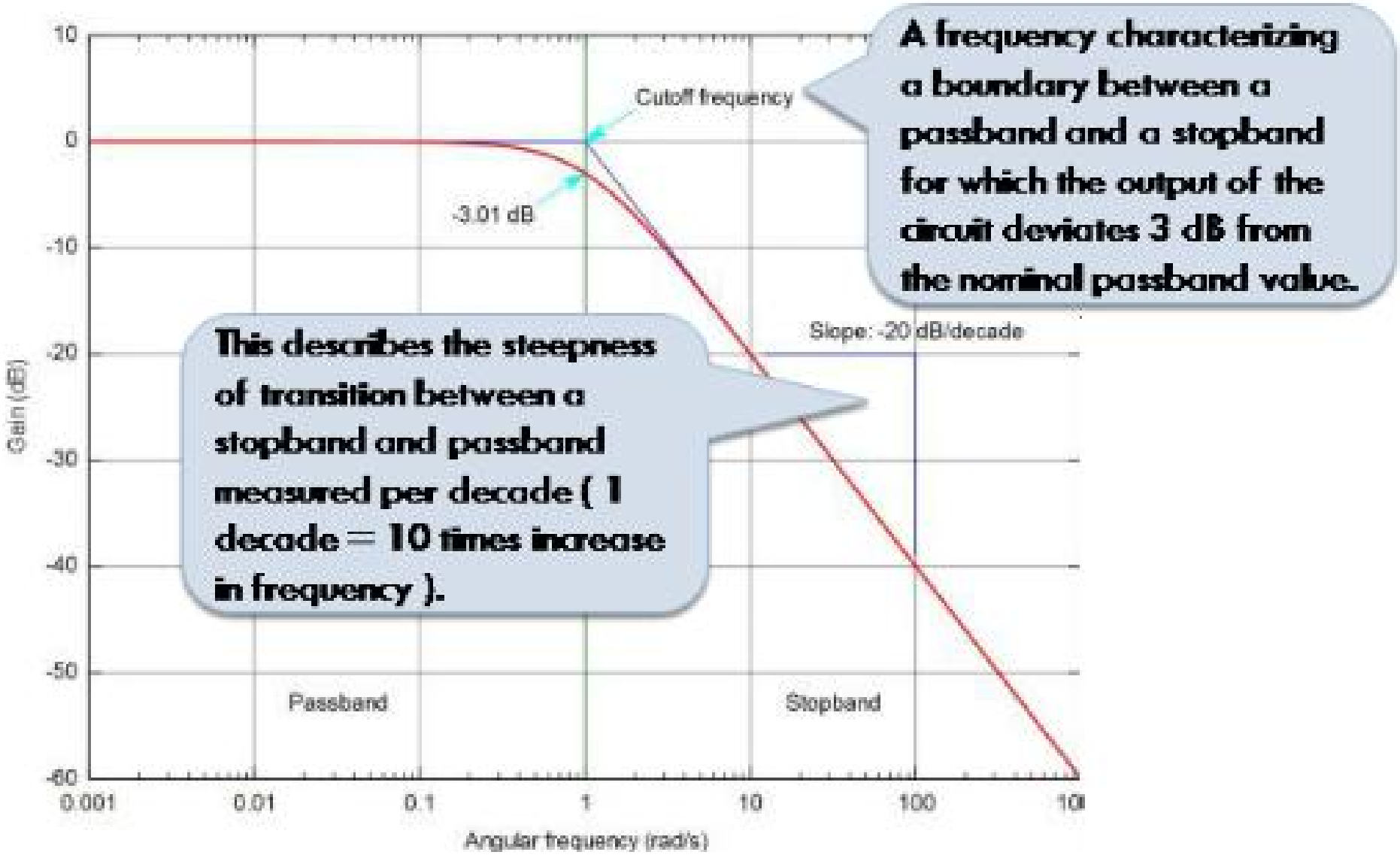
ADVANCED PULSE AND SWITCHING LAB

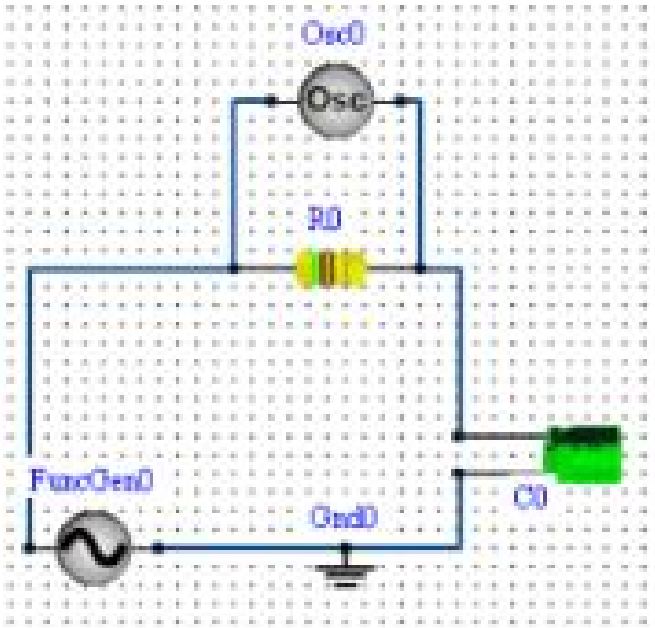
Studies on RC Low Pass Filter

Example Frequency Response of RC Low Pass Filter



Experiment Frequency - Response of RC circuit (Low Pass Filter)

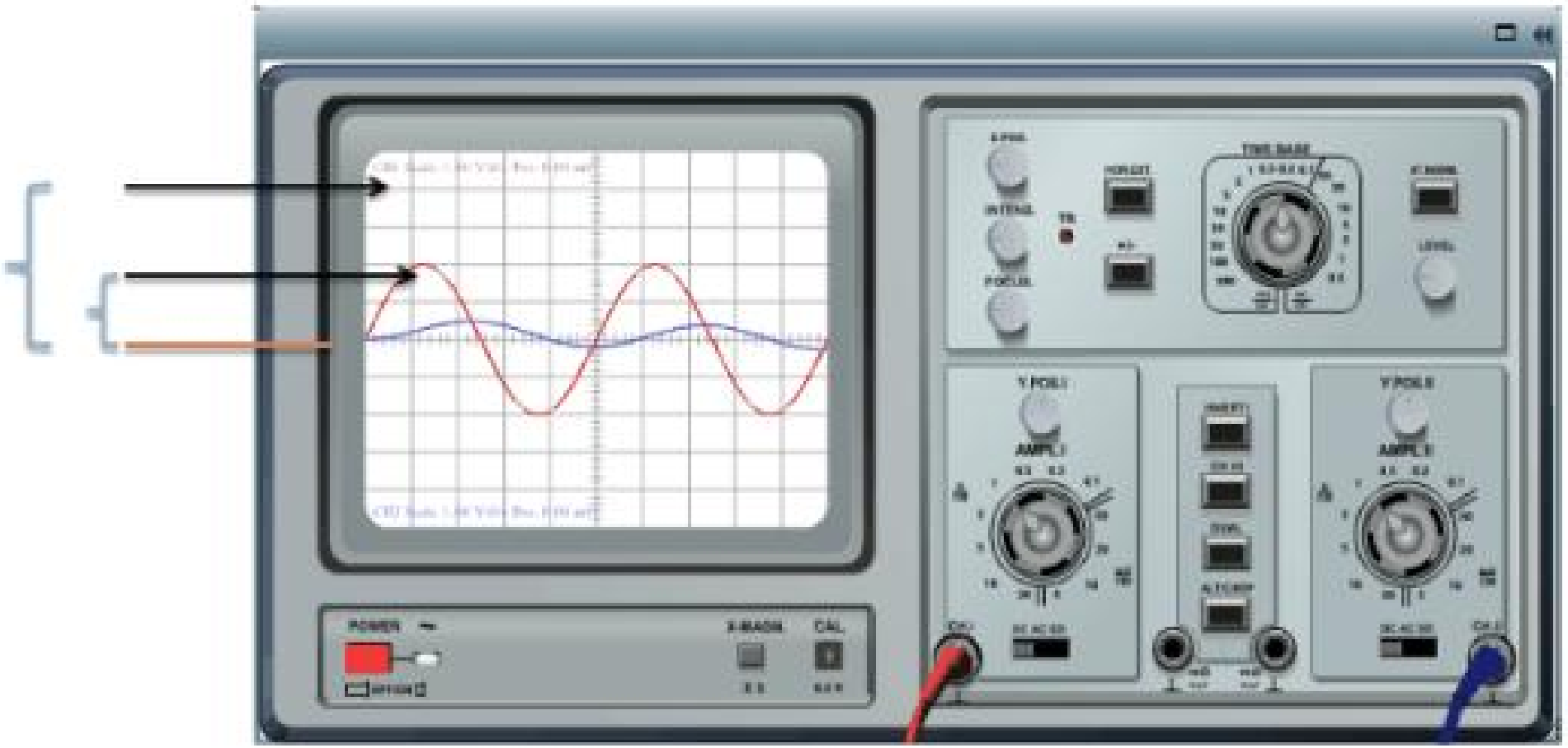
- Drag a function generator and Oscilloscope from the 'Basic' Panel.
- Drag a Resistor and Capacitor.
- Construct the circuit as below take R = 509 ohm and C= 2 uF.
- Connect the function generator and oscilloscope as shown below.
- Connect the ground of the circuit.



