Oscillator Design Report

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1. Introduction

- **Objective**: To design, simulate, and verify a stable RF oscillator operating at **5 GHz** using **Keysight ADS**, ensuring startup, steady-state oscillation, and spectral purity.
- **Applications**: Local Oscillators (LOs) in RF front-ends, frequency synthesizers, communication systems.

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2. Design Specifications

Parameter	Target Value
Oscillation Frequency	5 GHz
Output Power	0.600 dBm
Startup Condition	Satisfied (gain > losses)
Stability Factor (K)	K < 1 (required for oscillation)
Technology Used	[NPN BJT]

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3. Design Methodology

3.1 Device Selection

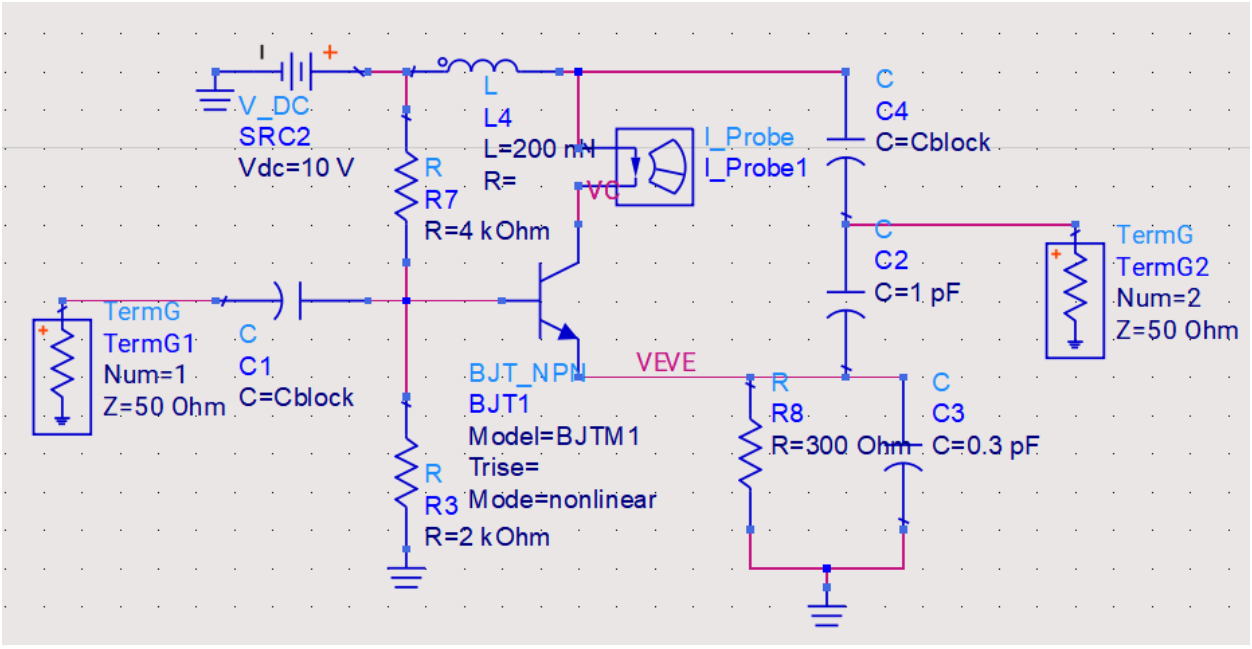
- Chosen transistor: ADS inbuilt _BJT_NPN ,Model=BJTM1
- Key specs: Transition frequency (ft), gain at 5 GHz, noise, S-parameters.

3.2 Oscillator Topology

The oscillator is designed using a **Colpitts topology** with a **BJT** (model: BJTM1) as the active device. The circuit uses a parallel LC resonator and capacitive feedback to satisfy the Barkhausen criterion for oscillation.

