THE BEGINNER'S GUIDE TO

Equalisers & Crossovers

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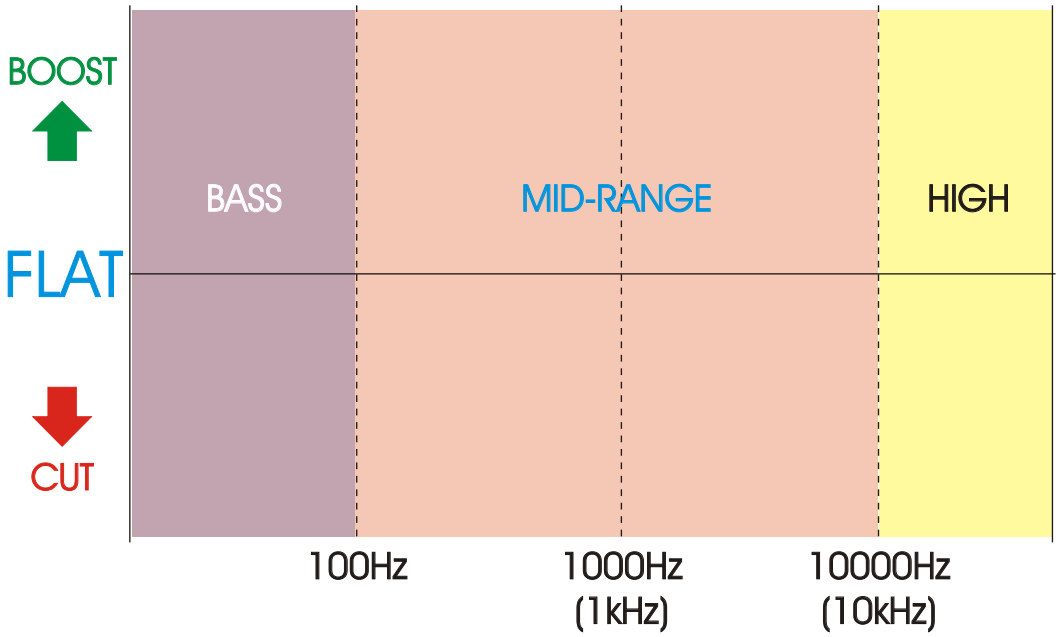


Some definitions...

Low frequency or LF - the "Bass" notes - typically 100Hz or lower.

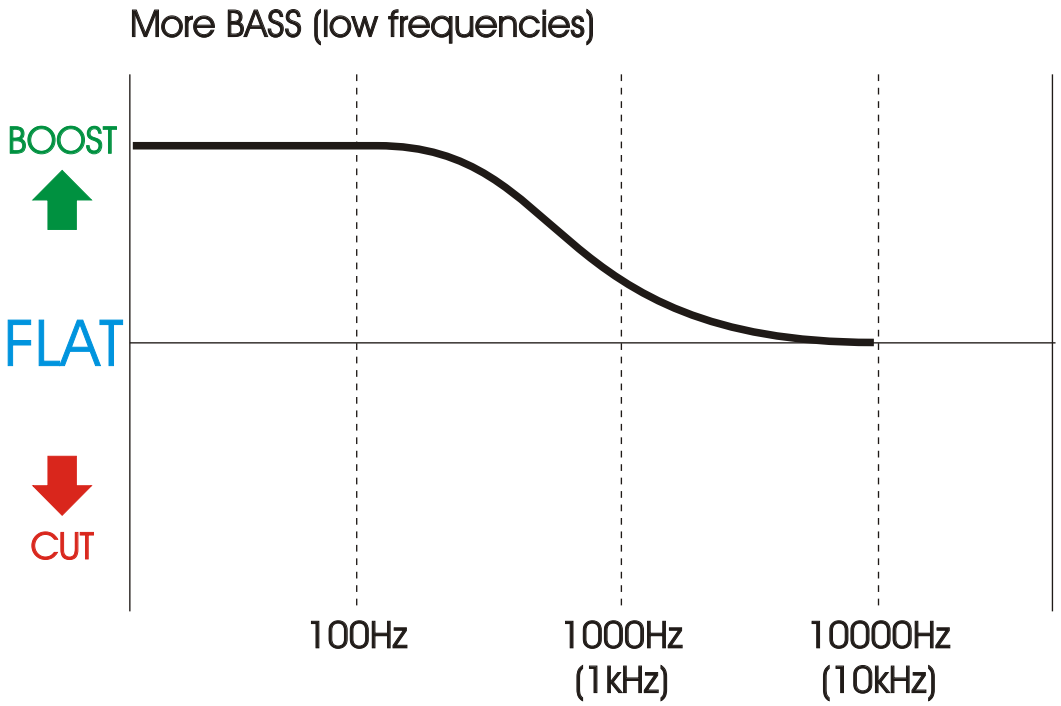
Mid-range frequencies or MF - the "Middle" notes - typically above 100Hz but less than 10,000Hz.

High frequency or HF - the "Treble" notes - typically above 10kHz.

Low frequencies responsible for weight of sound - bass guitars & drums.

Mid-range covers most instruments, including the human voice and guitars, brass, strings etc...

High frequencies responsible for "sparkle" - cymbals, clarity of voices - things sound muffled if HF missing.

