

**AC Frequency Analysis For Low Power Operational Amplifier Comparator Using Mentor Graphics Design Architect (DA-IC)**

1. Up to now we have finished DC analysis. Now let's move on to AC analysis. The testbench circuit structure for AC analysis is shown in Figure 1 below:

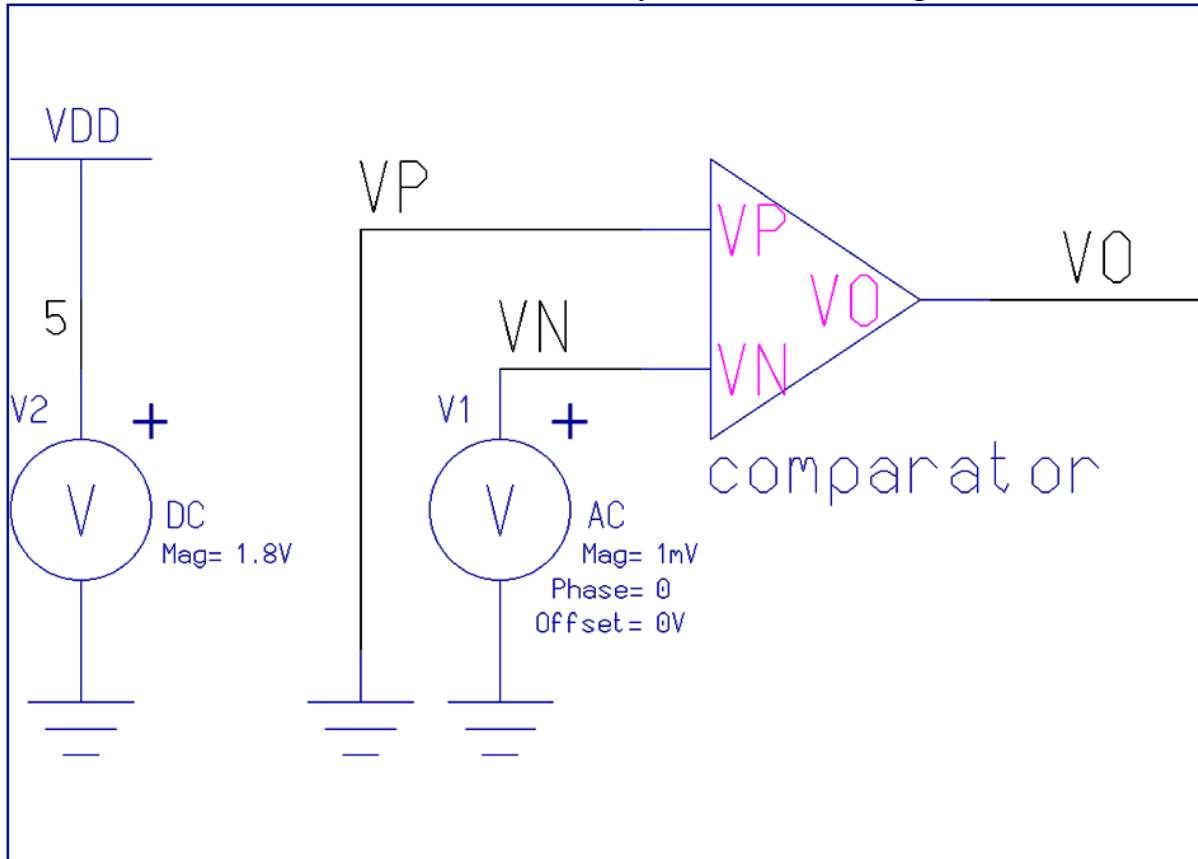
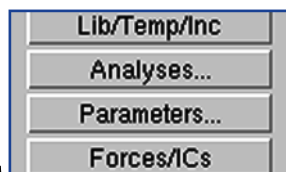


Figure 1: Comparator Testbench

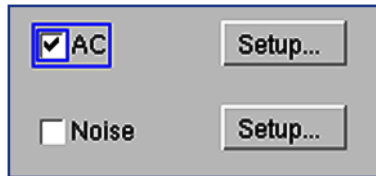
2. Click the properties for DC voltage and AC voltage to change each parameter values as shown in the Table 1 below:

