Revox A700

Test Report *(Studio Sound and Broadcast Engineering, October 1975)*

FOR MANY YEARS the name 'Revox' has been associated with high quality recorders in the professional/semi-professional and better-endowed domestic applications. For some reason Revox have seen little competition in the field; while others have designed recorders to compete with Revox, their end products have either been too expensive or lacking in the sound construction and good long-term performance that is associated with the Revox trademark.

While I do not know the numbers of Revox type *77s* sold, considerable confidence in the sales of the new type *A700* is confirmed by the fact that the pricing of the machine is based on 100 000 units and that the development of the specialised integrated circuits has probably cost £20 000, let alone the other development costs. With Revox working on such a large-scale production, it is of course difficult for newcomers to compete in this rather specialised market, and with a few exceptions the following review shows that the type *A700* is indeed a first-class recorder.

Tape transport

The basis of the tape transport is a flanged alloy die-casting, which is machined for the attachment of the three motors and the head block, itself a separate die casting. The remainder of the unit is in the form of a cadmium-plated steel chassis to which is attached the electronic parts and the heavy mains transformer which is, of course, better kept off the main die-casting.

Constant tension winding is obtained by servo control of the two outer-rotor type spooling motors, with the resulting capability of handling either 267 mm NAB spools or cine centred spools; however, NAB adaptors are not supplied with the recorder. Tension control signals are derived from tension arms adjacent to each spool, the tension arms being spring-loaded with their position sensed by a variable transformer which electrically controls the spooling motor torque. Proceeding towards the head block, there are two large diameter idlers, the right-hand one driving the tape timer which is calibrated in minutes and seconds at a tape speed of 19 cm/s, and is also used to detect tape motion—again using an rf variable transformer technique.

The head block casting forms a plug-in unit with space for four heads, the normal complement being the erase, record and replay heads. Azimuth adjustment is really sound, with very positive head location. The tape guidance has been given great thought; there are four adjustable spring-loaded guides on the head-block. I am, however, a little worried about the wear properties of the guides, which appear to be un-plated brass.

As with all respectable recorders, a flutter roller is included to reduce friction noise (scrape flutter), but I was surprised to find that a fixed guide is included between the flutter roller and the record and replay heads. The capstan motor is a special servo motor which is phase locked to a crystal oscillator, offering constant speed irrespective of the incoming mains frequency at the three tape speeds of 38 cm/s, 19 cm/s and 9.5 cm/s. However, when it is required to operate at different speeds an external frequency may be used as a reference. The capstan is of large diameter, thus easing mechanical tolerances. The pinch roller

operates in the trailing position by a solenoid-operated arm, which also manipulates the hinged replay head hum screen.

All the tape transport drive functions are electrically interlocked, and tape tension is even controlled in the start and stop modes with a resulting smooth operation without any tendency to throw loops or other untoward habits. It is quite possible to go directly from fast wind to record without disaster—the tape stops from fast wind, is lowered on to the heads and proceeds in the record mode!

However, not all is perfect; one shortcoming is that, in spite of the fact that tape motion is detected and the tape end is optically detected, when the tape comes to a finish the recorder takes a considerable time to stop the take-up spool with the result that tape can fly all over the place. This defect is caused by too much inertia and too little friction around the tape motion-sensing roller. A further matter is that, in my opinion, the fast wind modes are too fast, such that even 3M type *207* with its matt back does not give a very clean wind on the take-up spool.

All function controls are illuminated push buttons, the current function(s) showing a white light in the case of non-record functions and a red light in the case of record functions. The three tape speed selection buttons are only illuminated when the selected tape speed has been attained, providing a safety factor when changing speed. Other than the normal tape movement buttons, there is a non-locking 'pause' button which operates in any mode, including fast wind and two further control modes. One of these does a fast rewind when pressed and reverts to play when released—very useful for editing; the other button provides an 'auto' function whereby the recorder optically senses a spliced 'window' at the ends of the tape. When the end is reached, it rewinds and reverts to its original play or record mode at the beginning of the tape.

