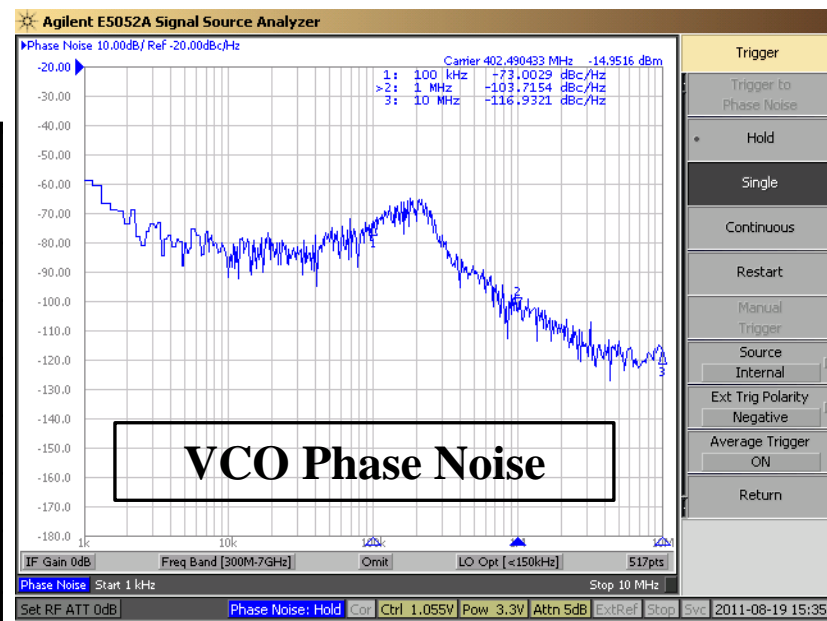


$$f_{\max} \cong \frac{1}{2\pi} \times \frac{g_{mn1}}{C_L}$$

$$f_{\min} \cong \frac{1}{2\pi} \times \sqrt{\frac{g_{mn1}^2 - g_{mp1}^2}{C_L^2}}$$

