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Analysis of Amplitude Modulation Using labVIEW

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***Abstract*—** Analog Communication techniques based on modulation of carrier signal are used from years ago and still they are widely used. Amplitude Modulation is one of them. In this paper we had done simulative investigation on effect of modulation index on AM Wave using LabVIEW software.Various cases are being discussed showing effect of modulation index on shape of AM .These different shapes of AM wave have many uses in communication. Power Spectral Density is also calculated also showing effect of modulation index on sideband power. Power Spectral density specifies relationship between power ,modulation index and carrier frequency.

***Keywords*—** Amplitude Modulation, Frequency, Power Spectral Density.

I. INTRODUCTION

Communication means the process of exchanging information. It is used for conveying thoughts, ideas and feelings to one another. Modulation is used in communication these days in form of Amplitude Modulation, Frequency Modulation. Modulation is necessary because it improves quality of reception and increases range of communication .In this paper we have performed simulation of AM and FM using the Labview. LabVIEW is a development environment for problem solving, accelerated productivity and continual innovation. Hardware integration can be done rapidly which aids to acquire and visualize data sets from virtual I/O devices and real time signals. It is combined with graphical programming syntax that reduces programming time.[1]

In this paper a brief idea about Amplitude modulation is given in second section and how it is achieved.LabVIEW is a wonderful tool and it is used here for attaining Amplitude Modulated Wave.LabVIEW has one Front Panel and Block Diagram.In the results we have calculated effect of modulation index on AM wave.

II. AMPLITUDE MODULATION

. Modulation technique is used in communication process which increases the range of communication, multiplexing and improves quality of reception. It is defined as the process of superimposing the information contents of a base band signal on a carrier signal (which is of high frequency) by varying the characteristic of carrier signal according to the message signal.[2]

In AM, the amplitude of the carrier changes in accordance with the input analog signal, while the frequency of the carrier remains the same. This is shown in Fig.1, where

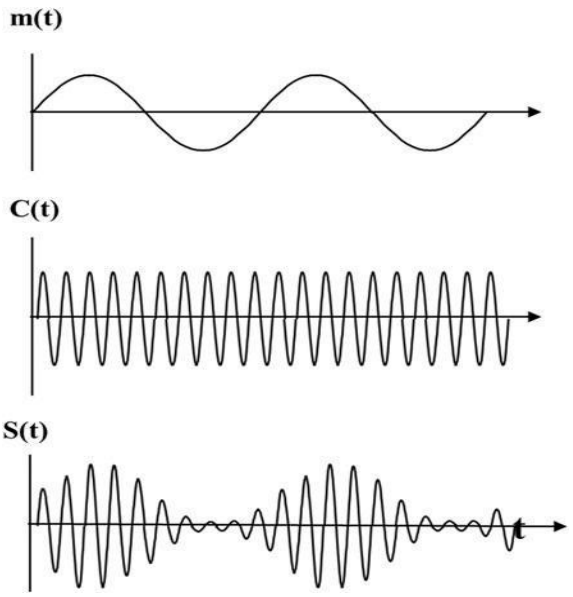

Fig 1 Showing AM wave

- m(t) is the input modulating audio signal,
- C(t) is the carrier frequency, and
- S(t) is the AM-modulated carrier frequency.

Consider a carrier wave (sine wave) of frequency f_c and amplitude A given by:

$c(t) = E_c \sin(2\pi f_c t)$

Let $m(t)$ represent the modulating waveform. For this
$m(t) = A \sin(2\pi f_m t)$

The Amplitude Modulated wave is given by
$S(t) = Ec\ (1+m \sin(2\pi f_m t))\ \sin(2\pi f_c t)$

Where Ec denotes the amplitude of carrier wave and m is the modulation index. The value of modulation index lies between 0 and 1. The value of m is given by m = Em/Ec
Where Em is the amplitude of modulating wave and Ec is the amplitude of carrier wave.[2]

