White Paper: Titanium Elite Speaker System

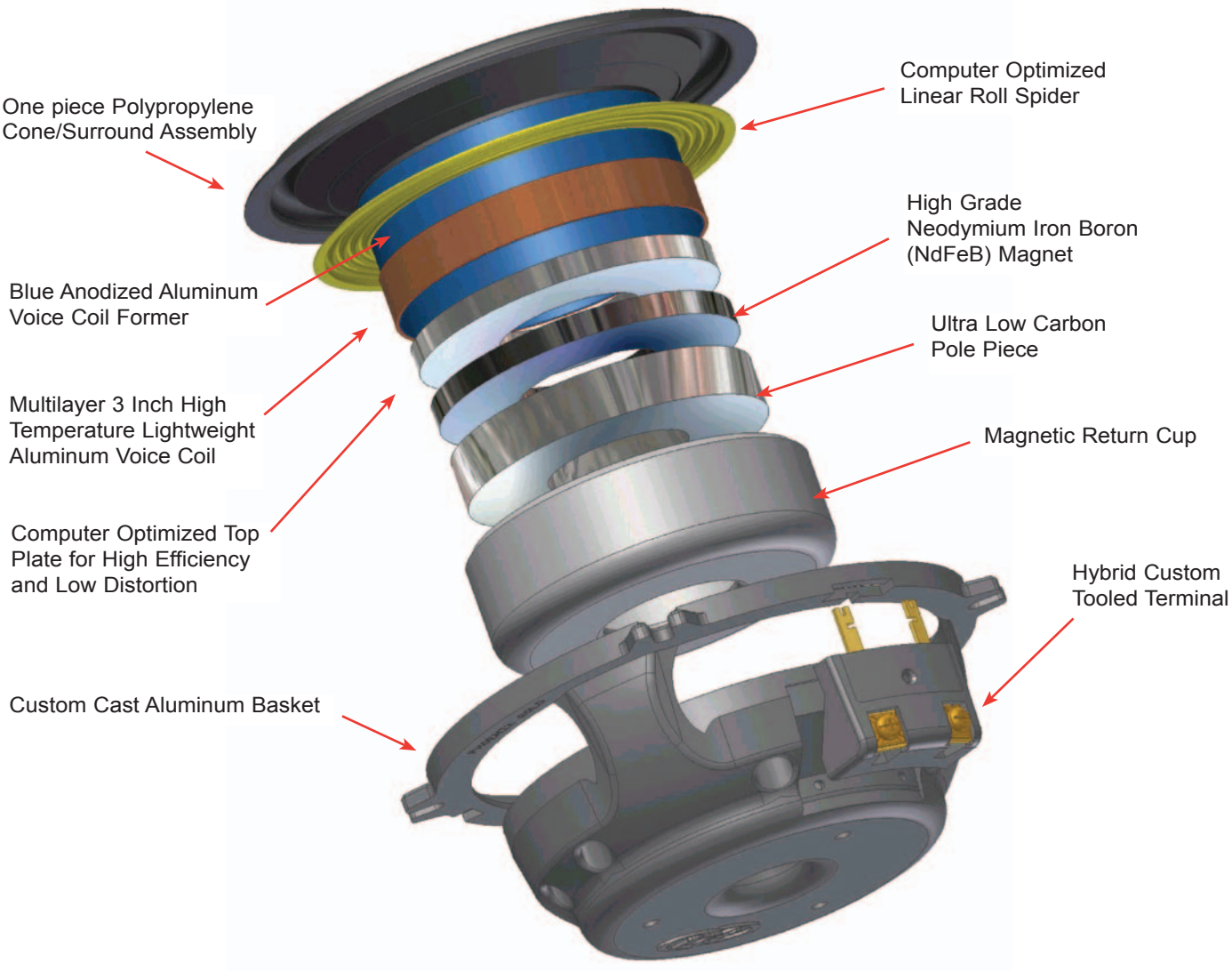
MODELS COVERED

-Titanium Elite 5 Component System
-Titanium Elite 6 Component System
-Titanium Elite 9 Midbass Driver

Three years ago, Phoenix Gold International set out to develop a car audio speaker that was unlike anything ever offered before. Our goal was simple: build the finest speaker available for an automobile today. If you want an entry upgrade from stock speakers then look elsewhere. If you want a speaker with the ultimate in sound and build quality ever available for an automobile then the Titanium Elite drivers have no equal.

