Advanced RFIC Design ELEN 359A Lecture 1: System Diagram and Foundry Design Rules
Instructor: Dr. Allen A Sweet
Class Project Definition

• Design a Multi-Function IC Chip containing at least two major components (i.e. an amplifier, a mixer(s) and their associated filters).

• Your Multi-Function Chip must contain some portion of an overall wireless system’s block diagram, or a related block of components.

• Prepare a project proposal and present it in front of the class at lecture 5.

• Search current literature for potential designs and specifications.
Fabricating and Testing Project Chips

• For those Students wishing to expand their design projects into Thesis Research, their final design may be fabricated at the Knowledge*On foundry in Iksan Korea.

• Foundry lead time is about 6 to 8 weeks, so elen359A will be over before chips would be available for testing, therefore Students who have their designs fabricated must make their own arrangements for testing. The foundry WILL NOT do the testing.
Design Priorities:

- Performance relative to Standard Specifications for the planned communications service (I.e. for example: 802.11A).
- DC Power Consumption (drives Battery life).
- Cost (I.e. Chip Area)
- Power Supply Voltage: +5 volts for infrastructure applications, +3 volts for mobile/handheld applications.
Wireless Frequency Bands and Mobile Transmit Powers

- **Cellular**: 850 – 900 MHz,
  - GSM, Ptx=+34 dBm
  - CDMA, Ptx=+28 dBm
- **PCS**: 1800 – 1900 MHz
  - GSM, Ptx=+34 dBm
  - CDMA, Ptx=+28 dBm
- **3G**: 2000-2200 MHz
  - Ptx=?
Wi-Fi Frequency Bands and Transmit Powers

- 802.11B/G: 2400-2483 MHz
  - $P_{tx}=+30\ \text{dBm\ max}$
- 802.11A: 5200-5900 MHz
  - $P_{tx}=+17\ \text{dBm\ max, 5150-5250\ MHz}$
  - $P_{tx}=+24\ \text{dBm\ max, 5250-5350\ MHz}$
  - $P_{tx}=+30\ \text{dBm\ max, 5725-5825\ MHz}$
Direct Conversion Receiver Project
Transmitter Chain Block Project
Phase Locked Loop Project
Frequency Translation Network Project

- Up or Down Converting Mixers plus Frequency Multipliers combine to give Multiple Local Oscillator Frequencies for dual/multi mode systems.

- Applications to dual/multi mode chips which can easily and efficiently switch between Wireless Bands.

- It is very Important to have component blocks serve multiple purposes in order to reduce chip area, and complexity

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Knowledge*On Inc. Foundry Design Rules

• Design Rules Review
• Layout Elements
• Models
• Layout Examples
Some Foundry Layout Elements
Blow up of 1x2x20 Transistor
VBIC IC Curves

Use with BJT_curve_tracer Schematic Template

VCE

IC, i, mA

m1

m1

VCE=3.000
IBB=0.000100
IC.i=0.012

IBB=1.000E-4
IBB=9.000E-5
IBB=8.000E-5
IBB=7.000E-5
IBB=6.000E-5
IBB=5.000E-5
IBB=4.000E-5
IBB=3.000E-5
IBB=2.000E-5
IBB=1.000E-5

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Gummel Poon IV Curves

Use with BJT_curve_tracer Schematic Template

IC, mA

VCE

m1

IBB=1.000E-4
IBB=9.000E-5
IBB=8.000E-5
IBB=7.000E-5
IBB=6.000E-5
IBB=5.000E-5
IBB=4.000E-5
IBB=3.000E-5
IBB=2.000E-5
IBB=1.000E-5

m1
VCE=3.000
IBB=0.000100
IC, i=0.008

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Resistor
Spiral Inductor Type PA
Spiral Inductor Type EA
LNA Design Example

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Blow up of LNA Layout
VCO Example

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