RAM 400
Programme Monitoring System

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Advance Information

After nearly two years of intensive research and development RAM is proud to announce the introduction of its new state-of-the-art moving coil transducer, the RAM 400 Programme Monitoring System. Designed to provide optimum stereo coherence, superior transient response across the audio bandwidth, the virtual elimination of transient interference effects, significant reductions in all known forms of distortion, above average sensitivity coupled to a remarkably extended and analytical bass performance, the RAM 400 will, we firmly believe, establish itself as one of the finest loudspeakers ever produced.

A Few Notes On Stereo Coherence.

In recent years more and more attention has been paid by designers, reviewers and public alike to imaging characteristics of loudspeakers. Unfortunately, however, the problems relating to achieving satisfactory stereo imagery have often been poorly understood, while the solutions put forward to deal with these problems have, in the main, tended to be somewhat 'vulgar'. Attempts at artificially contouring amplitude response by introducing, for example, troughs or in some instances sharp, fairly wide-band 'suck-outs' in the response may produce 'effects' which superficially seem to increase image depth or produce 'out-of-the-box' qualities, etc. It is abundantly clear to us that one 'effect' can only be introduced at the expense of some other vital aspect of the loudspeaker's performance and that the perceptive listener will always ultimately detect the consequences of such 'tinkering'.

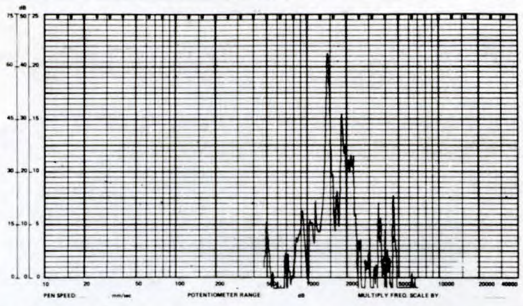
Our experience has taught us that to obtain a stereo coherent system, that is, the ability to obtain realistic spatial definition, is only achievable by carefully analysing the problems of directivity and dispersion in loudspeaker systems. Our point of departure in the design stage of the RAM 400 was, first of all, to examine the acoustic behaviour of virtually every high quality drive unit commercially available within the context of our criteria of wide dispersion over the selected operational bandwidth, response uniformity, controlled low Q resonances, minimum phase variations and low orders of non-linear distortion products. Early on in the prototype stage it was clearly demonstrated that stereo coherence is only partly a function of poor system directivity and that enclosure and drive unit mounting techniques have an influence in relation to imaging properties equal to or greater than the directional characteristics of the units themselves in the sphere of transient behaviour.

If, for example, we consider the functioning of a spherical dome tweeter covering frequencies from 3.5khz upwards when mounted on a conventionally wide, flat baffle, theoretically the sound from this unit should be able to propagate freely in all directions. However, the effect of the baffle will be to essentially block the primary sound wave from the high frequency unit, producing a secondary wave occurring in a later time domain. This interaction which we term 'Transient Interference' has a serious and deleterious effect on high frequency transient performance. In the RAM 400 such interference effects are avoided by mounting the high frequency unit on as small a baffle as possible. Additionally, all edges on the front baffle have been rounded to further avoid discontinuities in transient performance and amplitude response.

If we next consider the role of the mid-range unit in obtaining a stereo coherent image the problems are even more numerous although of a similar nature. Unlike a totally enclosed high frequency unit which performs very small excursions and has no rear chamber as such requiring damping and which therefore has virtually no cavity resonances, a mid-range unit, in order to produce useful low frequency output, must be able to perform relatively large cone excursions, for a given cone diameter. Consequently, the mid-range unit must be mounted in some form of enclosure. The volume inside this enclosure must inevitable produce unwanted cavity resonances which in turn will cause acoustic energy to be stored when any resonant mode is excited. The subsequent re-radiation of this energy back through the cone must be prevented if optimum transient performance is to be realised. The mid-range enclosure of the RAM 400 is consequently filled with selected long-haired wool to reduce re-radiation effects to an absolute minimum.

