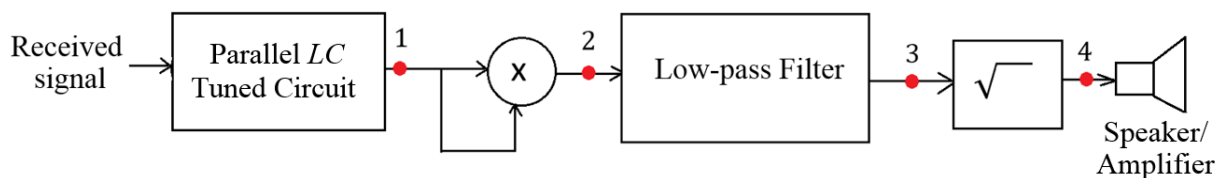
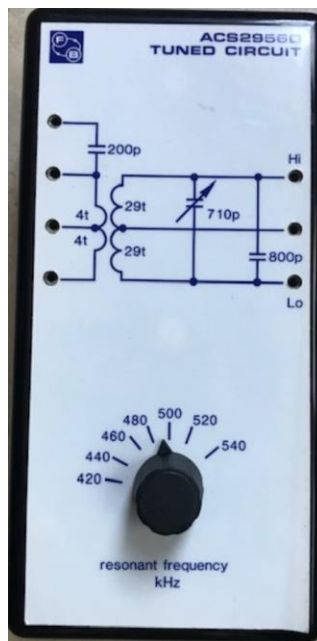


Communication System Implementation

Design and implement an AM modulation-based system with two broadcast stations and one receiver. The broadcast stations will each modulate a separate song track (generated by your laptop or smartphone). The carrier frequency for Station 1 is set to 420kHz and that for Station 2 is 540kHz. The modulated signals from those two stations are to be combined (added with a non-inverting op-amp-based adder). The output of the adder is to be picked up by one end of the longest BNC-terminated cable (ask your TA for one) available in the lab. The other end of the cable should reach and become the input to the receiver circuit that is placed at a distant workbench in the room. At the receiver end, the transmitted signal is to first pass through a tuned circuit (refer to the figure below) that selects one of the broadcasts. The output of the tuned circuit is then demodulated as follows (refer to the block diagram of the receiver system shown below): filtered signal is multiplied by itself (employ a AD633 analog multiplier), low-pass filtered (set the cutoff frequency to around 3.5 kHz), square-rooted and then fed into a speaker/amplifier as shown in the following block diagram. (Recall that you have built a square-root circuit earlier in this Lab.) You should demonstrate that you can listen to Station 1 and Station 2 by properly adjusting the station frequency in the “tuned circuit.



Note: care must be taken so as not to saturate the square and the square-root circuits.



The following is a sample (single sweep) scope display capture of the output of the tuned circuit at 420kHz (yellow trace) and the corresponding signal feeding the speaker (blue trace). It should be noted that the delay in the demodulated signal is due to the phase shift realized by the low-pass filter. Also, the blue waveform has been ac coupled, scaled and shifted in order to expose the “envelope detection” behavior of the demodulator.



In your report, you are to explain (mathematically) the operation of the above demodulator and sketch the spectra at the indicated (red) nodes in the figure. Assume the following spectrum for the bandlimited signal at Node 1. Also assume an ideal LP filter with cutoff frequency $\omega_o = 4\pi B$ rad/sec and $\omega_c \gg \omega_o$ (B is the signal bandwidth).

