Differential-Voltage Current Conveyor (DVCC)

AIM

1) To implement an All Pass Filter using Differential-Voltage Current conveyor (DVCC) circuit using SPICE software.
2) To evaluate the necessary parameters required for judging performance of the filter such as Input Noise, Output Noise, Noise Factor, Noise Figure, Phase Noise, Stability, Total Harmonic Distortions(THD), Power, etc using relevant plots.
3) To conduct a systematic comparison of the performance of DVCC as an All Pass Filter as compared to other current conveyor circuits.

THEORY

The configuration proceed in this segment is Differential-Voltage-Current-Conveyor and in this same as the DXCCI but the topology constitutes of differential configuration in which terminal relations are

$$\begin{bmatrix} V_X \\ I_{Y1} \\ I_{Y2} \\ I_{Z+} \\ I_{Z-} \end{bmatrix} = \begin{bmatrix} 0 & 1 & -1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \\ -1 & 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} I_X \\ V_{Y1} \\ V_{Y2} \\ V_{Z+} \\ V_{Z-} \end{bmatrix}$$

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At the Y1 and Y2 input ports if we apply the input frequency it results in the high impedance and low impedance is proceeded at the output and the voltage at the terminal X accompanies the sum of inputs

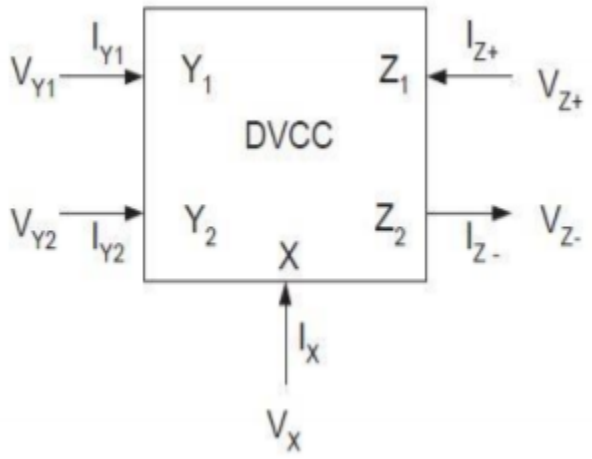
$$\frac{V_2}{V_{in}} = -\frac{sCR-1}{sCR+1} \qquad (6.19)$$

Current proceeded towards the terminal X will be conveyed across the Z1 and Z2 follows the high impedance and these high impedance infers the matched impedance towards the ports of Y1, Y2 and has

$$\frac{V_2}{V_{in}} = -\frac{sCR-1}{sCR+1} \qquad (6.20)$$

Phase response of the output with respect to the input is 180° and the minimum phase shift is required

$$\phi(\omega) = -2\mathrm{Tan}^{-1}(\omega CR) \qquad (6.21)$$



Given above is a DVCC Block. From the DVCC symbol it simplifies that it has the more port terminals to maximise more frequencies.

