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To: VLBA Data Recording Group

From: Alan E.E. Rogers

Subject: Tape Slitting Signatures and Head-to-Tape Tension Noise from Slitting Errors

1] Slittings

When tape is slit from a large web, the edges are not perfectly straight. To put some limits on the slitting errors I installed a simple optical edge detector (see Figure 1) and measured some typical edge signatures (see Figure 2 for scope photo). The typical slitting errors are as follows:

1) Finest structure (shortest wavelength) on good 3M5198 tape	≈5"
2) Finest structure on poor 3M5198 tape (at ≈10 μm p-p)	≈1"
3) Typical peak to peak variations on 3M5198	40 μm
4) Typical peak to peak variations on AMPEX 721	50 μm

2] Head to tape tension variations expected from slitting variations

When the tape moves at the edge guiding point in response to a slitting error it bends and starts to move along the capstan. However, since the motion of the tape along the capstan takes an amount of tape travel (approximately equal to the distance from the capstan to the edge guiding region) to reach equilibrium, there is a period of time during which the tape is deformed. The deformation or bending of the tape produces a variation in tension (using bending beam formula) equal to

$$\frac{3\,z\,E\,w}{L^2} \approx 2.3 \text{ lbs/sq"}/\mu\text{m peak-peak}$$

where z = slitting error

w = tape width

L = distance from edge guiding region to capstan (≈6")

E = Young's modulus (≈7×10^5 lbs/sq")

or 0.5%/μm when expressed as a fraction of the 500 lbs/sq" total tension. For peak to peak slitting errors of 40 μm the tension variations (at the edge of the tape) is 20%. Only the slitting errors with

wavelength less than L will produce tension variations, as longer wavelengths will be accommodated by motions along the capstan. The implications of this analysis are fairly serious, for any attempt to significantly shorten L will greatly increase the tension noise. However, the use of an idler roller will isolate the tension noise from the headstacks since the tension noise will exist between the idler and the edge guiding region. On the other hand, the presence of an idler can lead to tension variations if either the idler or capstan have any eccentricity.

3] Tension variations from capstan/idler eccentricity

With an idler, any capstan or idler eccentricity will produce tension variations and if both are eccentric they will beat with others with a period determined by the difference in diameters. The peak-peak stain is

$$2\epsilon/L$$

where ϵ = center of figure - center of rotation

L = distance between idler and capstan

which in turn produces a fractional tension variation of

$$\frac{2\,\epsilon\,Y}{PL} \approx 4\%/\mu m$$

where Y = Young's modulus (7×10^5 lbs/sq")

P = Pulling pressure (500 lbs/sq")

Thus the expected eccentricity for capstan/idler combination has to be carefully investigated if we are to return to the use of the idler.

