

EE 117B/217B Microwave and Wireless Measurements

Lab 5 Questionnaire - Communications Measurements

Fall 2026

Group members: _____

Answer each question in the space provided. One combined report per lab group.

1. AM and FM Modulation and Modulation Index Measurement

1.1 AM Modulation

Q1.1.1: Report the measured carrier amplitude A_c and sideband amplitude A_s (dBm), and the modulation index m computed from them. Compare it to the set value of 10%.

Q1.1.2: Plot the measured modulation index versus the modulation index set on the instrument (5% – 100%). At what point does the agreement start to get worse? Why?

Q1.1.3: Report $V_{\max}$ and $V_{\min}$ of the envelope and the modulation index computed from them. Does the time-domain value agree with the frequency-domain value?

Q1.1.4: Report the modulation index measured on the oscilloscope for set values of 20%, 40%, 60%, 80%, and 100%. Do these results agree with what you measured on the spectrum analyzer?

1.2 FM Modulation and the Bessel Null Method

Q1.2.1: Explain why the carrier nulls when $\beta = 2.401$.

Q1.2.2: Report the actual f_m at the deepest carrier null and the FM deviation $\Delta f = 2.401 \times f_m$ computed from it. How does it compare to the set value of 25 kHz?

Q1.2.3: Plot the spectrum at the first carrier null. How many significant sidebands do you count? Do the measured sideband amplitudes agree with $J_1(\beta) = 0.52$, $J_2(\beta) = 0.43$, $J_3(\beta) = 0.20$ and $J_4(\beta) = 0.06$?

Q1.2.4: Explain why the first sidebands are nulled at $\beta = 3.8317$. Report the FM deviation calculated from the first sideband null, and compare it with the value obtained from the first carrier null and the value set on the instrument.

Q1.2.5: At the second carrier null ($\beta = 5.520$), how many sidebands are visible? Report the measured occupied bandwidth and compare it to Carson's rule, $BW = 2(\Delta f + f_m)$.

2. IQ Demodulation and EVM Measurement

2.2 IQ Demodulation Setup

Q2.2.1: With a symbol rate of 125 ksps and an IQ sampling rate of 1.25 MHz, how many times is each symbol sampled?

2.3 IQ Streaming

Q2.3.1: With the VSG locked to the FieldFox reference and set to BPSK, calculate the rate of rotation of the vector diagram (the line).

Q2.3.2: What is the source of error making the line rotate? Why does the line still rotate despite the two sources being phase locked?

Q2.3.3: After adjusting the VSG frequency to minimize the rotation, what is the frequency on the VSG?

2.4 IQ Data Saving and Processing

Q2.4.1: For 16-QAM, plot the constellation diagram, the full vector diagram and the eye diagram constructed from the saved IQ data. Report the EVM and eye height, and estimate the BER.

Q2.4.2: Repeat for 64-QAM and 256-QAM at carrier power levels of -10 dBm and -40 dBm. Plot the constellation and eye diagrams and report the EVM for each case.