ECE478 Lab 6 Report

FM Modulation and Demodulation using TIMS Hardware

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ABSTRACT:

The following lab explores frequency modulation (FM) via TIMS modules. The modulation using a voltage-controlled oscillator (VCO). The demodulation is done two ways, using a zero-crossings detector and phase-locked loop.

FM – Generation by VCO

We can generate an FM signal by using a VCO where the input voltage is the carrier and the control signal on the VCO is the message signal, so the modulated signal will have the message embedded in the carrier.
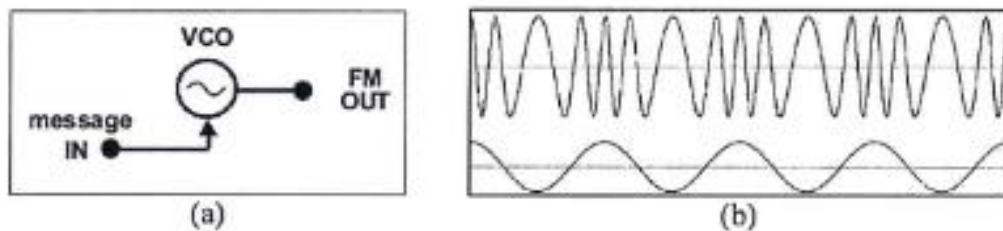

Figure 1: VCO approach to FM

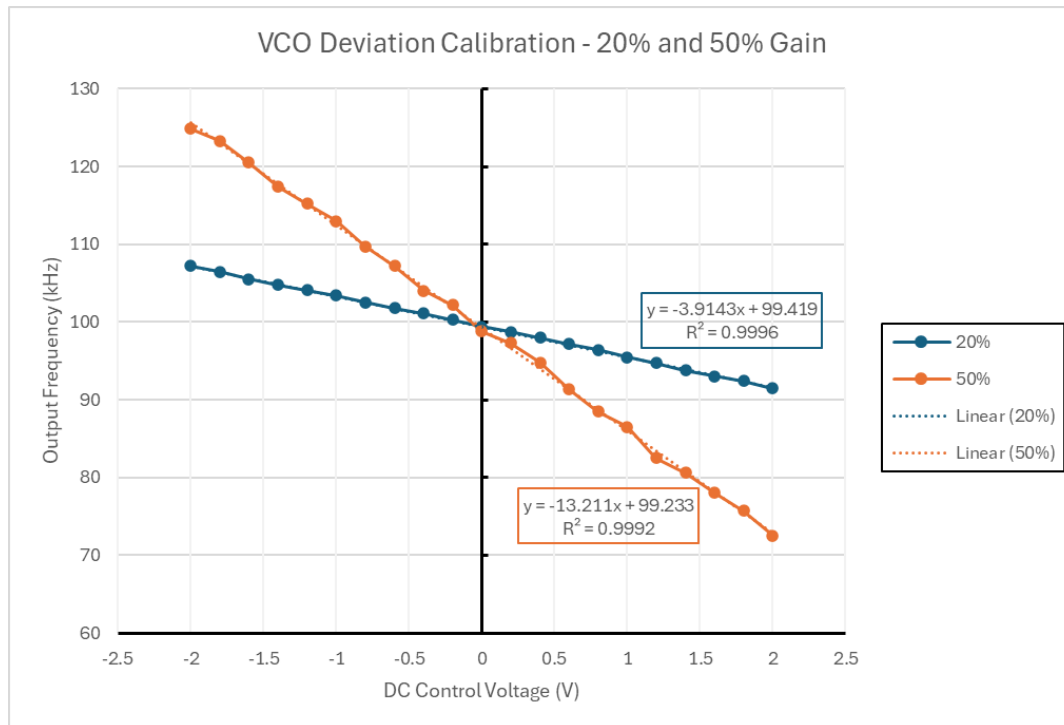Below shows the frequency deviation of the TIMS VCO module:
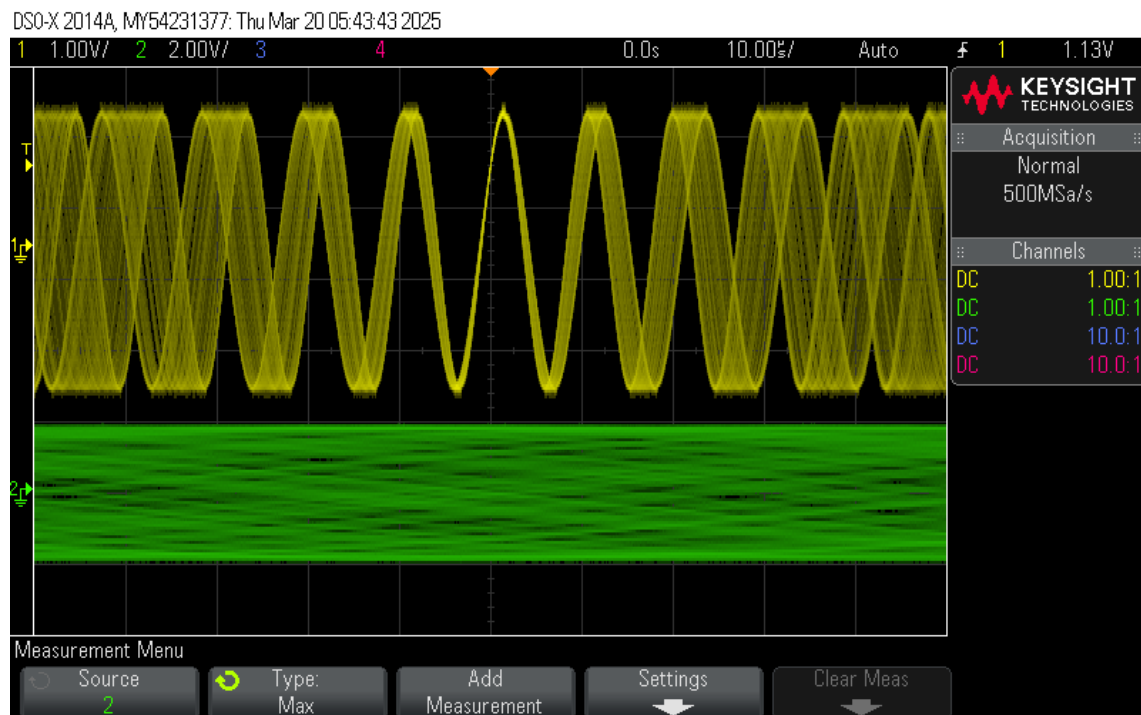

