

LAB 4 CHECKOUT: ACTIVE BANDPASS FILTER PROJECT

ELEC 3509A - L6

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$$X = 101103080$$

$$A = X \bmod 1031 = 127$$

$$B = X \bmod 1033 = 271$$

- **Lower Cut-off Frequency**

$$f_{-3dB\ Lower} = \frac{A^5}{5.534 * 10^9} - \frac{A^4}{2.11 * 10^6} + \frac{A^3}{2287} - \frac{A^2}{6.1} + 20.2A + 750 = 1449.64\ Hz$$

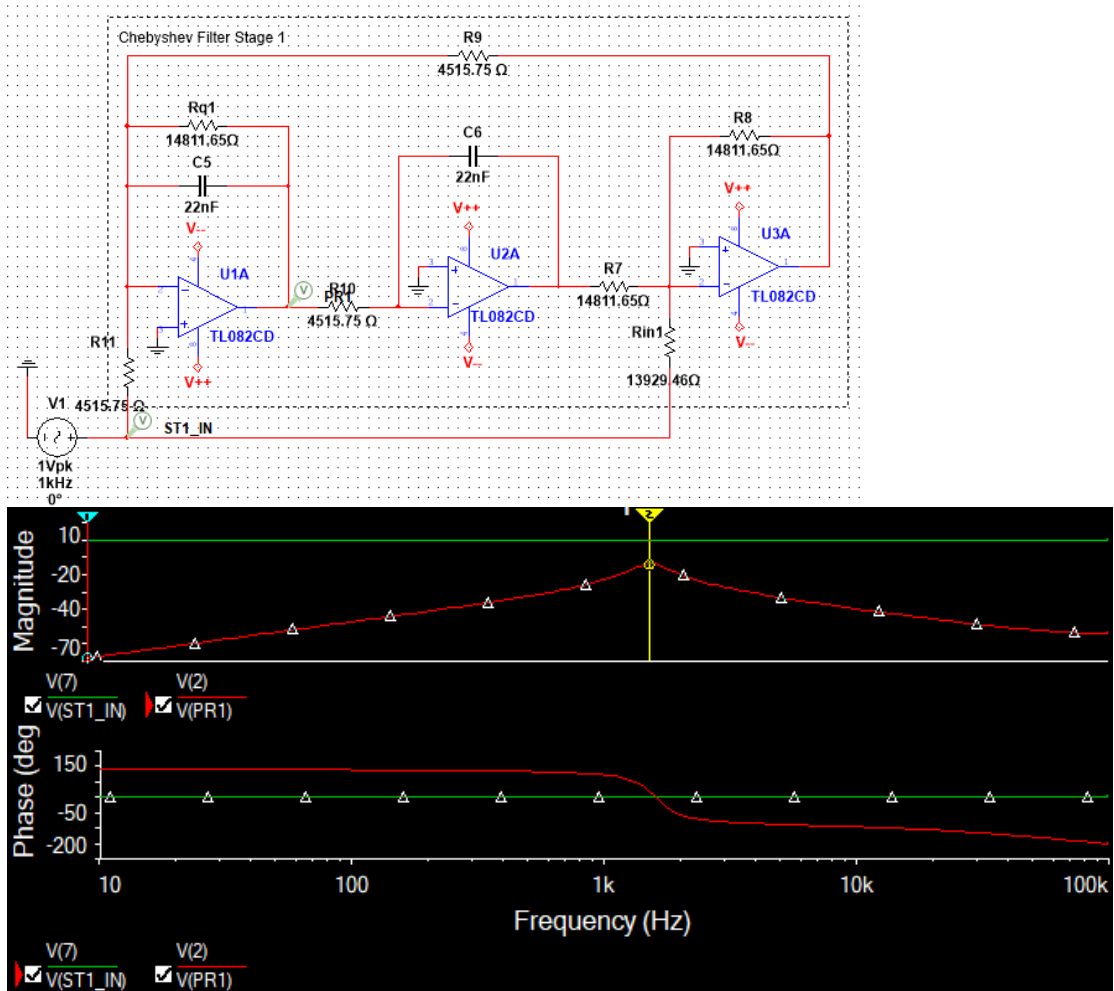
$$\delta = -\frac{B^2}{180000} + \frac{B}{173} + 0.5 = 1.66$$