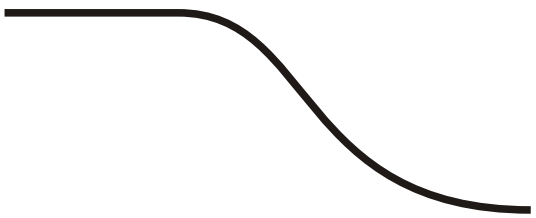


Adjusting the sound by boosting frequencies

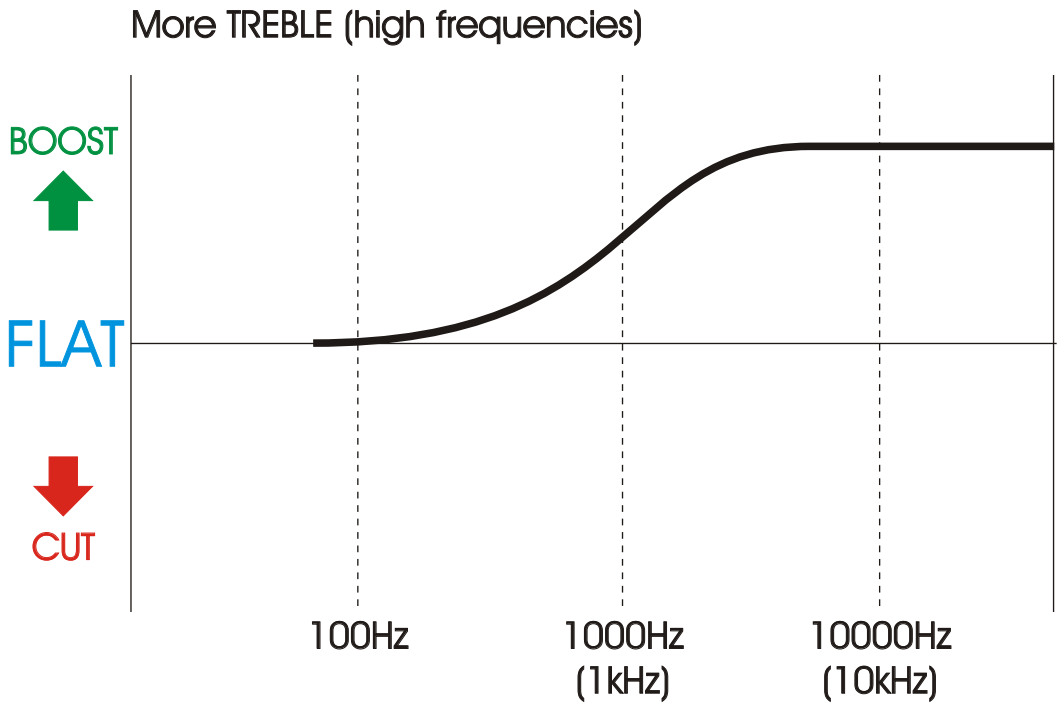
Boosting low frequencies emphasises the bass notes, making the sound more "weighty".

Note that this boost is constant over a range of low frequencies with less and less applied as the frequency increases, until at a certain frequency, there is no boost applied.

At this point the response is said to be FLAT.



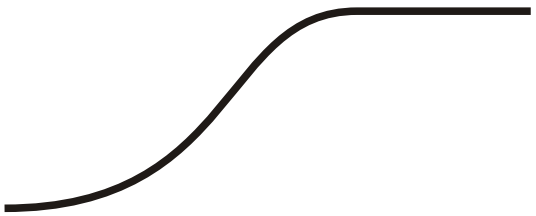
This is known as a Low Shelving Filter, due to its shape resembling a shelf.



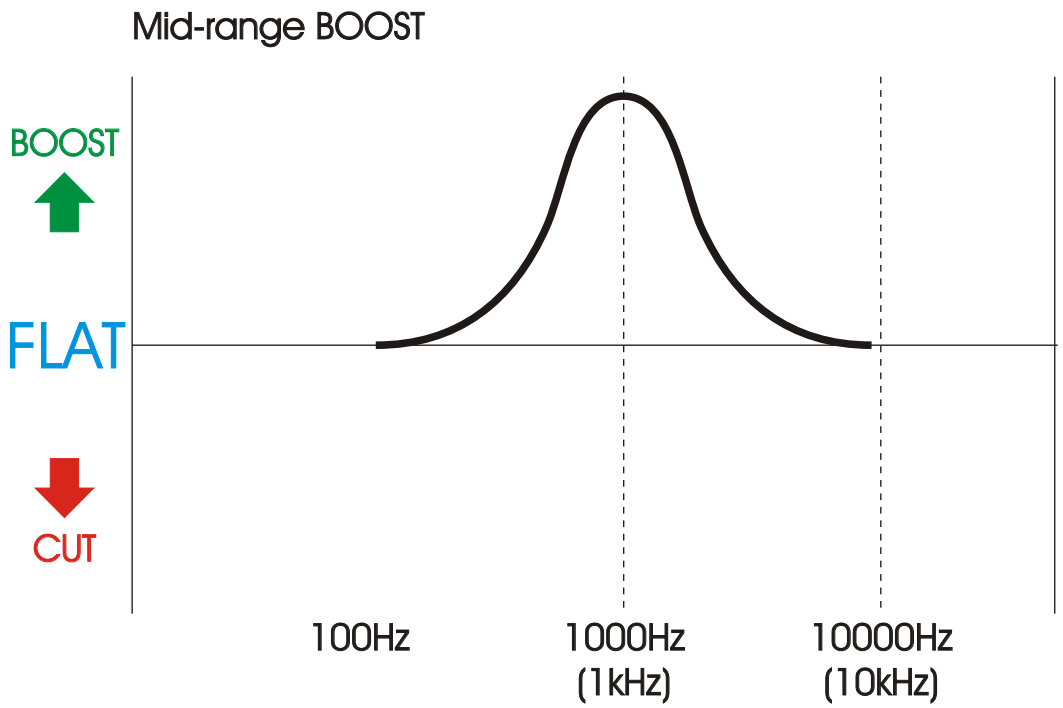
Adjusting the sound by boosting frequencies

Boosting high frequencies emphasises the treble notes, making the sound "sharper" or "clearer".

The response is FLAT at low frequencies this time, and more boost is applied at high frequencies.



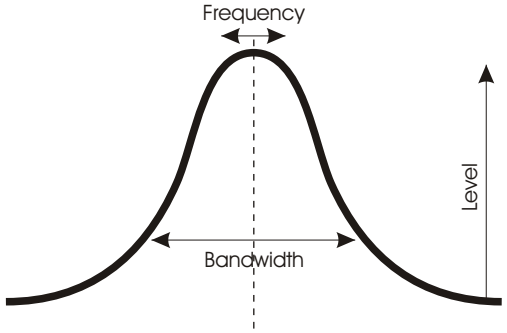
This is known as a High Shelving Filter, due to its shape resembling a shelf.



