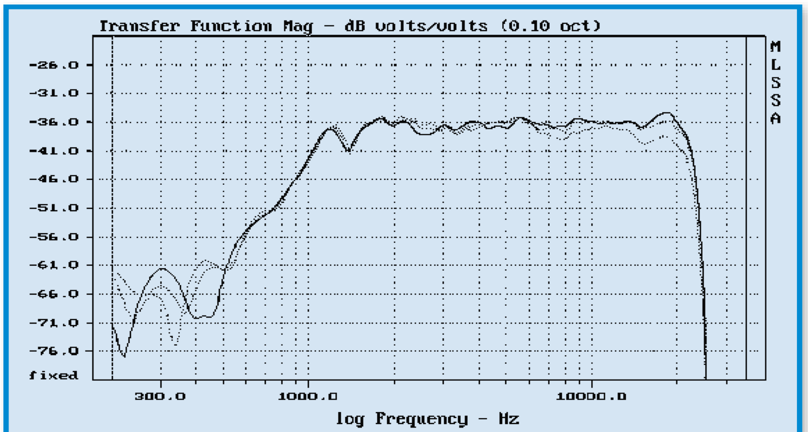
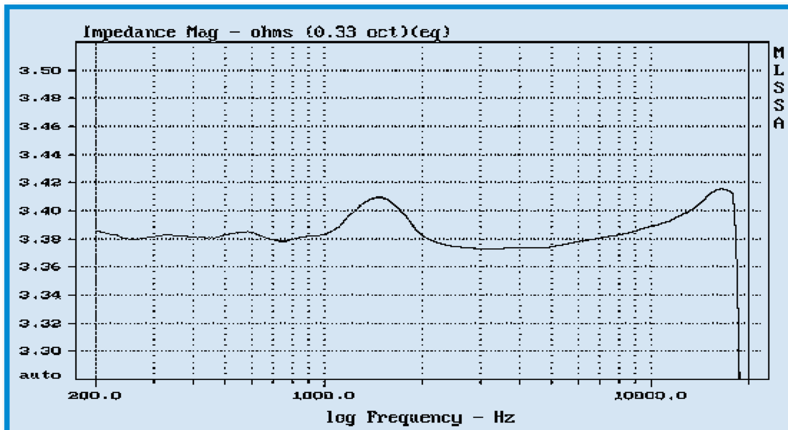
Accelerated Ribbon Technology explained

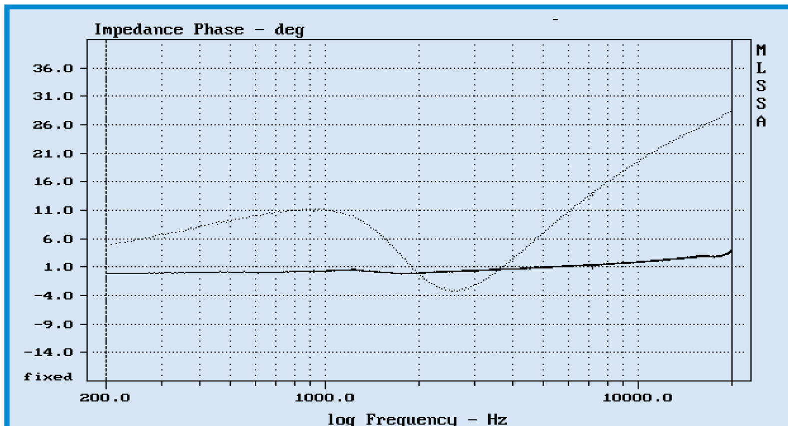
German monitor manufacturer ADAM has majored on its use of strange-looking drivers in its model range. ADAM Audio's KLAUS HEINZ explains how they put the ART in their midrange and tweeter driver designs.



Frequency response with 0, -15 and -30 degree microphone positions, indicating good dispersion characteristics comparable to the ones of flat mounted 1-inch domes. Note the system's 20 kHz measurement band limit.



Impedance mag plot, showing a resonance peak of 30mOhm only (= very good damping). Note the high resolution vertical scale here, in a normal plot this resonance would simply disappear in the line thickness.



Impedance phase plot, comparing the ART tweeter with a 1-inch dome, the latter showing some deviations due to the voice coil's inductive nature. Phase deviation for the ART tweeter in the used band is +/- 1.5 degrees compared to the +/-15 degrees of the dome tweeter.

ADAM (ADVANCED DYNAMIC AUDIO MONITORS) monitors are developed and manufactured in Berlin, Germany and employ innovative folded ribbon mid and high frequency drivers that incorporate a new approach to the Air Motion Transformer concept originally developed by Dr Oskar Heil 40 years ago. ADAM improved on this idea using superior geometries and materials and believed that this rare technical progress was reason enough for the two company founders to enter a market that wasn't exactly crying out for a new brand of studio monitors. As every ADAM monitor employs this new tweeter design it is worth looking at the transducer situation in general and at the ART (Accelerated Ribbon Technology) in more detail.