Access to the heads for editing is quite good, and certainly there is no problem in gaining proper access for cleaning and de-gaussing. However, it is not possible to listen in the fast wind modes where the tape is removed from the heads by two solenoid-operated guides. Rock and roll operation is possible in the stop mode.

Electronics

All the electronic components are mounted on printed boards, most of which are identified with component references as an ease to servicing. The general arrangement is that small boards plug into a mother board, which contains a number of components; however, access to these and other components is excellent and the many integrated circuits plug into sockets as a further aid to servicing. The overall standard of construction is excellent and the power supplies, which can be operated from all the common mains voltages and frequencies, are protected by some eight identified fuses. One small irritation is that the mains lead is not of the plug-in type; however, plenty of storage space is provided for it and its plug.

On the record side comprehensive mixing facilities are provided, selection of stereo inputs being by means of two input selector switches, each of which has two (left and right) slider-type level controls. One selector has positions for microphones of high or low sensitivity, RIAA phono, radio or auxiliary inputs, while the second selector provides for further microphones of high or low sensitivity, multiplay/ echo, an auxiliary input and an off position.

The microphone inputs are balanced 6.35 mm jack sockets on the front panel and, with the exception of the radio input, which is a five-pole DIN socket; the remaining rear panel inputs are phono sockets. A further slider control is provided for setting master level, recording on either or both of the half tracks which are selected by illuminated pushbuttons.

Two VU meters are provided for monitoring level in the before or after tape conditions and are also fitted with peak indicator lights which have a relatively fast response. I am, however, surprised that Revox have not gone to peak type meters.

The entire replay section is switched to before or after tape by the same switch as the level meters, and can also be switched to the four modes of operation—stereo, left, right or mono. However, of the two available line outputs, one is before the mode switch and the other after. These line output phono sockets and the DIN type record/play socket are at fixed level and occur before the tone control circuits which affect the remaining outputs.

These remaining outputs comprise a power amplifier output in the form of a DIN socket and two headphone outputs in the form of stereo jack sockets on the front panel; one of these disenables the power amplifier output when the phones are inserted. These outputs are controlled by a slider gain control and are affected by the bass and treble controls which take the form of rotary switches.

In addition to the audio facilities, the power amplifier output supplies a 20V dc line for switching the mains in the auxiliary power amplifiers made by Revox. As this socket is a standard 180° DIN socket it follows that some caution is required not to attach other equipment to the 20V dc line. Further sockets are provided for remote control, and for external speed control; a dummy socket being fitted to the review machine for the future addition of slide synchronisation.

Perhaps unfortunately, there is no provision for the addition of noise reduction systems, but such an addition should not be difficult as a customer modification.

Replay performance

Checking of the replay equalisation to the NAB standard was accomplished by means of DIN calibration tapes manufactured by BASF which are, themselves, subject to a tolerance of □1 dB at high frequencies. It is therefore most encouraging to report that the Revox performance was within □ 0.8 dB from 40 Hz to 18 kHz at a tape speed of 38 cm/s and □1.2dB from 40 Hz to 18 kHz at 19 cm/s or from 40 Hz to 16 kHz at 9.5 cm/s. Clearly the machine had been most carefully aligned, and this was confirmed by checking azimuth in terms of relative phase between tracks.

The signal-to-noise performance in terms of reference level to noise is also excellent as is to be seen from the following figures which show the performance of the replay amplifier system without tape but with all motors running **(see table 1)**.

TABLE 1

Tape speed	Reference level	Reference level to noise			
		Unweighted 20 Hz/20 kHz	'A' Weighted RMS	CCIR weighted ref 1 kHz rms meter	CCIR weighted ref 1 kHz DIN peak meter
38 cm/s	320 nW/m*	65·8 dB	74·0 dB(A)	68·6 dB	63·6 dB
19 cm/s	320 nW/m*	64·5 dB	73·4 dB(A)	68·0 dB	63·3 dB
9·5 cm/s	250 nW/m	58·8 dB	65·4 dB(A)	61·0 dB	55·5 dB

Figures are average of both channels.
*Add 4·1 dB for a reference level of 514 nW/m.

