ARGESIM Comparison C3 'Class E Amplifier' Numerically Solved by MATRIXx

W. Weidinger, F. Breitenecker, Vienna University of Technology; wieweit@fsmat.htu.ac.at

Simulator: MATRIXx is a so-called CNS – a Computer Numeric System, as MATLAB is (and as CONTRL_C has been). The structure is very similar to MATLAB: it consists of an environment called XMath, and a graphical simulation tool called SystemBuild.

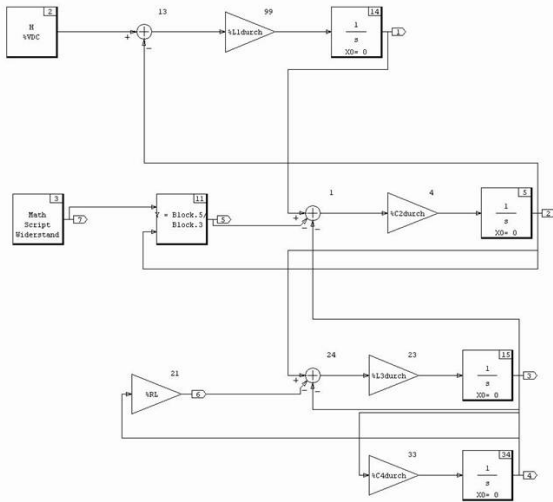**Model:** SystemBuild was used to model this comparison. The graphical description is shown in Fig.1.

Figure 1: Sytembuild Model

The resistance *R(t)* is computed by an Xmath function which is embedded in the SystemBuild model by the use of a "MathScript"-block.

```
function R_out=Widerstandc(t,TRF)
k=((5e+6)-(5e-2))/TRF
[t_red,rmod]=mod(t,(10e-6))
if(0<=t_red)&(t_red<TRF)
   R_out=(5e-2)+k*t_red
elseif(TRF<=t_red)&(t_red<(5e-6))
   R_out=5e+6
elseif((5e-6)<=t_red)&(t_red<((5e-6)+TRF))
   R_out=(5e+6)-k*(t_red-(5e-6))
elseif((5e-6)+TRF<=t_red)&(t_red<(10e-6))
  R_out=5e-2
endIf
endFunction
```

Task a - Calculation of Eigenvalues. This task was computed as a whole in Xmath. The differential equations were therefore transformed into *dx/dt = A*x* and the Eigenvalues of *A* were computed (results below - the system is stiff as the eigenvalues prove).

OFF – Period	ON - Period
-5.8228E+4 + 5.3275E+5 j	-1.1173E+9
-5.8228E+4 - 5.3275E+5 j	6.2578E+2
-5.4708E+4 + 1.0407E+6j	1.1304E+5 + 6.5835E+5j
-5.4708E+4 - 1.0407E+6j	1.1304E+5 - 6.5835E+5j

Task b - Simulation of the Stiff System. The ODASSL (Over-determined Differential Algebraic System Solver) was used which is especially suitable for stiff systems. Figure 2 shows a plot of the current *IR=x2/r* und the output voltage *VL=x3*RL* over time.
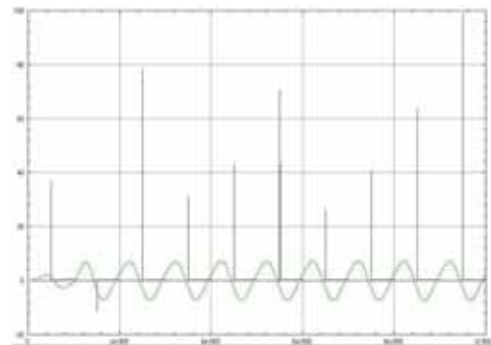

Figure 2: IR and VL over time, task 2
(Unfortunately the values of the peaks seem to be not exact. fortunately no error – only missing output points).

Task c- Parameter Variation. TRF (rise/fall time) was varied for values of 1e-15, 1e-11, 1e-9 and 1e-7. In addition the initial solution should be equal to the final solution of task b. The following Fig. 3 shows phase plane curves of *dx3/dt = VL3* as a function of the current *x3 = IL3:*
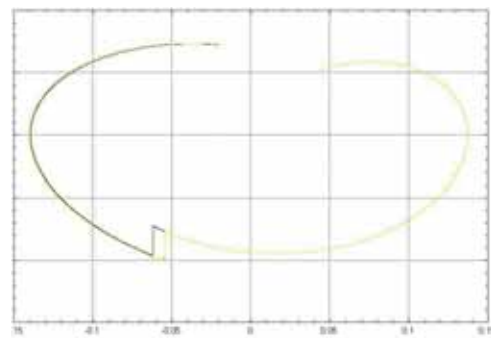

Figure 3: Phase diagram

The only differing result is given for TRF = 1e-7 because this value causes a very slow switching process (Frequency is 100 kHz).

C3 Classification: Numerical Approach

Simulator: MATRIXx Rel. 2004