Phoenix Gold Dealer Training Only

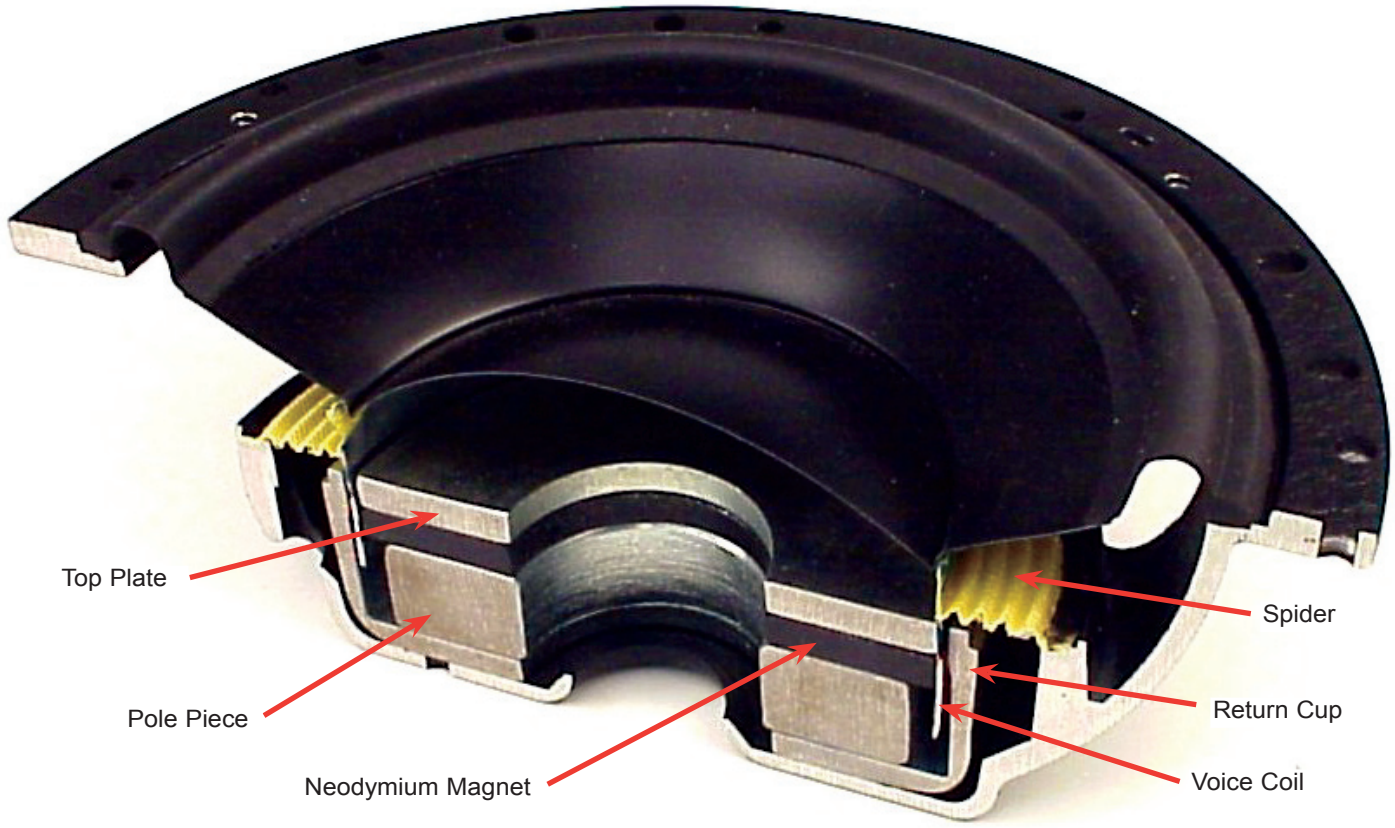
Titanium Speaker Anatomy



Computer Modeling:

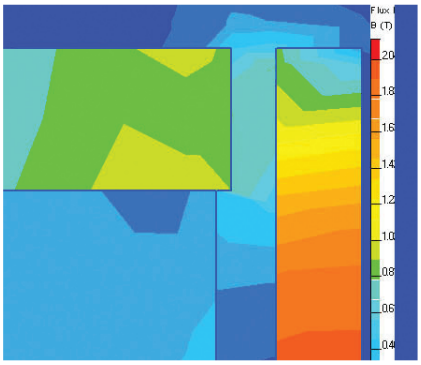
The Titanium Series is the first speaker series for Phoenix Gold that was completely designed and modeled inside of a computer prior to building any physical parts. Almost, every part on the Titanium Series was tooled from scratch; this allowed us to design the speakers without being constrained by off the shelf parts. The picture above is actually derived directly off of the solid model mechanical files that were used to tool the individual parts.

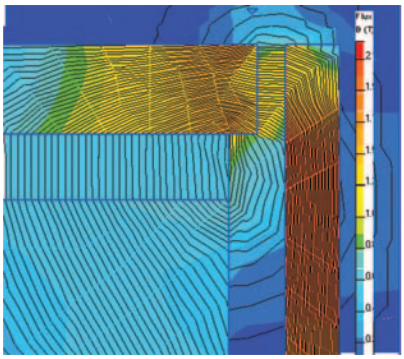
Once we have modeled all of the individual parts we can assemble them together into a completed virtual speaker to verify that we have no mechanical interference. Utilizing the mechanical constraints and modeled magnetic performance, a complete acoustical model of the loudspeaker can be calculated and evaluated all prior to building the first prototype. This allows the design engineer flexibility to play the "What If" game that would be cost prohibitive if building physical speakers.



What is an Inner Radial Design?

The Titanium Elite drivers use a revolutionary design in which the voice coil resides on the OUTSIDE of the magnet structure. This means that the Magnet and Top Plate assembly that are usually on the outside of the speaker are hidden in the depths of the voice coil. The advantage of this topology is that very large, lightweight voice coils can be used to drive the diaphragm assembly at its strongest point. All the Titanium Elite series utilize a huge 3 inch all aluminum voice coil to make an extremely lightweight assembly with lots of surface area for cooling. Also, all of the metal being in close proximity to the voice coil acts as a heat sink that sucks away thermal energy. This translates into higher power handing, reduced compression due to thermal drift and higher output levels.





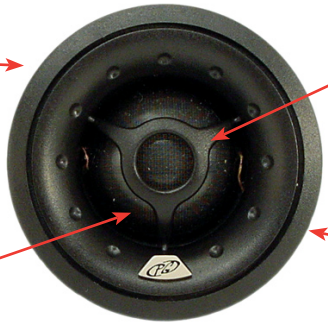
FEA (Finite Element Analysis)

Finite Element Analysis is a method used to evaluate the magnetic performance of a loudspeakers motor structure. The magnetic circuit is broken down in to very small finite sections so that the mathematical solution for the individual small sections is fairly easy. Utilizing computer simulation, all of the finite pieces are assembled and evaluated simultaneously until the complete bounded structure is solved. The resulting information is a model of the magnetic performance of the structure as a whole, derived from the sum of the finite parts. Shown to the left is an example of a graphical representation of the Magnetic Field Density in the Titanium Series Motor. The picture on the top shows a color representation of the field in the gap, the goal is to have the same color throughout the gap and also manipulate the structure so the color bands bloom on the top and the bottom of the gap the same. This assures that the coil sees the same motor strength on both the outward and inward stroke. The bottom picture is an example of the magnetic field lines as they pass through the air gap. The magnetic structure again would be modified to make sure that all of the field lines in the gap travel perpendicular to the gap surface.