$$\phi(\omega) = 180° - 2\mathrm{Tan}^{-1}(\omega CR)$$

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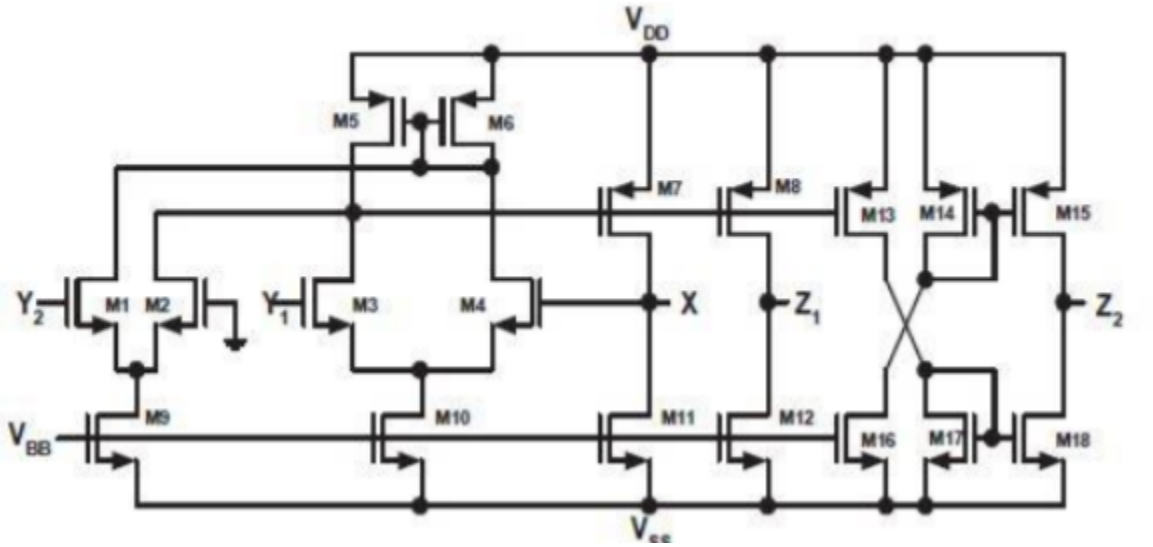
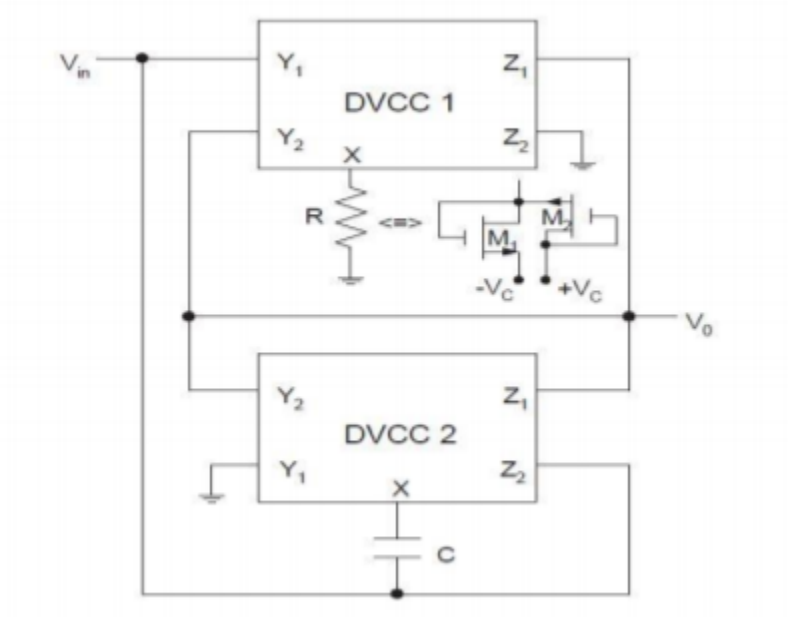
OBSERVATIONS