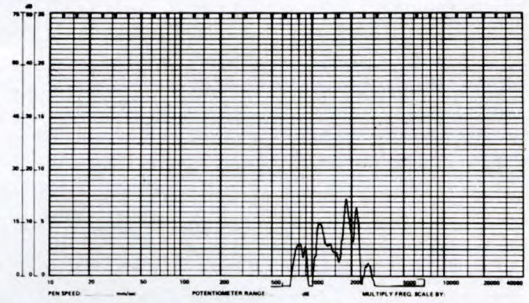
Transmission of mechanical energy as acoustic output caused by the panel walls of the enclosure is a form of undesirable secondary wave radiation which will impair the stereo coherence of the system. Because this spurious output is directly proportional to the size of the panel area relative to cone diameter for a given excursion of both cone and panel, the dimensions of the RAM 400's mid-range enclosure have been kept as small as possible consistent with the frequencies which the mid-range unit must operate down to in-system. In addition the panel walls of the enclosure have been heavily damped with 6mm solid bituminous pads to ensure that all resonant modes are thoroughly suppressed. A narrow baffle and rounded edges have been employed in the mid-range enclosure for the same reasons as in the case of the high frequency unit.

1. 27.3.79



RAM 400 Mid-range enclosure — Undamped mid-range enclosure of RAM 400 showing high Q peaks caused by panel resonances and standing wave modes due to cavity resonances.

2. 27.3.79



RAM 400 Mid-range enclosure — Mid-range enclosure of RAM 400 showing elimination of cavity resonances through the use of selected absorption materials; panel resonance transmission at 1.4khz reduced by over 25db with 6mm of solid bitumen applied.

The bass driver in the RAM 400, selected because of its close aproximation to a pure piston at low frequencies, is also mounted in its own isolated enclosure. In this way mechanical vibration-coupling to the rest of the system is completely excluded. Internal air-volume resonances are minimal due to the generous amount of long-haired wool applied, while panel resonances are very low Q because of the use of relatively thin panel walls heavily damped by solid bituminous pads and cross-bracing.

In the foregoing we have covered the contribution which directivity and structural resonances play in relation to achieving a stereo coherent system. The final dimension of the RAM 400's design vital to the realisation of this objective concerns drive unit displacement. The high frequency and mid-range units have been mounted, with respect to the low frequency unit, in such a way as to ensure that acoustic phase output is maintained in real time at the listening point. In the past we have consistently argued that phase linearity in itself is not enough to guarantee low colouration or stable stereo image presentation. By embodying low system directivity, absence of transient smearing effects and time arrival compensation, the RAM 400 Programme Monitoring System qualitatively advances the art of spatial definition.

Specifications

Enclosures: 1 x isolated LF chamber, 1 x isolated MR chamber, 1 x isolated HF sub-baffle. Construction: Low Frequency enclosure - High Density particle board, stress veneered, heavily damped by 12mm solid bituminous pads and cross-braced for maximum panel rigidity. Internal standing wave absorption achieved by use of selected long-haired wool. Adjoining edge between LF and MR enclosure rounded to inhibit sound scattering and interference effects.

Mid-range enclosure - High Density particle board, stress veneered and loaded with selected long-haired wool absorption materials. All front edges rounded for minimum diffraction and improved transient response.

High Frequency Enclosure - Because the high frequency unit is already totally enclosed there is no particular requirement for the unit to be mounted in an enclosure as such but in order to couple the tweeter to a diffraction-less surface and to avoid transient discontinuities a separate enclosure with rounded edges is utilised. In this way correct time arrival compensation is also obtained.

All units are flush mounted for optimum response linearity and minimum tunnelling effects.

Drive Unit Complement

1 x 330 x 225mm Low Frequency Unit. Polystyrene wedge massively damped with aluminium skin and selected visco-elastic materials. Ultra high power 50mm voice coil; low Q resonance die-cast frame.

1 x 165mm Mid-Frequency unit. Plastic cone critically profiled and terminated. Cone assembly damped with layers of selected visco-elastic materials to inhibit break-up modes and reduce Q of cone.

