

# Bi-wiring and bi-amping



Many modern speakers are provided with two pairs of speaker terminals; this allows you to either bi-wire or bi-amplify them. The aim of both these techniques is not to simply get you to spend more on cables and electronics (although we won't mind if you do!) but to improve the resolution of the speakers.

A multi-way speaker contains a crossover network that not only divides the incoming signal into different frequency ranges, appropriate to the working range of each drive unit, but also equalises each driver's response to be flat (raw driver responses are usually anything but flat).

There are two different basic types of crossover - series and parallel. Series crossovers are not suitable for bi-wiring or bi-amping. But by far the most common type is parallel. Here, each driver has its own filter wired between it and the input terminals. If there is only one pair of input terminals, the inputs to all the filters are connected in parallel to that one pair of terminals. If, however, you have more than one pair of terminals, you can completely separate the inputs to each filter. Why on earth would you want to do such a thing?

In the case of bi-wiring, the answer lies in the cable connecting the speaker to the amplifier and the fact that the amplifier is a voltage source but the speaker is a current driven device (force on voice coil = magnet flux density x length of conductor in the magnet gap x current).

Firstly, all cables are a compromise. Some types of construction work better at low frequencies and others at higher frequencies. Providing separate inputs to the speaker allows you to use different cable types, each optimised for the frequency range of use.

Secondly, consider that the cable has an impedance that causes a voltage drop along its length. Now consider the current flowing along the cable. Assume for the argument that the amplifier delivers a perfect voltage waveform to the cable and the cable itself adds no distortion. However, each driver has a non-linear impedance (for example, the inductance of the voice coil alters depending on its position in the magnet gap) that causes the current to be non-linear. This non-linear current through the impedance of the cable causes the voltage drop along the cable to be non-linear and thus the voltage across the speaker terminals is also non-linear, even though it is linear at the amplifier end.

If we were just concerned with one driver, things would not be too bad. But that non-linear voltage at the speaker terminals may contain harmonics within the frequency range of one of the other drivers and that driver will reproduce them, albeit at low level. If, however, you separate the inputs to each driver filter, each driver's distortion is kept to itself and the total system distortion goes down. We are talking small changes here, but the resolution of some modern drivers is now so good that small improvements like this are readily detectable by keen listeners.

Bi-amping takes advantage of all this and adds some benefits of its own. Like with cable, you can choose different amplifiers that excel in different frequency bands. You may wish to use a high powered amp to give good control on the bass while using something smaller and sweeter on the treble where power is not such an issue. However in practice it is generally better to use exactly the same type of amp for both treble and bass as this will eliminate issues of varying gain, phase and colouration between different amplifiers.

Unlike bi-wiring, the load to each amplifier is different from that using a single amplifier full range. The voltage demands on each amplifier remain the same (each is still fed a full-range input and gives a full-range output), but the current demands are reduced. This of itself can improve the amplifier's ability to deliver the signal to the speaker.