- **Upper Cut-off Frequency**

$$f_{-3dB\ Upper} = f_{-3dB\ Lower}(1 + \delta) = 3856.04\ Hz$$

- First Stage $H_A(S)$

➤ Simulation using Theoretical Values

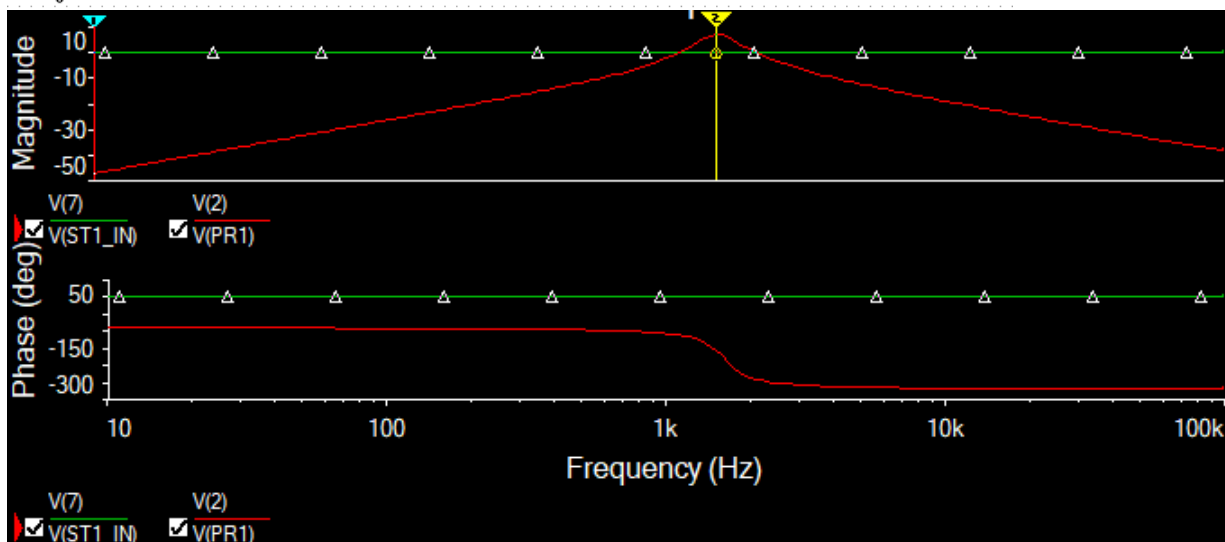
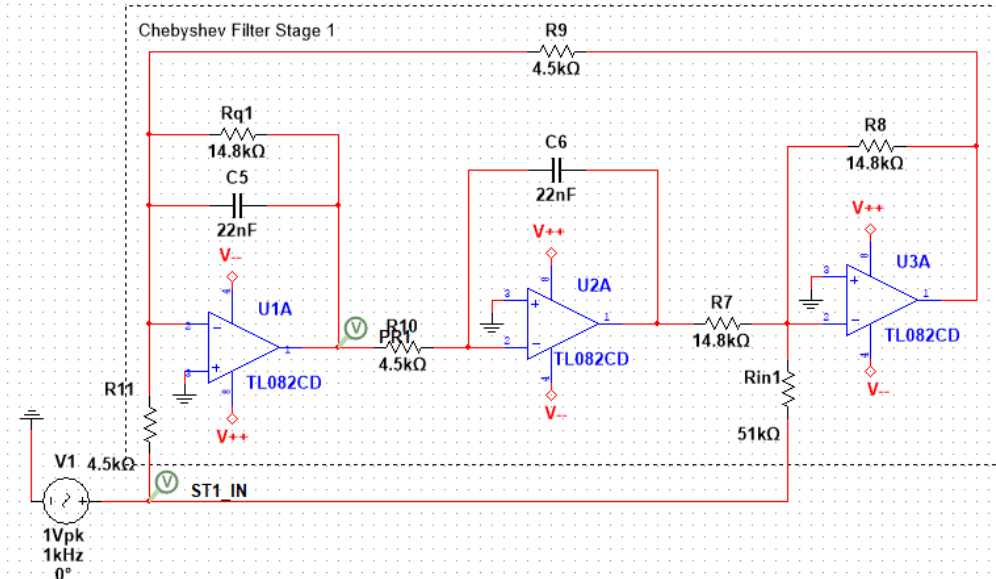