III. LABVIEW SOFTWARE

LabVIEW is systems engineering software for applications that require test, measurement, and control with rapid access to hardware and data insights. LabVIEW offers a graphical programming approach that helps you visualize every aspect of your application, including hardware configuration, measurement data, and debugging. This visualization makes it simple to integrate measurement hardware from any vendor, represent complex logic on the diagram, develop data analysis algorithms, and design custom engineering user interfaces.
The programming paradigm used in LabVIEW, sometimes called G, is based on data availability. If there is enough data available to a subVI or function that subVI or function will execute. Execution flow is determined by the structure of a graphical block diagram (the LabVIEW-source code) on which the programmer connects different function-nodes by drawing wires.[3] These wires propagate variables and any node can execute as soon as all its input data become available. Since this might be the case for multiple nodes simultaneously, LabVIEW can execute inherently in parallel

IV. LABVIEW IN COMMUNICATION SYSTEM

National Instruments RF software provides tools and source-code example programs to give you the flexibility to easily customize your RF application, which is important, given the rapidly changing nature of communications research and evolving standards. LabVIEW is a development environment for problem solving, accelerated productivity and continual innovation. Hardware integration can be done rapidly which aids to acquire and visualize data sets from virtual I/O devices and real time signals. It is combined with graphical programming syntax that reduces programming time.[4] The numerous applications of the NI Modulation Toolkit include digital modulation formats (AM, FM, PM, ASK, FSK, MSK, GMSK, PSK, QPSK, PAM, and QAM) that are the foundation of many digital communication standards found in 802.11a/b/g/n, ZigBee (802.15.4), WiMAX (802.16), RFID, satellite communications, and commercial broadcast among others. Additionally, the LabVIEW Spectral Measurements Toolkit provides functions for demodulating AM and FM signals and performing modulation measurements, as well as I/Q data for digital demodulation schemes[5].Virtual tools and labs in engineering education have increasingly gained attention parallel to the development in the electronics and computer technologies as well as wide spread use of internet facilities. Here we are using labview in generation of Amplitude Modulated wave and computing its parameters.[6]

V. BLOCK DIAGRAM

The block diagram consist of the source code. As labview is the graphical language the source code resides inside the Block Diagram.The block explains how the the code is made and how the data moves from one block to another. We have made the block diagram on basis of Amplitude Modulated Wave equation.

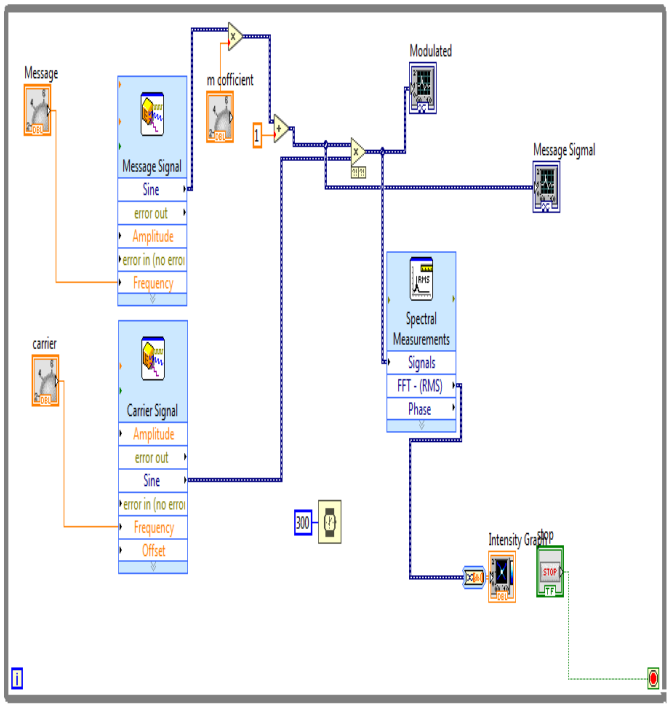

Fig 2. Showing Block Diagram

The Amplitude Modulated wave is given by

$$S(t) = Ec\ (1+m \sin(2\pi f_m t))\ \sin(2\pi f_c t)$$

Using the Equation we have made the Block diagram as per the parameters are there in the equation. The figure 2 shows Block Diagram based on this equation.

