Amplitude Modulation & Demodulation

AIM:- To study the function of AM & DM (under, perfect, over) and also to calculate the modulation index.

Apparatus: 1) PC with windows
2) MATLAB
3) AM & DM trainer kit
4) CRO
5) Function generator
6) cords & probes

The msg signal is given by the expression

$E_m(t) = E_m \cos W_m t$

where W_m is → AF

E_M → Amplitude

CV $E_c(t) = E_C \cos W_c t$

$E(t) = E_C + K_a E_m \cos W_m t$

$K_a E_m \cos W_m t$ → change in carrier amplitude

K_a → constant

$E = E(t) \cos W_c t$

From above 2 equations..

$E = (E_c + K_a E_m \cos W_m t) \cos W_c t$

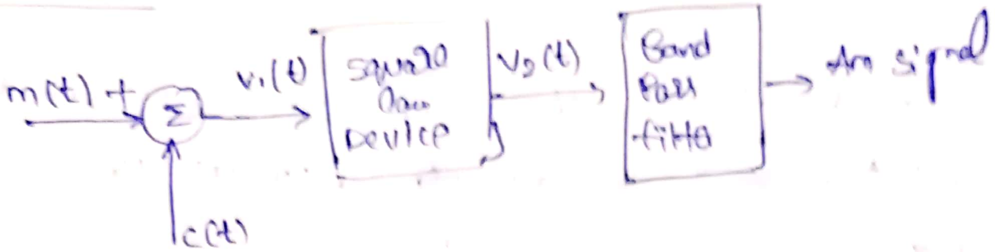
$E = (1 + K_a E_M / E_c \cos W_m t) E_c \cos W_c t$

$E = E_c (1 + M_a \cos W_m t) \cos W_c t$

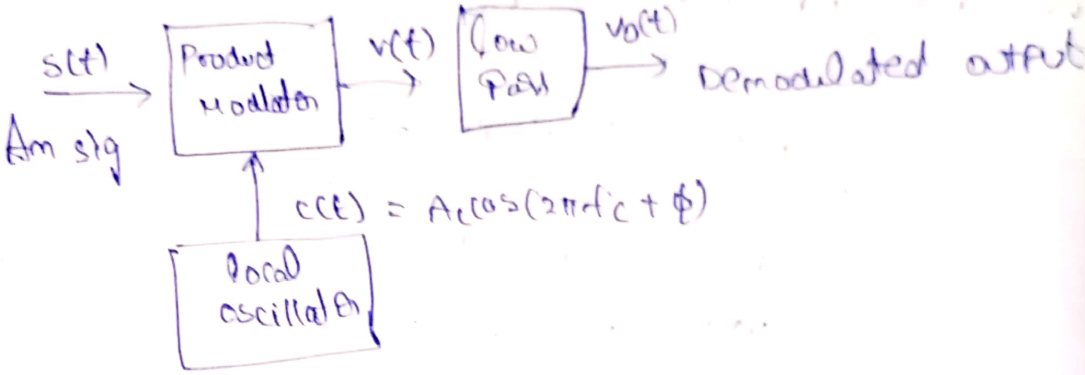
$M_a = K_a E_m / E_c$

100* M_a gives the percentage of modulation

AM - Modulator :



AM - demodulator:



PROCEDURE:

1) open the matlab software and click on new
2) Now go to script pad and write the code accordingly
3) Now save the file with the name
4) Now run the program and note all observation graphs in observation.

```
→ fm = 2;
fc = 50;
t = 0: 0.001: 1;
Ac = 0.2;
Am = 0.a;
Ka = 0.2;
Ka1 = 0.9;
Ka2 = 4;
message = Am* sin(2* pi *fm*t);
carrier = AC* sin(2*pi * fc *t);

modulated_signal = (1+Ka* message).* carrier;
modulated_signal1 = (1+ Ka1* message).* carrier;
modulated_signal2 = (1+Ka2* message).* carrier;
```

```
subplot(4,2,1);
plot(t,message);
title('message signal');
xlabel('Time(s)');
ylabel('Amplitude');
subplot(4,2,2);
plot(t,carrier);
title('carrier signal')
xlabel('Time(s)');
ylabel('Amplitude');
subplot(4,2,3);
plot(t,modulated_signal);
title('modulated signal');
xlabel('Time(s)');
ylabel('Amplitude');
subplot(4,2,4);
plot(t,modulated_signal1);
title('under modulation signal');
xlabel('Time(s)');
ylabel('Amplitude');
subplot(4,2,5);
plot(t,modulated_signal2);
title('over modulation signal');
xlabel('Time(s)');
ylabel('Amplitude');
m1 = modulated_signal.*carrier;
[b,a] = butter[1,0.01];
mr1 = filter(b,a,m1);
subplot(4,2,8);
plot(t,mr1);
title('demodulated signal for [ka*Am=1]');
```

```
r2 = modulated_signal.* carrier;
[b,a] = butter (1,0.01);
mr2 = filter (b,a,r2);
Subplot ( 4,2,4);
Plot (t,mr2);
title('demodulated signal for (ka,fm=0.5)');
r3 = modulated_signal2.* carrier;
[b,a] = butter (1,0.01);
mr3 = butter (1,0.01);
mr3 = filter (b,a,r3);
Subplot ( 4,2,8);
Plot (t,mr3);
title('demodulated signal for ka.fm=2.5'));
```