Cursor

	V (7)	V (2)
	V (ST1_IN)	V (PR1)
x1	10.0000	10.0000
y1	0.0000	-68.0584
x2	1.5884k	1.5884k
y2	0.0000	-13.6086
dx	1.5784k	1.5784k
dy	0.0000	54.4498
dy/dx	0.0000	34.4970m
1/dx	633.5573μ	633.5573μ

Center frequency is at 1588.4 Hz (9980.2rad/s), and Gain is -13.6086 dB.

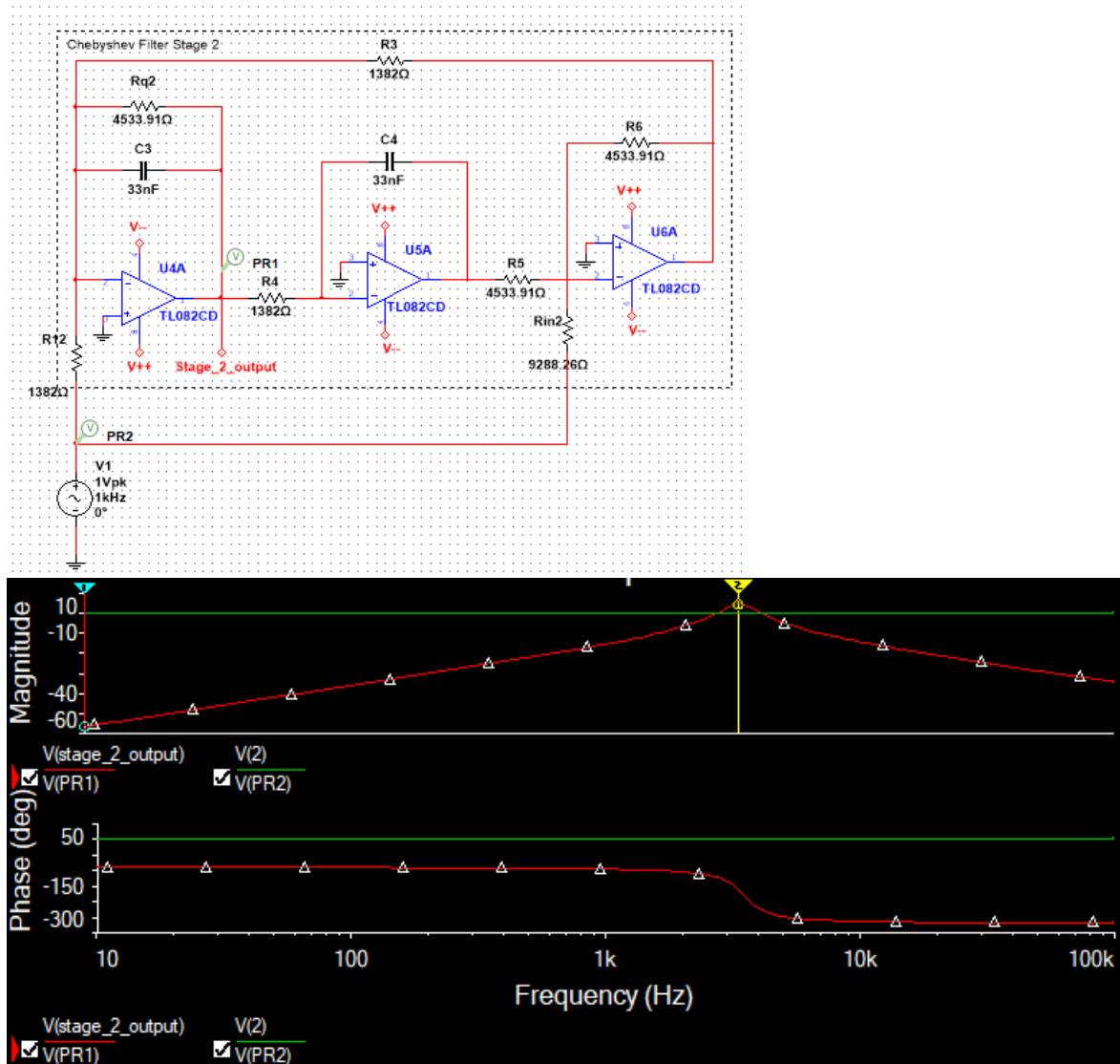
➤ Simulation using Standard Values



Center frequency is at 1588.4 Hz (9980.2 rad/s), and Gain is 7.3817 dB.

- Second Stage $H_R(S)$

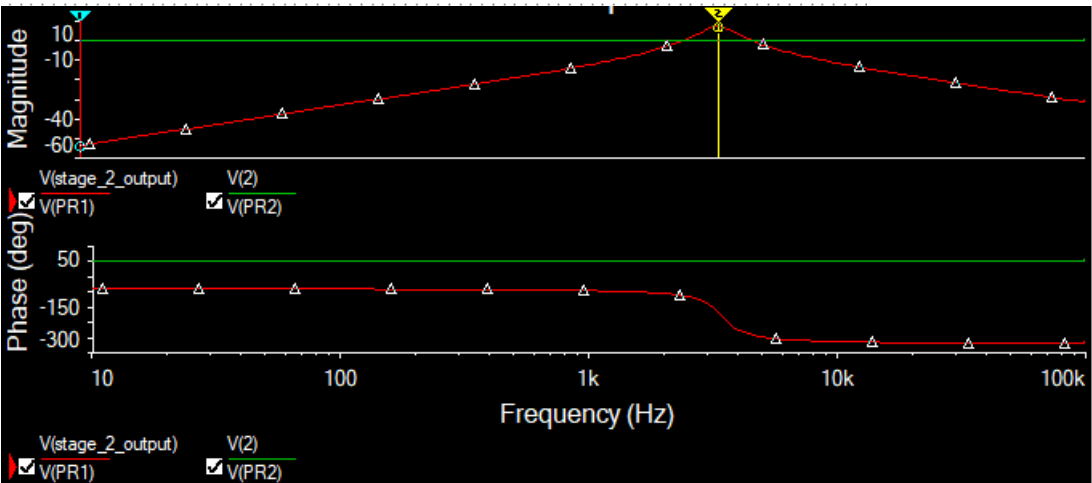
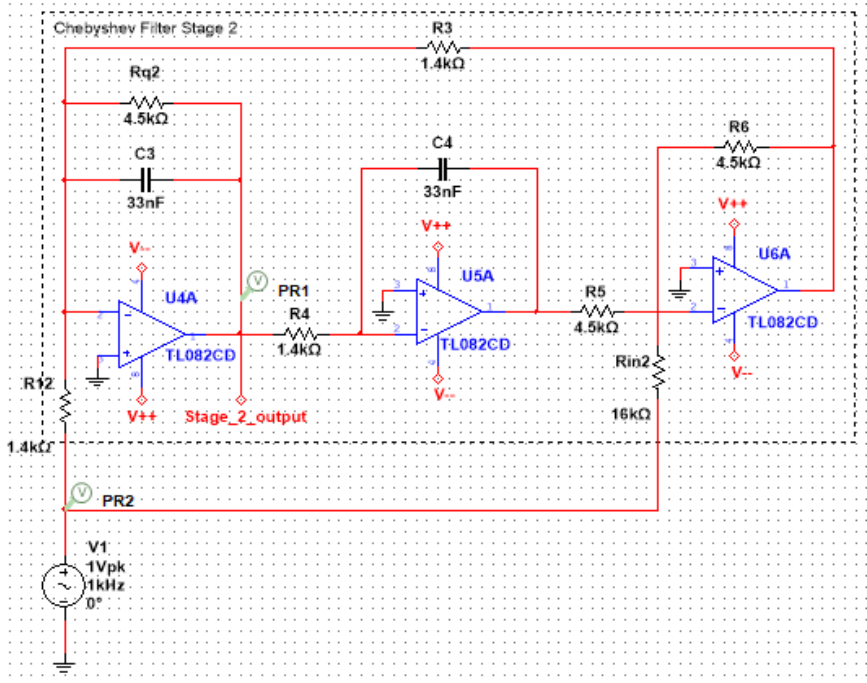
- Simulation using Theoretical Values



