The Avalon Eidolon Diamond

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'Perfectly Faceted Sound Reproduction' (and ultrasonic tweeters)

As one of the most perfect three-way speaker systems for the size and price, the Avalon Eidolon continues to represent something of a pinnacle in development at Avalon, building on an earlier line of highly respected models which reach back some two decades.

Many strands had been successfully woven together in producing the Eidolon. First there was an accumulation of experience in both system design and enclosure technology, the latter relating to acoustic diffraction and stereo image formation, these controlled via favourable external geometry. Important developments in drive units held the promise of higher sound quality. There was also that dogged determination to seek new standards for refinement, for imaging and perspective and for a natural yet extended frequency range sound. Lifelike, unexaggerated dynamics were important while other aspects included the precision of the time envelope, the proper integration of the driver outputs and appropriate low frequency tuning. These factors working together had to be sufficiently accurate for the speaker to accurately define tempo and be able to construct convincing musical transients.

This approach to quality on absolute basis is nonetheless contained within a relatively modest scale. The Eidolon may be a substantial speaker - over a metre high and some 85 litres in overall volume - but it's not in the monster class. It is relatively tidy for a high-end design and offers realistic if not ear shattering dynamic ranges.

Introduced in 1998, the has Eidolon made a name for itself, in particular where musical expression was valued more than outright exuberance or loudness. Highly recommended in 2002 it won the top HFN loudspeaker award for 2002-03.

Avalon owner/designer Neil Patel has had the original Eidolon objectives firmly in mind while working on a rather larger flagship. Nevertheless a question was put to him. 'Was there scope for another Eidolon, a speaker which would reach even closer to Neil's idea of perfection yet still be presented in this relatively tidy format?'

The emergence of a new tweeter design by German maker Thiel Accuton, the same company that builds the excellent inverted dome unit of pure ceramic already used in a number of Avalon designs helped Neil make up his mind.

Tweeter designers aim to control resonances in their radiating

diaphragms. With soft domes the route is through the shape of the dome, the choice of fabric or membrane and often the use of special damping layers. Such devices are in resonant breakup over most of their operating range but this inherent behaviour is sufficiently suppressed. For hard domes they try and make them so tough than the inherent severe resonances are pushed beyond the audible frequency range, in theory out of harm's way. Early metal dome tweeters had a resonance peak between 15 and 20 kHz and were audibly 'grainy' sounding. Superior examples today often put the resonance, which can be a lively 20dB high, at frequencies above 25 kHz. Some acute eared individuals may still be bothered by this behaviour especially directly on axis.

On the subject of extended high frequency response, some speaker makers strongly promote this bandwidth feature out of considerations of possible signal output beyond 20 kHz for certain DVD A and SACD issues. Ironically the bandwidth of many such releases is not significantly wider than CD. For extended reproduced bandwidth to make any sense, we need to know whether we can hear it if it's provided, and that the expense of a technical reproduction of the 'ultrasonic' band is judged to be effective for the purpose. It's no trivial matter to design a tweeter to operate smoothly even to 20 kHz, and the difficulty increases almost exponentially with further increases in frequency. You are up against power loss due to increasing damping, both mechanical, and electromagnetic power transfer loss due to rising electrical impedances, plus critical losses in structural rigidity for the radiating component. Not least, such broad-band tweeters often suffer from poor uniformity of phase and directivity with frequency.

Taking that last point, it's not just the axial or frontal frequency response which matters since this only represents a signal directed down a single line to the microphone or listener. If the output in the high range is to be useable, it should have a radiation angle not too dissimilar to the angle carefully designed for the lower, dare I say audible frequency range? Maintaining a wide radiation angle and good power response generally requires a reducing device diameter with increasing frequency.

