Driver Eye simulation

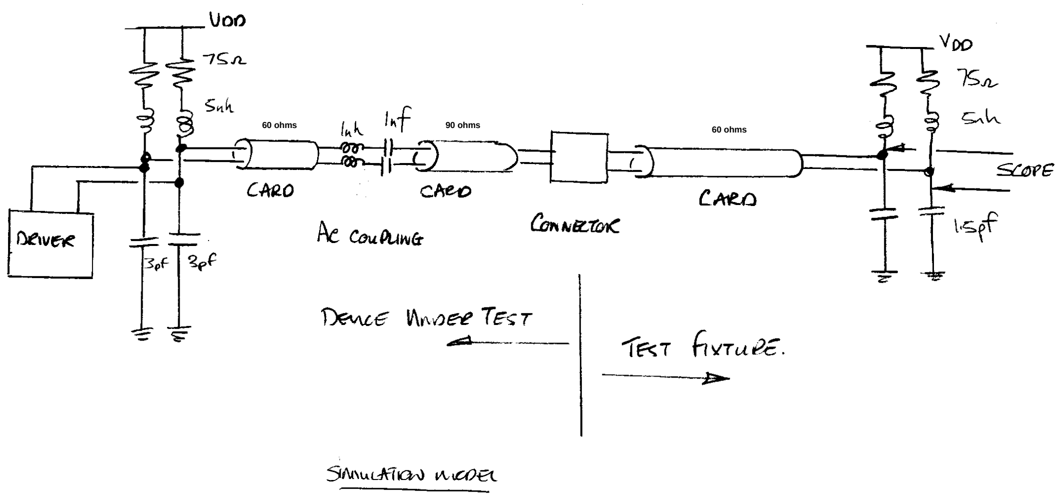
P J Murfet

13 Sept 96

Simulation

A circuit diagram of the simulation model is shown below. The model represents a typical card with a driver test fixture as defined in PH2 plugged into it. Impedances were chosen to be at their limits to give a worst case response.

Fig 1 simulation model



This model should be taken as one of many possible valid models, not a definitive model, however it should yield representative waveforms.

The following simulation runs were completed .

