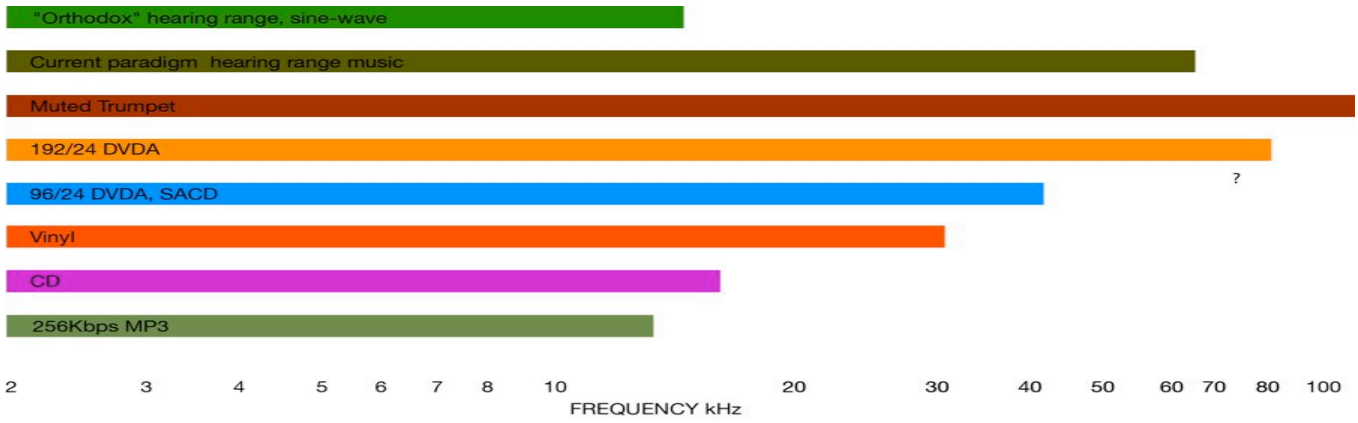
The Townshend Audio Maximum Supertweeters

Why do we need Supertweeters?

Since the late 1940s, when the term “hi fi” was first applied to high quality (**hi**gh **fi**delity) sound reproduction systems, it has been conventionally accepted that the range of human hearing has an upper limit of about 15 to 20 kHz. The signal used to measure this response is an artificially-generated sine wave. However, modern research and long term experience working with High Fidelity systems now questions this firmly held belief. Harmonically rich, highly transient, real-life sounds extend to well beyond 20 kHz; for example, the muted trumpet has a frequency response extending to beyond 100 kHz (see http://www.cco.caltech.edu/~boyk/spectra/spectra.htm). It is also common knowledge that even the best audio systems do not sound the same as real life.

Listening tests conducted by Townshend Audio and others have identified the lack of extended high frequency response as one of the shortcomings. This is illustrated clearly in Graph 1, which shows:

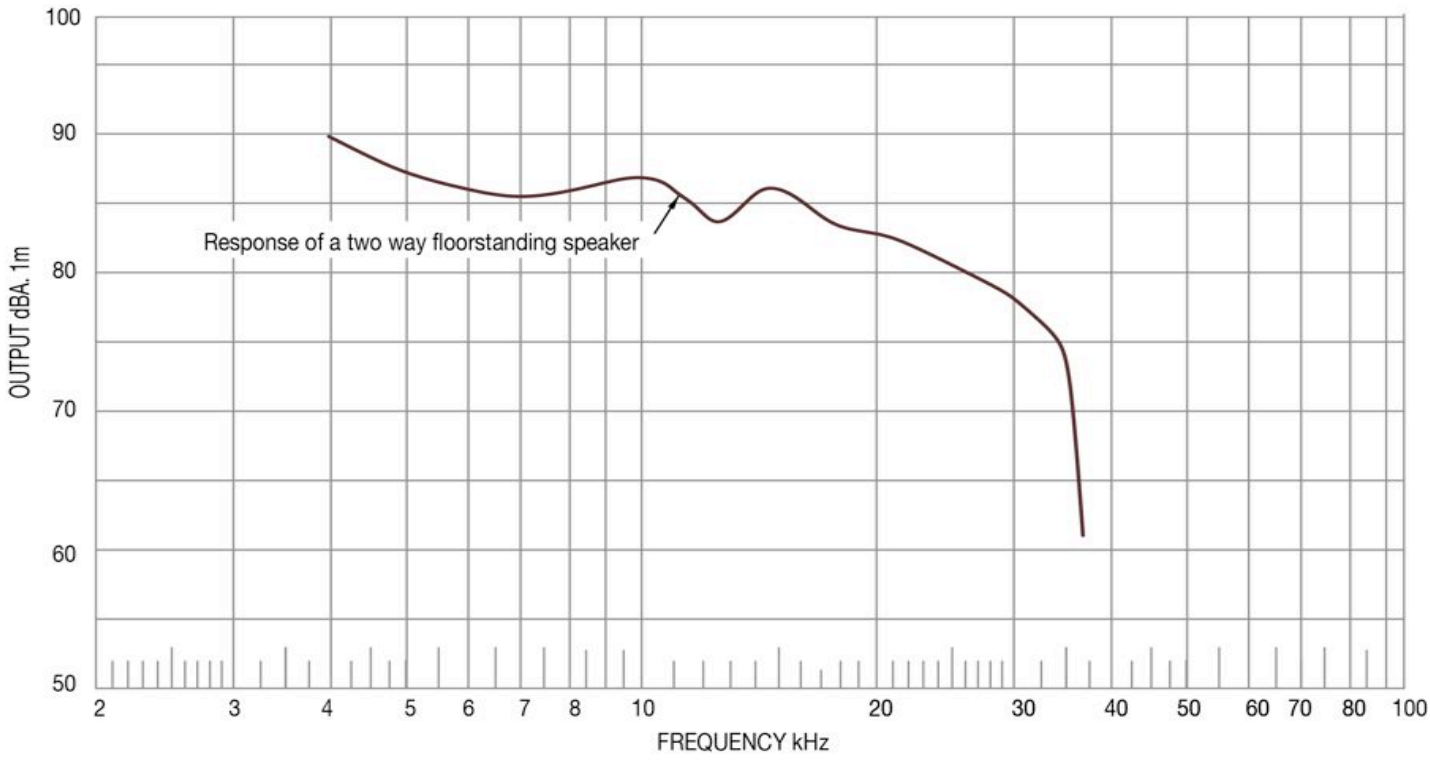
1 the orthodox range of hearing to 20 kHz.
2 The emerging belief that hearing extends to well over 60 kHz.
3 The range of sound from a harmonically rich instrument, for example a muted trumpet
4 The response of current mass media, including MP3, FM radio, Digital TV etc, extending only to 15 kHz.
5 The response of CD, where the upper limit is 21 kHz (proclaimed in 1983 as “perfect sound forever”).
6 The response of vinyl (LP albums), up to 40 kHz under ideal conditions.
7 The response of digital audio, including 96kHz/24 bit DVDA/WAV and SACD, extending to about 50kHz.
8 Last, and far and away the best, the response of 192kHz/24 bit digital audio, extending to around 90kHz.



GRAPH 1

So how can we improve our hi fi to benefit from the best of digital audio?