Experiment Frequency - Response of RC circuit (Low Pass Filter)

For the function generator select sine wave, and Amplitude 2V. In the Function generator, vary the frequency from 0 Hz to 1 KHz in steps of 100 Hz. For each time, note the peak amplitude of the 2 channels in the scope.

Experiment Frequency - Response of RC circuit (Low Pass Filter)



Note the PEAKS of CH1 and CH2 from Oscilloscope

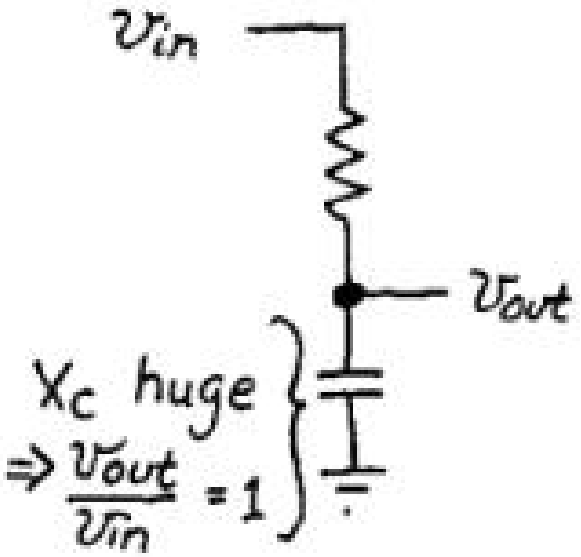
Experiment Frequency - Response of RC circuit (Low Pass Filter)

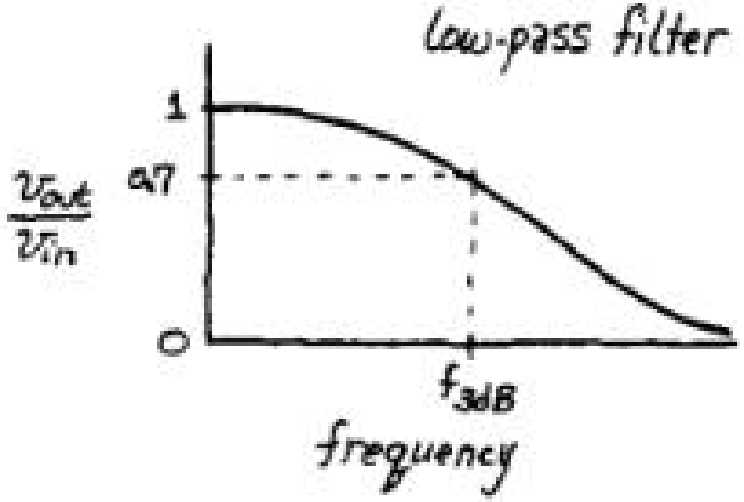
Note the readings of Vout, Vin and frequency over the frequencies and plot a bode graph (20 log(Gain) vs frequency). Observe the '3db' cut off point in the bode plot.

Vin (V)	Vout (V)	Freq (Hz)	Gain (Vout/ Vin)	20log(Gain)
2	2	0	1	0
2		100	.	.
2		200	.	.
2		300	.	.
2		400	.	.
…	…	…	…	…
2		1000	.	.

Experiment Frequency - Response of RC circuit (Low Pass Filter)

Confirm that the circuit indeed is passing lower frequencies and blocking higher frequencies.