Schematic Circuit Diagram



Circuit Diagram for DVCC as All Pass Filter



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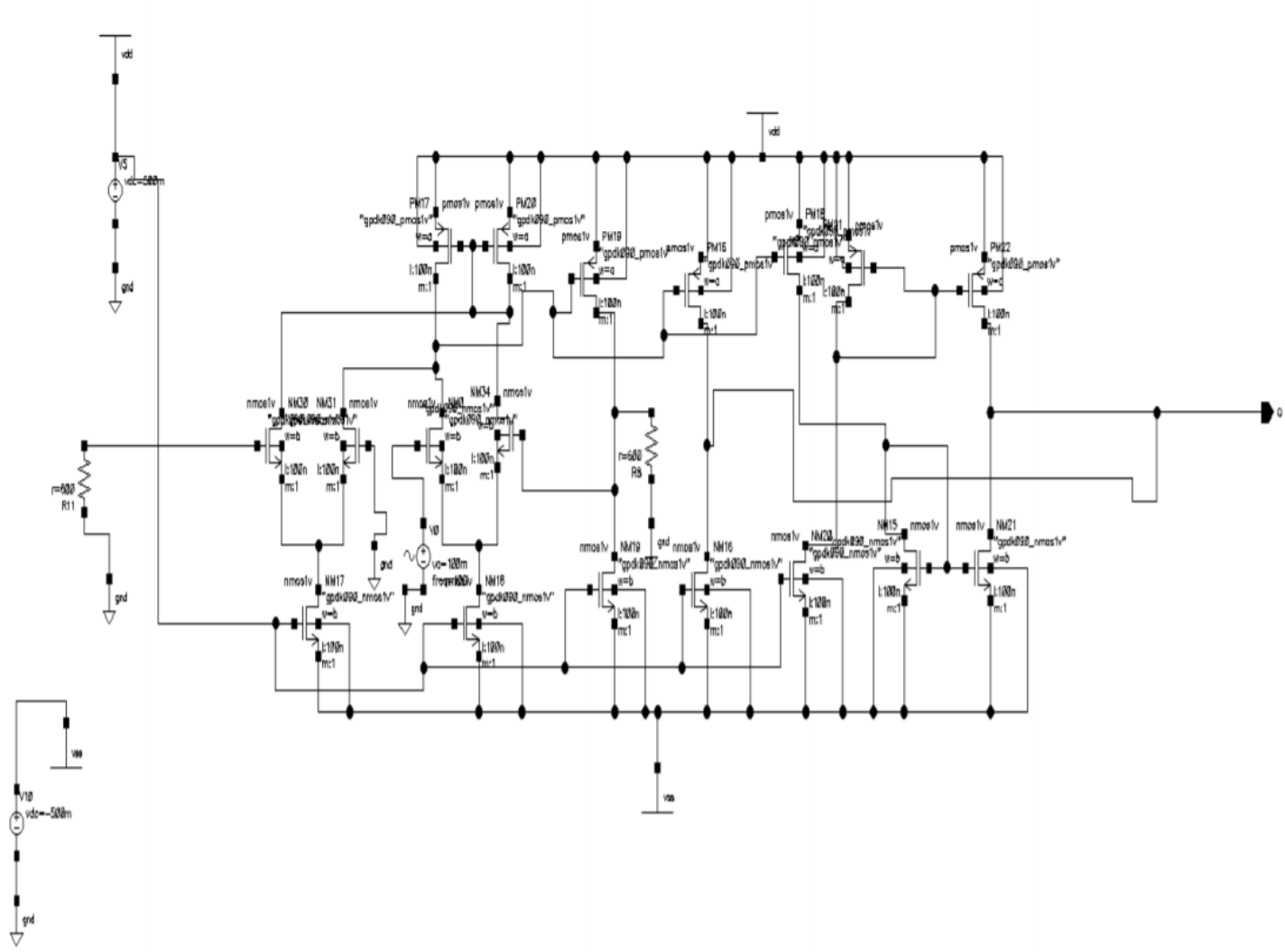