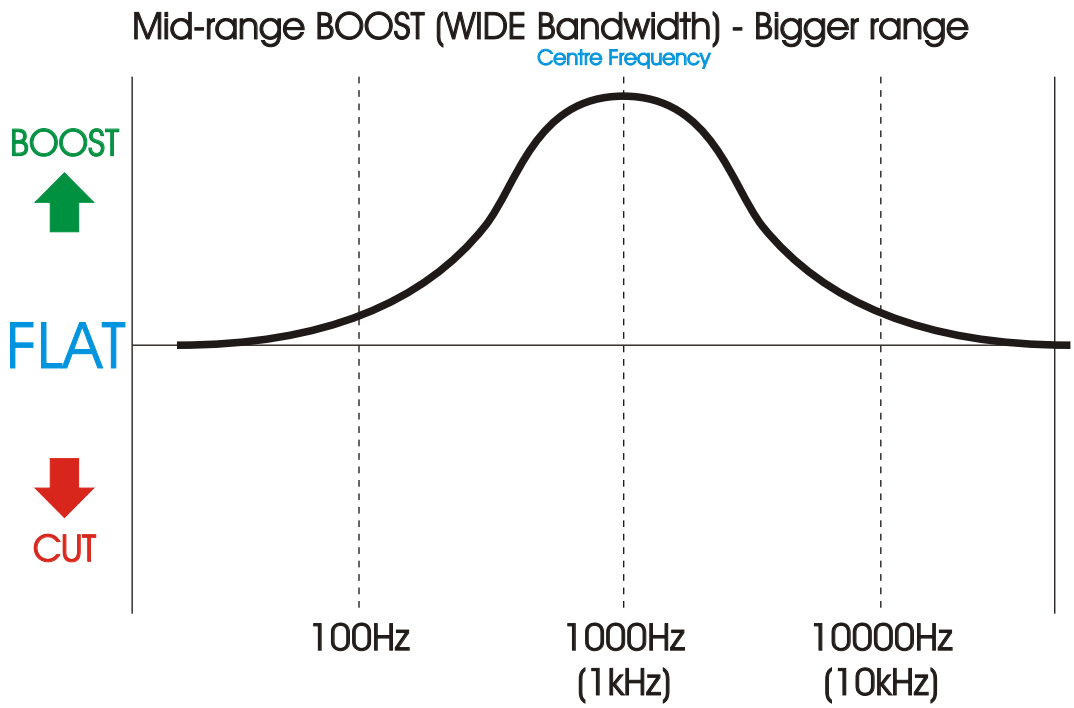
Adjusting the sound by boosting frequencies

Boosting mid-range frequencies emphasises the middle notes, making the sound "harsher" or "louder".

The response is FLAT at low and high frequencies this time, with boost applied only across frequencies in between.



This is known as a Standard Parametric Filter, not because of its shape, but because all three basic filter parameters are adjustable - Frequency, Level, and Bandwidth.

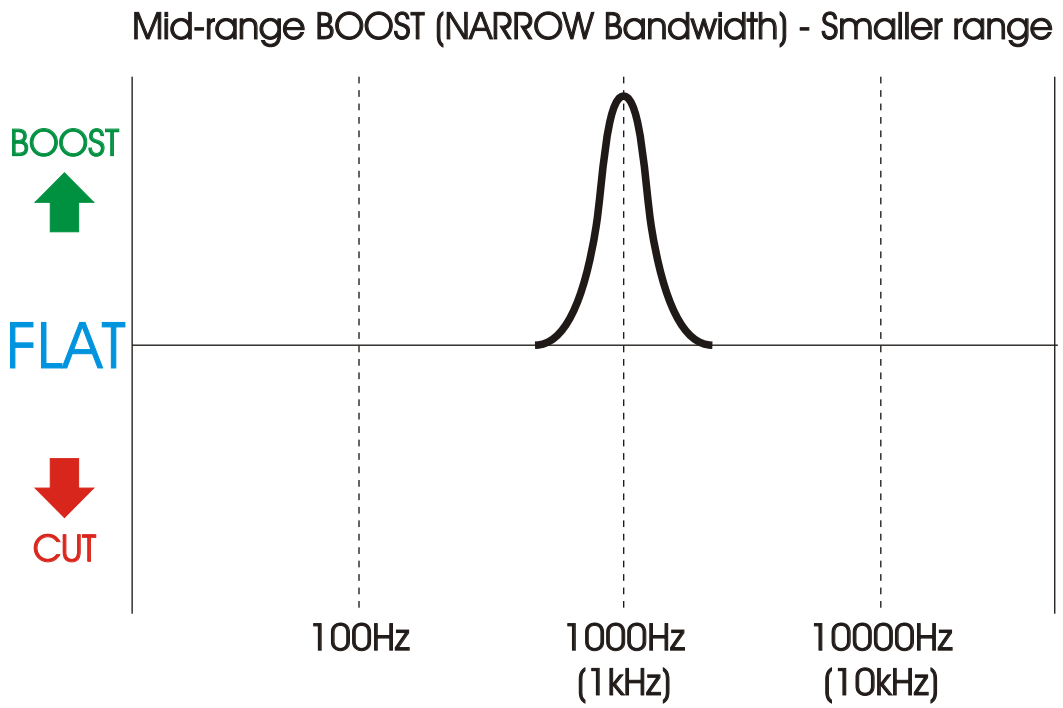


The Meaning of Bandwidth

The Bandwidth is a measure of how far the effect of the boost extends above and below the chosen centre frequency.

A WIDE Bandwidth means a bigger range of frequencies are affected - extending further to low frequencies and further into high frequencies.

This is always a symmetrical phenomenon - the same to the left and the right of the chosen centre frequency.

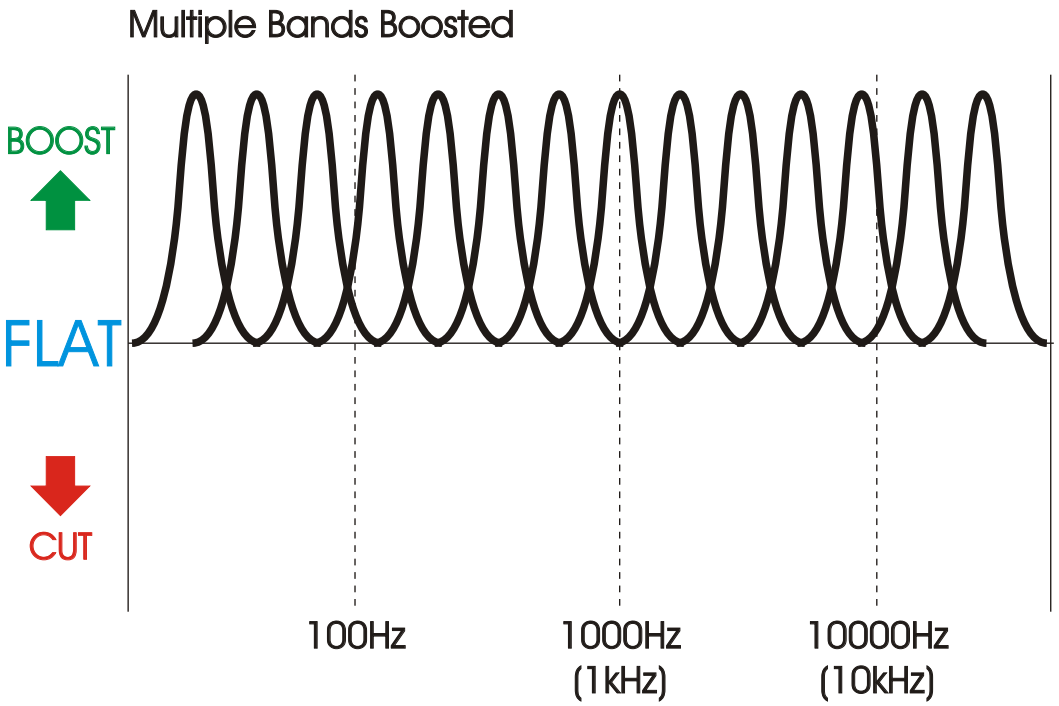


Changing the Bandwidth

A NARROW Bandwidth means a smaller range of frequencies are affected.