If a 25mm diameter dome tweeter is judged to be the largest practicable for a reasonable radiation angle at a nominal 20kHz limit, if properly scaled, we now require a tiny 10mm dome for an equivalent performance at a proposed new limit of 50kHz. Sony has been exhibiting a 100 kHz reproduced bandwidth with some speaker demonstrators that by rights ought to have a tiny 5mm dome. In fact the larger unit actually used results in laser-like sound beaming.

Just one of these problems is enough to put most designers off. In addition these smaller tweeters are quieter, i.e. less sensitive, and we cannot make them loud enough to match a good average sensitivity, e.g. 90dB for a watt. Thus impedance is often sacrificed for loudness. So in

addition to the numerous acoustic defects the ultrasonic capable speaker often has a vicious turn of impedance beyond 20kHz, of the kind that generally makes amplifiers sound worse and in some cases, become unstable or even burn out. These considerations nevertheless lead back to the idea of a putative 'Super' version of the Eidolon.

It turned out that the new Accuton tweeter proved to be the catalyst in creating an advanced Eidolon. It is made with a pure diamond diaphragm, painstakingly vapour deposited, crystal layer by crystal layer. At first it wasn't certain whether any benefit would be audible with the new model. In theory the relevant mechanical behaviour issues for the existing high performance 25mm ceramic dome and the new 20mm diamond tweeter were in any case well above 20 kHz and could be expected to be inaudible. However extended listening tests showed the diamond version to sound sweeter and clearer, more like a good electrostatic, and this seeded the design process began at Avalon.

The small size reduction to 20mm may engender a little more 'air' in the sound, slightly wider directivity at 20kHz, but the real reason is suspected to lie in the greatly increased stiffness which results in a first departure from pure piston operation at a doubled 80kHz frequency compared with still excellent figure of about 43kHz for the Eidolon ceramic equivalent. The diamond diaphragm has five times the critical stiffness to mass ratio than the best ceramic. Taking into account voice coil size and mass this results in just about a doubling of the first resonance to an amazingly high 85 kHz.

Even if the actual resonance frequency is too high to be audible, when such signal frequencies are present in the overall operating range the increased amplitude of motion can result in some distortion, of which the difference tone products may then be present in the audible range.

By greatly increasing the prime resonance frequency, distortion is measurably improved because there is much less energy present at these higher frequencies. The difference products now also tend to higher frequencies, beyond audibility. Hence in my view, the potential for a sweeter, clearer sound.

Just changing the tweeter would have improved the Eidolon but the proposition inspired further research. Admirable though the mid range is for the standard version, the upper mid, viewed critically, could be heard as a tad clearer and more explicit than the lower mid. The mechanism is a subtle one and is partly due to masking effects and partly to added signals, and is not necessarily coloration per se.

The loss in definition, and in wholly natural tone colour, is associated with mild and generally normal levels of distortion from the bass drivers. The 270mm unit operates up to 500Hz or so and has the usual distortion

content of up to 0.5%. When reproducing the working band, e.g. the low or fundamental part of the mid range, its main harmonics, i.e. second and third are typically voiced into the mid range. Thus a 300Hz note from the woofer also generates low level tones of 600 and 900Hz, precisely where the very low distortion ceramic mid driver operates.

Avalon worked with bass driver supplier Eton to formulate a new motor design for the Diamond woofer, with substantially reduced distortion. The resulting improvement in mid range overlap 'sound', despite no change to the cone, and a very close correspondence of electro-mechanical parameters, was so great that complete system realignment now became essential. Add in improvements to internal cables, to crossover components, and to internal acoustic damping, and the result is rather more than a mere evolutionary upgrade for the new Diamond edition.

The main detail and philosophy for the Eidolon is comprehensively covered in the published HFN review and essential details of its specification remain unchanged. This three-way system is founded on a 75 litre internal volume for the 270mm bass driver. A slim but deep design, this latter driver essentially sets the maximum width towards the base. Prismatically faceted, the clean edged form continues to taper towards the mid range and up to the tweeter, firmly controlling unwanted edge reflections and helping to maintain more constant directional off-axis response over the frequency range. Especially effective at mid and higher frequencies, the acoustically designed grille incorporates a dense felt liner with a contoured shape, and it further reduces edge reflection. It also vitally contours the power response of the drivers.

