



September 1, 2015

PA SYSTEM GUIDE

FOR SMALL CARNATIC MUSIC VENUES

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Author's Note & Disclaimer

At the outset, I would like to confess that I neither claim to be an expert at audio related matters and neither am I academically qualified in this particular realm. But I am certain in my desire for good sound and have some understanding through self-education, and it is my strident belief that Carnatic music could do much better with greater emphasis on sound related matters. Music after all is an art form where we enjoy the aesthetics in the realm of sound. So this is a guide seeks to simplify the PA System, the most integral component of sound in performances.

Although this guide is meant for Kutcheri (Carnatic music performance) organizers to address the typical needs and concerns surrounding kutcheri at small venues, this can also be of use to musicians and rasikas (connoisseurs) alike who are more interested about sound related matters. People looking for larger setups would likely seek professional help anyway. Although my aim is to address the situation pertaining to the needs of Carnatic music recitals, the salient points of this guide can easily apply to other musical forms as well.

The following guide is an accumulation of thoughts and opinions that I have gathered from self-reading and experimentation. Some part of this guide derives from my personal observations. So by definition, these cannot be scientific facts. Furthermore, the scope of this guide is only introductory. The PA system is only one part in the larger scheme of Live Sound. And live sound is only one specific application of the principles of acoustics and electronics, the study of which can take a lifetime. I earnestly hope that this guide of use to someone and hope that it results in some tangible change, in whatever small way. I welcome any corrections and suggestions that you'd want to see take shape in this guide.

Tejas Mallela

The Aim

The PA (Public Address) System is the collective name given to components that work together in amplifying and distribute the sound of a performer, presenter, lecturer, or other such sources of sound, so that the audio can be heard clearly by the audience. This guide seeks to simplify the technicalities of a basic PA system in the hope that it will result in better sound related practices, which will enhance the quality of the concert. The PA system tends to usually be a one-time purchase. So such an investment has the potential to yield results for a long time to come.

The Need

Just as a painter cannot excel at his capabilities if you present him with a poor canvas and bad paints, a musician cannot perform to the best of his/her abilities if he/she isn't in the presence of an environment conducive to the proper propagation of sound. And importantly, audience members are left with a less gratifying experience, regardless of their understanding of acoustics.

In general, the current state of PA systems at conventional Carnatic music kutcheris at small venues is not satisfactory at all. As an effect, the average Kutcheri is often a chaotic event (acoustically speaking) because of the improper use and inadequacies of the PA system. This results in frustrated artists and less-than-satisfied audience, and drastically mars the experience at a concert. It is my strong belief that bad sound practices are why Carnatic music may seem off-putting to many lay people. This also causes artists to resort to showmanship and theatrics, to compensate for the lack in aesthetics (or what we call naadam). The adoption of electronic amplification for acoustic instruments might also be such a reaction.

The Inadequate Typical PA System

To the right is an image of the typical PA setup used at many venues. The amplifier on the top is very inadequate as it tries to perform roles that are meant to be played by separate and specialized pieces of equipment. It provides power for the microphones, acts as a makeshift mixer and speaker amplifier. It is very inadequate in all three areas. The loudspeakers are locally sourced low quality speakers. Given their poor design, they are prone to distortion, feedback problems and completely alter the tone of music being played through it.



Such a system is inexpensive, yes. But often, organizers continue to use such inadequate systems out of habit and due to the lack of know-how. With the easy availability of products from across the world and emergence of high caliber Indian manufacturers, there is no more reason to stick to these 'tried and failed' methods. And with the influx of new money into the field, the time is ripe for substantial change. Anecdotal evidence suggests the systems used in music performances of other genres is much better, with adoption of better equipment and use of better techniques. It is time for the Carnatic music world to catch up.

Buy or Hire?

A lot of Carnatic music organizers choose to hire audio services so that they can delegate a task that requires a slight bit of know-how. But unfortunately many of the light-sound shop or tent shop owners who provide the service, make use of substandard equipment like that mentioned above. Furthermore, they often are not well informed about how to handle sound appropriately for the need.

