Microwave Metrology -ECE 684
Department of Electrical and Computer Engineering, University of Massachusetts

Laboratory Project Descriptions – an Overview

This laboratory project manual describes six sets of experiments loosely centered on microwave receiver front ends. These test and measurement experiments are:

1) Lab exercise G: Gain measurements
2) Lab exercise N: Noise measurements
3) Lab exercise O: Measurement of 3'rd order intercept
4) Lab exercise IQ: Measurement of I&Q Modulation
5) Lab exercise T: TRL Calibration and Probe Based Measurement
6) Lab exercise PN: Phase Noise Measurement

The specific receiver (downconverter) that will be studied is the conventional superheterodyne shown in Figure 1 below. It consists of a low noise amplifier, an image reject filter, a mixer, a channel select filter, some IF amplifiers, and a local oscillator. You will characterize each component individually. Then use these measurements to calculate the characteristics of the entire downconverter. The calculated results will be compared to measurements of the downconverter. This comparison is one of the most important objectives of this set of projects.

By doing these experiments you will gain experience making measurements of gain, LNA and mixer noise, oscillator phase noise, distortion, intermediate level network analyzer calibration techniques, circuit modeling, and relate the findings to time domain measurements and see the effects of measured performance on the signal modulation. As a RF and Microwave circuit and system designer or a radar system engineer or a test engineer or any similar career you will be exposed to these types of measurements. The goal of this course is not only to familiarize students with these measurement techniques and test instruments, but also to develop a clear understanding of what is being measured.

The measurement equipment in the lab has the capability to save data to a USB thumb drive or 3.5" floppy disk. If possible, each group should bring at least one thumb drive and one 3.5" floppy disk to the lab so that plots can be saved for use in lab reports. If this is not possible, the T.A. will assist in obtaining plot data in an electronic form so that plots can be reproduced in the lab reports.

The Downconverter

The downconverter selects frequencies from the ISM band centered at 915 MHz. A local oscillator at 975 MHz is used to mix down to an IF frequency of 60 MHz. The specific components that will be used are;

Function	**Manufacturer's part number**
Low Noise amplifier 1-1000 MHz	MiniCircuits ZFL-1000LN
Band Pass filter 915 +/-34 MHz	K&L 4B121-915/T68-0/DP
Mixer	MiniCircuits ZFM-5X
Band Pass Filter 60 +/-10 MHz	MiniCircuits SIF-60
IF amplifiers	MiniCircuits ZFL-500

Manufacturer's data is included in an appendix to this manual.

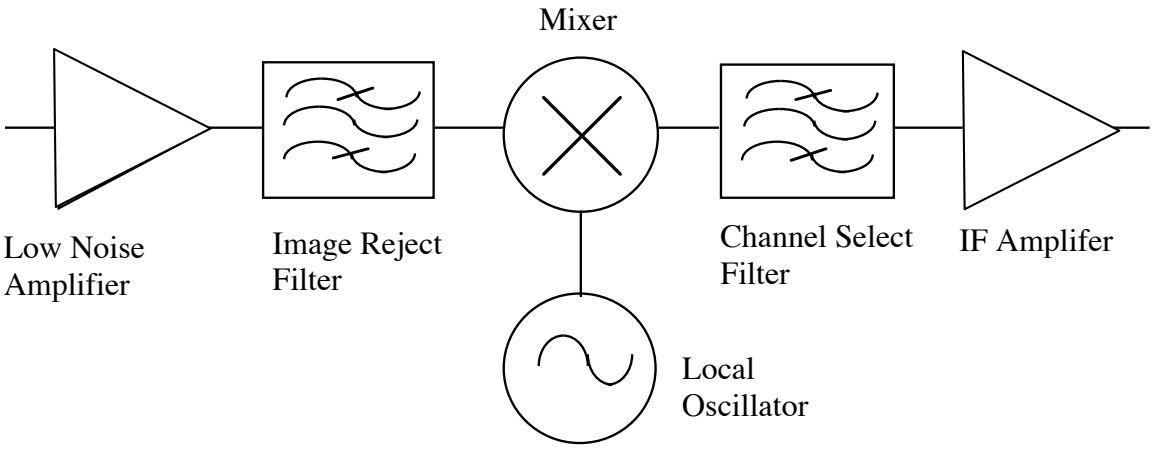

Figure 1. SuperHeterodyne Downconverter