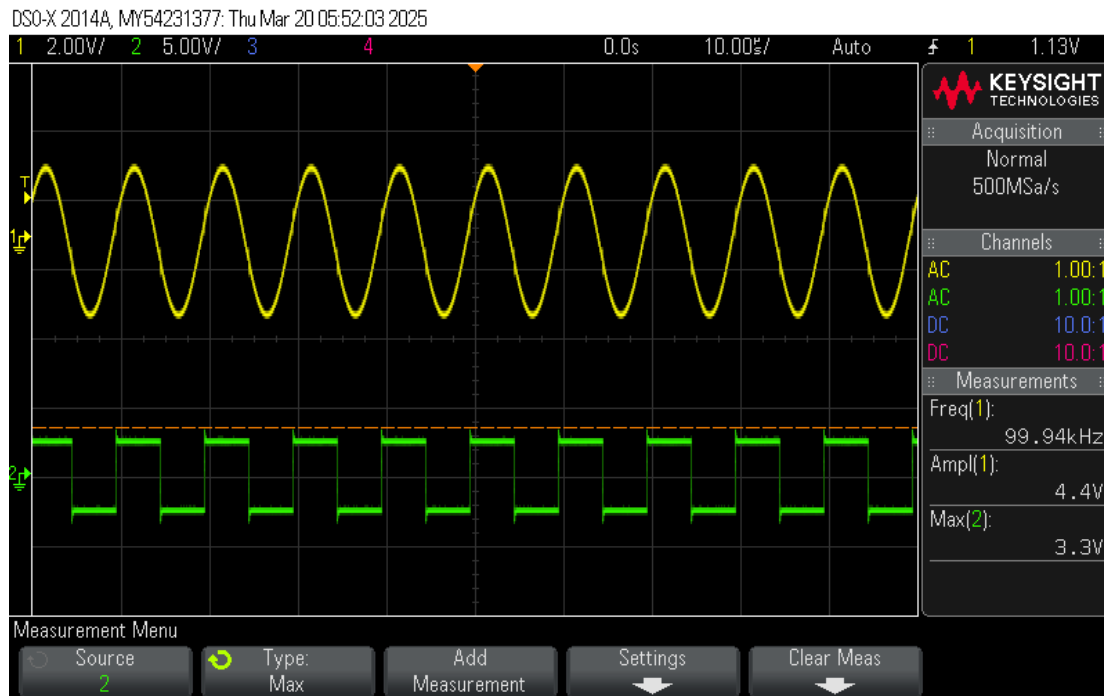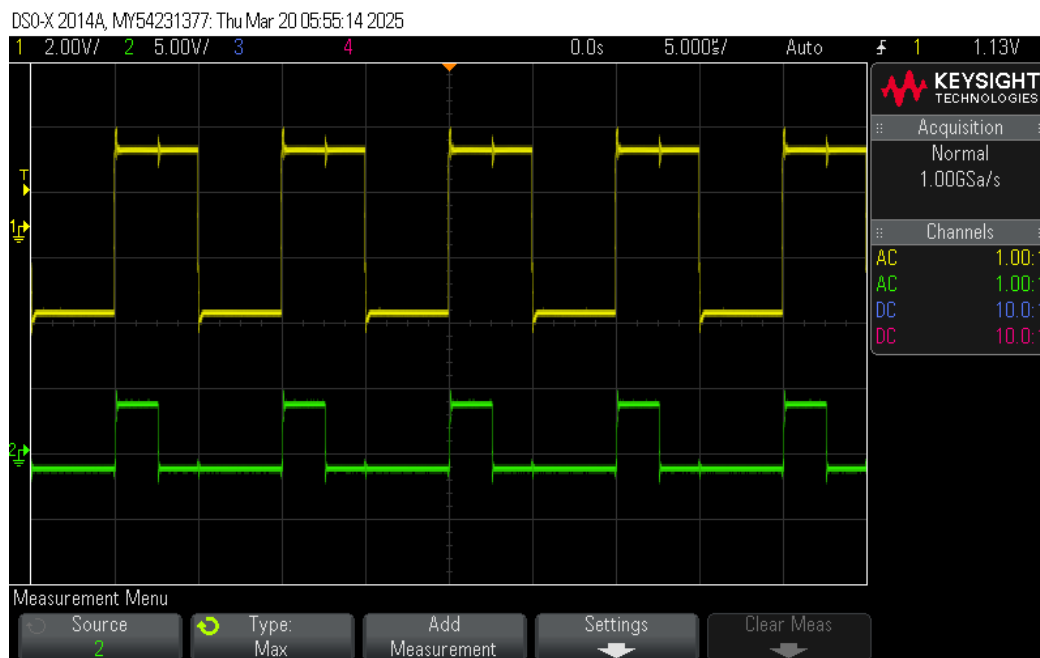Figure 2: VCO Frequency Deviation

