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Erik van der Bij
Silvio Orsi

Measures in the transition module S2P2

The board S2P2 is a transition module between an S-LINK (LDC) and a P2 connector; the signal (in this case a clock) arriving from a LSC goes through fiber optics to the LDC, that is plugged onto the S2P2 board, separated by a PMC connector. On the other side of the backplane the output is taken from a board (Technobox, reference: PMC EXTDR REV 5/15/95). Alternately we put in between an extender board, a 32 cm long PCB, with parallel circuit lines printed on it, which has the only effect to retard the signals, enhancing possible reflections. Another variable we could play with was the source (parallel) resistance, initially set at 10 Ω, then changed to 47 Ω and 68 Ω. From the analysis of various situations (with or without extension module, with different source resistors, with or without end termination), we could conclude that the output is more regular with high source resistances, even if it is always strongly dependent on the board connected on the other side of the backplane.
I am interested in the result of these measures since the S2P2 is a simplified version of the 9U transition module between 4 S-LINK cards mounted on it and the backplane to a VME64x board I will design (via P2 and P3 connectors); the main simplification is that the S2P2 can carry only one S-LINK.

The clock series resistor R44 is set to 10 Ω for the first few measures.
The rise times are unfortunately not reliable, even if they are sometimes reported in the figures, since they are not measured with constant standards. They can be used only to get rough indications and not precise values.

- Driving voltage 5 V; Extension module connected; the reflections are huge: an input between 0 and 5 V creates an output between –3.5 and 6.5 V ($\Delta V_{out} = 10\ V = 2 \times \Delta V_{in}$).

- Driving voltage 5 V; Extension module connected; measure performed with a 150 Ω parallel termination in order to reduce undershoot and overshoot; the goal is reached, even if the output is not very clean. (output figure not available)

From now on: always 3.3 V driving voltage; this doesn't affect our measurements, because the elements are linear. Three voltage levels are given in V: max (highest overshoot), high (level of the "high" plateau), min (lowest undershoot), exactly in this order.

- Without extender; open; the reflections are reduced a lot; output voltages: 4.68 4.40 -1.8

- With extender; open; 5.92 5.60 -3.16 V (enormous over- and undershoot). A picture of this configuration is available (figure 1).

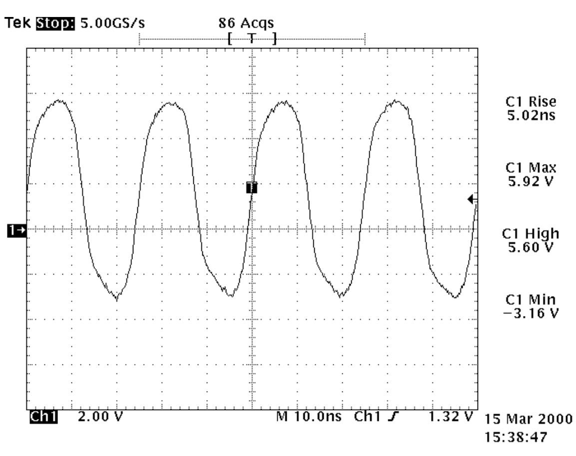

Figure 1: with ext.; 10 Ω

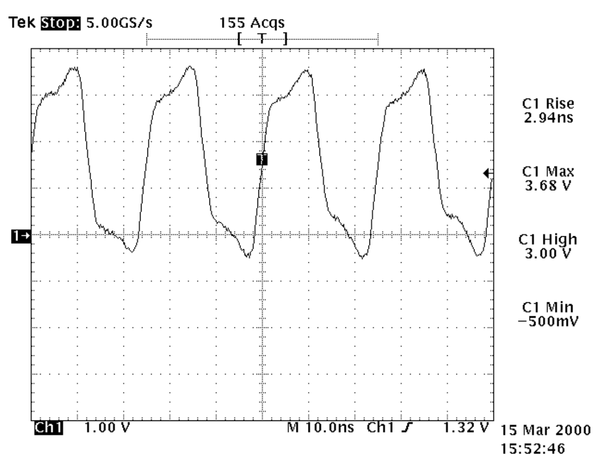

Figure 2: with extender; 68 Ω

- With extender; open; R44 = 68 Ω instead of 10 Ω; 3.7 3 -0.5 V; the signal has a nice shape, even if the maximum and zero levels are not constant. (figure 2)

- Like the previous measure, but without extender. Reflections are reduced, as we can see in fig. 3.

