they lack the automation and programmability you might want for more complex setups. While there's no wireless network remote control, analog consoles like the MG Series do offer a USB connection for both input and output operations.

While digital mixers offer a great deal more mixing options than analog mixers, analog can be a great choice for those on a small budget or for those tech teams that have limited audio mixing experience.

### POWERED MIXERS

A powered mixer is an integrated solution that combines power amplifiers with a versatile mixer in a single, compact unit. A powered mixer easily connects to passive speakers, making this type of system literally "plug and play."

Like the Yamaha [EMX Series](#), powered mixers have two main channel outputs and, depending on the model, additional AUX and recording outputs, as well. AUX channels are line-level, allowing self-powered monitor speakers to be added to the system if needed.



The EMX Series offers the same features as a stand-alone analog console: built-in compression, 3-channel semi-parametric EQ, and up to 24 DSP presets for effects. The EMX7 also has a 9-band EQ and an on-board feedback suppressor.

Despite powered mixers' compact construction, only speakers and microphones are needed to configure a fully functioning, extremely portable, reliable sound system with all the tools needed to mix.

### DIGITAL MIXERS

Digital mixers offer a wide range of control and recall capabilities. You have the capability to setup "scenes" on the mixer then save them into the memory of the mixer. This is very handy when you may have different groups using the mixer for different functions, all with different needs. When you need to restore the board back to your main service setup, a press of a button recalls all your settings instantly. Scene saving is also great for making quick scene-by-scene changes during holiday theatrical productions.

Most digital mixers also allow wireless remote control. Yamaha digital mixers use the remote software [StageMix](#), which allows you to use an iPad to walk around a room

while making sure the music sounds good everywhere. (Different manufacturers have their own version of remote software.)

If your worship band is using In Ear Monitors (IEMs), Yamaha [TF](#), [QL](#), [CL](#), [DM](#) and [Rivage PM Series](#) digital mixers coupled with [MonitorMix](#) – the Yamaha personal monitor mix software – gives each band member the ability to control their personal monitor mix, freeing the FOH engineer to focus on the house mix.



Digital mixers also come equipped with “presets” that allow the sound engineer to select specific microphones in use and what they’re being used for; what type of instrument inputs are being used; and what type of IEM is being used. These presets help the audio engineer “dial-in” the EQ and compression for these channels, making for not only a quicker setup, but a better sounding overall mix.

Digital mixers also offer DSP effects, from reverb to delay, that can be applied to an input channel.

Another advantage digital mixers have is overall size. Because they can have multiple “layers” that are accessed by the push of a button, you don’t have to have all the individual channels physically installed on the surface. For example, a 48-channel console can have 24 physical input channels DCAs, or “groups” of channels, on the board’s surface – this is “layer one.” By pressing the “layer two” button, the next group of channels, 25-48, appear. Additionally, there are easy access buttons to view and control the outputs, effects and AUX sends, all on their own layers and instantly accessible.

If it’s necessary to record the service, most digital consoles come equipped with a USB port that will accommodate a USB memory device. When the record function is engaged, a stereo mix from the mains bus can be recorded as an audio file. If you need to be able to record each independent channel, [Nuendo Live](#) software from Steinberg, installed on a laptop and connected to the console, will multitrack record separate channels. This is a great resource if you want to be able to create virtual sound checks or be able to do a full mix down of any performance.



A full digital setup also means using a digital cable. An I/O rack like the Yamaha [T10 1608](#) uses a single CAT 5E or CAT 6 Ethernet cable that runs from the console to the I/O rack located at the stage. Even systems that require 120 or more I/O channels are easily managed on this one cable, ending the need for large, heavy, and expensive analog snakes. Additionally, the system can be connected to through [Dante](#) to other Dante-enabled components in the system. This allows streamlining connections, aiding in troubleshooting and routing signal to where you need it.

Digital mixers can be flexible for any need or setup.

