Supplemental Technical Information for model

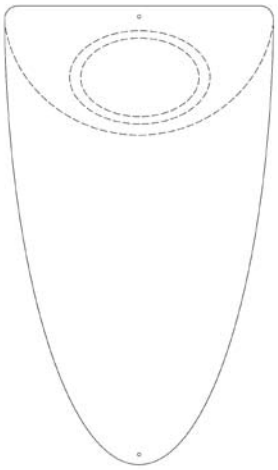
THIEL PowerPoint 1.2™

Coherent Source® Loudspeaker

This paper contains only information specific to the PowerPoint 1.2 speaker system. It is intended to supplement the general technical information paper which explains our engineering philosophy, goals and techniques.

THIEL POWERPOINT 1.2 SPECIFICATIONS

Bandwidth (-3 dB)	75 Hz - 20 kHz
Amplitude response	75 Hz - 20 KHz ±3 dB
Phase response	minimum ±10°
Sensitivity	89 dB @ 2.8 v-1m
Impedance	4Ω, 3Ω minimum
Recommended Power	30-200 watts
Size (W x D x H)	12.5 x 21 x 6.5 inches
Weight	16 lbs.
Cabinet Construction	Rigid die cast aluminum



Driver Complement:

Woofer

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 $^{3}/_{16}$" pk-pk, 3 in^3 linear displacement. 7.5 oz. neodymium magnet. Copper pole sleeve. Designed by THIEL.

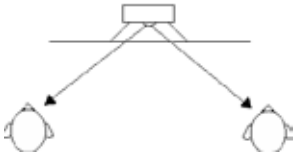
Tweeter

1" (1.2" radiating area) with anodized aluminum dome. Aluminum coil. Underhung coil (short coil/long gap) motor system. Linear travel $^{1}/_{8}$" pk-pk. Powered by 5 neodymium magnets weighing 1.7 oz. Copper pole sleeve. Ferrofluid. Coincident with woofer. Designed by THIEL.

Time coherent topology

An important design goal for the PowerPoint 1.2 which is not shared with our floor-standing products is placement flexibility. The requirement that the speaker provide time coherence while placed in any orientation and at any height necessitates that the speaker's drivers be placed symmetrically both horizontally and vertically and, therefore, that it use either coincident or D'Appolito driver configuration. The PowerPoint 1.2 uses coincident/coaxial mounting of a very high output 1" tweeter and a high output 6½" woofer.

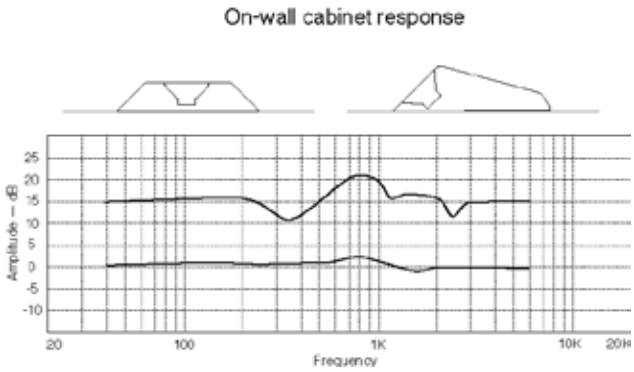
Two-way speaker positioned on its side causes the sound from the drivers to reach the off-axis listener at different times.



Coincident driver mounting results in all listeners hearing the sound from the drivers at the same time.

Wall Reflection Problems

Speakers mounted on a wall with their woofer parallel to the wall exhibit serious cancellation problems due to wall reflections. The upper graph below shows this effect. There is a depression in the response of about 5 dB at 350 Hz followed by an exaggeration of about 5 dB around 800 Hz. This rather severe coloration cannot be compensated in the network and results in a very characteristic "sound" of such speakers.



The PowerPoint 1.2 uses an unusual cabinet configuration to eliminate this effect. The woofer is mounted on an angled surface that is adjacent to the wall which allows the woofer to be closer than 1/2 wavelength to the wall at fequencies that the woofer disperses widely and, therefore, to essentially eliminate the wall reflection as an alteration on the speaker's output. This is illustrated in the lower graph above which shows the cabinet producing only very minor effects. The PowerPoint 1.2's unique cabinet therefore allows its reproduction to be as uncolored by the wall surface as any high performance floor standing speaker.

Coverage benefits

Since the PowerPoint 1.2's performance axis is 45° from the wall rather than the 90° of other on-wall and in-wall speakers, significant advantages in room coverage and placement flexibility are provided.