TABLE 2

Tape speed	Frequency response ref 1 kHz worst case	Channel balance worst case
38 cm/s	±1·5 dB 20 Hz to 20 kHz	±0·5 dB
19 cm/s	±2·0 dB 20 Hz to 20 kHz	±0·4 dB
9·5 cm/s	±2·0 dB 20 Hz to 18 kHz	±1·0 dB

TABLE 3

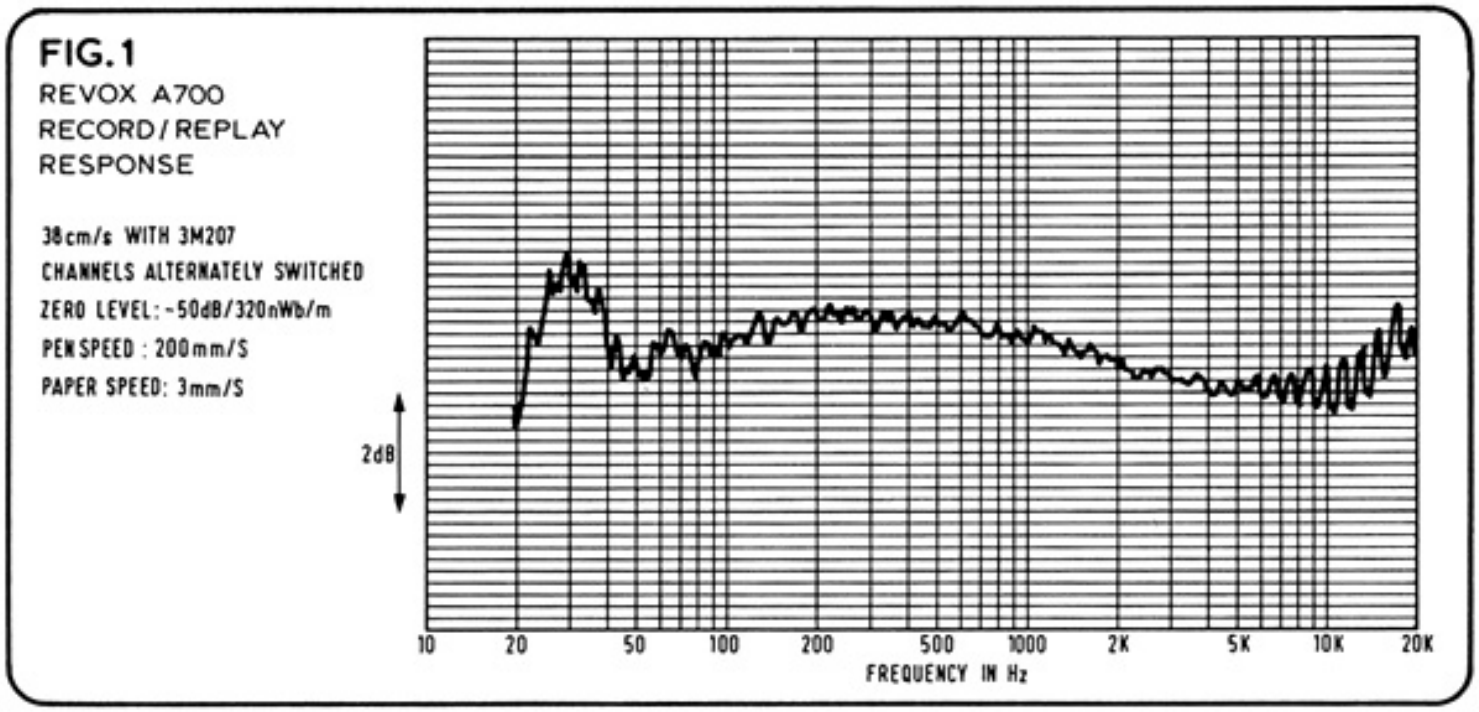
Tape speed	Reference level	Reference level to noise		
		'A' Weighted rms	CCIR Weighted ref 1 kHz rms meter	CCIR Weighted ref 1 kHz DIN peak meter
38 cm/s	320 nW/m*			
Bulk Erased		67·1 dB(A)	60·4 dB	55·4 dB
Machine Erased		63·2 dB(A)	55·9 dB	51·2 dB
19 cm/s	320 nW/m*			
Bulk Erased		67·7 dB(A)	59·7 dB	54·7 dB
Machine Erased		64·2 dB(A)	55·2 dB	50·5 dB
9·5 cm/s	250 nW/m			
Bulk Erased		61·8 dB(A)	54·7 dB	49·9 dB
Machine Erased		59·5 dB(A)	52·5 dB	46·5 dB

Figures are average of both channels, which were within close limits of each other.
*Add 4·1 dB for a reference level of 514 nW/m.