Expected waveforms:-

EX-NO. 2

DSB-SC Modulation

AIM: To study the working of the Balanced Modulator and demodulator.

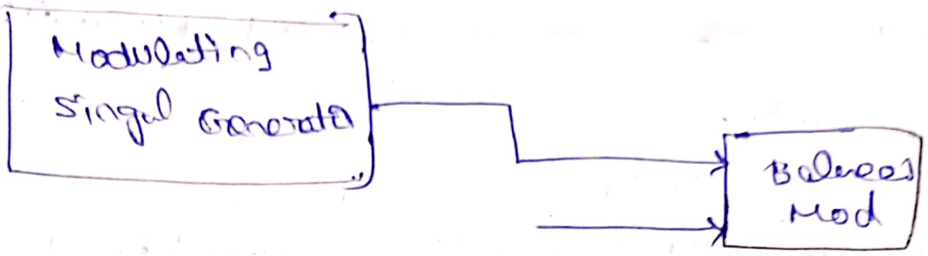
Apparatus:
1) PC with windows
2) MATLAB software with communication toolbox
3) Balanced modulator trainer kit
4) CRO (20 MHz)
5) connecting cords and probes
6) function generator (1 MHz)

THEORY:

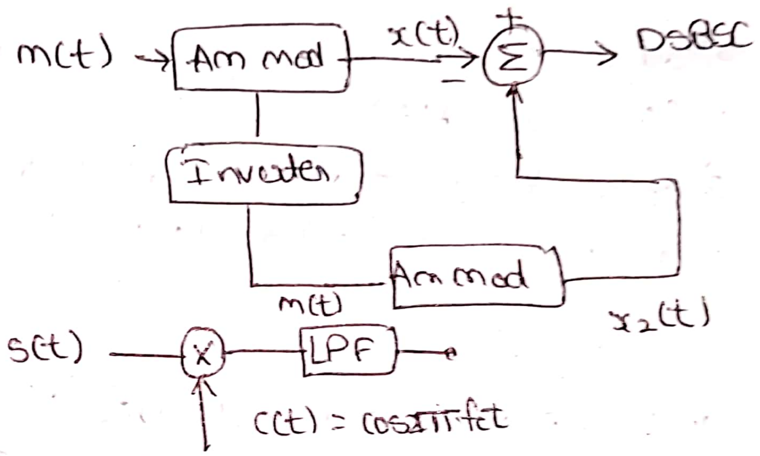
Balanced modulator circuit is used to generate only the two side bands DSB-SC. The balanced modulation system is a system of adding message to carrier wave frequency there by only the side bands are produced. two AM modulators arranged in a balanced configuration. The AM modulator is assumed to be identical. The carrier input to the two modulator is same. If we eliminate or suppress the carrier then the system becomes suppressed carrier DSB-SC. In this we need reinsert the carrier then the system becomes suppressed. In this we need reinsert the carrier is complicated and costly. Hence the DSB system may be used in point to point communication system. Generation of suppressed carrier amplitude modulated volt balanced modulator may be of the following types.

