VLBA ACQUISITION MEMO #237

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To: VLBA Data Recording Group

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Subject: Methods of measuring the headstack gap length

1] Introduction

There is now some concern that the gap length which is nominally 0.33 microns may be poorly controlled. Variations might explain the variations seen in the write performance of some of the VLBA/MKIIIA headstacks.

2] Gap null

The most definitive way of measuring the gap length is to measure the wavelength of the gap null. Measurements made on headstack B27 in Recorder 3 (reported in Acquisition Memo #184) gave a gap length of 0.33 microns while measurements on newer headstacks, (D45,D48,D49) all give a value (corrected by the factor of 1.1) of 0.25±0.02 microns.

3] Gap bar inductance

Measurements of inductance (or impedance) might also be used to estimate the gap length. If this works on the gap bar then they could be selected before committing them to headstacks.

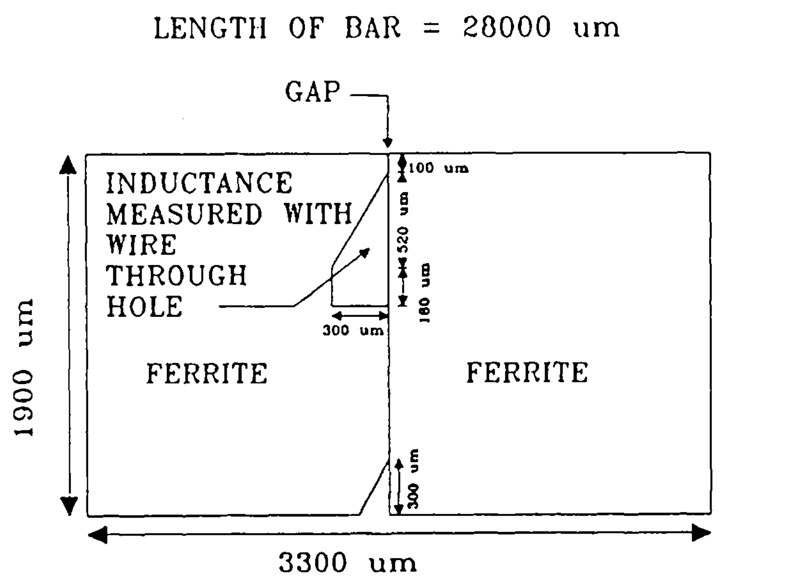
The cross section of the Hitachi gap bar is shown in Figure 1 along with a magnetic circuit for a single turn through the bar. The reluctance of the ferrite cross section of the gap bar was computed using the current conduction analog.

A scaled replica of gap bar cross section was cut out in copper foil and a constant current applied. The voltage drop was measured and then compared with the voltage drop through a rectangular section of the same foil. The resistance of the gap bar cross section was found to be equivalent to a rectangular cross section of 550±20 by 100 microns.

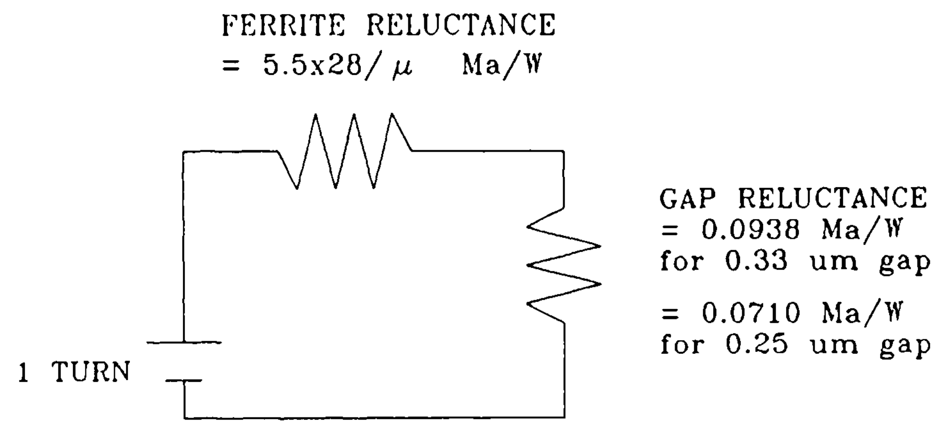
The table in Figure 1 gives the measured inductance as well as the model inductance for a gap length of 0.25 and 0.33 microns. The results are more consistent with a gap length of 0.25 microns than with the nominal gap length of 0.33 microns. The permeabilities are taken from a data sheet which came with another batch of gapped bars. The data sheets from the actual bars whose inductance was measured were not available from Metrum. These permeabilities were confirmed ±20% by measuring the impedance with the gap shorted by another bar. However, the permeability at 1 MHz has to be known to 5% in order to obtain the gap length to 10%. While the gap bar inductance measurements are useful as a means of checking the consistency of gap bars they may be biased - unless accurate values of permeability are available.