On the other end of the scale, it was found that amplifier clipping, at 1 kHz at a nominal tape speed of 38 cm/s, did not occur until the fluxivity at the replay head was increased to some +15 dB above 320 nW/m, which allows in the order of 5 dB margin for any current tape types.

Record replay performance

As with the replay only frequency response, the record/replay response with 3M type 207magnetic tape was really excellent. **Fig. 1** shows that the overall response at 38 cm/s is within ±1.3 dB from 20 Hz to 20 kHz including the minor bass boost at 30 Hz, which is probably due to head polepiece effects. It should also be noted that the balance between the two channels is really excellent.



The general pat-tern of the response at 38 cm/s was followed at two lower tape speeds as shown by the following **(see table 2)**.

The following table shows the reference level to noise ratio for 3M type *207* tape in its bulk--erased form, and when it has been erased and recorded with bias by the machine with all inputs shut **(see table 3)**.

Comparison of the above table with the replay only figures shows that there is a-considerable margin between the inherent machine replay noise and the noise from a modern tape such as 3M type *207*, it is however felt that a small improvement is still possible in the noise introduced by the record process.

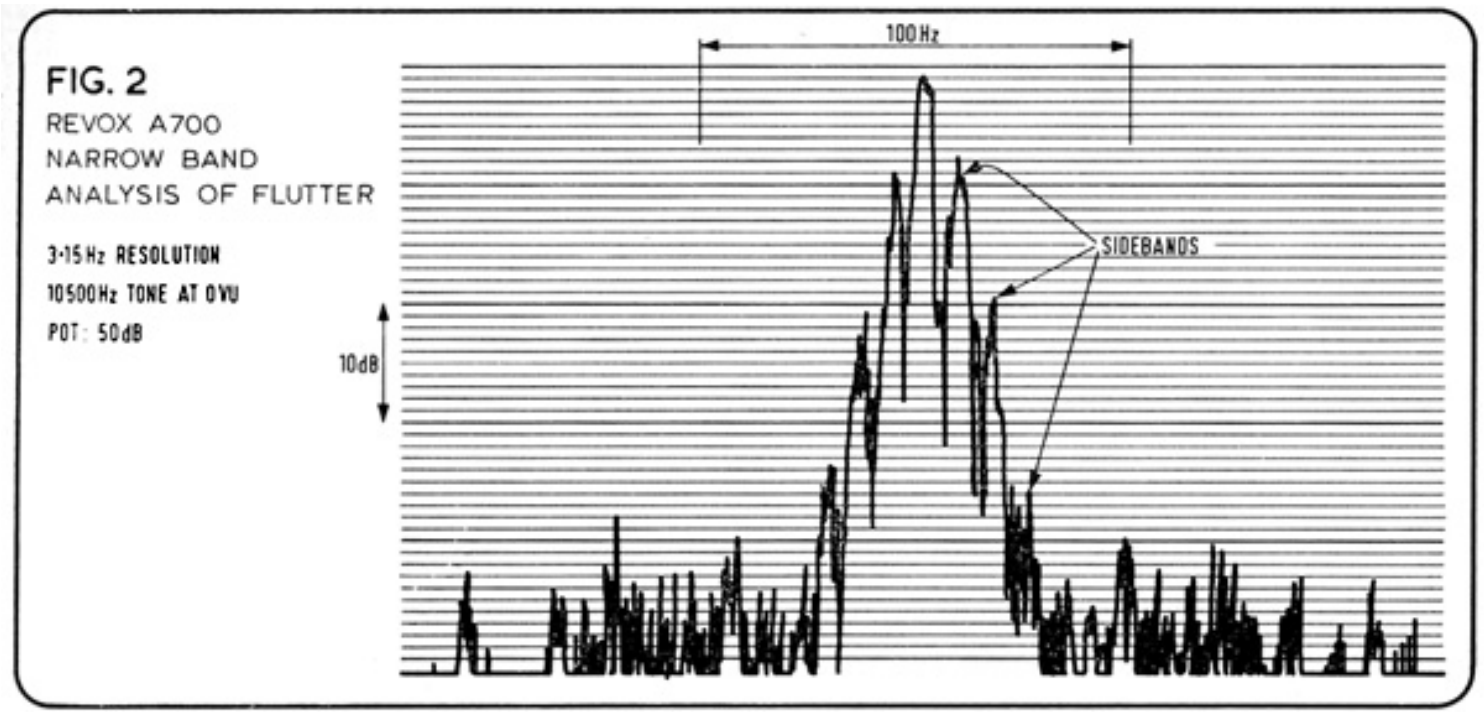
Distortion at the above reference levels was less than 0.8 % third harmonic at the two upper tape speeds, and less than 1.0% third harmonic at a tape speed of 9.5 cm/s. Three per cent third harmonic distortion occurred at +5 dB above reference level at the two higher tape speeds and 7 dB above 250 nW/m at 9.5 cm/s.