Narrow bandwidth filters are useful for picking out certain sounds without affecting other ones at nearby frequencies - for example highlighting a bass drum sound without making the bass guitar unduly obvious.

Lots of relatively narrow filters can be used together to form a GRAPHIC EQUALISER...

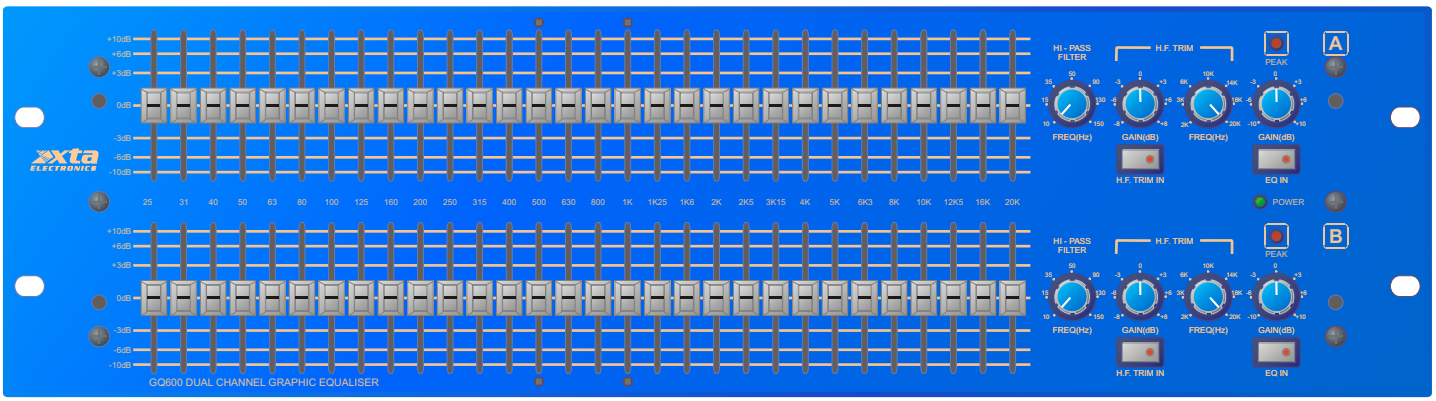


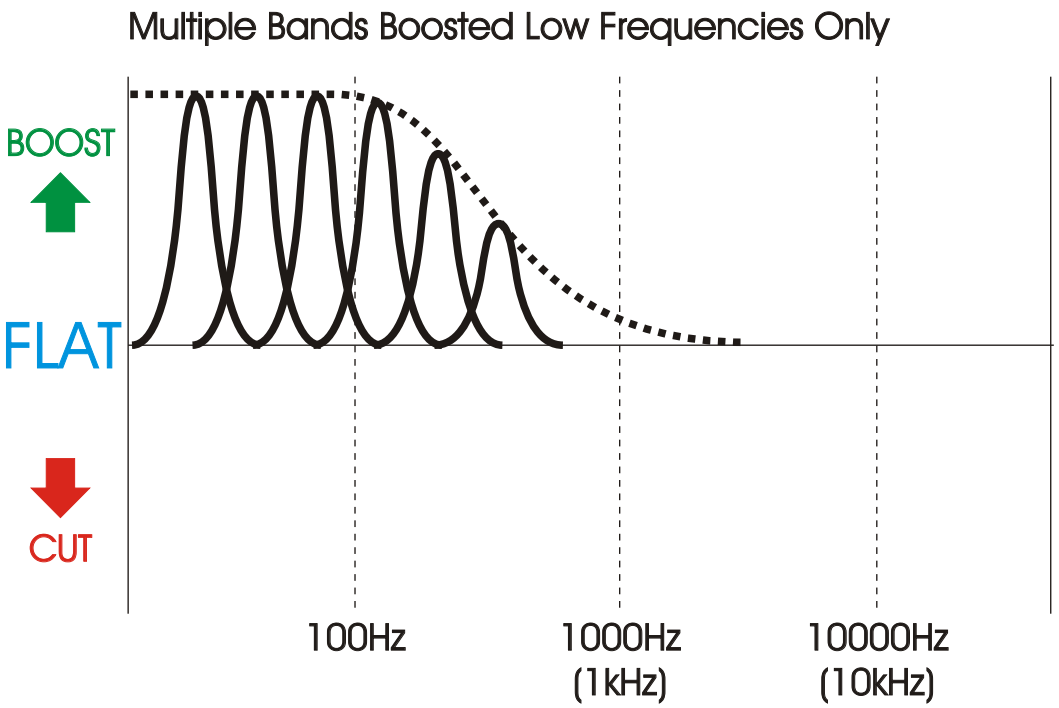
Multiple EQ Bands

Traditionally the BANDWIDTH of the filters in a graphic equaliser are all fixed at the same value, and their centre frequencies are equally spaced to cover as much of the audio band as possible.

The more bands available, the more accurate the adjustments that can be made.

The standard for a professional graphic equaliser is 30 bands spread from 20Hz to 20kHz.