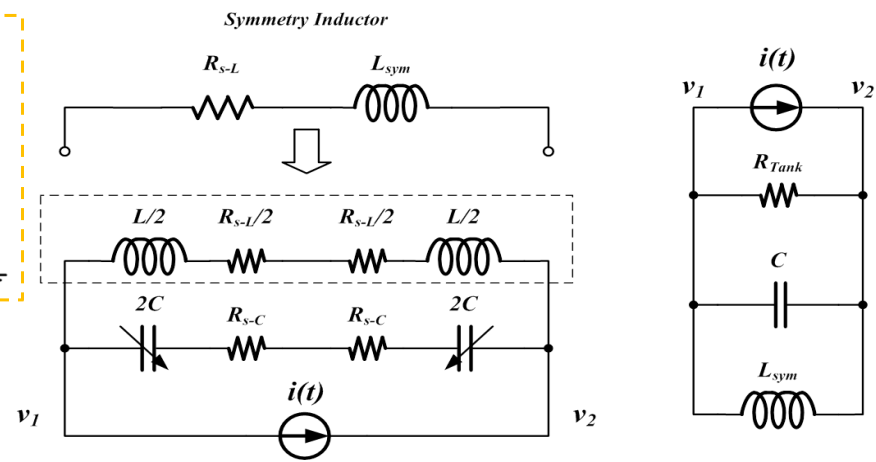
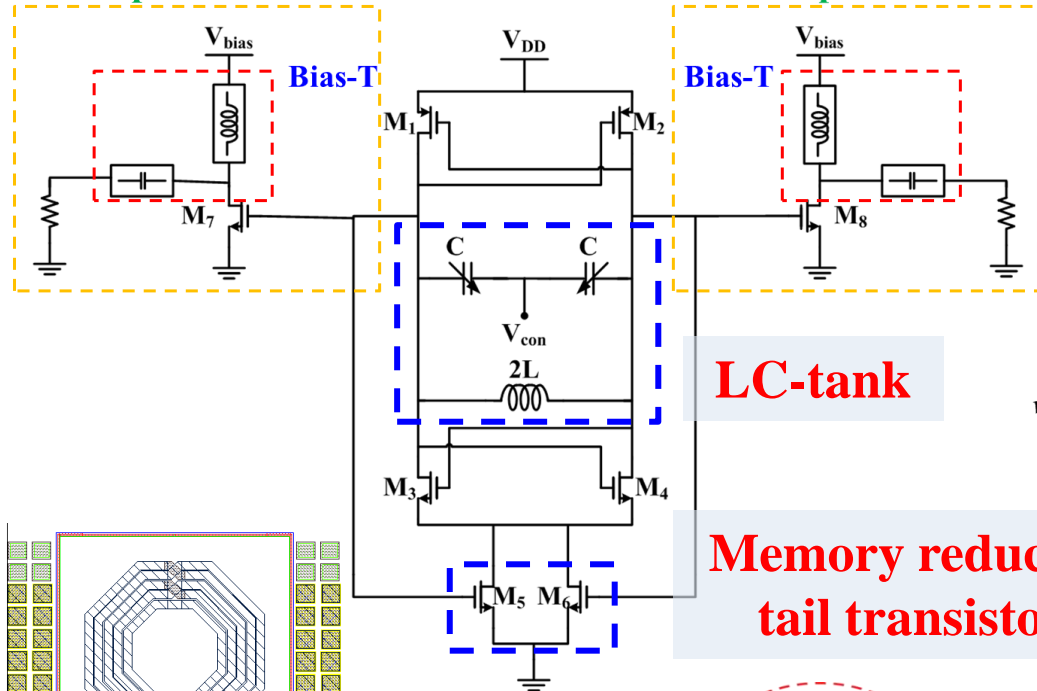
$$f_{\text{osc}} = \frac{1}{2\pi} \sqrt{\frac{g_{mn1}^2 - (-g_{mp1} + g_{mp2} + G_L)^2}{C_L^2}}$$

Specification	Simulation	Measurement
Supply Voltage (V)	1.8	
Controlled Voltage (V)	0 - 1.8	
Frequency Tuning Range (MHz)	154 - 846	234 - 888
402 MHz @ Controlled Voltage (V)	1.091	1.055
Power Consumption (mW)	3.46	3.20
Phase Noise @ 600-kHz Offset (dBc / Hz)	-102.93	-103.72
Chip Size (mm ²)	0.34 × 0.27	
FOM (dB / Hz)	154.06	149.07



