### ELEC 5705 RF Systems Design: Assignment #2

Due Feb. 22nd, 2021 (late assignments will be penalized at 25% per day)

In this assignment we will continue to develop models for various RF blocks to perform system level analysis.

This time we will look at an LO and mixer as basic building blocks we wish to model and test.

Task #1 LO:

Construct a model for an LO with realistic phase noise and spurs. The LO should be able to have an in band

phase noise level a corner frequency for the noise above which the noise should fall off till it hits some final

noise floor. The model should also be able to specify reference spurs which are so many dBc down from a

carrier at one offset frequency. The phase noise profile should look something like:



As a test simulate an LO with an in band phase noise of -80dBc/Hz, a 1MHz corner, an out of band noise

floor of -120dBc/Hz, and a center frequency of 100MHz. Include reference spurs at 10MHz offset at -40dBc.

Note that most synthesizers have a second-order response. The filter response looks follows the form:

$$F\left(s\right)=\frac{2ζω\_{n}s+ω\_{n}^{2}}{s^{2}+2ζω\_{n}s+ω\_{n}^{2}}$$

Filters are easy to do in Matlab if you use a command called lsim.

Task #2 Mixer:

You need to construct a mixer for this part of the assignment. It is to mix an information signal with an ideal

LO. In order to do this we need to know a little about its structure. Therefore you are to implement the mixer

as a set of ideal switches which have two positions as shown below:



Note that while currents are shown voltages work just the same. The LO is used to set the position of the

switches. Note that instantaneous switching times may have unusual results as they will have a VERY wide bandwidth.

Test the mixer with an input of 110MHz and an LO of 100MHz. The mixer is also to have a finite LO to output

isolation. Test the mixer both with an LO to output isolation of 100 and 40dB.