

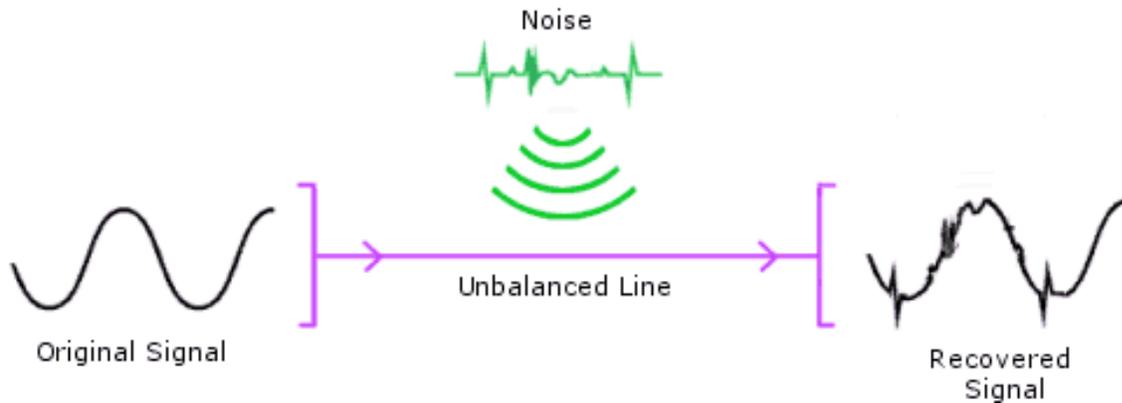
Balanced and Unbalanced Audio

This page attempts to provide a very simple overview on balanced and unbalanced audio systems.

What is an unbalanced line?

Unbalanced lines consist of two wires - one which provides the signal and the other which provides a reference (i.e. ground). They're the type of connections you get on guitars, domestic audio equipment and some keyboards. Often, 1/4" jack connectors or phono/RCA connectors are used to connect unbalanced equipment.

What are the disadvantages of unbalanced lines?

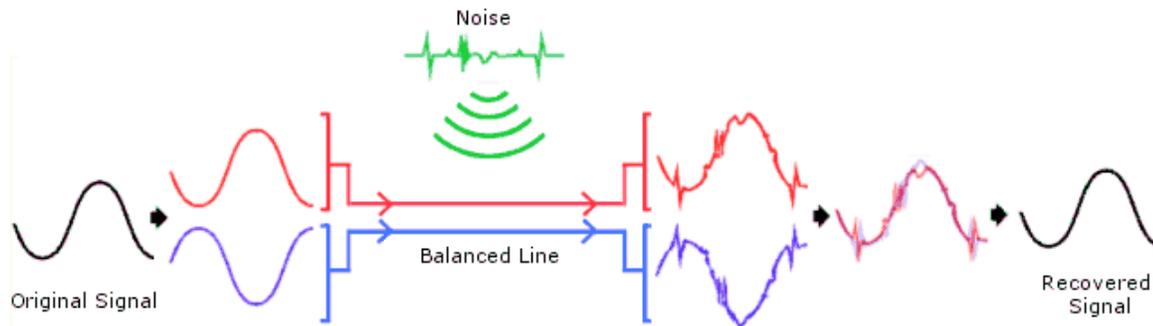


The diagram illustrates what happens when a signal travels down an unbalanced line. The line itself is exposed to noise and interference along its length and this noise appears superimposed on the wanted signal at the receiving end. The cable's shielding (not shown on this diagram) helps the situation a little, but in general unbalanced lines are very prone to picking up noise.

What is a balanced line?

A balanced line usually consists of three conductors - two carrying signal and a shield/ground conductor. These lines are often used on professional equipment for carrying mic and line level signals. They usually use XLR connectors or 1/4" TRS jacks for connection. In balanced lines, the shield/ground conductor does not carry any signal/reference itself, so it can be left disconnected at one end to reduce "ground loops".

How does a balanced line work?



To remove noise from a signal we need some way of working out what is our wanted signal and what can be thrown away. Balanced lines achieve this by transmitting two versions of the signal down their length. The source equipment sends the normal signal down one conductor and a polarity-inverted signal down the other. This is usually done using either transformer-based or electronic output stages.

The cable itself is designed with the conductors having very similar impedances and twisted along their length so that any noise is picked up equally by both conductors, no matter where in the cable it occurs.

The receiving equipment has a transformer or electronic differential amplifier, and takes the inverted signal and returns it to its correct polarity. At this point, the wanted signals on each conductor are both the same polarity, whereas any noise is of opposite polarity. Summing the signals from the two conductors together reinforces the wanted signal and cancels anything unwanted, leaving a recovered signal which is very close to the original. (this is known as Common Mode Rejection - i.e. any signal which is the same on both conductors is removed.)

Even balanced lines aren't perfect, though - slight differences in impedance, twisting or input gain will allow some noise to slip through. This isn't generally a problem unless you're using very long runs or working in areas of high interference.

How can I create a balanced output from my unbalanced equipment?

The best way of doing this is to use a DI box. A DI box uses a transformer or electronic components to isolate the input from the output whilst still passing audio. They can take an unbalanced input (usually of instrument, line or speaker level, depending on the pads available) and give a balanced output, to feed your balanced line.

How can I connect an balanced signal to my unbalanced equipment?

It is possible to make adaptors to connect an balanced signal to unbalanced equipment. However, all of these adaptors will unbalance the signal negating the benefits of balanced wiring.

The best option is to use a 1:1 repeater coil, or transformer. However, in most situations you can use a passive DI box in reverse to similar effect (bearing in mind that there will be a level change). This method retains the balancing of the cable run to the rep coil/DI and only unbalances the short run between the coil/DI and the equipment.

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