YAMAHA

Make Waves

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 suitable 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 places: community halls, roller rinks, movie theatres, coffee shops and more. If this describes your situation, you probably need a portable sound system. However, a permanently installed sound system would be the better solution if you meet in a dedicated space or established church building.

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.

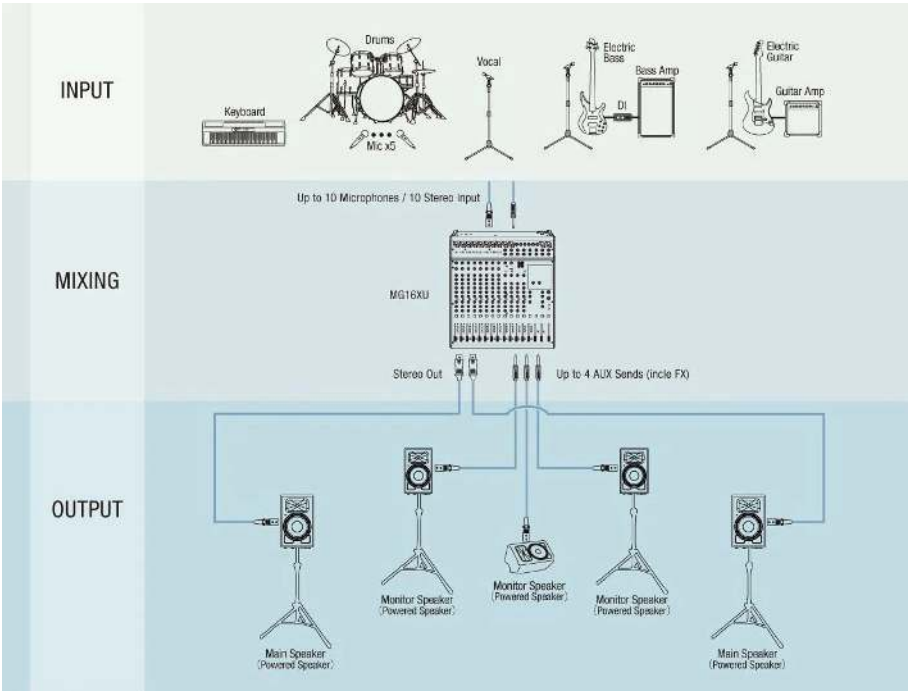
What is your worship style? Worship style often dictates sound system requirements. If you're just amplifying the pastor as he gives his message, a small system with good vocal intelligibility is all you may need. Suppose you're amplifying a large choir or a full worship team with modern electric instruments. In that case, a larger system can reproduce all the instrument and vocal frequencies clearly and evenly. 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 necessary. 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, remember what your needs may be in one, two or even three years. 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. 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, including your worship band, vocals, instruments, announcement microphones, speaker microphones and audio sent to places like the foyer, cry rooms, hallways, etc. Remember that it's often not just the main sanctuary that requires audio of the service (video live streams, 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 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 better for your situation. In either case, quality stage monitoring is essential. It's important to talk 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

Do you need a mixer for a portable or permanent system? If you meet outdoors, inside a temporary location or 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 designed for different portable applications. We'll also explain and give examples of consoles designed for permanent installation applications from small to large congregations.