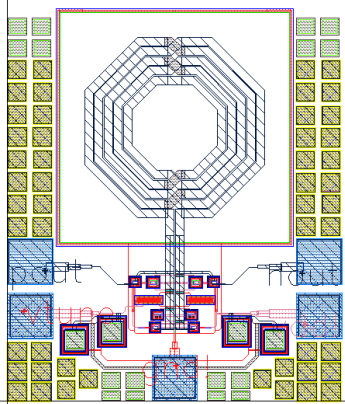
Output Buffer

Output Buffer

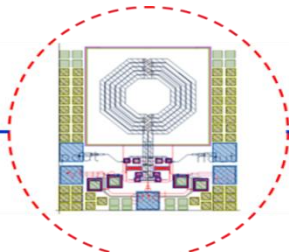


LC-tank

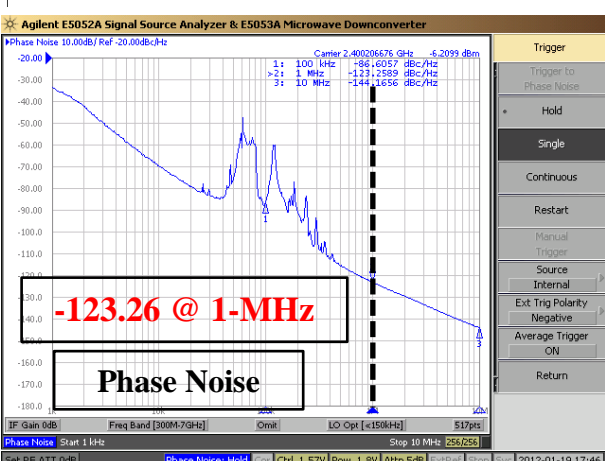
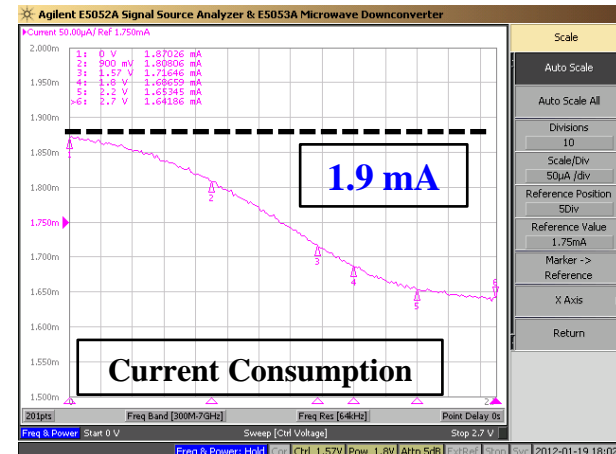
**Memory reduction
tail transistors**