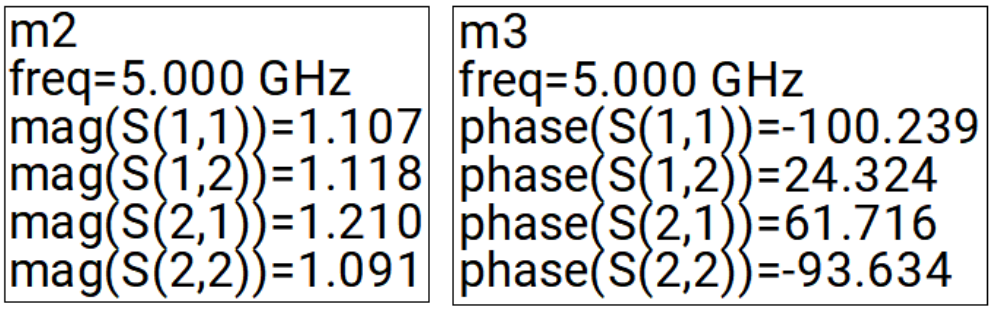
- Type: Common-emitter
- Justification: Simplicity, availability of component values, stable design.

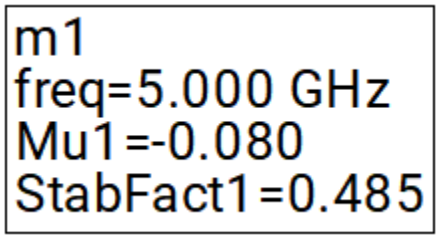
3.3 Biasing Network

- DC bias (V_CE=10 V, I_B = 64 uA) set for maximum gain and transistor linear region.
- 