VI. FRONT PANEL

The front panel contains the control and indicators. We can change the parameters. We can change the value of modulation index, carrier frequency and frequency of message signal. The Figure below shows the Front Panel.

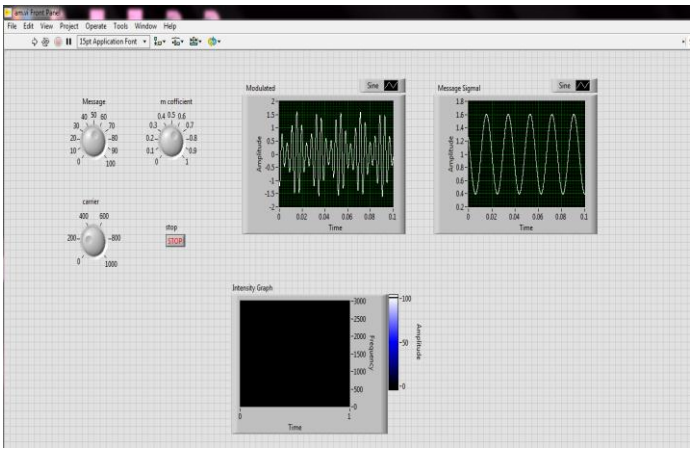

Fig 3. Showing Front Panel.

VII. EFFECT OF MODULATION INDEX ON WAVE

We already know the how important is the factor modulation index in forming AM wave. Its value lies between 0 and 1 generally. Using Labview we have generated Amplitude modulated wave . Now we will study its effect on AM wave. Various cases have been discussed here which shows affect of frequency and modulation index.

Case I: When Modulation index m=0

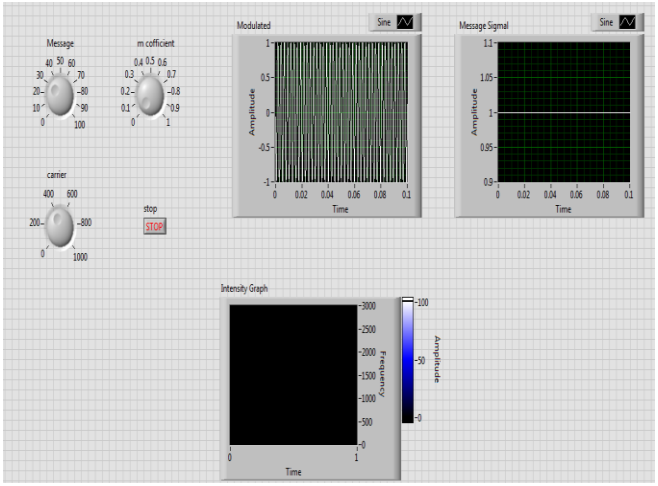

Fig 4 Showing the modulated wave

Case 2: When m lies between 0 and 1

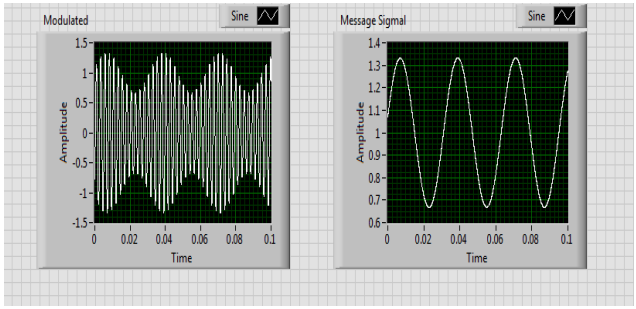

Fig 5. Showing the modulated AM wave

Case3 : When m lies above 1 (Overmodulation)