Fig2. SSA40 at 5v/ns min and max signal swing

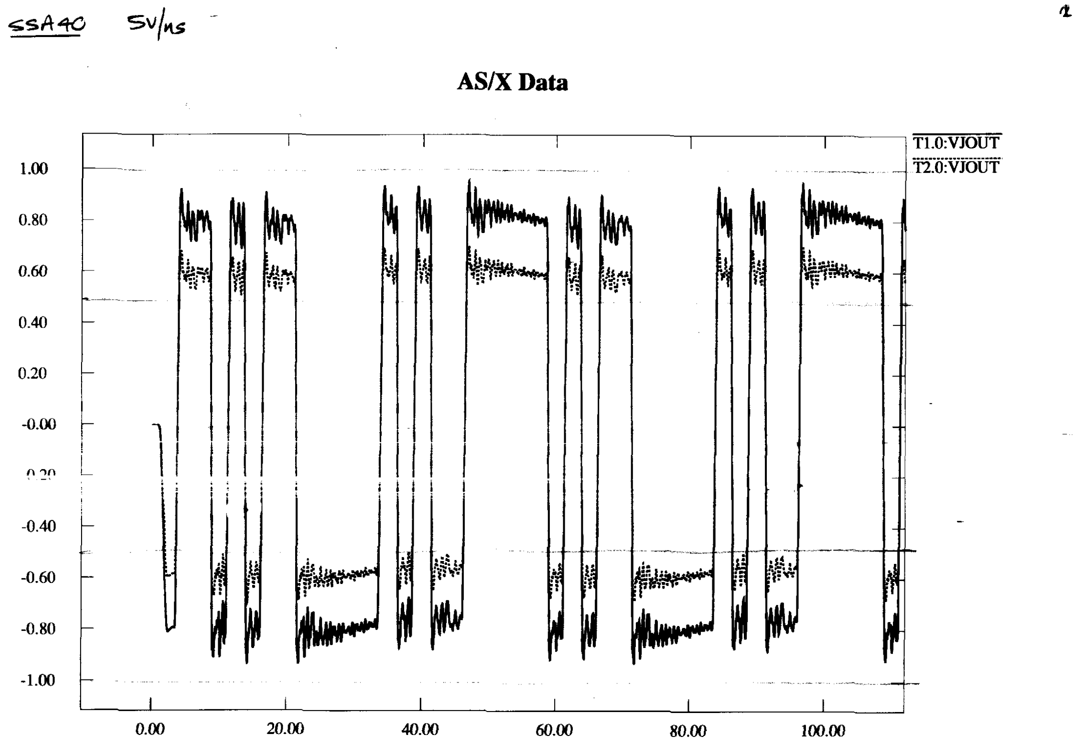


Fig2a. SSA40 at 5v/ns detail of fig 3.

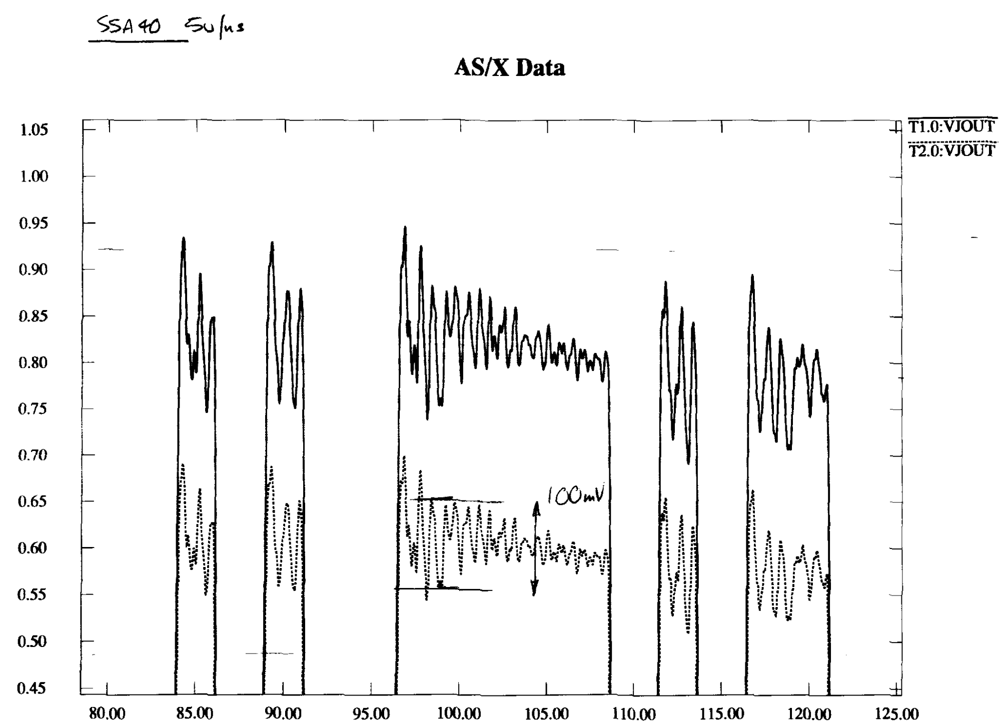


Fig3. SSA40 at 2v/ns min and max signal swing.

