Project Report

Experiment: 02

Amplitude Shift Keying (ASK) modulation

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Amplitude Shift Keying

Amplitude Shift Keying (ASK) is a digital modulation technique . It transmits the digital information by varying the amplitude of a carrier signal. In ASK, a high-amplitude carrier signal is used to represent a binary '1,' and a low-amplitude carrier signal represents a binary '0.'

It involves the superimposition of a carrier signal and a digital message signal. The carrier signal is often a high-frequency sinusoidal waveform, which serves as the carrier for the digital information. The binary message signal, consisting of '1's and '0's, is used to control the amplitude of the carrier signal. The resultant signal formed after the superimposition of message and carrier is transmitted over the communication channel.

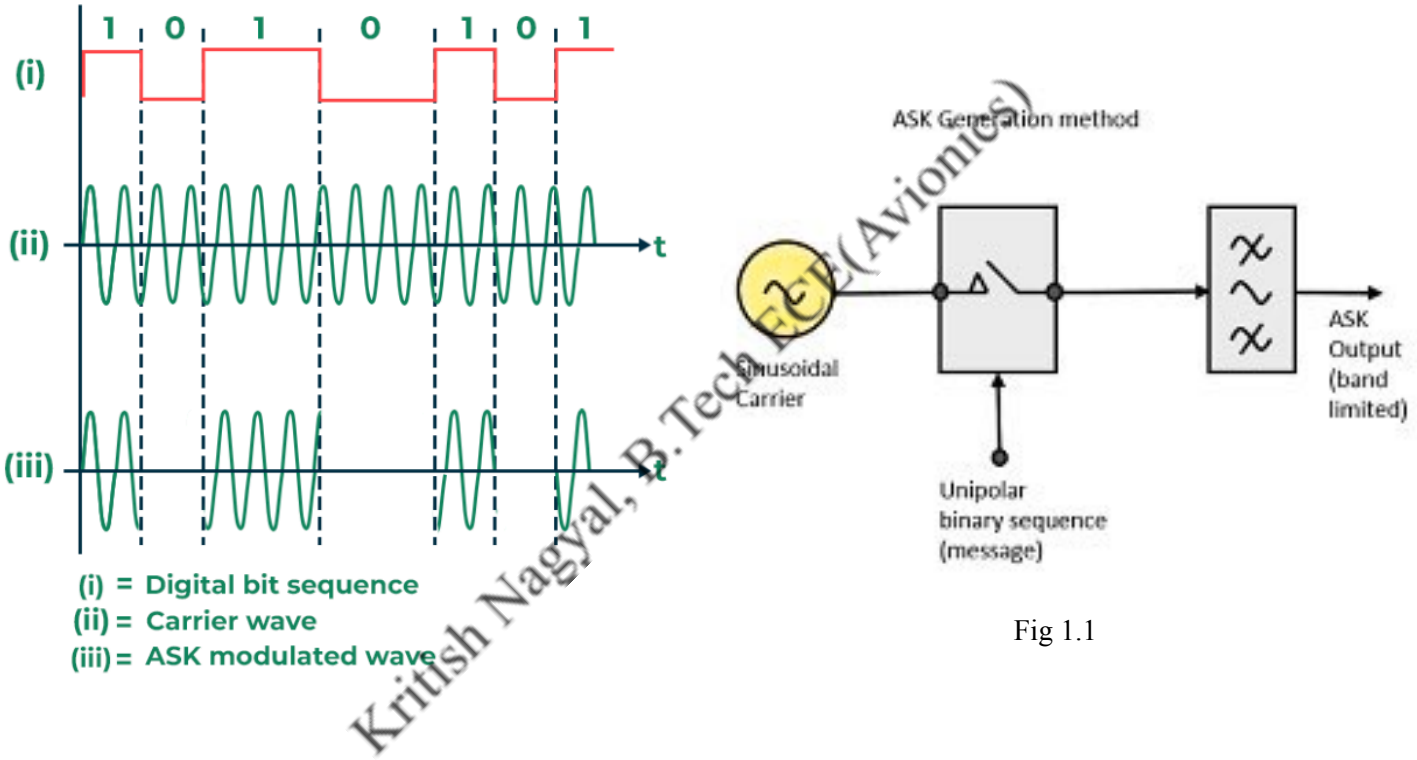


Fig 1.1

ASK Modulator - Fig. 1.1

The carrier generator, sends a continuous high-frequency carrier. The binary sequence from the message signal makes the unipolar input to be either High or Low. The high signal closes the switch, allowing a carrier wave. Hence, the output will be the carrier signal at high input. When there is low input, the switch opens, allowing no voltage to appear. Hence, the output will be low.