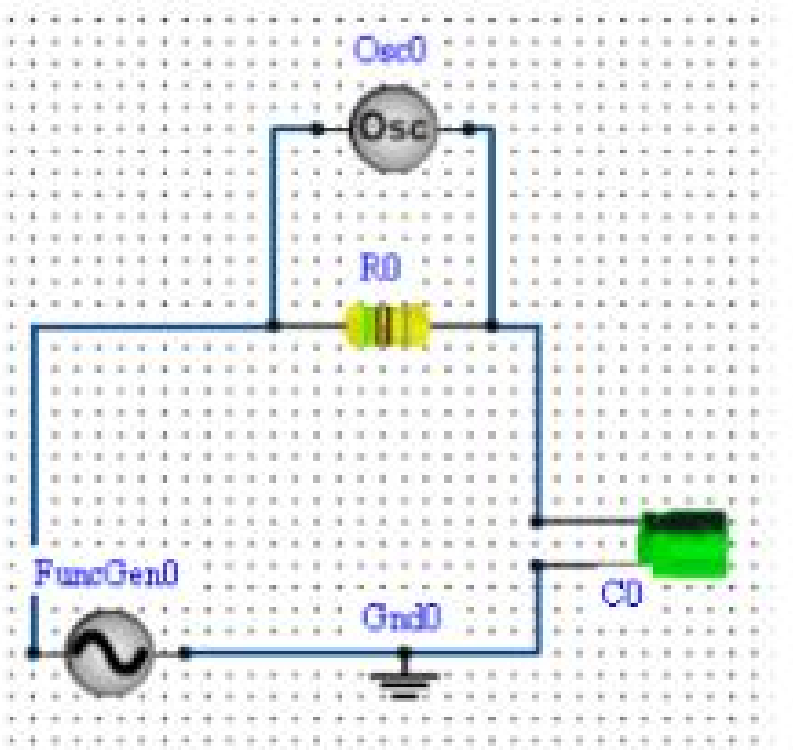
Is there an easier way of doing this ?

Indeed there is – a way to perform simulations in frequency domain.

Experiment Frequency - Response of RC circuit (Low Pass Filter)

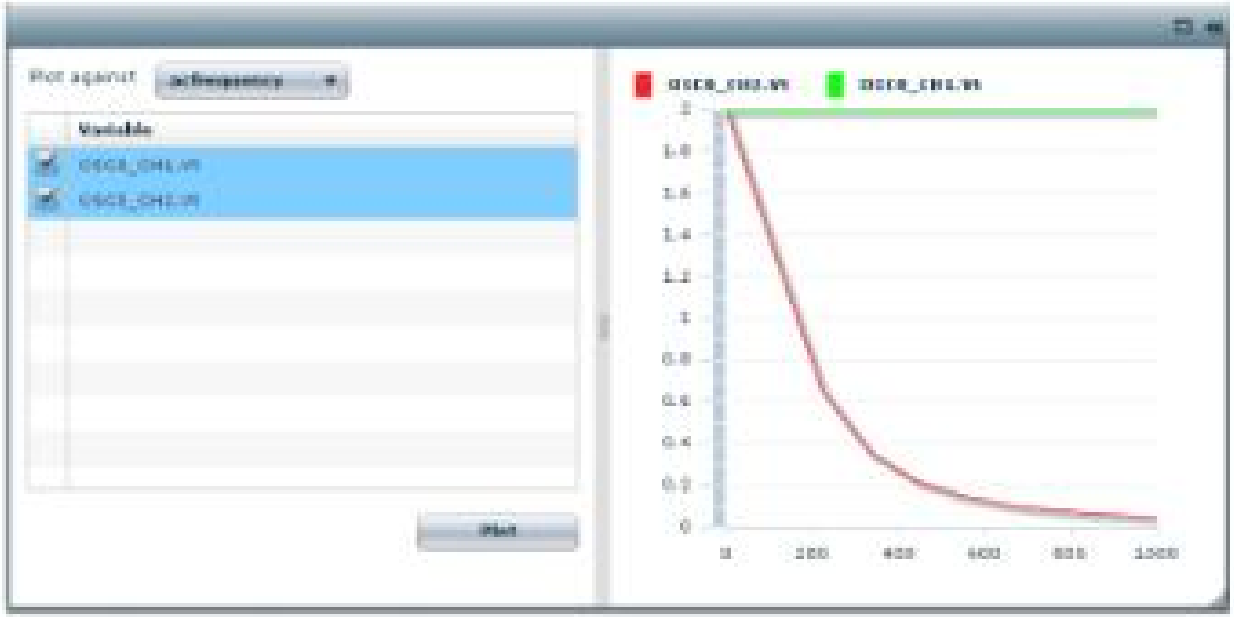
Construct the circuit as before, take R = 500 ohm and C= 2uF. For the function generator select sine wave, and Amplitude 2V. In the simulation properties, select 'Frequency Domain Analysis' and vary the frequency from 0 Hz to 1 KHz in steps of 100 Hz. Click on 'Run simulation'.