Using this information the geometry of the return cup and top plate can be manipulated to give the best overall magnetic performance. This iterative process allows the design engineer to optimize gap geometries to improve distortion, power handling and over all efficiency. Finite Element Analysis can be used to model thermal, mechanical and magnetic systems inside of a loudspeaker. Every part used in the Titanium Elite series components was computer optimized to work in perfect unison with each other.

Titanium Elite Driver Information

Titanium Elite 1t Tweeter



Three key areas of the Ti1t Elite tweeter were optimized to give the ultimate high frequency performance:

1. The 28mm hand doped silk diaphragm was computer optimized to give a very smooth response in the pass band from 2000 to 20,000Hz. The breakup commonly associated with soft dome tweeters has been pushed above 20,000Hz well outside of normal human hearing.

2. Utilizing high grade neodymium we computer optimized the magnetic circuit to give the best efficiency possible and reduce distortion due to stray magnetic fields.

3. The integrated phase plug not only ties the whole design together cosmetically, it also contours the tweeters acoustical response for optimal in car performance. The phase plug has a channel in the under side of the mounting lip that allows the flush mount housing to completely hide under the flange. This allows the phase plug to sit flush with the mounting surface and provides a nice smooth termination for the housing. The result of this is improved in car performance because there is no gap between the tweeter landing and the door panel. This is a common problem with most car audio component tweeters.