Cursor

	<u>V(stage_2_output)</u>	<u>V(2)</u>
	<u>V(PR1)</u>	<u>V(PR2)</u>
x1	10.0000	10.0000
y1	-56.6634	0.0000
x2	3.4600k	3.4600k
y2	4.6319	0.0000
dx	3.4500k	3.4500k
dy	61.2953	0.0000
dy/dx	17.7668m	0.0000
1/dx	289.8558μ	289.8558μ

Center frequency is at 3460 Hz (21739.8 rad/s), and Gain is 4.6319 dB.



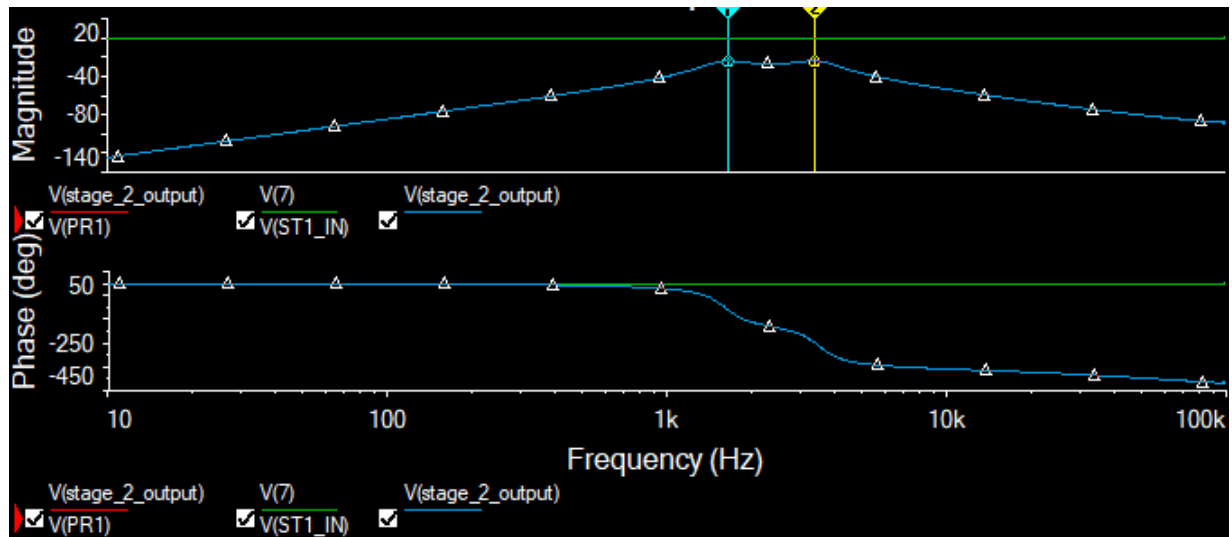
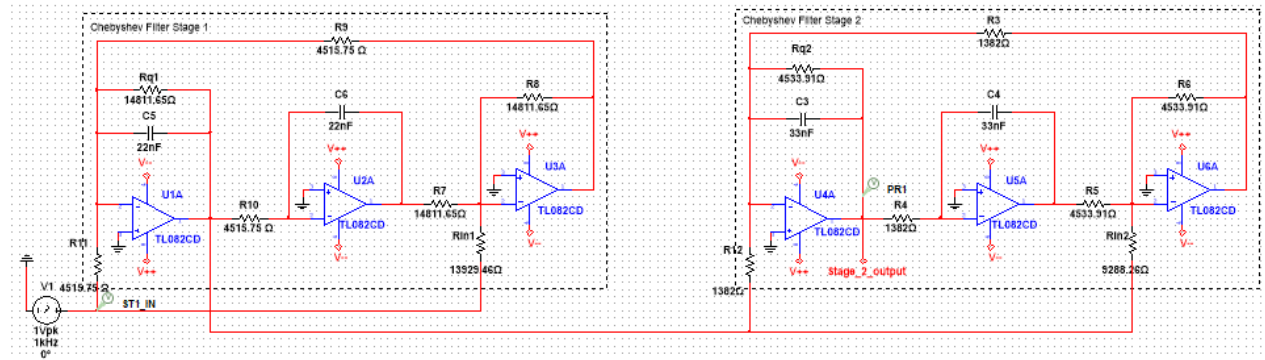
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	<u>V(stage_2_output)</u>	<u>V(2)</u>
	V(PR1)	V(PR2)
x1	10.0000	10.0000
y1	-53.6028	0.0000
x2	3.4600k	3.4600k
y2	7.3935	0.0000
dx	3.4500k	3.4500k
dy	60.9963	0.0000
dy/dx	17.6801m	0.0000
1/dx	289.8558μ	289.8558μ