SPICE Schematic



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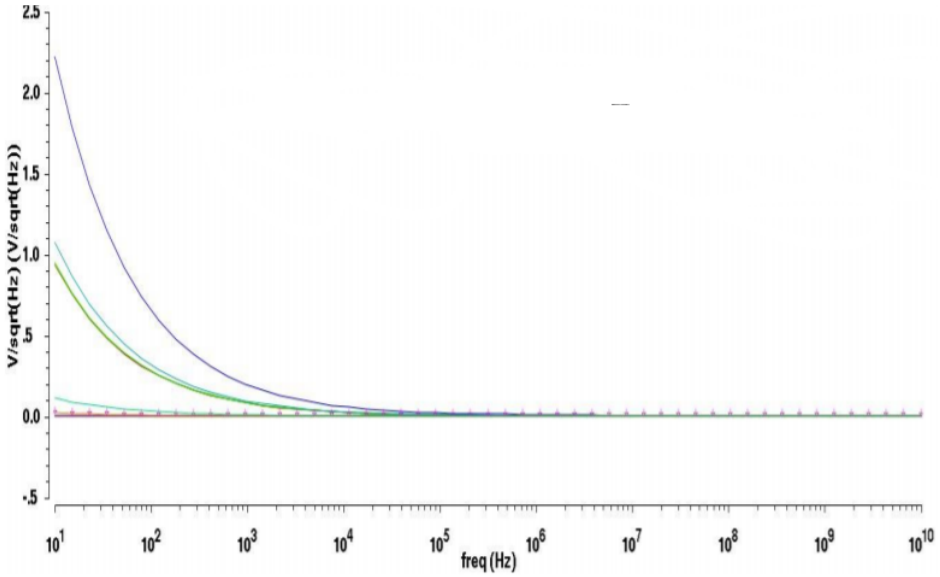
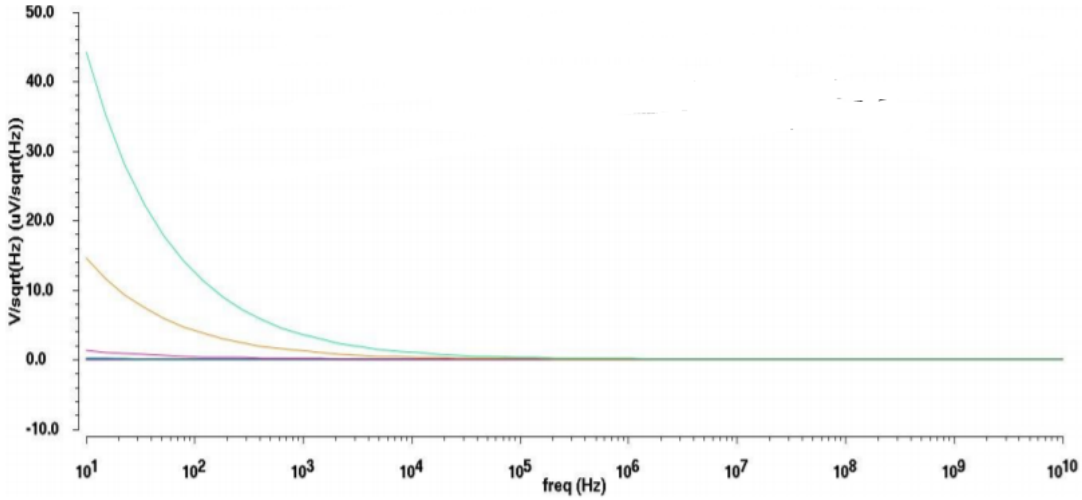
Input Noise = 27.1 micro



