

Implementation of receiver macromodel with supply port: first tests

I. HYPOTHESIS

- The input (IP) and supply (SP) ports of the receiver are physically separated,
- The solution couples (V_{IP}, I_{IP}) and (V_{SP}, I_{SP}) are determined as following:
 - if the incident voltages and past events on the IP and SP cells are \leq "precision", then

$$\begin{cases} (V_{IP}, I_{IP}) = (0, 0) \\ (V_{SP}, I_{SP}) = (0, 0) \end{cases}$$

- if the incident voltages and past events on the IP cell are \leq "precision", then
 - $(V_{IP}, I_{IP}) = (0, 0)$
 - (V_{SP}, I_{SP}) is searched using the one variable secant method
- if the incident voltages and past events on the IP and SP cells are \geq "precision", then the solution is looked for with the modified multivariate secant method [1].

II. FIRST TEST: CONNECTION OF THE SUPPLY VOLTAGE THROUGH A TRANSMISSION LINE

Fig. 1 shows the modeled structure in the TLM code. The dimensions are specified with the discretisation step $dl = 1\text{mm}$. The strip is zero-thickness and perfectly conducting, the substrate is assumed lossless. The configuration is surrounded by absorbing boundary conditions in the lateral and top directions, and a perfect electric conductor one at the substrate back.

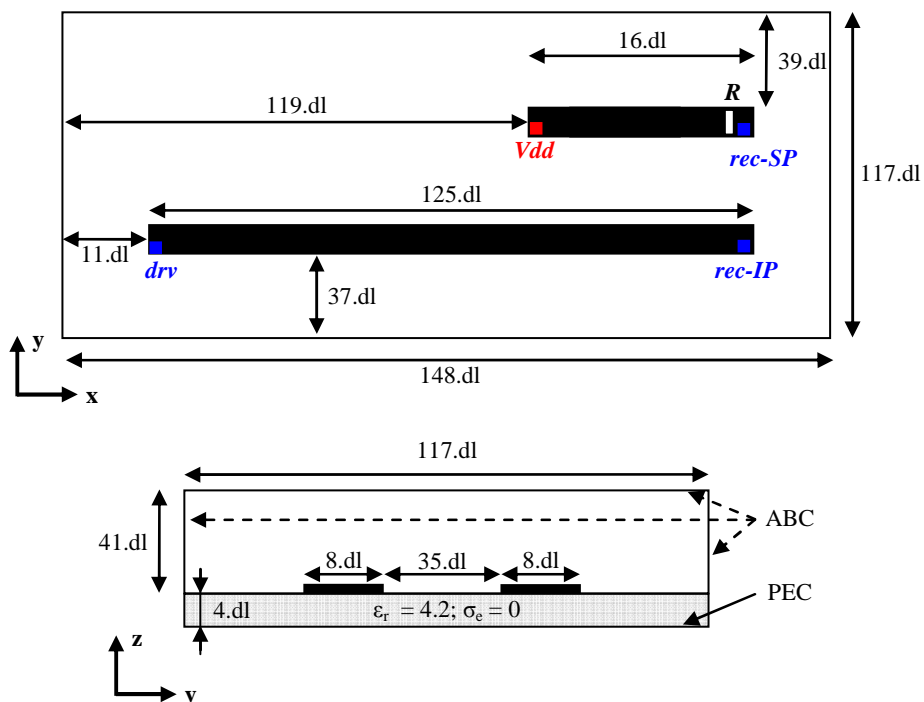


Figure 1: First test microstrip structure

The main strip is fed by the driver of a DDR (left side) distributed as specified in Fig. 2a). The signal is launched around 1ns in order to enable a stabilization of the supply voltage (that one being based on a step voltage). The load consists of the receiver input port of the same DDR (Fig. 2 b)).

