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Only a few concepts are necessary to understand the rationale behind the Serendipity design. Far from a definitive solution to rely upon, we tried to give the listener a better illusion of "being there" in two steps:

1. Pulling out existing ambience information from standard recordings presenting them to the ears in a different manner never tried before
2. Greatly reducing the influence of listening room boundaries

Surround audio is of course the target to be hit but physical laws can't be broken. Some limits will ever last while our goal is bringing the original sound from *acoustical-purpose* large venue into *living-purpose* small rooms.

An ordinary well balanced recording contains a lot of ambience information hidden into the decaying reverberant field. Strong reflections of the same amplitude of direct sound convey the width of the original venue and are related to Spaciousness & Localization sensation.

But the ambience of the performance, the depth of the stage, the air among the instruments and the holographic illusion which are responsible for increased detail and focus are carried to the listener by long-term decaying energy, whose destiny is to die away blurred below the background noise.

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You could think you don't have any knowledge of it, but you promptly recognize it when it is missing because your ear-brain detecting system experiences a *flat stage* presentation, like it happens with low-bit rate recording (lossy format) or else with full-bit rate recording played trough a low definition audio chain. Well, what is missing is just the long-term decaying energy.

Because the ratio direct to reverberant sound can reach 60 dB it is necessary to employ speakers able of handling this kind of vanishing information.

Once we have at our disposal all the potential information from the recording what do we do with it ? We should try to envelope the listener with a sound field as close as possible to the original, even if it can't be fully done using spaced speaker-pairs to synthesize phantom images because the ear-brain processor soon recognizes the very low spatial resolution responsible for *Geometrical Representation Distortion*.

Furthermore if we forced the two front sources (left and right speakers) to radiate also the ambience signals, our brain would perceive an evident paradox by recognizing both direct and reverberant sound coming from the same point.

It is compulsory to spread the information over a wider area (such as a true multi channel array) to let our brain localizing a multi-direction distribution of the ambience signals (holding the above mentioned limits) . Of course at the same time we have to avoid a smearing of the direct sound for not to loose the front stage localization.

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Academy Serendipity is based on the assumption that a vertical array of sources with different frequency bandwidth, different gain and different group delay can act as a distributed source (i.e. the opposite of the pulsating sphere), generating at the listener's ears some cross-talk signals useful to enlarge the side perspective while keeping the correct localization cues.

To help Academy Serendipity in doing its job properly the design takes into account the frequency distribution of acoustic energy from Floor & Ceiling first bounce, by means of the proprietary WMT™ Alignment Xover configuration working together with the geometry of the Reversed Vertical Array. For the purpose it's useful to take a look at the Three Hypothesis on Perception fully developed at Chario Loudspeakers Psychoacoustics Lab in Merate (LC) – Italy.

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First Hypothesis on Perception

Floor bounce control vs. timbre coloration

Acoustical measurements on loudspeaker system are normally made in suitable reflection free environments. But in real life, the finite physical sizes of all domestic rooms actually change the speaker response, and this in turn heavily modifies the listening experience. Since we face a great variety of speaker/room/furniture combination, any computer aided simulation can't tell the exact story of the reproduction, limiting our overall knowledge of the listening process to a mere picture of energy equilibrium within the living room. Updated psychoacoustic models are powerful but still incomplete and can provide us with good results only when the acoustical event is under fully control. Now, because any floor standing system keeps the distance from drivers to floor unchanged (disregarding its placement) we can think of this as a well controlled event. So, if one knows the distance between the speaker and the listening position it is easy to compute the interaction with the early reflection from the floor. Assuming by default that any other reflecting surface is far one meter away at least, the first arrival of energy from the floor can be taken under control by means of the right choice of cross over topology together with the vertical array of the drivers.
This type of interference is mostly harmful because the listener is aware of both a loss and an excess of energy within a frequency band an octave wide. Unfortunately, this frequency span is very close to the piano centre-octave and in general to the set of fundamental musical tones more recurrent in the western music compositions. The "musical octave" relationship between the dip and the peak implies a dramatic timbre alteration of the complex tone generated by the sound source because of the incremental difference of almost 10 dB between the fundamental and the second harmonic of the power spectrum. To some extent we could say that the speaker plays an altered version of the original tune