Output Noise = 237.8 pico



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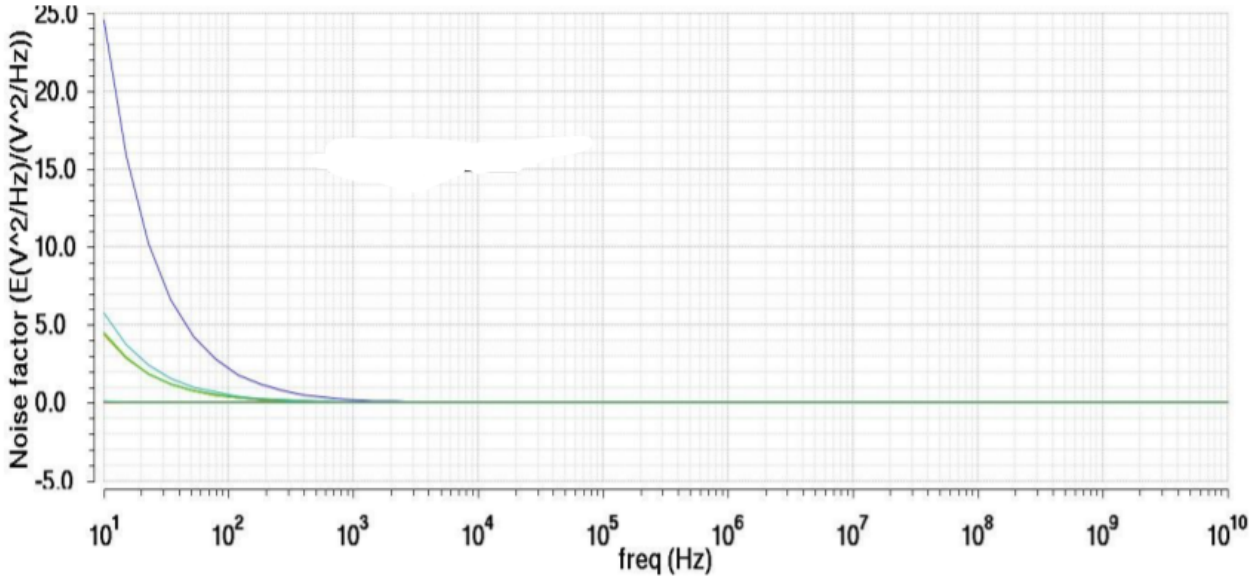
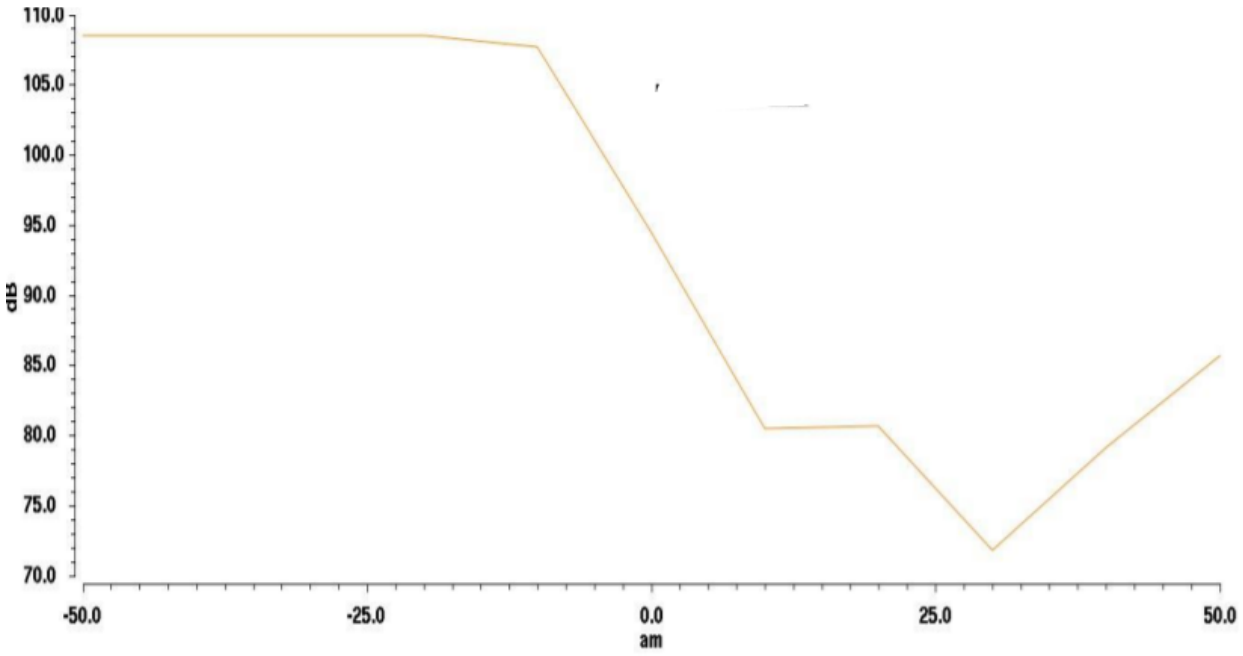
Noise Factor = 3.07