Figure 3: FM wave (yellow); Message wave (green)

FM – Demodulation by ZX Counting

Figure 4: Carrier in normal and TTL format
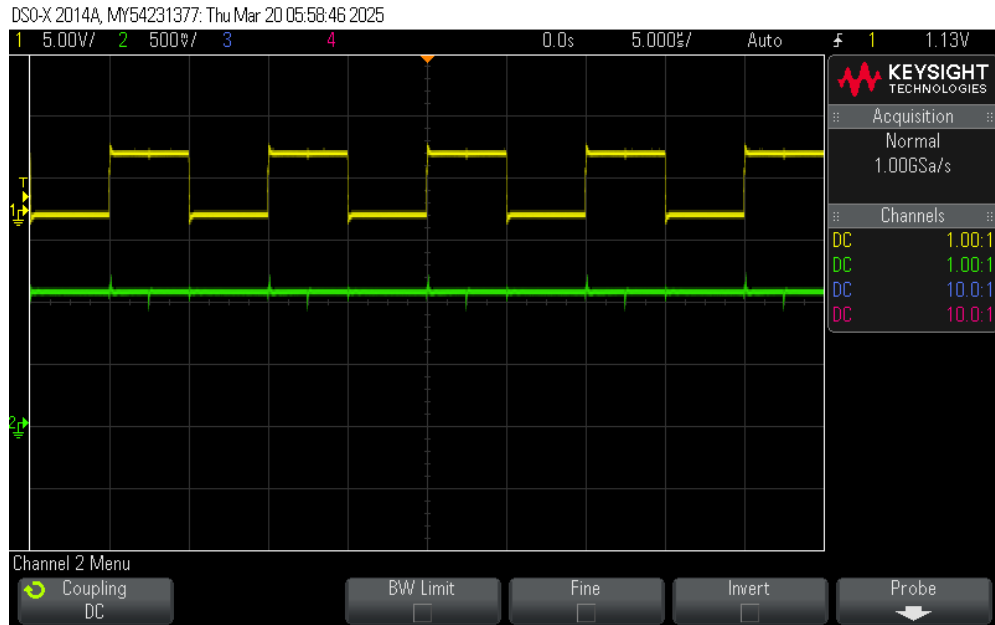