Intermodulation distortion was measured at a tape speed of 38 cm/s by the SMPTE method using 50 Hz and 7 kHz tones in a 4:1 amplitude ratio at the following equivalent peak sine wave levels:

Record level	IM distortion
320 nWb/m	5·5%
—10 dB	1·2%
—20 dB	less than 1·0%

While the figure at reference level demonstrates the shortcoming of the bass boost in NAB equalisation, the figures at lower levels are good by tape recorder standards. Of similar interest to intermodulation distortion is the effect of friction noise (scrape flutter). **Fig. 2** is a narrow band analysis of a replayed 10 500 Hz tone that

had been recorded at 38 cm/s. While flutter sidebands can be clearly identified at approximately ±10 Hz and multiples thereof from the carrier frequency, this performance is good in comparison to very many recorders.



Of further interest is the phase relation between the two stereo tracks; this property is shown in **fig. 3**, which is an oscillogram of the phase shift when recording and replaying a 10 kHz signal at 38 cm/s. This oscillogram, which shows a maximum phase deviation of ±6°, was obtained by using a Bruel & Kjaer *2971* phasemeter which has a response time of 2400°/s at audio frequencies. It is interesting to note that the periodicity of the phase shifts may be correlated with the pinch roller diameter.

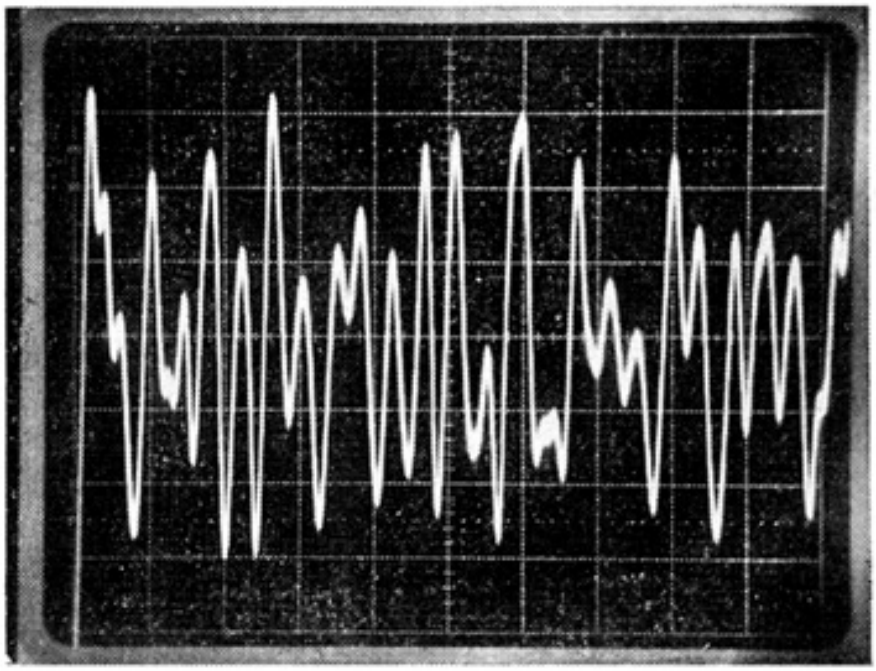


FIG. 3 *Showing phase error L-R (maximum ± 6°)*

The investigation into crosstalk performance yielded very good results with the measured record/replay crosstalk between channels being below -70 dB at mid frequencies, including head contour effects which remained below -53 dB at any audio frequency, 35 Hz being the worst case.