I am a huge advocate of buying your own live sound gear. But at the very least, resorting to knowledgeable vendors who can supply higher quality equipment is the least we can do. So knowing about the possibilities in the market can help us aim for higher quality. Also, knowing about the workings of live sound will help us better communicate our intent with the person mixing the sound.

What is good sound?

If the aim is to achieve good sound, it goes without saying that we have to first understand what it is. It is important not to confuse this topic with the ability of musician or quality of the sound source. If we are being purely objective, good sound can be defined by some simple parameters. Good live sound is audio of good fidelity when played in an intelligible environment with appropriate levels of loudness. What do I mean? :

Fidelity

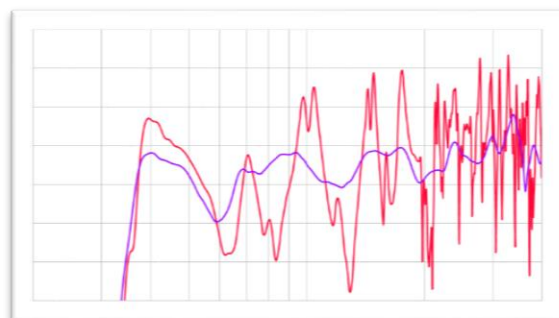
Fidelity is the measure of how accurate and faithful the reproduced sound is, when compared to the sound source. For example, the sound of a human voice on the telephone sounds 'unnatural' and is of 'low fidelity', as a lot of the bass (low frequencies) and treble (high frequencies) are removed.

So if the sound is captured (by the mic) and propagated (by the loudspeaker) in such a way that the sound is true to the source across the frequency spectrum, then the sound is said to be of **high fidelity**. All the components of the PA system should work in harmony to maintain the fidelity of sound.

Intelligibility

In order for the sound to be pleasing, it should be 'understandable' to the ear. For example, if there is too much echo/reverb for example, it becomes hard to hear speech (or other sounds) clearly. This causes our hearing senses to tire out, affecting both the performer and listener. Intelligibility of sound is usually affected by the acoustics of the space in which the PA system is used. Some factors which effect intelligibility:

- Too much echo/reverb.
- Noise levels: Traffic noise, industrial noise, noisy audience, etc.
- Poor frequency response: Due to the acoustic nature of the space, certain frequencies seem louder and others softer.



Red Graph: shows frequency response of bad room. (Notice the peaks and dips)

Blue graph: shows the same room after acoustic treatment. (Much more even frequency response)

Loudness

This is a straight forward concept to understand. Sound sources seem pleasing when they are set at an optimum level. If the sound is either too loud or too soft, it doesn't seem appealing. The sounds also have to be of appropriate loudness with respect to each other. For instance if the mridangam is too loud in relation to the vocals, the effect is displeasing. Appropriate output levels of loudness are to be set both on the stage monitors (for the artists) and house sound (sound for the audience).

In terms of the electronic equipment, when the audio signal is too high (or loud) it leads to clipping. This clipping might cause distortion (crackly audio



The signal displayed on the right side is starting to clip (shown in red)

sound) and might even damage the loudspeakers and other equipment. So the signals also have to be set at appropriately.

PA SYSTEM – A Brief Introduction

In this section, I will concisely introduce the separate elements of a PA system. Each element will be briefly explained, and I will list out some do's and don'ts which will help reader understands some commonly made mistakes and how to correct them with better practices. I will also include some purchase suggestions. (However, these are very flexible given that the market options and prices are forever changing.) It is also important to note that **proper use** of this equipment in a **proper space** also play important roles in the end goal of good sound.