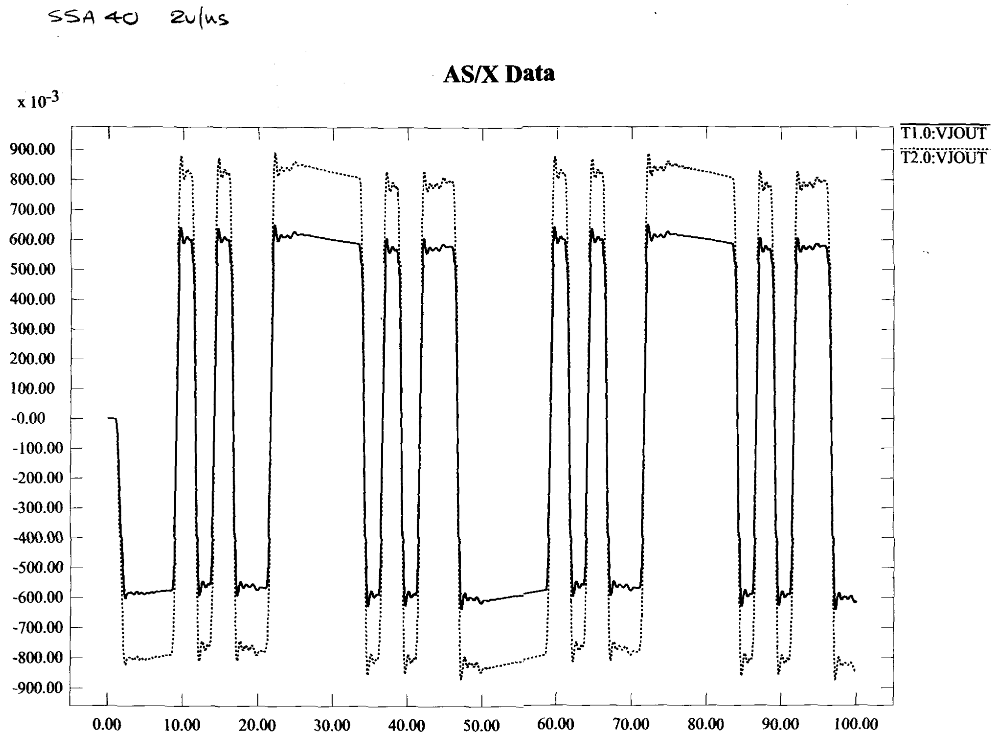


Fig3a. SSA40 at 5v/ns detail of Fig 3

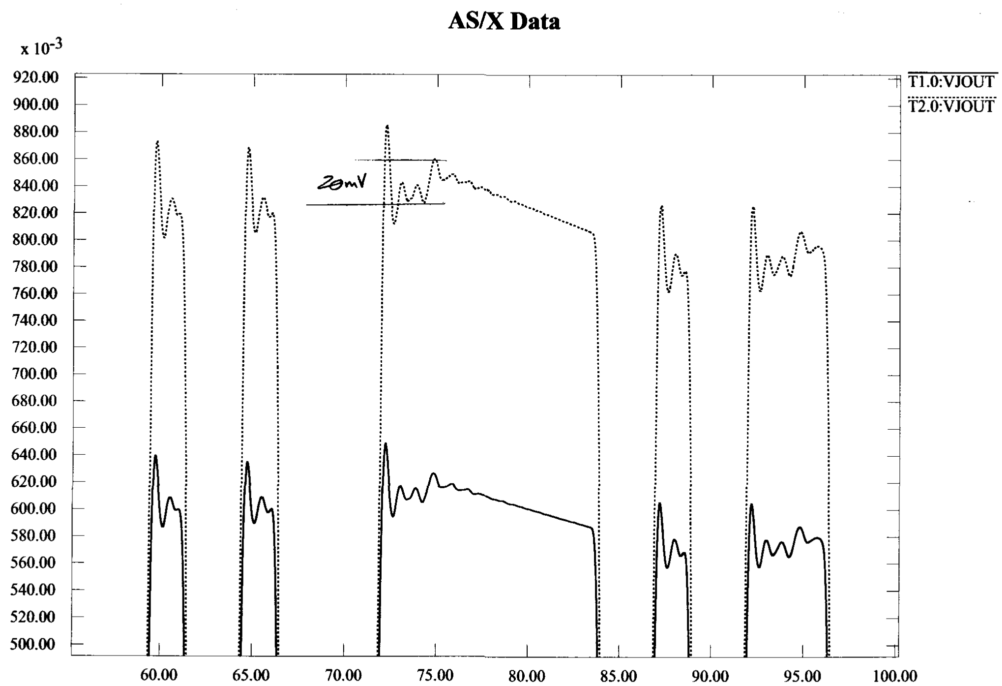


