



The Institute of Sound and  
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Engineering Note 34

## Calculating loudspeaker line losses using LTspice and MiscEI

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## Calculating loudspeaker line losses using LTspice and MiscEI

Calculating the line losses and the voltages at the loudspeakers can be quite a problem if the loudspeakers are in widely-separated clusters and the cables are no thicker than necessary. However, two of the free programs, Misc EL and LTspice, will do it for you.

There are several possible starting points, so I've chosen one that might well confront a consultant - analyse an existing installation.

So, we have a 100 V line amplifier feeding a ring-main as shown in the circuit diagram. (LTspice is an American program, so it uses zig-zag resistors by default, but a rectangle resistor is in the library.) The data for the cables and loads are:

Amplifier to Cluster 1: 95 m of 2.5 mm<sup>2</sup>;

Cluster 1: total power 200 W

Cluster 1 to Cluster 2: 65 m of 1.0 mm<sup>2</sup>;

Cluster 2: total power 133 W;

Cluster 2 to Cluster 3: 125 m of 1.0 mm<sup>2</sup>;

Cluster 3: total power 250 W;

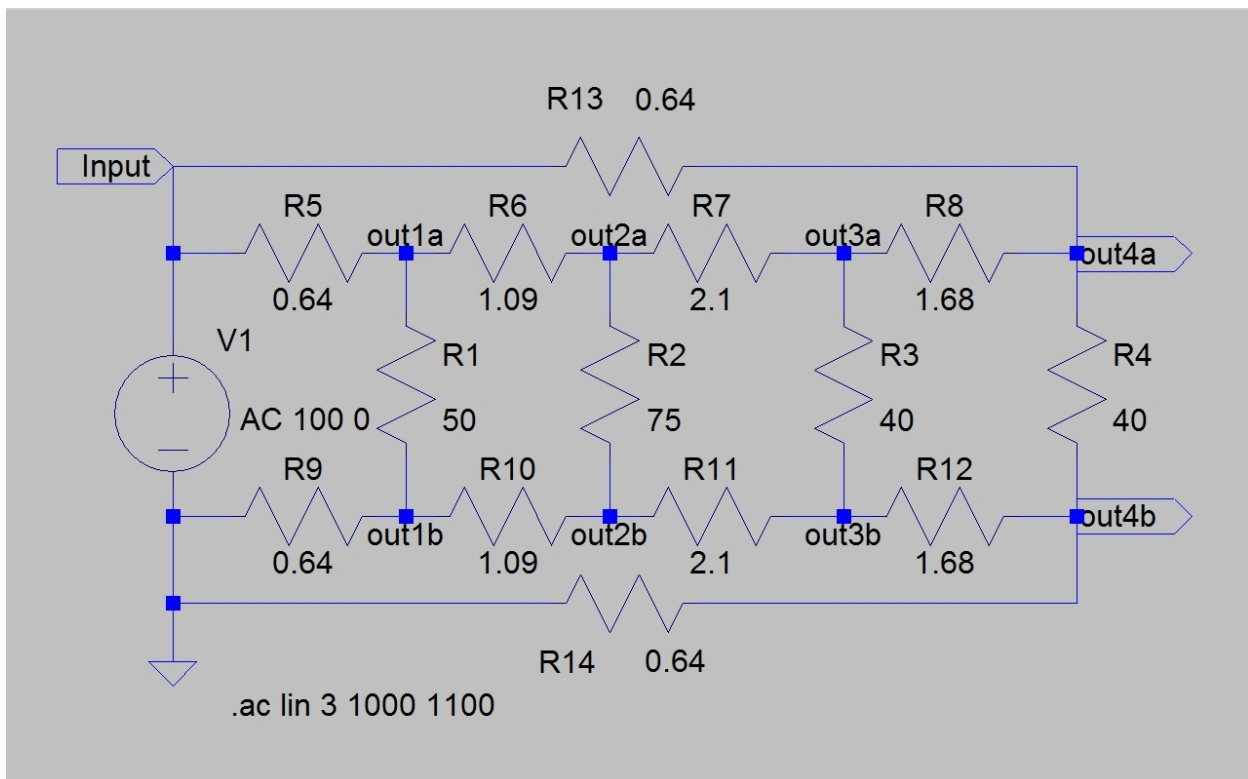
Cluster 3 to Cluster 4: 100 m of 1.0mm<sup>2</sup>;

Cluster 4: total power 250 W;

Cluster 4 to Amplifier: 95 m of 2.5 mm<sup>2</sup>.

