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Genelec M Series



Acoustic Design and Sustainability

For the past 35 years, Genelec has been known for its ability to introduce new and innovative technology. Genelec's new energy-efficient M Series takes a novel approach to monitor design and manufacturing as part of a wider ongoing sustainability program. M Series research and development work is focused on advanced sustainability without sacrificing accuracy and reliability.

By
Christophe Anet
(France)

Genelec, a manufacturer of active loudspeaker systems, is based in Iisalmi, Finland. The company designs and produces products for professional studio recording, mixing and mastering applications as well as broadcast and post production facilities. Genelec's M Series Natural Composite Enclosures (NCEs) employ a new environmentally friendly material manufactured in Finland from wood fibers and other recyclable materials. The M030 and the M040 bi-amplified active monitors also share a new technology platform featuring green power-saving electronics, Intelligent Signal Sensing (ISS), power management, automatic mains voltage selection, linear and clean Class-D power amplifiers, as well as easy-to-use room compensation adjustments (see **Photo 1**).

The monitors also have Genelec's enclosure

design heritage, featuring rounded edges and curved front and sides to minimize cabinet edge diffraction for precise imaging. The new vibration damping enclosure yields large internal volume and high mechanical strength. The integrated advanced Directivity Control Waveguide (DCW) enables neutral reproduction, particularly in acoustically compromised spaces. And, its novel Laminar Integrated Port (LIP) bass reflex system provides accurate low-frequency response and faithful tonal reproduction characteristics.

Ecologically Sustainable and Recyclable

Since its founding, Genelec's design philosophy has been based on sustainability and environmental values. Conservation of natural resources and efficient use of material and energy in all levels



Photo 1: The Genelec M030 features a Natural Composite Enclosure (NCE) in patterned finish.

of manufacturing, shipping, and during the product lifetime is essential to the brand. Genelec's low life cycle carbon footprint products are manufactured under the same roof, in Finland, which lead to environmentally efficient solutions.

For example, Genelec's factory is using renewable energy for its heating. The recycled aluminum used in the die-cast enclosure manufacturing saves 95% of energy compared to using virgin aluminum. The wood fibers used in the M Series enclosure material is sourced from sustainably managed forests. The M Series packing is made of recyclable cardboard. Shock absorber linings inside the packing are made of recycled paper pulp.

Conserving natural resources extends beyond the use of recyclable natural materials. From start to finish, the design principle for the M Series has been to make it ecologically sustainable. Products have been designed to be durable and have a long lifetime. Materials are selected so that they can be reused, either in their original purpose or as new types of products. This is the best form of sustainability.

Innovative Natural Composite Enclosure

Early in the company's history, extensive research was made to find new enclosure materials. In 1983, Genelec

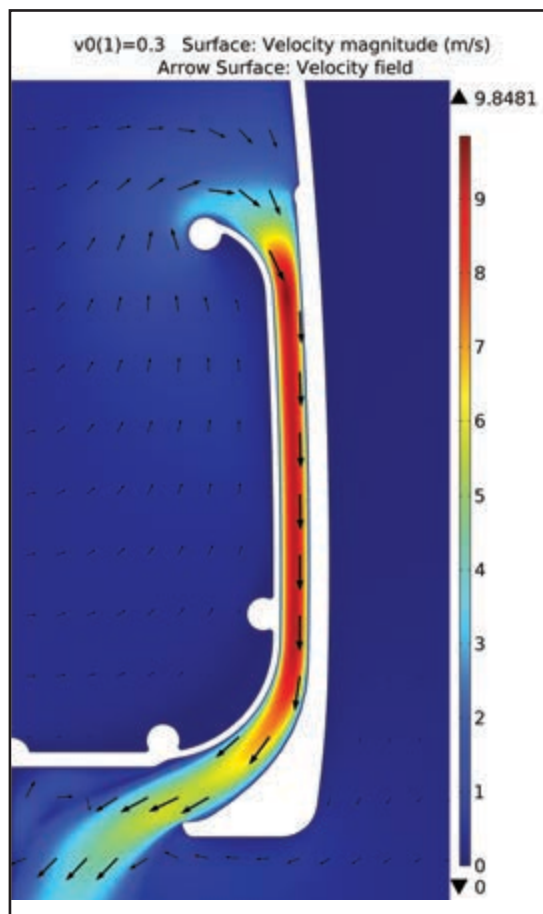


Figure 1: The cross-section plot of the flow-optimized Laminar Integral Port (LIP) is integrated into the Natural Composite Enclosure (NCE).