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Second Hypothesis on Perception

WMT™ Alignment for energy control vs. image shifting and early reflections

The WMT™ Alignment is a Chario Loudspeakers proprietary configuration for energy control of Woofer, Midrange and Tweeter. The three drivers don't merge in a classical manner by the superposition of three distinct frequency intervals, instead they work together within the octave from roughly 800Hz to 1,600 Hz where the saddle in the woofer-tweeter response is filled up by the midrange contribution. This proprietary crossover topology let the designer to "modulate" both amplitude and phase of the three sources to achieve a target energy envelope for out of axis control radiation in order to keep the early reflection field as close as possible to the direct field for a wider stage presentation.

WMT™ Alignment rely mostly on the fact that sound source localization on vertical plane is somewhat reduced within the 800-1600 Hz frequency span due to the smooth transition from phase difference to amplitude difference cues. This specificity of human perception can be exploited to allow a simultaneous energy radiation by three or more vertically aligned drivers covering a narrow bandwidth. Our brain will recognize the three sources as if they were just a single one , giving it an "apparent vertical size" of the whole array. This psychoacoustic performance is very useful in eliminating image shifting of fast varying spectrum audio signals and related spatial-jittering of the perceived stage.
By means of the WMT™ Alignment it is also possible controlling the downward energy emission with a substantial level reduction of the floor bounce. It is a "de facto" reduction of reflected energy around the frequency span of maximum ear sensitivity. The psycho acoustic effect from the listening stand-point is recognized as greater detail and transparency at middle frequencies without ruining both timbre and stage depth by unnaturally raising their level.

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Third Hypothesis on Perception

Original recording venue ambience vs. equal loudness contour

Musical instruments can produce sound levels as high as 140-150 dB SPL. However this huge amount of energy is not available for ordinary home listening because of two main reasons:

1. Small rooms are very fast saturated with level increase
2. High Resolution/Correct Timbre/High Level Reproduction can't be allowed at the same time by currently available electro-acoustic technology.

Therefore it is reasonable to take as the upper limit of feasible domestic sound level the figure of 110 dB SPL during a fortissimo passage(fff). Moreover any domestic environment is affected by an almost constant background noise of around 45-50 dB SPL all day long, so the actual signal dynamic range is not greater than 60 dB (the difference between 110 and 50). It's not accident that the same figure of 60 dB is the reverberation decay of any closed space. If we consider the recording venue, any signal captured by the microphone array after the direct sound from the source(s) is recognized by our auditory system as the "identity card" of that space which adds "warmth and spaciousness" to any playing musical instrument. The correct reproduction of these extremely weak signals is useful for recreating in the listening room the "ambience effect" i.e. the illusion to be seated within the original recording venue. We know our auditory system works in a very complex manner and - among the other things - it changes its sensitivity response according to intensity and frequency content of the sound. If the system frequency response is modelled around the Equal Loudness envelope of 45-50 phon then it will be able to correctly reproduce the recorded ambience signals by simulating the auditory sensitivity before the background noise becomes dominant.

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This procedure is not dissimilar from the "Spatial Equalization" introduced by other researchers at the recording stage. This unique feature is also useful in reducing the intrinsic paradox of music reproduction throughout loudspeakers. When we attend a musical performance in a closed space our ears are concerned with two acoustical fields:

1. The direct field coming straight from the source
2. The reflected field coming from all directions except the front path

Now, when listening to a musical programme throughout a loudspeaker stereo set up, our auditory system has to cope with a strange acoustical event for which both direct and reflected energy arrive from the same locus of points in space. This physical paradox makes the auditory process confused, so our brain is forced to concentrate itself toward the source, switching on the "intentional listening behaviour" i.e. focalising more attention to the sound characteristics than normal.
If the ambience information are reproduced by a loudspeaker system whose frequency response is more linear or perfectly linear our brain will be too much sensitive to middle frequencies and the stage collapses between the right and the left speaker missing both depth and width. Luckily, the ear-brain loudness contour becomes increasingly linear at higher reproduction levels and this counterbalances almost perfectly the dynamic losses at low frequencies due to thermal, mechanical and inertial limits of the subwoofer, hence keeping the correct performance up to the highest sound pressure levels.
Each Audiophile has of course different taste and different musical expectations as well, and last but not least, different outer-ear and pinnae structure. Nevertheless we encourage your critical listening at any level to confirm this theory.