## SPEAKERS

Achieving consistently high-quality live sound can be a challenge. Your choice of PA speakers can decide whether you're mixing to make something good sound great or struggling to solve sound reinforcement problems. There are three basic categories of systems:

- Personal PAs
- Medium-sized PAs
- Full-scale PAs

Personal PAs consist of single speakers or mini-speaker arrays, which serve as both main speakers and monitors. Medium-sized PAs consist of a pair of speakers on either side of the stage plus monitor speakers on the stage. Full-scale PA systems involve multi-speaker line arrays and complex monitoring systems.



### FIGURING OUT THE POWER DO YOU WILL NEED

If you're asking the question, "How much power is required for a PA system?" then the real question should be, "How loud do you need it to be for your room?" Power requirements vary according to your unique situation. First, the size and shape of the room is important. Then add in the number of people – human bodies make terrific sound absorbers. Are there windows or hard surfaces that sound can bounce

off? What type of flooring do you have: carpet, exposed concrete, etc.? Do you have an open ceiling or a drop-down tile ceiling? How much electrical power is available in the room, and where is it going to be installed? It's important to have as much of this information as possible ready when you consult a systems integration company.

While a speaker's wattage will affect its volume, its max SPL (Sound Pressure Level) is a better indicator of how loud the speaker can go. Understanding a speaker's coverage angle is also important. A powerful speaker with a narrow coverage angle will reach fewer people than a less powerful one with a broader coverage angle. It is also vital that you consider the speaker's sensitivity, which is a measurement of its ability to effectively convert power into sound. Sensitivity refers to the SPL that a speaker can produce from a one-watt signal, at a distance of one meter. The sensitivity spec measures efficiency and is a strong indicator of a speaker's loudness, which is why a less efficient 1,000-watt speaker isn't necessarily louder than an efficient 500-watt speaker. In fact, a 500-watt speaker with a sensitivity of 98dB will be the same volume as a 1,000-watt speaker with a sensitivity of 95dB.

### **ACTIVE (POWERED) VS. PASSIVE (UNPOWERED) SPEAKERS**

If you're not familiar with active speakers, the important thing to know is that the power amplifier and crossover are built into the same cabinet as the speakers. The benefit is, all you need are the speaker and a sound source, whether that's a mixer, a music player, or even an instrument in certain circumstances. Powered speakers simplify your PA system and are faster and easier to set up. However, they aren't always the best option when designing complex systems for permanent installation in large auditoriums and halls.

Passive speakers need separate power amplifiers and sometimes crossovers, too. For most small- to medium-sized rooms, passive speaker systems may not be the simplest option for a sound system. But for larger, more complex systems, it can be a huge benefit to have your system components separated. Because of the extreme amount of power needed for large systems, using separate amplifiers prevents your speakers from being overheated by the amps. And system maintenance in the long term is much easier when you don't have to climb to the rafters to adjust your amplifier settings.

Because passive speakers don't include power amps, their wattage isn't an indicator of how powerful they are. Rather, it's an indicator of the power they can manage. You'll generally find two values for power handling: their RMS (root mean square) value refers to how much continuous power the speaker can manage, while their peak value refers to the maximum power level that the speaker can manage in short bursts. Thus, if you have a speaker rated at 50 watts RMS and 150 watts peak, then it can manage 50 watts of continuous power with occasional peaks of up to 150 watts.

As you can see, choosing between active and passive speakers has more to do with how you're using the system than whether one type is superior to the other. Smaller churches may prefer the simplicity and reliable sound quality of active systems, while large churches will most certainly require the versatility and modular nature of a passive system.

### **SPEAKER DRIVER CONFIGURATION**

When choosing the right speaker for your needs, its driver configuration is another variable to consider. If the speaker only has a single full-range driver, that driver must cover the entire frequency range. A small speaker that is great for high frequencies won't reproduce low frequencies well, and a large speaker that's good for lows won't reproduce high frequencies well.

What's the solution? Multiple drivers. Speakers with multiple drivers do a much better job of reproducing the whole frequency spectrum. These types of speakers split the frequency range between two drivers – usually a high-frequency driver and a low-frequency driver. By giving each a specific frequency to cover, you increase the speaker's output, frequency range and efficiency.