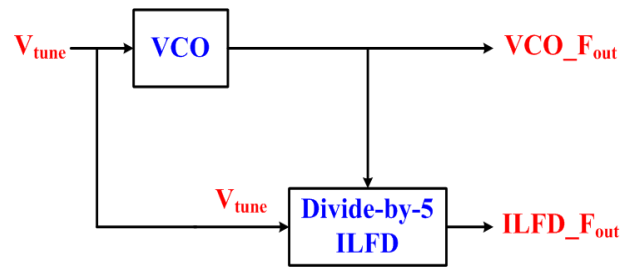
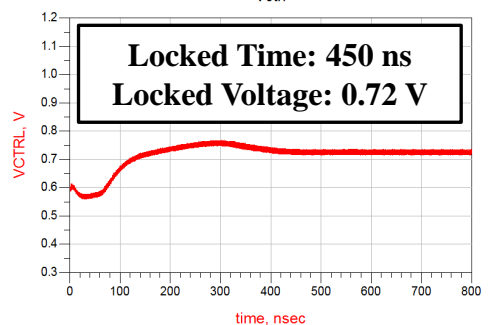
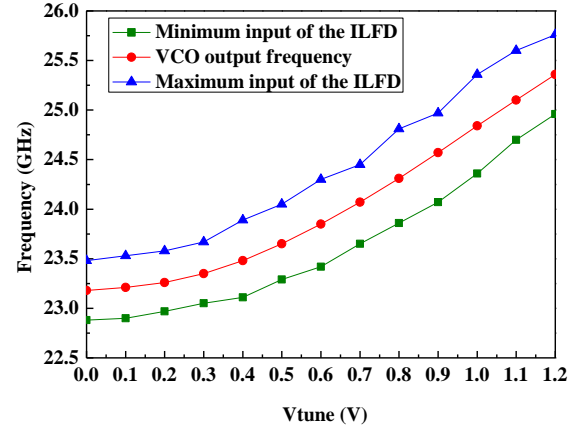
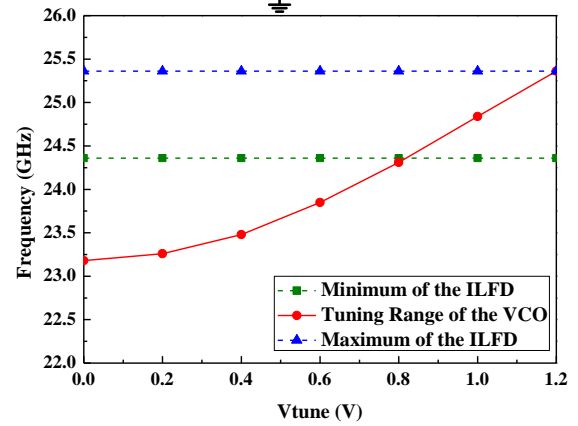
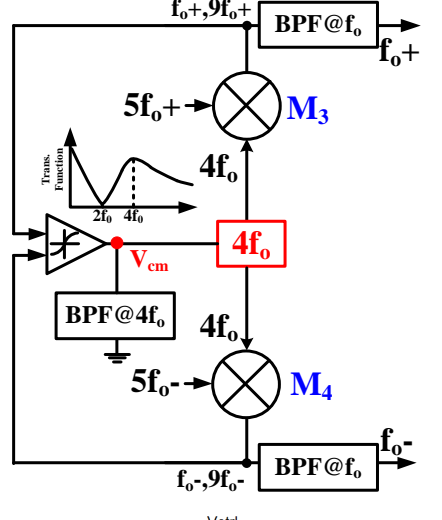
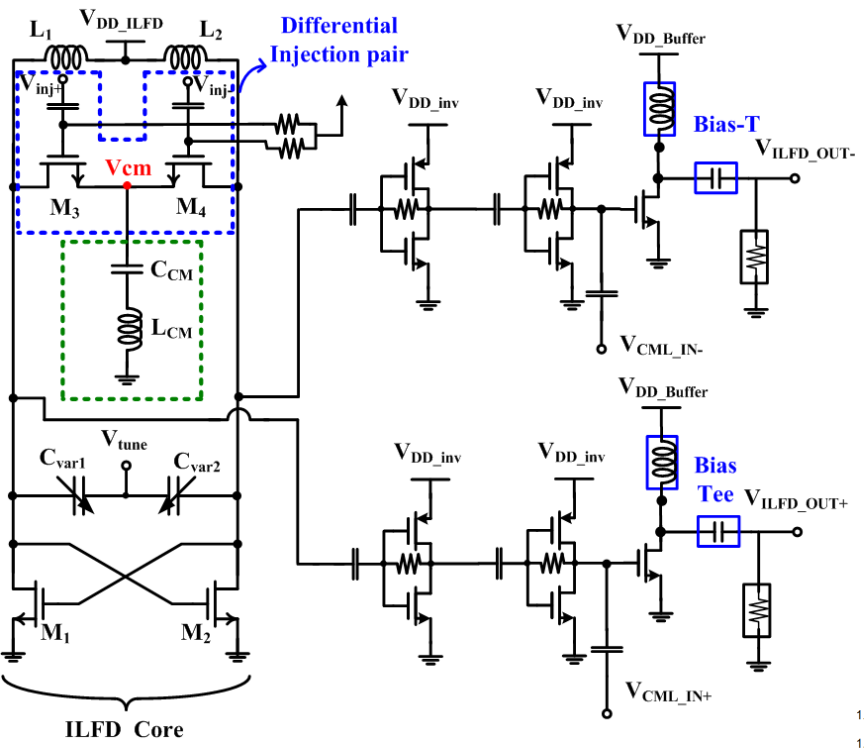
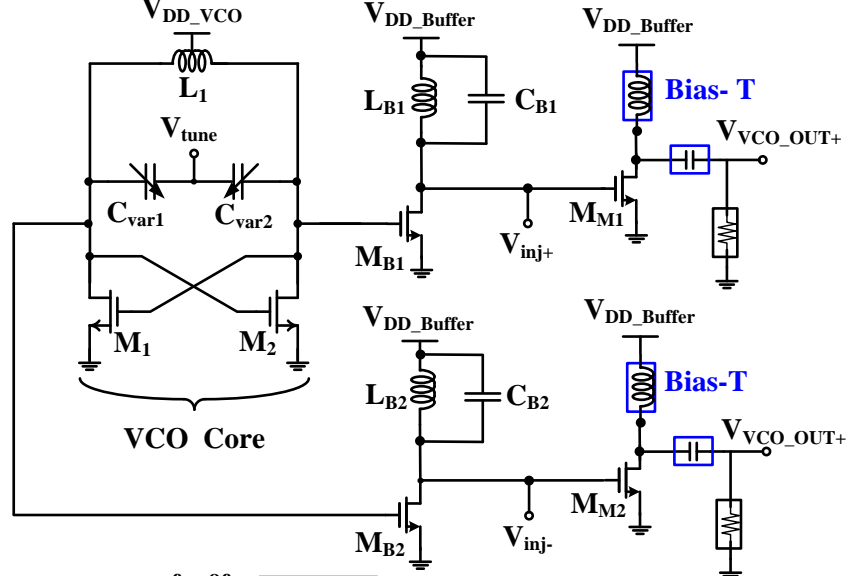
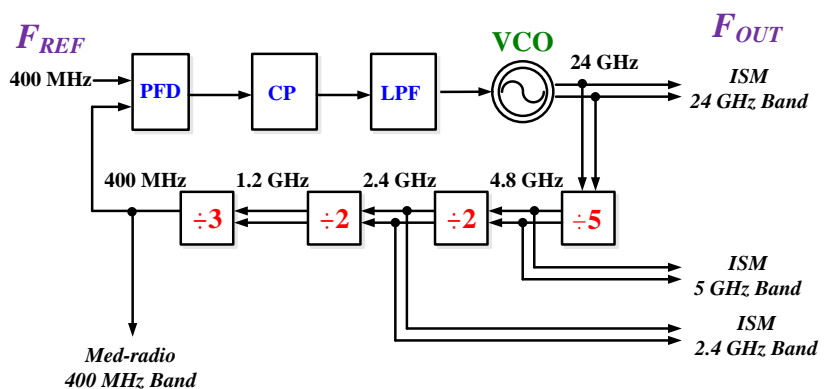
Signal Source Analyzer

