LP/HP Diplexer with Gaussian Response

20/09/07

The design for a LP/HP diplexer requires

1. LP transient response gives ~2ns flat top when generator pulse is 5ns rectangular.
2. LP 3dB cutoff frequency at 170MHz.
3. LP Attenuation at 600MHz ~ 30dB.
4. Constant impedance 50ohm towards the generator.

6^{th} order Gaussian LP is chosen, which satisfies the attenuation and flat top transient requirements. 6^{th} order LP ends with a capacitor, which could be used to incorporate capacitor in the following amplifier. HP channel uses Gaussian 5^{th} order. The LP and HP have the same cutoff frequency 170MHz. Constant impedance is achieved along the whole frequency range.

The design is realized with ladder circuits. Normalized element values are obtained from [1]. To achieve constant diplexer impedance, design of individual LP/HP circuits must use infinite source resistance. Figs. 1-3 show the design of exact values and its time/frequency domain responses. Figs. 4-6 show the practical element values and the corresponding time/frequency domain responses. The results show that the practical values satisfy the design requirements very well.

[1] Anatol I. Zverev, ‘Handbook of Filter Synthesis’, 2005 by John Wiely & Sons, Inc..

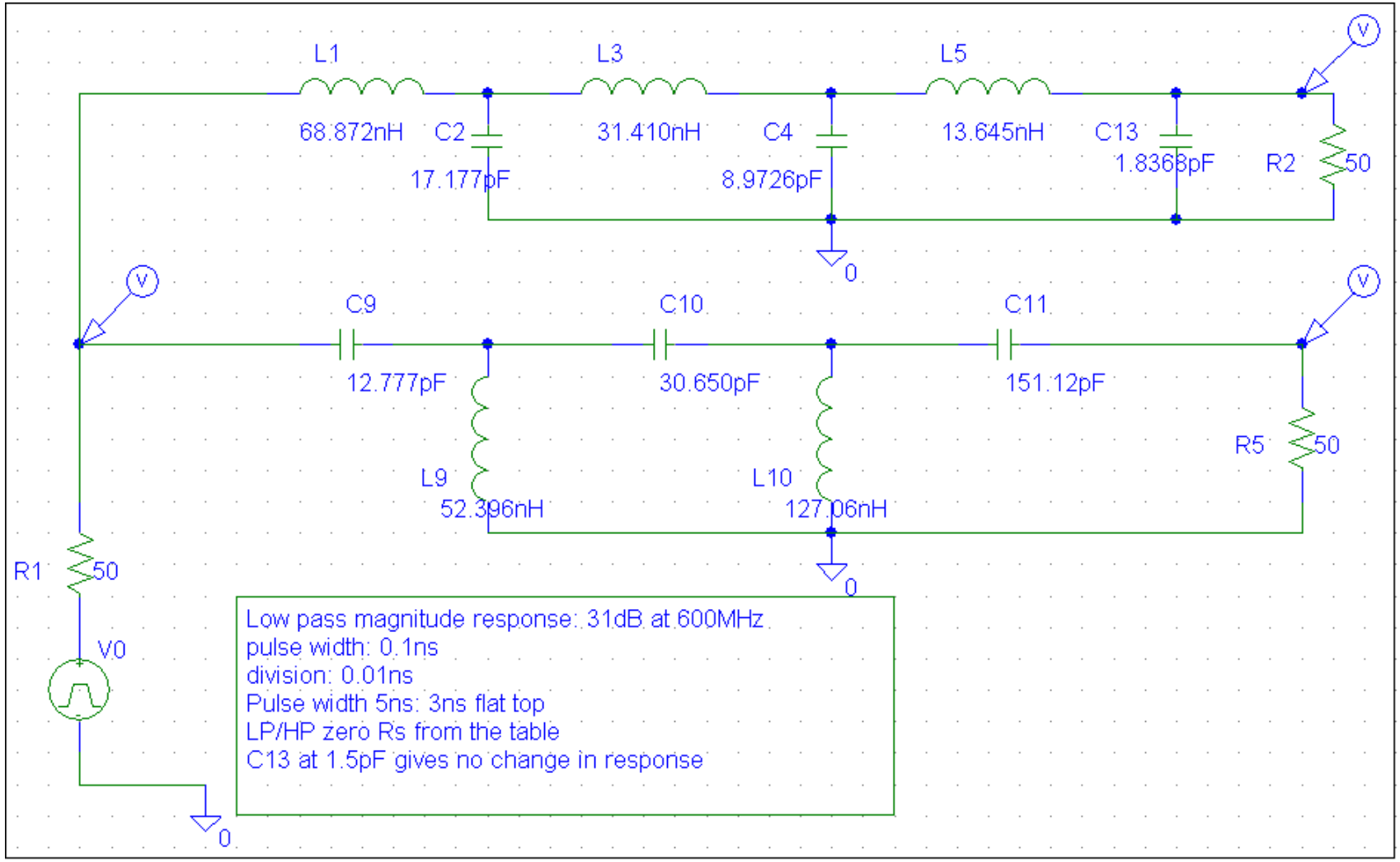
L1
68.872nH
C2
17.177pF
L3
31.410nH
C4
8.9726pF
L5
13.645nH
C13
1.8368pF
R2
50
0
C9
12.777pF
C10
30.650pF
C11
151.12pF
L9
52.396nH
L10
127.06nH
R5
50
0
R1
50
V0
0
Low pass magnitude response: 31dB at 600MHz
pulse width: 0.1ns
division: 0.01ns
Pulse width 5ns: 3ns flat top
LP/HP zero Rs from the table
C13 at 1.5pF gives no change in response