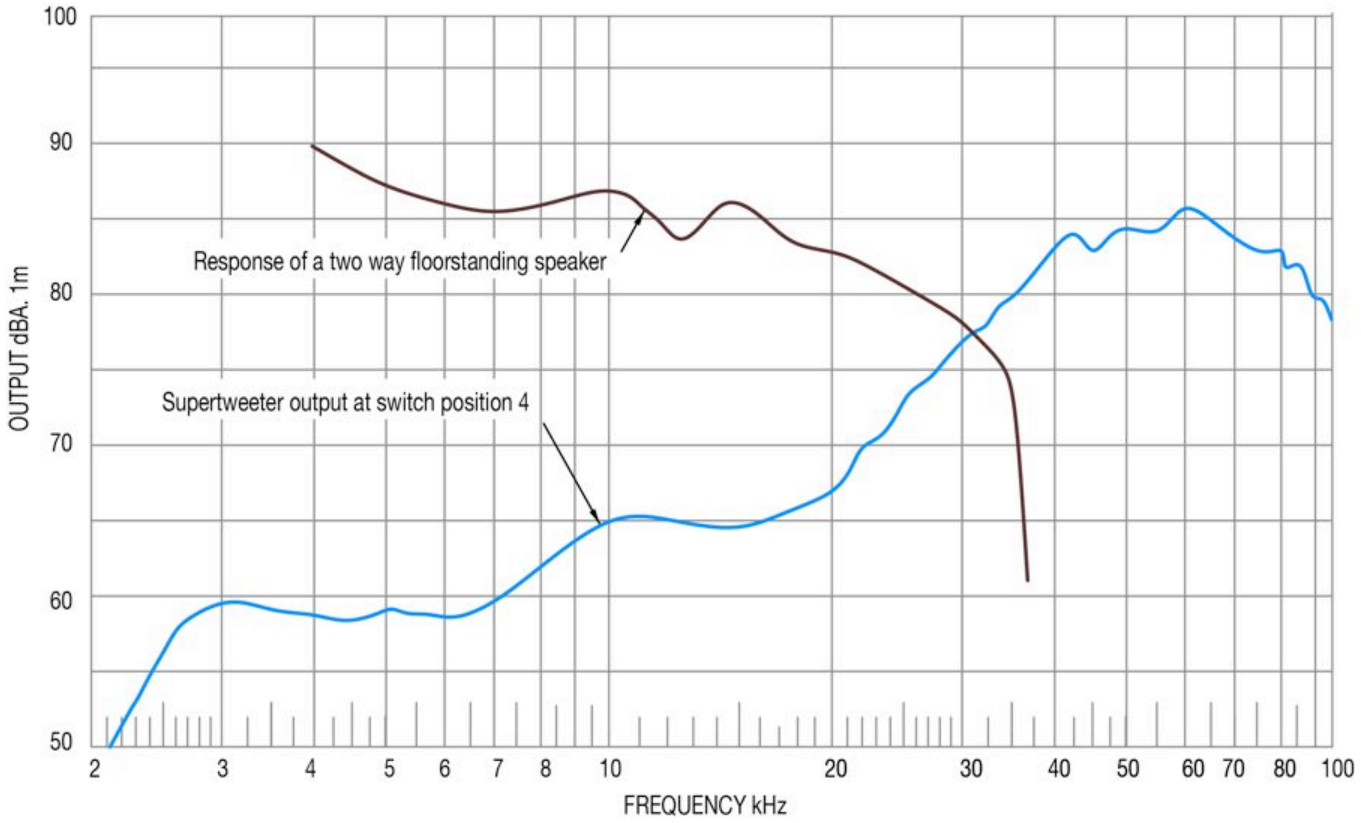
Graph 2 shows the response of a typical high quality speaker with a quality dome tweeter; it is clear that the high frequency response is falling away above about 10 kHz, and the important high frequencies are clearly attenuated.



