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To: Mark IV

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Subject: Stepped Head Stacks at 18 Mb/s/track

I have tested two stepped head stacks, one Metrum (J21) and one Spin Physics (46764) at 18 Mb/s/track (320 ips). When performing such tests, it is important to:

1. Be careful about the tape used for the test. I have had problems with some tapes at this data rate. For these tests, I used Sony D1K USNO1002, BE14.
2. Record all 32 tracks with heterogeneous (orthogonal) data, white noise filtered to 8 MHz band width. Because of mutual coupling between adjacent heads, recording the same data on all tracks, or recording with all odd or all even heads, can cause misleading results.
3. Perform the test in both directions of tape travel. Flying of the tape over the heads at high speed can occur in one direction, but not in the other.
4. Be sure that the heads are fully contoured. Better results in one direction than the other is a sign of a poor contour, because of unidirectional flying.
5. When shuttling the tape to contour the heads, position the heads at $-400\text{ }\mu\text{m}$ in the forward direction, and at $+350\text{ }\mu\text{m}$ in the reverse direction, to insure that the head stack is contoured slightly beyond the full range of normal stack motion (-350 to $+320\text{ }\mu\text{m}$)

The Metrum stack was useable at 18 Mb/s as delivered. But with the Spin Physics stack, the tape was flying so far away from the heads in the forward direction at 320 ips that there was nothing recorded on the tape at 18 Mb/s. Good performance was achieved after about 24 hours of shuttling thin Sony D1K tape at 80 ips and 40% relative humidity.

For each stack the head voltage was adjusted to the minimum value that produced good performance. These values were 11 volts for the Spin Physics heads, with $1.5\text{ K}\Omega$ series resistors, as the write-only stack in position 1; and 12 volts for the Metrum heads, with $2.0\text{ K}\Omega$ series resistors, as the read/write stack in position 2.

For the Spin Physics write-only heads, the worst-case error rates were $7\text{E-}4$ in forward and $6\text{E-}4$ in reverse. For the Metrum read-write heads, the worst-case error rates were $8\text{E-}4$ in forward and $7\text{E-}4$ in reverse. These results are for 32 tracks recorded at 18 Mb/s/track (320 ips) and reproduced at 80 ips.

I also performed the same tests on the operational head stacks at Westford: Metrum stepped, J78 and J82, installed on 31 March 1997. The head interfaces on this recorder have $1\text{ K}\Omega$ series

resistors. The vacuum was set to 10 inches. For the write-only head stack in position 1, the worst-case error rates were $8\text{E-}4$ in forward and reverse. The test of the read-write stack was complicated by the fact that it is almost worn out, as indicated by the low head voltage of 6.8 volts necessary to get good performance at lower speeds. At 18 Mb/s/track in reverse, error rates exceeded $1\text{E-}2$ for some heads; when recording in the forward direction, the error rates for all 32 heads in the stack were better than $2\text{E-}3$.

From these tests of stepped head stacks, and from the successful recordings made with Metrum stepped head stacks at MV-3 during two 1 Gb/s fringe tests, I conclude that Metrum stepped head stacks have satisfactory performance at 18 Mb/s/track. I have not had enough experience with triple-capped head stacks, or with Spin Physics head stacks, to reach any conclusion about the suitability of these other head stacks for use at 18 Mb/s/track. The performance of any head stack at 18 Mb/s/track is improved if the value of the $1\text{ K}\Omega$ series resistors is increased to 1.5 or $2\text{ K}\Omega$.