Fig. 1

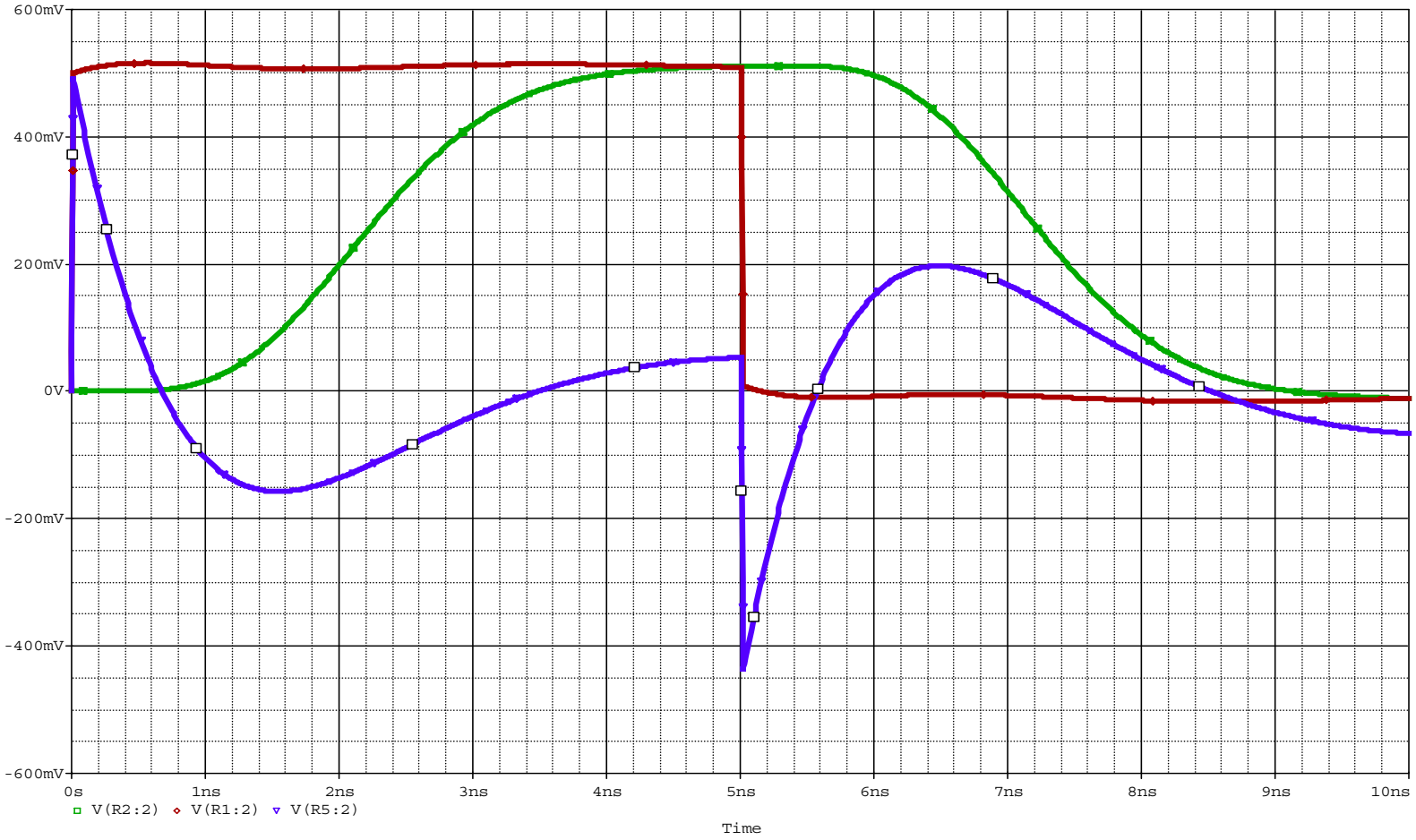

Fig. 2.
Horizontal: one division = 1ns. Vertical: one division = 200mV

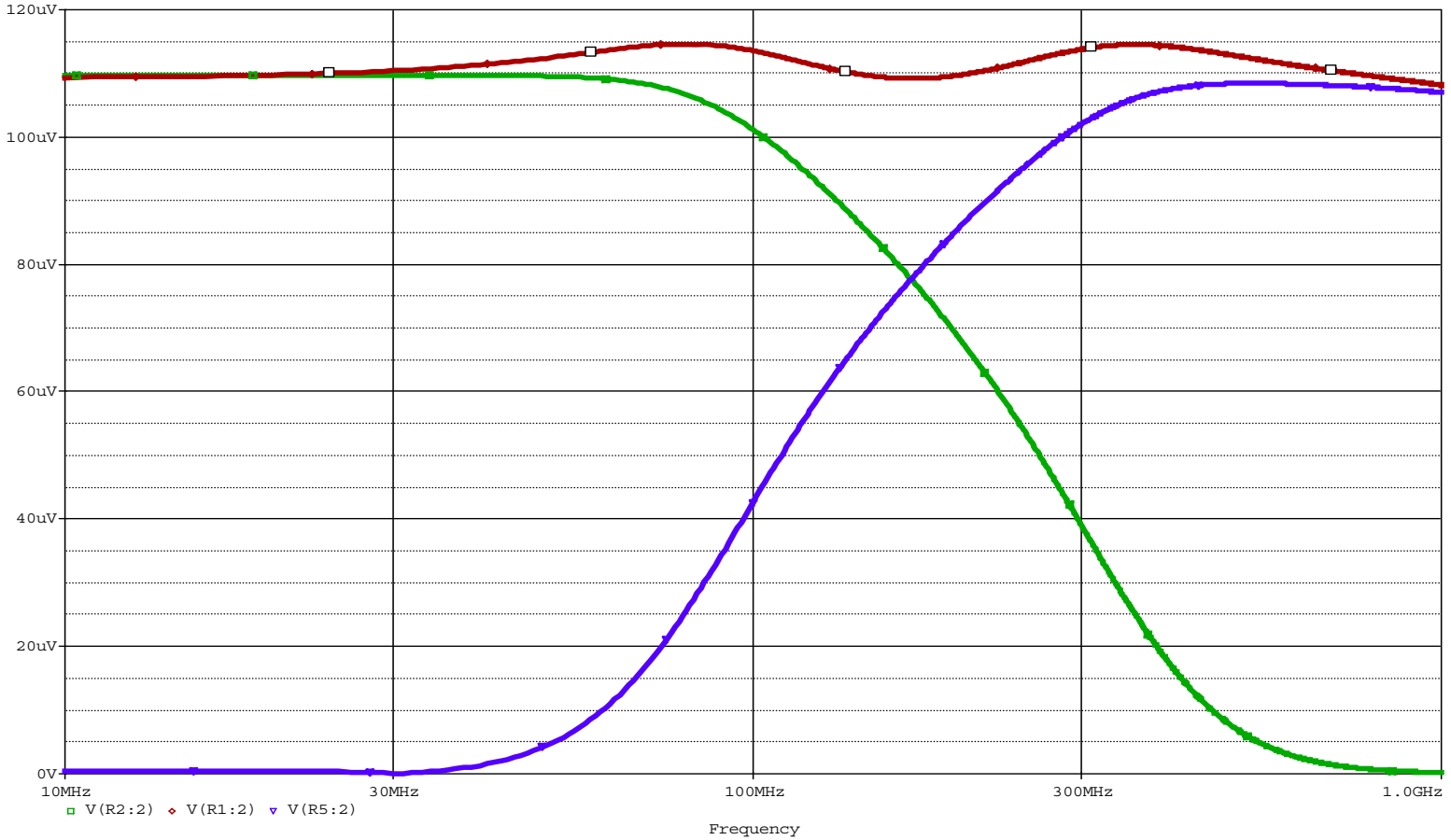

Fig. 3