Typical Components of a PA system: (Ordered sequentially based on how sound travels in the chain)

1. Microphone

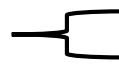
2. Stands

3. Cables

4. Mixer

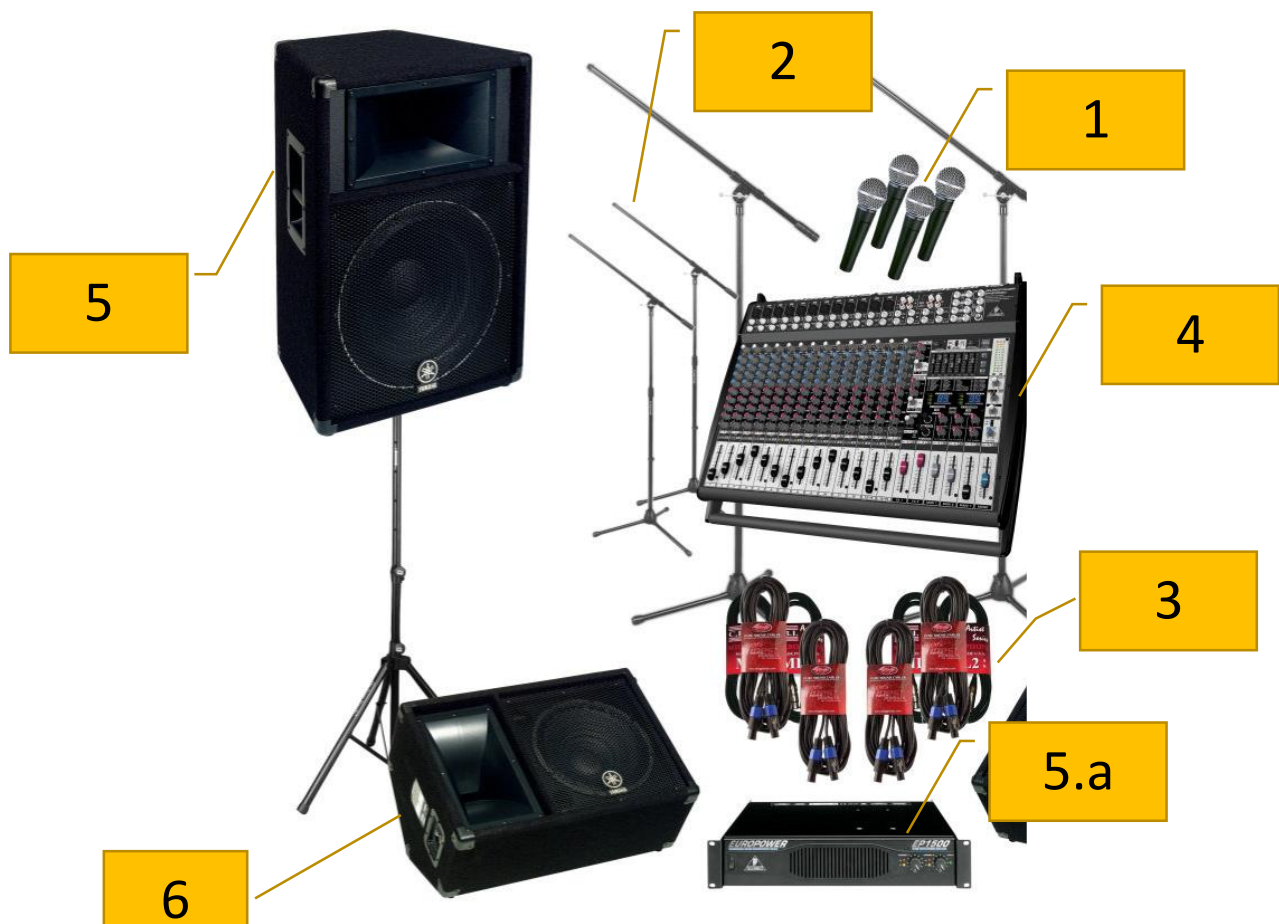
5. Loudspeakers

6. Monitor Speakers



Powered speakers (Or)

Amplifier (5.a) + Passive Speakers



1. Microphone

Introduction

It is a device that convert acoustic energy (the voice of the singer, for example) to an electrical signal. This signal can be manipulated in a mixer, amplified and then sent out to the loudspeaker.

There are innumerable types of microphones at different price ranges. But the type of mics best suited for live music are called **Dynamic Microphones**. They are physically rugged and can handle loud sources of sound, and more importantly they have excellent sound rejection qualities to prevent feedback. Dynamic mics can further be divided into two broad types: Instrument and Vocal dynamic types. The purpose for each type is self-explanatory. A good quality dynamic mic can **last you decades**, even after heavy abuse.