Figure 5: Carrier in TTL and 50% Twin Pulse Train

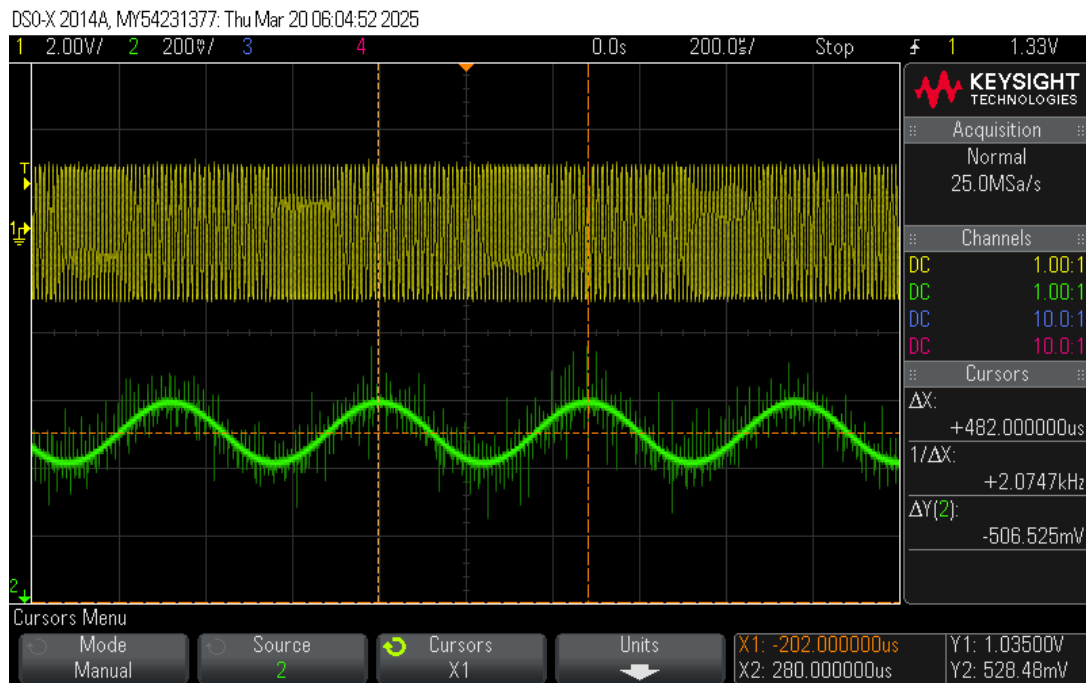*Figure 6: TTL carrier and LPF output*