In ceiling applications the advantages are great. Whereas most speakers direct their energy straight downward and therefore provide reasonable sound only for listeners near the speakers, the PowerPoint 1.2s project their energy at an angle of 45° and therefore allow coverage anywhere from directly under the speaker to the other end of the room. Furthermore, whereas most ceiling-mount speakers can only provide an "above your head" source of sound, the PowerPoint 1.2s provide a more pleasing "in front" or "behind" source for most listeners. Since there is no wall reflection effect and the speaker provides very even and wide dispersion due to the coaxial driver mounting, the sound image projected by the speakers is not from the ceiling but much more in front of (or behind) listeners who are at least 5 feet behind the speakers. For these reasons the PowerPoint 1.2s can provide extremely good performance as ceiling speakers for left/center/right applications as well as rear channel applications.

Conventional in-wall speakers used in ceiling applications allow coverage for only those listeners near the speakers.

THIEL PowerPoint 1.2 speakers provide coverage for listeners in a large area.

The PowerPoint 1.2s can also be used in many ways for wall mount applications. If the room is not extremely wide, they perform extremely well as left/right speakers when mounted on the side walls pointing forward toward the listening location. As rear speakers they can be mounted on the side walls behind the listeners pointing toward the front of the room. If the listening location is at the rear of the room, rear channel speakers can be mounted on the rear wall near the ceiling pointing down.

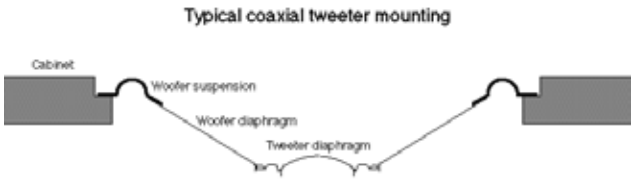
If an indirect type of sound presentation is desired for the rear channels, the PowerPoint 1.2s can be mounted pointing away from the listening positions. For example, they can be mounted on the rear or side walls somewhat near the ceiling pointing upward.

THIEL PowerPoint 1.2 speakers can be mounted on the side walls for left/right usage.

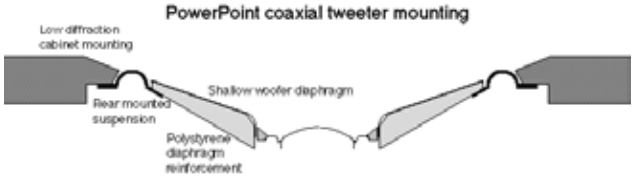
Coaxial tweeter response

To maintain time coherence the tweeter must be aligned with the woofer. There is usually a significant problem with the response of tweeters which are mounted coaxially in a woofer. Energy from the tweeter is reflected and diffracted from the woofer's diaphragm, suspension and cabinet and causes negative effects on the tweeter's output.

The PowerPoint 1.2's woofer diaphragm shape has been designed to greatly reduce negative effects on the tweeter's response. By shaping the diaphragm as a short tube opening into a shallow flare, reflections are almost entirely eliminated. In addition, the woofer's surround is mounted to the rear of the diaphragm such that the tweeter does not really "see" it as a diffraction-causing obstruction. Also, the woofer is mounted from the rear of the cabinet to obtain a smooth transition from the woofer's suspension to the cabinet.



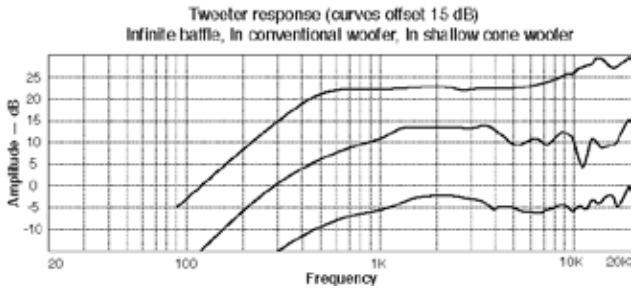
Typically, diffraction of the tweeter's energy is caused by the woofer diaphragm's deep shape, its suspension, and the cabinet mounting.



The PowerPoint woofer's shallow shape, rear mounted suspension, and cabinet mounting all greatly reduce diffraction of the tweeter's energy.

All these features greatly reduce diffraction of the tweeter's energy as demonstrated by the following graphs. The first shows the response of the PowerPoint 1.2's tweeter in an infinite baffle and the second graph shows the tweeter's response when coaxially mounted in a typical woofer. Irregularities can be seen above 4KHz caused by diffraction. The third graph show the response in the PowerPoint 1.2 to be much less altered than with typical mounting.

Since the shape of the woofer's diaphragm has been optimized for the tweeter's response rather than to minimize its own resonances, it would not exhibit response as good as it otherwise would. To remedy this problem the woofer diaphragm is reinforced with very light and stiff molded polystyrene on its rear surface. This reinforcement also provides the added benefit of damping the high frequency diaphragm resonances somewhat.