Horizontal: log, (10-100-1000)MHz. Vertical: arbitrary units

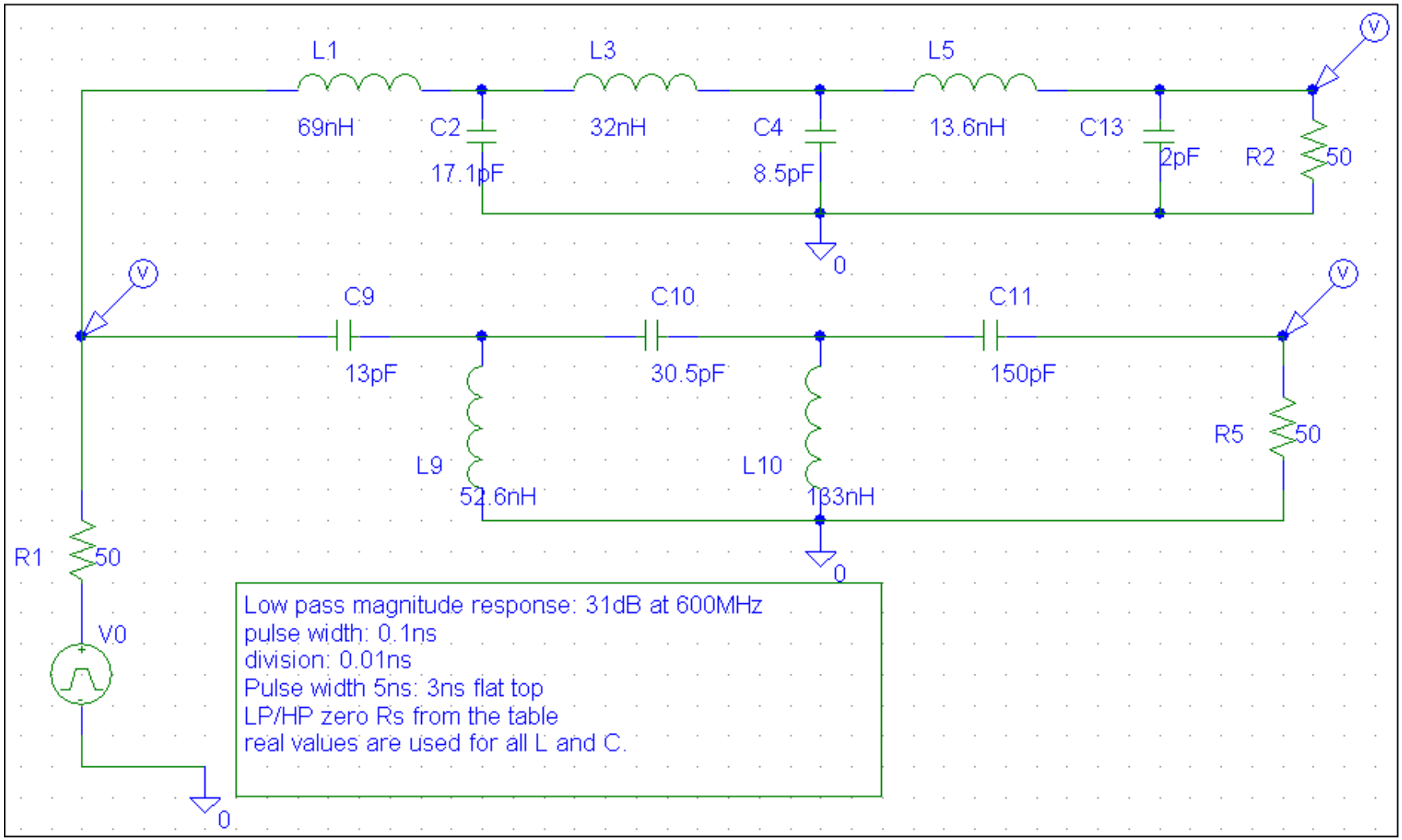
L1
69nH
L3
32nH
L5
13.6nH
C2
17.1pF
C4
8.5pF
C13
2pF
R2
50
0
C9
13pF
C10
30.5pF
C11
150pF
L9
52.6nH
L10
1β3nH
R5
50
R1
50
V0
0
Low pass magnitude response: 31dB at 600MHz
pulse width: 0.1ns
division: 0.01ns
Pulse width 5ns: 3ns flat top
LP/HP zero Rs from the table
real values are used for all L and C.