Center frequency is at 3460 Hz (21739.8 rad/s), and Gain is 7.3935 dB.

- Full Chebyshev Filter $H_4(S)$

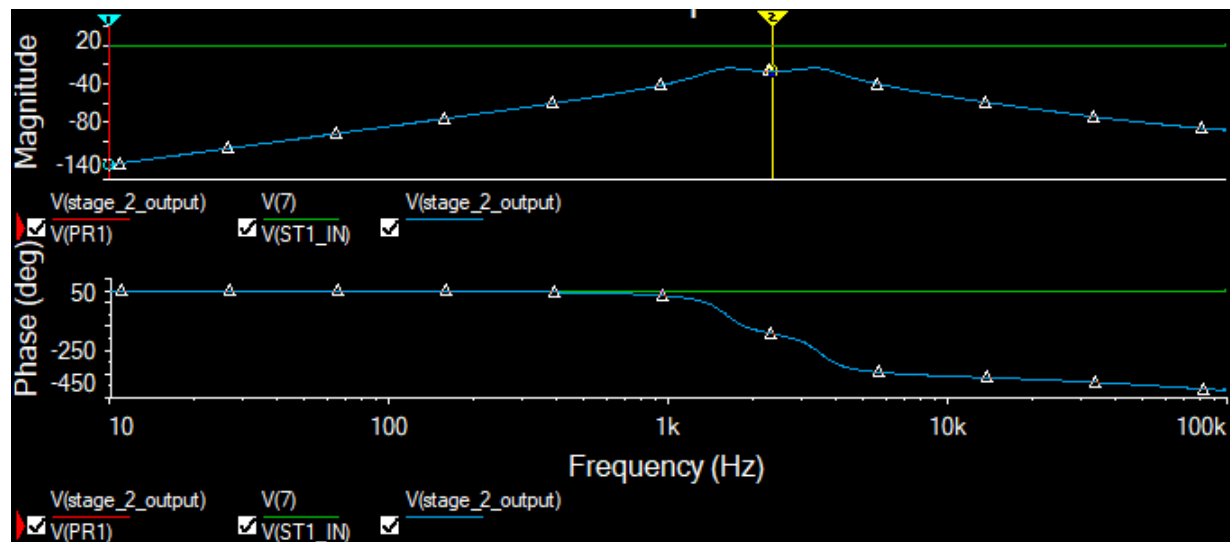
- Simulation using Theoretical Values



Cursor

	$\frac{V(\text{stage_2_output})}{V(\text{PR1})}$	$\frac{V(7)}{V(\text{ST1_IN})}$	$\frac{V(\text{stage_2_output})}{V(\text{stage_2_output})}$
x1	1.6571k	1.6571k	1.6571k
y1	-23.9947	0.0000	-23.9947
x2	3.3809k	3.3809k	3.3809k
y2	-23.9130	0.0000	-23.9130
dx	1.7238k	1.7238k	1.7238k
dy	81.7287m	0.0000	81.7287m
dy/dx	47.4126μ	0.0000	47.4126μ
1/dx	580.1217μ	580.1217μ	580.1217μ