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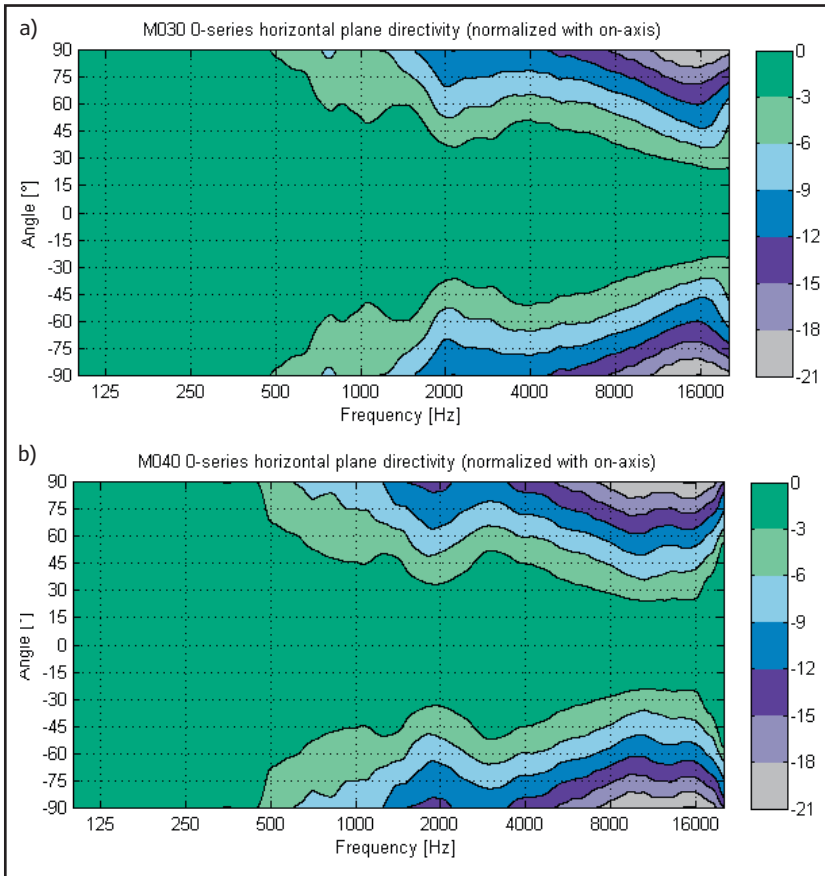


Figure 2: Directivity plots of M Series products including, the M030 (a) and the M040 (b), demonstrate excellent horizontal directivity control.

made its first prototypes of the 1022A , using an enclosure made of hand-laid glass fiber resin layers. The design came into production in 1985. This radical development in enclosure shape paved the way for diffraction-free enclosures and DCWs. In 1996, Genelec introduced its first die-cast

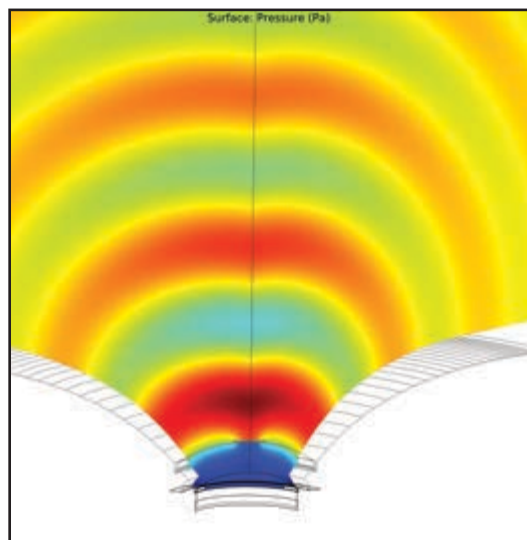


Figure 3: Optimized with Finite Element Analysis (FEA) simulations, the M Series injection-molded Natural Composite Enclosure (NCE) integrates an efficient Directivity Control Waveguide.

aluminum enclosure, with the small 1029A active two-way monitor. All the benefits of cast aluminum were immediately apparent including flexibility in enclosure shape design, structural stiffness, and a large internal volume in relation to external size.

Beginning in 2003, Genelec participated in a university research project studying the use of wood composites for injection molding. In 2006, the first exploratory loudspeaker enclosures in wood-based natural composite material were made. In 2009 Genelec started a program to develop loudspeaker enclosures containing half wood fibers.

The innovative NCE of the M Series products is made of a material that is best described as injection-moldable wood. This material is a natural fiber composite with about half natural wood fibers. Other materials include color pigments, flame retardants, lubricants, and so forth, which are all integrated in a polypropylene matrix. Polypropylene is a recyclable material (polymer resin identification code number 5) that features a low melting point ranging between 130°C and 170°C. This environmentally attractive polymer has been selected for its resistance and durability, its high internal damping and its resilience against impacts and physical damage.

