PLATINUM SERIES II

MONITOR AUDIO

PLATINUM II WHITE PAPER

The Platinum II project has produced the most accurate and beautiful loudspeakers Monitor Audio has ever made. Inspired by rigorous new analysis and breakthrough innovation by the engineering team, Platinum II is a potent mix of evolutionary refinement and discovery, offering genuine audiophile performance with simply stunning design and materials specification. In the pursuit of ever lower distortion, no detail has been overlooked. Through meticulous FEA modelling we've optimised the operation of electrical, mechanical, magnetic and acoustic systems, introducing new technologies where necessary to meet ambitious performance goals. The Platinum II range deploys a new generation of RDT bass and mid drivers and for the first time in a Monitor Audio product, the MPD (Micro Pleated Diaphragm) high frequency transducer. Including improved crossover and speaker terminal designs together with proprietary ARC®, TLE, HiVe®II technologies within beautifully curved, rigidly braced multi-layer cabinets, Platinum II builds on the advances of its predecessor to create a high-end speaker range of extraordinary calibre.

MPD (MICRO PLEATED DIAPHRAGM) HIGH FREQUENCY TRANSDUCER

Advantages

- Optimised diaphragm geometry
- Optimised magnetic geometry
- Improved power handling and higher sensitivity
- Flatter impedence
- Superior transient response
- Better damping

OVERVIEW: The MPD High Frequency Transducer uses an extremely thin, low-mass pleated diaphragm formed by the bonding of 12uM layers of high temperature Polyimide (Kapton) and aluminium. The aluminium is etched away to leave a resistive track (much like a printed circuit board), which operates like the voice coil of a typical electro-dynamic driver. The folded diaphragm is suspended between two steel plates, which provide the magnetic gap force. When a current flows through the conductive track, it produces a force which squeezes the pleats laterally, like an accordion, corresponding to the input signal.

OPTIMISED DIAPHRAGM GEOMETRY: Monitor Audio's MPD transducer is an improved version of Dr Oskar Heil's Air Motion Transformer design. Typical AMTs suffer from a null in their frequency response around 40 kHz with a -3dB point at around 28 kHz. Using FEA modelling techniques, Monitor Audio engineers were able to identify the root cause of this null and develop a solution. We discovered that the larger rolls in the diaphragm created an opposing phase shift, and by reducing the roll height and increasing the number of rolls, the null could be eliminated. Our resulting Micro Pleated Diaphragm (MPD) design operates with uniform output to over 100 kHz.

OPTIMISED MAGNETIC GEOMETRY: Two large blocks of high energy Neodymium/Iron/Boron (NeFeB) magnets are arranged to create a high flux density in the magnetic gap. Their poles at the front and rear of the diaphragm are off-set to produce a more uniform magnetic field across the diaphragm, reducing distortion.

IMPROVED POWER HANDLING AND HIGHER SENSITIVITY: The MPD transducer is directly coupled to the source without any matching transformer. It uses a non-inductive track for the electrical conductor, set within a surface area eight times larger than that of a traditional dome tweeter. Because the entire track is in contact with the surrounding air, any heat generated is dissipated very efficiently. The black front plate also acts as a heat sink for better cooling.

In addition power handling is improved by the MPD's high sensitivity. Its much larger surface area means that the MPD need move only a fraction (1/8) of the travel required by a conventional done to produce the same output. Furthermore the entire area of the diaphragm is suspended in the magnetic field, delivering greater efficiency and lower levels of distortion. This translates to a very high sensitivity of over 94dB for a typical 1W input. Attenuating the MPD transducer down to the system sensitivity level has the advantage of at least doubling the power handling; where typically every 3dB represents a doubling in power. This means that for the PL500, which measures 91dB at 1 metre for 1 watt, the MPD transducer is operating at less than half the power it would otherwise be required to run at.

FLATTER IMPEDANCE: The MPD design provides a constant non-reactive load to the amplifier, close to driving a purely resistive load. The easy load on the amplifier means it's able to deliver power more efficiently and with lower distortion.

SUPERIOR TRANSIENT RESPONSE: The folded diaphragm ensures that the MPD operates like a point source, but with a large surface area. Its large radiating area and low mass produces low inertia and a transient response similar to that of an electro-static driver: far superior to the response of a typical electro-dynamic driver.