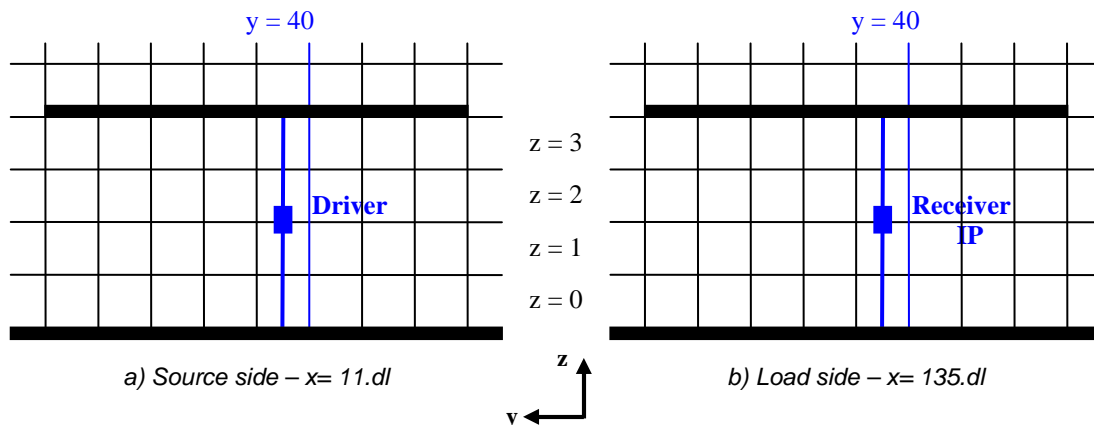


Figure 2: Distribution of the feed and load on the main strip

The supply strip is fed by four step voltage sources (Fig. 3a)), each one having the characteristics: $t_r = 50ps$, delay = 100ps, $|V| = 0.45V$, in order to get a 1.8V constant voltage after the transient period. The track is loaded with the supply port macromodel in parallel with a 100 k Ω resistance (R) (Fig. 3d)). All the macromodels are spread over several cells.