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Data Sheet

Low Frequency Load	NRS 2π sr Vented Isobaric Compound
Vent Geometry	Bi-dimensional Hyper-Exponential Hourglass Type
Configuration	5 way Reversed Vertical Alignment Floor-Standing
Drivers	1 Tweeter 32 mm SILVERSOFT™ dome NeFeB motor 1 Midrange 130 mm ROHACELL® Poly-Ring NeFeB motor 1 Woofer 130 mm ROHACELL® Full-Apex™ Poly-Ring NeFeB motor 1 Woofer 170 mm ROHACELL® Full-Apex™ Poly-Ring NeFeB motor 2 Sub 320 mm Natural Fibres - 2 Waves Surround HF motor
Sensitivity	93 dB SPL normalized to 1m with 2.83Vrms de-correlated L/R pink noise within IEC 268-13 compliant listening room
Low Frequency Cut Off	23 Hz @ -3dB referred to C_4 WETS
Overlapping Points	240/500/1250/1850 Hz (See plot)
Rated Impedance	Modulus 4Ω (min 3.0) Argument ±36°
Size	1610 x 400 x 580 mm (H x W x D)
Weight	100 kg

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Cabinet	Solid walnut or solid cherry and HDF. The structure is made up of two cabinets: the lower, containing two subwoofers and the upper, containing two woofers, one midrange and one tweeter. The two wooden structures are separated by means of four cylindrical proprietary-engineered elastomer puffers which act as vibration de-couplers dissipating mechanical energy by orthogonal elongation
Speakers orientation	The speakers should be tilted inward facing the listener
Listening distance	Optimum speaker-listener distance is within 3.5 - 4.0 m
Listening layout	A carpeted floor in front of the speakers is recommended
Side and Back walls	Should stay 1 m away from the speaker front baffle at least
Suggested Amplifier	
Normal amping	Rated for 400 W/4 Ω Average Power Max Run the cable from your power amplifier to the lower terminals of the subwoofer binding-post, then connect the upper terminals to the binding-post of the mid-high unit by means of the banana-plug terminated short cable, delivered with the speakers.
Bi-amping	Rated for 200 W/4 Ω Average Power Max Run the cable from your power amplifier to the lower terminals of the subwoofer binding-post leaving the upper ones idle. Do the same to connect the power amplifier to the binding-post of the mid-high unit (two terminals only)

Notes

1. All quantities in SI Units
2. Average Power computed as V^2_{rms} / R
3. Overlapping Points is a proprietary implementation for unconventional X-over
4. Specs subject to change without notice