Experiment Frequency - Response of RC circuit (Low Pass Filter)



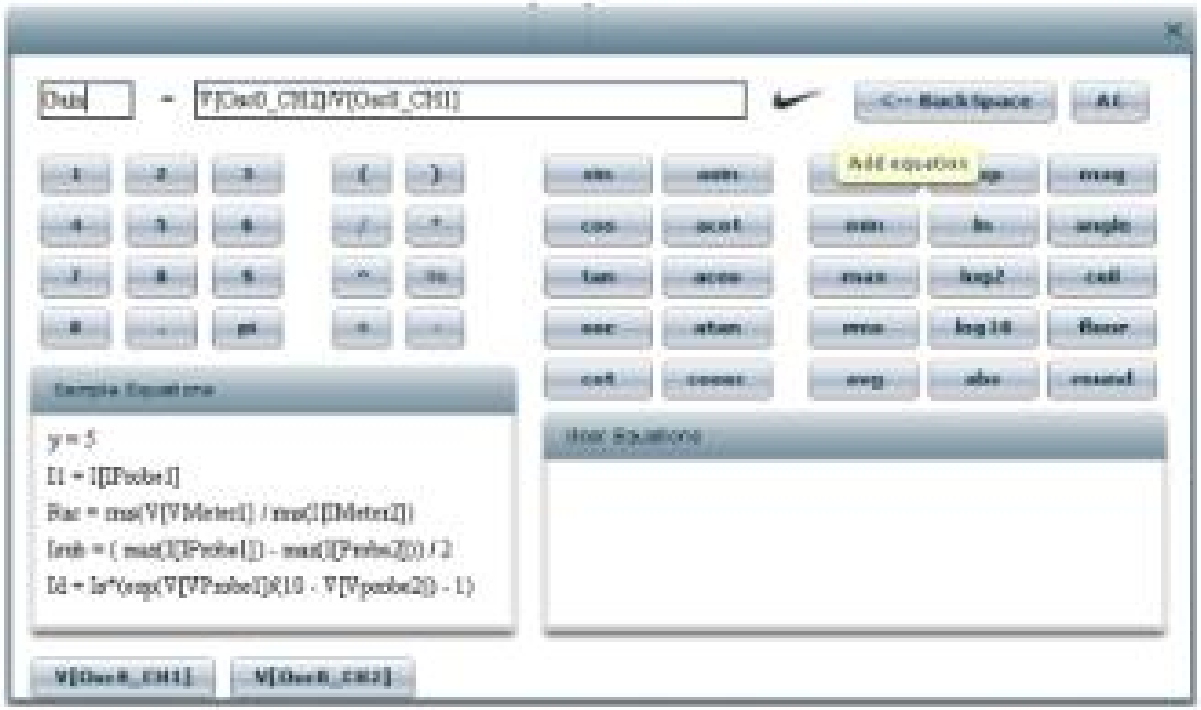
Experiment Frequency - Response of RC circuit (Low Pass Filter)

Click on the 'Data Analyzer' to see the results. Plot both the voltages (Vin and Vout) wrt Frequency. We can see that the lower frequencies as passed while the higher frequencies are not passed.