Fig4. SSA40 running at 200Mhz at 5v/ns min and max signal swing

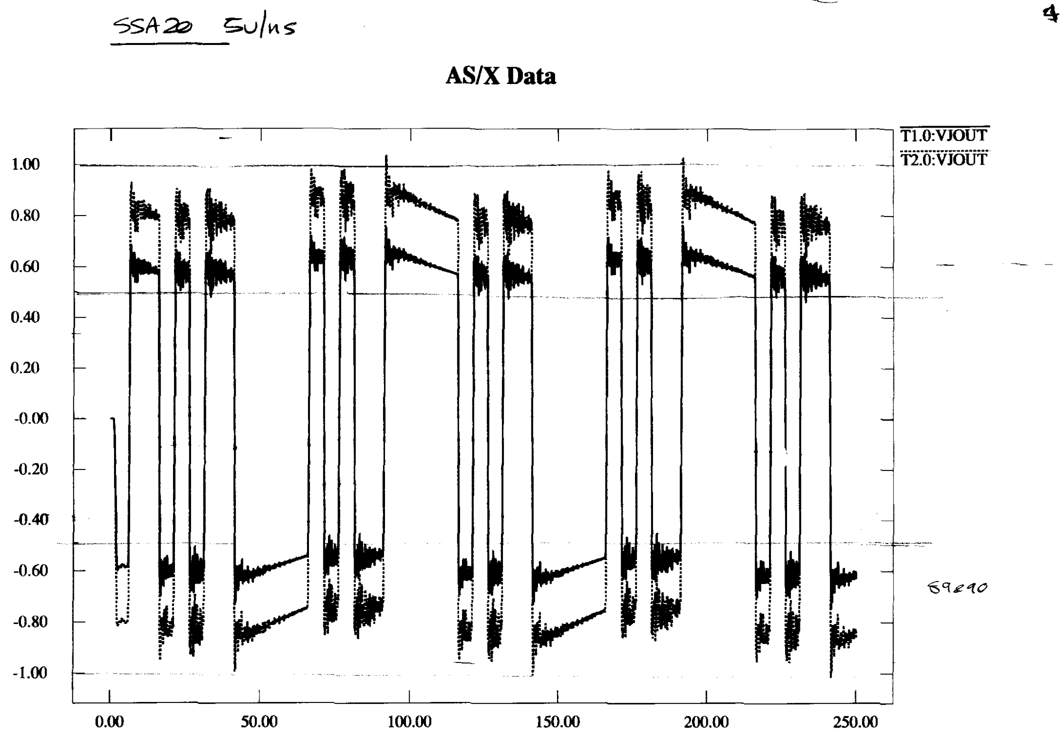
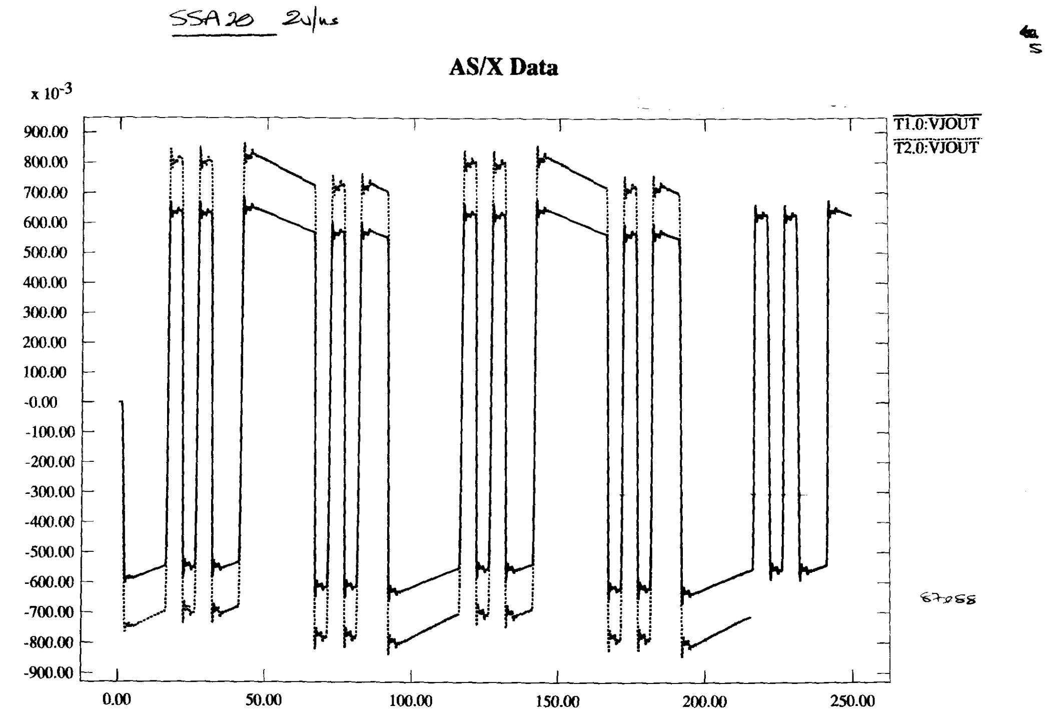