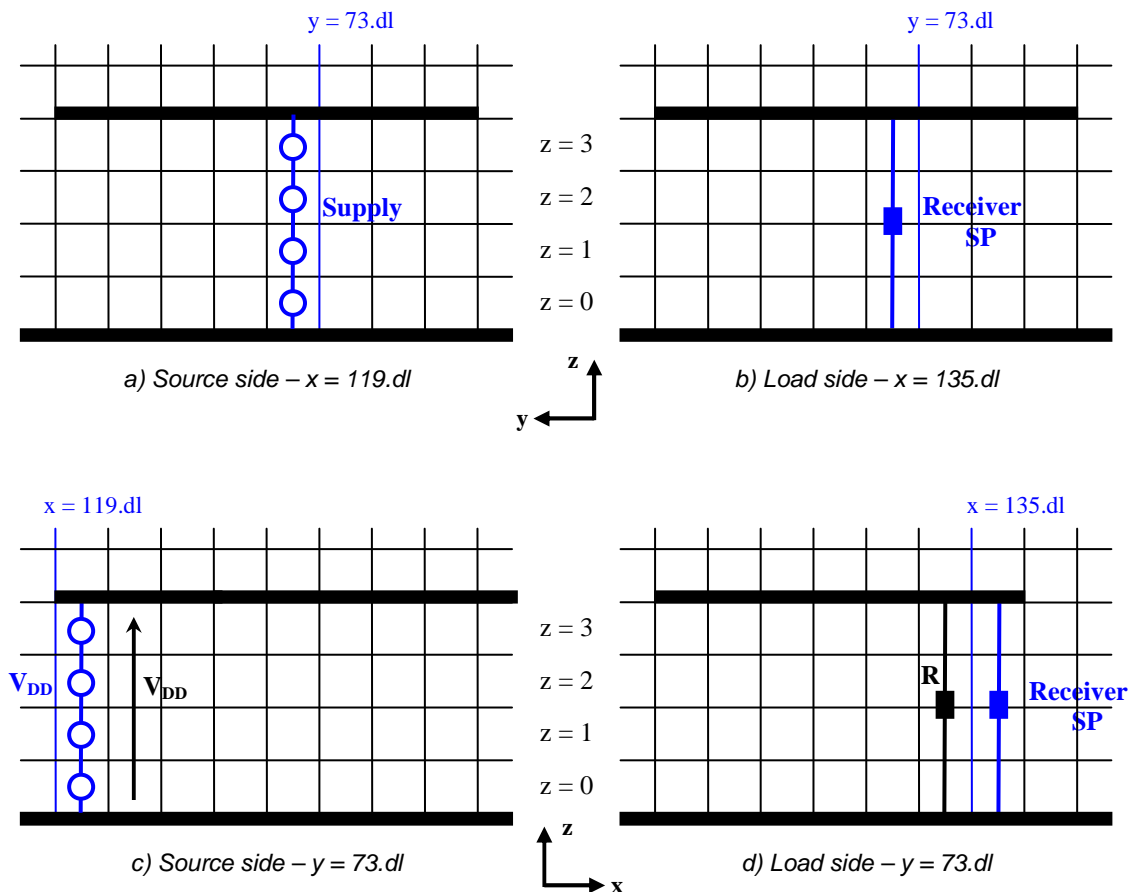


Figure 3: Distribution of the feed and load on the supply strip

The voltages are presented in Fig. 5 as well as that ones got with the HSPICE simulation of the same configuration. It appears that:

- the TLM simulation stops before the end time due to an infinite loop in the search function,
- the supply port behaves strangely both with HSPICE and TLM. This doesn't happen (check with HSPICE, Fig. 6) when the step voltage is directly applied to the SP (ie suppression of the 50Ω transmission line). Let's note the IP voltage is not altered. Also:
 - or problem with the macromodel (the static characteristic of the supply port has been modified due to 2 unusual values),
 - or problem with a supply provided through a transmission line due to the unknown impedance of the SP,
- the step voltage entails a coupling to the main strip and leads to a false information supplied on the IP cell (small ripples before 1ns),
- similar behaviour of the input port voltage of HSPICE and TLM

III. SECOND TEST: DIRECT CONNECTION OF THE SUPPLY VOLTAGE

Fig. 4 indicates the brought modification to the supply line. In that case the results are reported in Fig. 7. Same observation as above.

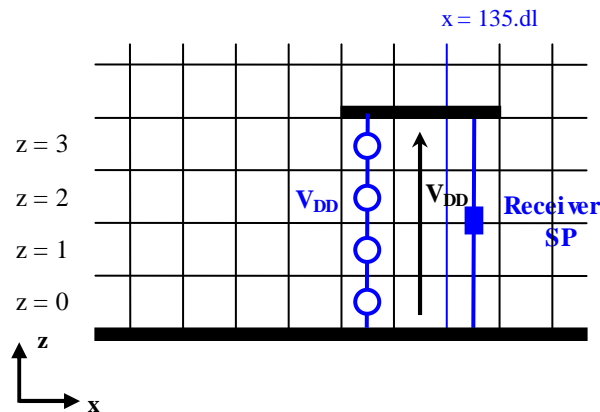


Figure 4: Modification of the supply line

IV. CONCLUSION

- check of the implementation with a new macromodel,
- modification of the algorithm by imposing directly the supply voltage inside the macromodel.

