Some tests on extended response cartridges

Tests complement those of July 1976 issue

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Earlier tests on nine extended-response cartridges with white noise record, demodulator and spectrum analyser are augmented with results for six further pickups.

In addition, damping properties are investigated and stereo compatibility assessed. Within the limitations of the tests the moving-coil pickups appear to be superior to the moving-magnet types.

APPEARANCE OF EARLY extended frequency response (e.f.r.) cartridges on the market highlighted the fact that while cartridge manufacturers placed much importance on extending the amplitude response of cartridges, few paid much attention to high frequency separation or phase response and delay properties of these cartridges. This initial oversight was a major contributing factor in the poor quality of recovered audio from CD-4 discs and only over the past few years have a new generation of extended-response cartridges appeared which display much superior characteristics in this regard.

Criteria which I believe e.f.r. cartridges should fulfil are as follows.

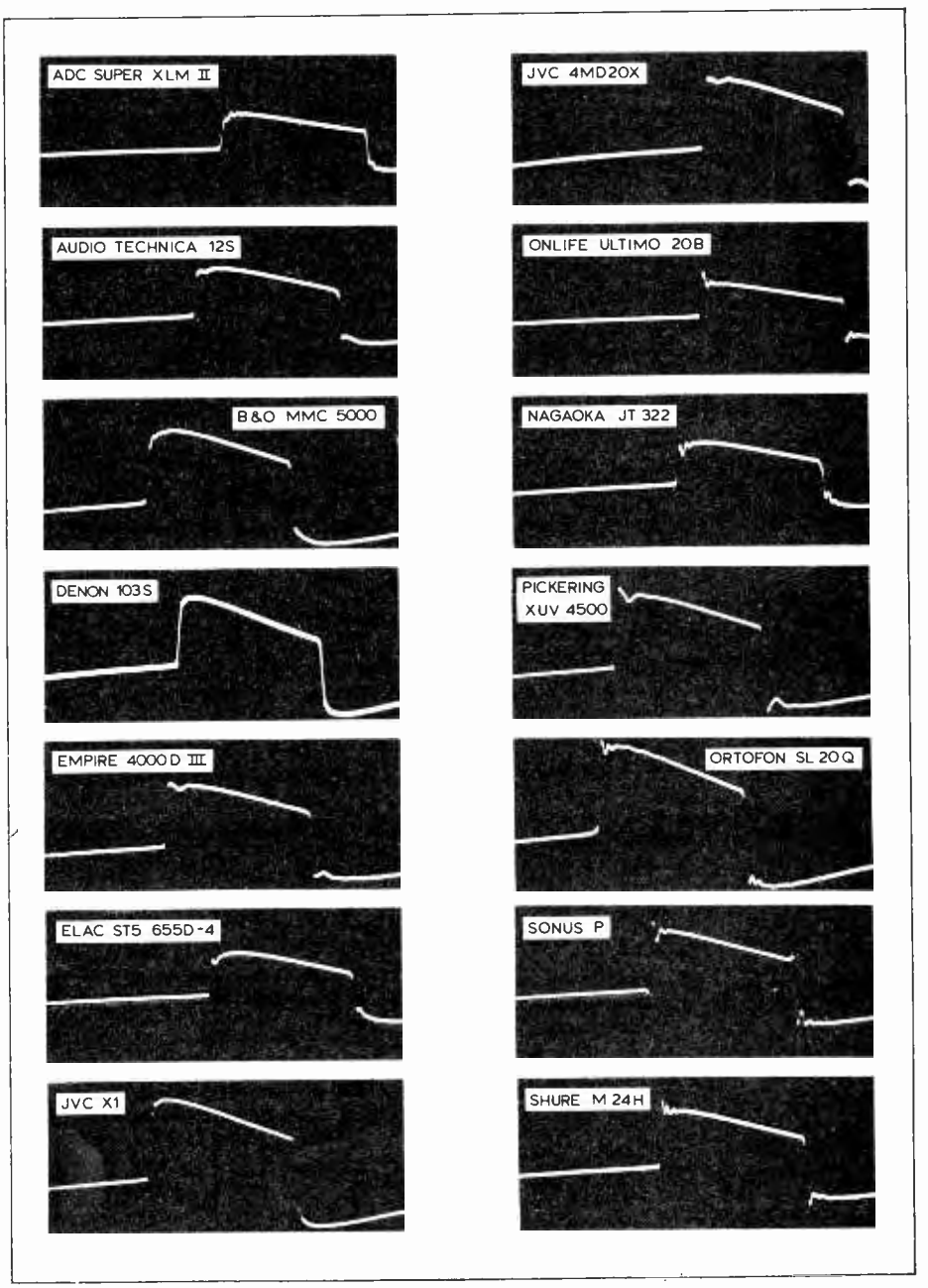
Amplitude response. When equalized through the required circuitry (normally RIAA) the frequency response should be flat to about 18kHz. In the range 18kHz to 45kHz the cartridge should be able to track such frequency bands with high output (0.5mV or greater) but a flat response over this range is not essential, because the signal is frequency modulated.