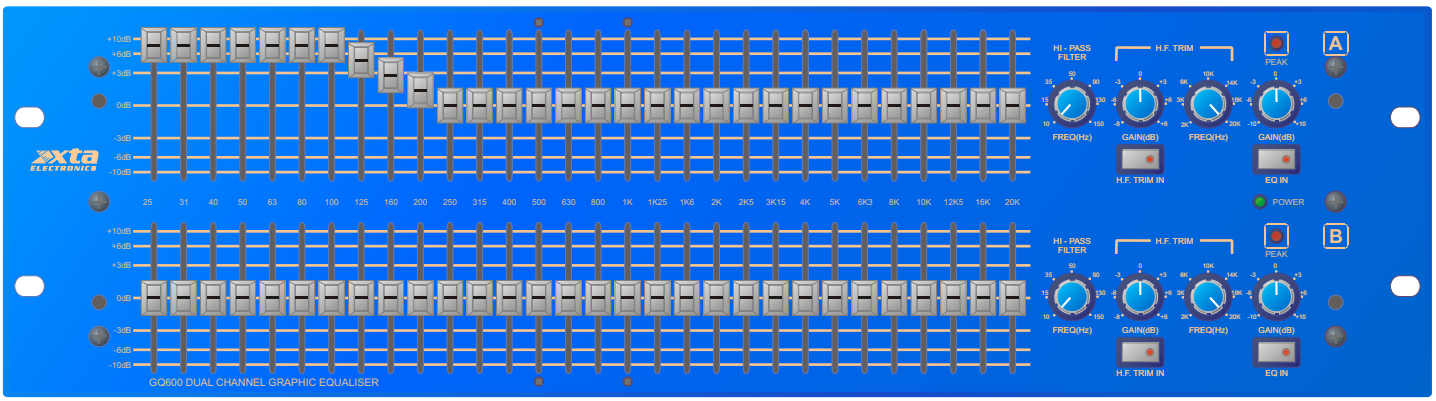


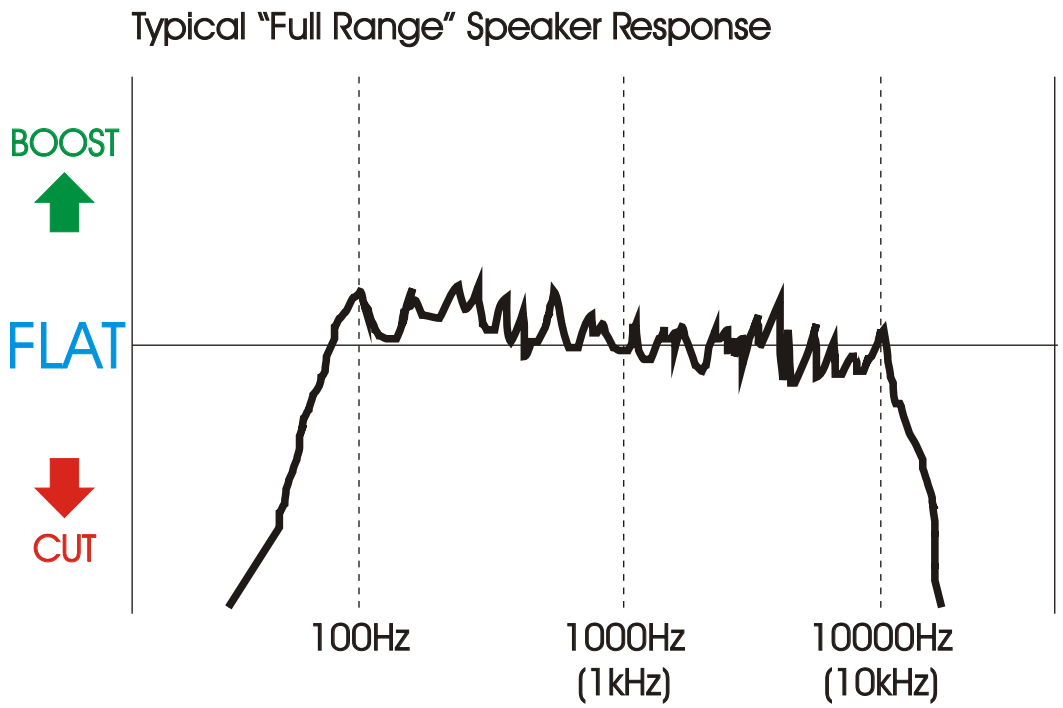


Graphic Equaliser Response

A GRAPHIC EQUALISER is so called as each slider represents the level of each of the filters, which combine to give a graphical representation of the response achieved.

Boosting the low frequency sliders as above will produce an affect similar to the low shelving filter seen earlier, and this shape is represented by the fader positions on the front panel.





One Speaker for All

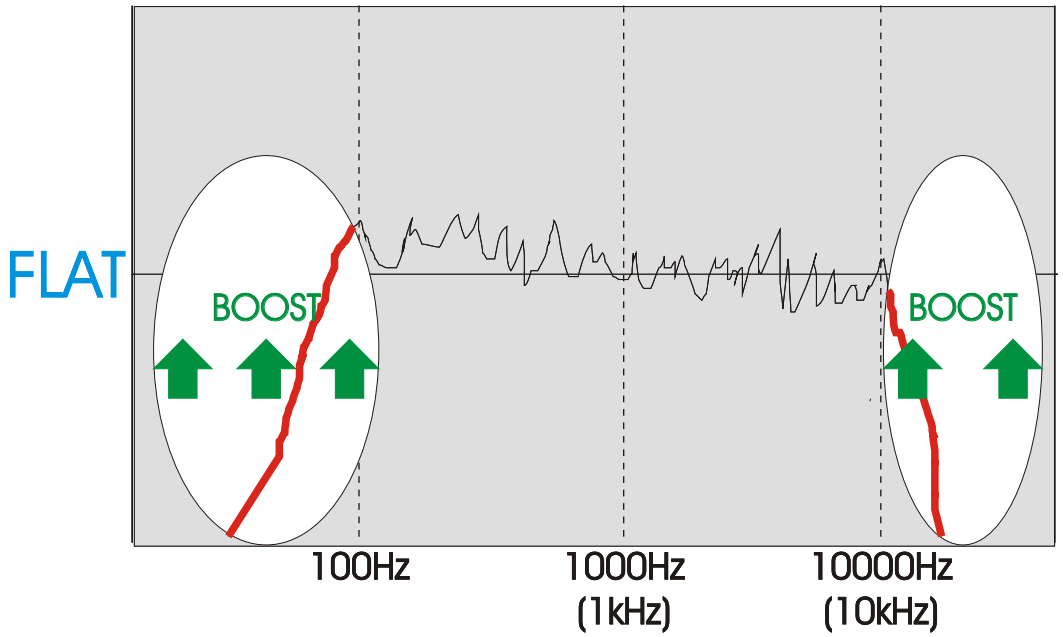
Can a single speaker reproduce all the frequencies we can hear at equal level so as to produce a FLAT RESPONSE?

Yes...and no...

This speaker will be able to reproduce frequencies from about 100Hz up to 10kHz quite well, but low bass and high frequencies will not be heard accurately.

