Project III – Active Mixer (Single-balanced mixer)

Fig.1 shows the block diagram of the active mixer (single-balanced mixer). It needs differential LO signals. Build your circuits to produce such differential waveforms from single LO (Hint : use Op-amp chip). Fig.2 shows the snapshot of differential LO waveforms you need to make.

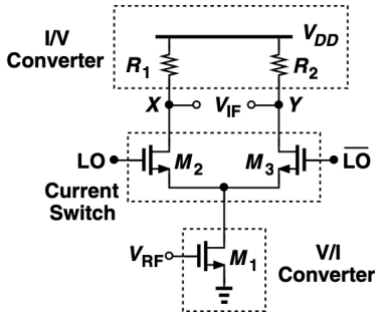

Fig.1 Block diagram of the active mixer

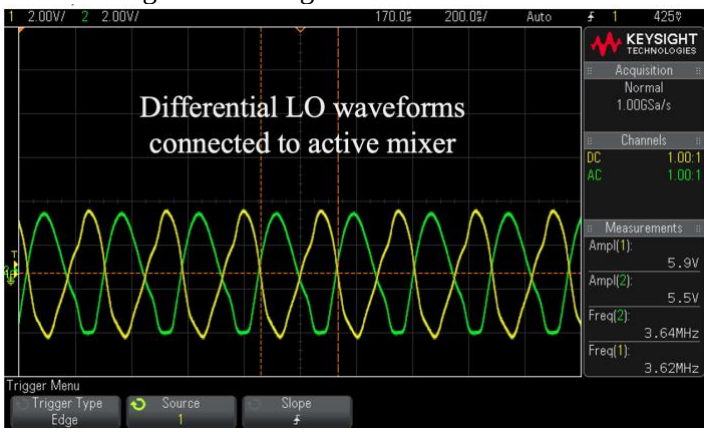

Fig.2 Differential LO waveforms

Let's use function generator to produce RF signal. Please tune it in order to have 4MHz frequency and sinusoidal waveform. After injecting all the necessary signals (RF and LO), show that your mixer works by measuring output FFT. Fig.3 shows the example of mixer output by FFT. You can see that there is a fundamental tone at 370kHz. There are tones at 4MHz and 3.63MHz as well (why?)

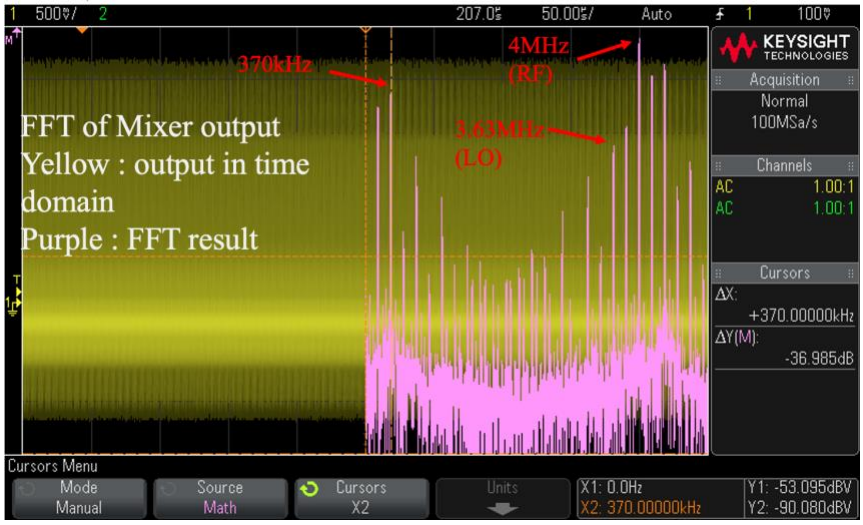

Fig.3 Real-time FFT of mixer output

As you can see mixer output, there are many harmonic tones in addition to fundamental (370kHz). It is common to use filter to remove such unnecessary tones. Build low pass filter and show high frequency harmonic tones are suppressed.

Fig.4 shows the example after applying low pass filter. Compared to Fig.3, you can see that the amplitude of 4MHz and 3.63MHz tones are suppressed.

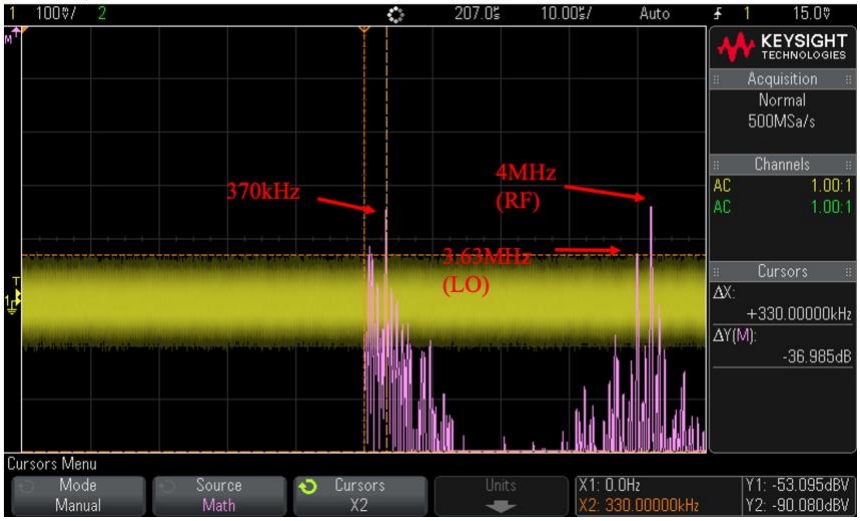

Fig.4 FFT of mixer output after low pass filter

Evaluation table :

- **Simulation results with and without low pass filter : 20 points**
- **Produce differential LO signals from single LO :**

Phase difference	Points
180º	40
120º	30
60º	20
Not differential	10

- **Show your active mixer works by measuring FFT of the output : 40 points**

To double check the functionality of your mixer, you can tune the frequency of RF and check the fundamental tone of mixer output follows the change of RF frequency. For example, Fig.5 shows that the fundamental tone changes to 1.4MHz (RF – LO) when RF increases up to 5MHz.

Fig.5 FFT of mixer output when RF increases from 4MHz to 5MHz