Crosstalk. High channel separation should exist over the frequency range to 45kHz, otherwise frequency beats occur in the carrier range which leads to distortion and degradation of the recovered audio signal. This phenomenon was apparent with earlier e.f.r. cartridges and data issued seldom gave reference to crosstalk characteristics in the carrier region. Crosstalk figures in excess of 15dB in the carrier region should be the minimum obtainable.

Phase response and delay. Two-channel matrix systems use amplitude and phase relationships for encoding and decoding so that phase differences between the left- and right-hand channels of the cartridge may affect performance. In the carrier region, phase imbalance may result in crosstalk. Delays between baseband and demodulated carrier signals should be determinable and constant over the required frequency band. (Early e.f.r. cartridges displayed delays of about 25μs at 30kHz and which varied over the frequency band. The latest type have cut this delay to about half this figure and are also less frequency dependent.)

In addition to these criteria I believe it is important that the cartridges should reproduce mono and stereo discs with the same quality as high-grade conventional cartridges, so listening tests were also carried out with reference to a good quality stereo pickup.

For the white noise tests a Rotel RP3000 turntable fitted with an SME Series II Improved arm with detachable headshell was used. Each cartridge was separately aligned according to SME instructions.



A CD-4 test record distributed by Sutton-Miller and produced by Louis Dorren and James Yabbert together with the aid of a Hewlett Packard audio spectrum analyser proved an invaluable tool. The record, whose pressing quality is not all that I would have liked, has a band of white noise which when passed through the cartridge and demodulator is used to maximize separation of the demodulator. The spectrum analyser then draws out the amplitude response for the front and back channels. The shape and distance between these two responses gives a good indication of amplitude response and delay characteristics.

The results of these tests are shown in the accompanying photographs. The top trace is the front channel response, the bottom trace is the rear channel and the difference between the two is the separation between front and back. In all cases only right-channel measurements were made. Each horizontal division is 1kHz while each vertical division accounts for 10dB separation.

The demodulator used (*Wireless World* June and July issues, 1976) had extremely linear phase, i.e. constant delay, through both the baseband and carrier signal paths. Therefore any variation in the delay of the cartridge would show up in the separation characteristics. Crosstalk would not do so because the white noise is played on one side of the groove only, the other side having no baseband or carrier modulation.

Examination of the various curves shows that the Denon 103S produced by far the best results with a consistent 18dB front/back separation over the range to 13kHz (only 10kHz shown here).

The JVC X1, ELAC ST5655D-4, Ortofon SL20Q and Onlife Ultimo 20B produced roughly equivalent results with peak separation of 18dB falling to 10dB at 7kHz and little separation at 10kHz.

The Pickering XUV4500 showed maximum separation of 10dB, but this was constant over the 10kHz bandwidth. This cartridge therefore has a constant delay over the desired frequency band, but its value is significantly different from the other cartridges tested in the group.

The B & O MMC5000 had slightly better separation (about 14dB) more or less maintained over the 13kHz band, again illustrating the constant delay characteristics of the cartridge.

The Audio Technica AT12S and the JVC 4MD20X (a selected version of the AT12S) produced peak separation of about 18dB, decreasing to 5dB at 8kHz and remaining at such to 13kHz.

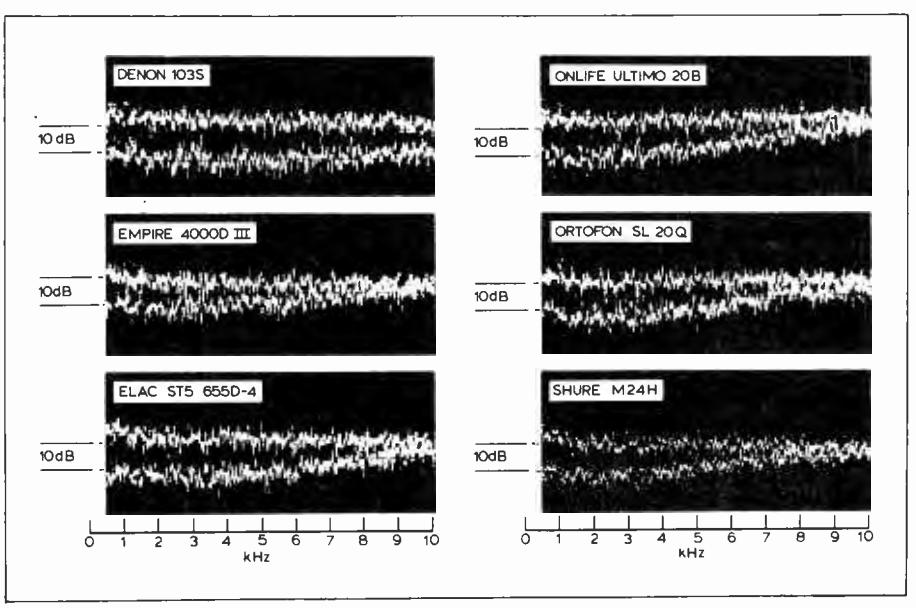
The Nagaoka JT322 showed peak separation of 15dB, but no separation was apparent after 9kHz.

