

EE430 Lab #3 (Week 8)

Frequency Modulation

This is an informal lab. It has not been tested, so prepare for surprises!

1. Equipment

- Agilent spectrum analyzer
- Digital oscilloscope
- Analog oscilloscope
- Tektronix function generator, with sweep (FM) input. (hereafter referred to as "transmitter")
- Philips or HP (preferred) function generator. (hereafter referred to as "modulating signal")

2. Setting up

Connect the equipment according to Fig. 1.

Note that the FM input of the Tektronix function generator is on the back.

- Set the transmitter to sine wave, 1 mHz, 10 volts p-p output.
- Set the modulating signal to sine wave, 1 kHz, sweep off, DC offset off, but disconnect the cable for now.

Set up the spectrum analyzer to view the spectrum near 1 mHz. As a starting point

- Measure -- Analyzer type -- Spectrum -- R.
- Center -- 1 MHz.
- Range -- 40 kHz.
- Scale Ref -- 30 dBm, 10 dB per division.
- Bandwidth -- 100 Hz.

3. Unmodulated carrier

Observe on both scopes that the unmodulated carrier is as expected.

4. FM modulation check

- Connect the cable to the modulating signal.
- Set the modulating signal frequency to 1 kHz.
- Set the level to provide a modulation index () of 2.4, using Bessel functions as your guide.
- Observe the modulated signal on the scope. Comment on its appearance.
- What is the bandwidth of the transmitted signal. Does it match your expectations? (Calculate it, both by Bessel functions and Carson's rule.)
- Observe the input modulating signal level. Switch the generator to DC. Adjust the DC offset for the positive peak level of the sine wave in the previous step. Check the output frequency. It should be 2.4 kHz below the nominal carrier frequency.
- Repeat for negative DC input.
- Switch back to AC. Sweep the frequency, from 100 Hz to 10 kHz, keeping the level constant, observing the spectrum. Note the bandwidth. Does it match your expectations?
- Verify that you see a carrier null with the modulating signal frequency at about 435 Hz.
- Verify that you see a null in the first sideband at about 627 Hz.
- Using Bessel functions, predict a frequency where you will see a null in the second sideband. Verify it.
- What is the bandwidth at 100 Hz, 1 kHz and 10 kHz. Compare with your predictions.

5. The report

For the report, give a quick summary of your observations.