Labor of Fundamentals of Electronics and Power Electronics

Exercise No. 20

SIMMULATION OF PULSATION FILTERS

20.1 Basic information

The purpose of this exercise is simulation and test of simple pulsation filters C, L and RC, LC, CLC filters. The PSpice 9.1 Student version is the simulator used in this exercise.

References:

Titze U., Schenk Ch.: Semiconductor Devices
PSpice Tutorial - http://dave.uta.edu/dillon/pspice/index.php
Baranecki A.: Laboratorium układów elektronicznych. Cz. 1
Kaźmierkowski M.P., Matysik J. T.: Wprowadzenie do elektroniki i energoelektroniki

20.2 Description of exercise

There are three files prepared to analyze (FILTR1.CIR, FILTR2.CIR, FILTR3.CIR)
The file FILTR1.CIR containing the simple capacitive filter model and RC filter model. The resistance R1 connected in circuit of simple capacitive filter are a sum of wires resistance, transformer winding resistance and rectifying diode resistance. This resistance (R1) are restrict the maximal value of capacitor charging current. The value of resistance R1 connected in circuit of RC filter are about several ohms to several kilo ohms.
The file FILTR2.CIR containing the simple inductive filter model.
The file FILTR3.CIR containing the inductive CLC filter model. The rule of resistance R1 form the file FILTR1.CIR is the same in this file.

Example program code from file FILTR1.CIR

```
*     FILTR   RC     *
************************
*  ELEMENTY  FILTRU  *
************************
R1 3 4 10
C1 4 0 100uF
Ro 4 0 300
************************
.TRAN 1ms 60ms
************************
*********************
*******************
*****************
***************
*************
**********
********
******
****
**
Vin1 1 0 sin(0 25 50)
Vin2 2 0 sin(0 25 50 10ms)
ra 1 0 1k
rb 2 0 1k
d1 1 3 dio
d2 2 3 dio
rc 3 0 10k
.probe
.model dio d
.options reltol=1e-6 itl5=15000
.end
```

Description of some lines from program code:
R1 3 4 10 - resistor R1 connected between nodes 3 and 4; resistance is equal 10 Ω
C1 4 0 100uF or 100u - condenser C1 connected between nodes 4 and 0; capacitance is equal 100 μF

.TRAN 1ms 60 ms – transient analysis with time step 1 ms; Stop time 60 ms

Vin1 1 0 sin(0 25 50) - Sine voltage source Vin1 connected between nodes 1 and 0 amplitude is equal 25 V; frequency is equal 50 Hz

Vin2 2 0 sin(0 25 50 10ms) - Sine voltage source Vin2 connected between nodes 1 and 0 amplitude is equal 25 V; frequency is equal 50 Hz; delay time is equal 10ms

The resistors ra and rb are auxiliary. Those resistors are not influence to simulation result.

20.3 Schedule of exercise

20.3.1 Simulation of simple capacitive filter and RC filter. File FILTR1.CIR. Fig 20.1
a) Estimate value of resistance R1. Output power and voltage about P = 10 W and 24 V

b) Insert estimated value of resistance R1 and C1 = 100 μF and Ro = 300 Ω, stop time = 60 ms. Simulate transient analysis.

c)usage of menu:

- add trace V(1), V(3), V(4) (Trace → Add trace)
- delete trace V(1), V(3) (select name of trace and press Delete)
- change axis range (Plot → Axis settings…)
- turn on cursors and measure load Ro voltage pulsation (Trace → Cursor → Display)
- change axis to full range (Press "Zoom Fit" icon)

d) Simulate circuit and edit I(R1) and I(Ro) traces. Measure maximal value of first current I(R1) impulse and compare it with maximal value of fifth and twentieth current impulse. If necessary change stop time of simulation.

e) Repeat simulation taking value of resistance R1 form point 20.3.1a for following:

C1 = 100 μF and Ro = 30 Ω, C1 = 1000 μF and Ro = 300 Ω, C1 = 1000 μF and Ro = 30 Ω

e) Make tests of RC filter. Set value of resistance R1 = 10 Ω for following:

C1 = 100 μF and Ro = 300 Ω (stop time 60 ms), C1 = 100 μF and Ro = 30 Ω (stop time 60 ms),

C1 = 1000 μF and Ro = 300 Ω (stop time 180 ms), C1 = 1000 μF and Ro = 30 Ω (stop time 100 ms)

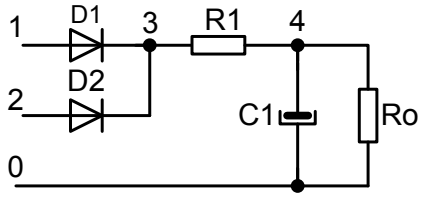

Fig.20.1

20.3.2 Simulation of simple inductive filter. File FILTR2.CIR. Fig 20.2
a) Simulate circuit and edit I(Ro) and V(4) traces, for following:

L1 = 30 mH and Ro = 20 Ω L1 = 30 mH and Ro = 200 Ω

L1 = 90 mH and Ro = 20 Ω L1 = 90 mH and Ro = 200 Ω

Measure load Ro voltage pulsation.

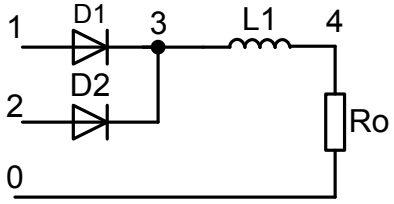

Fig.20.2

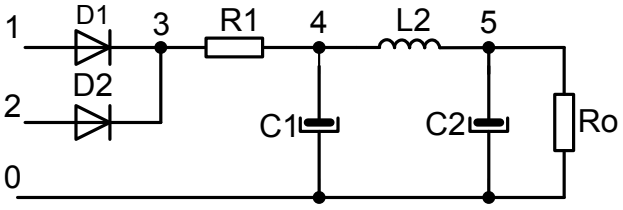

Fig.20.3

20.3.3 Simulation of inductive CLC filter. File FILTR3.CIR. Fig 20.3
a) Simulate circuit taking value of resistance R1 form point 20.3.1a and C1 = 100 μF, L2 = 30 mH, C2 = 1000 μF, Ro = 200 Ω. Make test of circuit and measure load Ro voltage pulsation.
b) Change resistance Ro to Ro = 100 Ω. Repeat simulation and measure load Ro voltage pulsation.