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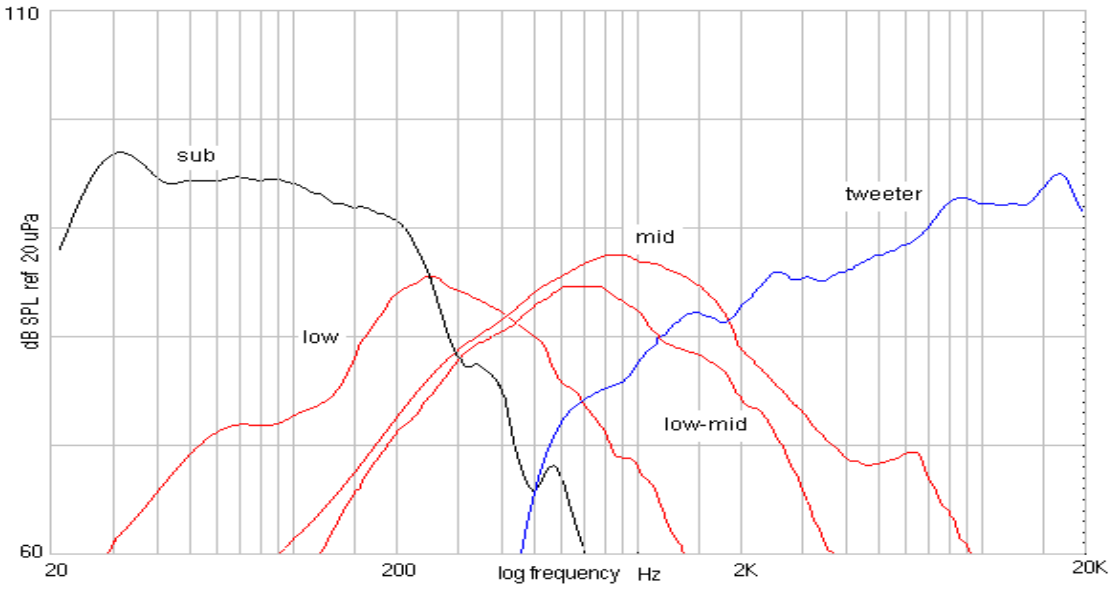
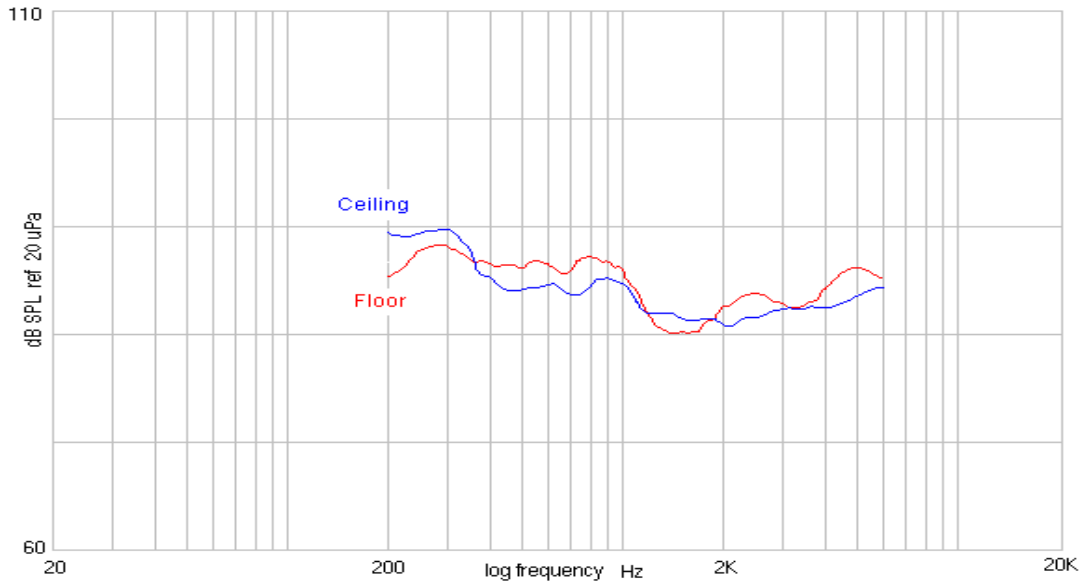
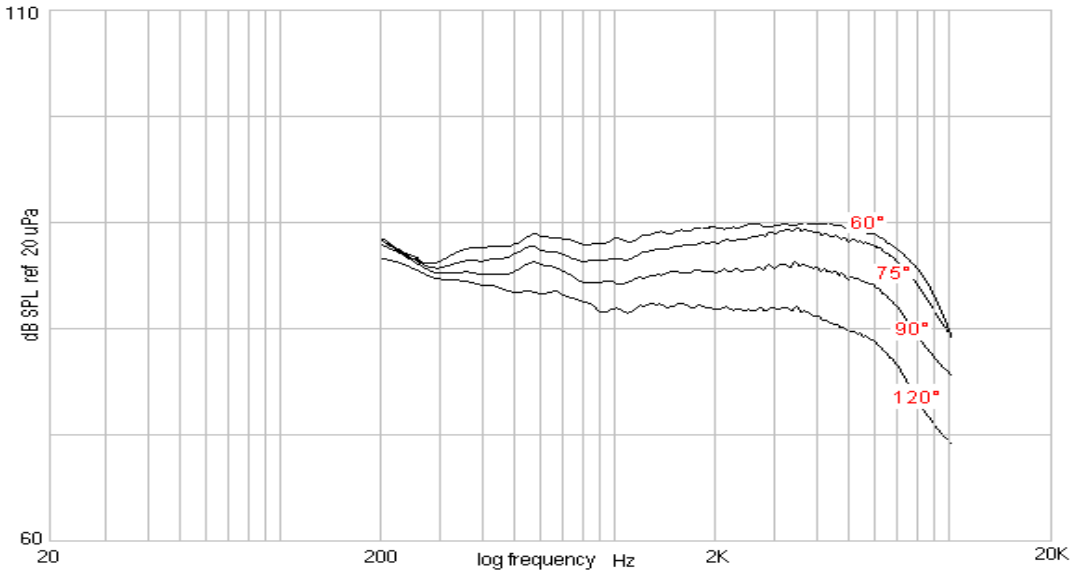
Frequency response on axis & Psychoacoustic compensation



