# ANALOG COMMUNICATION

## Hardware used:

- DSB/SSB AM Transmitter (ST2201)
- DSB/SSB AM Receiver (ST2202)
- FM Modulator/Demodulator (ST2203)

**Learning Tutorial**

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# Lab #1

## TO ANALYZE DOUBLE SIDE BAND (DSB) AM MODULATION

**OBJECTIVE:**

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**MODULATION;**

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**AIM OF MODULATION:**

- Transmit the signal to destination
- To remove interference
- To reduce noise
- To reduce the cost for the system
- To transmit signals of same frequencies without any interference on the same channel

**TYPES OF MODULATION:**

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**ANALOG MODULATION:**

The aim of analog modulation is to transfer an analog baseband (or low pass) signal, for example an audio signal or TV signal, over an analog band pass channel at a different frequency, for example over a limited radio frequency band or a cable TV network channel. Analog modulation can be classified as;

- Amplitude modulation (AM)
- Phase modulation (PM)
- Frequency modulation (FM)

**PULSE MODULATION:**

The aim of pulse modulation is to transmit data stream in the form of pulses over the channel. Pulse modulation can be classified as;

- Pulse Position Modulation (PPM)
- Pulse Amplitude Modulation (PAM)
- Pulse Width Modulation (PWM)
- Pulse Code Modulation (PCM)

**DIGITAL MODULATION:**

The aim of digital modulation is to transfer a digital bit stream over an analog bandpasschannel. Digital modulation can be classified as;

- Amplitude Shift Keying (ASK)
- Phase Shift Keying (PSK)
- Frequency Shift Keying (FSK)

**AMPLITUDE MODULATION:**

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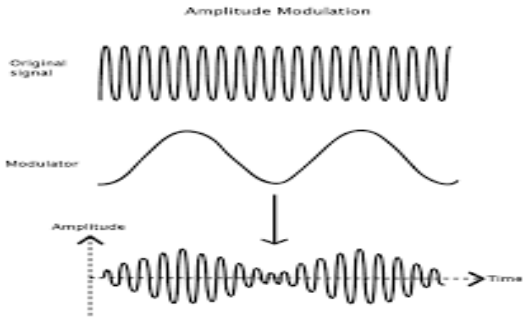
**DOUBLE SIDE BAND (DSB) AM MODULATION:**

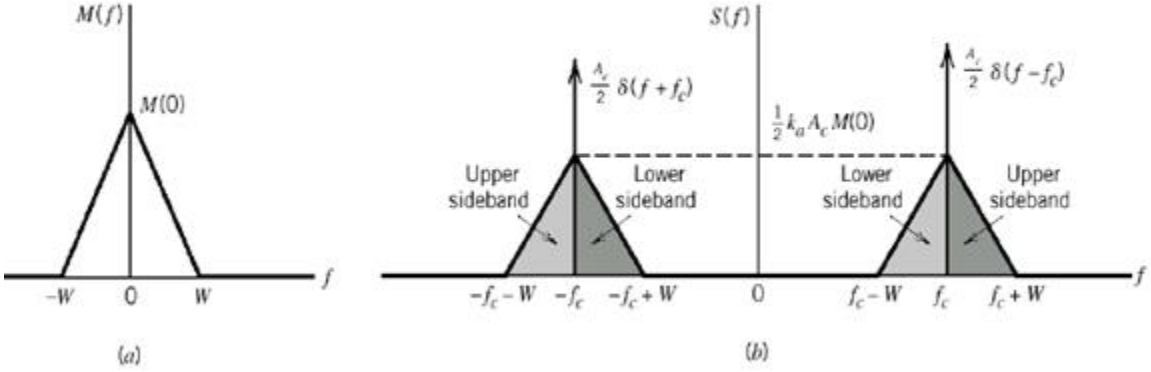
A message signal x (t) can be DSB modulated onto a carrier with a simple multiplication. The modulated carrier y (t) can be represented by;

$$y(t) = x(t) \cdot \cos(2\pi f_c t)$$

$f_c$ is the carrier frequency. Graphically, it can be represented as;
In time-domain



In frequency-domain

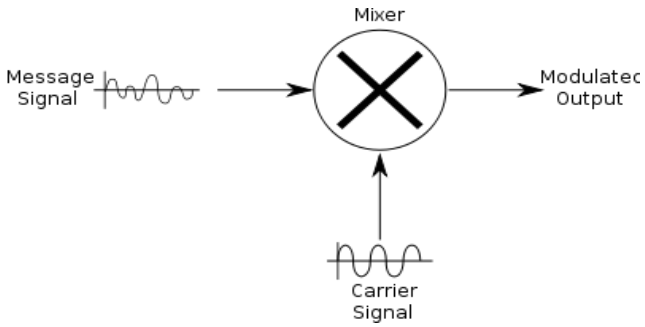



## DOUBLE SIDE BAND SUPPRESSED CARRIER MODULATION:

Double-sideband suppressed-carrier transmission (DSB-SC) is transmission in which frequencies produced by amplitude modulation (AM) are symmetrically spaced above and below the carrier frequency and the carrier level is reduced to the lowest practical level, ideally being completely suppressed.