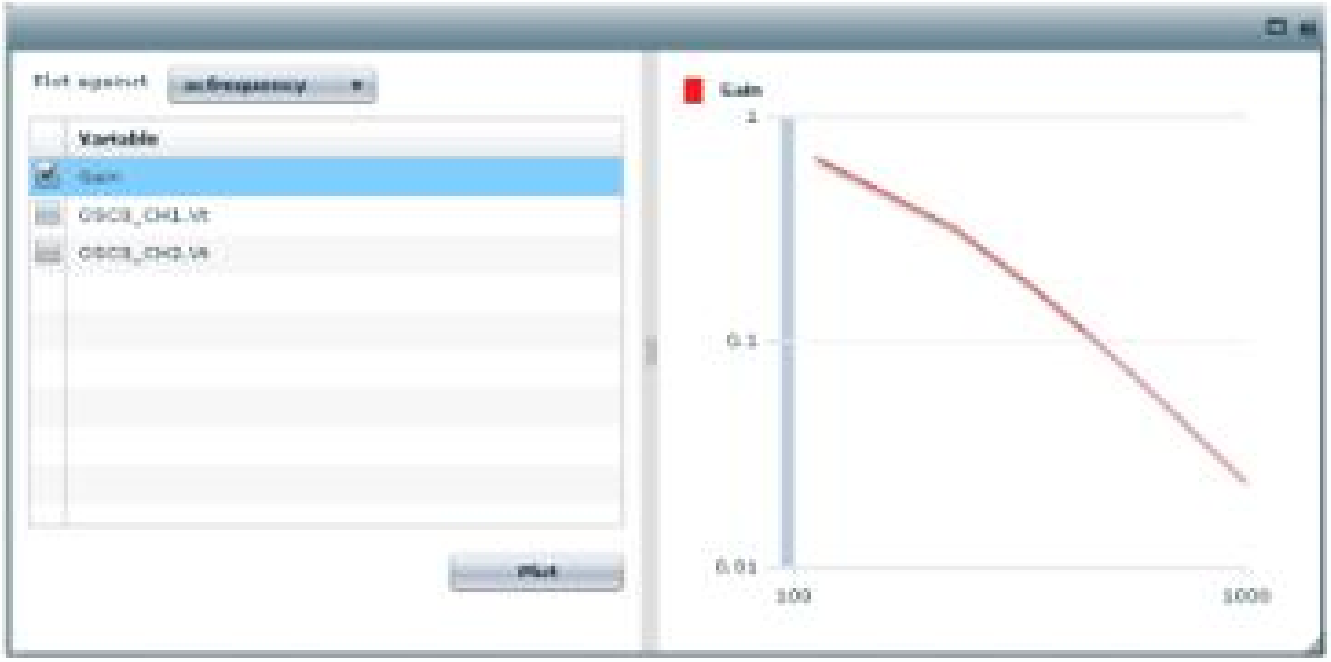
Experiment Frequency - Response of RC circuit (Low Pass Filter)

Let us now plot the Vout/Vin vs frequency and see the results and find out the '3db' point. Click on 'Add Equations' and add the Gain as an equation of Vout/Vin. Run simulation again and click on 'Data Analyzer'.



Experiment Frequency - Response of RC circuit (Low Pass Filter)

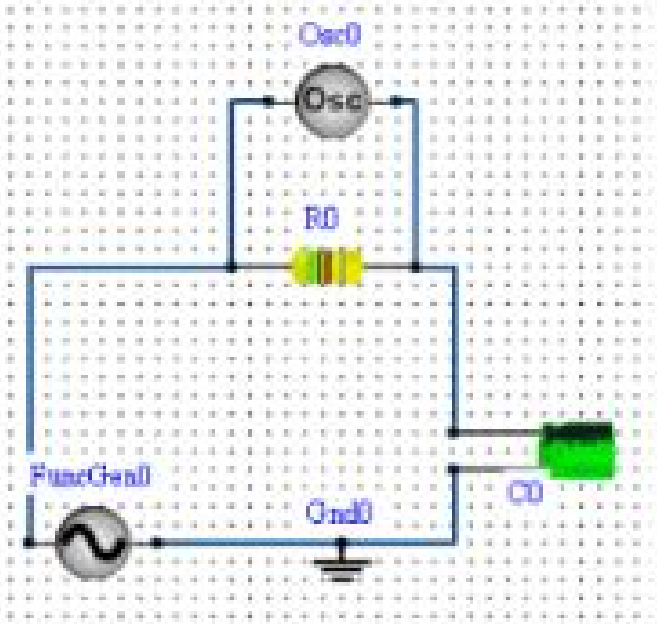
On the Data Analyzer, plot Gain vs Frequency and Select the Log scale for both X and Y axis to see the bode-plot. Select the full frequency range for the X axis.



The '3db' or the turning point can now be mapped in the plot.