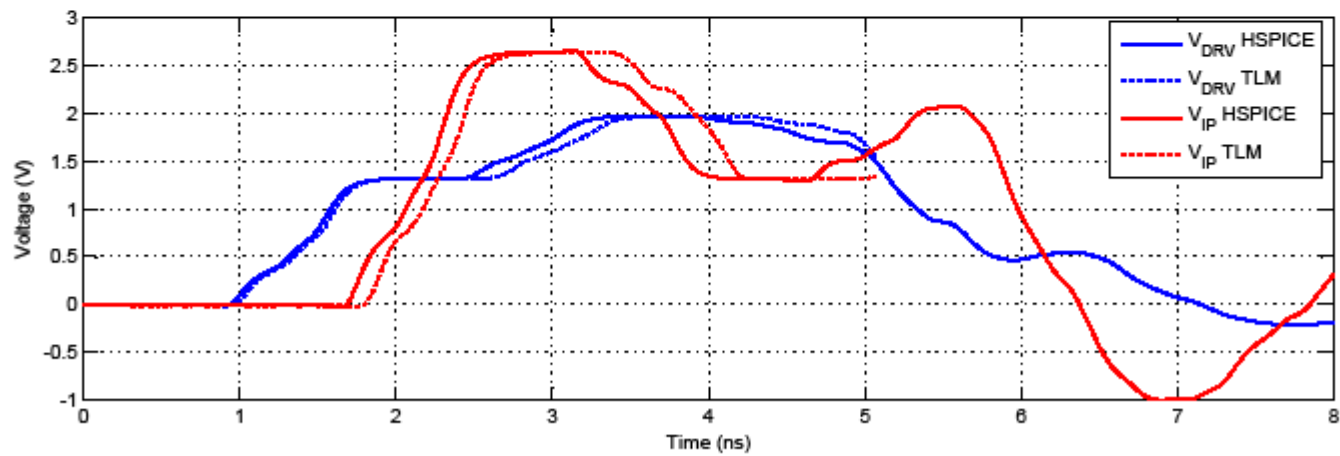
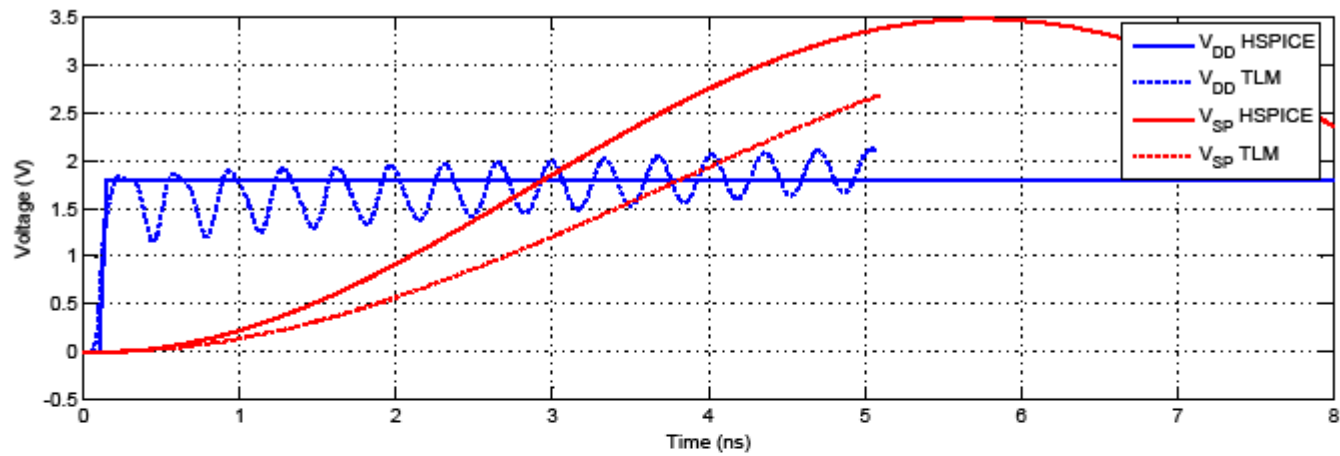


Figure 5: Comparison of the TLM and HSPICE voltages got on the supply and main strip