Erasure performance was measured by recording a 1 kHz tone at 38 cm/s at the reference level of 320 nW/m, and then measuring the residual signal after a further pass over the record and erase heads with the input faders shut... the resulting signal was reduced some 83 dB on the worst channel, the other channel offering some 87 dB erasure no complaints in this department.

Wow, flutter and speed

Wow and flutter to the DIN weighted method (as now agreed by the IEEE and ANSI) was measured at the beginning, middle and end of both 178 mm cine type spools and 267 mm NAB spools at the three tape speeds. While there was little variation of wow and flutter within a spool, the initial measurements at the tape speed of 38 cm/s were somewhat higher than those shown in the following table, which are average values:

Tape speed	Spool type	Weighted wow and flutter to DIN
38 cm/s	NAB	0·025%
	Cine 178 mm	0·04%
19 cm/s	NAB	0·035%
	Cine 178 mm	0·05%
9·5 cm/s	NAB	0·07%
	Cine 178 mm	0·09%

These results, which are well within specification, are outstandingly good for this class of recorder, and the initial measurements were within specification. However, no reason was found to explain the higher initial measurements, which were consistent over a period of time. The measurement of the tape speed indicated the identical error of +0.3 % at all speeds, which is on the tolerance limit of the calibration tape used; furthermore, the speed variation from one end of a NAB reel to the other was within ±0.01 %.

Inputs and outputs

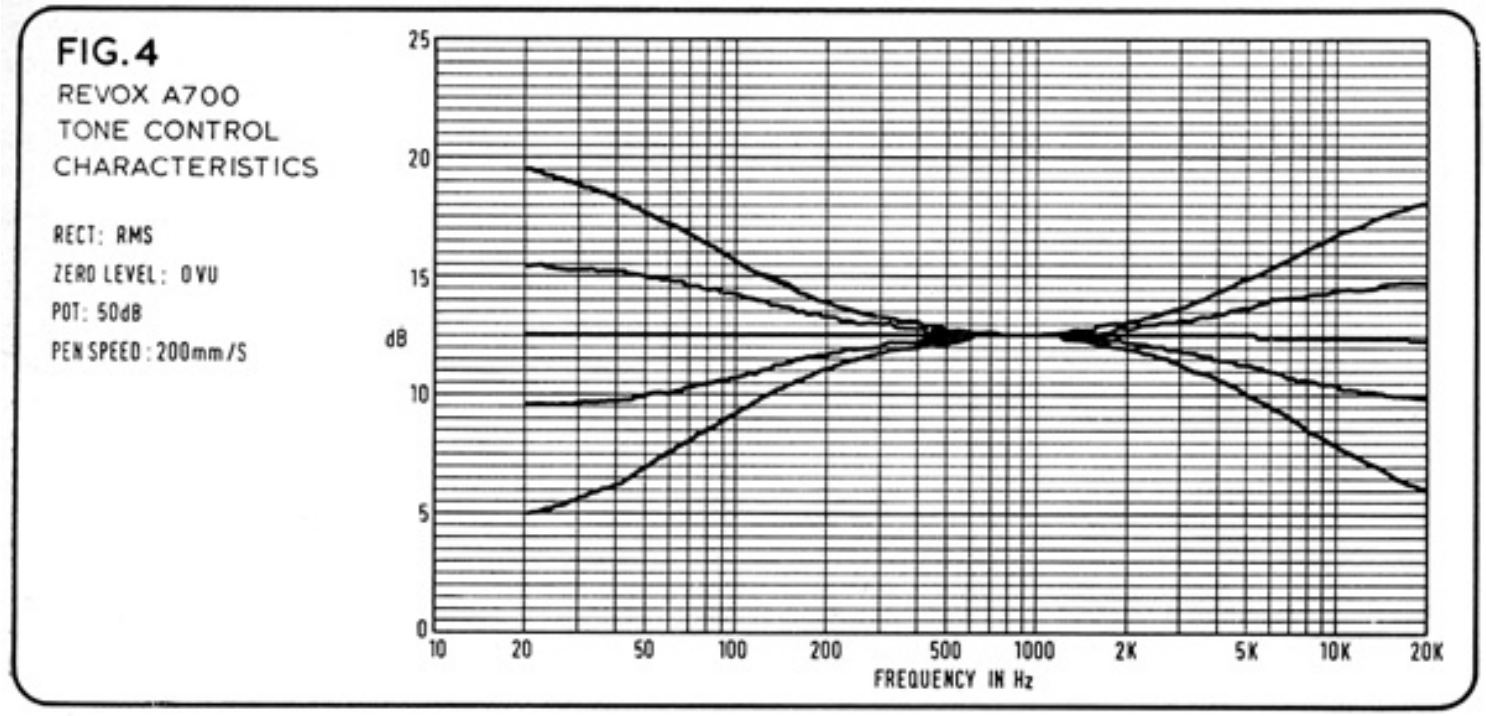
All the above performance figures were measured between the line inputs and the line outputs, the alternative facilities were therefore investigated. So far as frequency response is concerned, the microphone inputs to all intents and purposes were flat from 100 Hz to 20 kHz, but showed some roll-off in the bass with a -3 dB point at 35 Hz, which is no bad thing. On the other hand the phono input was within ±0.5 dB of the RIAA equalisation curve from 20 Hz to 20 kHz.