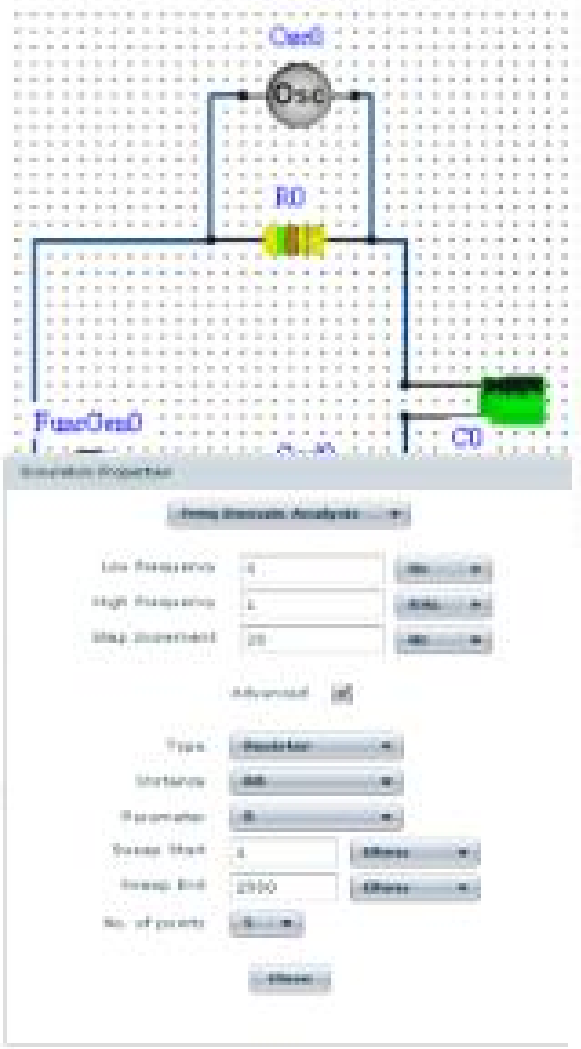
Exploratory : RC circuit (Low Pass Filter)

Having measured the 3db point, let us try and understand how the 3db point changes with change in Resistor and change in Capacitor.



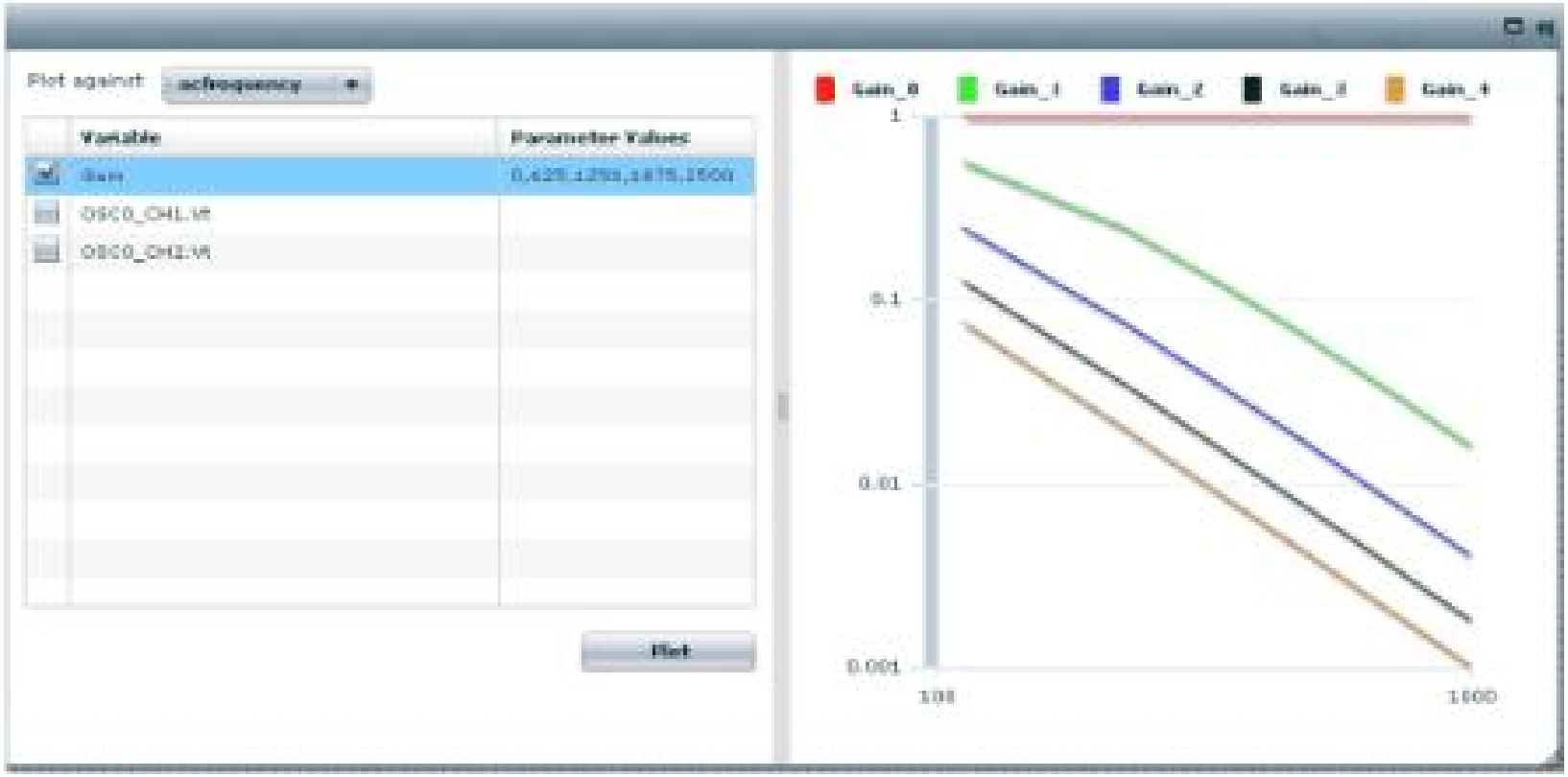
Exploratory : RC circuit (Low Pass Filter)