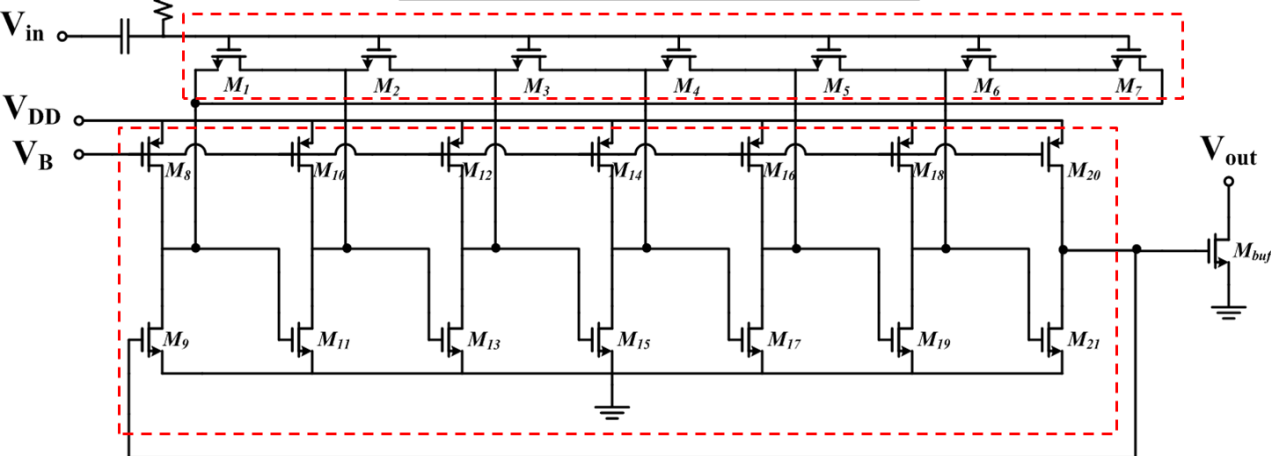
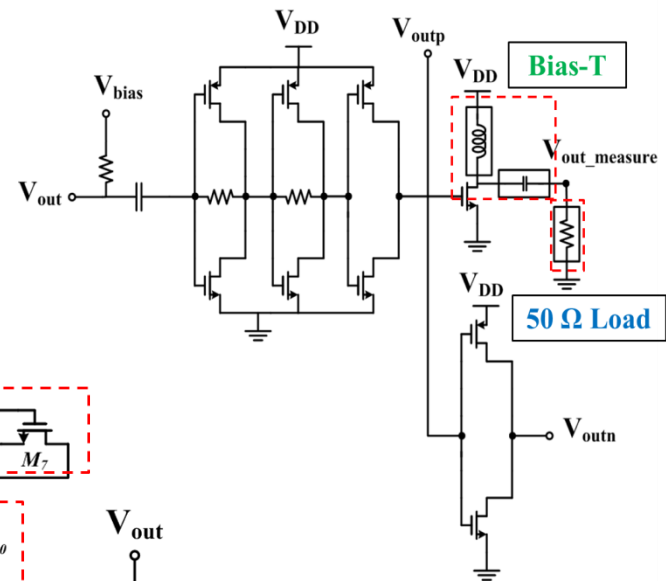
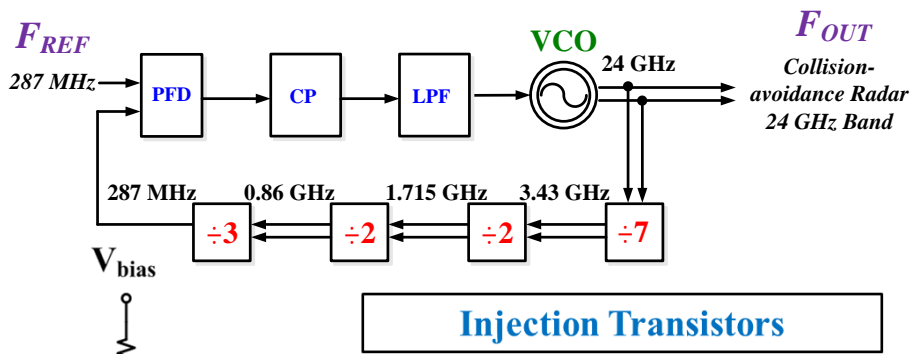


