

How to Choose A PA System

By Richard Harfield

If you read and understand this guide then you will be able to go into a store and understand what the salesman is on about, and hopefully you will not be baffled by technospeak.

The salesman should be your friend and guide you to the best P.A. system and armed with this information you will be able to tell him what type of system you are looking for.

What is a P.A. System?

A P.A. system (Public Address system) is a means of amplifying (making louder) speech, singing or music so that an audience can hear it.

It typically consists of several parts, which made be integrated together.

[Microphones](#)

The microphone converts the sound waves going into the microphone into an electrical signal which is then connected via a lead or cable to a

[Mixer](#)

A mixer takes the microphone signals and mixes them together into the music that you hear. The mixer enables you to set the individual volumes of each vocal, instrument or backing music and also to adjust the tonal variations that may be needed to make the sound how you want it and also may allow you to add effects such as [echo or reverb](#) to your mix. The mixer is then connected to an

[Amplifier](#)

Which takes the signal from the mixer and boosts it up to a level that can drive

[Speakers](#)

Which convert the electrical signal from the amplifier back to sound waves, in the opposite way that a microphone does.

Systems

As I mentioned before, some of these parts can be integrated together. So you may purchase a mixer / amplifier (also known as a powered mixer) as one item, or you might purchase a powered speaker (known as an active speaker) . A speaker without an amplifier is called a passive speaker. Or you might buy an all-

in-one, microphone, mixer, amplifier and speaker, although this item, called a megaphone, is really only used for addressing large crowds with limited sound quality and isn't suitable for anything but making a point to a crowd!

There are advantages and disadvantages of active versus passive systems. No one is better than the other, but there is one point that I would like to make with regard to the purchase of expensive active speakers and that is, don't partner them with a cheap mixer.

A system is only as good as its weakest link and it is far better to spend equal amounts on each part of the chain, rather than buying an expensive active speaker and then spending £100 or £200 on a mixer, it's just not going to deliver. In my 30 plus years of selling and using PA systems, I would find the best microphone, mixer, amp and speaker that I could afford, and it will give you good service for many years to come.

You will also have to consider weight; unless you have a full road crew with a big van! In general, light weight = more money.

Microphones

As I mentioned before, these convert sound to electrical energy. There are many types, but for the sake of this article we will only talk about the most popular ones that are used in PA systems: dynamic and condenser and ribbon. Most performance microphones are dynamic, most recording mics are condenser and very few ribbon microphones are used.

Dynamic Microphones

Dynamic microphones are very simple in operation. Behind the metal pop shield, they consist of a lightweight diaphragm connected to a multi-turn coil of wire, which is free to move in a magnetic field. The sound waves move the diaphragm and coil in the magnetic field, which produces a small electrical current, which can then be amplified.

Condenser Microphones

Condenser microphones or capacitor microphones use a different technique to produce an electrical signal, which rely on a very thin diaphragm of charged material a very small distance from a fixed back plate which moves in the sound field and produces very small currents which are amplified by a pre-amplifier which is in the microphone itself. Power to this pre-amplifier is normally provided by either a battery, or from the desk. This is called phantom power. Most desks have this feature, which prevents the microphone going off due to a battery end-of-life failure.

Ribbon Microphones

These are microphones which use a short ribbon of aluminium, or aluminium alloy which moves in a magnetic field. Very rarely used today as the ribbon is

very easily damaged (eg when someone blows into the microphone). Popular in the 1970's, the Beyerdynamic M500 and M260 were classic ribbon microphones.

Dynamic vs Condenser

A condenser microphone, due to the diaphragm not having a (relatively) heavy coil of wire to move in a magnetic field, is inherently more sensitive than a dynamic microphone and can capture every nuance of expression in a voice or in the sound of an instrument. The downside is that due to their sensitivity and clarity, they aren't always the "sound" people want, and people often want the warmth of a dynamic mic. This is why on expensive condenser mics the pre-amps often use old-fashioned vacuum tubes (valves) to give much needed warmth.

Mixers or Mixing Desks

The mixer's job is to take the component parts of the performance, mics and backing music etc. and enable you to mix them into a complete sound performance.

The mixer has to be able to let you take the small signal that you get out of a microphone and mix it with the (relatively) large signal that you might get from a CD player or other music source which might be 100 times as big.