Avalon Acoustics Eidolon Diamond

As a result the speaker may not be quite as loud as it might be but the forward output will have exceptional coherence, a factor working well in conjunction with low energy storage and an accurate tonal balance. Such technical detail is vital for the formation of the most focused and revealing stereo images. Reflex tuned, the bass port is concealed below the speaker and is silent in use. Again concealed, the single wire

connection is also below, not too convenient for trying out speaker cables, and is made via heavy duty screwdriver slot terminals with the shortest possible path to the crossover.

The enclosure is supported on three heavy duty cones, pointed and tapered, milled out of stainless steel.

The mid is a naturally pistonic 90mm concave ceramic driver with resonance damping geometry to quieten the behaviour above its intrinsic working limit of 12kHz, well beyond the range used here. A high power oversize voice coil drives the pure alumina, ceramic shell diaphragm. High current ultra rigid selected cabling is used inside, hard wired throughout to the hand-built crossover network, which has short path, point-to-point connections. Inside the enclosure looks like a cathedral roof with many beams and cross braces. These and the dense 150mm thick laminated driver panel holds the structure firmly. Damped bracing is applied to the magnet of the bass driver for increased dynamic stability. The whole is built with great integrity and strength to provide a platform for the driver to accurately launch their contributions to the radiated sound.

The Test System; Loudspeakers ; Avalon Eidolon, Quad 63, BBC LS3/5a, 15 ohm Spendor SP2/2. Amps; Krell FPB 700cx , Naim NAP250, Hot Tubes JD1 . Preamplifiers included for reference grading included the ART -2, Spectral DMC-15, and XTC PRE II and Audio Synthesis Passion. Linn LP12-Lingo -Naim ARO /AN IO II/ ANS-4, plus Marantz CD-7 and Naim cds3 comprised the sources. Cables were Cardas Gold Cross and Gold Reference, Wireworld Equinox 5 and Transparent XL series, the latter including the speaker cable. Items were supported on Finite Elemente stands with extensive use of SoundCare SuperSpike captive spikes to the hardwood floor.

Sound quality: I was fortunate to be able to change over from the standard Eidolon to the Diamond version in short order. Early findings and comparisons were then put on file and this new, factory burned-in example was given more still time to recover its thermal and mechanical equilibrium following its importation from Boulder Colorado.

Work then began to fine-tune the speaker placement and the matching system. Right away, the Diamond showed its mettle by ruthlessly mastering my reference system revealing unsuspected flaws and imbalances. This was cutting edge performance and the work undertaken in rebalancing the system proved most worthwhile.

Given that the standard Eidolon is one of the most natural sounding, revealing and transparent speakers made, the gain shown by the Diamond is an order of magnitude. However at first the Diamond sounded tense, hyper controlled even dry, and certainly a touch acidic. Gains in fluidity and integration were abundantly clear after it was fully run- in

[over 200 hours].

The Diamond emphatically does not sound like the standard Eidolon even though there are fundamental similarities. It's as if the designer has allowed the subtly differing ingredients of each version to bloom in the most musical way. Those differences have resulted in a significant overall change in character. It's a bit like colour temperature, the standard model by comparison is more like tungsten illumination while the Diamond veers towards a more sunlit balance.

Comparing the two Eidolons, it may come as something of a surprise to find that what you hear first is not the diamond tweeter, but the substantial improvement in lower mid range clarity, which when viewed in isolation was not a noticeable problem with the standard Eidolon. By comparison the Diamond clears away what can now be recognised as a degree of thickening, masking, if enriching bloom. Bass attack, differentiation of timbre, tune playing, timing and spatiality are all taken to a still higher standard. Paradoxically, another effect of this clarity is a perceived gain in bass extension. The speaker appears to go deeper, with purer more focused deep bass sound. I am certain this is all to do with the design target, a substantial lowering in harmonic distortion from the bass driver.