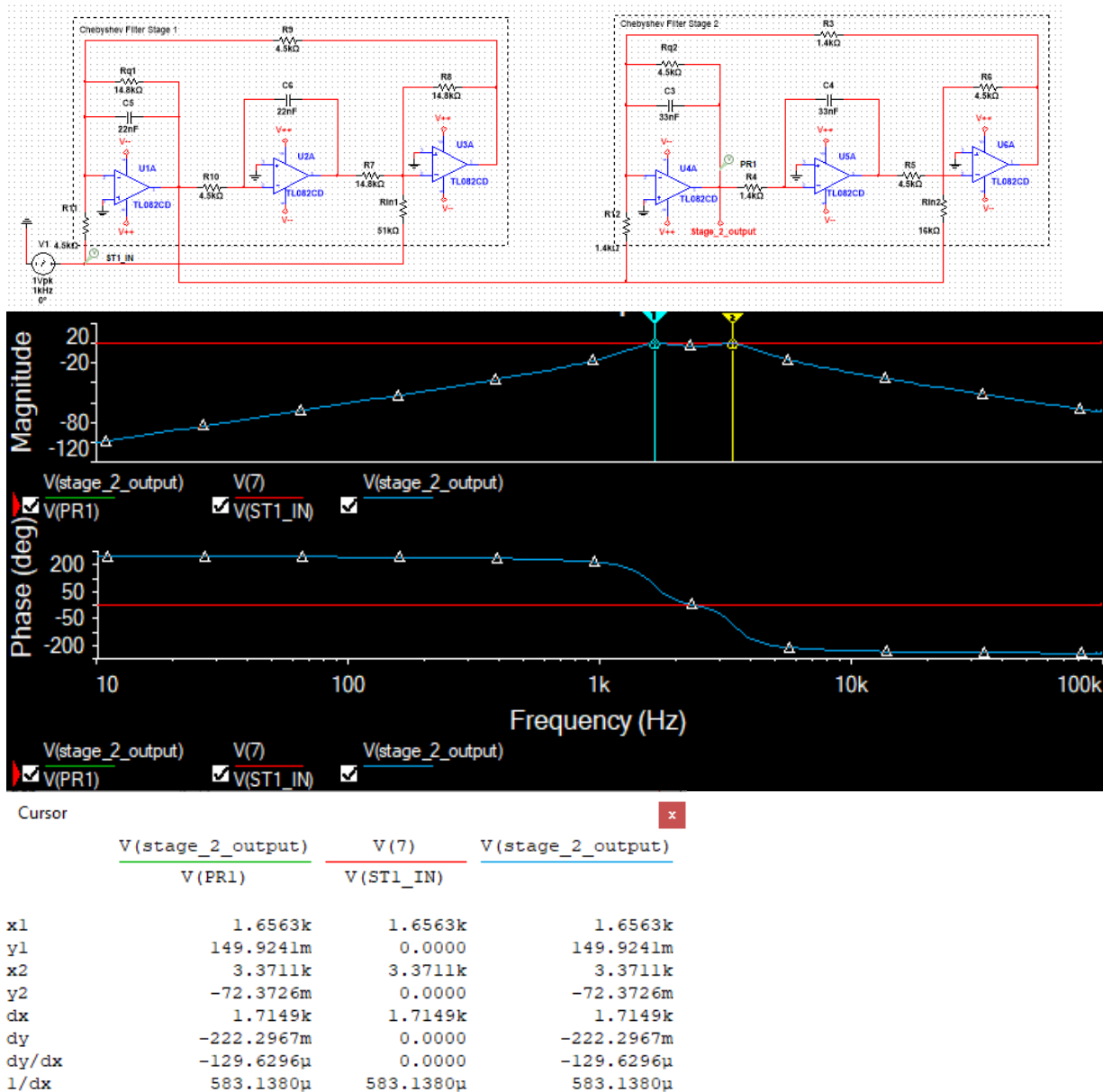
The Full Chebyshev filter has a lower -3db frequency equals to 1657.1 Hz (10411.8 rad/s), and upper -3dB frequency equals to 3380.9 Hz (21242.8 rad/s).



