Madhav Institute of Technology & Science Gwalior (M.P.)
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NAAC ACCREDITED WITH A++ GRADE

DEPARTMENT OF ELECTRONICS ENGINEERING

A Skill Based Mini Project Report

On

AC SSB-AMPLIFIER MODULATOR

Submitted By:

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Under the Mentorship of

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Certificate

We are hereby certify that the skill based Mini Project entitled Design hardware model for Invisible burglar alarm which is being submitted in the **Department of Electronics Engineering** is a record of our work carried out under the mentorship of Dr.Karuna Markam Assistant Professor, Department of Electronics Engineering, Madhav Institute Of Technology & Science, Gwalior.

Date:

Place: Gwalior

Ratnesh Asati (0901EC221087)

Ratnesh

This is to certify that the above statement made by the candidates is correct to the best of our knowledge and belief.

25/11/23

Dr.Karuna Markam
Assitant Professor
Dept. of Electronics

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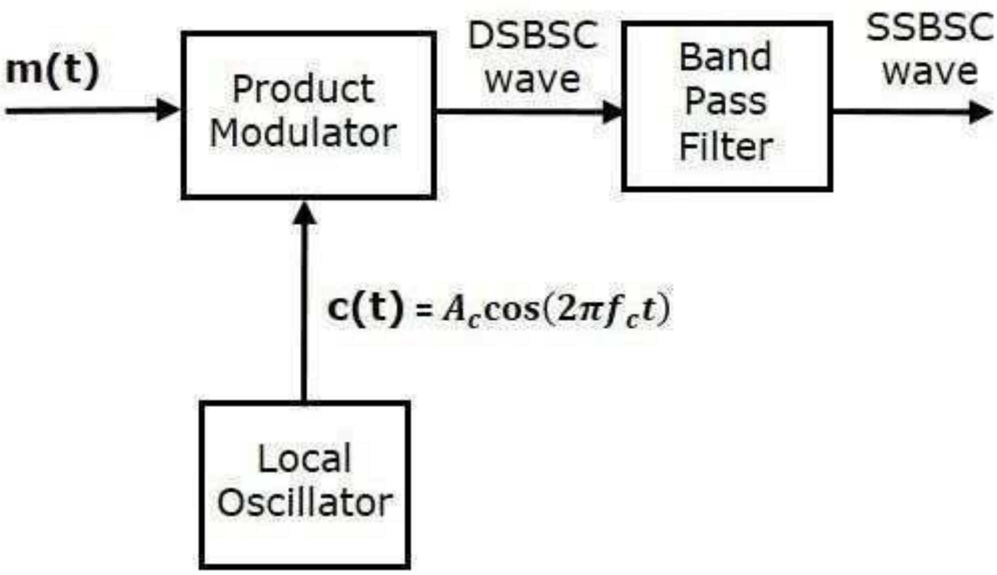
Content

OBJECTIVE:

Design a SSB SC- amplifier modulator.

Circuit diagram:



Introduction:

In the field of communication systems, modulation techniques play a crucial role in transmitting information effectively. SSB-SC modulation is a method that eliminates one sideband and the carrier, offering bandwidth efficiency. This project focuses on implementing and understanding the SSB-SC modulation technique.

