

MARK IV MEMO #282

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To: Mark IV Development Group
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Subject: 8 Mb/s Equalizers

To correlate double-speed (8 Mb/s/track) recordings, we need equalizers with good performance when playing thin tapes at 160 ips and thick tapes at 270 ips (from thick-tape stations). At one time, it was thought that all double-speed recordings would be played at 140 ips (7 Mb/s/track). Therefore, equalizers optimized for this playback data rate were designed and built. Since we have enough of these "NT140" equalizers for all playback units at all Mark IV correlators, I have investigated the possibility of using them at 160 and 270 ips, and compared their performance with that of the Mark IIIA "NT270" equalizer design. The results of that investigation are summarized here.

Testing with the configuration described below showed that the "NT270" equalizer is clearly better at 270 ips, and somewhat better at 160 ips, than the "NT140" design. Unmodified, the NT140 is marginal when playing thick tapes at 270 ips, because it has approximately 9 dB more output than the NT270, and saturates the reproduce electronics. But, since we have a full complement of the NT140 equalizers, and not many NT270 equalizers, I reduced the output of the NT140 by adding a 120-ohm resistor in parallel with Rx3 to reduce its effective value from 120 ohms to 60 ohms. With this change, the NT140 is usable for playing thick tapes at 270 ips, but still not as good as the NT270, and its performance at 160 ips is degraded.

Therefore, we have three options for 270 ips playback: 1) Reduce the gain of the Pre-Amplifier as described below. 2) Build some more (approximately 250) NT270 equalizers. 3) Modify all the 140 ips equalizers by putting 120 ohms in parallel with Rx3. The modification for Option 1) is required for quadruple-speed (14Mb/s @ 280 ips) playback and its long-term cost is zero, because it is a necessary modification for 14 Mb/s/track operation. Option 2) is more costly than Option 3), but will give better performance.

All of the results reported here were performed using a head assembly that was modified for playback at 14 Mb/s/track. These changes improve the performance of the NT140 equalizer with thick tape at 270 ips, and do not degrade performance at 80, 135, or 160 ips. I recommend that these changes be made on the head assemblies on all playback units. Those modifications are summarized here:

- On the Head Interface Boards:
Remove R1-R18 and D1-D18.
- Put ferrite beads (J.W. Miller FB73-085) on the red (read) wires between the Head Interface Boards and the Pre-amplifier Boards to suppress oscillations.
- On the Pre-Amplifier Boards:
 1. Change C41-C58 from 100 pF to 100 nF to improve phase response.
Required for quadruple-speed (280 ips) playback.
 2. Change R4 and R10 from 3K3 to 1K8
 - Doubles the band width from 4 to 8 MHz.
Required for quadruple-speed (280 ips) playback.
 - Reduces gain by 6 dB.
Improves performance of NT140 equalizer with thick tape at 270 ips.

The results reported here were performed using a Parallel Reproduce Piggy-Back (PRPB) Board with the following modifications:

- Change R1-R6, R25-R30, R49-R54 from 1K2 to 100R to reduce output offset voltage of input amplifiers.
- Change R7-R12, R19-R24, R31-R36, R43-R48, R55-R60, R67-R72 from 82R to 100R to reduce over-all gain by 2.5 dB.
- Change R13-R18, R37-R42, R61-R66 from 1K to 5K1 to reduce the output offset voltage and improve the dynamic range of the output amplifiers when using the NT140 equalizers.