BETTER DAMPING: Due to the low mass and large surface area of the diaphragm, the air around it offers a significant amount of damping, which combined with the native damping properties of the polyimide inhibits the propagation of surface standing waves ensuring a smoother frequency response.

NO BREAKUP: The MPD is designed to bend, unlike a trad dome, which relies on structural integrity to extend high frequency range. This means that the MPD does not exhibit break-up across its range, producing a clean sonic character free of any harmonic artefacts.

RDT II BASS AND MID-RANGE DRIVERS

Advantages

- New RDT II diaphragm design for significantly lower levels of distortion
- Improved suspension design for lower distortion and improved symmetry/linearity
- Patented build-ring mechanism for lower distortion and reduced high frequency artefacts, resulting in a more uniform frequency response
- Optimised magnetic and voice coil design for higher overall sensitivity
- Underhung edge-wound voice coil arrangement for greater efficiency and driver linearity
- Multiple thermal optimisation techniques deliver higher power handling and lower distortion

NEW RDT II DIAPHRAGM DESIGN RDT II (Rigid Diaphragm Technology 2nd Generation)

OVERVIEW: RDT II is a composite 'sandwich' structure made from ultra-thin low mass skins, bonded to a honeycomb Nomex® core material. The overall thickness of the RDT II diaphragm is only 2mm, yet exhibits 150 times the strength of a conventional loudspeaker cone. The overall aim was to reduce mass, whilst increasing stiffness and damping properties. RDT II is a unique development conceived by Monitor Audio engineers for the new Platinum series.

RDT II uses two different skin materials, both presenting dissimilar mechanical properties. This structure differs from the original RDT construction, which used two C-CAM® skins. RDT II uses C-CAM for the front skin, while the rear skin is made from a woven Carbon fibre material. The benefit from using two different materials comes from the way they interact at higher frequencies. We discovered that the new structure reduces distortion by over 8dB above 300Hz. This result represents a 60% reduction in the energy of harmonic components, which makes RDT II the lowest distortion cone technology in Monitor Audio's history. In addition, the use of new materials has allowed us to reduce the overall mass by 3% compared to the previous RDT diaphragms, resulting in higher efficiency.

At just 35uM thick, the outer C-CAM skin is extremely rigid, yet light enough to yield high overall efficiency. Originally developed by the aerospace industry, C-CAM (Ceramic-Coated Aluminium/Magnesium) has been refined and deployed by Monitor Audio over many years. After forming the shape, the cone undergoes a high temperature anodic coating process through which a layer of pure ceramic (alumina) is depleted onto the surfaces to give a completely rigid exterior. C-CAM cones are designed to have high resistance to bending stress. When formed into a cone, C-CAM material provides increased clarity and reduced distortion when compared with conventional cone materials.

C-CAM has a high degree of tensile strength to density which is why it was originally chosen as a skin material for RDT diaphragms, but our choice for the inside RDT II skin, carbon fibre, remains stronger for a given mass. Woven into a workable sheet material for the RDT II sandwich, it creates a difference in material properties, eliminating natural resonances in relation to frequency and providing better damping.

The skins are bonded to a honeycomb core of Nomex®: a lightweight aramid polymer fibre material, patented by DuPont for its unique strength to weight characteristics. Nomex® is especially resilient to shear force (effectively it stops the skins from moving) and exhibits excellent damping properties at high frequencies to create a constrained layer design, which absorbs energy from the bending motion. This makes it an ideal material for the core of a 'sandwich' construction with very low mass, but with extraordinary strength and resilience to bending forces.

The final optimisation of the cone was made by prototyping the cone with a number of different adhesives between the skins and the core. This is a critical region and requires perfect tuning in order to maximise the performance of the cone and keep the mass low. Further improvements in the production process have been made to ensure that each cone is as close as possible to the units used for the final listening sessions.

