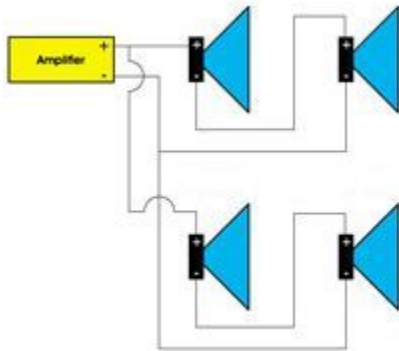


100 Volt Line Speaker Systems and how they work

In a typical paging, background music, announcement system in a hotel, school, church or pub several loudspeakers are placed across a single amplifier in parallel. This article provides an insight into how these speaker systems work.

100V Line Loudspeakers

100V Line speaker systems are sometimes referred to as "constant-voltage system" it is the most economic way to install a multi-speaker sound system. The term 100V system relates to the maximum output voltage of the amplifier. To generate this voltage the amplifier is equipped with a step-up transformer, which increases the normal output voltage of around 30 Volts, up to 100 Volts



Series Parallel connection of low impedance speakers

The main difference between a low-impedance speaker system (4 or 8 Ohms) is the way the individual loudspeakers are connected to the amplifier, with the conventional low-impedance system special care has to be taken to maintain the correct impedance for the amplifier.



Parallel connection of 100V Line Speakers

In a 100V line system, a large number of single loudspeakers each equipped with a step-down transformer can be connected to

one single speaker cable. With the 100V line installation, each speaker is equipped with a step-down transformer

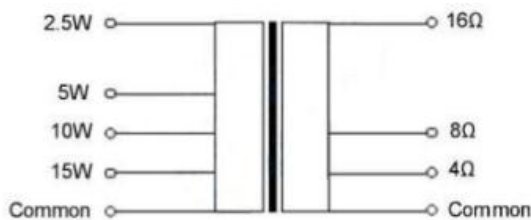
Each loudspeaker's step-down transformer can be designed for a single power level or it can have multiple taps, one of which is selected to match the desired power level to be applied to the loudspeaker. Transformers with various taps allow the contractor to adjust the sound pressure level up or down at an individual loudspeaker. To minimize power losses, the wires connecting the loudspeaker to the step-down transformer are kept as short as possible.

Occasionally, two or more loudspeakers are connected to a single step-down transformer; one that is capable of handling their combined power needs. Again, to minimize power losses, the speaker lines are kept as short as possible.

All the loudspeaker step-down transformer primaries are connected in parallel to the constant voltage line

Step-Down Transformer

A step-down transformer has a relatively high impedance at the primary side and the secondary side of the transformer matches the speaker impedance (typically 8 Ohms). The primary side of the transformer normally has several tapings, these are marked in watts and are used to enable each speaker to be set at different volume levels. The total primary wattage should not exceed 90% of the amplifiers output. A step-down transformer will be required for each loudspeaker connected to the amplifier.



100v line step-down transformer

100V Line Speaker Cable

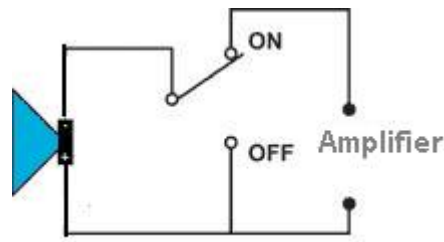
When installing a 100V line system, it is important that the correct size of cable is used. The following table gives an indication of the distance a particular cable can deliver the full power of the amplifier.

	Cable Size					
	0.75mm ²	1.0mm ²	1.5mm ²	2.5mm ²	4.0mm ²	6.0mm ²
30 Watt	800m	1066m	1600m	2666m	4266m	6400m
60 Watt	400m	533m	800m	1333m	2133m	3200m
120 Watt	200m	266m	400m	666m	1066m	1600m
240 Watt	100m	133m	200m	333m	533m	800m

As the voltages can approach 100 volts, a double insulated cable should be used. The cable should be adequately secured and cable runs should be kept away from any potential source of interference. These include other cables for mains wiring, lighting, security, data and telecomms cables etc.

