VLBA ACQUISITION MEMO #235

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To: VLBA Data Acquisition Group

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Subject: Limitations of the track selector switch in the VLBA formatter.

Introduction:

We have observed on tapes from Pie Town, that when more than one track is assigned to a channel, the formatted data are not identical. George Peck ran some tests on the cross-point switch in the formatter "A/D" board and found that when many tracks (more than 4) are assigned to one output from the sampler differences start to appear in the track data. We have studied the problem further.

Cross-point switch model

The data sheets for the MITEL MT8804A switch arrays are difficult to interpret as they lack precise definitions of the quoted switch capacitances. A simple model which fits the observed performance is one in which there is 5 pf across every switch junction to ground. With this model the 32 x 32 configurations (made from 8 x 4 MT 8804As) so that each input and output line is shunted by 5 x 32 = 160 pf to ground. This model (shown in Figure 1) results in a time constant (assuming 50 Ω driving source) of approximately
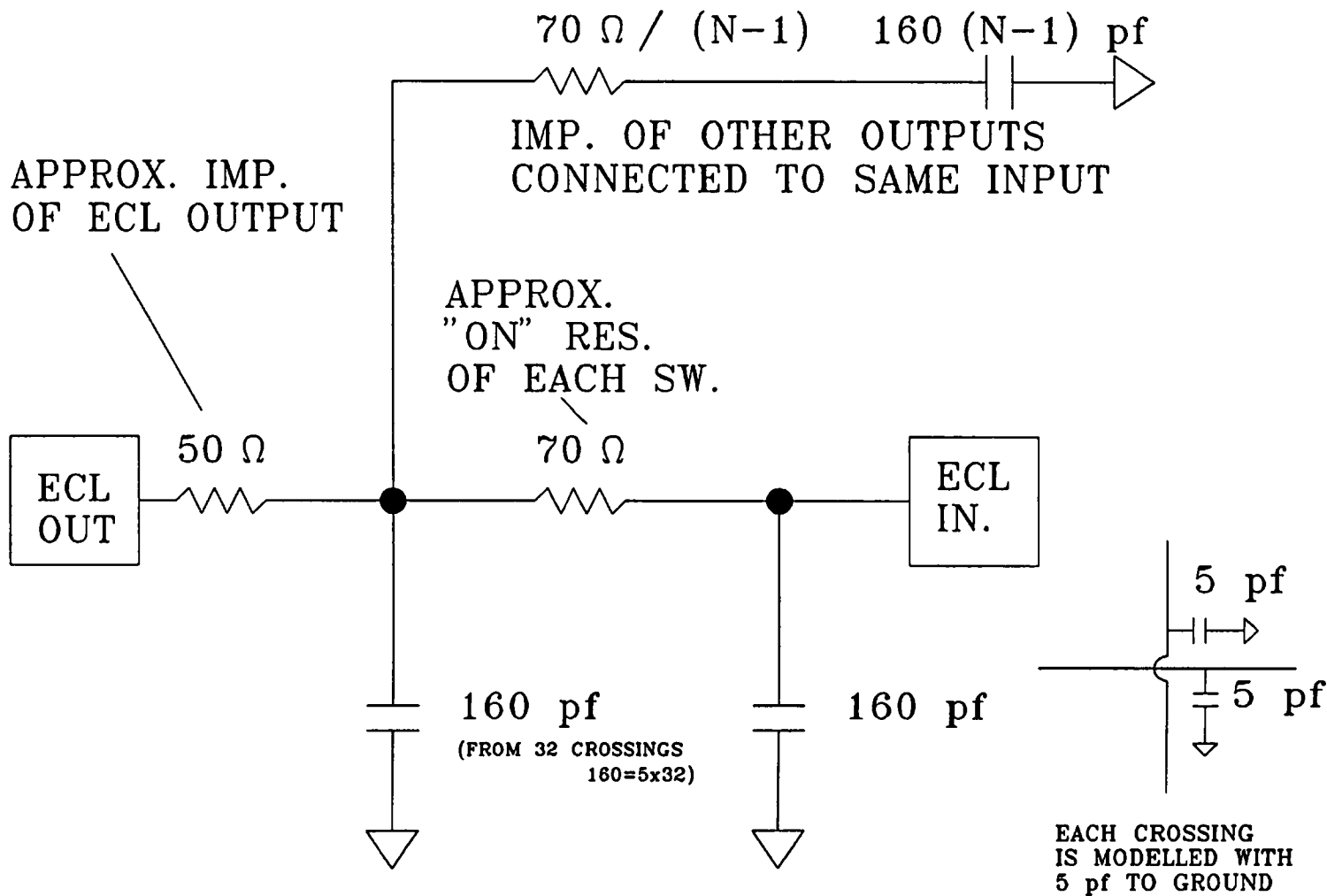
$$8 (N + 1) \text{ nanoseconds}$$

where N is the number of outputs assigned to one input.

Limits of acceptable performance

The switch outputs have only 31 nanoseconds to settle as the inputs can change every 31 nanoseconds (owing to fixed 32 MHz sample clock for the inputs) and the output clocking occurs on the positive going edge of the output sample clock which is aligned with the input clock. When N > 4 the outputs take too long to settle and the output is not reliable. Since the inputs to the cross-point switch always enter at the 32 MHz rate the problem is independent of the actual formatter sample rate. Figure 2 shows the output for formatter track 8 (pin 5 on 5253) and the clocking waveform for various numbers of multiply assigned tracks.

