

## A.2 - Amplitude Modulation

### A.2.1. Experimental Setup for DSBLC Modulation

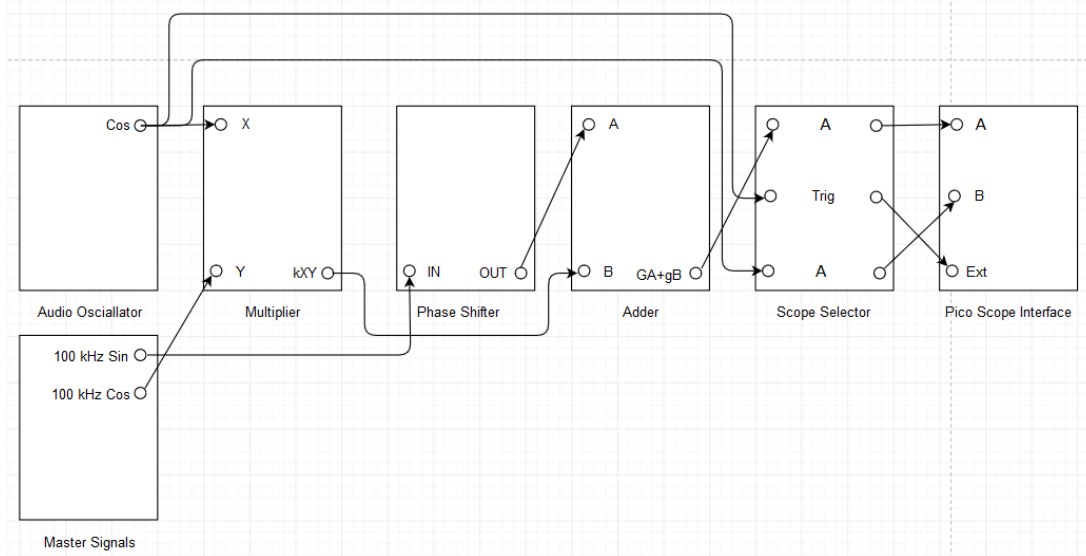


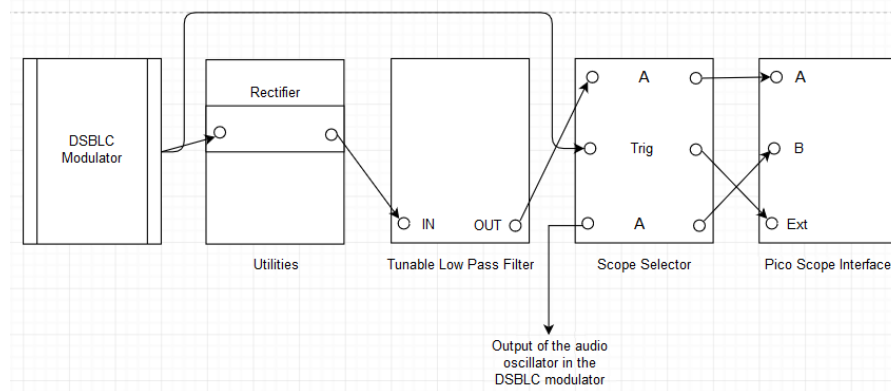
Figure A.2.3: DSBLC modulator setup.