### **UNDERSTANDING CROSSOVERS**

A crossover is a device that divides an audio signal into separate frequency ranges that are routed to different drivers (speakers, tweeters, horns, etc.) in an audio system. For example, a two-way crossover may include a low pass filter, which passes a signal with low frequencies to a subwoofer, and a high-pass filter, which sends proper frequencies to the tweeter. Crossovers can have passive or active designs. You don't need to know everything about crossovers to set up a good system but knowing where the crossover points lie in the sonic spectrum can help you set up a better mix.

### **BI-AMPLIFICATION**

Bi-Amplification is the process of dividing an audio signal into two frequency ranges which are then sent to two separate amplifiers that, in turn, drive separate loudspeakers. An active crossover network sends low frequencies to the larger driver (woofer) and high frequencies to the smaller driver (tweeter). Bi-Amping also allows the amplifier(s) to be chosen or designed specifically to match your speakers and enclosures. Bi-Amping, Tri-Amping and beyond have been used in sound-reinforcement systems for years and have become quite common in active studio monitors, as well.

## AN ALL-IN-ONE PA SOLUTION

For small churches or “on-the-go” ministries, a portable all-in-one solution may be the best solution. Systems like the Yamaha [STAGEPAS](#) Series integrate a mixer with a built-in amplifier, passive speakers, signal processing, and even effects into a simple, compact design. These PA systems can save you money, time and space. Plus, they’re easy to set up and use.



## INTELLIGENT SPEAKER SYSTEMS

There are now speaker systems that can automatically recognize what you’re plugging into them and will optimize their sound accordingly, like the Yamaha [PX Series](#) amplifiers. They can recognize whether you’ve arranged them vertically on speaker stands or horizontally on the stage as floor monitors and will automatically change their sound for that orientation. Other built-in intelligent features can include automatic feedback suppression, networking capability and remote control. How you plan on using your system on a regular basis determines which of these advanced features, if any, will ultimately benefit you.

## SUBWOOFERS

Subwoofers are speakers that are built for reproducing just the low bass frequencies. However, just adding a subwoofer will not necessarily make your system louder. When properly implemented, they can allow you to run your system at a lower overall volume while still keeping a full-range punch and impact.

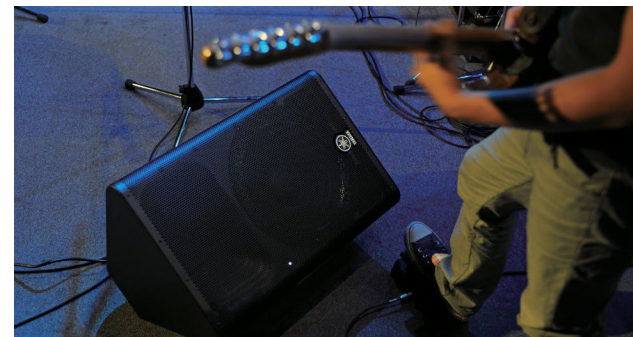
- Active Subwoofers
- Passive Subwoofers

Subwoofers usually focus on the 20Hz to 100Hz frequency spectrum, which can be difficult to reproduce accurately with smaller PA speakers. Larger speakers can respectably reproduce low frequencies but for true full-range sound, you need a dedicated subwoofer.

Subwoofers can also play an important role in filling out the sonic spectrum for any room or worship style. Subs also allow the main speakers to sound better, giving them valuable headroom to better reproduce the dynamics of your instruments and vocals. As with full-range speakers, subwoofers can be either active or passive.

## MONITOR SPEAKERS

When the worship band is playing and singing, they need to be able to hear themselves; proper monitoring is crucial to a good performance. There are two types of stage monitors: wedges and side-fills. A wedge is essentially a speaker cabinet with an angled back so it can be placed on the stage floor. Their angled shape allows them to aim sound up toward the performer’s



ears, while their low profile keeps them from blocking the audience’s view of the performers. Side-fills are larger full-range speakers that are placed off to the side of the stage. They enable performers to hear a rough mix of the whole band, while wedges offer individual mixes to each performer.

