Department of Electronic & Telecommunication Engineering
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EN3013 - ANALOG CIRCUIT DESIGN

DESIGN OF AN ANALOG MIXERS

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This report is submitted as the fulfillment of Lab-02 of module EN3013

1 DESIGN OF ANALOG MIXERS

1.1 Objective

1. Develop an understanding of analog mixers employing diodes as key components.
2. Acquire practical knowledge of how mixers facilitate the conversion of signals from one frequency to another through the application of nonlinear transfer functions.
3. Explore the real-world applications of mixers in the context of radio frequency (RF) systems, both in receivers and transmitters.
4. Analyze and experiment with diode-based mixer circuits to comprehend how they generate new frequencies at the output.
5. Identify opportunities for signal quality enhancement and gain hands-on experience in implementing basic filtering techniques to improve the performance of the mixer circuit.

In this report, we will follow the steps to the implementation of the Analog mixers mentioned in the lab sheet.

1.2 Procedure

Step 1:

1. Connect the circuit as shown in Figure 1. Apply a 1MHz carrier sine wave at S1 and a 10kHz triangular wave at S2. Set an appropriate offset to your inputs.

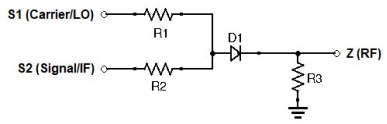

Figure 1 — Diode Mixer

2. Observe the frequency spectrum of the RF signal at the output Z.

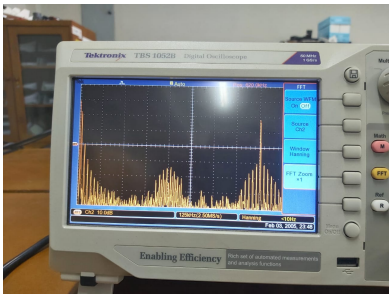

Figure 2 — Frequency spectrum of the RF signal at the output Z

3. Adjust the values of R1 and R2 to achieve a better spectrum.

$$\begin{aligned} R_1 &= 100\Omega \\ R_2 &= 100\Omega \\ R_3 &= 1k\Omega \end{aligned} \tag{1}$$

(a) (b)

Figure 3 — Adjust the values of R1 and R2 to achieve a better spectrum

4. Investigate how the diode generates new frequencies at the output?
   By operating it in non-linear region
5. Identify improvements that are needed for the RF signal?
   Apply the band pass filter
6. Implement a simple filter to clean the RF signal.

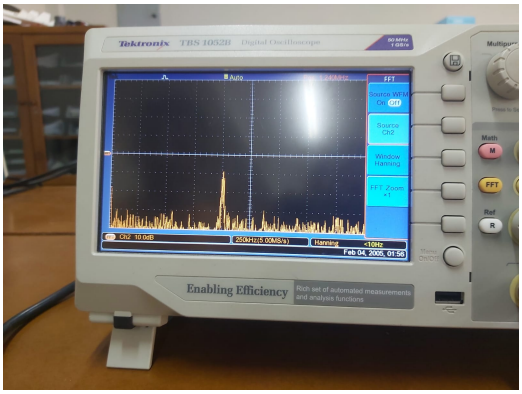

Figure 4 — Implement a simple filter to clean the RF signal

Step 2:

7. Connect the circuit as shown in Figure 5.

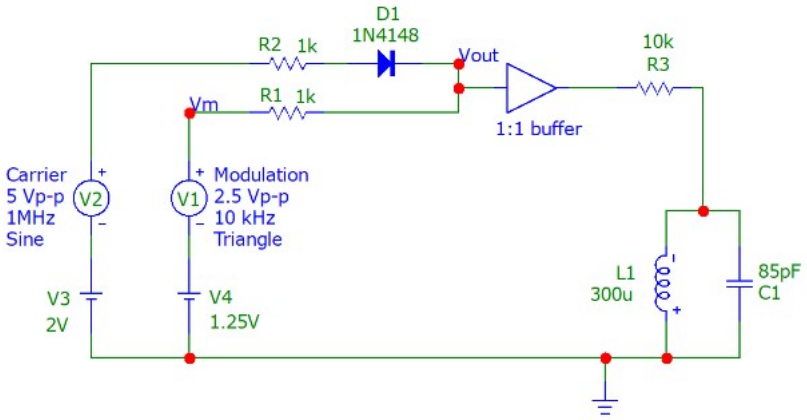

Figure 5

8. Observe the frequency components at the output.

(a) (b)

Figure 6 — Observe the frequency components at the output

9. Comment on your observations and suggest improvements.

1.3 Challenges Faced & Discussions

1. Calibration of circuit parameters, particularly R1 and R2, to optimize the RF signal spectrum.
2. Implementation of an effective filter to eliminate unwanted components and enhance the quality of the RF signal.