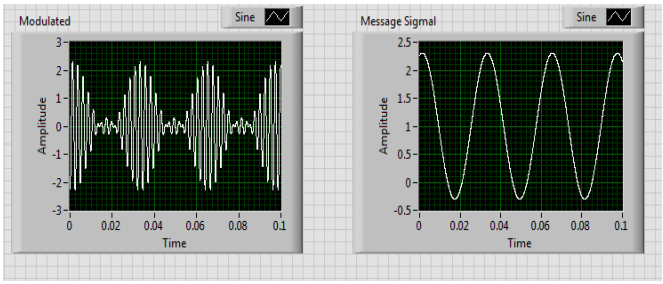

Fig 6 .Showing the modulated wave that is overmodulated

VIII. POWER SPECTRAL DENSITY

A Power Spectral Density (PSD) is the measure of signal's power content versus frequency. A PSD is typically used to characterize broadband random signals. The amplitude of the PSD is normalized by the spectral resolution employed to digitize the signal.We get the frequency domain analaysis and the AM wave signal obtained is called as Double Side Band Full Carrier (DSB-FC).We get one carrier and two sidebands which are also known as Upper sideband and Lower sideband.

Below is the representation power content versus frequency in which Fm =40 Hz and Fc= 800 KHz and modulation index m = 0.8.

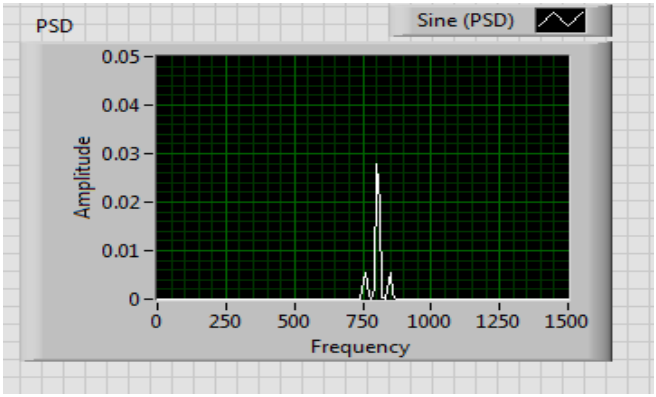

Fig.7 Showing the Carrier and Sidebands signal

If we decrease the value of modulation index power in sidebands also decreases.This can be seen from Image below where value of modulation index m= 0.2 and other parameters being the same.

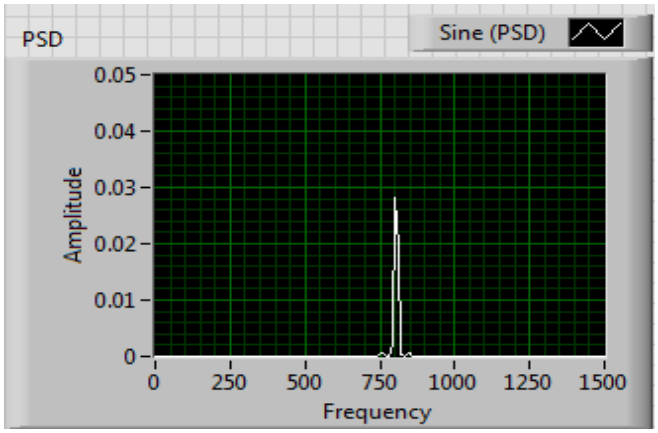

Fig. Showing the decrease power in sidebands

X CONCLUSION

Modulation has become need for today's era.Amplitude modulation is useful technique for communication purpose as it consumes less bandwith.We have seen the effect of value of modulation index on AM wave.Its value must lie between 0 and 1 otherwise it gets overmodulated and results are also verified using labVIEW software.From results we have concluded how the modulating frequency and carrier frequency affects the shape of wave.Power Spectral Density calculated from graph we have seen its largely depends upon modulation index.If we want to save power and bandwidth value of modulation index must be low.

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