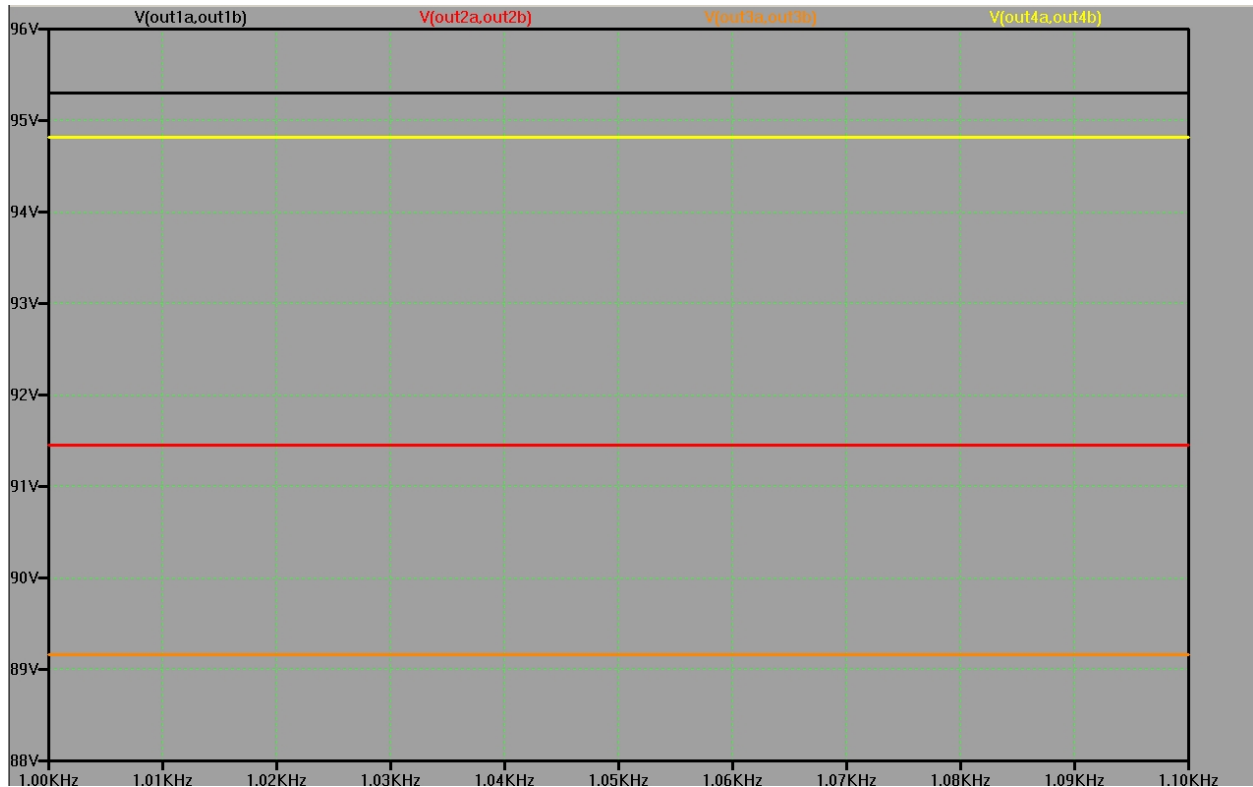
NOTE - Never mind whether this is a good design or not; it shows the principles involved.

Now we can use the 'Wires' tab of Misc EL to calculate the resistances of the cables and, if we really need its help, it will also convert the power figures into resistances. The results are in the circuit diagram.



**Loudspeaker distribution circuit (LTspice .asc file)**

Now, we want to know the voltages across each cluster, and there are several ways of finding that in LTspice, but an easy way is to do a dummy frequency sweep; the response is bound to be flat because we only have resistors in the circuit. LTspice will plot the voltage differences and if the cursor is placed on a trace, a precise value is given in a bar at the bottom left of the screen. But it's quite easy to read them from the graph anyway.



**Loudspeaker distribution circuit results (LTspice .raw file)**

Quite a lot of fairly intricate number-crunching has been replaced by mouse moves and clicks. If you don't like the result for Cluster 3, even though it's only 1 dB down, it's very easy to try some 'what if's?' to fix it with minimum re-cabling.

You can, of course, use LTspice for simulating quite complex active circuits, with bipolars and FETs of both sorts, even valves if you are so inclined. And Misc EI will help with those awkward component values that are not even close to a preferred value or what is in the stock cupboard.

Not only that, but you can add cable capacitances to the circuit and even include 'models' of the line transformers, with magnetizing and leakage inductance and winding resistances. The models can even include non-linear magnetization — saturation and hysteresis. LTspice will go as far as you want to, and then some!