The dynamic tweeter used in more than 99% of all loudspeakers today generates sound via a voice coil that is mechanically connected to a stiff cone or dome. The materials preferred are fabric, polyamide, or aluminium. The unavoidable shortcomings of this construction method are the relatively high mass of the membrane/voice coil assembly, and the tendency of the assembly to lose stiffness over time. The former constrains the upper frequency range and the latter progressively degrades the overall sonic performance.

A relatively early attempt to solve these problems was the ribbon tweeter, in which current is passed through a small aluminium ribbon located in a strong magnetic field. Problems with this design included limited efficiency and dynamics and the very low impedance necessitated an extra transformer to drive it.

Their viability as a general replacement for dynamic tweeters was further reduced by the fact that these tweeters typically could only be used for frequencies above 5kHz, consequently missing a great deal of critical timbral information.

Within the last 20 years or so, magnetostatic designs have superseded the original aluminium ribbons. In this method of construction, the aluminium ribbon was used in conjunction with a Kapton foil. These designs achieved normal impedances, and therefore eliminated the need for the extra transformer.

The ADAM ART tweeters and midrange units take a completely new approach to the kinematics of moving air. The ART membrane consists of a pleated diaphragm in which the folds compress or expand according to the audio signal applied to them. The result is that air is drawn in and squeezed out, like the bellows of an accordion.

All other loudspeaker drive units (regardless of whether they are voice coil-driven, ribbons, electrostatic, piezo or magnetostatic) act like a piston, moving air in a 1:1 ratio with regard to the motion of the driver. The problem with this is that the specific weight of air is much lower than that of the driving mechanism. As a result, the air does not couple effectively with the transducer. The analogous situation in electrical terms is described as bad impedance matching between source and load. In both cases (acoustical and electrical) the result is less than optimal power transfer.

The ART design achieves an improvement in air loading by a factor of 4 over conventional transducers. This superior 'motor' is responsible for the clarity and transient reproduction that can be heard from ART drive units.

In addition to the improved air coupling, the ART tweeter's pleated membrane avoids the typical break-up and subsequent dynamic limiting at higher frequencies of stiffer voice coil designs, such as those found in dome and cone tweeters.

Another positive of the ART design is that the driving 'stripes' are in direct contact with the outer air and are cooled immediately. Thermal power handling of the units is increased and surpasses that of 1-inch domes by a factor of more than 2:1.

Many functional distinctions in construction and kinematics can be drawn between the ART tweeter and voice coil-driven dome tweeters. Previous 'esoteric' designs have always exhibited technical shortcomings, such as very little impedance (ribbons), bad dispersion (electrostatics, as with the original Heil Air Motion Transformer), low efficiency (magnetostrictive tweeters) or environmental problems (ozone from the ionic tweeter).

ART tweeters show none of the engineering limitations of previous designs and have an efficiency of approximately 92dB/W/m, a linear impedance of 3.2 ± 0.05Ohm, a 'perfect' phase response of +/-1 degree within the used bandwidth, excellent directivity characteristics and a power handling two or three times that of 1-inch domes.

Diaphragm area is another important factor in determining the dynamic range of a transducer. Basically, what you see is what you get. The cone area you can see is always the acoustically active area of the loudspeaker and this is true for practically all other drive units. By folding the ART diaphragm into the third dimension (as seen from the listener's position) a larger foil can be used, thus increasing the acoustically effective area of the diaphragm by a factor of more than 2.5. This results in higher dynamic output with excellent dispersion.

The ART midrange driver uses a diaphragm that weighs only a fraction of comparable voice coil units, and can cover the range from 600Hz to 12kHz. The large diaphragm area — comparable to a 7-inch conventional midrange unit — permits very high, uncompressed SPL without compromising dispersion. The unit has an absolutely flat impedance curve and consequently exhibits linear phase behaviour, with a +/- 0.75 degree deviation within the used frequency band.

The literature behind speaker engineering deals frequently with the question of how much does phase linearity influence sound quality. Transients often change their appearance in the time domain if they go through a system with only slightly nonlinear phase behaviour. The audible quality, however, is the same in many cases, so the proof, once more, is in the listening. We neither can nor want to finish the phase discussion, but it is good to know that the ART midrange units excel in this discipline.

The woofers used in ADAM's S Series monitors have a special diaphragm called HexaCone. The core is a honeycomb structure made of Nomex, making them light and stiff. The front and back of the cone has been coated with Kevlar, which withstands elongation and enables the cone to resist deformation. HexaCone woofers are far more rigid than paper, polypropylene or aluminium devices of similar dimensions.

The effective length and diameter of the voice coils, together with the strength of the magnets and the available cabinet volume are aligned for musically optimum low frequency reproduction, not for the most impressive bass drum per cubic inch.

All in all, ADAM is trying to make a step forward in the precision of music reproduction and to develop 'the sharper tool' for the demanding sound or mastering engineer.

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