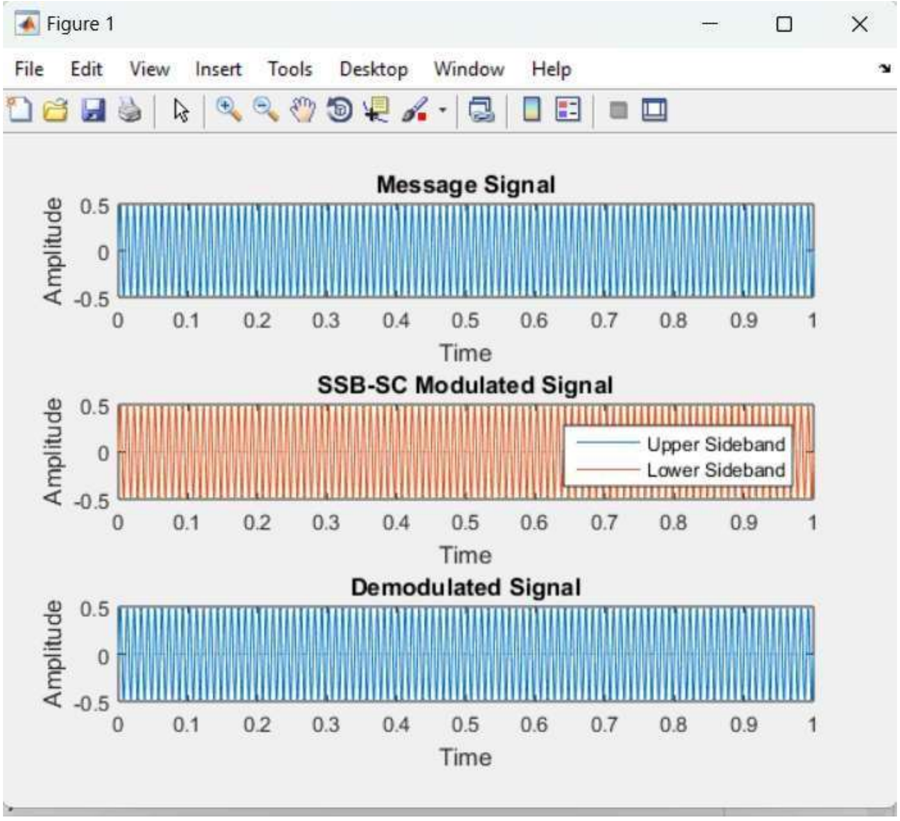
COMPONENTS REQUIRED:

- Message signal source (e.g., function generator)
- Carrier signal source (e.g., RF signal generator)
- Mixers
- Hilbert transformer
- Oscilloscope
- MATLAB for simulation

CODE:

```
% Parameters
fc = 1000; % Carrier frequency
fm = 100; % Message signal frequency
t = 0:0.001:1; % Time vector
Ac = 1; % Carrier amplitude
Am = 0.5; % Message signal amplitude

carrier = Ac * sin(2*pi*fc*t); % Carrier signal
message = Am * sin(2*pi*fm*t); % Message signal

% SSB-SC Modulation using Hilbert Transform
h = hilbert(message); % Hilbert transform of the message
signal
SSB_upper = real(h) .* cos(2*pi*fc*t) - imag(h) .*
sin(2*pi*fc*t); % Upper Sideband
SSB_lower = real(h) .* cos(2*pi*fc*t) + imag(h) .*
sin(2*pi*fc*t); % Lower Sideband

% Plotting
subplot(3,1,1);
plot(t, Ac * message);
title('Message Signal');
xlabel('Time');
ylabel('Amplitude');

subplot(3,1,2);
plot(t, SSB_upper);
hold on;
plot(t, SSB_lower);
hold off;
title('SSB-SC Modulated Signal');
xlabel('Time');
ylabel('Amplitude');
legend('Upper Sideband', 'Lower Sideband');

% SSB-SC Demodulation (Using coherent detection)
demodulated_signal = SSB_upper .* cos(2*pi*fc*t) - SSB_lower
.* sin(2*pi*fc*t);

subplot(3,1,3);
plot(t, demodulated_signal);
title('Demodulated Signal');
xlabel('Time');
ylabel('Amplitude');
```

Output:



WORKING:

The working of an SSB-SC modulation system involves the following steps:

1. **Message Signal Generation:**
   - Generate a message signal that represents the information to be transmitted. This signal is typically a low-frequency signal.
2. **Carrier Signal Generation:**
   - Generate a high-frequency carrier signal using a sinusoidal waveform.
3. **Hilbert Transform:**
   - Apply the Hilbert transform to the message signal to

     obtain its imaginary part. This introduces the necessary 90-degree phase shift.
4. **Modulation:**
   - Multiply the message signal by the carrier and subtract the Hilbert-transformed message signal multiplied by the carrier. This results in the SSB-SC modulated signal.
5. **Visualization:**
   - Use MATLAB or other simulation tools to visualize the original message signal, carrier signal, and the SSB-SC modulated signal.