Table 1: Parameter

Instrumental	Component	Parameter
V1	AC Voltage	Mag=1mV
V2	DC Voltage	DC=1.8V



3. Next, click on **Analysis** on the right hand palette.



4. Choose **AC** and click **Setup** then configure the popup with detail in Figure 2 as shown below:

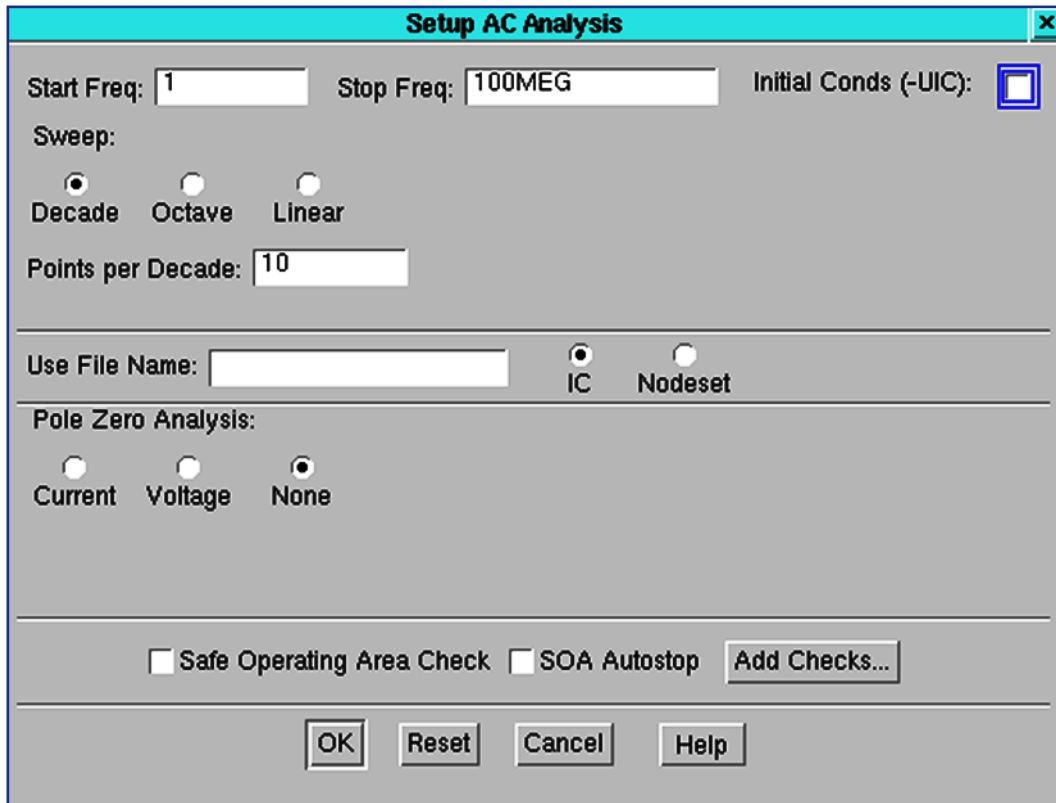
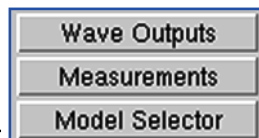


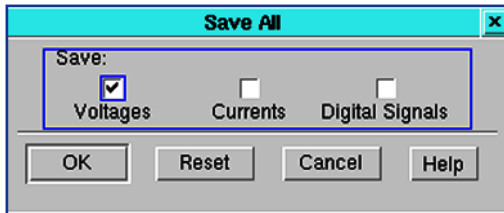
Figure 2: Setup AC Analysis



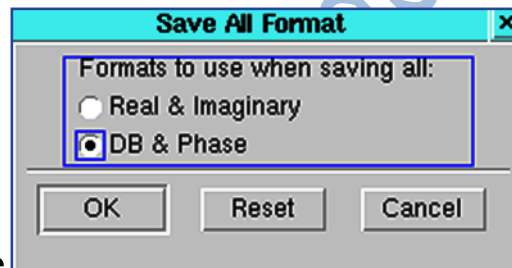
5. Then choose the **Wave Output** from the right hand site palette.



6. Select **Save All** and choose **Voltages**



. Then click OK.



7. Next, choose **DB & Phase** and click OK.



8. Now, run the simulation by clicking on **Run Eldo** from the palette.

9. Two windows will pop-up. One window for netlist design and another for simulation design as shown in Figure 3 and Figure 4.

```
Netlisting design : comparator_tb/eldonet
Primitive [$CEDEC_KIT/lib/ac_v_source] [ac_v_source/ac_v_source] [SPICE=V] (NCF
entry line:8 file:$CEDEC_KIT/lib/ac_v_source/@ncf.dir/ac_v_source.ncf)

**** Writing </Projects/izat/test7/schematic/comparator_tb/eldonet> netlist for
ELDO ****

Number of cells: 8
Number of primitive instances: 14

Done...
// Registration file '/Technology/CEDEC/cedec_sil018_digital/lib/ac_v_source/@nc
f.dir/ac_v_source.ncf' closed.
// Registration file '/Technology/CEDEC/cedec_sil018_digital/lib/dc_v_source/@nc
f.dir/dc_v_source.ncf' closed.
// Registration file '/Technology/CEDEC/cedec_sil018_digital/lib/nmos4/@ncf.dir/
nmos4.ncf' closed.
// Registration file '/Technology/CEDEC/cedec_sil018_digital/lib/pmos4/@ncf.dir/
pmos4.ncf' closed.
// Registration file '/Technology/CEDEC/cedec_sil018_digital/lib/ideal_capacitor
/@ncf.dir/ideal_capacitor.ncf' closed.
// Registration file '/Technology/CEDEC/cedec_sil018_digital/lib/ideal_resistor/
@ncf.dir/ideal_resistor.ncf' closed.
Press the return key to continue.
□
```