Noise Figure = 93.67



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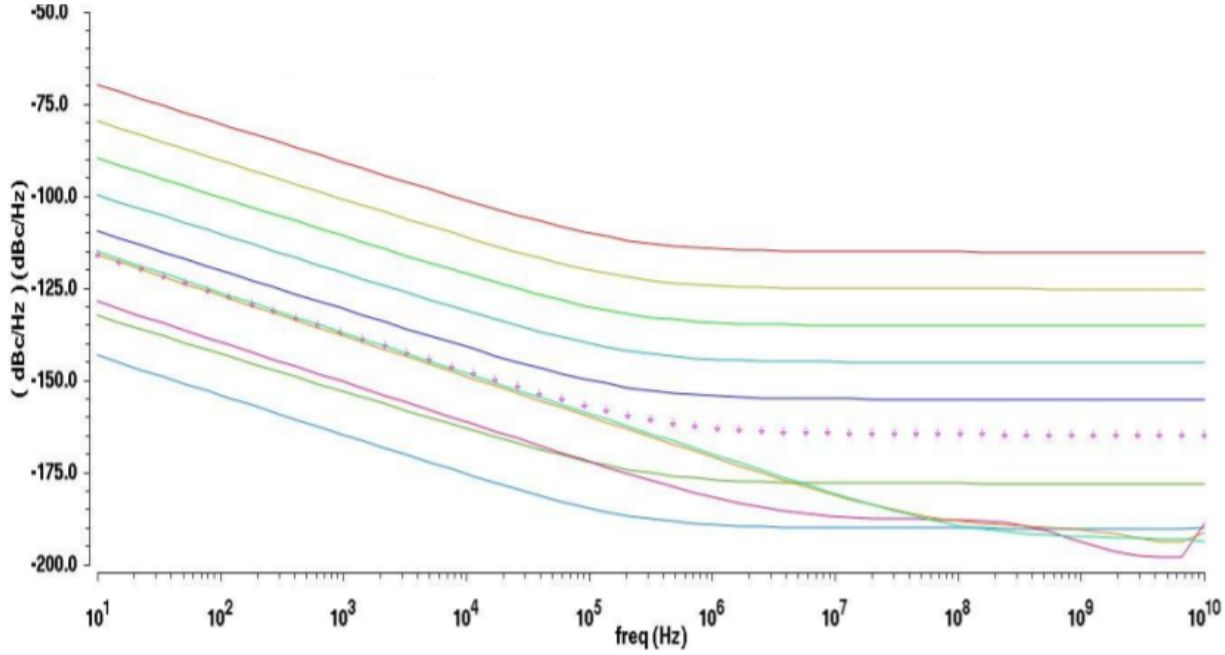
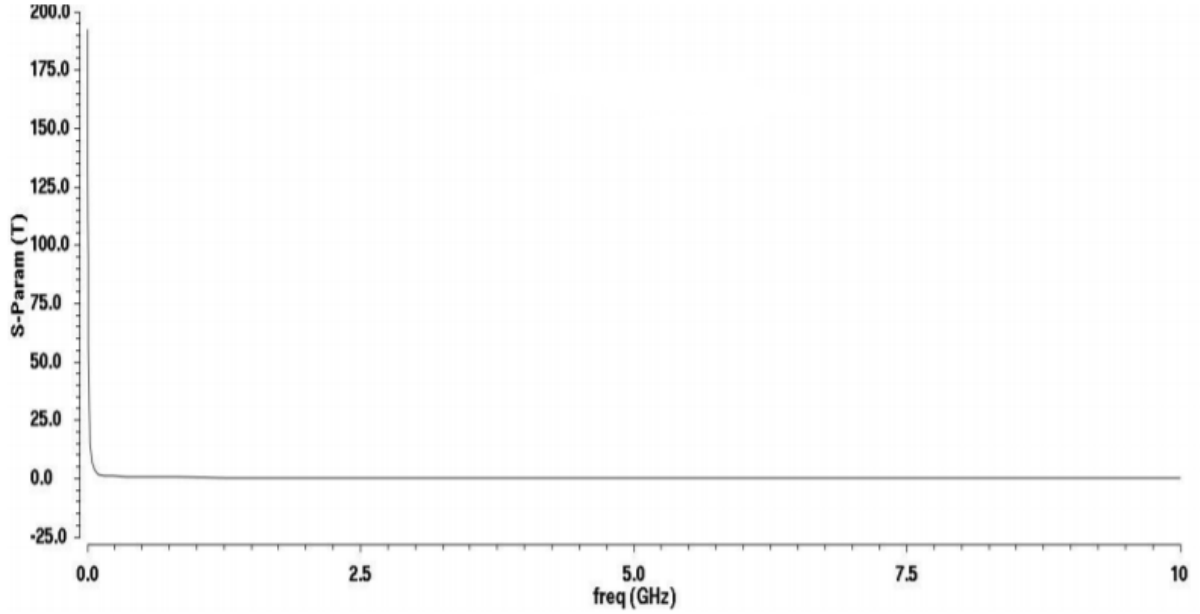
Phase Noise = -165.8