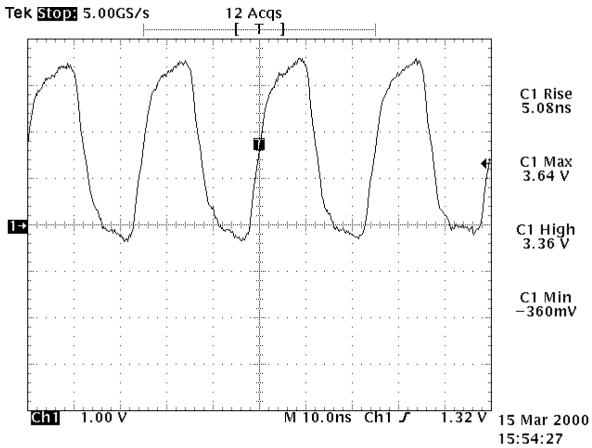

Figure 3: without extender; 68 Ω

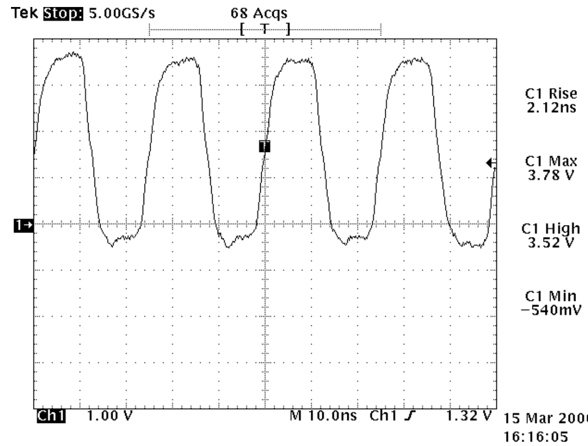

Figure 4: without extender; 47 Ω

- Without extender; R44 = 47 Ω; the top is flatter, but more over- and under-shoots are present. (figure 4)

- Similar to the latter case, but with extender; from figure 5 one can notice a reflection on both high and low plates, probably given by some stub terminations on the read out PCB.

Notice that from now on the zero voltage level is shifted downwards by 2 V, in correspondence with the symbol "2→" on the left of the curve, since we measure on channel 2.

- Same case as the last one, but this time we use a high-speed probe on channel 2, instead of the usual probe on channel 1, in order to get a better resolution. In fig. 6 there are many curves; the one we are interested in is the lowest one, and the zero level is in correspondence with the number 2 on the left (y-scale: 2 V; time-scale: 5 ns).

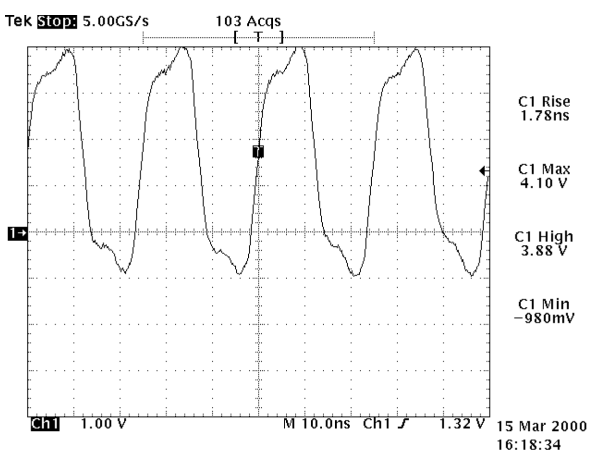

Figure 5: with ext.; 47 Ω; normal probe

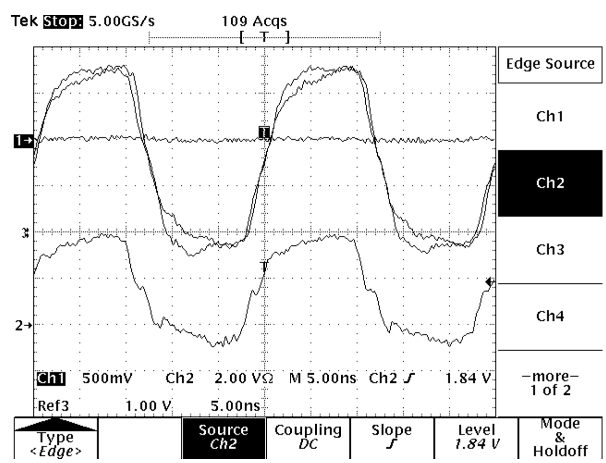

Figure 6: with ext.; 47 Ω; high speed probe

At this point we can comment that the ideal case, i.e. the best until here, is depicted in fig. 4 (47 Ω series resistor, without extender), because it is more square-shaped, but the best among those with extender (this case is closer to real applications, i.e. with VME boards connected on the other side of the backplane) is the one with 68 Ω resistor (fig. 5, 6), that results to be more "solid" when we add an unknown PCB on the other side.

- With extender; series resistor 47 Ω; high speed probe; measured at the very end of the read out PCB, avoiding in this way a dead termination, which reduces drastically reflections present in the rise and fall edges, as seen in figure 7.

- Without extension; without dead termination; R = 68 Ω; normal probe; this is a bad signal, since there is a reflection for each cycle starting at around 0 v and 0.5 V high, that can be interpreted as a clock pulse. (figure 8)

- Like the latter measure, but with a better resolution (high speed probe), depicted in figure 9.