Figure 3: Netlist Design

```
Simulating design : comparator_tb/eldonet

***>Current simulation completed

SIMULATION INFORMATION
memory size allocated in bytes 1822281
nb of components: 13
nb of nodes: 8
nb of MOS or BIP calls: 202
Number of steps computed: 0

***>CPU TIME 0s 000ms <***

***>GLOBAL CPU TIME 0s 020ms <***

***>GLOBAL ELAPSED TIME 4s <***

Press the return key to continue.
□
```

Figure 4: Simulation Design



10. Click View Waves to view the result simulation.

11. An EZwave viewer will pop-up. Next, drag the VDB(VO), VDB(VN), VP(VO) and VP(VN) into the Wave Window.
12. The simulation waveform will appear as shown in Figure 5, Figure 6, Figure 7 and Figure 8 respectively.
13. The simulation waveform is not finish yet because we want the VDB(VO) is minus with the VDB(VN) to get a gain waveform by using **Waveform Calculator**.
14. Same goes for VP(VO) and VP(VN) too. Minus VP(VO) with VP(VN) will get a phase waveform.

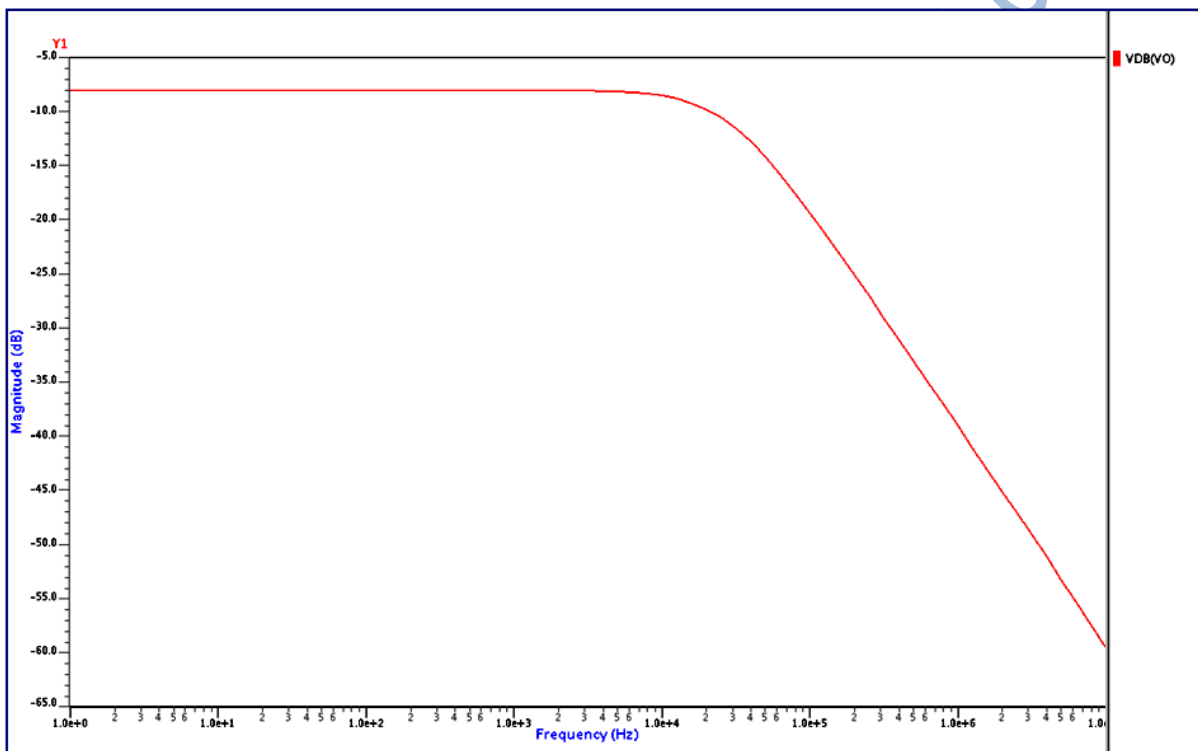


Figure 5: Simulation Waveform for VDB(VO)