- Construct the circuit as before.
- In the simulation properties, select 'Frequency Domain Analysis' and vary the frequency from 0 Hz to 1 KHz in steps of 100 Hz.
- Click Advanced and vary the resistance from 0 Ohms to 2500 Ohms.
- Run simulation.



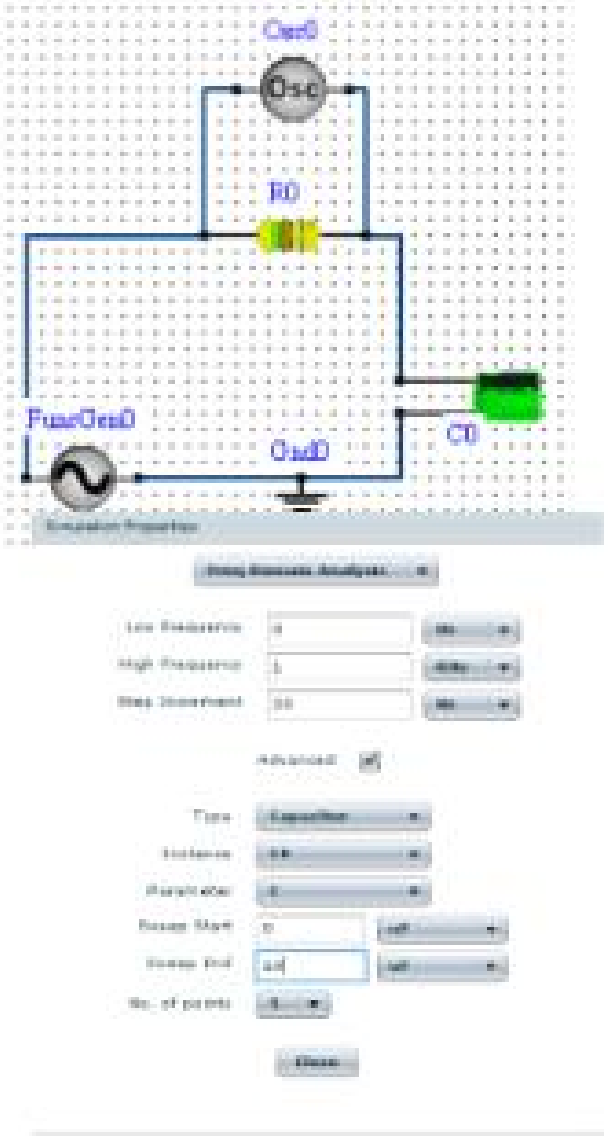
Exploratory : RC circuit (Low Pass Filter)

Click on Data Analyzer to view the change in 3db point. We can see that 3db point is inversely proportional to change in R.



Exploratory : RC circuit (Low Pass Filter)

- Let us now vary the capacitance.
- In the simulation properties, select 'Frequency Domain Analysis'
- Vary the frequency from 0 Hz to 1 KHz in steps of 100 Hz.
- Click Advanced and vary the Capacitance from 0 F to 10 uF.
- Run simulation.



Exploratory : RC circuit (Low Pass Filter)

Click on Data Analyzer to view the change in 3db point. We can see that 3db point is inversely proportional to change in C.