



from sound services

Know-how - An introduction to 100v line PA systems and their wiring



Basic description

On the following pages we will discuss the planning and design of 100v line PA sound systems - some basic knowledge and hints are given to assist in the design and installation of your sound system. The 100v line system for the distribution of sound is used in PA sound systems for background music, speech announcement, shopping malls, outside events, sports stadia etc. These PA sound systems are used daily – in all areas of life.

In a 100v line PA sound system the output signal of the amplifier is transformed to a high impedance with a voltage rating of 100v AC. This allows the installer to supply a number of different wattage 100v line loudspeakers which can all be wired in parallel as long as the total rated wattage of all of those loudspeakers does not exceed the rated output of the amplifier. Different areas may have different loudspeakers that are running at different wattage's (volumes) - all driven by the same 100v line PA amplifier.



Mono or Stereo

If 100v line PA sound systems are examined in detail, you will find that almost all are mono. Why? To produce a stereo signal, 2 speaker systems must not only be driven by 2 power amplifiers but the listener must be at the same distance from both of those speaker systems and he must stay there. If he leaves this position, there is no stereo perception any more. In offices, factories, shopping malls and other public buildings people move freely in the room and, therefore, a genuine mono technique is the absolutely right choice for background music, public address and similar sound systems.

This mono-stereo consideration is not a question of quality because a mono signal is not in any way, technically or audibly inferior to a stereo signal. The quality is solely determined by the components used. The sound of a horn or column speaker is of course not as good as that of a hifi speaker system. This is, however, due to the speaker type and not due the fact that the system is mono rather than stereo or to the use of the 100v line transformer which is usually fitted to a horn or column speaker. A good quality, modern transformer can achieve a frequency response of 20 to 20kHz.

What is the basic difference between a 100v line mono PA sound system and a low impedance hifi stereo system? The home hifi system will usually consist of just two loudspeakers placed in optimum conditions in a relatively small room. The listener will normally sit in a predefined position to gain the best from his investment. Whereas a large 100v line PA sound system or background music system will have loudspeakers sited where the people are - a great number of different types and sizes of speaker may be employed so that the best overall sound coverage can be achieved. This type of sound system has to produce reasonably clear sound quality above the ambient noise levels at a perceived constant sound pressure level in a number of acoustically different areas - a seemingly impossible task!



Radiomicrophones

Diversity radiomic receivers feature two aerials and two separate receiver sections. The receiver continuously compares the signal from each section and always selects the strongest. Therefore there are far less 'drop-outs' and missed words with this type of receiver. It is often wise to offset the receiving aerials – have one vertical and the other at an angle so that the chance of 'drop-outs' is even further reduced.

Multiple transmitters can only be used if you have multiple receivers. Each radiomic receiver can only receive from one transmitter – if you attempt to use more than one transmitter on the same radio frequency they will interfere with each other and neither will perform as expected.

Squelch (or mute) controls are fitted to all radiomic receivers. These controls are usually accessed with a small screwdriver – they should be adjusted so that the receiver is silent and is not receiving any radio signals when the respective **transmitter is turned off**.

Approval of radiomicrophone equipment in the UK demands that the equipment is DTI approved, operates on regulated (an annual operators licence is required) or de-regulated (no user licence is required) frequencies. The equipment should always display an appropriate RTD approval number.



Safety

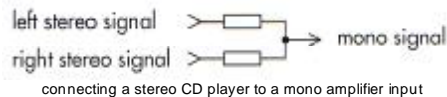
- Please observe all BS and other directives relating to electrical safety when specifying and installing 100v line PA sound systems.
- Use only cables and connectors that are rated and approved to 100v AC or a greater AC voltage.
- Always turn off and isolate all amplifiers when working on loudspeakers or cabling to avoid risk of death health hazard from a fully modulated 100v line PA sound system.

Hints & Tips

Ceiling speakers should ideally be placed using the equation distance apart is twice the (ceiling height less 1.5m). ie: if the ceiling is 4m high the average distance between each ceiling speaker should not exceed $2 \times (4-1.5)\text{m}$ – that is 5m spacing between speakers.

Dual speaker circuits can be employed where an increased safety margin is required. Alternate loudspeakers should be driven by the second amplifier so that if one amplifier or loudspeaker circuit develops a fault the system keeps working. This is an ideal 'fail safe' when the PA sound system is also being used as a fire alarm or other voice evacuation system.

Low impedance speakers such as those used for hifi and disco may be used on a 100v line PA sound system provided they are connected to the 100v line output of the amplifier using a suitable 100v line transformer which has a suitable wattage tapping. Stereo outputs from CD players etc. can be easily converted to mono to connect to the amplifiers auxiliary input using the circuit shown in fig.12. Resistor values of 4.7k/0.25w have proved to be successful for this application.



Hum and earth loops can occur when connecting different types of audio equipment together. Often this problem will be present when the sound system electronics are mounted in a metal 19" rack. The problem is caused when there is more than one earth path such as the mains earth, the audio lead screens, the metal cases of the equipment and the metal rack supporting the items. Care should always be taken to ensure that the earthing integrity of a metal rack is maintained. Stereo ground isolators such as the Monacor FGA40 can also help solve the majority of earth and hum loops.

Microphones in 100v line PA sound systems are often connected to mixers or amplifiers by long cable runs of 50m or more. To avoid electrical interference microphones should always be connected using two core screened, balanced line microphone cable. It is important to use both balanced line microphones together with mixers and amplifiers with balanced line microphone inputs. Balanced line microphones are usually connected using XLR connectors – the wiring of which follows the convention of pin 1 – ground/screen, pin 2 – signal, pin 3 signal return.

Loss on Speaker Cables

Often the speaker wiring on 100v line PA sound systems can be hundreds of metres in length.

This is, possibly, the major reason for using 100v line operation – the resistance of the loudspeaker cable is more negligible at the high impedance used in 100v line than it would be in a low impedance 8 ohm speaker system.

Suppose that an 8 ohm speaker system is connected to an amplifier with 100w RMS output power. The cable length is 225m with a cross section of 1mm². The resistance of the cable is $2 \times \text{length of cable}$ (being the total length of both cores) divided by $56 \times \text{the cross section of the cable}$.

$$\text{ie: resistance} = 450\text{m divided by } 56 \times 1 = 8.038 \text{ ohms}$$

Therefore the actual amplifier output reaching the loudspeaker is just 25% of the available power – as the line load impedance (cable plus speaker) is doubled from 8 to 16 ohms the amplifiers output current is halved – thus only 25w of the original 100w are actually reaching the loudspeaker.

If, however, we use the 100v line system the cable resistance will be the same but the 100w, 100v line speaker load will have an impedance of 100 ohms. Therefore the total line load impedance (cable plus speaker) is 108 ohms and, using ohms law as above, nearly 86 watts of the available 100w is presented to the loudspeakers.

Cable with a greater cross section has a lower resistance and will always present more available power to the loudspeakers.