Shure SM-58, a typical Dynamic Mic

Best Practices

- Don't use poor quality microphones. They don't last very long and produce very thin sounding output which drastically effects the quality of sound from the speakers.
- Use microphones specific to the use. For example, an instrument mic has special characteristics that might not suit a vocalist.
- Microphones shouldn't be pointed directly at or be close to the monitor speakers or loudspeakers. That causes feedback.
- Calculate the adequate number of mics needed. Very often, the mridangam bass side is not miced due to the lack in number.
- Try not to use 2 mics on the same sound source, as this might result in something called phase cancellation when done incorrectly, which negatively effects the tone of a sound source.
- Be aware of the **pickup pattern of mics**. A lot of poor quality mics pickup sound from unwanted directions, and cause feedback problems.
- Place mics at a proper distance away from the sound source. By placing it too close to the sound source, the loud parts will seem very loud. So making sense of this 'proper' distance will take some time and study to understand.
- Some mics might need a windscreen to prevent making a 'pop' sound, especially for vocals.



[Microphone Pickup Pattern](#)

Purchase Suggestions

It is important to note that there are **no absolute rules** when it comes to microphone selection. It is an art and skill in itself. And also, there are hundreds of choices available in the market. But some common recommendations include: (Most of these mics cost between 4-6 thousand rupees each)

- Vocal Dynamic Mics: Shure SM58, Sennheiser e835, AKG D5, Audix OM2, Shure BETA 58A
- Instrument Dynamic Mics: Shure SM57, Audio-Technica ATM650, Audix I5, AKG D40

2. Stands

Introduction

A stand is a mechanical device which allows the mic to be mounted and positioned in a desirable way, so that the sound is picked up well by the mic.

They come in a variety of sizes, but can be categorized into three categories based on purpose. Full size ones (used when standing), medium ones (used while sitting on the floor), small ones (to capture very low height sound source, like a mridangam.)

Best Practices

- Stands should be of adequate height. Low height stands often cause the vocalist to need to hunch. Similarly, if the stand used is too tall, it might be visually unappealing and difficult to adjust while seated.
- Stands should be sturdy and have a heavy enough weight so that they can stand steadily.
- Organizations should maintain spares as a last resort to fall back on when the usual stands malfunction.
- All the clamps and poles should ideally be rust free and free moving so that it can be adjusted without problem.
- The microphone clip should attach well to the head of the microphone pole. If the thread on either device has worn out, it should be replaced.
- Using adhesive tapes and other make shift measures to keep the mic and stand steady, should be considered only when there is no other option.
- Every sound source requires a stand. Often the mic used for the bass side of the mridangam doesn't have a stand.
- Periodically check the condition of the stands.

Purchase Suggestions

Mic stands is a category for which there are only few options in the market. Check to see if the stands are sturdy and buy. As suggested before, it is a good practice to have a spare stand to use in case of a malfunction.

3. Audio Cables

Audio cables are used to connect the mics, speakers, mixer, musical devices etc. to one another so that the audio signal can be moved and manipulated as desired. Cables are an often overlooked component in the PA setup. Proper use of cables is **equally easy to achieve or neglect**, and the result either case can be dramatic. Apart from proper use, the thoughtful presence of cables in **quantity and type** is also important.

Cables come in two broad categories, **balanced** and **unbalanced**. Balanced cables have a shielding inside the cable which eliminates interference/noise problems that are caused in unbalanced cables. If the mic cable has XLR connectors like the one on the right, it is most likely a balanced cable

Check to see exactly what kind of cables will work to connect with different devices

