

Supplemental Technical Information for model

THIEL PCS

Coherent Source[®] Loudspeaker

This paper contains only information specific to the PCS speaker system. It is intended to supplement the general technical information paper which explains our engineering philosophy, goals and techniques.

THIEL PCS SPECIFICATIONS

Bandwidth (-3 dB)	55 Hz - 23 kHz
Amplitude response	57 Hz - 18 KHz ± 2 dB
Phase response	minimum $\pm 10^\circ$
Sensitivity	87 dB @ 2.8 v-1m
Impedance	4 Ω , 3.3 Ω minimum
Recommended Power	50-200 watts
Size (W x D x H)	7.25 x 11.5 x 19 inches
Weight	30 lb

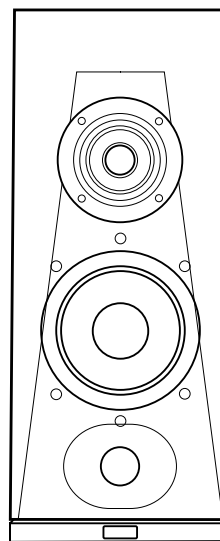
Driver Complement:

Woofers

6.5" (5.1" radiating area) with anodized aluminum cone, cast frame, 1.7" dia voice coil. Underhung coil (short coil/ long gap) motor system. Linear travel $\frac{3}{16}$ " pk-pk, 3 in³ linear displacement. 2.5 lb. magnet, 6 lb total magnet structure plus 1.2 lb. shielding magnet. Copper pole sleeve. Made by THIEL.

Coaxial Midrange/ Tweeter

Midrange 4" (2.7" radiating area) with anodized aluminum diaphragm, cast frame, 1" dia voice coil. Underhung coil (short coil/long gap) motor system. Linear travel $\frac{1}{8}$ " pk-pk. Magnet weight of .7 lb powers midrange and tweeter. Tweeter 1" (1.2" radiating area) with anodized aluminum dome. Coincident with midrange. Copper pole sleeve. Ferrofluid. Magnetically shielded. Made by THIEL.



Our goal for the PCS was to develop a compact speaker system that did not compromise sonic quality. Accepting that the small size would limit low frequency extension, it was decided that no other significant limitation on performance would be made and that every engineering technique used in our larger speakers would be applied to this design.

Motivation for the design was to take advantage of our (then) newly developed mechanical crossover coaxial midrange/tweeter to achieve 3-way performance in a compact speaker. Since virtually all speakers in this size category are 2-way designs, this new driver would allow superior performance for this type of system. Since the woofer would be small, performance could be achieved equivalent to a large 4-way system, except for the deep bass. (This is analogous to small 2-way systems achieving performance equivalent to a large 3-way, except for the deep bass.)

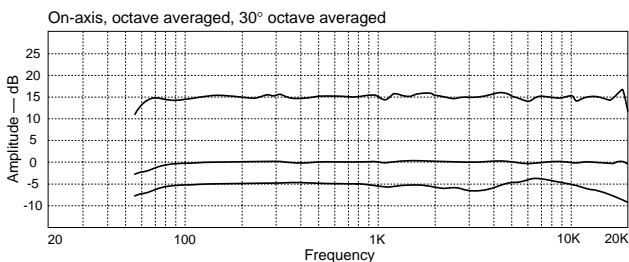
Further motivation was the realization that this performance level could be achieved at a relatively reasonable price since the new coaxial driver was more cost-effective than separate mid and tweeter drivers of similar performance. In addition, the elimination of the costs of an electrical mid/tweeter crossover would also contribute to a very good performance/cost ratio.

Frequency response

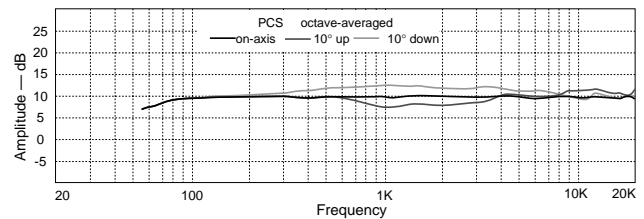
The graphs below show the frequency response of the PCS. The upper graph shows the (normal) on-axis response and illustrates the very high degree of accuracy; no frequency is under or over emphasized more than 2 dB.

The second graph shows the on-axis, octave-averaged response. This curve is representative of the speaker's tonal balance and shows that the PCS is very accurately balanced; any over or under emphasis above 90 Hz is less than 0.5 dB.

The third graph shows the 30° off-axis, octave averaged response and illustrates that the speaker's overall energy response is well balanced, with no large depressions in any area of the spectrum. It is also noticeable that this response remains stronger in the 1 KHz to 3 KHz region than can be achieved with 2-way designs. This high degree of uniformity is in part the result of the PCS's first order crossover system.

