The Hashemite University
Faculty of Engineering
Department of Electrical Engineering

Experiment Number (3)

DSB Transmitter and Receiver

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Objectives:

- Understand the main function of AM DSB receivers.
- Learn about the ANACOM 1/2 boards' function and main parts.
- Analyze the received signal during every step of the demodulation process.

Equipment:

- Dual oscilloscope.
- Power supply.
- ANACOM 1/2 board.

Theory:

We know the mathematical expression for an AM wave is:

$$s(t)=A_c[1+\mu\cos(2\pi f_m t)]\cos(2\pi f_c t).$$

But how can we generate such signal using electrical components? How to send it? How to receive and understand the data in it?

These processes of transmission and reception of information is called communication.

The system which describes the information exchange is called a communication system.

A communication system in its simplest form must have three components:

- Transmitter
- Channel
- Receiver

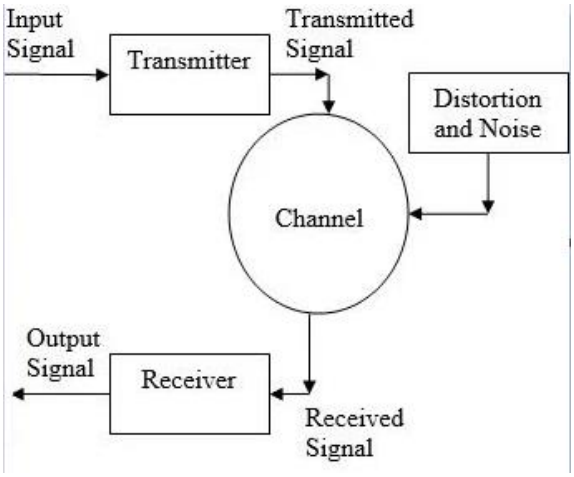


Figure 1 typical communication system

The transmitter: it's the part responsible for encoding, modulating and sending the message signal.

The transmitter uses a circuit called the modulator to modulate the message signal and an antenna to send it.

Antenna is a transducer used to convert electrical signals to electromagnetic waves and vice versa so it's used in both of the transmitter and the receiver.

There is plenty of modulators used in DSB generation such:

- Switching modulator (used to produce DSBFC)
- Balanced modulator (used to produce DSBSC)

The channel: is the physical medium used to transmit the waves.

The receiver: it's the part responsible for decoding, demodulating and receiving the message signal.

The receiver uses the demodulator circuit to reconstruct the message signal.

In DSB demodulation it's common to use an envelope detector as a demodulator.

The envelope detector uses a diode as a detecting element and a low pass filter (resistor and a capacitor).

We know the standard form of AM wave is

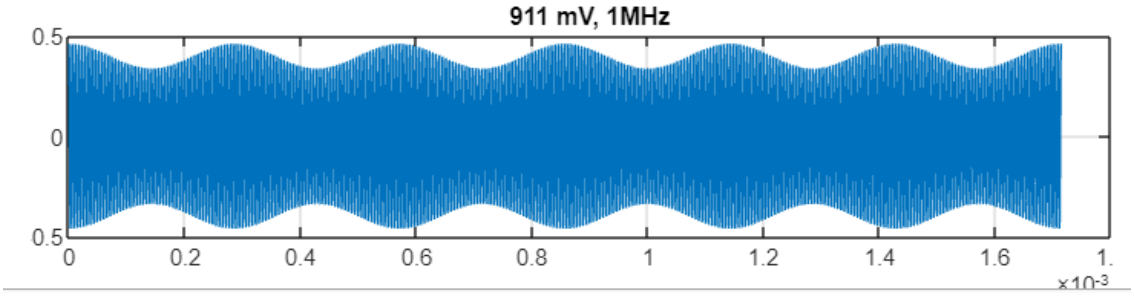
$$s(t)=A_c[1+\mu m(t)]\cos(2\pi f_c t)$$

In the positive half cycle of AM wave, the diode conducts and the capacitor charges to the peak value of AM wave. When the value of AM wave is less than this value, the diode will be reverse biased. Thus, the capacitor will discharge through resistor till the next positive half cycle of AM wave. When the value of AM wave is greater than the capacitor voltage, the diode conducts and the process will be repeated.