IMPROVED CONE GEOMETRY: The new RDT II diaphragms have a shallower 'dished' profile which helps to utilise the natural strength of the honeycomb core without excessively deforming it. In a conventional cone bass driver, the cone is punched with a hole in the middle to allow a voice coil to protrude for ease of assembly. Because of this, its strength is reduced considerably; resulting in poor frequency response and system design challenges. The 'dished' RDT II diaphragms are formed without a centre hole to create a radiating surface of greater strength and structural integrity. The voice coil and motor sit behind the cone, producing more efficient excursions, lower distortion and a wider response. Our 4" RDT II mid-range driver for instance has a uniform output to over 6kHz - at least one octave above the crossover point. This ensures the system designer is able to create very uniform transition between mid-range and high frequency elements.

OPTIMISED SUSPENSION DESIGN: An increase in bandwidth and improved frequency response have been achieved by a combination of developments in diaphragm geometry and surround coupling. In order to reduce interference at high frequencies a new synthetic rubber has been chosen for the surround and adhesive selected for the surround/diaphragm coupling. The sudden transition from the diaphragm surface to the soft rubber surround causes energy to be reflected back into the cone. In order to mitigate this effect, the coupling of diaphragm and surround has been mechanically impedance matched through the use of a specially formulated adhesive. Combined, these improvements have resulted in reduced distortion of around 6dB between 1kHz to 4kHz.

Developed using advanced FEA tools, dual-inverted spider arrangements have been applied to the suspension design of the 8" driver used in PL300 II, PL500 II and PLC350 II. The opposing spiders act to cancel out each other's non-linearities, improving the symmetry of the spider system and thereby reducing 2nd order distortion at low frequencies.

NEW PATENTED DCF (DYNAMIC COUPLING FILTER) MECHANISM: In a traditional cone loudspeaker, the voice coil and diaphragm (cone) are coupled using rigid materials, such as aluminium. However, the cone does not act as a perfect piston, especially at high frequencies. Breakup modes (standing waves across the cone surface) create peaks in the frequency response and increase distortion. We wanted to mechanically de-couple the cone from the voice coil at high frequencies and have achieved this using a carefully tuned cast nylon ring, which we're calling a 'Dynamic Coupling Filter' (DCF). It acts as a 'solid' part up to the crossover frequency, faithfully transmitting the motion of the voice coil directly to the cone. Above the crossover frequency it acts like a damped spring, reducing the transmission of energy between the voice coil and cone. The DCF mechanism effectively adds an additional first order mechanical filter to complement the electrical network, resulting in a compound attenuation of 18dB per octave above the crossover frequency, leaving the tweeter to take care of the high frequencies without interference from the bass driver.

The DCF mechanism is also designed to maximise venting around the voice coil, reducing power compression by cooling the voice coil and by relieving the back pressure from air normally trapped behind the diaphragm and inside the magnet system. The traditional technique of adding a centre pole vent has also been applied, but we've taken the effect one step further. Patent Application filed in the UK under GB 2516936 A

OPTIMISED MAGNETIC AND VOICE COIL DESIGN

OVERVIEW: We've utilised FEA analysis to optimise motor assemblies for all drivers. The resulting increase in linearity throughout the magnetic gap has led to a reduction in flux leakage and better overall efficiency. Bass drivers make use of high flux ferrite motor units, whilst the mid-range drivers use a high powered Neodymium ring motor arrangement. The magnetic design incorporates numerous techniques to improve thermal properties, reduce distortion and increase efficiency (through lower leakage).

UNDERHUNG VOICE COILS: A short magnetic gap with a long coil (over-hung) arrangement represents the most common and cost effective type of speaker design. However, it presents many problems if the objective is to deliver high performance. During operation, most of the voice coil will not be in contact with the magnetic field. Outside the magnetic field the coil converts electrical energy into heat, which is very inefficient. During its travel within the magnetic gap a long coil will usually exhibit high inductance, which creates high levels of back EMF, opposing the amplifier. As a result, the amplifier may struggle to deliver its power effectively. All drivers in the new Platinum series have been designed using an 'underhung' technique. In this case a short voice coil in a long magnetic gap ensures that even at extreme conversions, the coil remains within the gap, converting electrical energy into movement and resulting in greater efficiency and driver linearity. The modulation is low and the partnering amplifier is able to drive the speaker with relative ease, compared to a conventional driver.

COPPER SHORTING RINGS: The internal pole structure of the Platinum II bass and mid drivers is bonded to copper shorting rings, which serve to reduce non-linear distortion. This has the effect of significantly lowering low frequency distortion and reducing inductance, thereby reducing high frequency modulation.