When it comes to stage monitors, bigger isn’t better. Low-frequency buildup onstage is an ongoing issue and since larger speakers produce more bass, they only contribute to the problem. Monitoring speakers with a narrower coverage angle and a pronounced upper midrange will do a better job of penetrating the dense sound onstage. Consequently, it’s better to have more focused stage wedges than to have fewer monitors with broader coverage and deeper lows.

Stand-mounted monitors are smaller, unobtrusive monitor cabinets usually mounted on a mic stand and placed closer to the performer’s ear for better intelligibility and less overall sound pressure onstage. Keyboard/synth players will be able to hear themselves better with a stand-mounted monitor.

### SPEAKER CONNECTORS

Normally, the choice of cable connectors is decided by the connection types on the speakers you have chosen. When connecting a mixer’s outputs to multiple crossovers, then those to power amplifiers, and then those to speakers, you’ll most likely be using at least two different cable connector types. Because audio equipment does give you a choice of connections, this reference guide should help you decide which cable connector type is best for your situation.



**SpeakON** is a type (and brand) of multi-pin connector that’s commonly found on speakers and amplifiers with high wattage ratings. SpeakON connectors offer an exceptionally reliable connection, they can manage extremely high power, and they’re durable.



**TRS** is the abbreviation for “Tip-Ring-Sleeve.” This term describes ¼” (or ⅜”) balanced connectors. A TRS plug can be found at the end of most headphone cords, if you want to know what one looks like. It looks like a standard ¼” plug with an extra “ring” on its shaft. TRS connectors are used wherever you need to have two conductors plus a ground (shield) in one plug.



**XLR** (External Line Return) is a circular three-pin connector with positive, negative, and ground pins. These are normally used for transmitting balanced mic-level signals to mixers or line-level signals to powered speakers.



**TS** is the abbreviation for “Tip-Sleeve” and refers to a specific type of ¼” connector that’s set up for two-conductor, unbalanced operation. The tip is generally considered the “hot,” or where the signal is applied, while the sleeve is where the ground or shield is connected.

## IN-EAR MONITORING

The concept of in-ear monitoring is quite simple. Introduce a high-quality signal to the musician's ear that allows them to clearly hear the mix at any chosen volume. In-ear monitoring has been around since the mid-1980s and was originally used only by top touring professionals because of their cost. However, technological advances in recent years have put in-ears within reach of musicians on a budget.

The benefits of using IEM's for the musician and engineer are at once clear: better sound, improved stereo imaging, less vocal strain, protection against hearing damage, portability, increased gain before feedback, and lowered onstage volume. In-ear monitoring works best with relatively low stage volumes, so it's ideal for acoustic performers and electric ensembles who use low-powered instrument amps. If your sound is reliant on massive guitar amp stacks, in-ear monitoring is probably not the way to go.

In-ear monitoring systems are best known for their ability to reduce stage volume. When each band member hears vocals or instruments through wedges and instrument amplifiers, competitive monitoring (individual band members turning up to hear themselves better) often results in a loud, cacophonous stage. This has the effect of muddying the house mix and causes excessive overall volume as the sound engineer is forced to turn up the mains to compensate for stage levels.

When used in conjunction with personal mixer systems, such as those by Aviom, in-ear monitors give musicians absolute control of their own monitor mix onstage. Artists can have any mix they want at any volume. Singers can independently increase their voice's volume separate from the band's mix, reducing voice fatigue and the risk of hearing damage. This also gives the engineer better isolation, because loud stage monitors bleed into adjacent microphones, which can muddy the overall mix. For smaller venues and bands without the luxury of a separate monitor engineer and console, it frees up the FOH mixer from having to send separate cue mixes.

## SUMMING UP

We strongly suggest that, if possible, you should consult with a reputable system integrator experienced in designing, installing and servicing PA systems. While this guide only touches on areas you, as a consumer, need to be aware of, hopefully we've given you enough of a start on your journey to your dream sound system. Armed with that information, you are now better equipped to find the right gear to match your needs and budget.

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