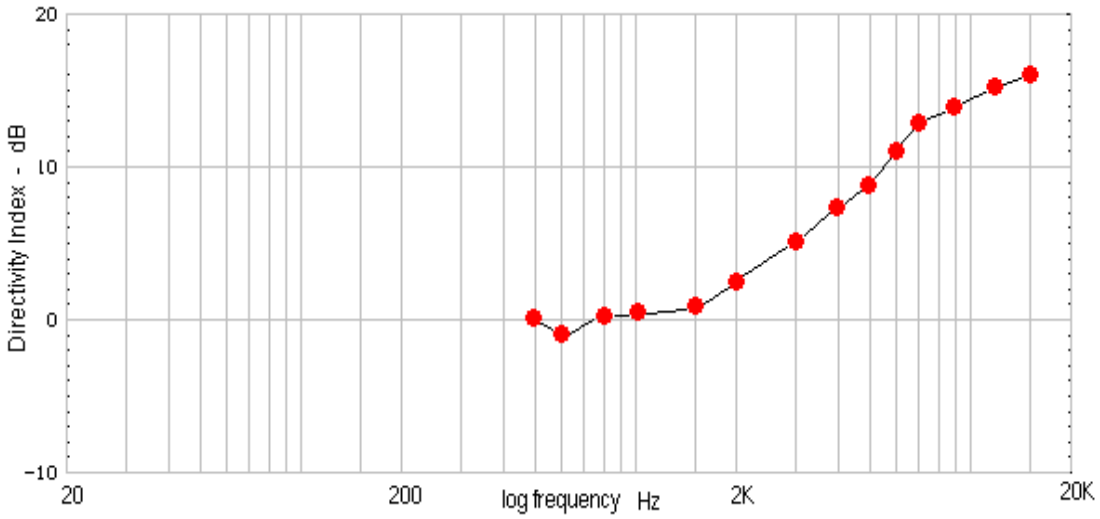
Single driver response on axis - WMT™ Alignment & Overlapping Points



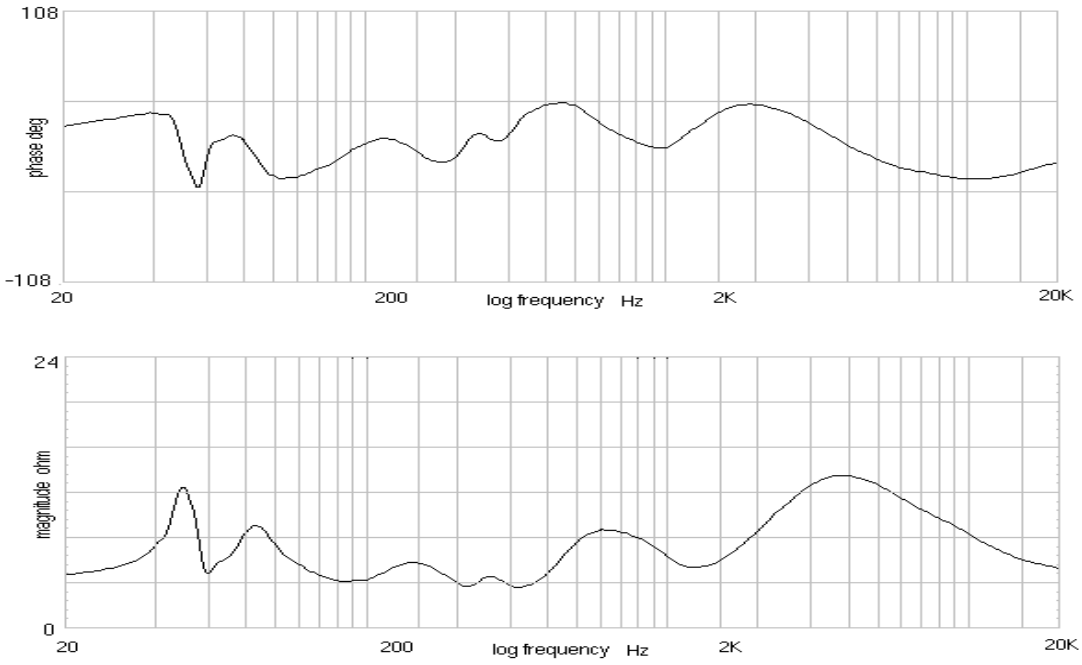
First Bounce – Sagittal Plane Decorrelation