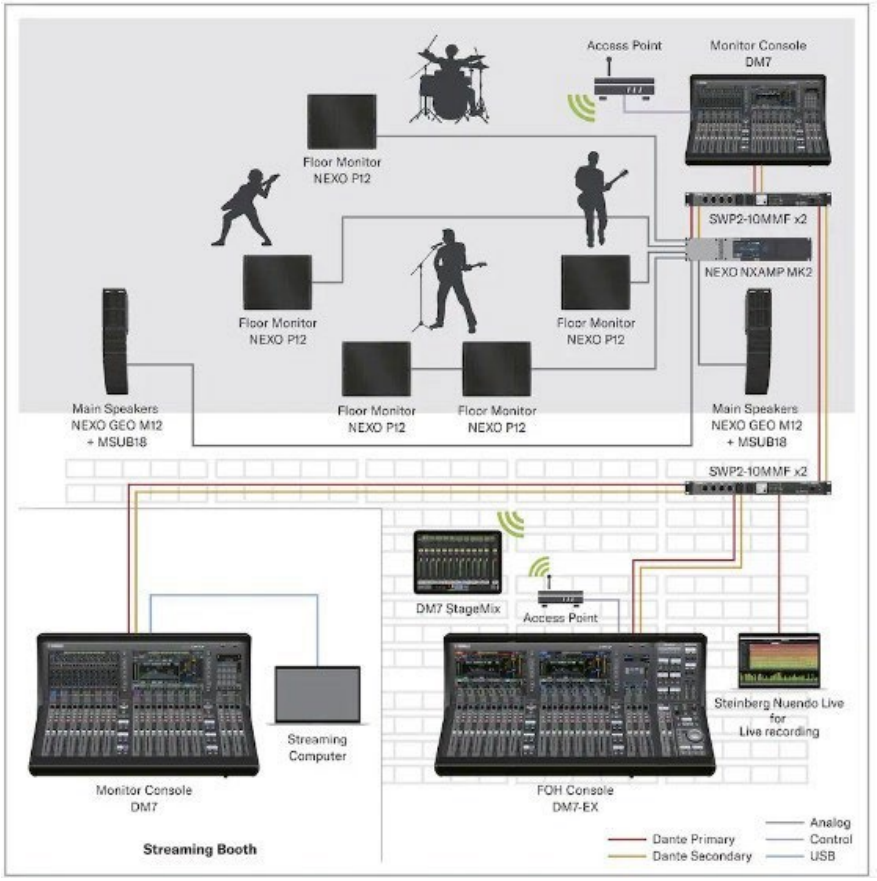
What is your worship style? You'll have different requirements depending on your worship style. A small console may be all you need to amplify the minister's message with one or two acoustic instruments and vocals. Your mixing needs will be more complex if you have a large choir or a worship team with electric instruments. A coordinated networked system will be needed if you have multiple worship styles and different campus locations that need to be interconnected.

Who is your tech staff? From the beginning, it's essential to know the experience level of the people 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 so that it's easy to use and understandable and allows intuitive access to settings? A good mixer enables you to adjust a large quantity of variables and parameters, see what you need to see without getting overloaded and then interact quickly with all those parameters.

Figure out the inputs and outputs you will need. One of the first criteria to consider 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 decide to livestream? All these circumstances will undoubtedly increase your I/O requirements.

CONNECTION ABILITY

Will the main soundboard 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. For example, if you need more consoles for broadcast or monitors, 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 crucial to consider your system's overall possible "network" expansion. You may eventually get to a place where nothing 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 most significant advantage of a digital snake is that it's a single cable that replaces the large, heavy, cumbersome analog snake and can 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 simultaneously on service days, all needing sound engineers, and those engineers are often rotated among the rooms. Consoles from different manufacturers often entail numerous training sessions to ensure the entire staff is competent on the different platforms. Churches today opt for "brand family" consoles so that the training is on the same operating platform, no matter the size or model. For example, Yamaha DM3 and DM7 mixing consoles use the same workflow, making it easy for a tech to mix on a DM3 this week and a DM7 next week. The 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 lot of the preliminary work in setting up a new console can be done using the old one as a reference, especially 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. 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, discover what the console is capable of and get comfortable with how it works. While there may be more capability and flexibility built-in, there will 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 send 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. When more channels are required, the footprint will get significantly larger as more channel strips are added.

Analog mixers usually have a shorter learning curve and are often a good choice for teams with limited experience.

Many analog consoles, like the Yamaha MG Series and MGP Series, include built-in effects and compression. 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 offer a USB connection for input and output operations.

While digital mixers offer many more mixing options than analog mixers, analog can be an excellent choice for those on a small budget or for tech teams with 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. 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 onboard 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 required to mix.