Titanium Elite 5m / 6m

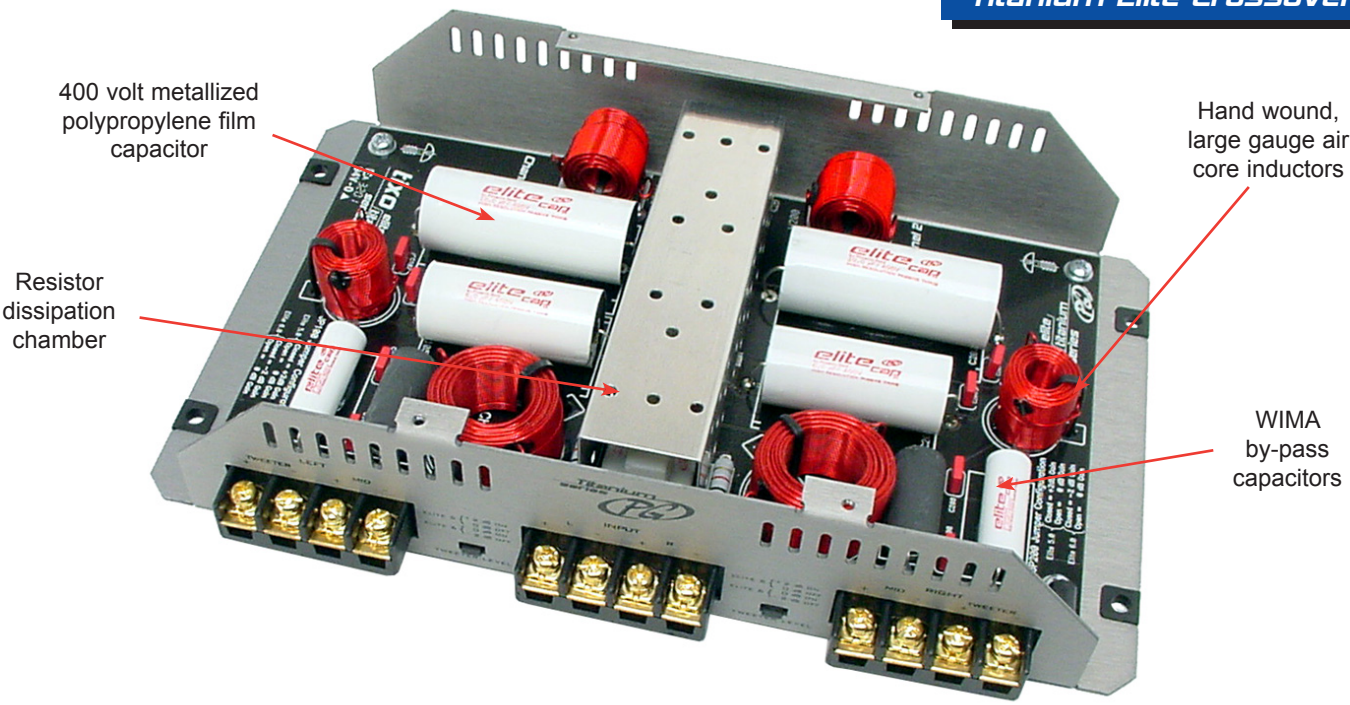
*Titanium 5m pictured

The Titanium Elite series midranges are design to give the ultimate acoustic performance in a small efficient space. By utilizing an inner radial motor structure we can "hide" all of the magnetic material inside of the voice coil which provides for a shallow mounting depth and greatly improved acoustical performance. The motor is designed around a 3" neodymium slug that sits inside of the massive 3" voice assembly. The return cup and top plate geometries were computer optimized utilizing Finite Element Analysis (FEA) to maximize magnetic efficiency and equalize the stray magnetic fields so that the magnetic gap is completely symmetrical. The result is a midrange driver with very low distortion and superb power handling.

Titanium Elite 9m

The Titanium Elite 9m is the pride of the Titanium Elite Speaker Series; it definitely shows off the advantages of the inner-radial design technique. With a mounting depth of just over 2.5", it is now possible to achieve truly great mid bass performance in the front of the vehicle. The return cup and top plate geometries were computer optimized utilizing Finite Element analysis (FEA) to maximize magnetic efficiency and equalize the stray magnetic fields so that the magnetic gap is completely symmetrical. The result is a mid bass driver with very low distortion and superb power handling all in a 2.5" mounting depth.

Titanium Elite Crossover



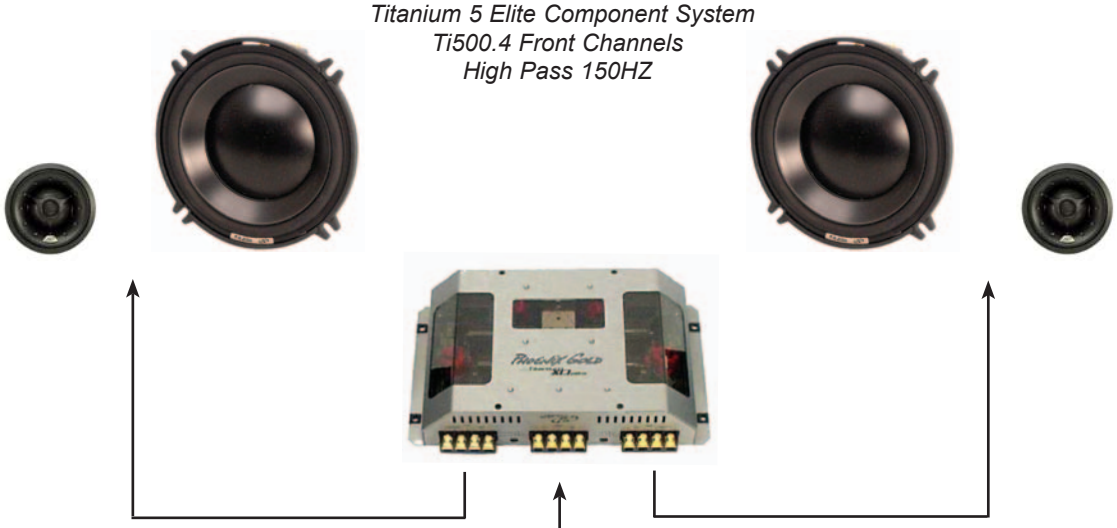
No expense was spared in developing the ultimate passive crossover network for the Titanium Elite series components. Utilizing state of the art computer aided design, the transfer functions for the passive networks were painstakingly designed to perfectly match the individual driver's acoustical response. Using 24dB per Octave acoustical slopes, the mid and tweeter blend perfectly to give a ruler flat frequency response. This is accomplished by using the best components available in the market place. All the inductors are a custom wound Bobinless air-core design with large gauge wire. The capacitors are custom manufactured to Phoenix Gold's specification at 400V rated Metallized Polypropylene Film with a very low .07% Dissipation factor.