GRAPH 2

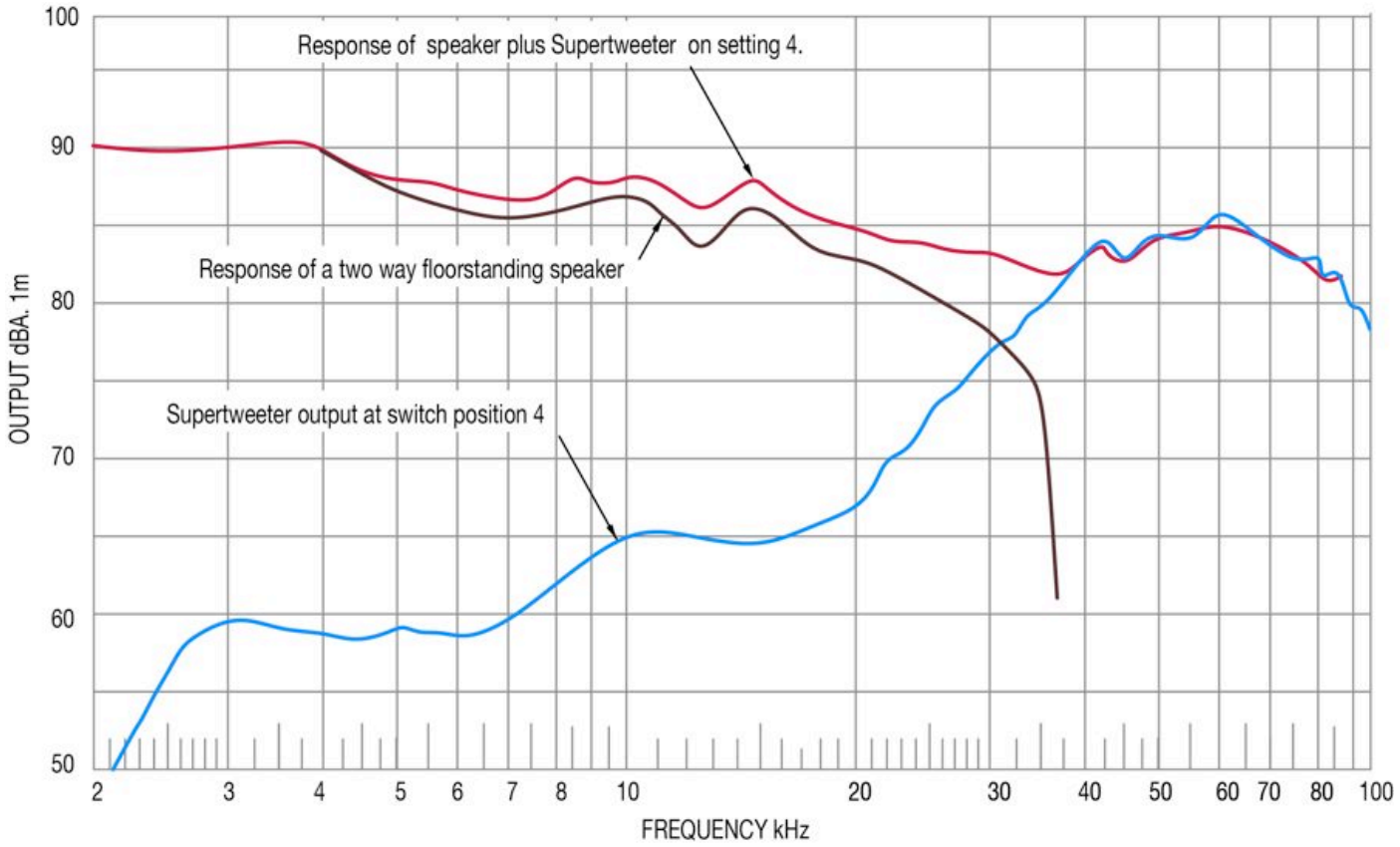
How do we improve this? Add a pair of Townshend Supertweeters.

Graph 3 shows the same speaker with the Townshend Supertweeter response superimposed. It is clear that the Supertweeter output mirrors the speaker output below 30 kHz, but supplies the important high frequency content above this frequency.