If the ferrite permeability is inversely proportional to the square root of the frequency the intercept of a straight line fit to the measured inverse inductance will give the gap reluctance. This method is tested in Figure 3 and also yields are result consistent with a gap length of 0.25 microns. The inductance data at 50 KHz is not very reliable and was found to increase following degaussing of the gap bar. This method can be used to derive the gap reluctance (and hence its length) without knowledge of the geometry of the ferrite reluctance path as it separates the frequency dependent and frequency independent parts of the reluctance.

Attachments: 3 Figures



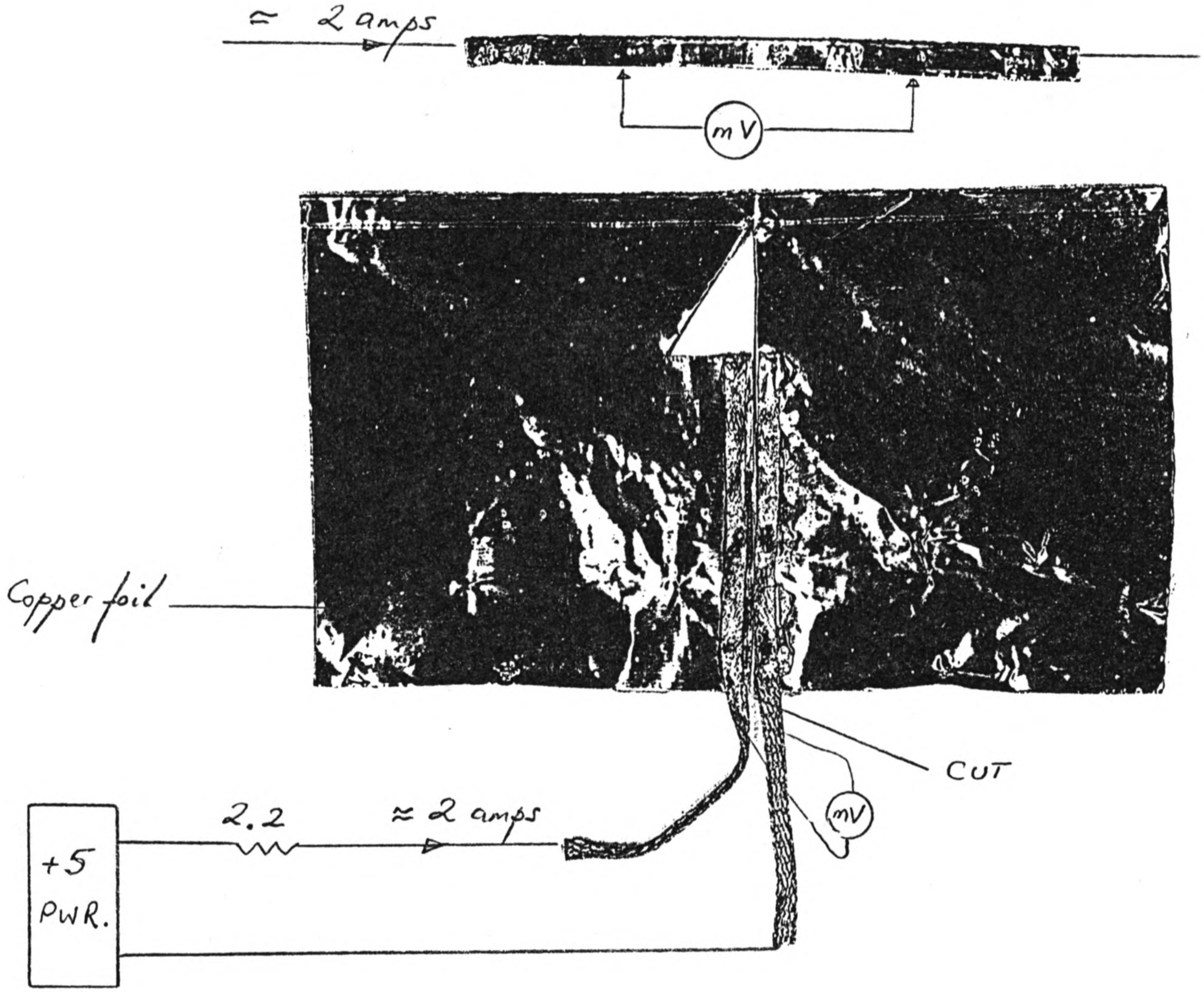
GAP BAR CROSS SECTION



MAGNETIC CIRCUIT

Freq. MHz	μ	meas.ind. μH	model(gap=0.33)	model (gap=0.25)
1	900	4.2	3.80	4.13
5	363	2.3 (interpol.)	1.90	2.02

Figure 1.