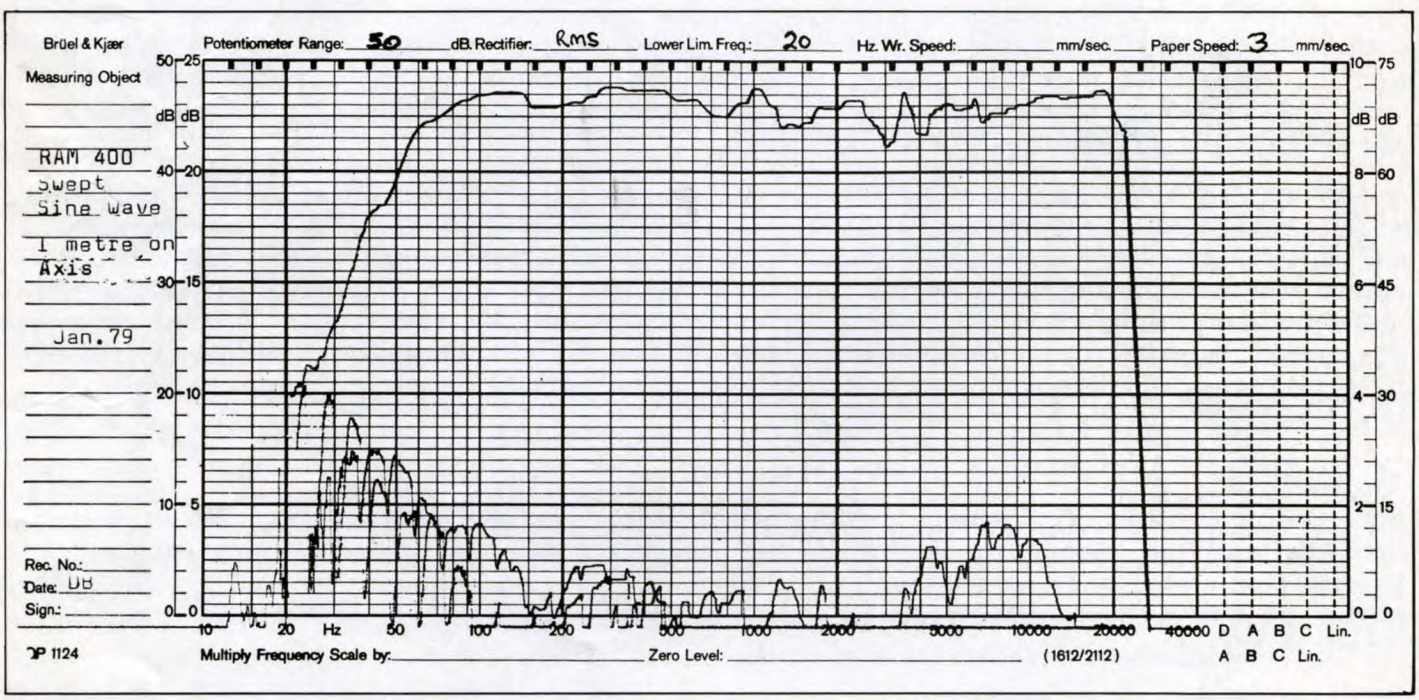
1 x 25mm Soft Dome High Frequency unit, chemically impregnated with unique butyl latex damping materials. Protective grille cage fitted which also contributes to achieving a very linear response characteristic.

Cross-Over Network

Optimally equalised terminal voltage characteristic for each driver, of low reactance and phase shift. Inductors in the high pass filter are of the Super Low Loss, Super High Power variety and are based on a ferrite core so advanced in terms of design and construction that its performance is essentially indistinguishable from air-cored inductors while possessing none of the latter's disadvantages. The low pass filter employs selected, close tolerance high stability, ultra low loss capacitors in order to provide smooth and predictable transition in the cross-over region.

To ensure stable phase integration symetrical Butterworth roll-off rates are employed throughout the circuit, 3rd order being used in the HF/Mid-range cross-over region and 2nd order in the Mid-range/LF section.

Power Handling: 120 watts programme.
Nominal Impedance: 8 ohms.
Frequency Response: Measured at 1 metre on axis with HF unit – ±2db 50hz – 22khz
Distortion: 2nd Harmonic - Less than 1% at 100hz; less than 0.5% at 1khz.
3rd Harmonic - Less than 0.3% at 100hz; unmeasurable at 1khz.
Listening Window Adjustment - 60 degrees overall.



RAM 400 — Frequency response and 2nd and 3rd harmonic distortion plots for RAM 400. Measured at Hirst Research Centre.

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RAM Electronics Limited The Granary Bracondale Trowse Norwich Norfolk England
Telephone: Norwich (0603) 614479 Telex: 975247 CHACOM G