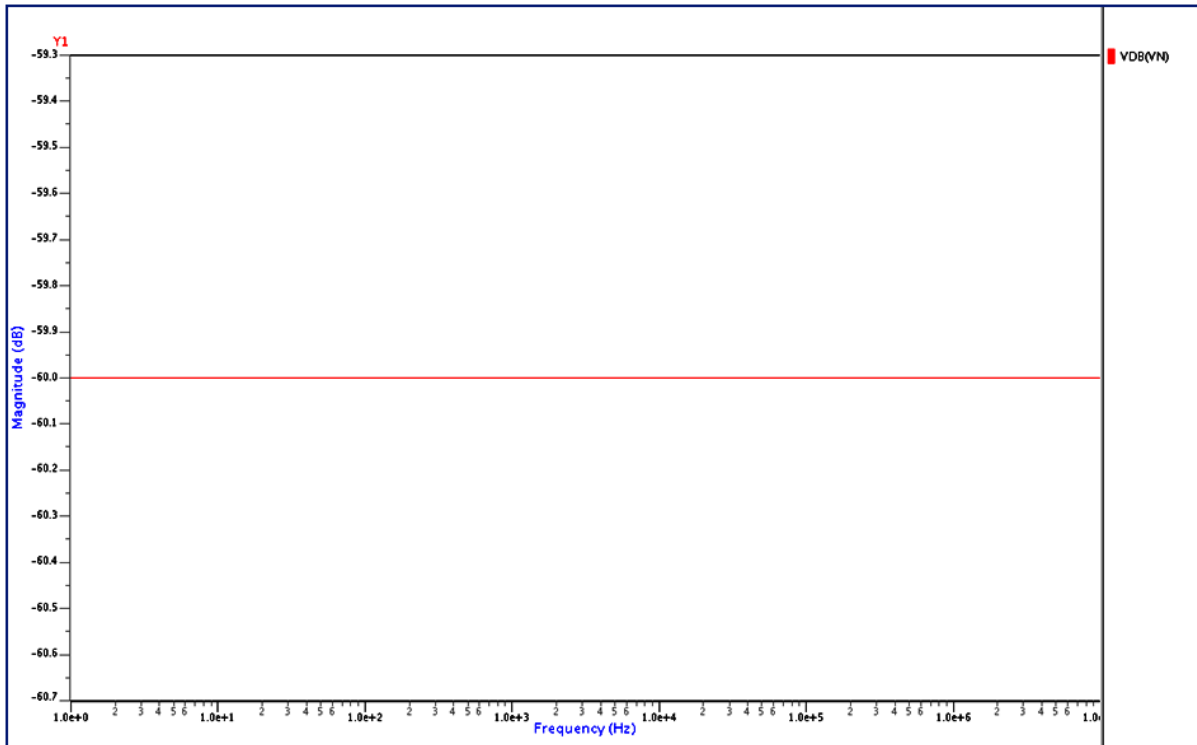


Figure 6: Simulation Waveform for VDB(VN)