Theory:

1. SSB-SC Modulation:

Single-Sideband Suppressed Carrier (SSB-SC) modulation is a technique used in communication systems to efficiently transmit information while conserving bandwidth. Unlike Double-Sideband Suppressed Carrier (DSB-SC) modulation, which transmits both upper and lower sidebands along with the carrier, SSB-SC modulation transmits only one sideband, either the upper or the lower, and suppresses the carrier.

Advantages of SSB-SC Modulation:

- Bandwidth Efficiency: SSB-SC modulation is more bandwidth-efficient than DSB-SC modulation because it eliminates redundant information in one sideband, reducing the overall bandwidth required for transmission.
- Reduced Interference: By transmitting only one sideband, SSB-SC modulation reduces the potential for interference and crosstalk in communication channels.

SSB-SC Modulation Process:

1. Message Signal: The information to be transmitted is represented by a message signal, which is typically a low-frequency signal.
2. Carrier Signal: A high-frequency carrier signal is generated, usually using a sinusoidal waveform.
3. Modulation: The message signal is multiplied by the carrier signal. In SSB-SC modulation, either the upper or lower sideband is selected, or the carrier signal is suppressed.

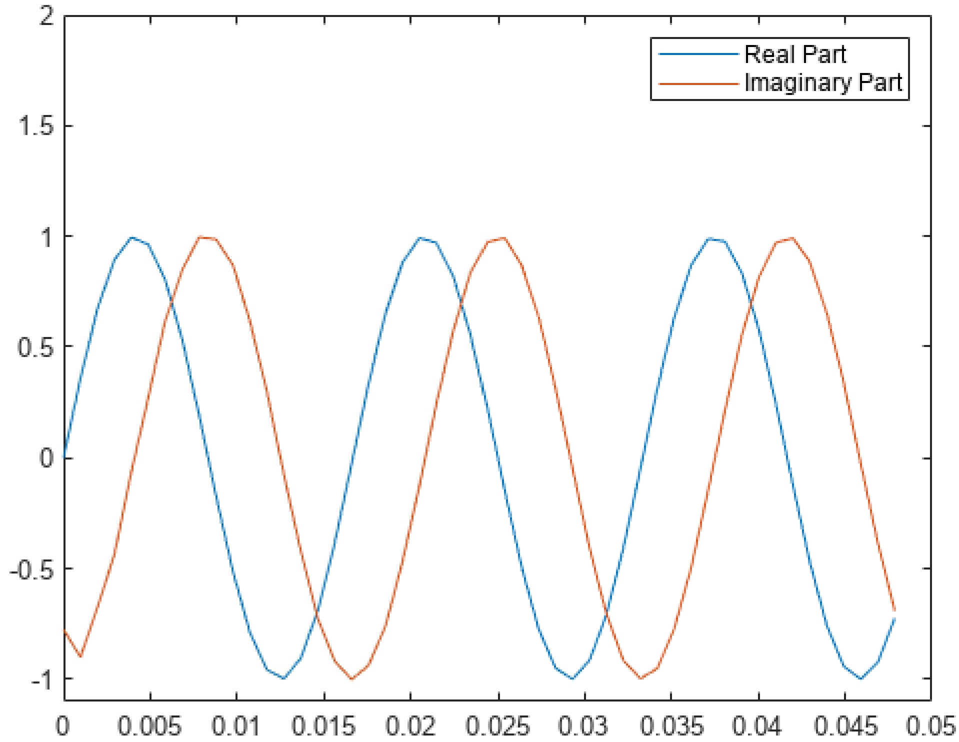
Hilbert Transform:

The Hilbert transform is a mathematical operation that can be applied to a real-valued signal to obtain its analytic representation. In the context of SSB-SC modulation, the Hilbert transform is used to generate the imaginary part of the analytic signal. This imaginary part is then combined with the original signal to create the SSB-SC modulated signal.