Fig. 4

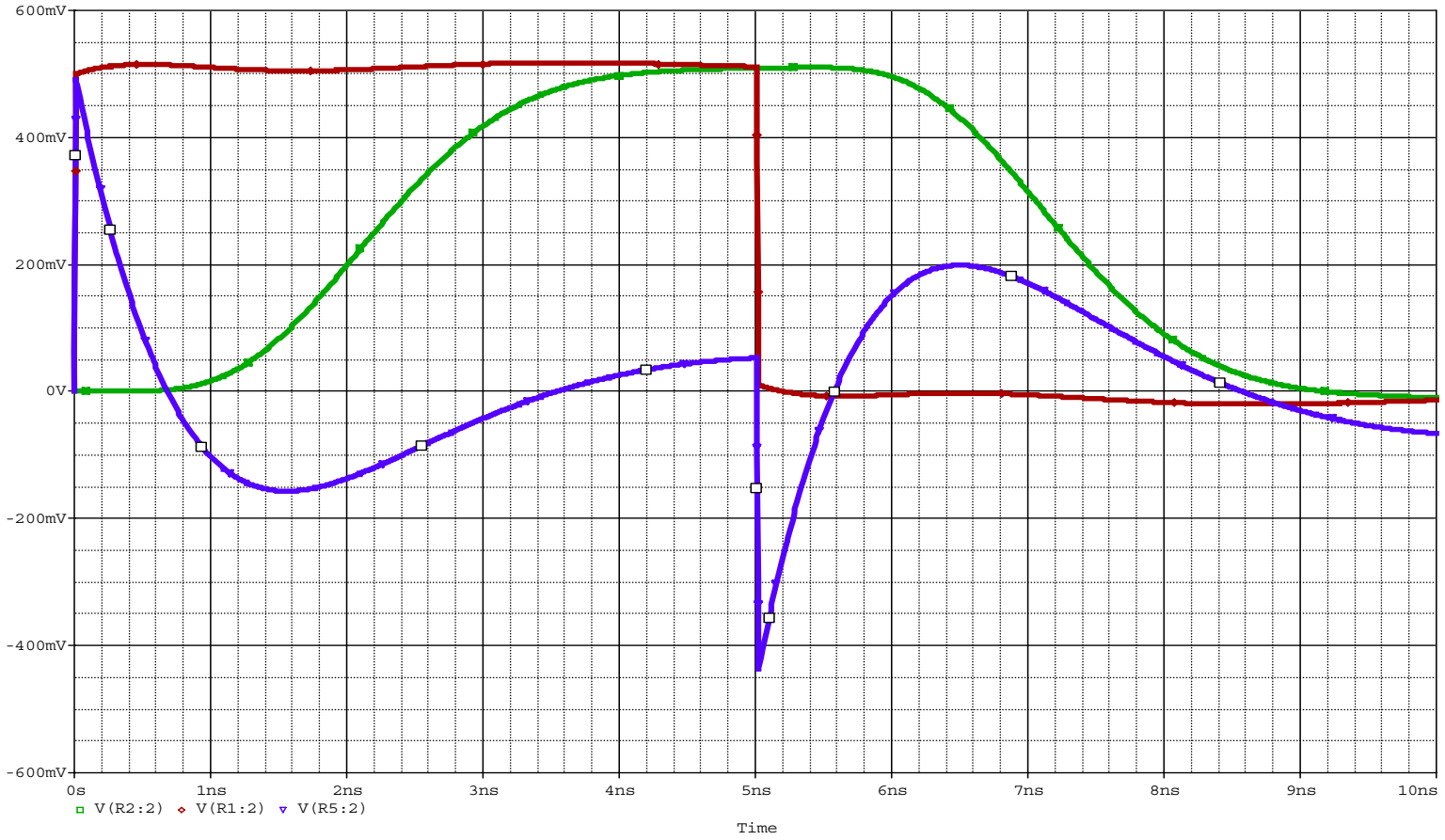

Fig. 5
Horizontal: one division = 1ns. Vertical: one division = 200mV