Loudspeaker switching

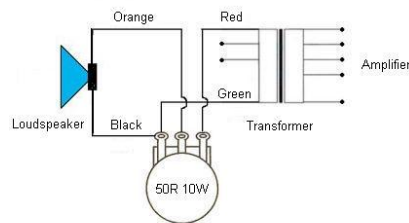
When switching 100 volt line loudspeakers "on" or "off", it is necessary to use the circuit indicated below. This circuit will ensure that the loudspeaker is not affected by inductive pick-up in the disconnected cable, this can happen when speakers are switched at the amplifier and leave long open ended cables. The loudspeaker is not only isolated from the line but also shorted to itself in the "off" position this ensures that there is no possibility of breakthrough.



Speaker isolation switch

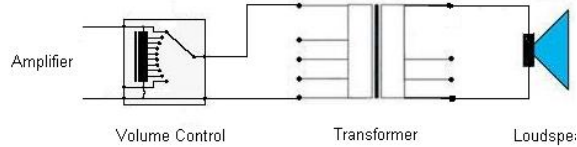
Volume Controls

There are two ways to adjust the volume of individual 100V line loudspeakers. Sometimes speakers are fitted with a wire wound potentiometer which absorbs power so reducing the volume of the speaker. This is a very inefficient way of reducing the volume and only works with low power speakers.



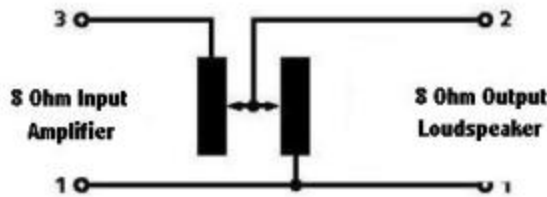
10 Watt Potentiometer Volume Control

The preferred method uses controls which are specially designed for 100V line operation (attenuators) and simply wired between the amplifier and the loudspeaker. The maximum power rating of the volume control should be checked and not exceeded, otherwise damage to both control attenuator and amplifier can occur.



Inductive Attenuator Control

L Pad attenuators are designed to be used with low impedance (8Ω) loudspeakers. The L Pad is fitted after the amplifier and before the speaker to be attenuated. The L Pad will always give a constant load of (8Ω) to the amplifier.



Typical L Pad Attenuator

Advantages

The main advantages of using a constant voltage speaker system over a conventional low impedance speaker system are:

- **Multiple loudspeakers:** Many loudspeakers can be driven by a single amplifier without complex series/parallel connection schemes.
- **Multiple power levels:** Different sound pressure level targets can be achieved at different listening areas while still using a single amplifier.
- **Less expensive:** Since the voltage of the signal has been stepped up and the current is relatively low, lighter, less expensive cable can be used without incurring additional power loss. Where a typical 8-ohm speaker system might require 12 gauge cable, a 100-volt system could use 18 gauge or smaller cable

Disadvantages

- **Frequency Response:** Inexpensive transformers may have poor reproduction of low and high frequencies.
- **Distortion:** Overdriven transformers can add ringing distortion to the audio signal. Low cost transformers are prone to distortion at higher power levels, especially with regard to low frequency response. Low level signals can fail to energize a poorly designed transformer core enough to prevent higher than normal amounts of harmonic distortion.
- **Delay:** More distant speakers on the same constant voltage line can not be delayed to match the speed of sound in air so that the impulses from a string of loudspeakers arrive at the same time from the point of view of a distant listener.
- **Insertion loss:** The transformers themselves commonly reduce total power applied to the loudspeakers, requiring the amplifier to be some ten to twenty percent more powerful than the total power that is intended to be applied to the loudspeakers.

About the Author

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