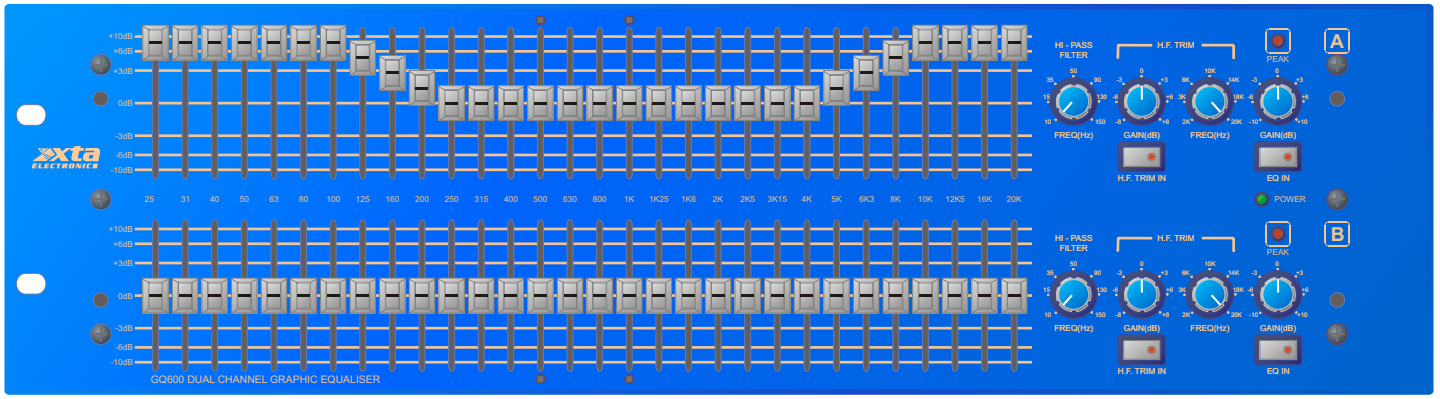
Is there a way to correct this, based on what we know about equalisers so far...?

Typical "Full Range" Speaker Response



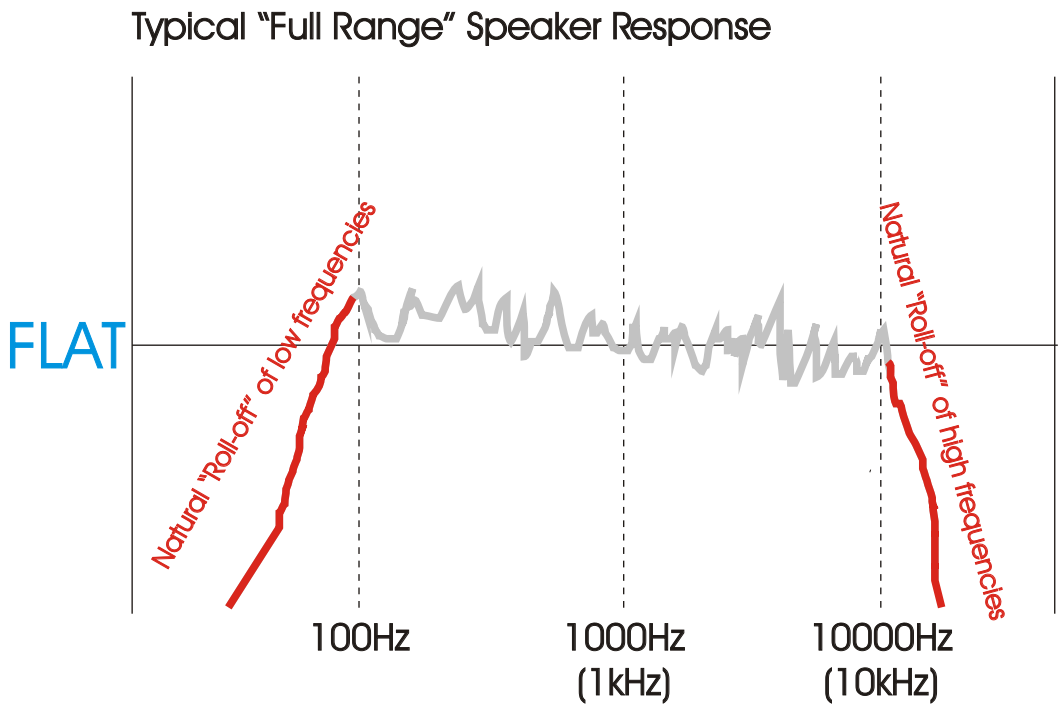
Correcting the Speaker's Response?

How about boosting the parts of the response that are too low in an attempt to produce the required flat response?



This doesn't really work!

Boosting frequencies that the speaker cannot naturally reproduce will result in wasted power, damaged speakers and lower sound levels than could otherwise be achieved.



Correcting the Speaker's Response Properly!

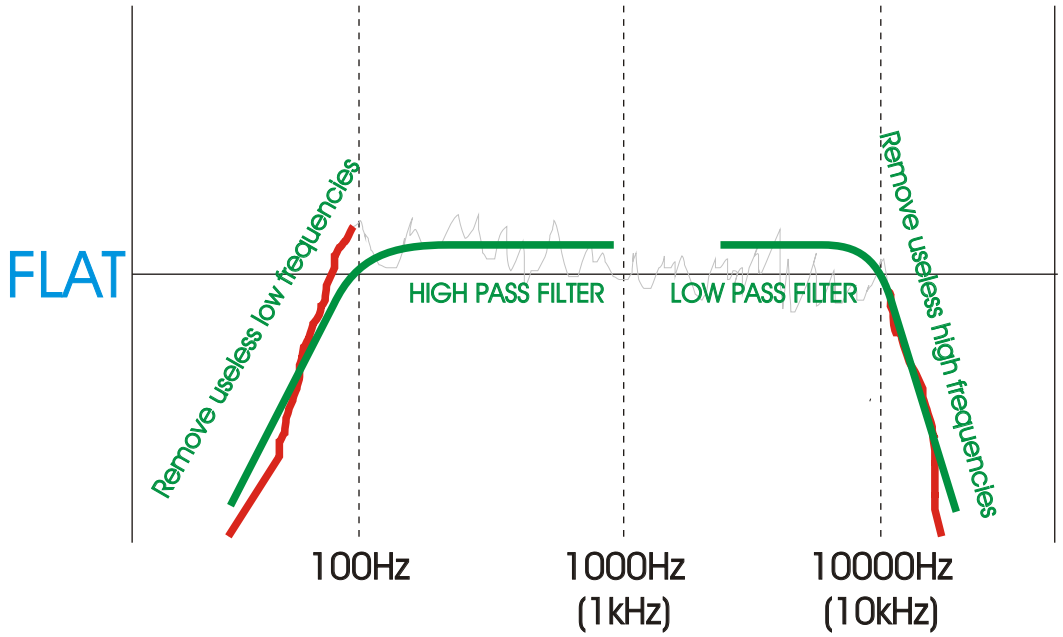
The best method to fix this problem is to use multiple speakers, each specifically designed to cover part of the entire audio range. When all heard together, these will be able to reproduce all the frequencies as required.

First step in ensuring this all works correctly is to cut back all the frequencies that the speaker cannot properly handle.

This ensures it will operate correctly and not be unduly stressed.

To achieve this we use a different type of filter - a high pass or low pass filter.

Typical "Full Range" Speaker Response



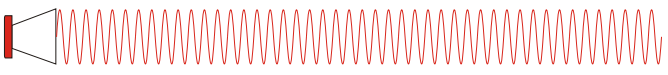
Crossovers - what they do...

