GENELEC®

The Technology behind Genelec 8000 Series Active Monitors

Genelec active monitor evolution spans over more than 25 years with strong commitment to research work and development of unique technical solutions for the monitoring environment needs. In the continuous quest to provide the best possible monitoring solutions, marketing and R&D teams decided to define and create a new range of two-way speakers that would clearly outperform the famous industry standard models 1031A, 1030A and 1029A. It is always a challenge to improve strongly established and very good products. Outstanding technical performance in all material respects and excellent functionality were set at the top of the list. A talented Finnish industrial designer, Harri Koskinen, who has an international reputation for his clean and timeless designs, joined the team to bring also aesthetic uniqueness in these new active monitors.

As defined in the early days of the company, a monitoring loudspeaker should reveal the truth about the program being monitored. The system should not add, remove, mask or alter any part of the signal in its reproduction. As Genelec have measured and studied the effect of the operating environment and room acoustics in hundreds of control rooms each year, every generation of monitors is designed to perform even better in typical spaces providing real solution to audio professionals.

In a conventional speaker box design, the front panel has four well-defined edges. For a sound wave, they represent an acoustic discontinuity and they form a secondary radiator. The actual driver emits the original sound, but the total radiation also includes the effects of the other four secondary sources. Their strength depends on frequency and directivity of the drivers. The resulting frequency response, at the listening position, is the sum of all these sources. The summed frequency response has usually irregularities due to the summing of components with different arrival times.

When the listener moves off-axis, the summed response heard at listening position is now different because the arrival times change. Diffraction is a common phenomenon - and problem - in speaker design. Objects around the speaker can reflect the sound like a mirror, and cause comparable effects at the listening position, only a bit later because such objects are usually further away.

In 1983 Genelec started to design a loudspeaker system that was radically different. The work of Harry F. Olson and others concerning the effects of enclosure shape and driver position on diffraction was taken a step further by matching the directivities of multiple real sources whilst minimising diffraction through contoured cabinet edges. The 1022A was produced in 1985 and it was a major step forward from the popular three-way designs of the time, featuring the first development of the Directivity Control Waveguide (DCW™). However excellent the on- and off-axis performance of this speaker was, customers were hesitant to buy such a strange egg-looking three-way speaker. The conservative market was asking for rectangular boxes, and so the waveguide was further developed for such enclosure types. First in this category was the famous flagship 1035A, followed by smaller flush-mounted monitors and later a range of two-ways including models discussed now.

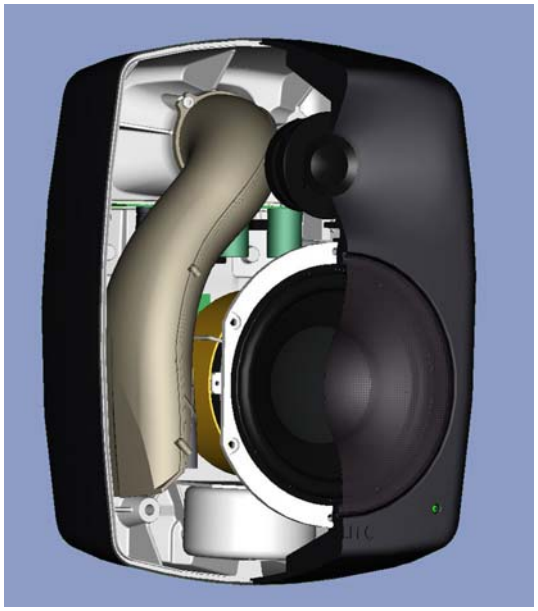
To improve the total performance of the existing excellent two-ways, we decided to go back to a clean paper and analyse what can be done to each major component in the system. First was the enclosure itself and its parts. Detailed analysis on the behaviour of speaker cabinet shape was performed. The outer contour line was designed based on mechanical, acoustical and aesthetical reasons. A curved structure is inherently stiffer than a straight-sided one and it is also an essential element for minimizing diffraction. At low frequencies all pressure radiators are omni-directional, and in the case of free-standing loudspeakers, the

enclosure starts to become directive when the baffle dimensions are comparable to 1/3 - 1/2 of the wavelength. To minimize this effect as well as diffraction at higher frequencies, the enclosure was designed with rounded edges and curved surfaces all around. This translates in an even more natural sound reproduction in the critical midrange region.

The new advanced waveguide was extended to provide improved control of the speaker's directivity. Basically, the low frequency limit for constant directivity is determined by the size of the waveguide, so the larger the surface the better the control. With a very controlled off-axis radiation, the listening window becomes consistent, which is of utmost importance with multi-channel audio monitoring. Controlled directivity also reduces possible first order reflections on surfaces near the loudspeaker, helping to provide consistent audio reproduction in different acoustical environments. The advanced 8000 series waveguide is integrated with the rigid front baffle surface and extends smoothly to the cabinet rounded sides. The entire front baffle is gently curved and the acoustically transparent grilles are part of the outer cabinet aesthetics, blending perfectly with the various other curved surfaces.