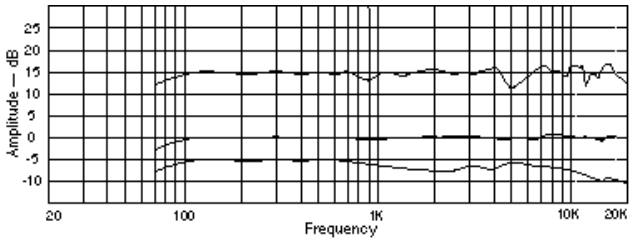


Frequency response

The graphs below show the frequency response of the PowerPoint 1.2. The upper graph shows the (normal) on-axis response and illustrates the very high degree of accuracy; no frequency is overemphasized more than 3 dB or under-emphasized more than 3 dB.

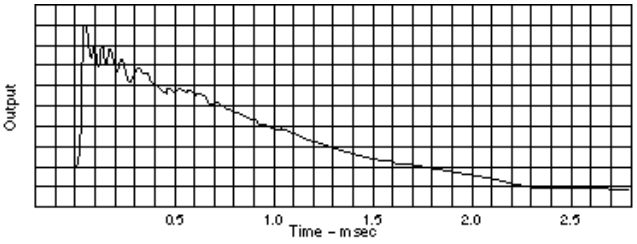
The second graph shows the on-axis, octave-averaged response. This curve is representative of the speaker's tonal balance and shows that the PowerPoint 1.2 is very accurately balanced;≠ any over or under emphasis is not more than 0.5 dB.

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 and only a gentle slope above 1 KHz that reaches only -5 dB at 20 KHz. This high degree of uniformity is in part the result of the PowerPoint 1.2's first order crossover system.



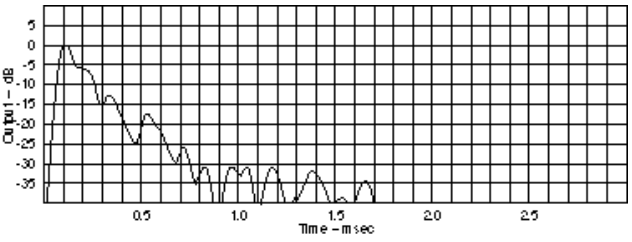
Step response

The graph below shows the PowerPoint 1.2's response to a step signal. Notice that the overall triangular shape is very well preserved with the output remaining smoothly positive until 1.3 ms when it finally crosses zero due to the fact that the bass response extends to 75 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 PowerPoint 1.2 shows that the speaker's output quickly decays to -40 dB in 1.7 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 strong, non-resonant cabinet construction.



PowerPoint 1.2 tweeter

The PowerPoint 1.2's tweeter, designed by THIEL, is a unique and sophisticated device that incorporates many unusual features that provide extremely uniform response, enhance output ability and reduce distortion. The most significant features are:

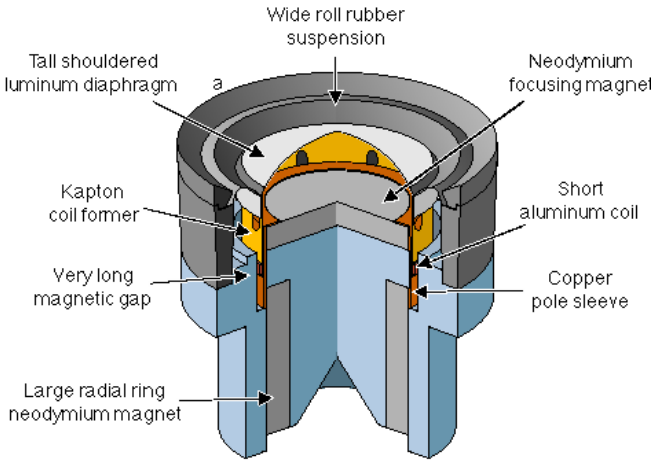
• Very high output ability and very low distortion is provided by a very long, 5 mm magnetic gap which allows linear excursions of 3 mm peak to peak.

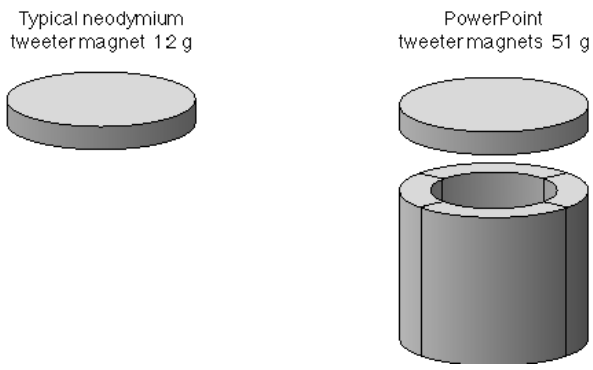
• To power the long magnetic gap to field strengths necessary for high efficiency, an unusual arrangement of a large, ring-shaped, radially magnetized neodymium magnet is used in conjunction with an additional disc-shaped neodymium magnet above the gap. The combined magnet weight of 51 grams is more than 4 times the magnet size usual in neodymium-powered tweeters.