### A.2.2. Laboratory Exercise for DSBLC Modulation

- i. Set an audio oscillator to generate 1 kHz cosine signal.
- ii. Make the modulator setup as shown in the Figure A.2.3.
- iii. Toggle the on board switch-frequency range of the phase shifter to HI, toggle the front panel switch of the phase shifter down and toggle the front panel switch of the multiplier to DC. Turn both the knobs of the phase shifter to maximum and turn both the knobs of the adder to minimum. NOTE: On board switch is a part of PCB of the module and front panel switch is present on the front end of the module.
- iv. Increase the carrier signal at the adder to obtain a carrier signal with 4 V peak to peak amplitude.
- v. Unplug the carrier signal at the adder and increase the sideband signal at the adder to obtain a DSBSC modulated signal with 4 V peak to peak amplitude.
- vi. Plug the carrier signal back at the adder to obtain the DSBLC modulated signal.
- vii. Observe that the carrier signal is added to the DSBSC modulated signal to obtain the DSBLC modulated signal.
- viii. Adjust both the knobs of the phase shifter to obtain modulation index of 1.
- ix. Keep the carrier signal at the adder constant and adjust the sideband signal at the adder to obtain modulation index of 0.
- x. Measure  $A_{max}$  and  $A_{min}$  and calculate the observed modulation index.

- xi.** Take a screenshot of output of the adder and output of the audio oscillator under the scope mode.
- xii.** Measure the observed power difference between the carrier peak and the sideband peaks.
- xiii.** Take a screenshot of output of the adder and output of the audio oscillator under the spectrum mode.
- xiv.** Repeat step **ix** through step **xiii**, for modulation index of 0.4, 0.8 and 1, accordingly.

### A.2.3. Experimental Setup for DSBLC Demodulation



**Figure A.2.4: DSBLC demodulator setup.**

### A.2.4. Laboratory Exercise for DSBLC Demodulation

- i.** Retain the modulator setup with modulation index of 1 and make the demodulator setup as shown in the Figure A.2.4.
- ii.** Toggle the front panel switch of the Tunable Low Pass Filter (TLPF) to wide. Turn both the knobs of the TLPF to minimum.
- iii.** Adjust both the knobs of the TLPF to obtain the demodulated message signal with minimum phase shift and equal amplitude.
- iv.** Take a screenshot of output of the TLPF and output of the audio oscillator under the scope mode.
- v.** Repeat step **iii** and step **iv**, for modulation index of 0, 0.4 and 0.8, accordingly.
- vi.** For modulation index of 1, zoom around 0 Hz to 5 kHz to measure frequency of the demodulated message signal peak.
- vii.** Take a screenshot of output of the TLPF and output of the audio oscillator under the spectrum mode.

### A.2.5. Experimental Setup for SSB Modulation

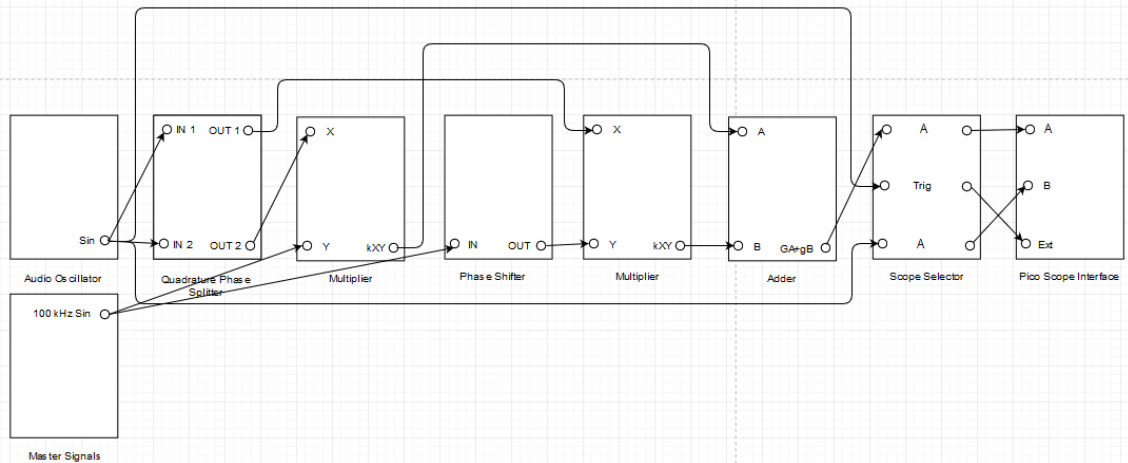


Figure A.2.5: SSB modulator setup.