The mid range proper now sounds freer and faster, if a touch more clinical, less kind to forward sounding amplifiers and programme than the standard model. The Diamond is like a racing machine - it goes faster, has more precision, but demands greater support from the track, the driver and the team. Because the Eidolon treble is already so fine, you find that you have to let the quality of the Diamond treble grow on you. It demonstrates an astonishing grainless purity and has the ability to construct timbres in the treble in a manner which you usually demand from a fine mid range driver. Like the Eidolon, Diamond treble is never obvious or exaggerated. Sure it reproduces distortion in sources but without drama. It doesn't ring or fizz on spurious sounds, in fact sounding very like a top class electrostatic in this respect. Its rendition of vocal sibilants is well nigh perfect.

Finally, before leaving the standard Eidolon behind, I must mention that stereo focus and depth are even better with the Diamond version. Width, depth, and overall focus are exceptionally fine with the upgrade.

I moved house during the evaluation and the two listening rooms involved showed different virtues. The Diamond had been doing well in the old room but happily adapted to the new, despite a considerably livelier acoustic. If anything the sense of spaciousness and image depth is now even better, while the bass is significantly more even, if perceptibly dry; this for example, noted by comparison with the more ample bass of recently reviewed Sonus Faber Stradivarius, another fine example of the

art.

The Diamond dictates terms and takes no prisoners, but as the micro tuning and the balance of cable, platforms, support and placement settled down, so musical harmony was attained. Quite simply the Diamond is addictive. It constantly reveals much about the music, from top to bottom; so much about expression and rhythm, about micro and macro dynamics that the results can often be breathtaking. Like the standard model it's not a powerhouse; it will play realistically loud with substantial power amplifiers but it's not been designed to shake the walls of your house. Instead, it aims to stir your soul.

Over many months of use, every minute with the Diamond has been a special pleasure. I haven't yet managed to revisit all my collection, but I'm playing more vinyl than ever before. Reaching deep into the source the Diamond conveys more of the inner glow, the spatiality and the atmosphere of great performances. All that the standard model achieves has been used as a building block for the Diamond version.

Returning to the bass, here the Diamond is wonderfully articulate and transparent, transcending the usual expectations of a wood based box energised by a tardy heavy piston. I had long suspected that the accepted levels of residual distortions at low frequencies might be an issue with very good speakers. Convincing proof of this is provided by the revised woofer used in the Diamond. The gains in bass resolution and clarity are not trivial while low frequencies sound freer and more powerful without sounding out of balance.

Like the standard Eidolon the Diamond has that uncanny inner tonal balance which means that it sounds neutral and clear at a wide range of sound levels, without needing to be wound up before it becomes detailed or interesting. Even more than with the standard model, leaving the Diamond's grille off really upsets the design. The tweeter is left sounding exposed, the mid uneven while the stereo focus is substantially degraded. In place, snugly aligned with the front baffle and driver outlines, the whole is mellifluously blended. The design has certainly been voiced with the grille in place. I also use a second grille with the cloth only deleted, for a touch more transparency. Complementing the crisp, dynamic and highly detailed mid range, we have the new tweeter which is never obvious - you just never hear it working per se. It simply adds the required airy harmonics to the mid range without ever getting in the way.

I commented that the standard Eidolon was one of the best timed, most upbeat three-way speakers made; when appropriately driven it was capable of revealing satisfying syncopation in complex rock and jazz material and maintaining the sense of life and energy in classical works. I can report that the Diamond is faster, still better defined on percussion transients, making it easier to follow complex pattern rhythms. It teaches

you deeper levels of rhythm more clearly, magnificently defining counterpoint and the well judged ensemble playing which can accompany it.