Fig5. SSA40 running at 200 Mhz at 2v/ns min and max signal swing



Eye vertical size

From the above figures I suggest that the limits for both SSA40 and SSA40 running at 200Mhz should be the same. Min= 500mv and Max 1v.

Eye rise time

Rise time for both eyes should be set to min dV/dT as stated in PH2.

Eye jitter Components

The eye jitter is the time interval between two eyes, this could be expressed as the (bit period - eye width). As measured in PH2 it consists of five components.

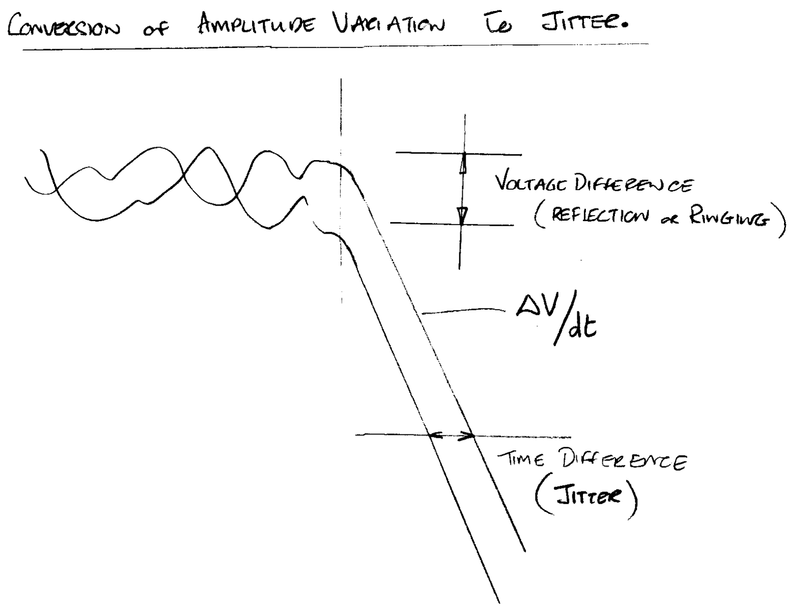
1. Intrisic driver jitter.

The jitter that would be observed if the driver were to drive a perfect 75 ohm resistor. It will almost certainly be random jitter from the PLL. Their may be a small amount of deterministic jitter but in most cases this should be insignificant. This is the original 140ps in the first attempt at the driver eye.

2. Jitter resulting from reflections and ringing .

This jitter results from the variation in amplitude of the signal because of the reflections or ringing. See Figure 6 below. If the data level is higher than normal the point at which the transition passes through zero will be late and if the data level is lower than normal the transition through zero will be early. The transition time is a function of the variation of amplitude and the dV/dT.

FIG 6



Thus Jitter = Voltage variation/ (dV/dT), this assumes the dV/dT is reasonably constant through the zero crossing point. The jitter will be calculated once for the 5V/ns case and again for 2V/ns and the maximum used for the total jitter equation.

From figure 2a the amplitude variation is taken to be 100mV for the 5V/ns. The initial overshoot has not been included as the next transition will not start for 2.5ns. Similarly the 2V/ns noise has been taken as 20mV from Figure 3.

For 5V/ns jitter= 100mV/5V/ns=20ps
For 2V/ns jitter=20mV/2v/ns=10ps

This jitter is deterministic, not random.

3. Jitter resulting from random noise induced onto the transmission line.

Same as above but the source of the voltage variation is induced noise. The simulation does not include noise however it has been estimated at 50mV.

For 5V/ns jitter= 50mV/5 V/ns=10ps
For 2V/ns jitter= 50mV/2 V/ns=25ps

This jitter is random.