Properties of the Hilbert Transform:

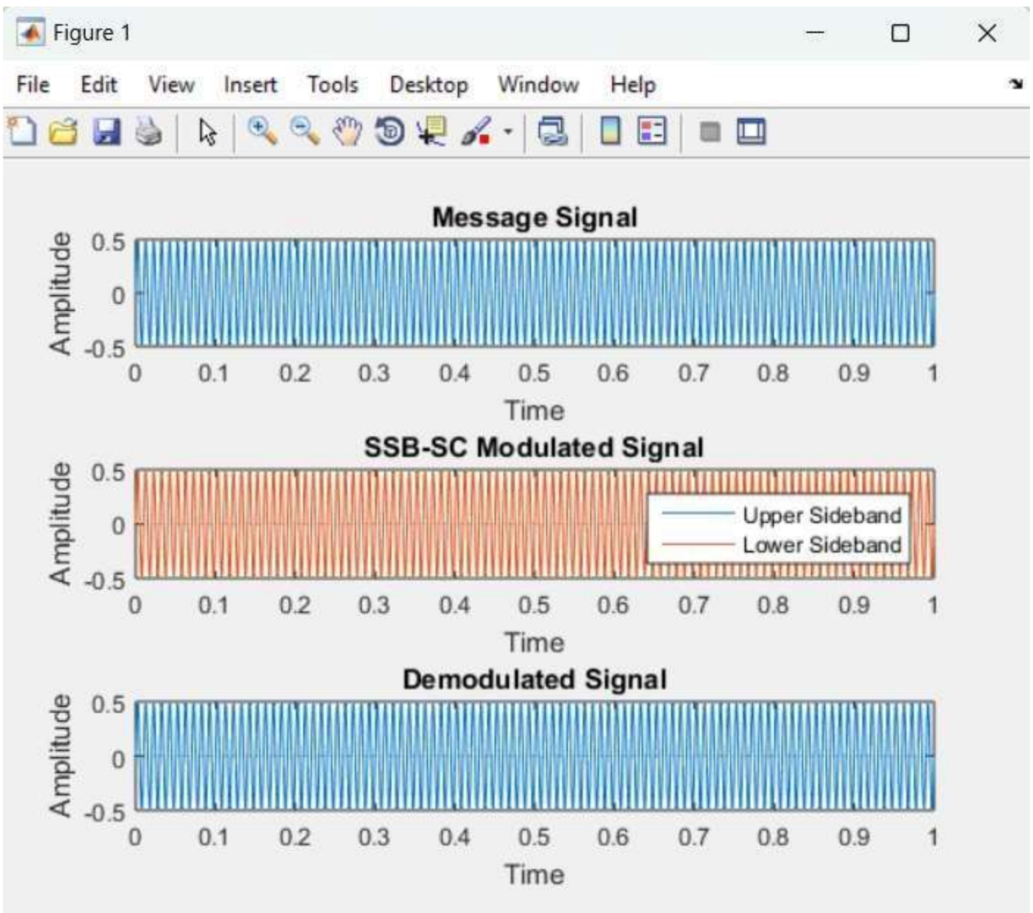
- 90-Degree Phase Shift: The Hilbert transform introduces a phase shift of 90 degrees to the signal, making it useful for creating the in-phase and quadrature components required for modulation.

- Analytic Signal: The combination of the original signal and its Hilbert transform results in an analytic signal, which is essential in SSB-SC modulation for eliminating one sideband.



Hilbert Transform

Output:



CONCLUSION:

Understanding the principles of SSB-SC modulation is crucial for designing efficient communication systems. This modulation technique's ability to conserve bandwidth and reduce interference makes it a valuable tool in various applications, including radio communication, telephony, radar systems, television broadcasting, and sonar systems.

REFERENCES:

1).Carlson, A. B. (2009). Communication Systems: An Introduction to Signals and Noise in Electrical Communication (4th ed.). McGraw-Hill.

2).https://www.tutorialspoint.com/analog_communication/analog_communication_dsbsc_modulation.htm

3). https://en.wikipedia.org/wiki/Single-sideband_modulation