Stereo images are significantly wider, deeper and more focused than the standard model - really exceptional. I have found this aspect to reveal astonishing differences between different grades of amplifier and signal source. In this respect the Diamond can be ruthlessly analytical. An accurate tonal balance and very low colouration ensures that image perspective is stable and convincing, while tone colour is consistently natural throughout the range, faithful to the recording and instruments.

Amplifiers of up to 500W are fine with it. I have known still larger amplifiers to be used, for a sense of greater ease on big classical climaxes, but they must certainly be used with care. Its moderate sensitivity of 87dBW means that amplifiers less than 80W/ch are not really worthwhile. Successful combinations have included the two biggest Karan Acoustic models, the Krell FPB 4000cx and 700cx and perhaps for me, the most successful has been the comparatively modestly priced Conrad Johnson Premier 350SA.

With that potential for hyper analytical focus, the listener may suffer an increased awareness of accuracy of head location. The classic theoretical issues for the stereo medium of perceived inter-channel phase differences due to small differences in speaker distance are spot lit by the Diamond's exceptional time and phase accuracy.

And there's more to tell. With prolonged use, you realise this speaker has neither the deepest bass nor the widest dynamic range and maximum loudness for its class, but it does have an excellent resolution of dynamics right across the dynamic range. It reveals loudness contrast at whisper quiet levels, yet magically holds on to the low level micro-detail while the major themes roar in. It's hard to convey just how satisfying this becomes. Substitute another reputable speaker and you feel like your hearing has undergone a serious accident!

Lab report: Measuring very like the standard model I didn't have a mic capable of reaching beyond 40kHz, I so wasn't able to confirm the upper limit for the tweeter, said to be effective up to 60kHz. Here output continued smoothly tapering down to my mike limit.

Sensitivity was within 0.5dB of the 87dBW spec and though I would swear the Diamond sounded a bit louder than that, perhaps it was just the psycho acoustic effect of the extra clarity. Diamond actually measured 87.5dB, an average industry value, and allowing for the mic spacing to the slanted driver baffle.

Spot checks on distortion confirmed that at low frequencies for moderate

powers up to 10W, it was reduced by 50 to 70% over the normal values. Distortion through the mid was low at normal operating power, typically reading 0.15 to 0.2%. Up to the mic limit for fundamentals of 13kHz for 3rd harmonic readings and 20kHz for 2nd harmonic distortion, the Diamond tweeter was typically 0.1% - and these are very good figures indeed.

I would rate the Diamond as a 6 ohm speaker which is certainly usable with the larger 4-8 ohm rated push pull valve power amps of 75W or more. The low frequency definition available is so special that the prospective owner is generally advised to seek an exceptional solid-state amplifier of 200W to 1000W rating. The latter is possible is used with care. The largest of the test amps was capable of over 900W per channel into this load, and could be operated close to full power to particular advantage on classical programme with this speaker.[FPB700cx]

The minimum impedance was 3.8 ohms located over a narrow part of the mid range, and thus the amplifier loading is rated 'average'. The very low port tuning is set at around 18Hz which does more to free up the bass unit and improve power handling and dynamics than contribute to the in-band bass output. In room the speaker has the potential to operate down to 26Hz though this will depend on the room acoustic as well as speaker and listener positioning. Experiments with some of the most advanced sub woofers indicated despite their pedigree, they were a waste of time - the Diamond and partnering audio system always sounded better with the sub both out of the loop and out of the room.

For every speaker there is a natural, measured nearfield [1m] frequency response where the designer has struck a balance between driver characteristics, the resulting room driven response related to acoustic power, and the axial response uniformity. The reference response for the Diamond is not intended to be, nor is it, ruler flat; it has a linear bass, smooth slightly forward upper mid range and a very extended, gently tapered treble. Integration and uniformity over various axes was excellent. +/-2dB will define a respectably accurate 45Hz to 15kHz response but the subtle shadings of level within this range have been deliberately adjusted to provide the most natural timbres from this sophisticated speaker design. In marked contrast to all the metal dome alternatives, treble output continued smoothly to my test limit of 43kHz.