- The high speed probe is placed directly in the backplane; the signal (fig. 10) is clean, as expected; after this last measure we can conclude that the main problems arise from the read out PCB; from here the need of finding good recommendations for the designers of the read out PCBs (VME64x, in particular), like for example the use of point to point connection instead of multipoint, at least for the most critical lines.

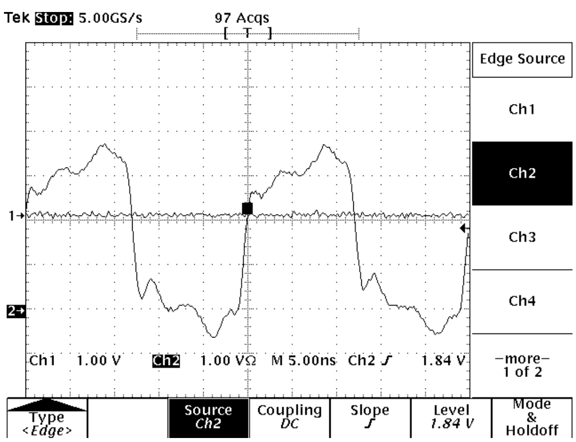

Figure 7: w.ext.; 47 Ω; h.s.p.; without stub

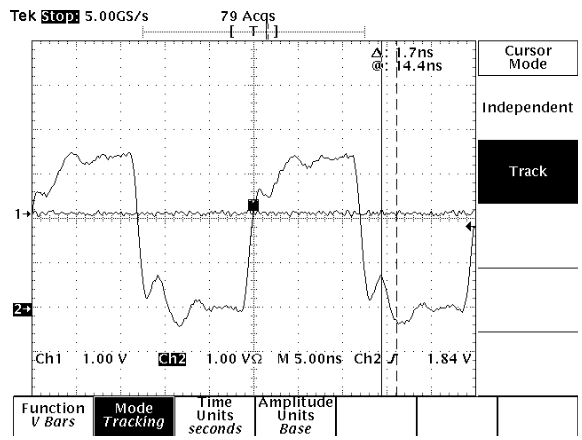

Figure 8: w/o ext; 68 Ω; n.p.; w/o stub

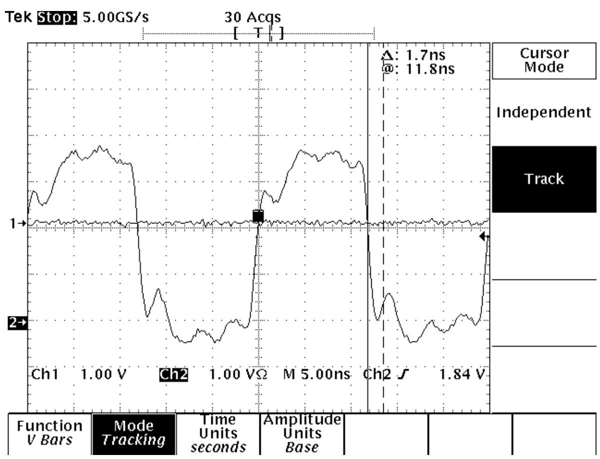

Figure 9: w/o ext.; 68 Ω; h.s.p.; w/o stub

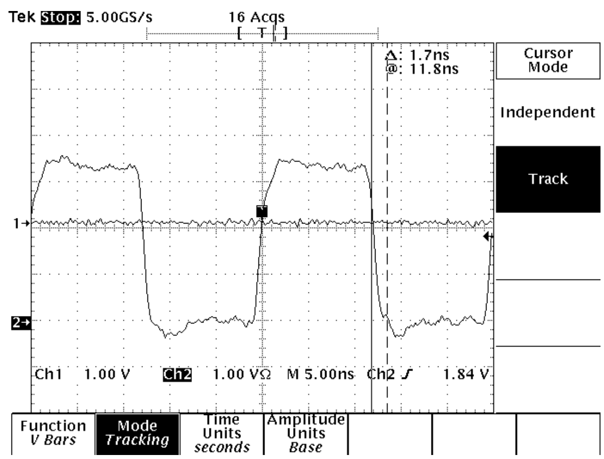

Figure 10: 68 Ω; h.s.p. in the backplane

Conclusions:

We noticed that the output signal had very powerful reflections in the initial case of 10 Ω series resistors for all data and control lines, which we could immediately put aside. The case of 47 Ω series resistors is too much depending on the read out PCB (lengths, stubs), even if it is the best shaped without extension module.
We decided to focalize our attention to the 68 Ω series resistors, which provide an almost square-shaped (but lower as high values) output voltage. All the existing series resistors on the board will be changed into 68 Ω, and starting from this experience I will use typical values between 60 and 70 Ω in my pre-layout simulations for the 9U transition module I am working at.
I remark here once more that our group designs only the S-LINKS boards and the transition modules, and our system has to be capable of supporting the widest range of boards characteristics on the other side of the backplane. Our goal is to reduce the number of recommendations and requirements we will impose to the VME64x designers.