Commercial Audio

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Some preparation before you start testing.

Whether you are commissioning, fault-finding or maintaining a PAVA system, you need to check whether the loudspeakers and cabling are correct. To do this, you'll need your:

- Impedance meter, Zircle or another;
- Multimeter.

Before you start testing, the following are always worth doing:

- Estimate the power (load) you expect on each loudspeaker circuit. More on doing this below.
- If your batteries are low on one or both of your meters, change them. You can't trust those readings otherwise.

HOW TO ESTIMATE THE LOUDSPEAKER CIRCUIT LOAD

Count the number of loudspeakers. If all are tapped the same, multiply by that tapping. If some are tapped differently, then you'll need to do a bit more adding up.

Remember, it's an estimate.

Example ❶

25 ceiling loudspeakers, each tapped at 2 watts.

$$25 \times 2\ W = 50\ W.$$

example ❷

- 10 ceiling loudspeakers tapped at 2 watts;
- 10 wall cabinets tapped at 5 watts and
- 5 music horns tapped at 20 watts.

$$10 \times 2\ W + 10 \times 5\ W + 5 \times 20\ W = 170\ W.$$

Record your results.

We've created a form for this that you can download here.

Tip 1

How to measure the impedance

IMPORTANT:

Disconnect the loudspeaker circuit from the amplifier. Otherwise, your readings will be odd, and if the amplifier's powered up, you risk your meter.

Connect the Zircle (or another impedance meter) test leads to the loudspeaker cable at the start of the loudspeaker circuit.

NOTE:

Polarity is not important, although it is good practice to test all the circuits with the leads in the same orientation.

- On the Zircle, press and hold down the TEST button.
- On other meters, you'll need to choose the test range and possibly the test frequency (use 1000 Hz).
- Wait about 1 second.
- Note down the impedance readings.
- With the Zircle, note down the watts reading too.
- For other impedance meters, use the equation in Tip 2 to calculate the watts.

Tip 2

How to calculate the power (watts) based on the impedance reading

Zircle does this for you, but for other impedance meters or if the loudspeaker circuit is not 100 volts read on.

You need to know:

- The voltage of the loudspeaker circuit. Often 100 volts, but also 70, 50 or even 25 volts.
- The impedance meter reading you just made.

The power is calculated by squaring the voltage and then dividing this by your meter reading.

$$Power\ (W) = \frac{Voltage^2}{Impedance\ meter\ reading}$$

Here's an example

Your impedance meter measures 25 ohms, and the loudspeaker circuit is 100 volts.

100 volts squared (100 x 100) = 10 000.

Divide 10 000 by the 25 ohms.

10 000 ÷ 25 = 400 watts.

Tip 3

How to interpret unusual results on any loudspeaker circuit type

If your mental maths calculations are significantly different to your measurements, something is wrong. If you are confident your maths is correct and your meter is reading correctly, then the following might be helpful:

- If the measured power is high, check for short circuits.
- If the measured power is low, check that the circuit is not broken anywhere.

HINT:

If you can hear the tone through the loudspeakers, leave your impedance meter connected and walk around, listening to all the loudspeakers on that circuit.

Where the tone stops is probably the location of your problem.

- Check the dc resistance (using a multimeter) between an electrical earth and each conductor; it should be open circuit - more in Tip 5 below.
- If the cable has a third wire, ensure it is not connected by accident anywhere.

If all that does not resolve the problems, double-check:

- You are connected to the correct loudspeaker circuit.

If you are not using a Zircle:

- Are you squaring the voltage before dividing it by the impedance.
- Are you using the correct frequency?

Four common faults that can derail your efforts:

1. Loudspeakers sometimes have tappings for different voltages and powers; make sure the loudspeaker tapping is suitable for the circuit voltage.
2. Ensure all loudspeakers have a transformer. A loudspeaker without a transformer is low impedance and won't work on a 100 V, 70 V or 50 V system.
3. Make sure no amplifier is connected to the circuit. Whether that amplifier is powered on or not, it will have an effect.
4. For a dc monitored loudspeaker circuit, check every end-of-line resistor is connected and that you have the correct number of resistors for that circuit.

If the results are still wrong, call us on 01273 034630. We've found that just speaking to someone else can trigger you to find the issue.

Tip 4

How to make helpful resistance measurements with your multimeter

Every 100-volt loudspeaker has a transformer fitted; the multimeter dc voltage will pass straight through that transformer. It's similar to you shorting out your meter probes - pretty unhelpful.