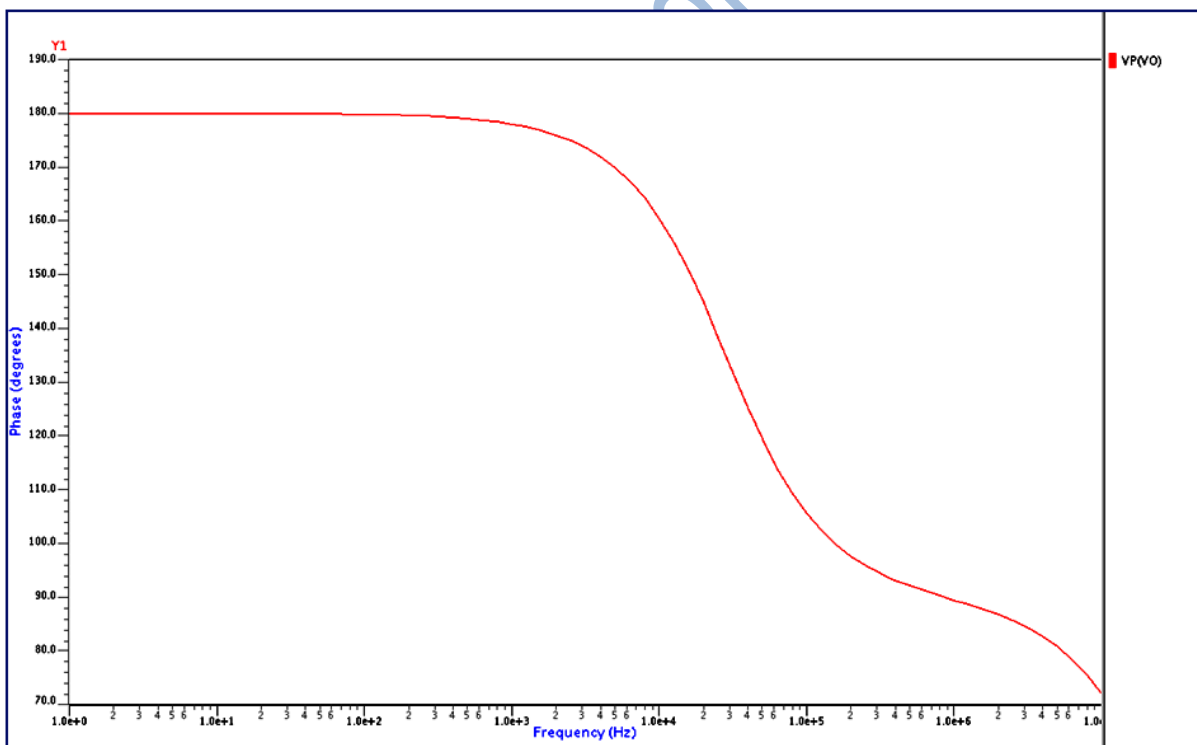


Figure 7: Simulation Waveform for VP(VO)

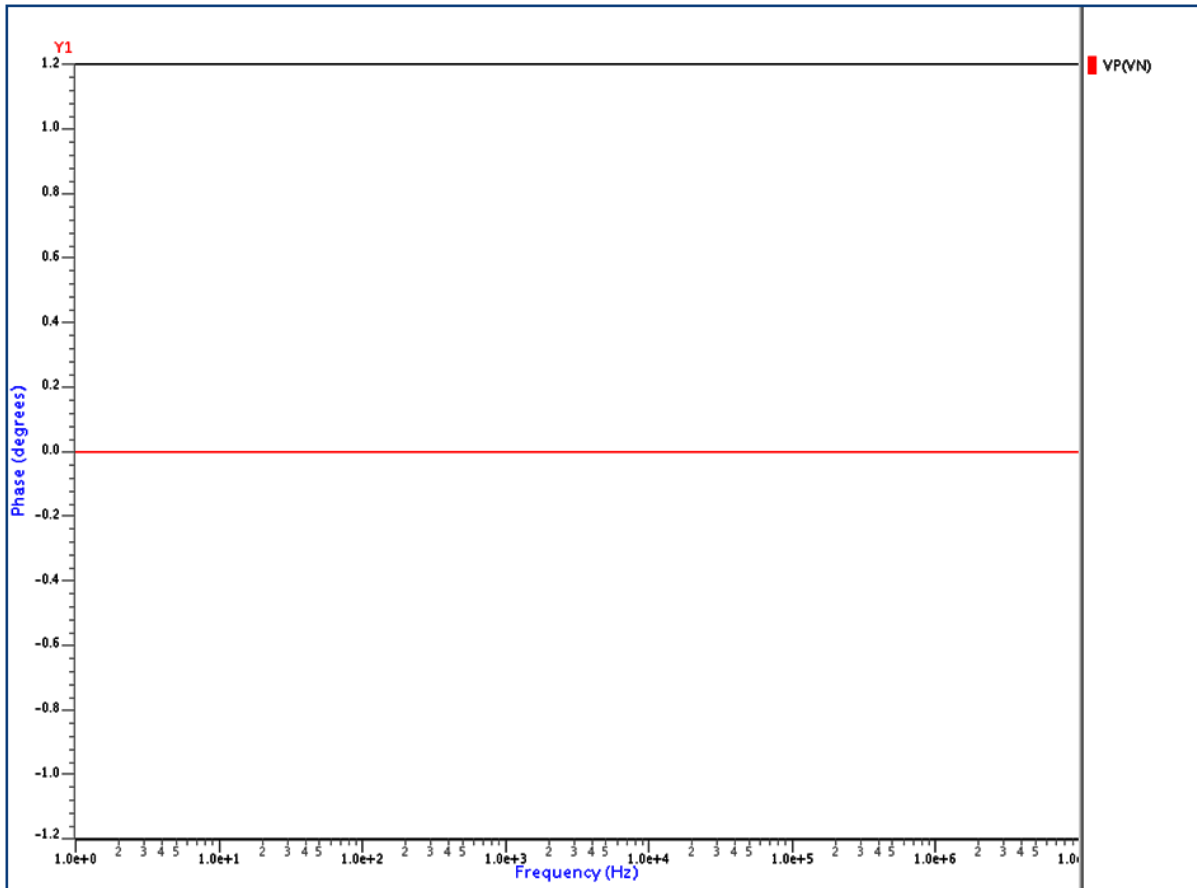


Figure 8: Simulation Waveform for VP(VN)