The Shure M24H showed peak separation of 15dB, dropping to 10dB at 6kHz and disappearing at 9.5kHz, with the Empire 4000DIII following much the same pattern, but only displaying peak separation of 12dB.

Finally the ADC Super XLM/II and the Sonus P failed completely to show any separation for the white noise test. On closer examination, this did not prove that either of these cartridges could not track the carrier, only that they were incapable of doing so effectively during high and rapid baseband modulations. This was later borne out in listening tests with CD-4 discs.

With the aid of a JVC test record which had 300Hz square-wave tracks, it was possible to test the various damping properties of the test cartridges. No RIAA equalization was used. Page 71 shows the results.

Again the Denon 103S proved superior with the B & O MMC5000 and JVC X1 showing very similar results to the Denon. Although the remaining cartridges exhibited some overshoot, this was rapidly damped in all cases. The Ortofon SL20Q would probably have exhibited better results in another arm with heavier damping as the SME/Ortofon combination is not believed to be particularly good.



Listening tests

The test disc already mentioned has a track with music coming from the four speakers in sequence. This track is used to set the demodulator for maximum separation and this is achieved by turning the front channel gain down and adjusting a separation control for a null in the back channels. As both left and right channels are done independently, one can listen for crosstalk between left and right. In only one case (the Shure M24H) did this prove noticeable and not annoyingly so, but it was higher than with the other cartridges.

A second disc used was a CD-4 pressing of Mandigo which had a severe warp. All the cartridges, except the Ortofon SL20Q, tracked the worst track with no audible loss of carrier. I believe that the Ortofon problem relates to its combination with the SME arm and headshell and SME have themselves recognised this and intend releasing an attachment which may be added to the SME arm to improve performance of such cartridges in their arms.

A third disc was a fairly early CD-4 pressing which had some noticeable carrier loss, but which was not warped. Here the JVC X1, the Pickering XUV4500, Ortofon SL2Q, Elac ST5 655D-4 and Denon 103S proved best. Next the AT12S, Empire 4000DIII, JVC 4MD20X, and Ultimo 20B gave very acceptable results. The Shure M24H was not as good but proved superior to the Nagaoka JT322. The B & O MMC5000, ADC Super XLM/II and the Sonus P displayed frequent carrier loss especially when high baseband modulation was present.

Finally informal subjective listening test were carred out by a small panel using the Shure V15III as a reference. It is difficult to choose a standard for such comparative tests, but the V15III was chosen because of its relative popularity and well-known tracking ability. The first result was surprise at the very high standard of reproduction when used on conventional discs. Secondly, the major default of most cartridges tested was their susceptibility in picking up noise from dirty or scratched discs. And a final point was the consistently good results achieved by the moving-coil cartridges.

Conclusion

The cartridges which tracked well and exhibited large carrier outputs so that so-called "carrier breakup" was less apparent on bad records were the JVC X1, Pickering XUV4500, Shure M24H, Elac ST5 655D-4, Denon 103S, AT12S, Empire 4000DIII, Ortofon SL20Q, Ultimo 20B and JVC 4MD20X. Of these the only one whose tonal quality I found disturbing was the Empire 4000D which seemed very "brittle". As regards playback of conventional two-channel or mono discs the best were undoubtedly the moving-coil types, with the Denon 103S being superior and the Ortofon

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SL20Q a close runner-up. The JVC X1, B & O MMC500 ADC Super XLM, Nagaoka JT322, Elac and Sonus P gave a very good account of themselves.

My choice overall would be the Denon 103S followed by the Ortofon SL20Q which is about a third of the price of the former and gave a really good account of itself. It would probably do even better in another arm. The best of the non-moving coil types would be the JVC X1. The best of the cheaper type is undoubtedly the AT12S which still gives very good value for money.

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