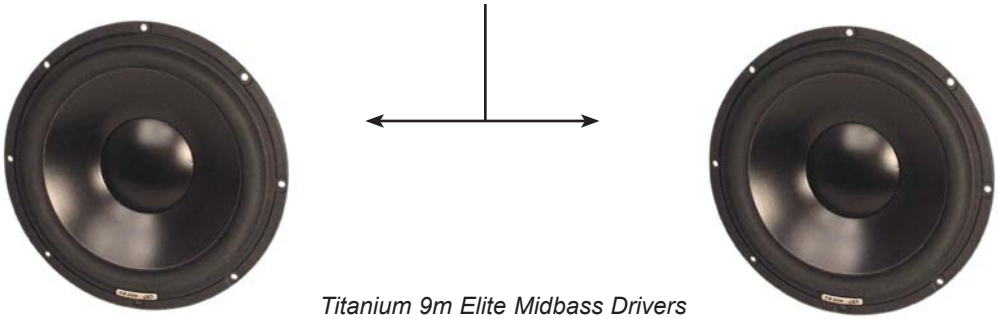
Utilized throughout the design are Wima ultimate low distortion by-pass capacitors for each component, this insures that the very high frequencies are carried through the absolute best components possible. In the center of the crossover is our exclusive dissipation chamber that houses all of the custom manufactured wire wound resistive components. The chamber acts as a cooling channel for all of the resistors and also insures that as the system heats, all the resistive components will heat in unison for improved filter characteristics at full drive levels. Also integrated in to the dissipation chamber are multiple blue LEDS that illuminate the chamber as the system is driven.

Titanium Elite 3 Way Speaker System

The example below illustrates how the Titanium 500.4 and Titanium Elite Speaker system are specifically designed to work together to achieve maximum speaker performance. The reason an active filter works perfectly between the Ti9m and the midrange is because both speakers are well within their pass band region. The idea is to set the crossover points where the frequency response of the individual driver is still flat for an octave on each side of the crossover frequency. This means that you can apply a symmetrical filter slope to each driver and expect them to blend smoothly. We recommend using either the Ti5 or Ti6 Elite Component sets in a three-way setup. In this example the Titanium Elite 5 Component system is powered by the front channels of the Titanium 500.4, set high pass at 150Hz. The rear channels power the Titanium 9m set bandpass from 40Hz to 150hz. Please note the electronic crossover in the Ti500.4 creates the bandpass filter for the Titanium 9m midbasses. The Tantrum 600.4 and 400.4 can also create this same bandpass signal for the Titanium Elite 9m.

Titanium 5 Elite Component System
Ti500.4 Front Channels
High Pass 150HZ





Titanium 9m Elite Midbass Drivers
Ti500.4 Rear Channels:
Band Pass 40 to 150Hz

Titanium Elite FAQ

What Titanium Elite speaker systems are available?

Titanium Elite 5 Component System: (2) 1t Tweeters, (2) 5m Midranges, (1) TXO Passive Crossover
Titanium Elite 6 Component System: (2) 1t Tweeters, (2) 6m Midranges, (1) TXO Passive Crossover
Titanium Elite 9 Midbass Driver System: (2) 9m Midbass

What is the "Elite" status all about?