HIGH PASS FILTERS cut out low frequencies and allow high frequencies to pass;
LOW PASS FILTERS cut out high frequencies and allow low frequencies to pass.

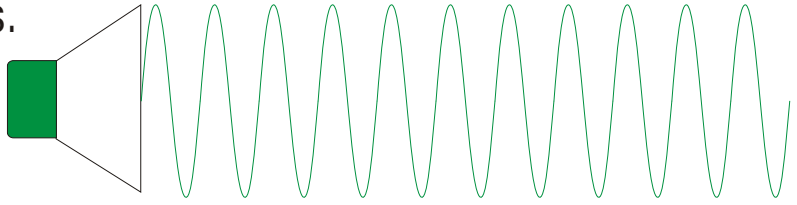
These filters only REMOVE frequencies - they cannot boost anything.

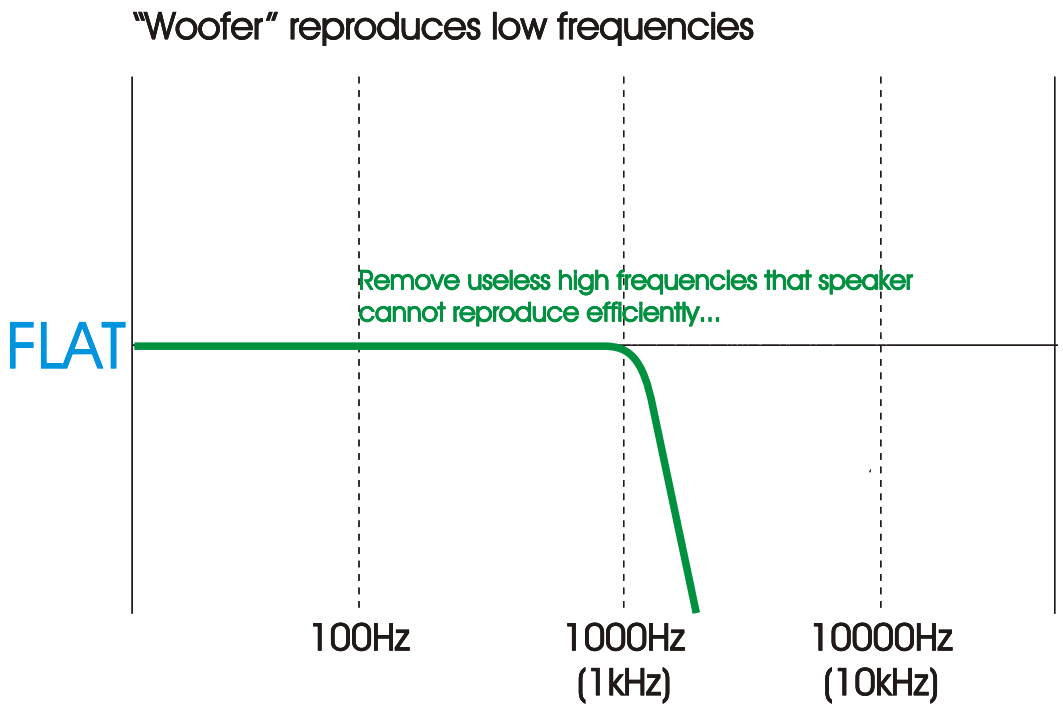
Combinations of these filters form what are known as crossovers - the basis of what a DP224, DP226 and DP428 does.

"Tweeters" reproduce high frequencies, but cannot reproduce low frequencies.



"Woofers" reproduce low frequencies, but cannot reproduce high frequencies.

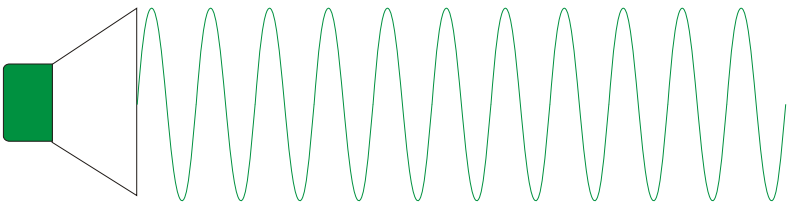


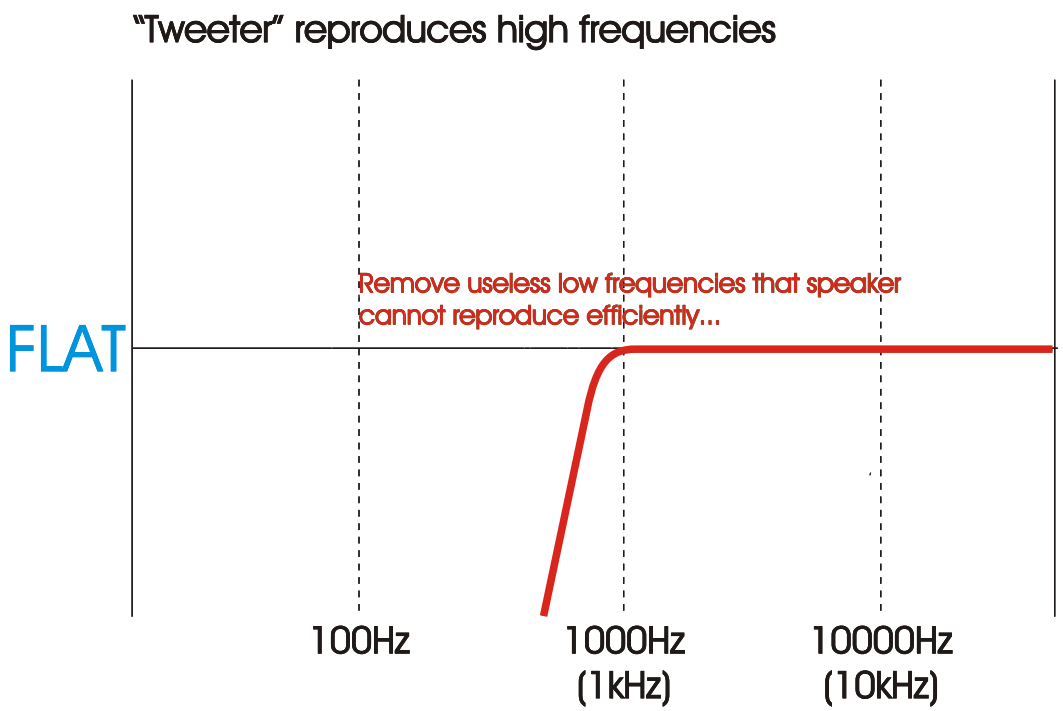


LOW PASS FILTER = LOW FREQUENCIES ONLY

The LOW PASS FILTERS cut out high frequencies and allow low frequencies to pass.