Due to complicated stuff, which we won't go into here, these signals are measured in dB (decibels). The level that you need to drive an amplifier fully these days is +4dB (1.2volts). A microphone typically when sung down might produce -30 dB. A CD player might produce +10dB. To get them to mix together you need to put +34 dB on the microphone and take -6dB off the CD player to get them to be the same level, which is +4 dB.

If you look on a microphone channel on a mixer, you will see that it has a marking on the input control from 0 to maybe 50 or 60 dB. This is marked "Gain". Gain is the amount of volume increase that the channel can "gain". So we need to put about 30 odd dB of gain on our mic, and nothing, or maybe a decrease on our CD player to get them to balance or mix together.

There is often a channel fader at the bottom of the desk. This is for mixing the precise amounts of each channel together to make a good mix. Again these are marked in dB gain. Set to zero the circuitry adds no further gain to the signal; above that there is a gain increase, below that there is a gain decrease.

The master volume sliders or faders, which are normally to the bottom right of the desk set the overall volume of the system, and again are marked in dB.

There are often tone controls on each channel. These can be treble, middle and bass. They can make a big difference to your soundfor better or worse, and need to be used with care. They also increase the gain of your system and too much of any can result in that dreaded howling sound – Feedback!



The Dynacord Powermate 600 Mk3 is probably the best known mixer amp. Despite its small size and low weight it delivers 1000 watts per channel and has a USB socket for connecting a laptop without using the computers headphone socket. It's also got a fantastic effects unit in it, and can pretty much be used straight out of the box without any training.

Amplifiers & Why You Can't Always Trust Manufacturers' Power Ratings

The amplifiers job is simply to make the signal from the mixer bigger, in order to drive the loudspeakers. It takes a signal that is approximately 1 volt to one of 50 volts or more.

Amplifiers are rated in watts output. However one manufacturers' watt doesn't seem to be the same as another manufacturers. I know it sounds strange, but some manufacturers will stretch the truth as to what the amplifier actually gives. At HW Audio, we think that an amplifier should run at full power for 8 hours with a low distortion figure, continuously and that should be its rating. However, if you run music through the amp, then there are times when the music is quieter and sometimes louder, with peaks and troughs and the "music power" figure quoted can be twice the power of the continuous figure. Furthermore, some manufacturers use a peak figure with an instantaneous burst of power measured, which is 4 times the continuous figure.

So an amplifier that is sold as 1600w per channel may in fact really be a 400w per channel amplifier.

Go for a reputable make, like Electrovoice, Dynacord, Crown or QSC.

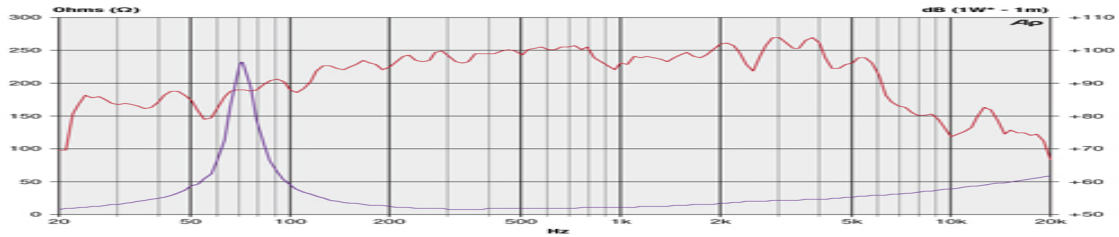
Ohms & Watts it All About?

Power is measured in watts. Resistance is measured in Ohms. But speakers have an impedance, as well as a resistance, and these figures are different...why?

Resistance is measured using a dc voltage like a battery and a meter, and shows the amount of resistance to the flow of current flowing from the battery. But the speaker has a different resistance to different frequencies or notes in a scale.

This is called impedance and varies tremendously.

For example see below.



Thanks to Precision Devices for this plot. The purple line shows the impedance of a speaker and the red line shows the frequency response of it. Note how much the impedance varies especially at the lower end of the frequency range. The impedance quoted is an impedance that you would reasonably expect to get within the frequency range in which you are using the speaker.