THERMAL OPTIMISATION: While most of the heat generated by a driver is conducted, infra-red radiation can account for up to 25% of the thermal cooling and its contribution is overlooked by many driver designs. The ability to radiate differs between metals and finishes. A polished silver surface

for instance will have a very low emissivity in the IR spectrum and a high reflectivity. Ideally therefore all metal driver parts should be coloured black to increase thermal absorption/radiation. A layer of paint will create an insulating layer which would be counterproductive, so instead we've used thin coatings such as anodising and chemical electro-deposition processes. Magnets have been coated black to absorb as much thermal heat radiated from the voice coil as possible. The large steel top plate and die-cast aluminium chassis have been designed to move heat away from the voice coil. Voice coil formers are of aluminium and anodised black to dissipate thermal energy. Even the voice coil wire has been coated black. All Platinum II bass and mid-range drivers use edge-wound, single layer voice coils to ensure each turn has a thermal path to the outside of the voice coil or the voice coil former. There's also large reduction in the amount of adhesive insulating the voice coil. The turns have less adhesive between them allowing the whole voice coil to maintain a consistent temperature with no hot spots. Thermal optimisation delivers a significant reduction in power compression and increases overall power handling.

EDGE-WOUND VOICE COILS: Rectangular wire wound onto a former is much more efficiently packed, commonly referred to as 'stacking factor'. This means that in a given space a significant increase in the number of turns on the voice coil can be achieved. In order to maximise the excursion, the shortest voice coil is required whilst still needing to get the required number of turns and match the impedance. With the new 'underhung' edge wound coil design we can increase excursion by 15% over a standard round wire configuration, without affecting any of the other design targets.

MECHANICAL COMPONENTS

BOLT-THOUGH DRIVERS: Each Platinum II driver is fixed to the cabinet from the back using a long bolt tightened to a specific torque during production. The bolt serves to provide the driver with an equal clamping force around the periphery, while ensuring the motor system in braced. Since this is effectively an additional form of bracing, the cabinet with drivers installed becomes even more rigid.

ARC (ANTI-RESONANCE COMPOSITE) is a cast thermo-set polymer loaded with minerals to provide very inert, optimally damped components. This type of material is ideal for high-end acoustic applications where a high degree of structural rigidity and vibration damping is required. ARC is used in the original and new Platinum II series for mid-range housings and baffle components.

TLE (TAPERED LINE ENCLOSURE): The tapered, parabolic shaped enclosure for Platinum II's mid-range drivers is cast from ARC material and designed to prevent the propagation of standing waves and modal resonances. Its tapered shape combined with the use of graduated damping materials also has the effect of attenuating high frequencies.

HIVE II (HI-VELOCITY-VENT, 2ND GENERATION): A new port technology which uses a straight rifled design to accelerate air flow and reduce turbulence. HiVe II technology has the ability to move air in and out much more rapidly than a conventional port. The result is fast powerful bass coupled with a superior transient response.

MULTI-LAYER CURVED CABINET CONSTRUCTION: Platinum II cabinets are hand built using multiple laminations of wood veneer and shaped using complex curved jigs to form a rigid shell. Curved surfaces are inherently stronger than flat surfaces, and since the internal sides are non-regular curvatures, standing wave formation is supressed.

NEW INTERNAL BRACING STRUCTURES have been developed to ensure the ultimate in structural integrity, as well as serving to break up long acoustic paths internally. Small compartmentalised spaces replace large open internal spaces. This design is particularly efficient at preventing the formation of standing waves at lower frequencies. Bitumastic internal damping material is applied to all internal cabinet walls to provide an additional layer of 'mass-damping', ensuring that any residual energy is absorbed. The resulting homogenous enclosure is supremely rigid, acoustically inert and able to deliver the sound as it was intended, natural and uninhibited.

INDIVIDUAL DRIVER GRILLES: Drivers are covered by individual grilles for optimum acoustic transparency. The system will sound the same whether the grilles are on or removed. However, the grilles can be removed according to taste.