Conclusion

In order to maintain sufficient margins, no more than 2 tracks (not counting systems tracks which are assigned beyond the cross-point switch) should every be assigned to one input. We are currently investigating ways of improving the performance of the analog cross-point switch or perhaps replacing it with a digital switch (which has become available since the formatter was designed).

70 Ω / (N−1)   160 (N−1) pf

IMP. OF OTHER OUTPUTS
CONNECTED TO SAME INPUT

APPROX. IMP.
OF ECL OUTPUT

APPROX.
"ON" RES.
OF EACH SW.

50 Ω

70 Ω

ECL
OUT

ECL
IN.

5 pf

160 pf

160 pf

5 pf

(FROM 32 CROSSINGS
160=5x32)

EACH CROSSING
IS MODELLED WITH
5 pf TO GROUND

N= number of tracks assigned to one input
model assumes 5 pf per switch node

Figure 1. Model for cross−point switch

1 Track
assigned
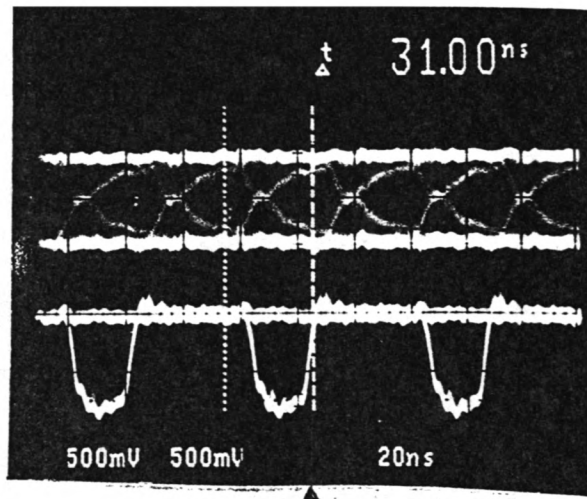
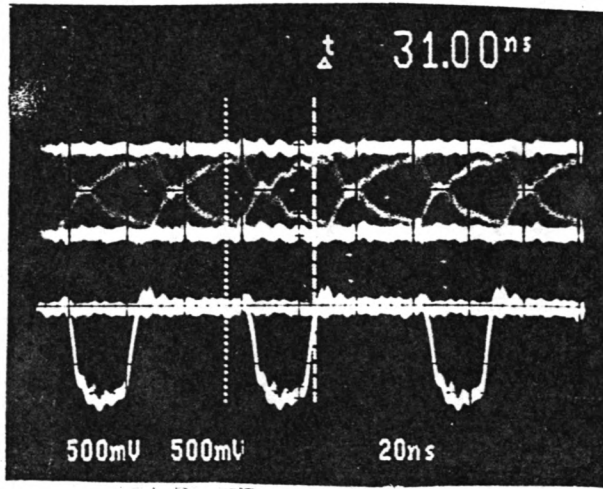Decision margin
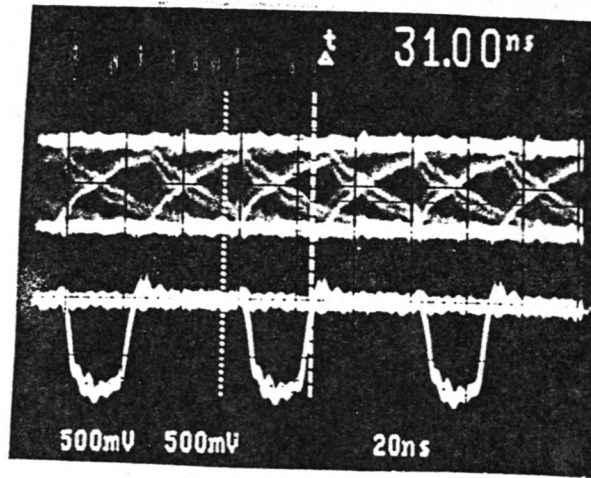~ 300 mV

500mV   500mV   20ns

Cross-point switch
output sampled
at this time

2 Tracks
assigned

500mV   500mV   20ns

4 Tracks
assigned

~ 100 mV

500mV   500mV   20ns
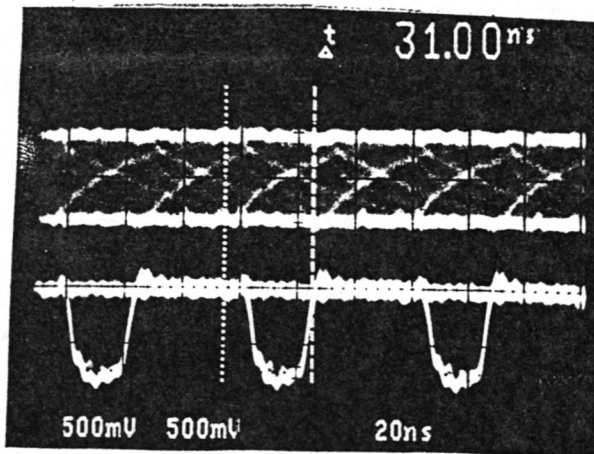
8 Tracks
assigned

Top trace: 5253A pin 5
Bottom trace: 5253A pin 4

500mV   500mV   20ns

FIGURE 2