VLBA ACQUISITION MEMO #211

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

HAYSTACK OBSERVATORY

WESTFORD, MASSACHUSETTS 01886

17 July 1990

Area Code 508
692-4764

To: VLBA Data Recording Group

From: Alan E.E. Rogers
Dan L. Smythe

Subject: Record Cross-talk Theory

The VLBA/MKIIIA headstacks have an inductance of 25 μH and a mutual inductance of 3.8 μH (See VLBA Acquisition Memo #155). While the cross-talk mechanism is discussed in VLBA Acquisition Memo #152, the treatment is oversimplified. Figure 1 shows the equivalent circuit for the mutual inductance between heads using the measured value of mutual inductance. There are two limiting conditions. The first is for a shorted or heavily loaded secondary and the second is for a secondary which is terminated with the same resistance as in the primary. In the first case, the current in the secondary is approximately the same as in the primary times the coupling coefficient K = 3.8/25 = 0.15. However, since both adjacent heads produce cross-talk, the secondary current is doubled for in-phase cross-talk to a value of 0.3 or 30% of the primary. Thus if the condition of a loaded secondary exists (which bench tests show to be a good approximation for the VLBA owing to the capacitive loading of the preamp) a cross-talk signal will be written if the head field is three times the coercivity at the surface of the tape. For the second case of a resistively terminated secondary the secondary current peaks at a value that is (1/e = 0.37) times the value for a shorted secondary. It might be thought that the MKIIIA interface would be close to this case and thus have negligible cross-talk. However, measurements show that the level of cross-talk is only slightly lower in the MKIIIA (see VLBA Acquisition Memo #210). The reason is probably that the tape particles respond to any magnetic field pulse - no matter how short, and thus even the current ripples produced by the small capacitance (few pf) connections to the head coil can magnetize the tape. The simulated waveforms given in Figure 1 show that the peak current produced by these ripples is about the same as that produced with a shorted head. The measured head inductance of 28 μH is for a new head with 38 μm depth of gap. A worn head with almost no depth of gap will have a lower inductance (a value of 16.5 μH was measured) and hence a larger coupling factor (goes from 0.12 to 0.20). The mutual inductance does not depend on the depth of gap. Thus the worst case cross-talk current is expected to go from about 25% for a new head to about 40% for a worn-out head.

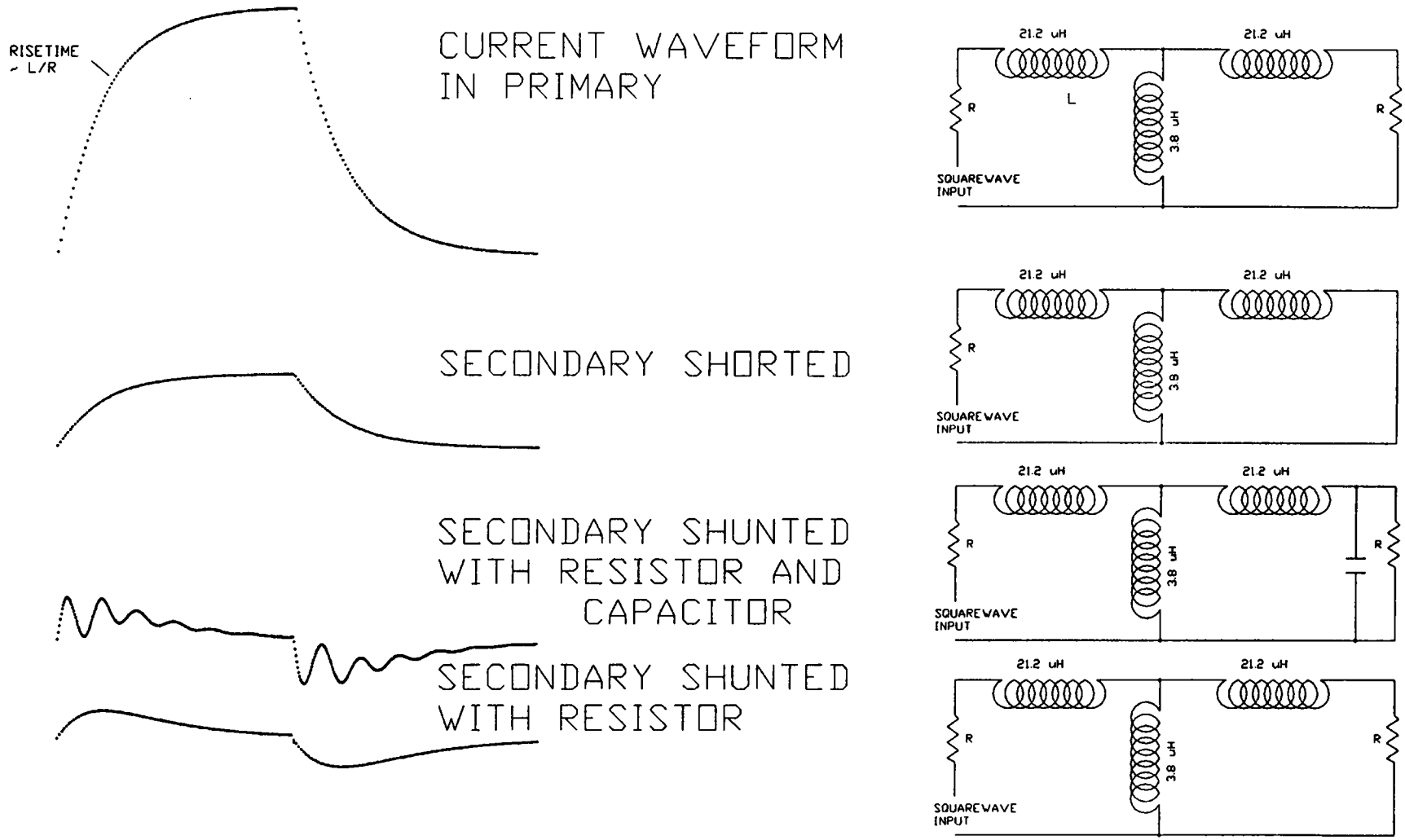

FIGURE 1 CURRENT WAVEFORMS IN PRIMARY AND SECONDARY (PRODUCING CROSS-TALK)