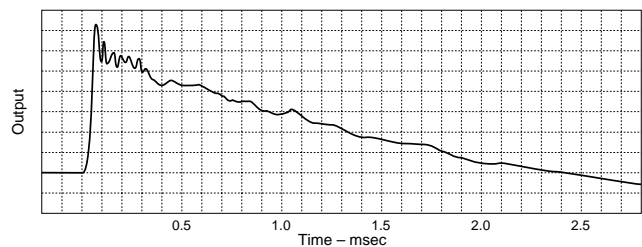


The PCS uses a coaxial tweeter/midrange driver in order to greatly reduce changes in response caused by different listener heights. The coaxial driver configuration ensures that energy from these drivers always arrives at the listener's ears at the same instant, regardless of the position of the speaker or the listener. As can be seen on the following graphs, changes in the high frequency response, where the greatest variation would normally occur, are very small. Also, variations in the mid frequency response are only moderate, even with rather large 10° changes in the listening axis. 10° represents a height change of about 22 inches at a distance of 10 feet, covering listening heights (with a 32" stand) of 20 to 64 inches, equivalent to sitting on the floor to standing.



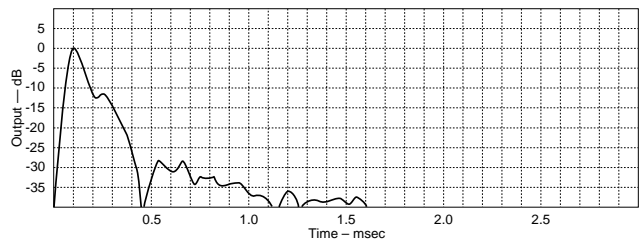
Step response

This graph below shows the PCS's response to a step signal. Notice that the overall triangular shape is very well preserved with the output remaining smoothly positive until 2.6 ms when it finally crosses zero due to the fact that the bass response extends to 55 Hz rather than DC. The irregularities seen in the first few hundred microseconds are due to the tweeter diaphragm resonance at the ultrasonic frequency of about 23 KHz. Waveform accuracy this good can only be achieved with first order crossovers and time coherent driver positioning.



Time response

The energy-time response of the PCS shows that the speaker's output quickly decays to -40 dB in 1.6 milliseconds, indicating very clean inter-transient silence. Such performance is the result of metal diaphragms that have no resonances within their operating frequency range and very strong cabinet construction using a 2" thick baffle, 1" thick cabinet walls and internal bracing.



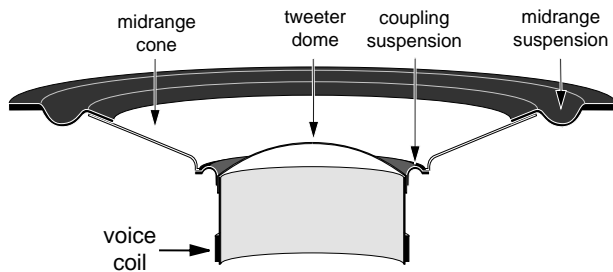
Compound driver

The most unusual technical feature of the PCS is its use of a compound driver where the tweeter dome and the midrange cone are both driven by a single voice coil. The design is implemented with a mechanical crossover – a “coupling” suspension between the coil and the midrange cone. The stiffness of the coupling suspension is sufficient so that at low frequencies the voice coil moves both the tweeter dome and the mid cone in unison. However, at high frequencies the coupling suspension's compliance is sufficient to “decouple” the mass of the mid diaphragm from the movement of the coil and dome.

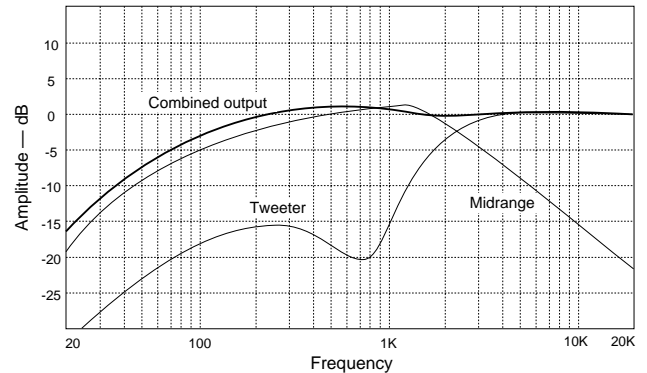
The advantages of this unique driver are that perfectly time-coherent performance is achieved without the cost and complexity of two magnet structures or an electrical crossover network for the mid-to-tweeter transition. By optimizing the compliance and damping of the coupling suspension and the ratios of area and mass of the two diaphragms, the driver exhibits extremely uniform response from 100 Hz to 20 KHz.

THIEL PCS compound Mid / Tweeter

Moving system



Mechanical crossover



PCS WOOFER

- The aluminum diaphragm is stiff enough so that all internal resonances are above the operating range of the driver. The lowest diaphragm resonance is at 4.5 KHz, 2-1/2 octaves above its crossover frequency. Below this frequency there is no internal energy storage to reduce clarity.

- The copper pole sleeve reduces the voice coil's inductance and, therefore, the distortion caused by the nonlinearity of this inductance due to its steel core of the magnetic pole. It also reduces distortion by stabilizing the magnetic field strength through its self inductance.

- The long magnetic gap and the short voice coil ensure that the entire coil is within the magnetic gap during excursions and therefore that the coil is acted upon by a very uniform magnetic strength. Distortion is greatly reduced since the coil sees a magnetic strength that does not change with its position.