Most amplifiers are designed to run into a 4 ohm impedance. Most speakers are designed as 8 ohms impedance. But using an 8 ohm load, you will only get about half the output from the amplifier. They will give the full wattage into 4 ohms. 4 ohms is 2 x 8ohms speakers connected together in parallel. The maths is

$$\frac{1}{\text{IMPEDANCE}} = \frac{1}{\text{SPEAKER 1 IMPEDANCE}} + \frac{1}{\text{SPEAKER 2 IMPEDANCE}}$$

So in our case

$$\frac{1}{4} = \frac{1}{8} + \frac{1}{8}$$

Some amplifiers (notably Peavey) design their amplifiers to run into 2 ohms. This is great when you want to run 2 x 4 ohm speakers together, but here we have to be really careful with our speaker cables. Cables have a resistance. It is quite possible that our speaker cable will have a resistance of 1 ohm. In that case 1/3 of our power is wasted as heat in the cable! So make sure that your speaker cables are very chunky if you want to run into 2 ohms.

(Loud)Speakers

Speakers are the heaviest part of the PA. They are available in several different sizes. In general they range from 8" to 18". The figure quoted there is the diameter of the bass speaker. Not all sizes do the same job. See below for what they do:

8". Suitable for speech and vocals, but not in general for full range music, without using an extra bass speaker. This extra bass speaker is known often as a bass bin.

10". Again, suitable for vocals only. Very few of them are genuinely full range. Don't pay too much of the specifications....people who pay attention to the specifications are the copy writers dream, they can be fudged to make the speaker seem better than it is. There is NO SUBSTITUTE for trying them out!

12" A good 12" speaker can handle backing tracks and vocals. Probably the best all round passive speaker is something like the Electrovoice SX300. It's relatively light and sounds pretty good. It's also one of the most efficient speakers available, which means it's louder than the competition. Active speakers such as the FBT range are also excellent on a price to quality level, but all speakers sound different and you need to find something to suit your voice. Don't be shy...you are used to singing in front of an audience of many, in a shop, only an audience of a few. An average, fit person can carry most 12" speakers relatively easily, although older people and some ladies might want a lighter speaker.



Most speakers consist of a bass driver and a tweeter to give the full range of frequencies of music. Here's the Electrovoice SX300, on its side here, which has a 12" bass unit and a 1" horn loaded tweeter which gives solid bass and a crystal-clear treble sound.

15" Suitable for full range music and vocals...BUT in general, the 15" speaker does not reproduce the higher tones of the voice and where the transition between the bass speaker and the tweeter occurs there can be a harshness or "shoutiness" which can be unpleasant. It's a fine balance, and that is why FBT have made a 14" cabinet, which gives the best of both worlds. However, it's not cheap!

Also 15" are the most common sizes for portable bass bins, which only reproduce the bass of the music, normally the lowest octave of the music.

18". These are suitable for very low bass reproduction. Normally quite heavy and generally a 2 – person carrying job.

Other sizes.

21" and 24" drivers are also made, but some of these cabinets are very, very large.

Other types of Loudspeaker

Small line array systems.

Popularised by Bose, this type of system gives excellent coverage in both horizontal and vertical areas. The Bose systems are suitable for smaller venues and are primarily designed to be used as a personal PA system, with one system per performer. They have an excellent sound, very smooth, but have limitations as the actual sound pressure level (volume) that can be achieved.

For larger venues there are similar systems available with higher powers which often are more suitable.

Large Line Array systems

Used in larger venues, concert halls etc.

Horn Loaded systems

Ideal for very large systems, or where there is only a small amount of power available and a large area to cover. Cinema systems used to be the most popular application for horn loaded systems.

It should be very easy for you to find a speaker that fits your weight requirement, sound quality and pocket. Please don't buy the cheapest, buy the best you can afford, and try to spend an equal amount on each part of the chain within reason. For example, if you have a £500 radiomic, then spend £500 on a mixer, £1000 on a pair of active speakers or £500 on an amp and £500 on a pair of passive speakers. This is lots better than buying a £500 radiomic, a £100 mixer, a £200 amp and £1300 passive speakers.

Please try the system out. It's unlikely that you can try it out in a gig situation but try it out in the store with your choice of music. Sing a few songs, and only buy if you are totally happy.

Thanks for reading

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References:

Microphones & How to Use them, Martin Clifford, 1977, Tab Books.