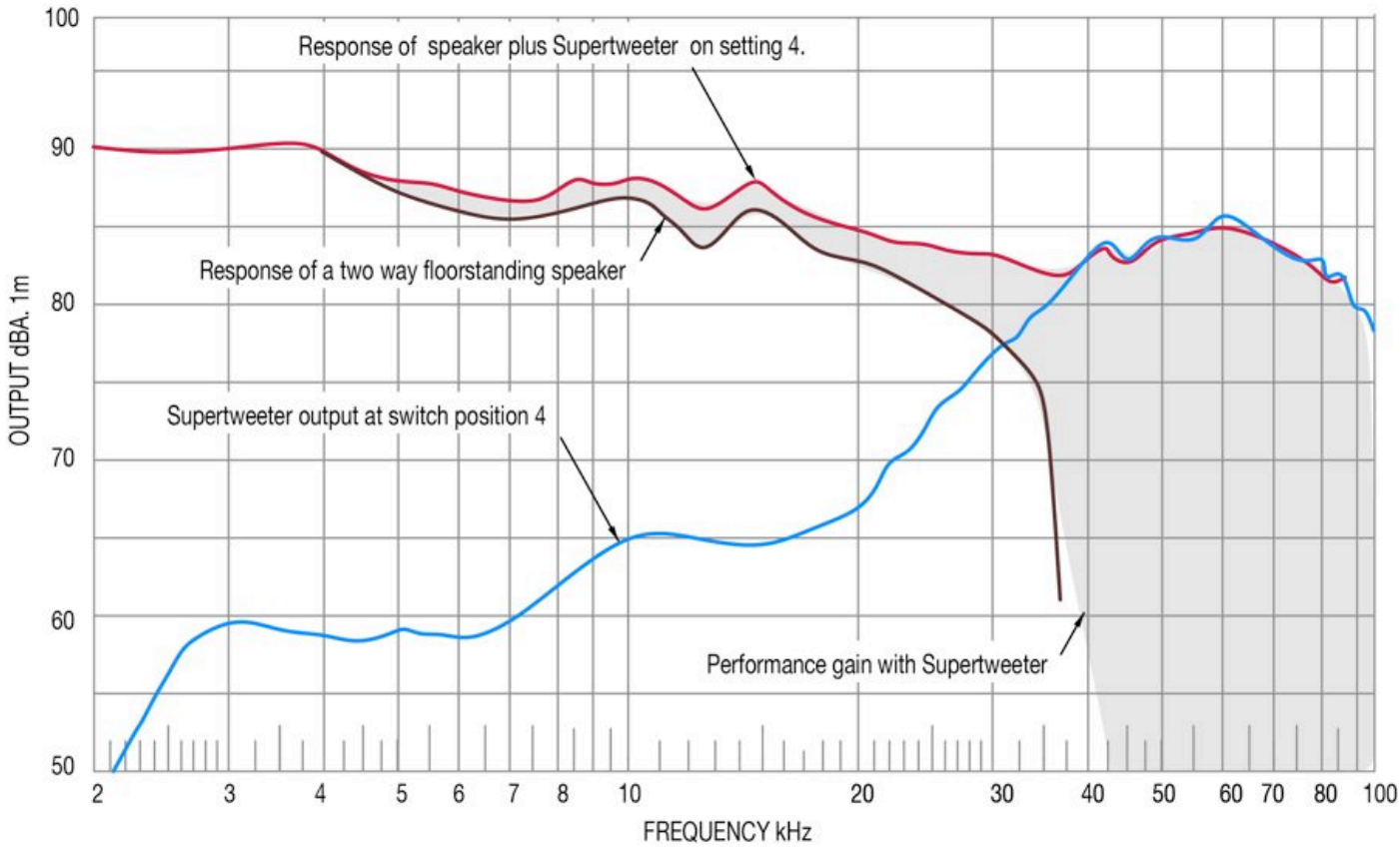
GRAPH 3

Graph 4 shows the result when these two outputs are summed together; it is clear now that the Supertweeter has seamlessly integrated with the main speaker to extend the response up to over 90kHz.