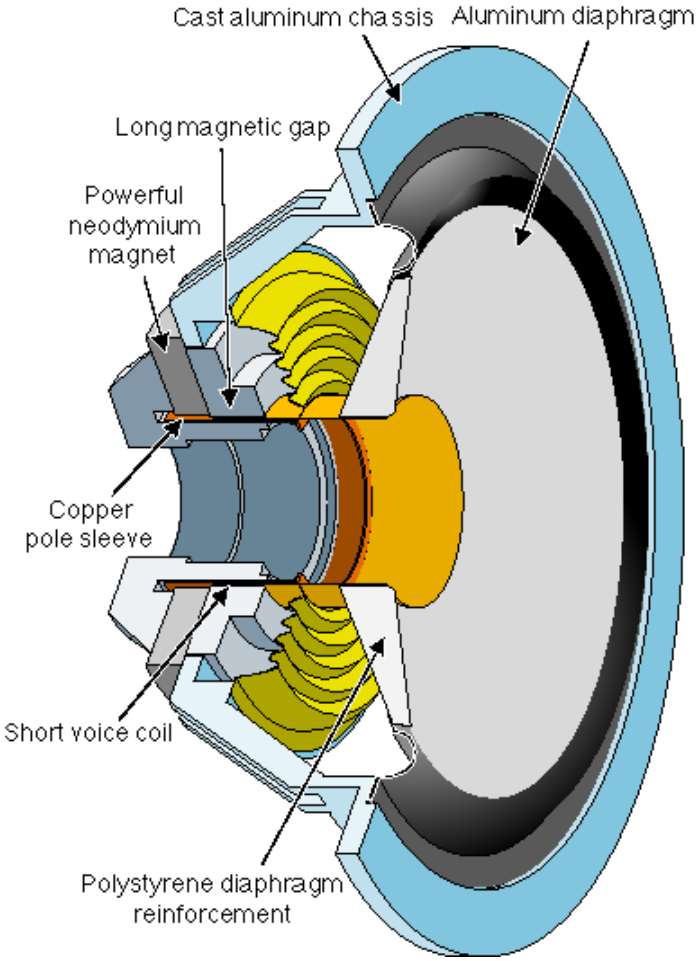
• Very long, linear mechanical excursion is provided by a unusual wide roll suspension that is molded of rubber rather than thermoformed of plastic so that it possesses low memory, reducing a subtle form of distortion termed hysteresis.

• In order to eliminate another subtle form of distortion caused by electrical currents in the voice coil former, Kapton is used for the former material. Since this material does not provide the mechanical stiffening of the diaphragm usually provided by an aluminum former, a diaphragm with a long shoulder is used that possesses its own stiffness.

• A copper sleeve is used around the pole to stabilize the strength of the magnetic field which reduces distortion, particularly at higher output levels, and reduces the coil inductance and therefore distortion caused by the nonlinear magnetic characteristics of the steel pole. Reducing coil inductance also extends the high frequency response.







PowerPoint 1.2 woofer

In addition to the already discussed feature of a shallow, reinforced aluminum diaphragm, the PowerPoint 1.2's woofer also incorporates several other high performance features. Among these are a very low distortion short coil/long gap motor system and a copper sleeve around the magnetic pole to reduce the distortion component of the voice coil inductance. (Please see our generic technical information paper for details of these techniques.)

Another unusual feature of this woofer is the utilization of a neodymium magnet instead of the usual ferrite. Since a fundamental concept of this product requires the woofer to be as closely adjacent to the wall surface as possible in order to eliminate wall interactions, it was necessary to make the woofer much shallower than conventional drivers. By utilizing neodymium which is ten times as powerful per size compared to ferrite, the woofer could be made much shallower than normal.

Measuring the PowerPoint 1.2

Since the PowerPoint is intended to be used mounted to a wall or ceiling surface, representative response will not be measured when the unit is in the free field or on a stand. It is suggested that measurements be taken with the unit placed on the floor.

The design axis is 45° from the wall surface, on-axis with the drivers. Since the unit is completely coaxial, representative results can be obtained with mic distances of only 1 meter.

Axially-symmetric (coaxial) designs can exhibit anomalies when measured directly on-axis. These are not representative of the response heard by listeners or measured with mic positions even slightly off axis. It is suggested that on-axis response be obtained by averaging several 5° off-axis measurements.

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