DIGITAL MIXERS

Digital mixers offer a wide range of control and recall capabilities. You can set up "scenes" on the mixer and then save them into its memory. 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.

Most digital mixers also allow wireless remote control. Yamaha digital mixers use the remote software StageMix, which enables you to use an iPad to walk around a room to ensure the music sounds good everywhere. If your worship band is using In-Ear

Monitors (IEMs), Yamaha 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, what they’re being used for, what type of instrument inputs are being used, and what kind of IEM is being used. These presets help the audio engineer “dial in” the EQ and compression for these channels, making for a quicker setup and 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 to accommodate a USB memory device. When the record function is engaged, a stereo mix from the main 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 an excellent resource if you want to create virtual sound checks or do a full mixdown of any performance.

A full digital setup also means using a digital cable. An I/O rack like the Yamaha TIO 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 requiring 120 or more I/O channels are easily managed on this cable, ending the need for large, heavy, expensive analog snakes. Additionally, the system can be connected through Dante to other Dante-enabled components. This allows for streamlining connections, aiding in troubleshooting, and routing signals to where you need them.

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

Personal PAs consist of single speakers or mini-speaker arrays, serving as 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, "How much power is required for a PA system?" 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 essential. 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 or drop-down tile ceiling? How much electrical power is available in the room, and where will it be installed? When you consult a systems integration company, it's important to have as much of this information as possible.

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 to consider the speaker's sensitivity, which measures its ability to convert power into sound effectively. 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 unfamiliar with active speakers, the critical thing to know is that the power amplifier and crossover are built into the same cabinet as the speakers. The benefit is that you only need the speaker and a sound source, whether 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 most straightforward option for a sound system. Separating your system components can greatly benefit larger, more complex systems due to the extreme amount of power needed. Using separate amplifiers prevents your speakers from being overheated by the amps. In the long term, system maintenance is much easier when you don't have to climb to the rafters to adjust your amplifier setting. Since 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. The 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, 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 use 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 a passive system's versatility and modular nature.

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 high-frequency and low-frequency. You increase the speaker's output, frequency range and efficiency by giving each speaker a specific frequency to cover.

UNDERSTANDING CROSSOVERS

A crossover is a device that divides an audio signal into separate frequency ranges 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 to match your speakers and enclosures. Bi-amping, tri-amping and others 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

A portable all-in-one solution may be the best for small churches or "on-the-go" ministries. 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 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 include automatic feedback suppression, networking capability and remote control. How you plan on using your system regularly determines which of these advanced features, if any, will ultimately benefit you.

SUBWOOFERS

Subwoofers are speakers that are built to reproduce only 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 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 need a dedicated subwoofer for truly full-range sound.

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. 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 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 better penetrate the dense sound onstage. Consequently, it's better to have more focused stage wedges than 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 can hear themselves better with a stand-mounted monitor.

SPEAKER CONNECTORS

Typically, 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, power amplifiers and speakers, you'll most likely use at least two cable connector types. Since 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 commonly found on speakers and amplifiers with high wattage ratings. SpeakON connectors offer an exceptionally reliable connection as they can manage extremely high power and are durable.

TRS is the abbreviation for "Tip-Ring-Sleeve." This term describes ¼" (or ⅛") 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 usually transmit balanced mic-level signals to mixers or line-level signals to powered speakers.

TS is the abbreviation for "Tip-Sleeve." It refers to a specific type of ¼" connector 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 (IEM) is quite simple. IEMs introduce a high-quality signal to the musician's ear, allowing them to hear the mix clearly at any chosen volume. They have been around since the mid-1980s and were initially 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 IEMs for the musician and engineer are clear: better sound, improved stereo imaging, less vocal strain, protection against hearing damage, portability, increased gain before feedback and lowered onstage volume. IEM 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 relies on massive guitar amp stacks, IEM is probably not the way to go.

IEM 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, raucous stage. This muddies 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, IEMs give musicians absolute control of their 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 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 this information, you are now better equipped to find the right gear to match your needs and budget.

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