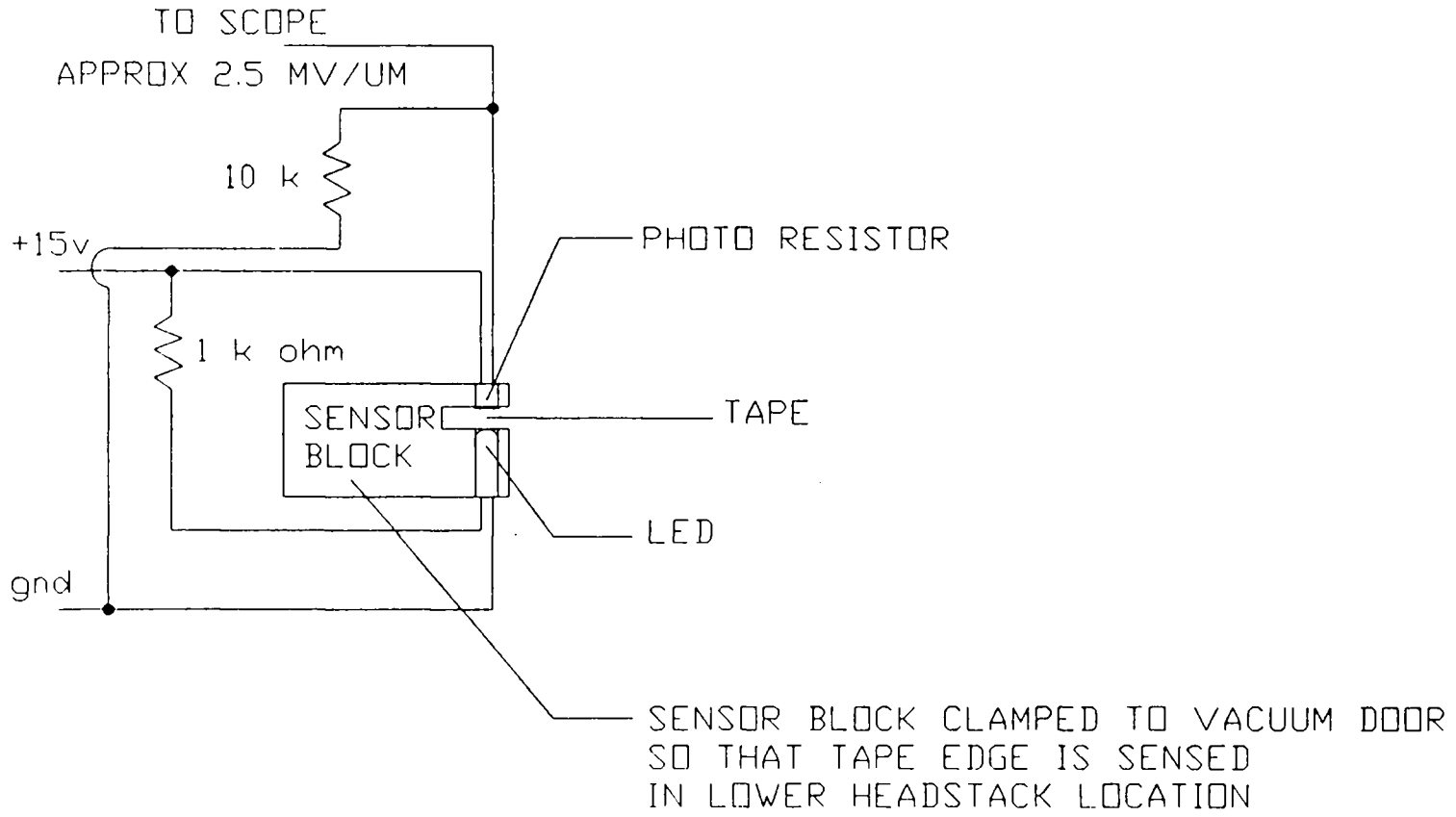

FIG. 1 SIMPLE OPTICAL EDGE DETECTOR

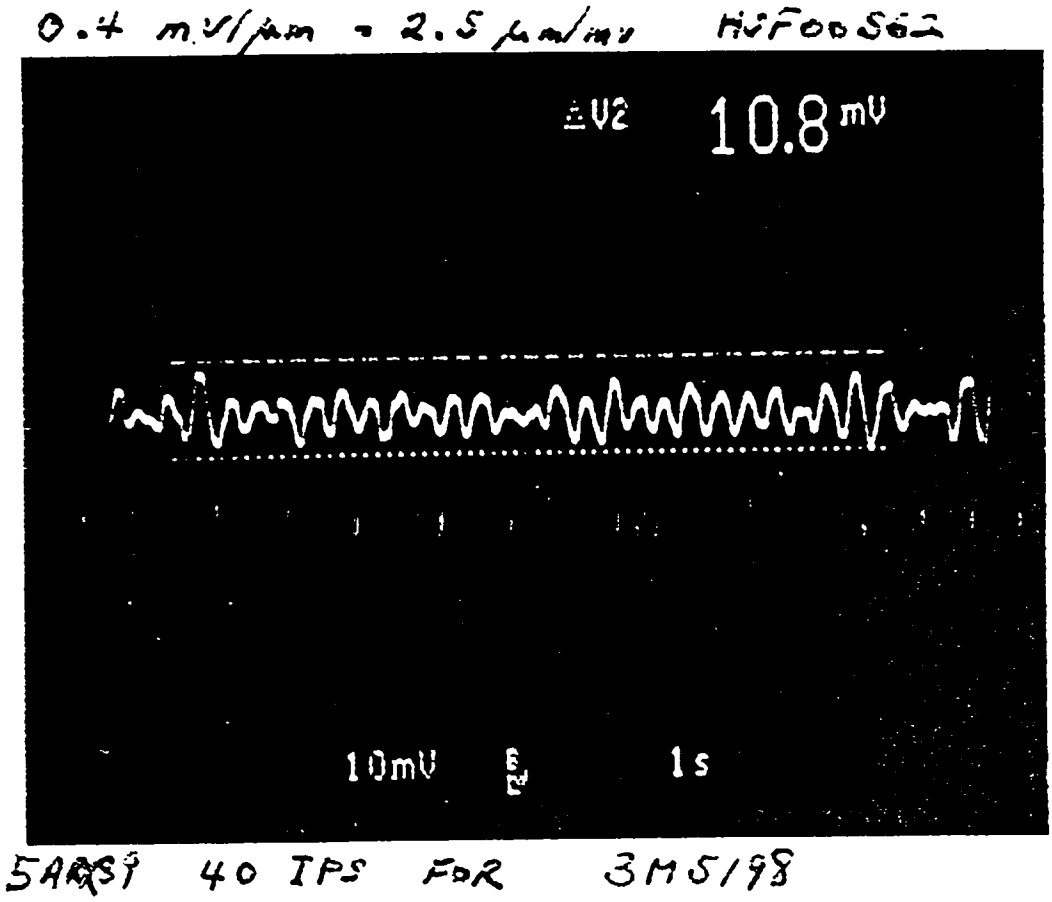

Figure 2. Edge Tracking Signature