Stability = 3.27



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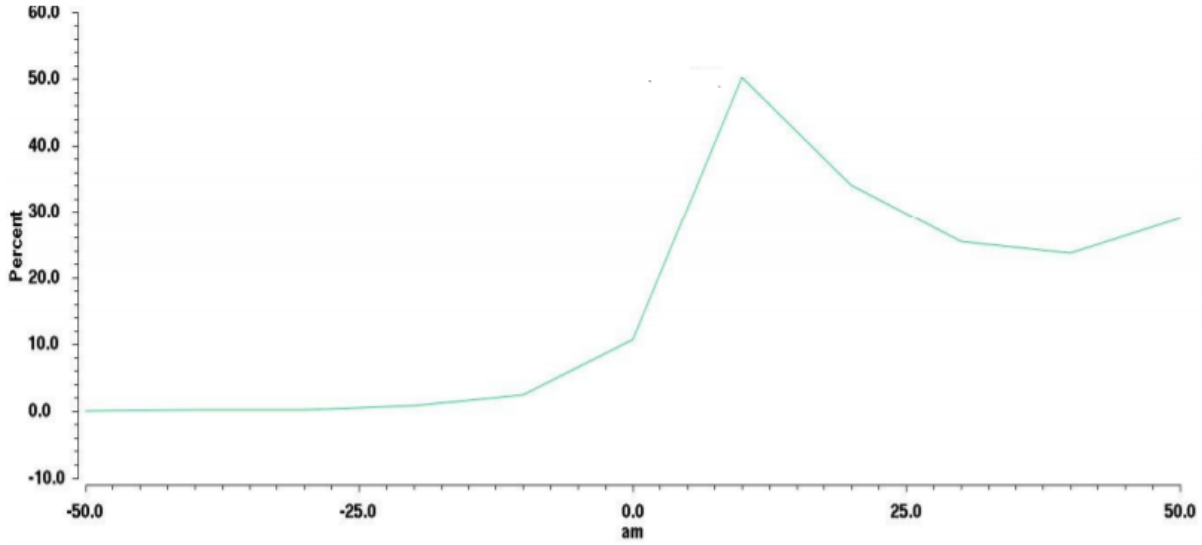
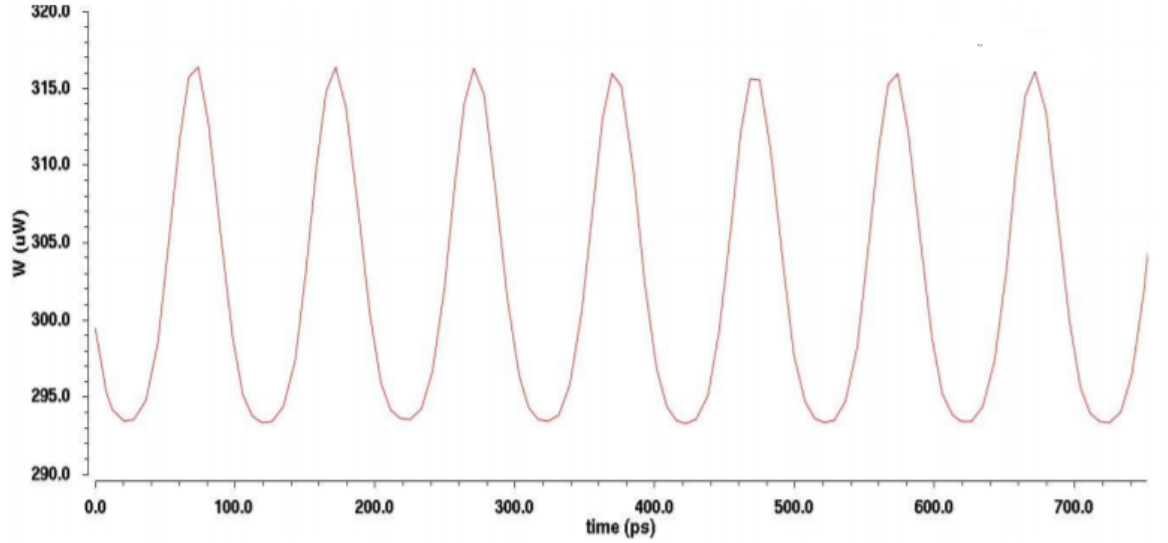
Total Harmonic Distortions (THD) = 16.17



Power = 302.2 micro



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RESULTS AND CONCLUSIONS

Table below shows a Relative Comparison with other current-conveyor based All pass filters

All Pass Block	Power (watts)	Input noise (dB)	Output noise (dB)	Noise Factor (dB)	Noise figure	Stability	THD (%)	Phase noise (dB)
CCI	1.5m	22.6p	555.6n	258.3	90.3M	6.9	7.45	-132.67
DXCCI	812.6u	4.8p	513.8n	490.3	490.3	13.6	8.148	-156.7
DVCC	302.2u	27.1p	237.8P	3.07	93.67	3.27	16.17	-165.8
DOCCI	5.4m	31.34p	27.39n	23.6	94.22	1.6	17.41	-136.5
Five Transistors Model	1.06m	640.9P	495.6P	16.23	219.3	2.4	8.76	-173.8

- **CCII** - Second generation Current Conveyor
- **DXCCI** - Dual-X-Current Conveyor of second Generation
- **DVCC** - Differentials Voltage Current Conveyor
- **DOCCI** - Dual Output Current Conveyor

Based on this table, we can select the appropriate All Pass Filter depending upon the parameter values we require for that application.

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