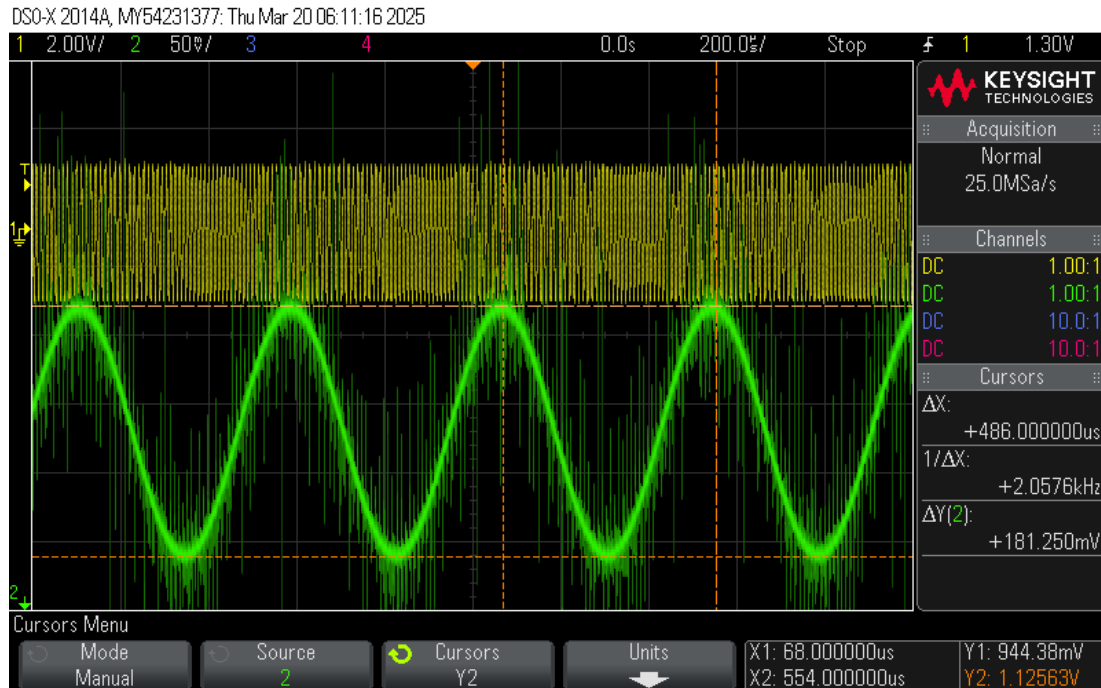*Figure 7: FM signal and ZX demodulated message*
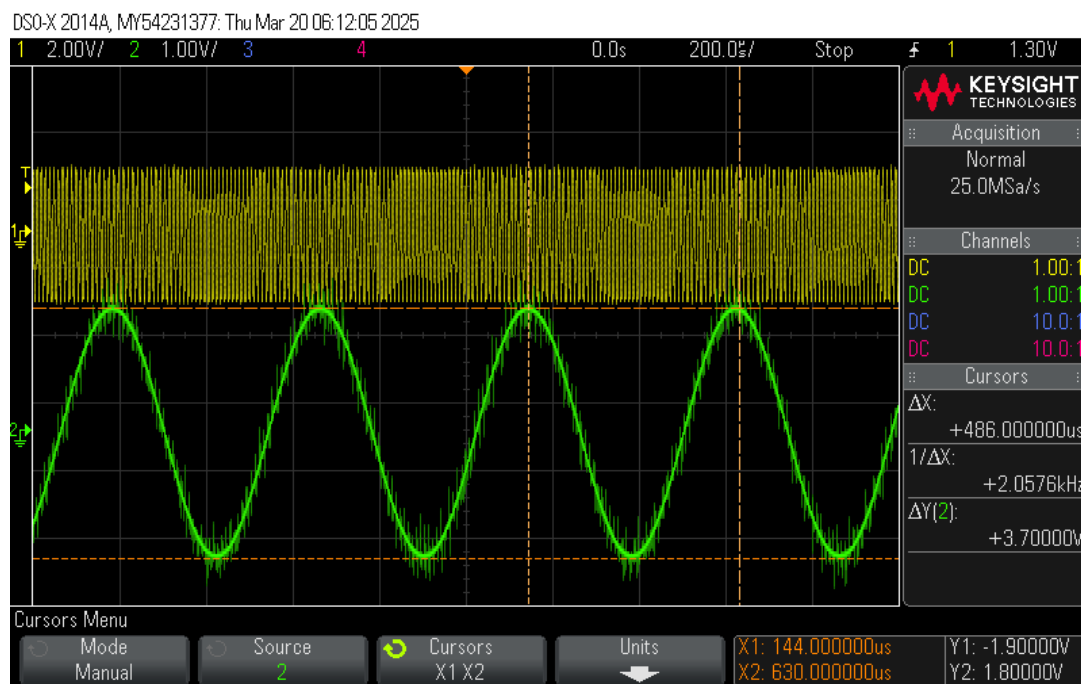
Figure 8: Received message