NOTE:

Where each loudspeaker on a circuit is fitted with a dc blocking capacitor is seen differently by a multimeter. This means you can do a handy extra test; see Tips 5 and 6.

However, you can use it for one helpful test: checking the resistance between each leg and earth.

To do this test, find some metal that you know is earthed.

Then with your meter set to read resistance, touch one of your probes on this earth point and the other probe on one of the loudspeaker wires.

Your meter should read open circuit or at least 50 000 ohms (50 kohms).

Anything below this means something is amiss. Possible issues are

- Water (particularly if the reading keeps changing). Check junction boxes and any kit or cabling outside.
- Loose wire: if the reading is close to zero ohms, it's likely a wire has worked free and is touching some metal. Ceiling loudspeakers are notorious for this.

Tip 5

Using your multimeter to test dc blocked loudspeaker circuits

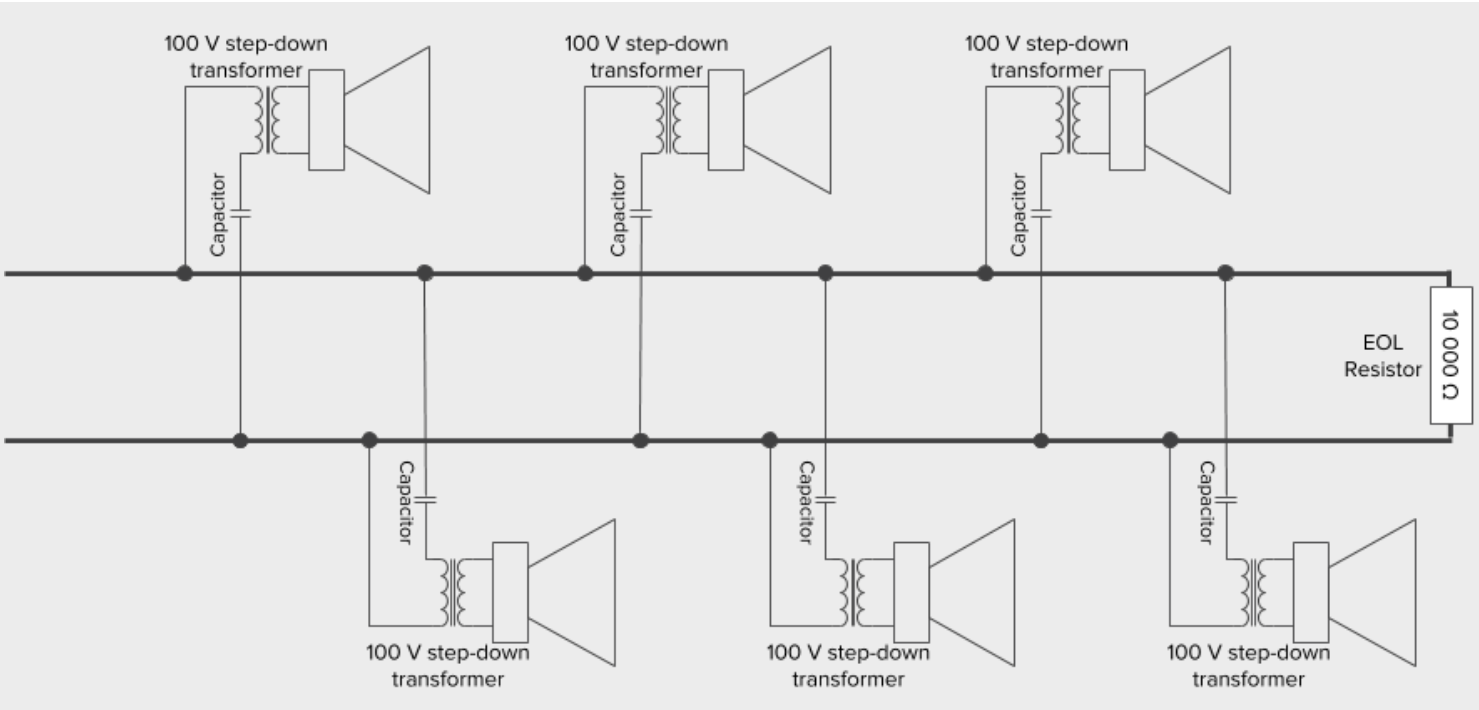
As mentioned above, a dc voltage passes straight through a loudspeaker transformer like it isn't there. That's because it provides little resistance; the dc voltage sees the transformer as a short circuit.