Waveform Calculator



15. Click **Waveform Calculator** on EZwave viewer and the **Waveform Calculator** will pop-up as shown in Figure 9.

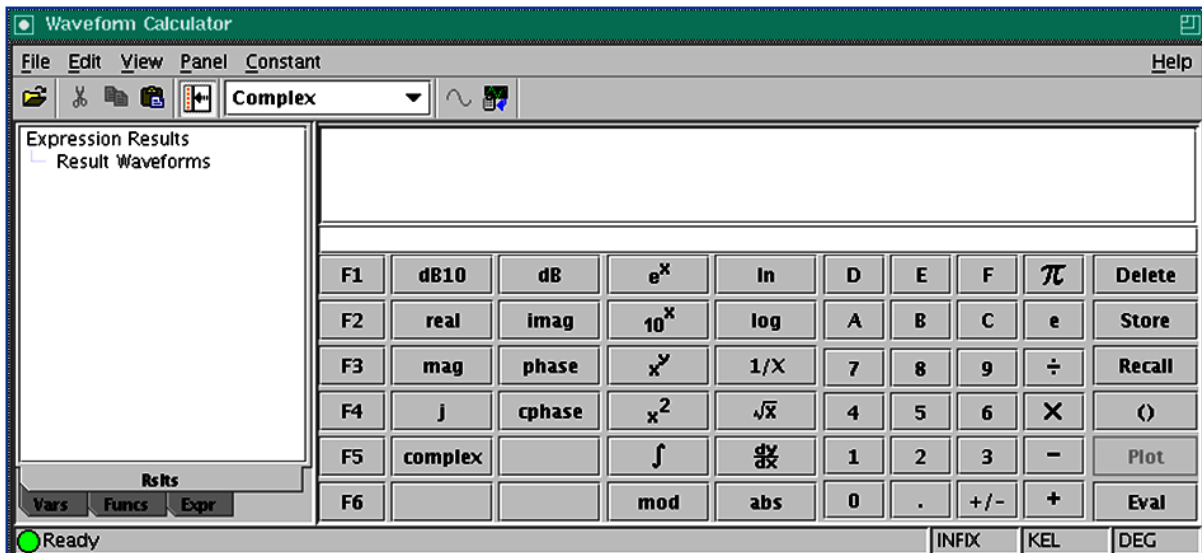
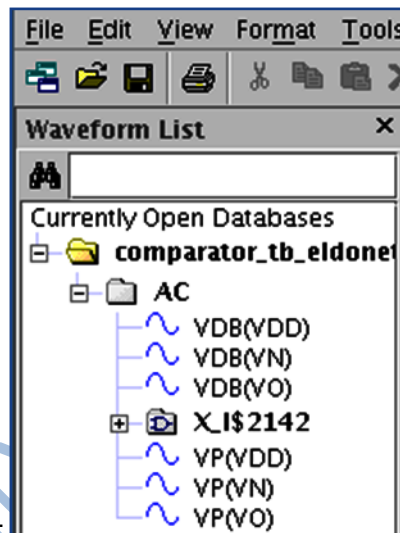


Figure 9: Waveform Calculator



16. At the Waveform List click VDB(VO).

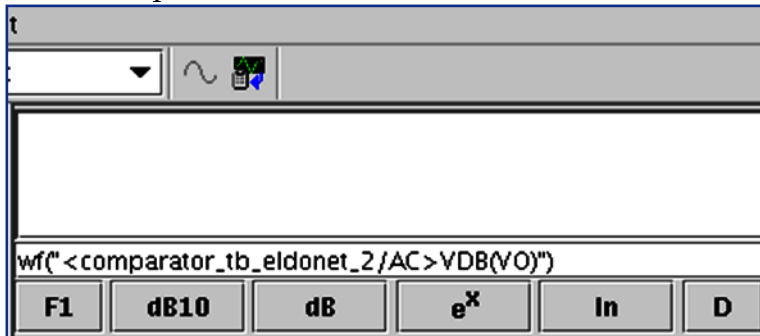
Add Selected Waveform



17. Click Add Selected Waveform on Waveform Calculator.



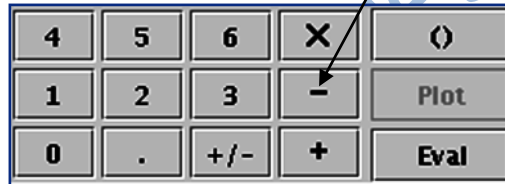
18. The expression for VDB(VO) waveform



will appear at display

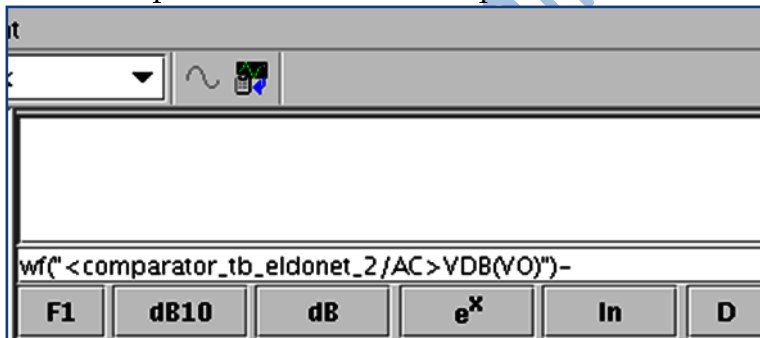
Waveform Calculator.