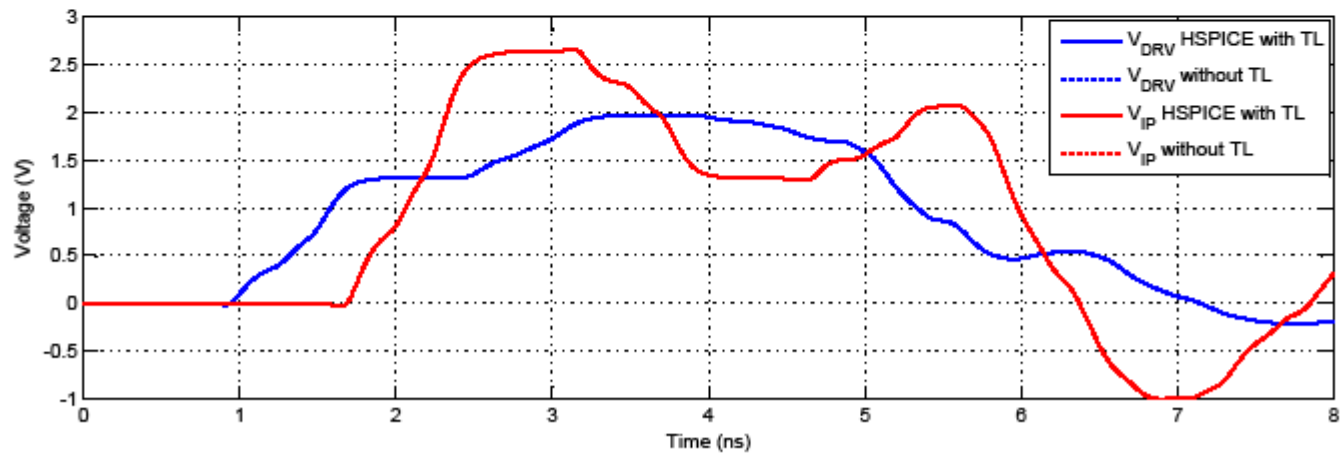
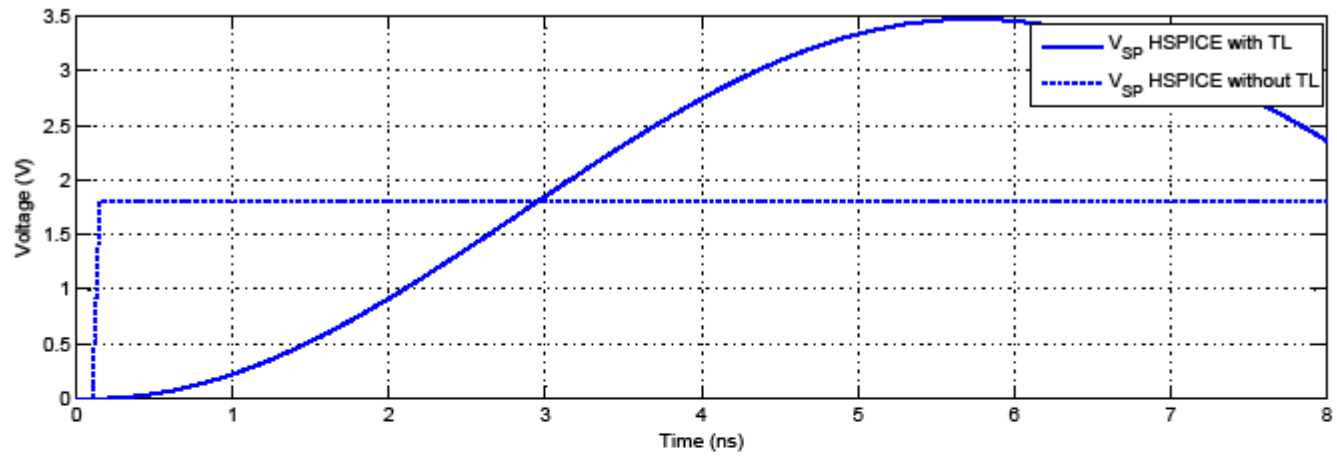


Figure 6: Comparison of the HSPICE results got for a supply voltage applied through a TL and without