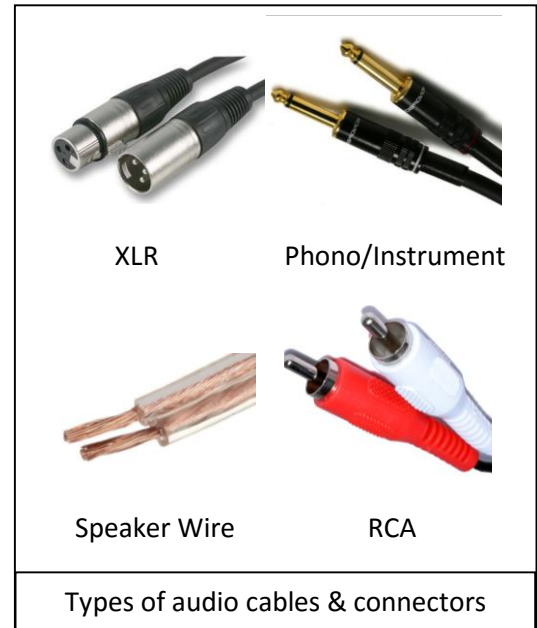
- Microphone to mixer
 - Mixer to Amplifier
 - Amplifier to speaker
- (If powered speakers are used, then the mixer will directly be connected to the powered speakers)

Best Practices

- The organization should carry with them phono/instrument cables and also a cable with 3.5mm cable to connect to the mixer. More and more artists carry amplification devices for their instruments or electronic tamburas, which they would wish to connect to the mixer.
- Cables should be wrapped properly after use. (Look into the over-under technique of cable wrapping). Just coiling/rolling up the cable can lead to loose connections within the cable.
- Having spares cables is a good idea, as they can go bad without any notice.
- Used balanced cables wherever possible to reduce chances of noise/interference.
- If you have cables with a loose connection, get the repaired soon instead of trying to manage with them always.
- Don't use cheap electrical wire to connect the amplifier to speaker. Use speaker wire of proper gauge.
- Not all sound signals are the same. Understand the difference between mic level, line level and speaker signal; and use adequate cables accordingly.
- A cable with a loose connection is often caused by a bad connector. But the cable itself might still be very usable.

Purchase Suggestions

- Buy good quality cables, which will last you a long time.
- MX is a budget Indian brand for quality cables and connectors. If the finances allow for it, brands like Neutrik and Amphenol can be considered.
- For the technically capable, you can buy loose cable and connectors separately and solder them yourself or by an electric repairman. This turns out to be much cheaper than buying readymade cables.



4. Mixer

An audio mixer is a device that allows one to combine multiple audio signals into a unified output that can be sent out to the loudspeaker. Importantly, it allows us to manipulate each of the individual audio signals as desired. The mixer is **arguably the most important component** in shaping the output sound.

Using the mixer is a skill in itself, best understood by live sound engineers. But with some effort, the basics of live sound mixing can be learnt by amateurs as well.

A typical mixer offers us many input and output options for shaping what kind of sound we want.



Inputs:	Outputs:
<ul style="list-style-type: none">• Microphone• Instrument cables (from an amplified violin for example)• Line level sources (like MP3 players, smartphones)• Effects processors	<ul style="list-style-type: none">• Amplifiers• Powered Loudspeakers• Stage Monitors• Headphones• Effects processors

Best Practices

As mentioned earlier, using a mixer is a skill. So directions to use a mixer is beyond the scope of this particular guide. So I will have to come up with a **separate guide** for mixing as well. Alternatively, you can use the manufacturer's own detailed manual (which is provided typically with the mixer) or you can look up tutorials online.

Here are some general tips:

- Buy a mixer made by a reputed company (some brands are mentioned below).
- Familiarize yourself with all the knobs and buttons on the mixer. When the unexpected problem arises, you should know how to fix it.
- Set up your mixer in a logical manner, and know which mic is connected to which channel. (For example, if you want to alter the sound of the vocalist, you should know exactly what channel knobs to turn.)
- Buy a mixer with adequate number of microphone inputs. (I would recommend at least 8 microphone inputs). That way when they need arises, more microphones can be hooked into the mixer.
- Many mixers are capable of 2 (if not more) 'mixes'. What the audience wants to hear is different from what the artists want to hear on stage.