Subtraction Operator



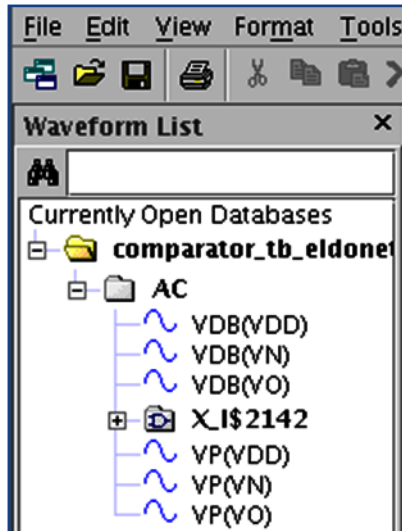
19. Click Subtraction Operator.

20. The expression subtraction operator



will appear at display

Waveform Calculator.



21. Click VDB(VN) at the Waveform List.

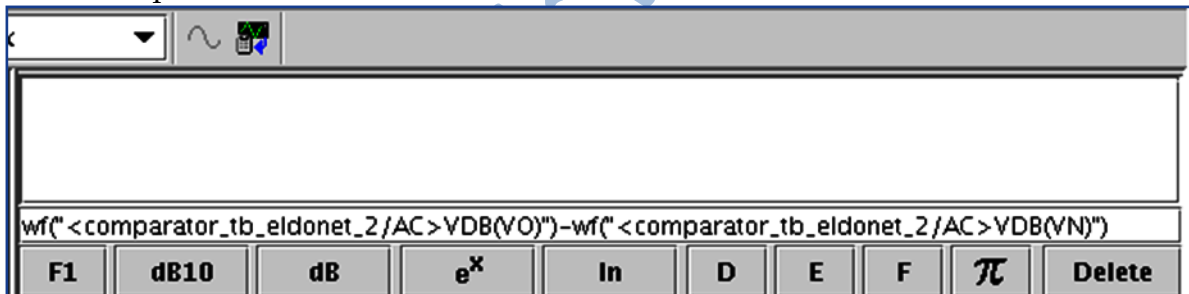
22. Then click Add Selected Waveform

Add Selected Waveform



on Waveform Calculator.

23. The expression for VDB(VN) waveform



will appear at display Waveform Calculator.



Evaluate the Expression

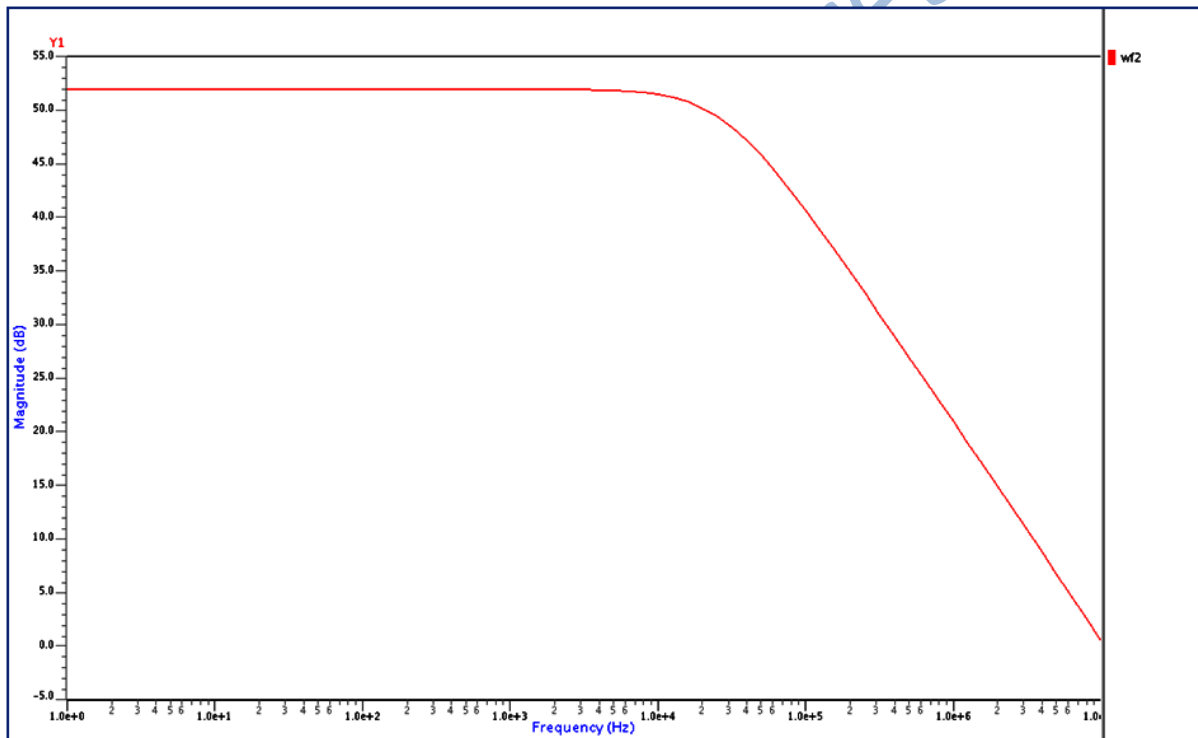
24. Click Evaluate the Expression at the wave Waveform Calculator.