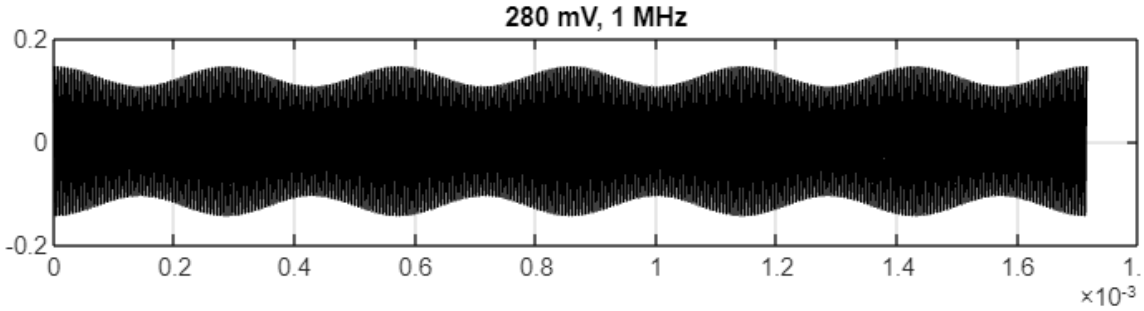
We should select the component values in such a way that the capacitor charges very quickly and discharges very slowly. As a result, we will get the capacitor voltage waveform same as that of the envelope of AM wave, which is almost similar to the message signal.

Procedure:

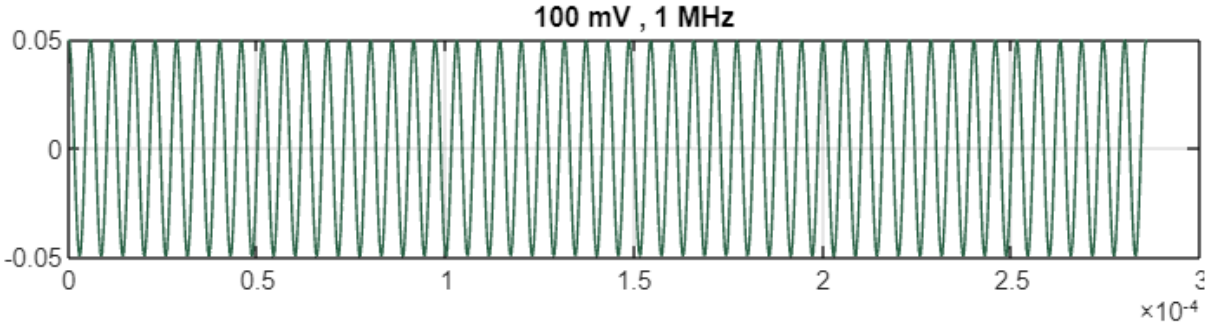
1. Investigate the AM transmitted signal on tp13 in ANACOM1/1, Record the waveform (determine the amplitude and frequency).



2. Use channel 2 to monitor the RF Amplifier output at tp12 on ANACOM 1/2 Record the waveform (determine the amplitude and frequency).