Block Diagram:

Modulation:



Modulation:



PROGRAM:

```
fm=2;
fc=50;
t=0:0.001:1;
Ac=0.2;
Am=0.5;
message=Am*sin(2*pi*fm*t);
carrier=Ac*cos(2*pi*fc*t);
Modulated_signal=message*carrier;
subplot(4,1,1);
plot(t,message);
title('message signal');
xlabel('Time(s)');
ylabel('Amplitude');
subplot(4,1,3);
plot(t,carrier);
title('carrier signal');
xlabel('Time(s)');
ylabel('Amplitude');
```

```
subplot (4,1,2);
plot (t ,modulated_signal);
title('DSBSC modulated signal');
xlabel ('time(s)');
ylabel ( 'Amplitude');
g1 = modulated_signal*carrier);
[b,a] = butter (1,0.01);
demodulated_signal = filter(b,a,g1);

subplot(4,1,4);
plot(t,modulated_signal);
title( 'Demodulated_signal');
xlabel('time(s)');
ylabel( 'Amplitude');
```

PROCEDURE:

For MATLAB:

1) open the matlab software and click on new
2) Now go to script pad and write the code accordingly
3) Now save the file with the name
4) Now run the program and note all observation graphs in observation.

Expected waveforms:

[EX.NO-3]

SSB-SC Modulation & Detection

AIM: To generate SSB using phase method and detection of SSB signal using synchronous detector.

Apparatus:

1) PC with windows
2) MATLAB software with communication toolbox
3) SSB trainer kit
4) CRO (20MHz)
5) Patch cords
6) CRO probes

Theory:

AM and DSBSC modulation are wasteful of band width because they both require a transmission band width which is equal to twice the message bandwidth. In SSB only one side band and the carrier is used. The other side band is suppressed at the transmitter, but no information is lost. Thus the communication channel needs to provide the same band width when only one side band is transmitted. So the modulation system is referred to as SSB system. The base band signal may not be recovered from a SSB signal by the use of a diode modulator. The base band signal can be recovered if the spectral components of the shifted to either the LSB or USB is multiplied by the carrier signal.

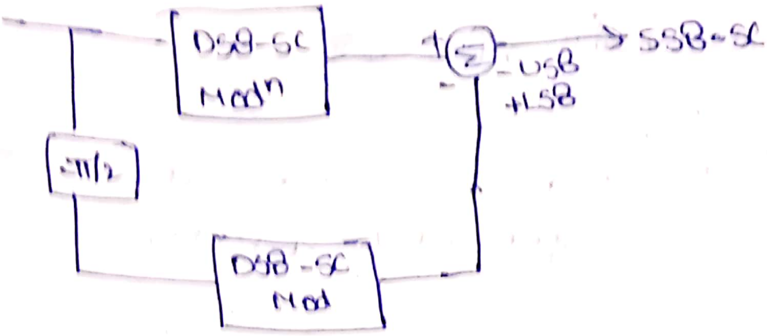
Consider the modulating signal

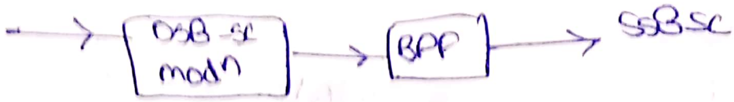
$M(t) = A_m \cos W_m t$

$c(t) = A_c \cos W_c t$

$M(t) c(t) = A A_m \cos W_m t \cos W_c t$

Leads to SSB signal.





Program:-

```
fm=2;
fc=50;
t=0:0.01:1;
Ac=6;
Am=3;
m= Am* cos(2*pi*fm*t);
c= Ac* cos(2*pi*fc*t);
m^ = Am* sin(2*pi*fm*t);
Subplot(3,2,1);
Plot(t,m);
title('message signal');
xlabel('Time(s)');
ylabel('Amplitude');
    subplot(3,2,2);
    plot(t,c);
    title('carrier signal);
    xlabel('Time(s)');
    ylabel('Amplitude');
Modulated signal = (m*c)-(m^*Ac*sin(2*pi*fc*t);
Subplot(3,2,3);
plot(t,Modulated_signal);
title('SSBSC-USB modulation);
xlabel('Time(s)');
ylabel('Amplitude');
```

```
modulated_signal = (m*c)+(mh*Ac*sin(2*pi*fc*t);
subplot(3,2,4);
plot(t, modulated_signal);
title('SSBSC_LSB modulation);
xlabel('Time(s)');
ylabel('Amplitude');.
```

PROCEDURE :-

1) open the matlab software and click on new
2) now go to script pad and write the code accordingly
3) now save the file with the name.
4) now run the program and note all observation graphs
in observation.

Expected waveforms :-