A Numerical Solution to ARGESIM Comparison C3 'Generalized Class-E Amplifier' using MATLAB - SIMULINK

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Simulator: MATLAB is an intuitive language and a technical computing environment. It provides core mathematics and advanced graphical tools for data analysis, visualization, and algorithm and application development. SIMULINK is a simulation and prototyping environment for modelling, simulating, and analyzing real-world dynamic systems.

Model: The solution of the problem is based on a pure SIMULINK model. A straight forward approach is used implementing the system of ordinary differential equations mainly using Integrators, Sum – blocks and Product – blocks. The time dependent resistor R(t) is realized using a Look-Up Table – block (Fig 1).

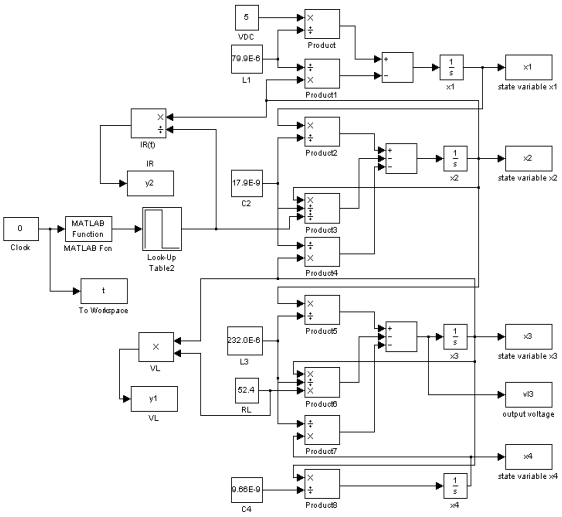

Figure 1: SIMULINK model of the amplifier

Task a – Calculation of Eigenvalues. The Eigenvalues in the ON – and OFF – period are calculated by means of the eig() – function introducing the 4-dimensional system dx/dt = A*x as m-file in MATLAB (since R(t) is constant in ON- and OFF – period, this approach is correct):

Eigenvalues on period	Eigenvalues off period
1.1173e+09	-5.4699e+04 + 1.0408e+06i
6.2578e+02	-5.4699e+04 - 1.0408e+06i
-1.1282e+05 + 6.5839e+05i	-5.8226e+04 + 5.3275e+05i
-1.1282e+05 - 6.5839e+05i	-5.8226e+04 - 5.3275e+05i

Task b: Simulation of the Stiff System. The simulation in the time interval [0, 100E-6] is performed with the MATLAB ode23 – solver, a Rosenbrock method for stiff differential equations. The results are shown in figures 2 and 3.

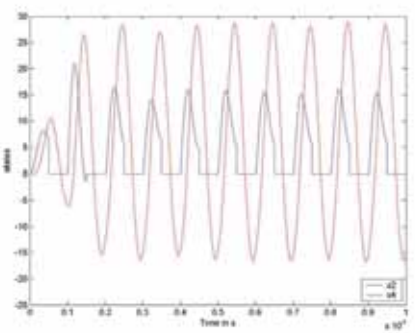

Figure 2: current in the switch resistor and output voltage

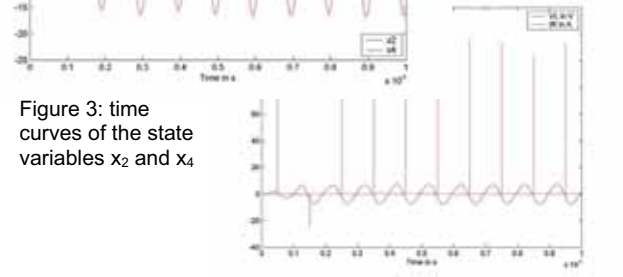

Figure 3: time curves of the state variables x_2 and x_4

Task c – Parameter Variation. The final solution of task b serves as initial state of this task. Therefore the init(i) values are set with the last entries of the state vectors x1 – x4. The different values of the rise- and fall-time TRF are also stored in a vector. The simulation is then started four times iterating these parameters. Figure 4 shows the resulting phase curves and one can notice, that only for a relatively slow toggle-time of 1E-7 the results differ slightly.

```
init(1) = x1(k);...init(4) = x4(k);
TRF_V = [1E-15 1E-11 1E-9 1E-7];
for i=1:4
    TRF = TRF_V(i); sim('comp3hh',[0 9E-6]);
    ph_x3{i} = x3;     ph_vl3{i} = vl3;
end
```

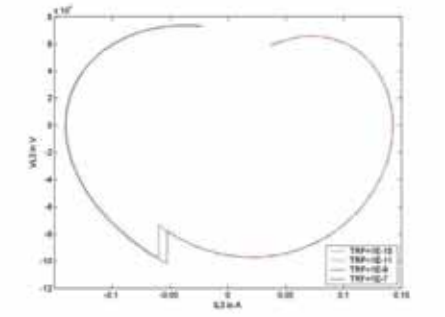

Figure 4: Phase curves for different TRF – values

C3 Classification: Numerical Approach
Simulator: MATLAB / Simulink Rel. 13, 2004