BESPOKE TERMINALS: Platinum II's bespoke speaker terminal design is precision milled from solid copper with Rhodium plated conductor parts. Rhodium has been selected for its excellent electrical conductivity and resistance to oxidisation. These properties deliver uniform contact resistance when used with similarly designed cable terminations. A slip ring inside the terminal body ensures that force can be applied without the cable or spade connector turning in the process. Terminals are designed to accept a spade, 4mm banana plug or bare wire, up to a diameter of 4mm diameter (AWG7)

CROSSOVER DESIGN

Crossovers have been completely re-developed from the best possible components. We've utilised air core inductors in all mid-range and tweeter sections to minimise distortion and component interaction. Laminated steel cores have been specified for bass sections, providing low resistance (DCR) in series with the bass drivers to ensure the highest electrical damping for improved bass clarity and dynamics. Every inductor core has been specified to comfortably exceed the peak system power rating, removing the risk of saturation at any level.

Audiophile grade metallised polypropylene capacitors have been custom made and selected for best possible sound quality after many hours of listening and evaluation by our engineers. Hand-picked within a 1% tolerance, the capacitors use silver lead wires for excellent electrical conductivity. Attenuation resistors are aluminium-clad to provide improved power handling through better heat dissipation. This careful attention ensures that electrical values remain consistent with increased power and over a wider temperature range.

SILVER-PLATED COPPER INTERNAL WIRING: Platinum II series speakers are internally wired using our 'Pureflow' silver-plated OFC copper cable, selected for its audio purity and high conductivity.

PL100 II CROSSOVER: The PL100 II uses a mid-bass driver operating below 3 kHz and a tweeter above. The crossover design for this speaker uses a third order on both the tweeter and the mid-bass driver. One octave above the crossover on the mid-bass section, the low pass filter starts to add a further order making the equivalent of a fourth order crossover at higher frequencies. This design ensures that a consistent phase response can be held through the crossover region while at 12 kHz the filter has added an additional -6dB of cut equivalent to half the energy, improving the quality of the high frequencies by reducing the amount of contribution from the mid-bass driver.

AESTHETIC DESIGN

All front baffles are hand-upholstered using Inglestone leather supplied by Andrew Muirhead. Inglestone is the best quality natural leather available and is used in high-end furniture, automotive and marine applications by the most quintessentially British brands. It conveys a tactile sense of luxury which blends with the lustrous beauty of Platinum's lacquered veneer finishes to impart an immediate impression of excellence in any room.

Only the most exotic natural wood veneers are used, hand selected, matched and coated with 11 layers of clear gloss piano lacquer. Each cabinet is hand veneered after the cabinet structure is made, using very traditional craftsmanship to deliver immaculate grain matching and finish. The beautiful definition and rich colour variations of Santos Rosewood and natural Ebony make a powerful statement of beauty, comfortable in any interior, however lavish. Platinum II models are also available in a penetrating piano black gloss lacquer, which will offer a luxurious contrast with room décor.

Meticulously machined from high-grade alloy and anodised to the most exacting quality standards, adjustable spiked feet are supplied with the PL200 II, PL300 II, PL500 II and PL100 II/ PLC150 II/ PLC350 II floor-stands. The alternative 'bullet' spikes are precision milled from high-tensile steel and chrome plated to the finest mirror finish. For hard or solid wood flooring, a non-slip rubber pad is integrated with the foot design.

ABOUT MONITOR AUDIO DESIGN

- State-of-the-art 'fully-coupled FEA simulations' are used to design all the drivers and the cabinet interactions
- Full simulation capability of driver elements and system design, including Spice crossover simulation

Monitor Audio employs state-of-the-art facilities in the design of the new Platinum series, including:

- Purpose built identical Anechoic chambers in UK and China for accurate measurements of all the drivers and speaker systems from initial R&D through to final QC checks
- Klippel laser scanning vibrometer for accurate measurements of the cone surface
- Driver analysis tools from Klippel
- Isolated double walled listening room with acoustic treatment
- In 2009 Monitor Audio was the first company to release an AES conference paper describing the accuracy of fully-coupled multi-physics modelling of transducers in COMSOL

For Platinum II the virtues that have won Monitor Audio worldwide acclaim have been tuned to a cutting-edge intensity, allowing rarefied audio transparency, flawless build quality and unqualified value to be celebrated and enjoyed by audio lovers around the world.

Dean Hartley, Technical Director
11/12/2015

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