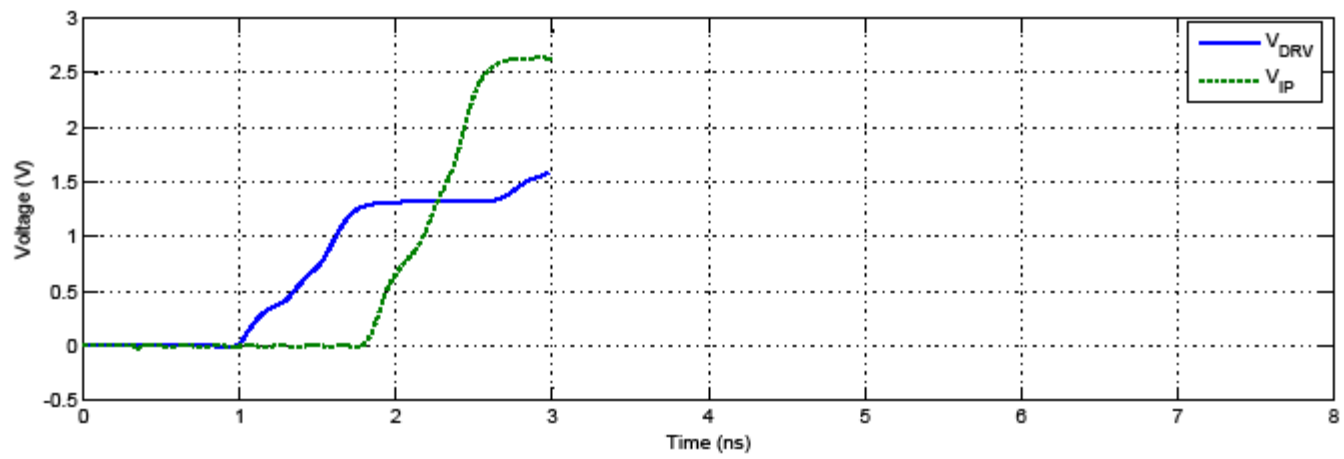
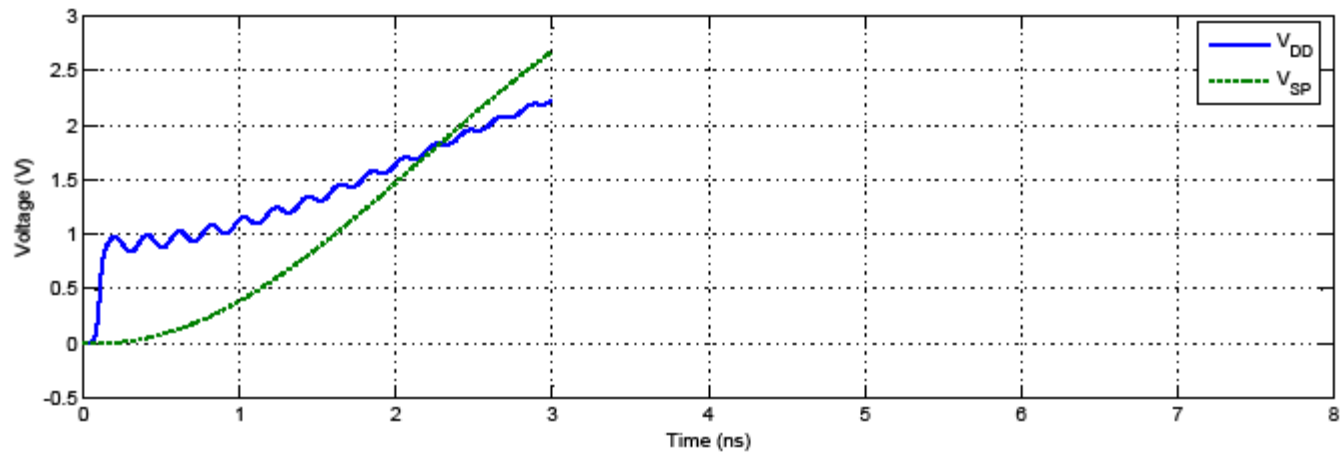


Figure 7: Voltages got with the supply source applied directly to the supply port

[1] Podisuk M., "Modified multivariate secant method", *Universitatis Iagellonicae Acta Mathematica*, Fasculus XXXI 1994, pp. 265-271