As the woofer cannot reproduce high frequencies, power would be wasted sending them to it.

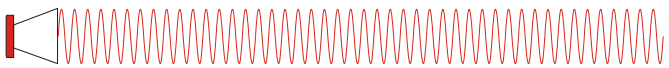




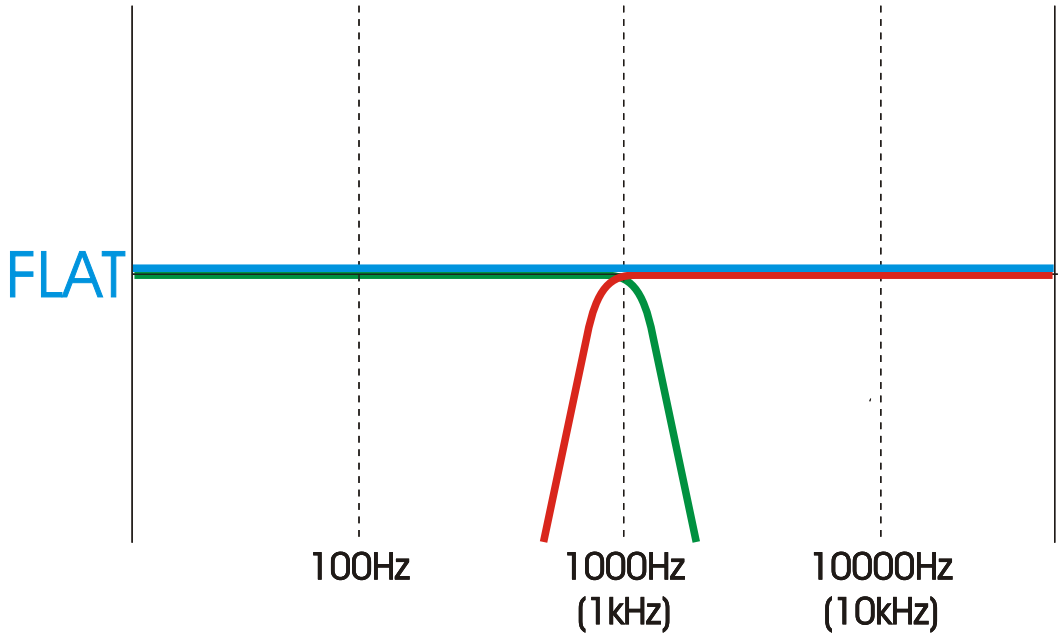
HIGH PASS FILTER = HIGH FREQUENCIES ONLY

The HIGH PASS FILTERS cut out low frequencies and allows high frequencies to pass.

The tweeter cannot reproduce low frequencies: it would most likely be damaged by receiving them, due to low frequencies almost always being much higher power in a normal audio signal.

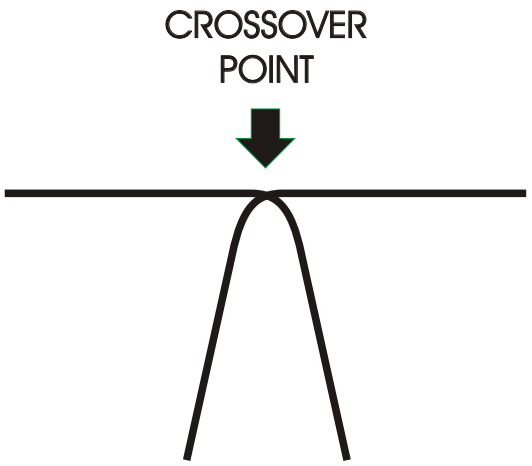


Recombining two responses covers complete spectrum



WOOFER + TWEETER = FLAT RESPONSE!

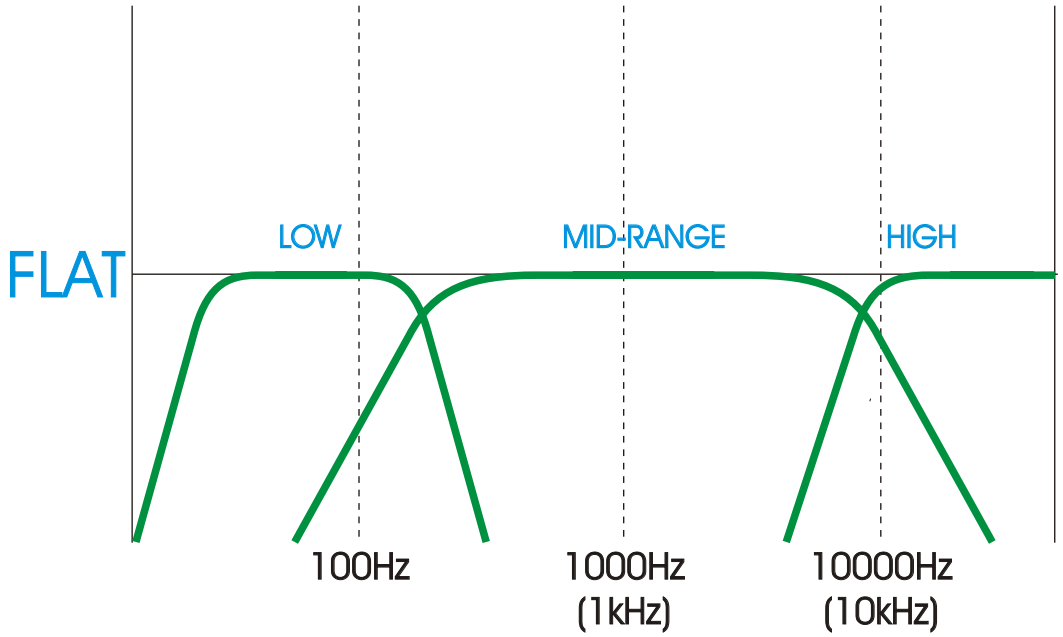
Each output on a crossover will have both low pass and high pass filters to permit only a certain band of frequencies to get through, as appropriate to that speaker's useful reproductive range.



High and low pass filters are called CROSSOVER filters when used like this, due to the fact that the bands overlap enough to produce a FLAT RESPONSE.

The point at which the bands overlap is called the CROSSOVER point.

Multiple bands can be used for multiple driver systems



SPLITTING THE SOUND MORE...

The signal may be divided up into more than two bands - typically 3 or 4 when dealing with a large professional concert sound system.

This is mainly because when high powers are involved (and the requirement for high sound levels), speaker drivers become more specialised over smaller frequency ranges.

This allows their design to be tuned to give higher efficiency and so be louder, at the expense of wide bandwidth - so we need more overlapping over to cover the entire audio spectrum.