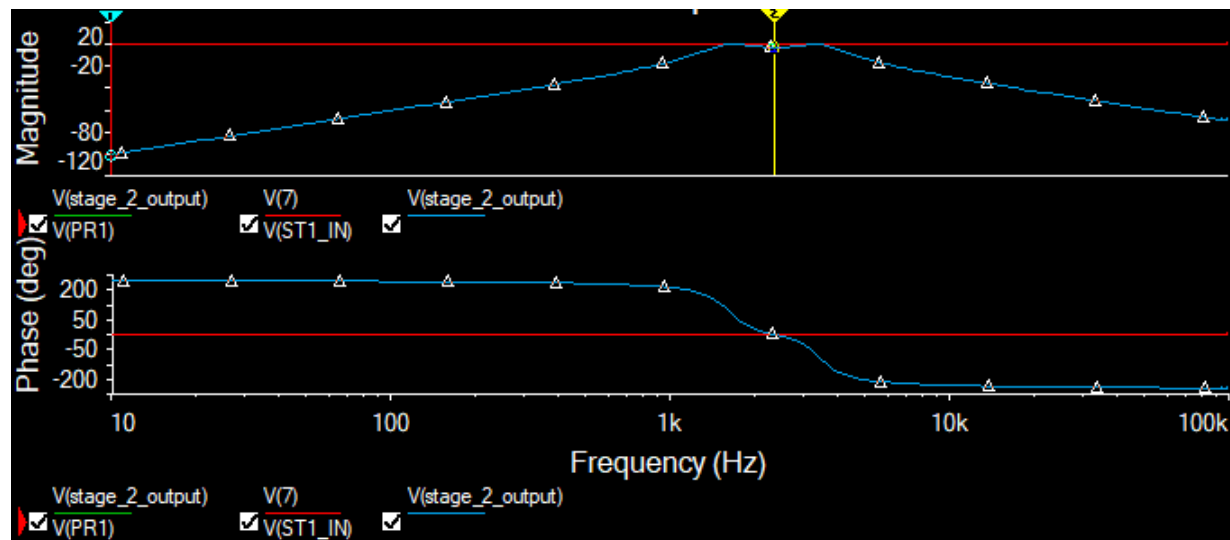
Cursor			
	$\frac{V(\text{stage_2_output})}{V(\text{PR1})}$	$\frac{V(7)}{V(\text{ST1_IN})}$	$\frac{V(\text{stage_2_output})}{V(\text{stage_2_output})}$
x1	10.0000	10.0000	10.0000
y1	-124.7218	0.0000	-124.7218
x2	2.3670k	2.3670k	2.3670k
y2	-27.0113	0.0000	-27.0113
dx	2.3570k	2.3570k	2.3570k
dy	97.7104	0.0000	97.7104
dy/dx	41.4559m	0.0000	41.4559m
1/dx	424.2728μ	424.2728μ	424.2728μ

The Full Chebyshev filter has a gain of -27.0113 dB and center frequency equal to 2367 Hz (14872.3).

➤ Simulation using Standard Values



The Full Chebyshev filter has a lower -3db frequency equals to 1656.3 Hz (10406.8 rad/s), and upper -3dB frequency equals to 3371.1 Hz (21181.2 rad/s).



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	$\frac{V(\text{stage_2_output})}{V(\text{PR1})}$	$\frac{V(7)}{V(\text{ST1_IN})}$	$\frac{V(\text{stage_2_output})}{V(\text{stage_2_output})}$
x1	10.0000	10.0000	10.0000
y1	-100.6991	0.0000	-100.6991
x2	2.3670k	2.3670k	2.3670k
y2	-2.7443	0.0000	-2.7443
dx	2.3570k	2.3570k	2.3570k
dy	97.9548	0.0000	97.9548
dy/dx	41.5596m	0.0000	41.5596m
1/dx	424.2728μ	424.2728μ	424.2728μ

The Full Chebyshev filter has a gain of -2.7443 dB and center frequency equal to 2367 Hz (14872.3 rad/s).

The table below show the theoretical and standard values for the different resistors used in the simulation.