While noise in the record section was generally good, the microphone inputs were rather excessively noisy, the equivalent input noise being -113 dBm when loaded into 200 ohms this figure could be considerably improved.

The sensitivities and impedances of the inputs and outputs were all checked and found to be to specification, although some comment is appropriate. Firstly, the input impedance at the microphone input is effectively around 6k ohms which is far higher than is required for 200 ohm microphones which are probably the most common impedance. The measured noise from the microphone inputs correlates very closely with the unnecessarily high input impedance, and the provision of an impedance in the order of 1k ohms would make a very substantial reduction in the noise from this source.

Secondly, the impedance of the line outputs at 4.4k ohms (as measured) is unduly high for professional applications, and while the alternative headphones and power amplifier output are available, they are after the level control and tone controls.

On the subject of the tone controls, these are seven-position rotary switches giving 2 dB steps at 80 Hz and 10 kHz, the good characteristics of which are shown in **fig. 4**, which shows the response at alternate positions.



The level meters
While most manufacturers claim to fit vu meters, inspection often reveals that the so-called meters are nothing like the ASA standard meter not so with Revox, the vu meters are to the proper specification with average rectifiers and the correct rise time the return time is however measured at nearer 400 ms than the recommended time which is close to 300 ms. I am not however at all happy about the tape flux level corresponding to 0 vu which was found to be -1 dB relative to 320 nW/m which only leaves a 6 dB margin between 0 vu and 3% third harmonic distortion as opposed to the NAB recommendation of 8/10 dB.

On the other hand the peak indicator lamps operated at the 3% distortion point within 10 ms of an overload, and stayed on for 130 ms thus easing readability.

Summary
During the course of this review I have been critical of any minor shortcomings of the Revox *A700* for the simple reason that this is a very interesting machine which will, without doubt, sell in great numbers; it is a very fine machine for its price and thoroughly recommended.

I would however suggest that the microphone input impedances should be modified to reduce the rather high noise level that results from such a high input impedance and that some attention should be paid to the zero level settings of the vu meters.

On the credit side there are many excellent aspects of the machine; among which signal-to-noise in the

replay department, frequency response, speed stability and wow and flutter deserve special mention. Furthermore, the standard of both mechanical and electrical construction are beyond reproach. In fact, the two latter aspects of the machine put some recorders costing very much more into disgrace.

by Hugh Ford