Examining the off-axis responses, the output dipped slightly in the presence band below axis so listener height should be adjusted so that ears are approximately in line with the directed axis or slightly above the lower part of the mid range driver. As regards stereo positioning, the traditional 60 degree equilateral triangle is a good start but with the enclosures slightly toed out for a glancing angle, almost to provide the listener sight of the inside edges of the enclosures. Experimenting with this is well worthwhile to help maximise focus stability and tonal balance

for any given room and system.

Energy decay measurements were made which showed the Diamond to be one of the top performers, storing very little unwanted sound energy. Stethoscope and accelerometer tests on the enclosure showed a first rate result for panel resonances. Suppression of the most common critical effects in speakers is essential if coloration free sound with great transparency is to be obtained. Dynamic contrast also relies on low stored energy. Impulse testing showed excellent decay characteristics. The transient weighted waterfall display illustrates fine phase integration and rapid clearing agreeing with the listening result for transient definition. Additionally the resonance weighted decay result showed very little energy storage in the upper range measured, conferring high resolution and low colouration.

With a rated power handling of 500W for unclipped programme a decently loud maximum level of 109dBA will be possible. The Diamond will handle some pretty powerful drive on heavy rock but this speaker also showed an intrinsic and exceptional run-in linearity at which point clarity reached an absolute maximum. Heavy bashing somewhat disturbs this point of refinement and it can take a few days of more gentle use before that particular sense of inner harmony returns.Looking at the reactive value of the amplifier loading the typical value was +/-20 degrees above 80Hz which was supported by a mean impedance value of 6 ohms. This presents no problems and on test a classic push -pull valve amplifier design drove it well.

+/-2dB errors in the frequency response occur if the grille is removed, with the upper mid in particular becoming more strident. The spatial average showed a generally uniform characteristic with a mild 2dB plateau elevation of the upper mid, nevertheless the whole range ran from 28Hz to 2.5kHz +/-2.5dB when room loaded. The slightly recessed but smoothly extended treble was also characteristic, and in practice you don't feel the need for more treble, such was the clarity of the tweeter. Many of today's designs are by contrast rather bright, while trying to achieve clarity through excess.

Conclusion:

The Eidolon Diamond is a monument to musical balance, with a vein of absolute quality that runs really deep. It's neither showy nor exuberant, and doesn't seek to thrill or excite through the use of artifice or excess. Instead, this relatively compact package produces a marvellously controlled yet revealing sound, intrinsically natural and lifelike. Highly resolving, you find that subtleties of expression, detail and timbre are effortlessly revealed. Spatial exposition and especially the command of focus are both first rate.

This speaker was upbeat and involving, cruelly revealing shortcomings in respect of listener involvement and rhythm in ancillary equipment. An out and out head banger would probably need something louder and larger, but when properly set up the Eidolon Diamond will play all kinds of music well. I see the Diamond as a loudspeaker which Neil Patel had to make; he just had to see whether the performance achieved by the standard Eidolon could be taken just that bit further.

The Diamond is no bigger, no more sensitive and no louder than its cheaper brother. But the value lies in its unsurpassed subtlety, its phenomenal resolution, the deep, wide and accurate sound stages. Tonal purity, limpid clarity, refinement and exquisite smoothness combine with an excellent standard for neutrality, accurate timbre and very low colouration. Detail is abundant over the entire frequency range, in achieving this here is a speaker which also times very well, sounds taut and upbeat, yet remains involving on all kinds of music from Reich to Mahler, from Mitchell to Leftfield, from Bach to Bartok, from Ricki Lee to Ke'b Mo.

The Eidolon remains a genuine landmark in speaker system design and my strong recommendation remains in place. For those who care about music and nothing but the music, and can afford it, the Eidolon Diamond has aimed still higher; excellence is valued for its own sake.