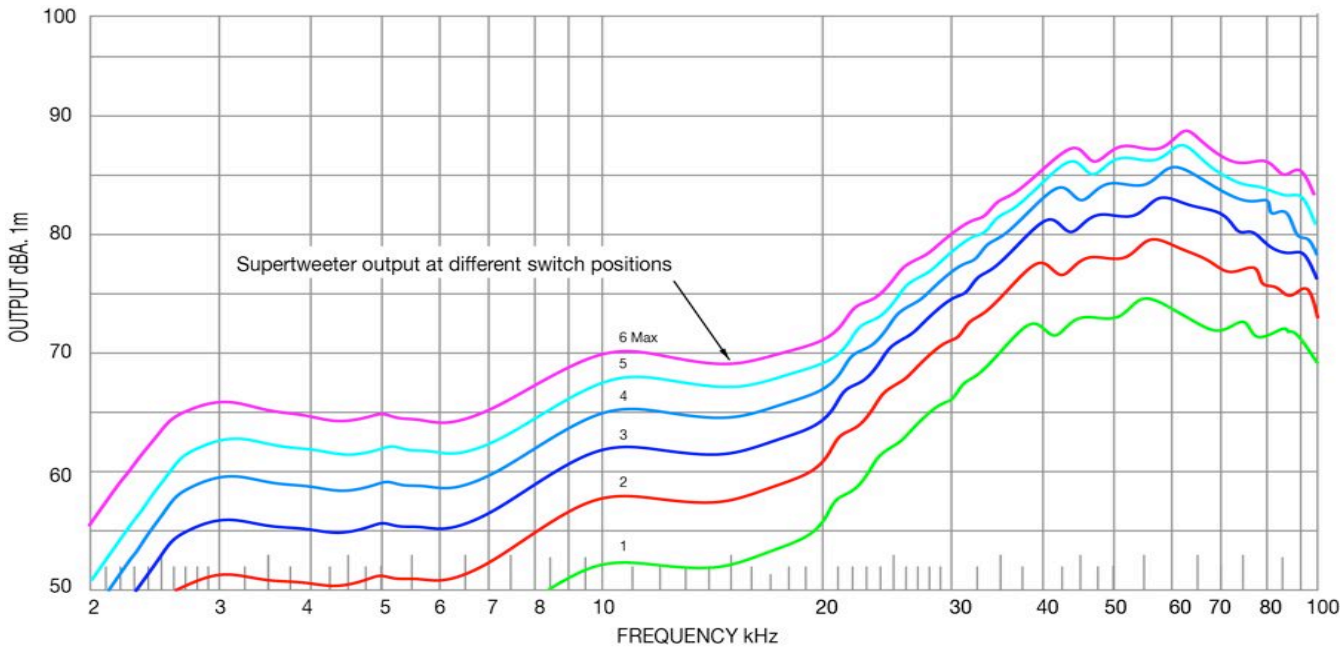
GRAPH 4

The shaded area in Graph 4 shows the contribution of the Supertweeter.



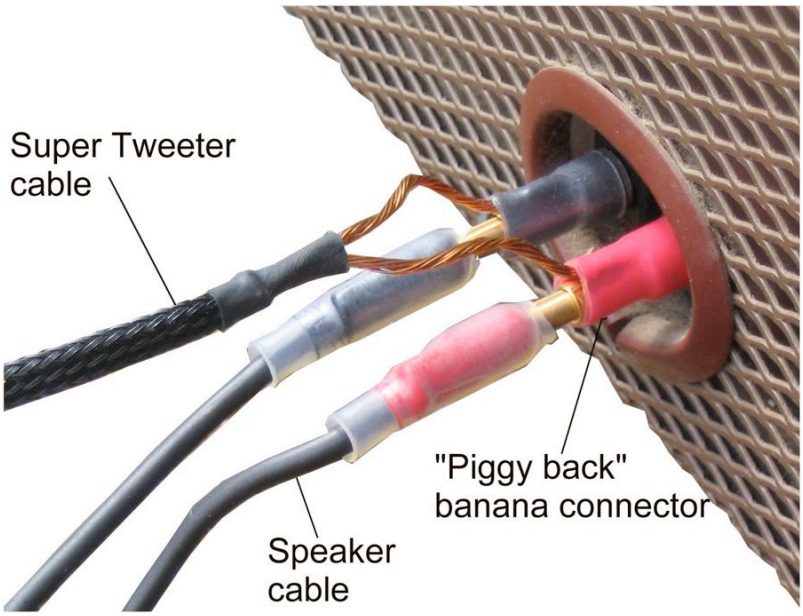
GRAPH 5

Graphs 5 and 6 show the range of Supertweeter sensitivity that may be selected by adjusting the Supertweeter level control to match the sensitivity of a range of different partnering speakers.



GRAPH 6

Integrating the Supertweeter with your own speaker is simplicity itself:

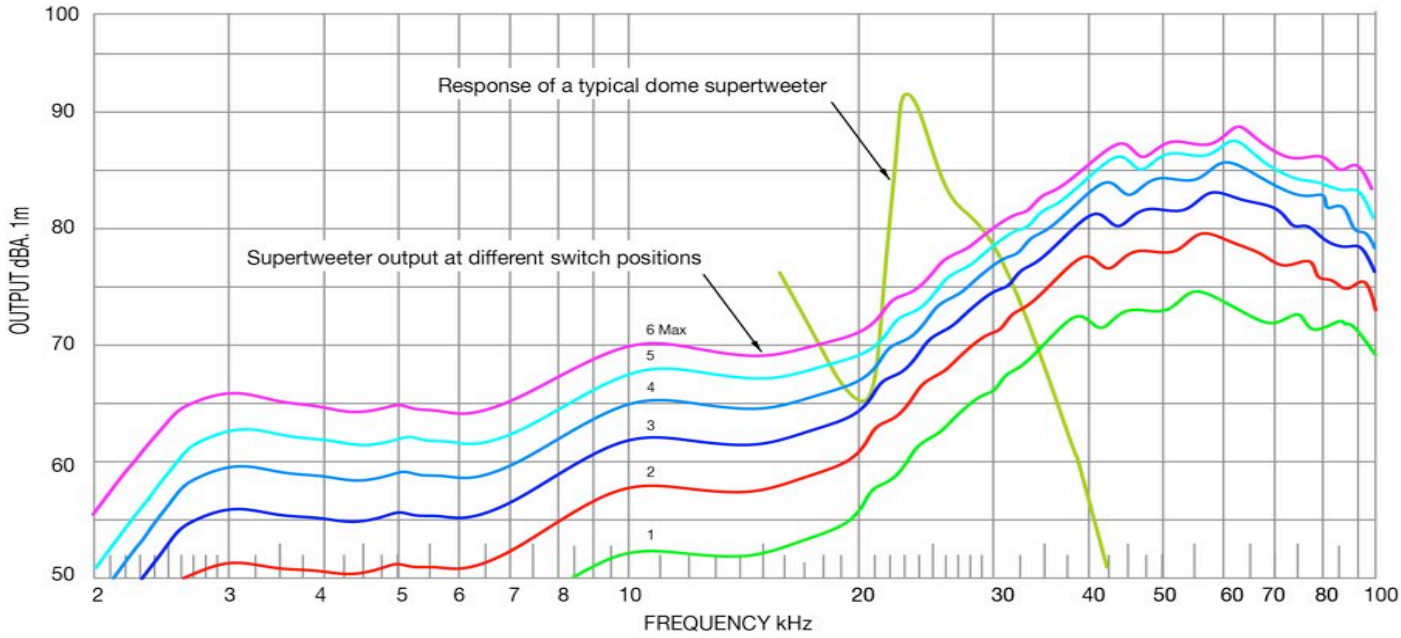


Picture 1

Supertweeter connected to Quad 57 ESL.

Just connect the supplied Supertweeter cables in parallel with the speaker terminals or tweeter terminals. The supplied 1.5m cables have piggyback banana connectors fitted as standard. We can supply spade terminals in place of banana plugs, or longer cable to special order.

It is clear from Graphs 4 and 5 that the Supertweeters have a small, but surprisingly significant effect on the response between 5 kHz and 20 kHz. Low distortion in this part of the frequency range is crucial for pleasant sound and it is here that the Supertweeter has a distinct advantage over the commonly-used dome tweeter, because the component that radiates the sound, the ribbon, measures a mere 25mm long x 5mm wide x 0.01mm thick and weighs in at a miniscule 0.003 grams! Compare this with the moving mass of a dome tweeter, which is rarely below 3 grams, i.e. 1000 times heavier than the ribbon. The ribbon can accelerate and decelerate much faster than the dome because it is so light and also because it is driven by a very powerful electromagnetic force over the entire area of the moving surface. With a dome, there is inevitably some compression and tension in the mechanical parts that connect the tweeter coil to the dome and flexure in the dome itself. This leads to a particular distortion which cannot occur in the case of the ribbon. This effect is shown in Graph 7, which illustrates the response of a popular dome Supertweeter compared with the Townshend Supertweeter.



GRAPH 7

A further advantage of the Supertweeter is that the air in contact with the ribbon acts as a very effective brake on any resonant movement of the ribbon after the cessation of a transient. In the case of the dome tweeter, only 1% of the electrical energy sent to the tweeter results in sound; the rest of the energy being stored in the dome as ripples which dissipate slowly and incoherently over time. This is heard as an irritating edginess or sharpness in the sound, sometimes referred to as “machine-gun treble”.

A surprising and fortunate benefit with the addition of a Supertweeter with the much faster transients, is that the ear detects these first arriving coherent sound from the ribbon and rejects the delayed smeared output from the dome. The effect is to make the sound appear far smoother and clearer, as the ear/brain combination rejects the smeared sound from the dome and locks onto the first and fastest sound. This is known as the Precedence Effect. This means that it is not necessary to modify an existing speaker setup when adding Supertweeters.

The ear may not be able to detect totally alien sine-waves above 20 kHz, but the ear can definitely discern information up to 100 kHz in the complex transients present in real life sound. Even 90 year old men can still discern time differences between the left and right ears of 50 micro-seconds!

Adding Townsend Supertweeters makes your hi fi system “High Res Ready”. The Supertweeters really come into their own when reproducing modern high resolution audio shown in bars 7 (48kHz) and 8 (96kHz) of Graph 1. The addition of Supertweeters has an astounding effect: the whole soundstage becomes far more realistic because all the fine detail of the complex harmonic structure of musical instruments is now played back as it should be. The effect is not subtle – the resultant sound is far more tangible and lifelike, and provides a satisfying fatigue-free sound which will be enjoyed for many hours.

Many listeners have remarked that when the Supertweeters are removed from their system, the sound totally crashes. This is mentioned in the numerous reviews on the Supertweeters elsewhere.