In terms of manufacturing, the injection-molding process allows design of structures with small wall thicknesses and multiple internal support and bracing to increase the enclosure stiffness. Production of acoustically highly optimized outer shapes and forms is also possible. At the same time, the enclosure internal volume is maximized. This is paramount to achieve high acoustic output at low frequencies. The material itself has high internal vibration energy losses, which is advantageous in enclosure design where damping and rigidity is required.

Unpainted Enclosure Finish

The highly renewable NCE enclosure material has many of the outstanding acoustical properties found in wood fibers. It is 100% stiffer than the common ABS plastics typically used in loudspeaker enclosures. Due to the high quality of the wood fibers and the virgin polypropylene material used, the resulting NCE raw granulates are clean and odorless. Additionally, the often environmentally hazardous painting has been eliminated from the production process, which saves on transportation and handling. In fact, enclosure front and back parts are manufactured as finished elements, ready for assembly, in factories near Genelec's manufacturing plant. The unique patterned finish is created during the injection-molding process by the interaction

and combination between the wood fibers and the polypropylene matrix.

Laminar Reflex Port

Genelec's choice of vented (or bass reflex) enclosures dates back to 1978 and its first active monitor, the S30. The company has pursued research to improve the performance and efficiency of reflex ports ever since. A typical reflex port enclosure features a tube and an opening area. To avoid turbulences in the tube, the airflow should not meet any acute angles, as this would generate noise, compression, distortion and losses of the total radiated energy. To minimize the air flow speed, both the tube and its cross section have to be large. Often, the outer enclosure dimensions become a limitation, because a long tube will not fit in the available volume anymore.

The M Series features two vent tubes with openings stretching across half of the enclosure's depth to address these specific issues. The novel patent-pending LIP has been flow-optimized using computer-based finite element models to achieve low distortion and high efficiency even at very high audio output levels (see **Figure 1**). The reflex ports are integrated in the NCE enclosure during the molding process, avoiding the need for separate additional components. The cross-section plot demonstrates the efficient flow characteristics of the port. The natural installation orientation of the M Series is vertical and to enable easy placement of the monitor against a wall, the M Series ports opening face downwards, in the space under the monitor.

Efficient Directivity Control

Genelec's pioneering DCW technology was first developed in the early 1980s to significantly improve the performance of direct-radiating multi-way monitors. The DCW waveguide is designed to match the frequency response and directivity of midrange driver to woofer and high-frequency driver to midrange. This results in excellent flatness of the overall frequency response for on- and off-axis listening positions (see **Figure 2**). As a consequence, the reflected sound energy at the listening position is reduced. Controlled directivity is associated with neutral uncolored sound, particularly in acoustically compromised spaces.

With a heritage of 30 years of DCW design, the M Series injection-molded NCE enclosure was developed to feature a large, highly efficient DCW integrated into the enclosure front structure (see **Figure 3**). The directivity characteristics have also been matched between the two monitor models, resulting in similar neutral sounding products.

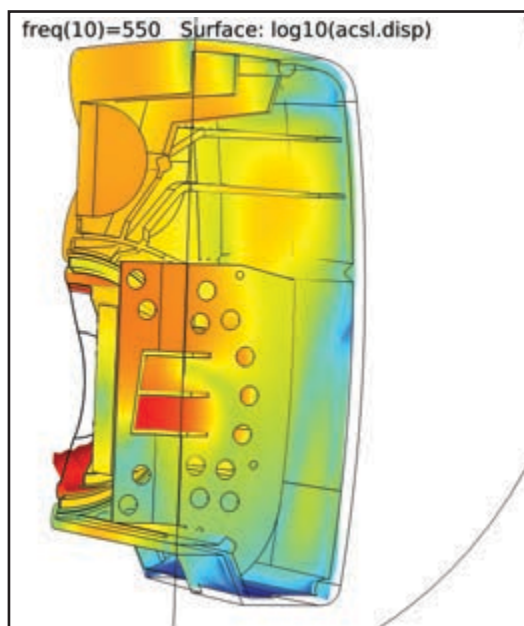


Figure 4: The Genelec M040 enclosure simulation is shown using the finite element analysis (FEA) method.