Plot the Last Created  
Waveform

25. Then click **Plot the Last Created Waveform** to get the result of the gain waveform.

26. The waveform simulation for gain is shown in Fig 10 below and the gain we get is 51.96dB.



**Figure 10:** Gain waveform

27. Repeat *Step 15 until Step 25* to get the phase waveform. Use the same method also, minus it with VP(VO) and VP(VN) by using **Waveform Calculator**.

28. The waveform simulation for phase is shown in Fig 11 below and the phase we get is  $180^{\circ}$ .

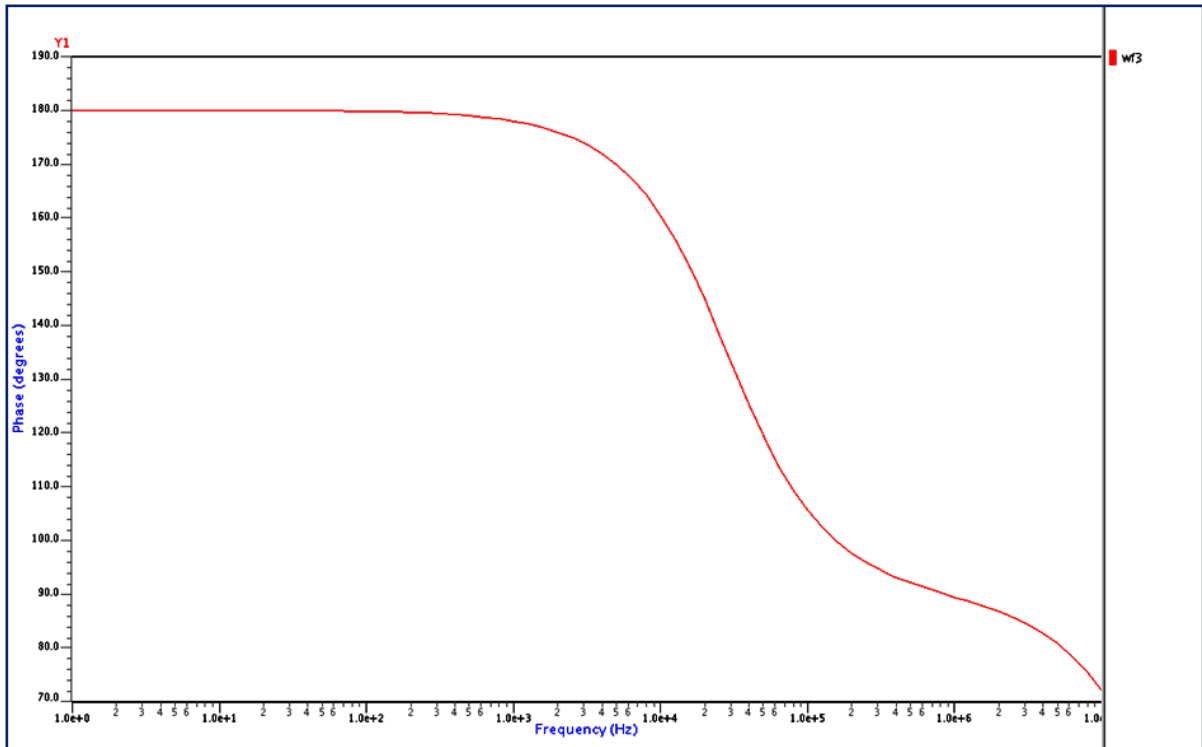


Figure 11: Phase waveform

www.izatxamir.wordpress.com