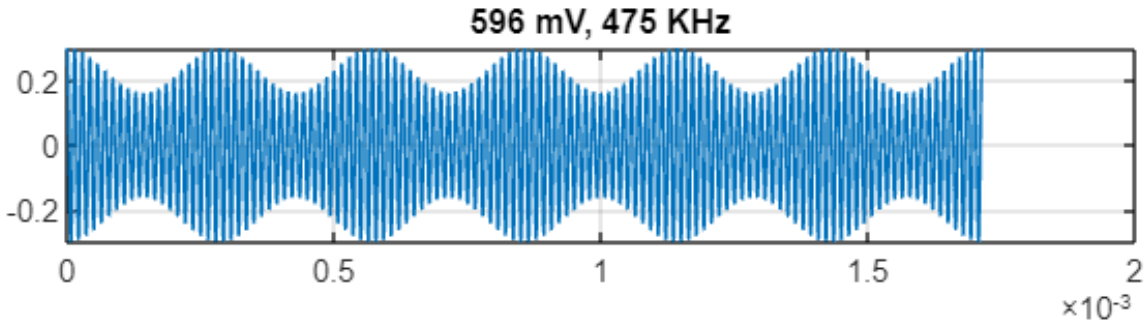


3. Record the waveform at the output of the local oscillator at tp40 (determine the amplitude and frequency).

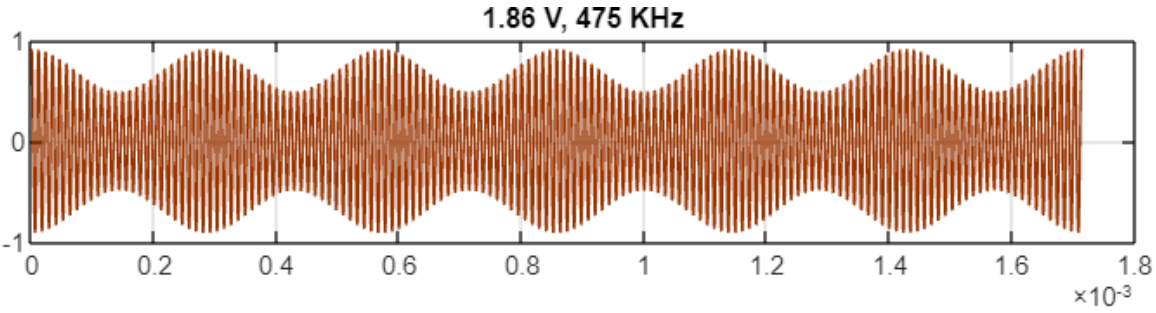


4. Record the waveform at the output of the Mixer at tp20 (determine the amplitude and frequency).

5. Record the waveform at the output of the first IF amplifier at tp24 (determine the amplitude and frequency).



6. The final IF amplifier provides some additional amplification and more selectivity. This can be seen by observing the waveform at tp28. Record this signal (determine the amplitude and frequency).

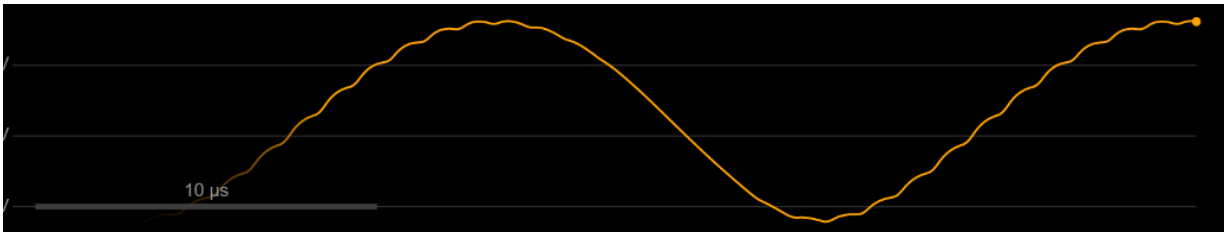


7. By comparing the signal amplitude of tp24 and tp28, the gain of the second IF amplifier can be calculated. Record your calculated value for the gain of the second IF amplifier.

$$\text{gain} = \frac{\text{Vout}}{\text{Vin}} = \frac{1.86}{0.596} = 3.12$$

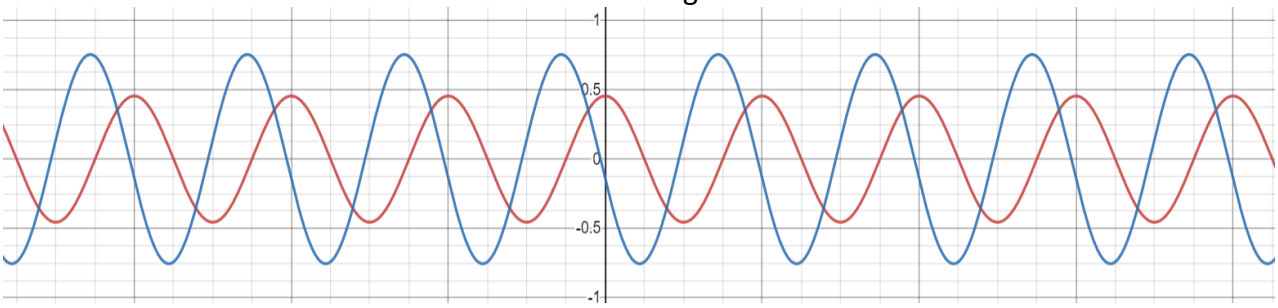
8. Observe the detector output at tp31 switching the oscilloscope input to DC coupling. Record the waveform (determine the amplitude and frequency).

304 mV, 3.513 KHz



9. We can see that the information signal has been passed through the transmitter and the receiver with very little distortion. Draw both the transmitted signal on tp14 in ANACOM 1/1 and the o/p signal from the lowpass filter on tp39 in on ANACOM 1/2 in same time scale.

Carrier in blue and message in red.



Conclusion:

In this experiment, we've went through the steps of sending an am signal using ANACOM 1/1, receiving and demodulating it using ANACOM 1/2 which contains an antenna to receive the signal, two IF amplifiers the first one works as a narrow band pass with some amplification, the second one to add extra selectivity and amplification, an envelope detector for the demodulation of the signal, and a lowpass filter to remove all unwanted components which will result in an amplified and shifted version of the message signal This is due to the circuits of the Transmitter and Receiver.

The experiment intended to guide us through the steps necessary to achieve a practical understanding of the concepts studied not only in the theory, but also in other courses of the curriculum.