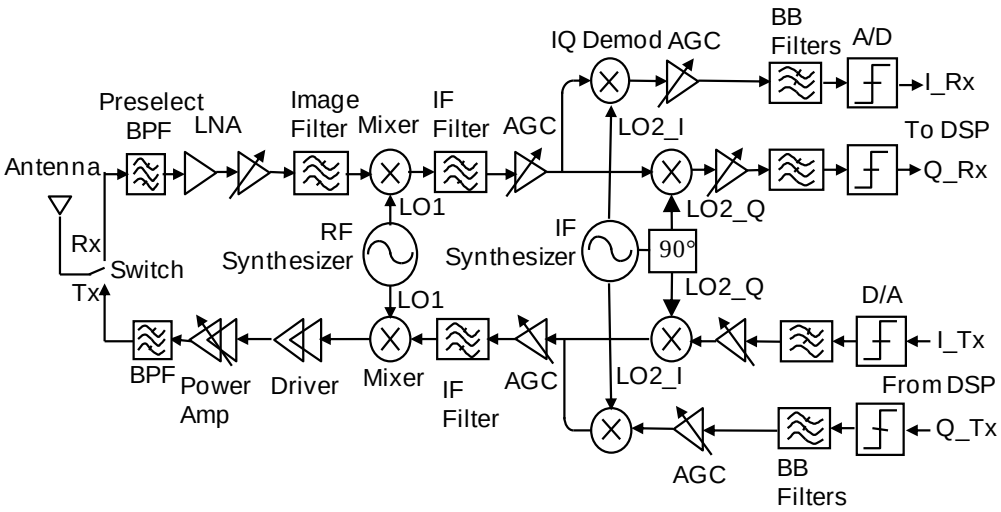
ELEC 5705 RF Systems Design: Assignment #2

Due April 2nd, 2012

The goal of this course will be to come up with a complete architecture for a radio. This second assignment will be to specify the block diagram and specifications for the transmitter. Reports will be in the form of a 15 page report on your radio plus problem set solutions. A rough guide for what a completed assignment should include is:

- Gain, linearity and noise specs for all active transmit chain circuits.
- Tuning range, phase noise, spurious performance, step size, and phase matching of any LOs.
- A detailed description of any filters required.
- DAC specifications should be given.
- Specify what EVM you are going to aim for.
- Discuss in as much detail as possible ACPR.



Continue this assignment with whatever choice you made in assignment #1:

1) A 2.4-2.5GHz radio with a transmit power of 23dBm. The channels will be 25MHz wide and the radio will need to operate as a full duplex system. Two in band interferers with a power level as high as -30dBm may be close by, and you can expect at least one out of band interferer with a power level of -15dBm at any frequency which is most troubling.

2) A 5.1-5.3GHz half duplex radio with a transmit power of 18dBm. The channels will be 25MHz wide and the radio will need to operate as a half duplex system. Two in band interferers with a power level as high as -36dBm may be close by, and you can expect at least one out of band interferer with a power level of -15dBm at any frequency which is most troubling.

3) A 60-64GHz radio with a transmit power of 10dBm. The channels will be 1GHz wide and the radio will need to operate as a half duplex system. Two in band interferers with a power level as high as -45dBm may be close by, and you can expect at least one out of band interferer with a power level of -35dBm at any frequency which is most troubling.

4) A 1000MHz to 1960MHz cable system. Receive power is to be +15dBmV into 75Ω across 5 miles of cable. The channels will be 8MHz wide. Since this is a cable no unwanted signals will be present.

Problem Set:

1) Determining Phase Noise:

What phase noise is required to achieve an EVM of 1%? Assume that the base band signal bandwidth is 256MHz and that the phase noise of the synthesizer is flat across the entire bandwidth.

2) Setting the linearity:

A OFDM 16QAM signal with a bandwidth of 512MHz uses 64 sub carriers. The transmit power is 0dBm. What linearity is required for an EVM of 0.5%?

3) ACPR:

For question #2, what will the ACPR be in this case?

4) Transmission Power:

What transmit power is required to send a signal 50feet in a building and have it received with a SNR of 10dB assuming that the transmitter has an EVM of 1%, the signal has a bandwidth of 512MHz, and the antennas each have a gain of 2dBi? Compare this to the transmit power required if the receiver uses two antennas.

5) High offset phase noise:

A full duplex radio has TX and RX bands separated by 50MHz and the channel bandwidth is 1MHz. The duplexor can provide 40dB of isolation between the TX and the RX. Transmit power is 27dBm, and minimum RX power is -90dBm. Required SNR is 20dB. What phase noise is required?

6) BB filter Requirement:

A signal with a BB bandwidth of 20MHz is being processed by an 8 bit ADC with a sampling frequency of 80MHz. A tone is present at the IF at 30MHz with equal power to the in band information signal. An SNR of 30dB is required for this application. Determine the filtering requirements of the BB filter. If the sampling frequency of the ADC is reduced to 40MHz what does this do to the filter requirement?