Lab # 2 FM and PM Modulation and Demodulation
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Objective: Study how Frequency Modulation (FM) and Phase Modulation (PM) are generated using two methods: the direct method with a Voltage-Controlled Oscillator (VCO) and the indirect method using Armstrong's technique.

1. Steps

A. Generate FM using VCO (direct Method).
B. Generate PM using the (indirect method).

A. put m(t) as input of VCO and show the output of VCO by using a channel as shown in Fig. 1.

B. Put m(t) as input in multiplayer and the second input is carrier , put carrier in a phase shifter then put the output of multiplayer and phase shifter as inputs of adder then put it in hard limiter to get square wave then use BPF to get sinusoidal wave NBPM as shown in Fig. 2.

2. Results and Observations

In the direct method, we generate Wideband Frequency Modulation (WBFM) using a Voltage-Controlled Oscillator (VCO). When the digital input signal is high, the FM wave gets compressed, and when the input is low, the FM wave expands, as shown in Fig. 1.

In the indirect method, we use a Band-Pass Filter (BPF) to remove amplitude variations, resulting in Narrowband Frequency Modulation (NBFM), as shown in Fig. 2.

3. Discussions

In the indirect method, WBFM is created by using several frequency multipliers and mixers, which increases the frequency deviation but can introduce noise. The direct method, however, provides a larger frequency deviation, but the frequency stability is not as reliable.

References

[1] Use some images from the lab experiments.
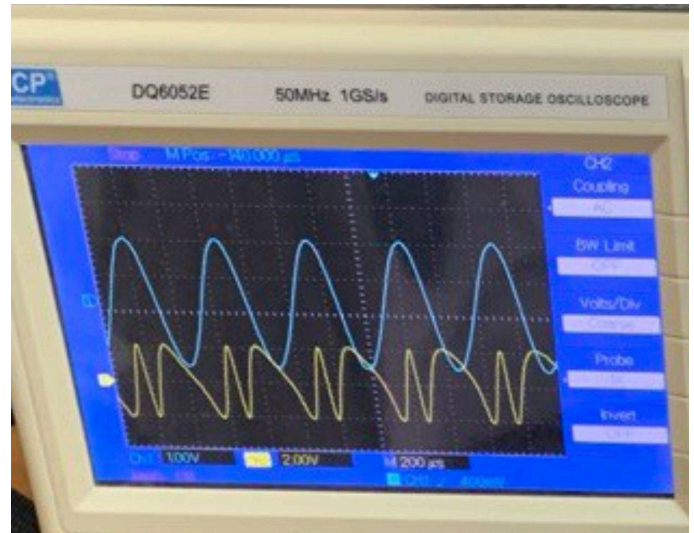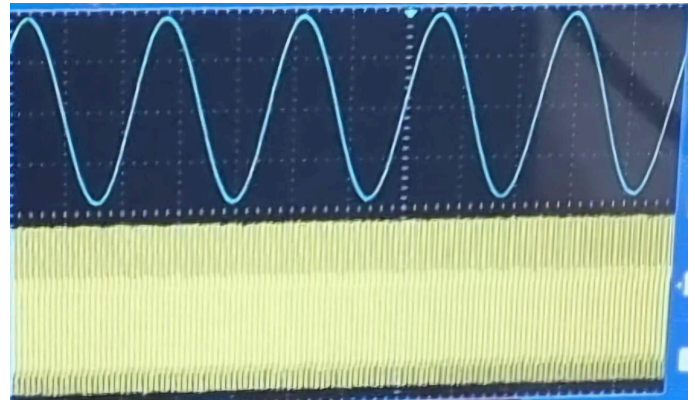[2] Barry Duncan & carlo Manfredini, Emona 101 Trainer Lab Manual, Emona pty ltd .

Fig.1. FM using VCO

Fig.2. PM using indirect method