Purchase Suggestions

- Given the importance of the mixer, you need to make sure that it is reliable. So stick with quality brands like Yamaha, Soundcraft, Mackie, Allen & Heath.
- Soundcraft EMP8 represents great value, at around Rs. 14,000
- Solicit the opinion of a professional for your needs, if needed.

5. Loudspeaker

Loudspeakers are components that convert an electrical signal into acoustic energy. As the name suggests, they produce sound at loud enough levels so that the entire audience can hear the sound sources.

Loudspeakers come in two primary varieties:

- Powered Loudspeakers: (also called Active Loudspeakers). They come inbuilt with all needed components.
- Passive Loudspeakers: Needs to be powered using an amplifier.



Powered Loudspeaker

Why should you prefer using Powered Loudspeakers?

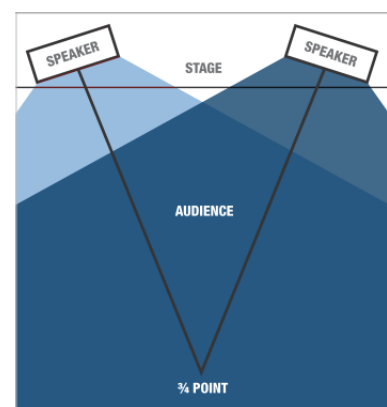
Here is an analogy. Let's say you wanted to buy a car, but you had to buy the body and the engine separately. You have hundreds of combinations to choose from, and have to make sure that the engine is able work together with the car in many respects. Most people wouldn't have the technical expertise to make such judgments. They just want a vehicle that they can drive that gets them from place to place.

Buying a passive speaker is much the same. You need to understand basics of electrical measurements like power rating (watts), impedance values (ohms), distortion, wiring techniques, etc. Most lay people find this complicating, and it actually is. The only case in which I'd recommend loudspeakers to organizers is in the case of permanent installations in venues, where you have some expertise to help you with the setup.

It is far simpler to buy a Powered Loudspeaker that comes inbuilt with the amplifier and crossover, decided appropriately by the manufacturer. Using a powered speaker is no different than using computer speakers. You just plug in the audio signal and power cable, and turn on the speaker.

Best Practices

- Choose your loudspeaker based on the size of your venue and approximate audience size. If the loudspeaker is too weak (low in power), it won't sound loud enough for the audience.
- Prefer using speakers in a stereo setup (where the signal of left speaker is different from signal of right channel). Just the way that we have two ears, it is more pleasing to hear stereo sound.
- Speakers need to work together as a group, so correct placement is key. If the speakers are not distanced and/or angled correctly, the effect is quite displeasing.
- Choose a reliable brand of loudspeaker, which usually ensures longevity and quality of sound. (suggestions below)



Purchase suggestions:

- Some reputed manufacturers of speakers are JBL, Mackie, Yamaha, QSC, and Behringer (to a lesser extent).
- Buy an appropriate stand for the speaker.

6. Monitor Speakers

Also called stage monitors (or floor monitors), these are speakers for the performers on stage so that they can hear themselves. From the artists' perspective, this is arguably the most overlooked component of the PA system.

Like in the case of the loudspeakers for the audience, it is best to use a powered monitor speakers to keep things simple and reliable. Use only speakers **specifically manufactured** for the purpose of monitoring.



Best Practices:

- You need to be able to make a separate audio mix for the monitors (typically called monitor mix). The point of this mix is for the artists to hear themselves best.
- Changing the direction of the audience speakers to compensate for the lack of monitors is not the solution. It neither satisfies the need for the audience nor the performer.
- If possible, using more than one monitor speaker is recommended. Depending on the capabilities of the mixer, it is even better if each one of these speakers had their own mix. The mridangam artist might want to hear more of himself and less of the other artists for example.
- Given that the monitor speakers are close to the artist, they have to be placed and mixed such that feedback problems are avoided.
- Indian classical music is performed seated on the stage. So place monitors such that they don't obstruct the audience's view of the artists. Using low-profile monitors helps too. The problem can also be avoided by having the artists sit on a raised platform.

Purchase suggestions:

- Manufacturers of loudspeakers also usually make monitor speakers.
- Buy low profile monitors that are not too high.