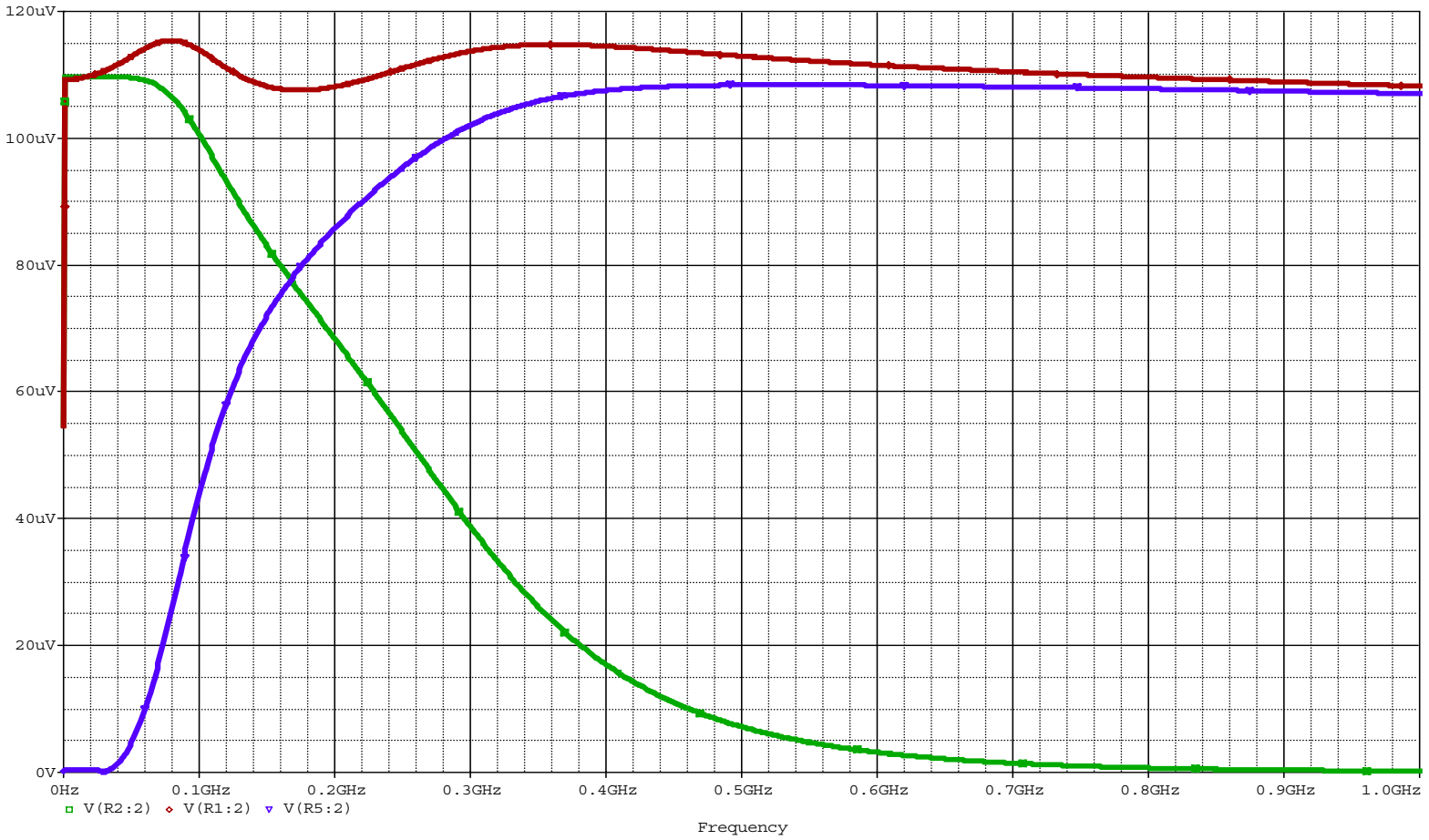

Fig. 6
Horizontal: linear, (0-1000)MHz. Vertical: arbitrary units