

ECE 444 – Design Project #1

Temperature Stabilized Ring Oscillator using a Band-gap Reference Voltage Source

March 5, 2020

Introduction: The output frequency of a CMOS ring oscillator is strongly dependent on both the operating temperature and the supply voltage. The frequency increases with increasing supply voltage, and increases with decreasing temperature.

Design a ring oscillator, using the 65nm CMOS process, that has a nominal oscillation frequency of 500 MHz. Design a band-gap reference circuit, using the 350nm process, to provide temperature and supply voltage compensation to the ring oscillator, such that the oscillation frequency remains close to 500 MHz as the temperature is varied between 0° and 100° C, and the supply voltage is varied between 3.1 and 3.5 V.

The operational amplifier in the band-gap reference circuit should be biased using a boot-strapped bias circuit. Designs with minimal variation in the output frequency as a function of the supply voltage and temperature will be considered superior.

Specification:

1. Nominal oscillation frequency: 500 MHz
2. Input voltage: 3.1 – 3.5 V (single rail)
3. Temperature: 0° to 100° C
4. Variation in output frequency: minimal