Spectrum Analyzer

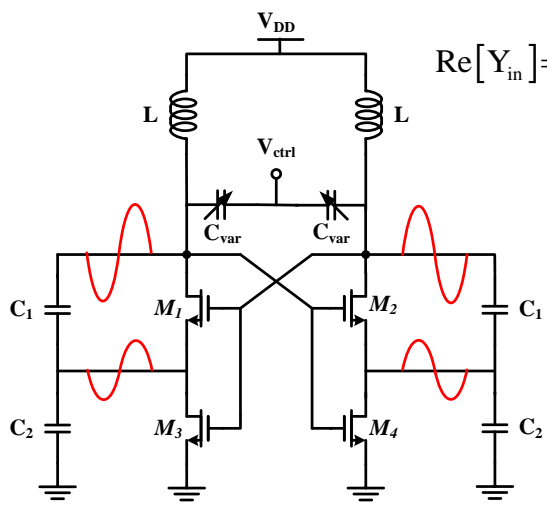


Parameter	Simulation	Measurement
Power supply (V)	1.8	
Controlled Voltage (V)	0 – 1.8	0 – 2.7
Frequency Tuning Range (GHz)	2.20 – 2.56	2.14 – 2.54
2.4 GHz @ Controlled Voltage (V)	1.15	1.57
Core Power Consumption (mW)	3.078	3.096
Phase Noise @ 1-MHz Offset (dBc / Hz)	-123.76	-123.26
Chip Size (mm ²)	0.586 × 0.686	
FOM @ 1-MHz Offset Frequency (dB)	-186.42	-185.96





Ring Oscillator



$$\text{Re}[Y_{in}] = -\frac{g_m \omega^2 C_1 C_2}{g_m^2 + \omega^2 (C_1 + C_2)^2}$$

$$\text{Re}[Y_{in}] = -\frac{g_m \omega^2 C_2 [2C_1 + C_2]}{g_m^2 + \omega^2 (C_1 + C_2)^2}$$