Can a dc voltage damage a transformer?

If there's any power behind that dc voltage, then that short circuit will generate high currents. This will heat the transformer wire, and being thin can melt. Which is the end of that transformer.

Is dc monitoring a bad idea, then?

Not at all. By fitting a capacitor in each loudspeaker, you can block the dc from passing through the transformer. The diagram below shows each loudspeaker with a capacitor fitted in series on one leg of the 100 V transformer.



Six loudspeakers, each with a dc blocking capacitor & 10 kohm resistor on the line end.

You've now got one of the best forms of loudspeaker circuit monitoring.

dc monitoring works reliably with any type of cable. Whereas ac monitoring has to be suited to the cable type.

With ac monitoring:

- **MICC type cable** may not pass higher frequencies, so 20 kHz (ultrasonic) fault monitoring can be problematic.
- **FP-type cable** is susceptible to ac voltages being induced on circuits running parallel to each other. Induced voltages can fool the fault monitoring detection into thinking a faulty circuit is OK.

The blocking capacitors mean that the monitoring circuit would see an open circuit. However, by adding a resistor to the end across the wires, you can measure that resistor with your multimeter.

Now the resistance reading you see on your multimeter will tell you how many resistors are fitted.

Here's how...

EXAMPLE:

The manufacturer requires a 10 000 (10 k) ohm resistor to be used.

You connect your multimeter to the loudspeaker circuit at the rack (remember to disconnect the amplifier), and it reads 2500 ohms.

As the resistors are all in parallel, you can divide your multimeter reading by one resistor value (10 000 ohms), meaning there are four resistors.

In this example, this suggests there is one main run and three branches or spurs.

Are you thinking that's a bogus assumption?

Well, you'd be right.

That measurement...

- doesn't tell you if any branches have become disconnected;
- doesn't tell you if connected branches have no resistor fitted;
- doesn't tell you if two resistors have been used on the same branch;
- doesn't confirm that those resistors are really at the end.

The following are possible but less likely causes:

- There is just one 2500 ohm resistor fitted;
- There's a fault that just happens to cause the resistance to be 2500 ohms.

However, all these assumptions are equally valid for all unknown circuits, whether dc blocked or not. You are just more in the dark when loudspeakers don't have capacitors.

Tip 6

How to take this test a step further to reveal more.

Go and divide the circuit midway along its length and measure the resistance in both directions.

Now you read 3333 ohms in the direction of the amplifier and 10 000 ohms to the end of the line.

This tells you there are three resistors nearer to the amplifier and just one in the other direction.

Do this test without blocking capacitors, and you'll see a short circuit in both directions. The circuit might be faulty or healthy.

A short circuit on a loudspeaker circuit where all the loudspeakers are fitted with capacitors means you know you have a fault. The only time it might not be a fault is if one or more of the loudspeakers have no capacitor fitted, although that is still a fault.

You'll get even more insights by breaking the circuit again.

The essential point is that you will be able to find the cause of a fault in less time. You can then quote for the repair confidently, which pleases your client and increases your income.

Tip 7

Why you should specify loudspeakers with blocking capacitors for all projects.

There are two general ways to monitor a loudspeaker circuit using an ac or dc voltage.

Most monitoring systems use an ac voltage; to them, a capacitor is invisible, and dc monitored systems need the capacitor.

You'll find the price difference between those loudspeakers with and without capacitors is tiny often, they are the same.

Five advantages to using loudspeakers fitted with capacitors.

1. You don't need to stock two types of loudspeakers.
2. Fault-finding a loudspeaker circuit is similar to fault-finding a fire alarm loop.
3. You have two ways to fault-find and test loudspeaker circuits: your multimeter and impedance meter;
4. If you are called out and don't have your impedance meter, you stand a better chance of finding the problem.
5. Only using one type of loudspeaker means you can buy in larger quantities, increasing your discount.

Remember, without capacitors in the loudspeakers, your multimeter is nearly useless for fault-finding, testing and commissioning. You will need an impedance meter.

You still need an impedance meter for loudspeaker circuits where loudspeakers have a capacitor fitted, but your multimeter makes everything easier and quicker.