Figure 9: Transmitted message

The Tx and Rx messages are at the same frequency, but the Rx message is about a twentieth the voltage of the Tx message, so losses are heavy.
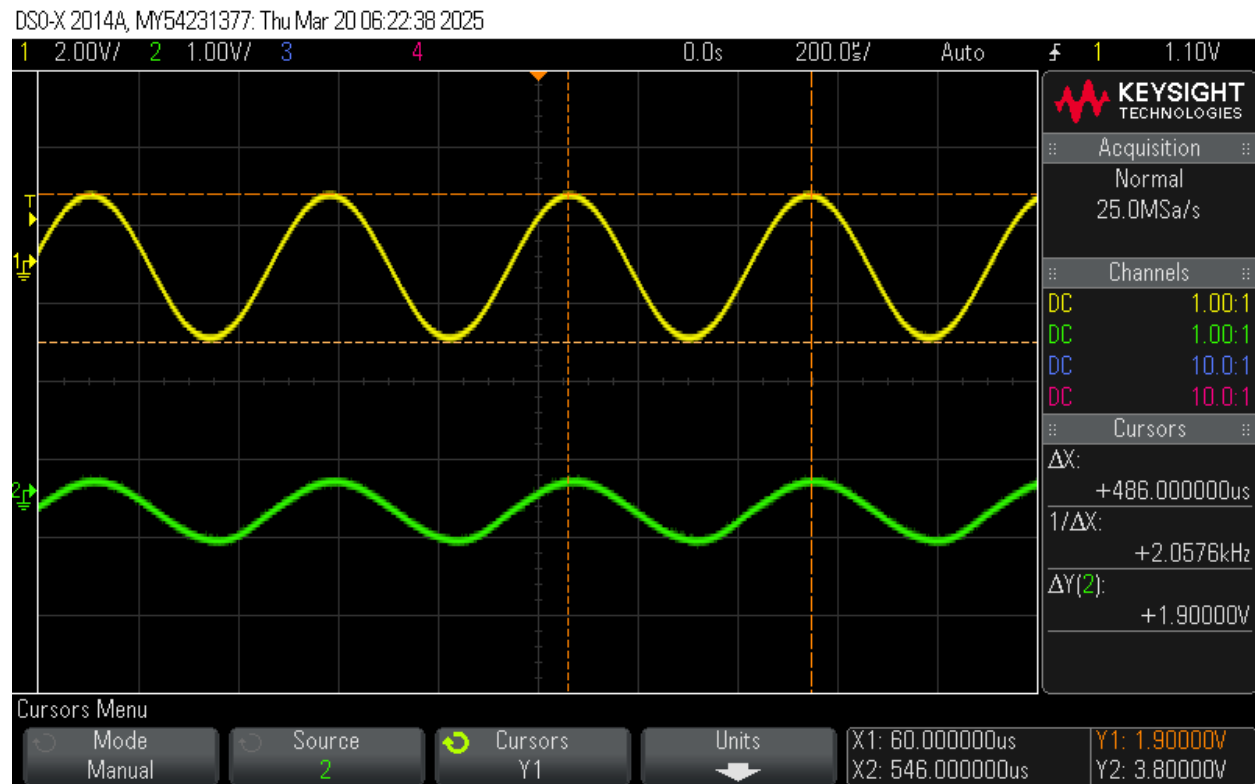
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FM – Demodulation by PLL

Figure 10: Transmit message (yellow); received message (green)

Similarly to the ZX detector, the frequencies of the Tx and Rx messages are the same, but the Rx message is an attenuated version of the Tx message. The Rx message is half the voltage.