Analog "computation" (measurement) of ferrite reluctance path

Figure 2

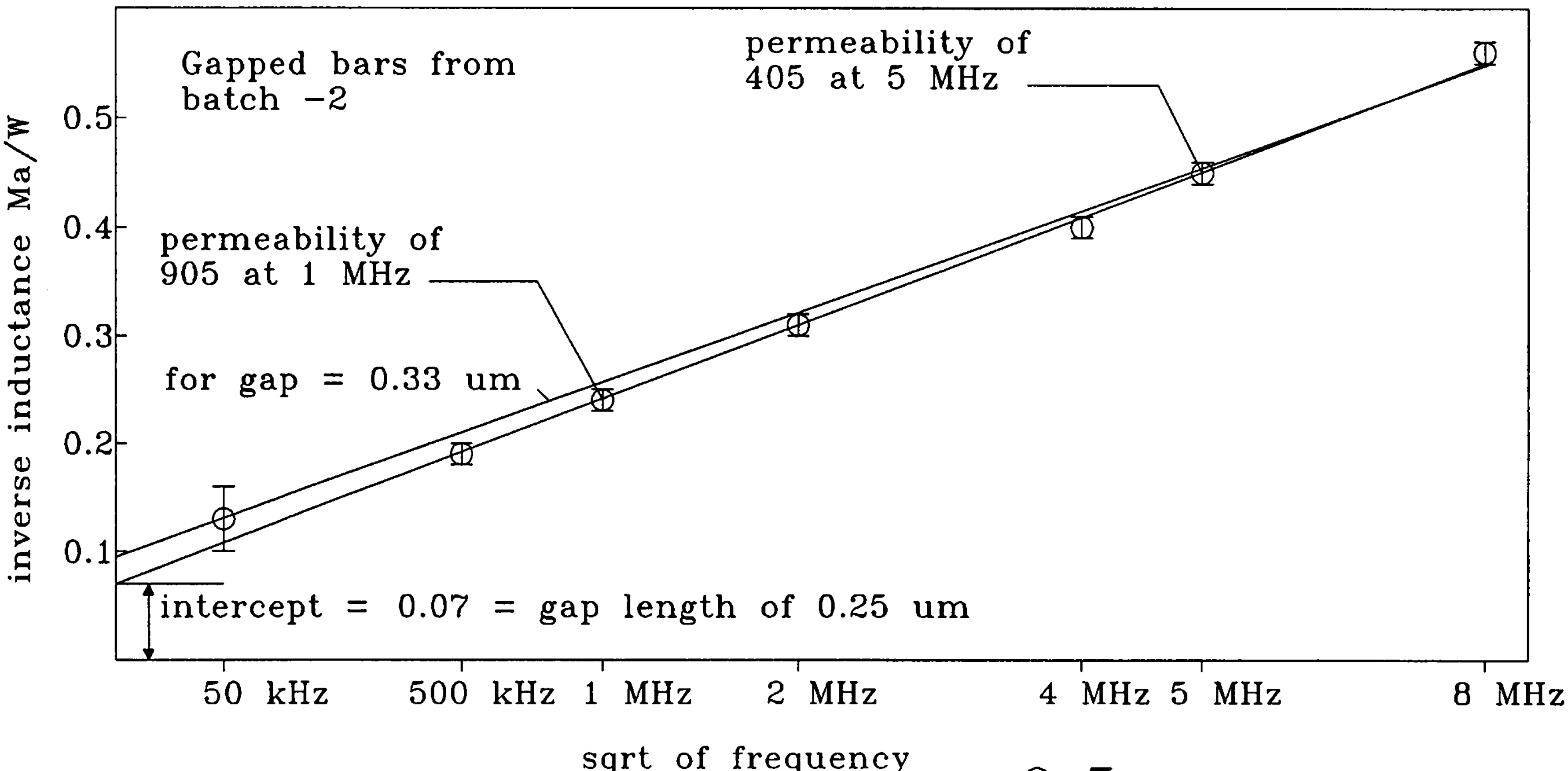


Figure 3. 1/L vs frequency $^{0.5}$