Coherent Radiation on Binaural Plane – Lateralization Cues



Horizontal Directivity Index – Front Stage Localization



Impedance Modulus & Argument

Subwoofer WBT Binding Post – Low Res & Tight Contact

Mid-High WBT Binding Post – Low Res & Tight Contact

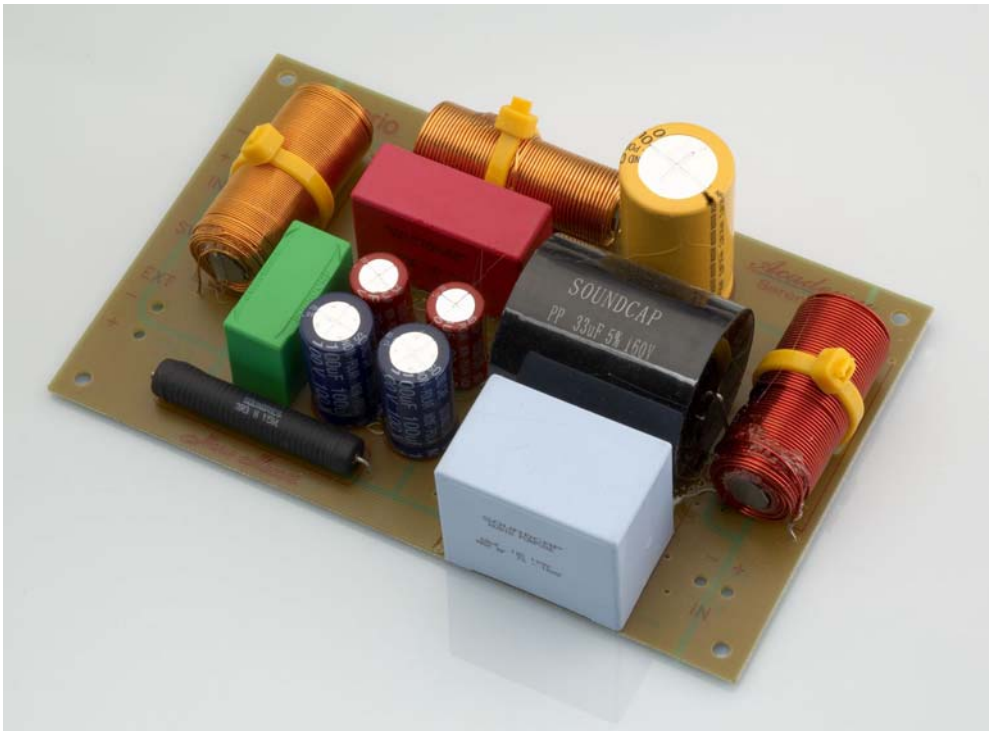
ROHACELL® Full Apex™ Diaphragm - Break-up Control

ROHACELL® Diaphragm & Phase Plug – Midrange

Poly-Ring Neodymium Magnet – No Power Compression

T32 SILVERSOFT Dome Tweeter – High Frequencies Coherence

Mid-High Xover – SOUNDCAP™ High Grade Capacitors & MIL Resistors



Low Xover – IRON POWDER Cores & HIGH Q Inductors

Subwoofer ISOBARIC COMPOUND & 2 WAVES SURROUND