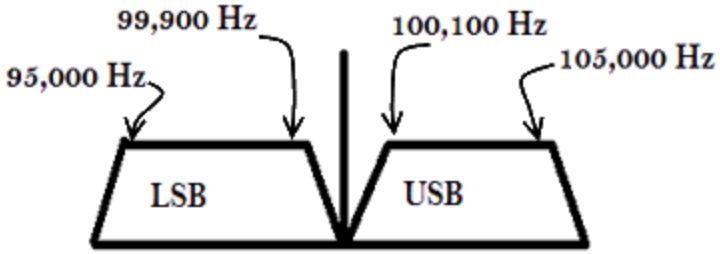
DSB-SC is generated by a mixer. This consists of a message signal multiplied by a carrier signal. The mathematical representation of this process is shown below,

$$\underbrace{V_m \cos(\omega_m t)}_{\text{Message}} \times \underbrace{V_c \cos(\omega_c t)}_{\text{Carrier}} = \underbrace{\frac{V_m V_c}{2}\left[\cos\left((\omega_m+\omega_c)t\right)+\cos\left((\omega_m-\omega_c)t\right)\right]}_{\text{Modulated Signal}}$$

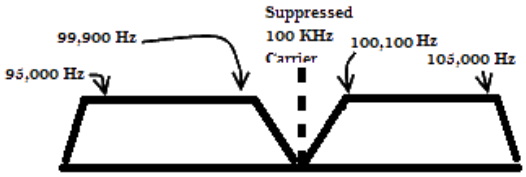



## DIFFERENCE BETWEEN DSB AND DSB-SC:

To get the two side bands with the carrier. The carrier should be modulated by the moduating signal using simpe modulator. After modulation the result is USB, LSB and the carrier.




DSB-SC transmission is achieved when carrier is modulated by the modulating signal using balance modulator. When two signals (message and carriers) are fed to the balance modulator, the modulator will produce the amplitude modulated signal with two side bands and carrier is cancelled out.




**EQUIPMENT USED:**

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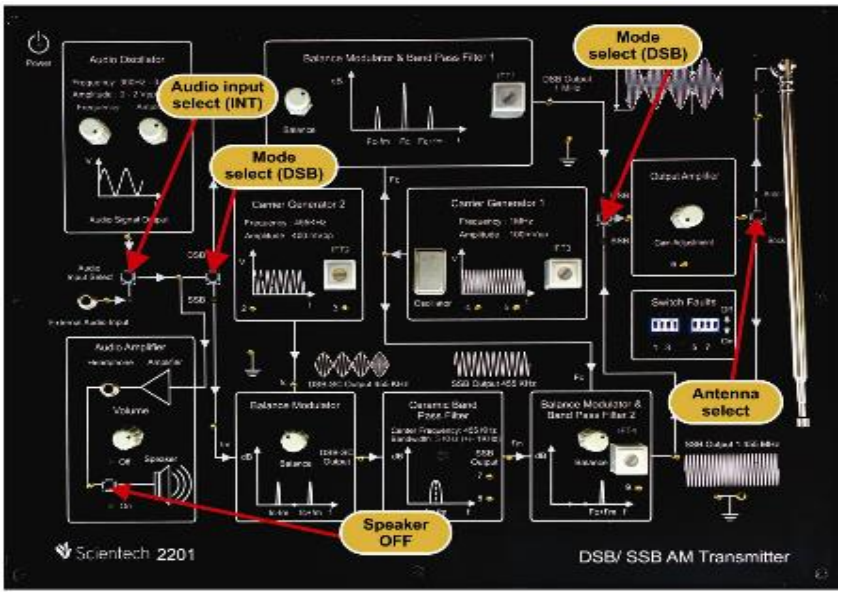

**MAIN COMPONENTS:**

- *AUDIO OSCILLATOR*: The device that generates one pulse tone or frequency at a time is the audio oscillator.
- *AUDIO OUTPUT***:** This is an amplifier with a speaker.
- *MODULATOR***:** Balanced modulator with the pass band filter (1MHZ)
- *BALANCED MODULATOR***:** A modulator with frequency of 455kHz.
- Carrier Frequency 1 MHz
- Transmitter amplifier output
- Power supply 220V

**PROCEDURE:**

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## Lab Task

*Observe the output of Audio Oscillator, Carrier Generator 1 and Balance Modulator and attach the output.*

**CONCLUSION:**

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# Post Lab Questions

a) **What are types of modulation?**

b) **What is the aim of modulation?**

c) **What is audio oscillator used for?**

d) **What is Pulse Modulation?**