

VK-1 Dipole Loudspeaker

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How good can a high-quality driver sound when freed from an enclosure? The reduction of stored energy alone is a compelling reason for choosing a dipole system, especially given the improvement in time-domain performance. The ease of construction is just icing on the cake.



As a side note, the name “VK-1” comes from my son who, when he first saw the baffle, said, “It looks like a Vermicious Knid!” He had recently been read Roald Dahl’s “Charlie and the Great Glass Elevator.” Personally, I had wanted to call them “Aphrodite” since they were intended to be wed to the Hephaestus Monaural Amplifier...

Notes on the Design

- The tweeter and midrange are spaced further apart than the typical recommendation of no more than one wavelength of the crossover frequency
 - It has been suggested that some vertical extension of the drivers may be needed to produce a believable image
- The baffle is $\frac{1}{2}$ " MDF with a height of 48", top radius of 6", and bottom radius of 12"
- The amplifier is an 8 x 250W switching amplifier with DSP
 - Two channel pairs are bridged to drive the woofers
- The CD player is a cheap one from Target (yes, life is full of inconsistencies...)



Drivers Used

Tweeter

Aurum Cantus G2Si aluminum ribbon tweeter

Aluminum ribbon tweeters are often perceived as superior to dome or compression types of high-frequency drivers. Measurement of typical parameters does not tend to support this, however it is a reality that drivers with characteristics similar to the frequency range they are intended to reproduce tend to sound the most natural: for example, a “light and airy” tweeter versus a “heavy and powerful” woofer.

Midrange

Eminence Lil' Buddy 10" hemp cone driver

This midrange was selected primarily for the paper former and the hemp cone. The goal was to use a very “musical” driver for the midrange that did not require any special attention outside of the passband.

Woofer

Eminence Sigma Pro-18A 18" paper cone driver

This driver represents tremendous value. It boasts a very large diaphragm, a good Xmax, and a large magnet – all for a very modest price. It is usually difficult to beat Eminence for cost-to-performance.

DSP Settings

The DSP settings were adjusted to give as flat of a measured response as possible, without going overboard with processing. It was found subjectively that the system sounded better when the midrange was allowed to roll off naturally, rather than using a low-pass filter at 2kHz. This was the case even when the measured response was still very flat. It could be the result of “euphonic” distortion from the upper end of the response, or perhaps it simply aids with driver integration.

Overall

800Hz; +6dB; 1-octave parametric EQ
15kHz; +6dB; 1-octave parametric EQ

Correction of dipole “null”
Correction of ribbon tweeter response

Tweeter

2kHz; 8th-order; Linkwitz-Riley high-pass
26dB net gain; normal polarity

Midrange

200Hz; 8th-order; Linkwitz-Riley high-pass
14dB net gain; normal polarity

Woofers

20Hz; 8th-order; Linkwitz-Riley high-pass
200Hz; 8th-order; Linkwitz-Riley low-pass
20Hz; +15dB; 1st-order L-shelf
20Hz; +15dB; 1st-order L-shelf
20dB net gain; normal polarity

Compensation for dipole rolloff
Compensation for low Q_{ts} of woofer

Subjective Impressions

This is the first speaker system that I have heard that does not get *loud* when you turn it up – it simply gets *bigger*. The impression is similar to hearing an acoustic instrument in close proximity: the level of the sound can be quite high; however, it tends to fill the space rather than simply being loud. Also, the listening space I have the drivers in is not especially large, however it sounds quite large with these speakers. Dipoles really do have a way of presenting a big image.

The bass response was the biggest surprise. I had elected to use an 18" woofer because I was certain I would need this size to get adequate bass from a modest size baffle without any sort of "wings". Well, I was wrong. I believe I could have used a comparable 12" woofer and had *plenty* of bass for my tastes. The gentle 6dB/oct rolloff of a dipole seems to really help with low-frequency extension.

I dared on one occasion to serenade the neighborhood with Tchaikovsky's *1812 Festival Overture*. It was worth it. The bass from Kraftwerk's *Aero Dynamik* is something to hear and goes way, way down. The "Pilgrim's Chorus" from the Solti recording of Wagner's *Tannhauser* does not sound like a jumbled mess of voices – it manages to remain distinct and, again, very big. There is Berlioz's *La Marseillaise* too, oh and Faure's *Pavane*...okay, I need to stop typing and go listen! How about a little of the Rod Blumenau Trio?