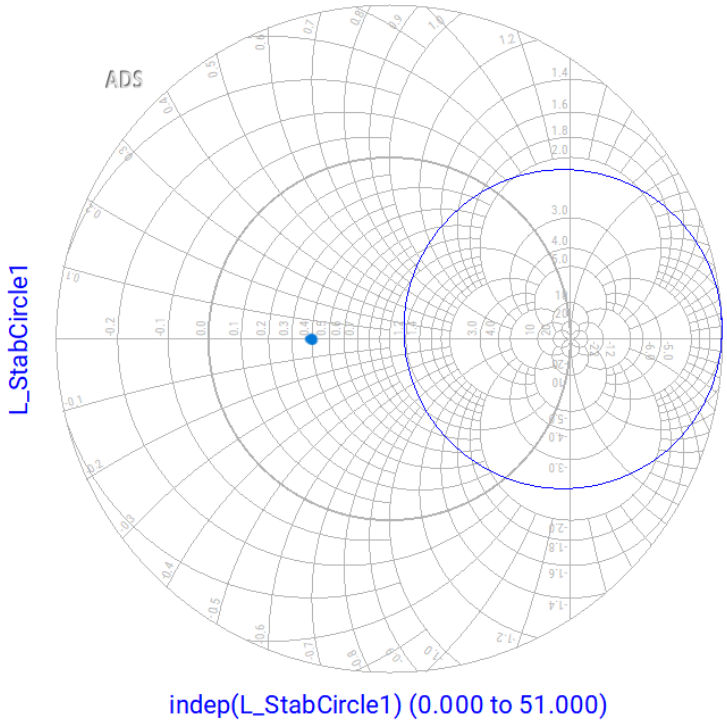
5. Results

5.1 S-Parameters and Stability

- Show plots of S11, S21, and K-factor.
- 

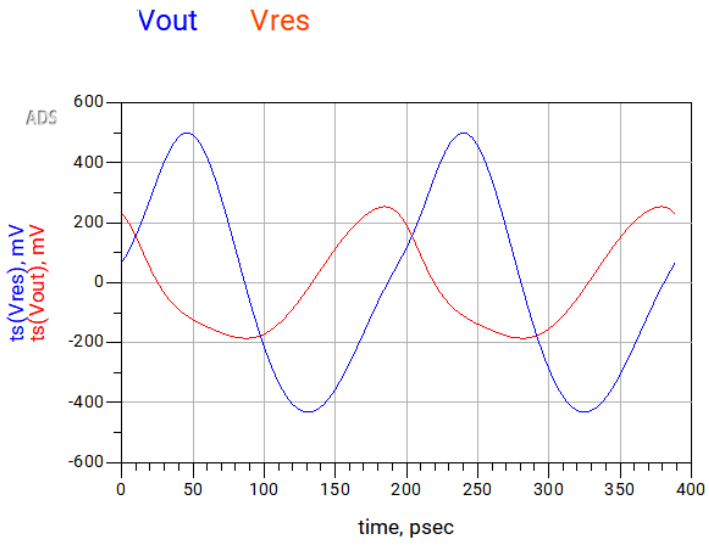
- 

- K=0.485 ⇒ potential oscillation region.
- Selection of Gamma_T = 0.4285,ang 180 and Z_T =20 ohm.



5.2 Transient Waveform

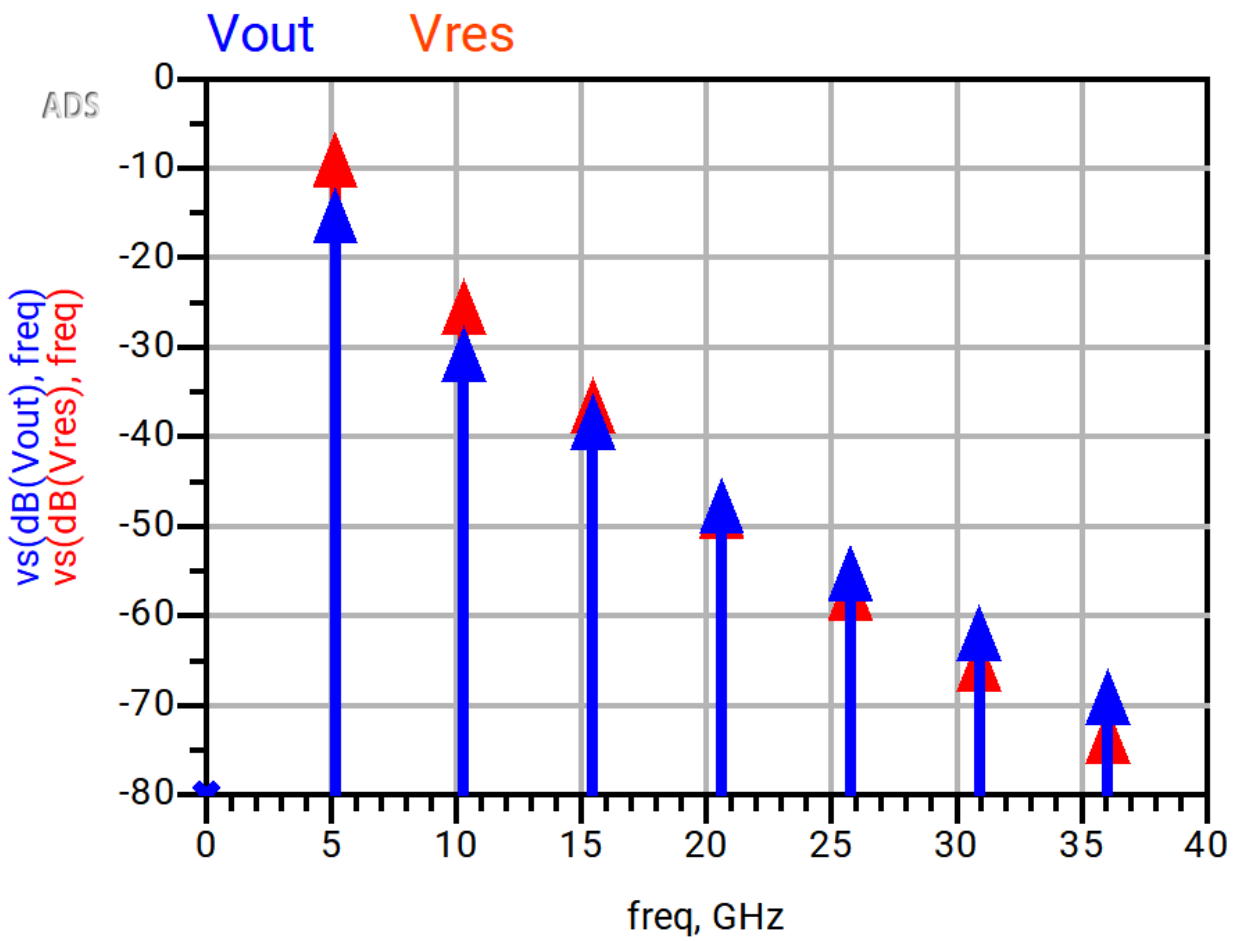
- Plot of voltage at output node.