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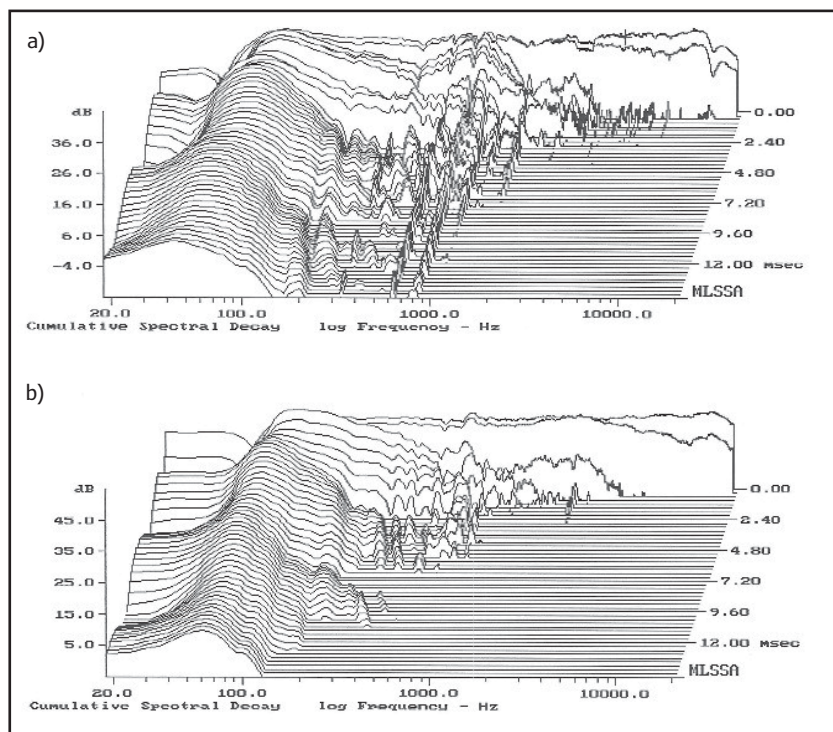


Figure 5: Waterfall plots show the release of resonant energy for a typical two-way active monitor (a) and the Genelec M030 (b).

Low-Diffraction Enclosure

One of the important phenomena affecting sound radiation is called diffraction. Any acoustical discontinuities around the drivers (e.g., enclosure edges) act as secondary sound sources because of diffraction. The typical four edges of the baffle front create a system that has five radiators operating at the frequencies of interest. These are the actual driver and the four secondary sources created by diffraction at the four cabinet edges. The resulting frequency response at the listening position is the sum of these sources. As the listener moves off axis, the time relationships of the different sound sources will change and the degradation to the monitor response will vary with location.

Pioneered by Genelec since 1985, carefully

contoured smooth acoustically optimized rounded enclosure shapes can minimize diffraction and improve sound quality. Enclosure corner shapes of the M Series products have been optimized to minimize any sound coloring diffraction from the enclosure edges and corners. In addition to achieving an unsurpassed flatness of the frequency response, minimum diffraction enclosures yield accurate imaging.


Absence of Delayed Resonances

When an audio signal fed to a monitor stops, there should be nothing left but silence. Resonating enclosure structures store mechanical energy. This energy will be slowly released at the resonance frequencies, after the audio stops, and instead of silence there will still be some output. Release of this stored resonant energy can color the audio we hear.

The challenge in enclosure design is to minimize and damp structural resonances (see **Figure 4**). Detailed measurements and study of the release of resonant energy has allowed Genelec to understand where resonances happen and what are their mechanisms (see **Figure 5a**). The M Series acoustical radiating system—consisting of enclosure, drivers, and reflex ports—has been carefully modeled and optimized to keep resonances inaudible. The outcome is audio accuracy and the capability to reproduce details and nuances without masking (see **Figure 5b**).

Distinctive Finnish Engineering

For more than 35 years, Genelec has been guided by a single idea—to make perfect active monitors that deliver neutral and accurate sound in every kind of acoustical environment. The essence of the company's engineering philosophy is to use industrial design to serve the products' acoustical performance. For many years, Genelec has cooperated with renowned Finnish industrial designer Harri Koskinen. His involvement in the designs brings a unique voice to the aesthetics of Genelec's products.

Dedicated to the Music Creation work, Genelec's new M Series provides a unique combination of high linearity, low distortion, clean and neutral audio reproduction. The products feature room compensation adjustments, universal power supplies, and versatile inputs. Adapted to mobile work, M Series products respect sustainability and environmental values, with low life cycle carbon footprints. Genelec's efforts to improve all aspects of monitoring has led to the use of NCE, an environmentally friendly material featuring outstanding mechanical and acoustical properties. 

About the Author

Christophe Anet holds a Bachelor of Engineering degree with honors in electroacoustics from the University of Salford, Manchester, UK. Starting his career at Genelec Oy as an R&D trainee, he has held various positions including customer support acoustic engineer and technical editor. He has also worked in environmental acoustics and traffic noise control for the Swiss state administration, as well as for leading architectural acoustics consultant Walters-Storyk Design Group.

Christophe is now the education and training manager at Genelec. He is a regular writer for professional audio magazines.

Fluent in French, English, Italian, and German, Christophe is also proficient in a wide range of software tools, including acoustical measurement equipment and graphic design.