Phoenix Gold has always been know for building the highest quality car audio components period. Our "Elite" status takes this to the next level. While our competitors are using ever cheaper materials and third party manufactures, we will not compromise the quality of our products. Any product branded with the "Elite" status signifies that this product has been engineered and manufactured with the finest materials and state of the art processes. The final product contains unbelievable reliability, performance, and cosmetics that has never been available from any car audio manufacture before.

Can I use these speakers in my home system?

Absolutely. These speakers can also be used in a reference home system.

The Titanium Elite 9m mounts in only 2.5 inches of depth. Is this right?

Yes. The inner radial design allows for the slim mounting depth. The Titanium Elite 9m will easily fit into the doors of most cars on the market.

Where are the Blue LEDs on the Titanium Elite passive crossover?

Two blue LEDs are located inside of the dissipation chamber. Their light intensity changes with the signal level of the music.

How much power do the Ti Elite Speakers need?

For best performance we recommend the following power ranges:

Titanium Elite 5 Component System:	75 to 250 Watts
Titanium Elite 6 Component System:	75 to 300 Watts
Titanium Elite 9 Midbass System:	75 to 175 Watts

Can I use an Active Crossover to for my Mid and Tweeter?

Because speakers do not symmetrically roll off smoothly at the required crossover frequencies, it is impossible to get an acceptable acoustical response utilizing the built in active crossovers commonly found in today's amplifiers. We only recommend using the passive network provided for best performance.

What took So Long?

Because this is the first project that was completely designed and modeled inside of a computer, it took a few years to become completely comfortable with the modeled results. Remember, almost every part on the Titanium Series was tooled from scratch; we all believe it was worth the wait.

Will there ever be a Three-Way system?

Yes, there already is a Three-Way system. We only recommend the Ti9m to be used with an active 24dB per Octave symmetrical filter between 150 & 200Hz. By using a Ti5 or Ti6 Elite Component set with the Ti9 Mid you by definition have a Three-Way system. At no point does Phoenix Gold plan on doing a Passive crossover for the Ti 3-Way system, the performance would not be as good as the active crossover.

White Paper: Titanium Elite Driver Specs

Titanium Elite 1t Tweeter

Flush Mounting Depth	1.125 in
Flush Mounting Hole Diameter	1.85 in

Titanium Elite 5m Midrange

Mounting Depth	1.95 in
Mounting Diameter	4.8 in
Overall Diameter	5.9 in
Optional Sealed Enclosure Size	0.02 - 0.05 cu ft

T/S Parameters:

Fs	73.6 Hz
Re	3.16 Ohms
Qms	1.76
Qes	0.4
Qts	0.32
Vas	5.46 liters
Mms	10.71 grams
Cms	436 uM/Newton
Vas	6.29 Tesla-M
SPL	90.2dB
Sd	94.34 sq cm

Titanium Elite 6m Midrange

Mounting Depth	2.2 in
Mounting Diameter	5.5 in
Overall Diameter	6.5 in
Optional Sealed Enclosure Size	0.04 - 1 cu. ft.

T/S Parameters:

Fs	62.2 Hz
Re	3.07 Ohms
Qms	2.13
Qes	0.4
Qts	0.33
Vas	10.24 liters
Mms	13.10 grams
Cms	500 uM/Newton
Vas	6.31 Tesla-M
SPL	90.9dB
Sd	120.76 sq. cm

Titanium Elite 9m

Mounting Depth	2.52 in
Mounting Diameter	8 in
Overall Diameter	8.78 in
Optimal Sealed Enclosure Size	0.1 - 0.4 cu ft

T/S Parameters:

Fs	46.3 Hz
Re	3.20 Ohms
Qms	2.51
Qes	0.53
Qts	0.44
Vas	34.10 liters
Mms	27.26 grams
Cms	434 uM/Newton
Vas	6.94 Tesla-M
SPL	87.9dB
Sd	236.42 sq cm

PHOENIX GOLD

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