### A.2.6. Laboratory Exercise for SSB Modulation

- i. Set an audio oscillator to generate 1 kHz sine signal.
- ii. Make the modulator setup as shown in the Figure A.2.5.
- iii. Toggle the on board switch-frequency range of the phase shifter to HI and toggle the front panel switch of the multipliers to DC. Turn the fine knob of the phase shifter to minimum, turn the coarse knob of the phase shifter to maximum and turn both the knobs of the adder to maximum.
- iv. For lower sideband modulation, toggle the front panel switch of the phase shifter down.
- v. Adjust the coarse knob of the phase shifter to suppress the upper sideband to minimum.
- vi. Take a screenshot of output of the adder and output of the audio oscillator under the spectrum mode.
- vii. Observe that the envelope of the modulated signal is not flat. What does it signify?
- viii. Take a screenshot of output of the adder and output of the audio oscillator under the scope mode.
- ix. For upper sideband modulation, toggle the front panel switch of the phase shifter up. Repeat step v through step viii, accordingly.

### A.2.7. Experimental Setup for SSB Demodulation

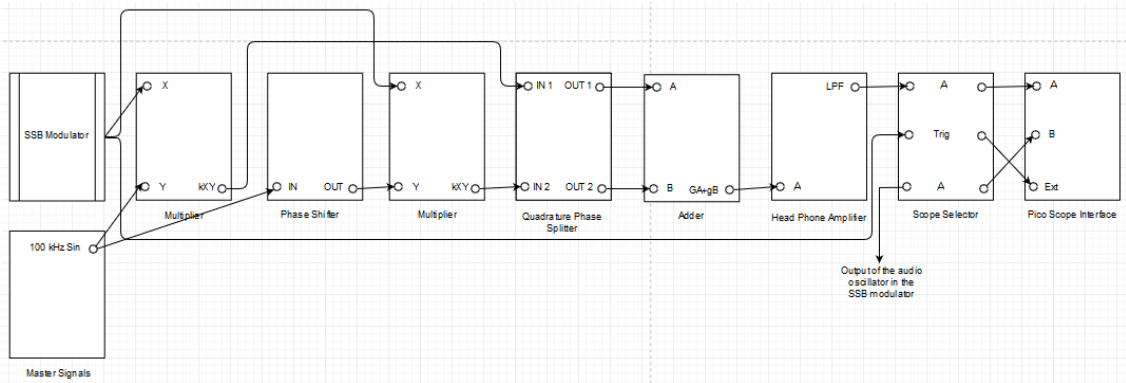


Figure A.2.6: SSB demodulator setup.

### A.2.8. Laboratory Exercise for SSB Demodulation

- i. Retain the modulator setup with upper sideband modulation and make the demodulator setup as shown in the Figure A.2.6.
- ii. Toggle the on board switch-frequency range of the phase shifter at the demodulator to HI, toggle the front panel switch of the multipliers at the demodulator to DC and toggle the front panel switch of the headphone amplifier to IN. Turn both the knobs of the phase shifter at the demodulator to minimum and turn both the knobs of the adder at the demodulator to minimum.
- iii. For upper sideband demodulation, toggle the front panel switch of the phase shifter at the demodulator down.
- iv. Adjust both the knobs of the adder at the demodulator and both the knobs of the phase shifter at the demodulator to obtain the demodulated message signal with minimum phase shift and equal amplitude.
- v. Take a screenshot of output of the LPF at the headphone amplifier and output of the audio oscillator under the scope mode.
- vi. Zoom around 0 Hz to 5 kHz to measure frequency of the demodulated message signal peak.
- vii. Take a screenshot of output of the LPF at the headphone amplifier and output of the audio oscillator under the spectrum mode.
- viii. For lower sideband demodulation, toggle the front panel switch of the phase shifter at the demodulator up. Repeat step iv through step vii, accordingly.