- Confirm startup and steady-state oscillation.
- Measured frequency: ~5.151 Ghz

5.3 Spectrum / FFT

- Spectrum plot showing oscillation tone at ~5 GHz.
- Harmonic content analysis.



Pdc	Pout	PoutdBm
0.099	0.001	0.600

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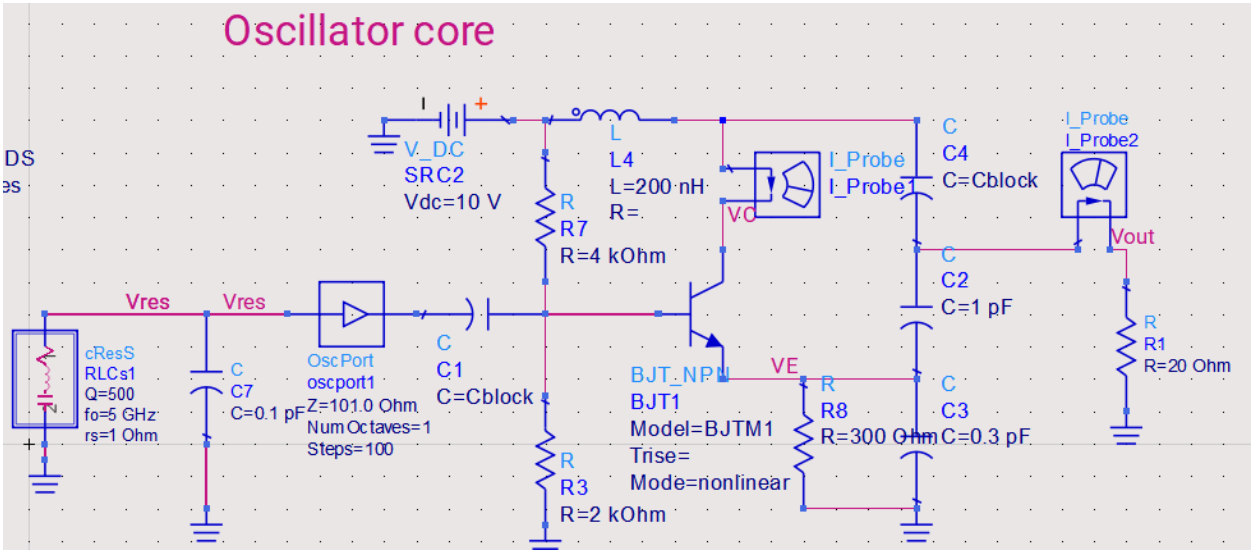
7. Layout



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9. Conclusion

- Successfully designed and simulated a **5 GHz oscillator** in ADS.
- Oscillation confirmed using transient and HB simulations.
- Oscillator can be used as an LO in RF systems.
- Future improvements could focus on optimizing phase noise and output power.