To achieve such a smooth and elegantly curved cabinet surface, new materials and

manufacturing methods had to be investigated. A wooden MDF cabinet could not easily be shaped into such a complex form. To reduce the outer dimensions of the speaker cabinet and at the same time maximize internal volume for improved LF efficiency, we designed a die-cast aluminium cabinet. Aluminium is a good material for this purpose; it is lightweight, stiff and very easy to damp to yield a "dead" structure. The cabinet walls can be fairly thin, providing at the same time good EMC shielding and excellent heat sink for the power amplifiers. Die-casting is made in two parts, front and rear, and they are easy to separate for potential servicing needs.



Genelec's choice for vented, or reflex, enclosures dates back to the S30 model, the first Genelec product from 1978. Port performance has been improved over the years, and it was an essential part of the 8000 series monitors design process. The aim was to increase the woofer's low frequency extension and SPL capability to provide outstanding bass articulation and definition. Both driver and vent contribute to the total radiation of a reflex enclosure. Most radiation comes from the driver, but at the vent-enclosure resonant frequency the driver amplitude is small and most of the radiation comes out of the vent. To minimize the air speed in the tube, the cross sectional area of the vent should be large. This in turn means that the vent tube has to be long. Again we have the question where to put the long vent and where the orifice should be. As the vent could not be practically located on the top, on the bottom or on the sides of the enclosure, the best place for the large flared orifice was the rear side. Also, the curvature of the tube has been carefully designed to minimize any audible noise, compression or distortion. The inner end of the tube has proper termination to minimize chuffing noise and air turbulence at the vent entry. The resulting performance of this high efficiency reflex tube is well demonstrated in the 8030A model (5" bass driver) that has a lower cut-off frequency (-3 dB) at 55 Hz. The response extends down to 35 Hz (-3 dB) for the largest model, the 8050A (8" bass driver).

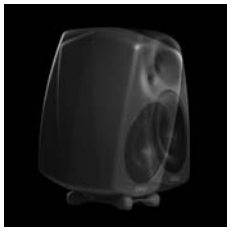
The development of driver technology goes together with the evolution of very low distortion power amplifiers. Since the very beginning of the company all electronics has been designed and assembled in-house, so that the R&D department has gained an incredible amount of knowledge in these fields. For the 8000 series a new level of driver performance was specified to fulfil the stringent design criteria. Extremely smooth response, minimum distortion and very high reliability were demanded. The mid-band distortion is typically 10 dB lower than before. Also, to complement these new drivers in an optimum manner, new types of filtering techniques were developed to achieve improved crossover.

To match the speaker with the acoustic environment, extensive and precise room response controls are once again featured in these new monitors. Bass tilt, Bass roll-off and Treble tilt can be selected to retrieve a flat and neutral frequency response in most acoustical environments.

However good an active monitor may be, its performance is always only as good as the combined speaker/room interaction allows. Compromised room acoustics and speaker placement in relation to boundaries and equipment can cause severe deterioration on reproduction and listener's monitoring abilities. Recognizing this Genelec new 8000 series monitors provide several possibilities for proper mounting and placement in the control room.

Four M6 support points have been integrated in the die-cast enclosure for wall mounts. The 8030A has also a 3/8" thread at the bottom to fit a robust microphone stand. The larger 8040A and 8050A are too heavy for microphone stands and hence the bottom thread is M10 for fixing the speaker in some cases with a normal bolt.

Instead of using proper floor stands as often recommended, the very common way of locating speakers directly on a table or a meter bridge cause several unwanted side effects. Aiming of the speaker axis towards the listener is rarely implemented, also, unwanted mechanical vibration do propagate from the speaker to the mounting surface, and first order reflection on the work surface causes comb filtering and hence ripples in the frequency response. To solve these very common problems Genelec developed some practical solutions. First, a proper, adjustable floor stand becomes available. Second, we designed a device called Iso-Pod™ - Isolation Positioner/Decoupler (or Frog, as some friends call it). It has four shallow feet and it is made from special lossy rubber-like material. It is fitted to the enclosure so that it can be slid along the curved bottom or side surface for a ±15° tilt of the speaker. The speakers' acoustical axis can then be pointed precisely towards the listener by adjusting the enclosure's inclination on the Iso-Pod™. The vibration isolation and damping properties reduce midrange coloration caused by unwanted vibration transmitted to supporting surfaces.



A typical consequence of locating a speaker onto a meter bridge or table is a boost around 160 Hz followed by cancellation dips at higher frequencies. Because a boost is more audible than a dip, and creates a certain 'boxy' sound, a specific room response control was incorporated in the 8040A and 8050A models. This 'Desktop Low Frequency Control' attenuates the boost and reduces the associated colouration.

Great care has been taken in these three new designs to bring superior accuracy, exceptional reliability, consistency and innovative solutions to the professional monitoring environment. New solutions always exist. Genelec's goal is not to engineer and manufacture products that are just good enough, but rather to exceed expectations and bring joy to the end users.

Written by Christophe ANET, Genelec.