4. Jitter resulting from droop on the AC coupling capacitor.

Again same as above however this time the voltage variation is due to the charging of coupling capacitor. From the simulation the voltage drops at a rate of 5mV/ns. The maximum run length of the 8b/10b code is 5, therefore.

For SSA40 max time between transitions = 5*2.5=12.5ns
Therefore droop= 12.5ns* 5mV/ns= 62.5mV
At 2V/ns jitter = 62.5mV/2V/ns=31.25ps

For SSA40 at 200Mhz max time between transitions = 5*5ns=25ns
Therefore droop= 25ns* 5mV/ns= 125mV
At 2V/ns jitter = 125mV/2V/ns=62.5ps

This jitter is deterministic.

5. Pattern dependant jitter from transmission line attenuation.

Attenuation is very low on such a short transmission line and this component can be taken as zero.

Total Jitter.

These five components are combined to for a single figure for jitter.

SSA40 jitter

Source	value	type
Intrinsic jitter	140ps	Random
Reflections and ringing	20ps	Deterministic
Noise	25ps	Random
AC Noise	31ps	Deterministic
Attenuation	0ps	Deterministic

Combining the two random components (140**2+25**2)**0.5 = 142.2

Summing this with the rest = 142+20+31=193ps

Suggest this be rounded to 200ps

SSA40 running at 200Mhz jitter

Source	value	type
Intrinsic jitter	140ps	Random
Reflections and ringing	20ps	Deterministic
Noise	25ps	Random
AC Noise	62ps	Deterministic
Attenuation	0ps	Deterministic

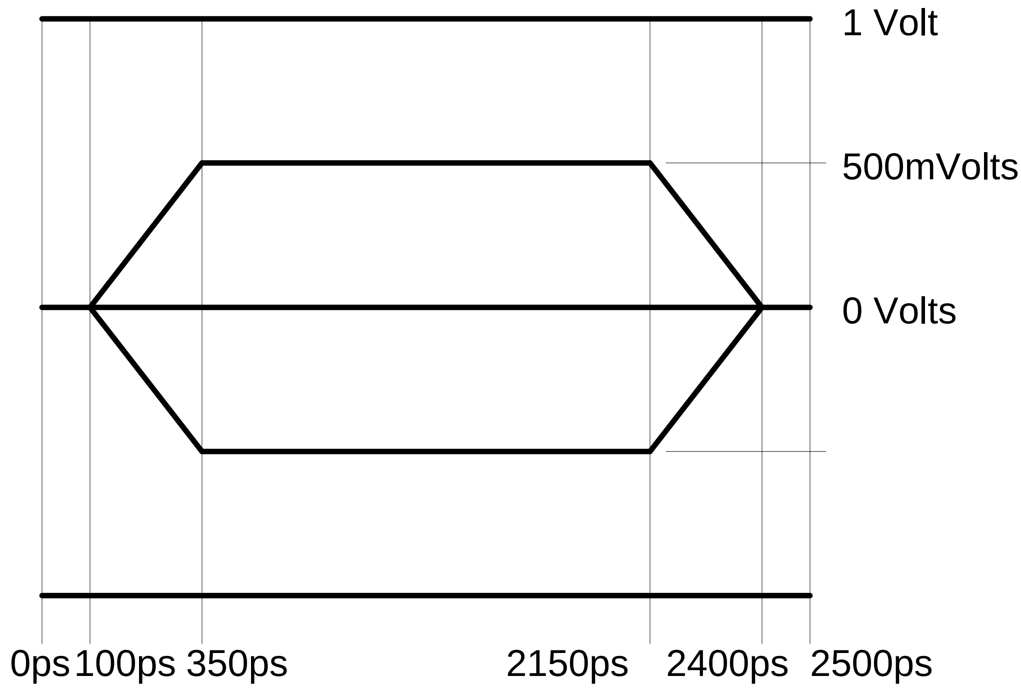
Combining the two random components (140**2+25**2)**0.5 = 142.2

Summing this with the rest = 142+20+62=224ps

The original SSA20 Jitter was 280ps therefore as the error rate requirements are the same I suggest this be left at 280ps.

The Eye

SSA40



SSA40 running at 200Mhz