The band-limiting filter, shapes the pulse depending upon the amplitude and phase characteristics of the band-limiting filter or the pulse-shaping filter

Objective:

To understand and implement Amplitude Shift Keying (ASK) modulation using simulation in Multisim and practical setup on a breadboard. The modulated signal is observed using a Digital Storage Oscilloscope (DSO).

Theory:

Amplitude Shift Keying (ASK) is a type of amplitude modulation where the carrier signal's amplitude is varied according to the binary data signal (digital signal). It is one of the simplest digital modulation techniques used in communication systems

Principle of ASK:

In ASK: *Binary **1** is represented by the presence of a carrier signal.
*Binary **0** is represented by the absence (or lower amplitude) of the carrier signal

Mathematical Representation of ASK Modulated wave:

$s(t)=Am(t)\cos 2\pi f\, t,\ 0<t<T$

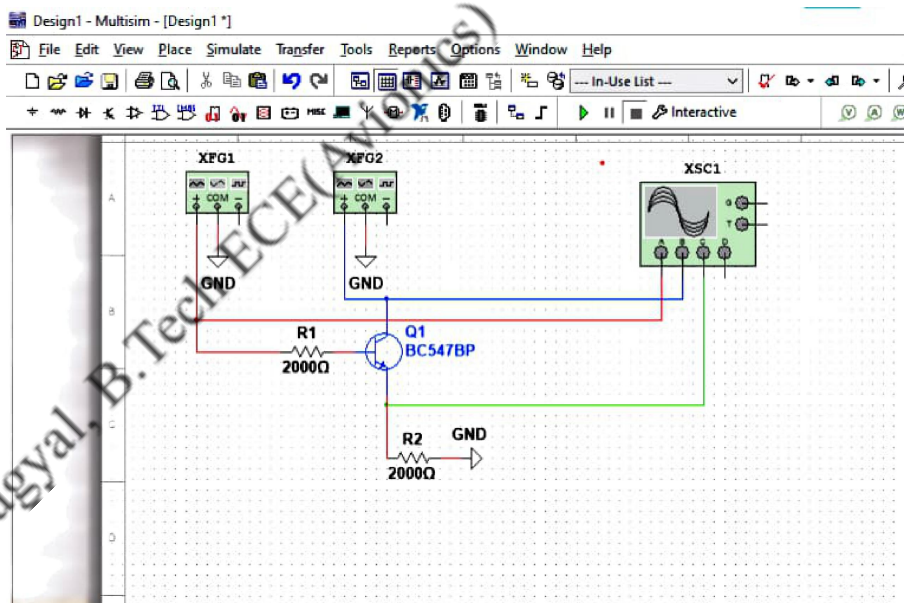
$\phi(t)= \sqrt{2/T}\ x\ cos 2\pi f_c t$

A = Amplitude of the carrier, fc = Carrier frequency, t = Time

Simulation Using the Multisim Software:

Components Used

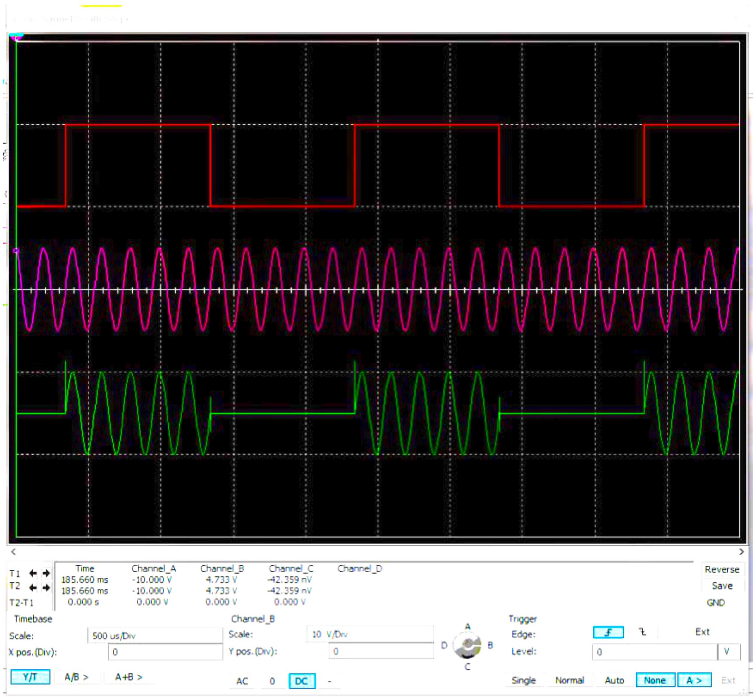
- Sine wave generator (carrier signal and message signal)
- Resistors of 2k ohm, BC547BP (NPN) transistor
- Oscilloscope
- Power and Ground connections



Carrier Frequency: 5kHz. Message Frequency: 500 Hz.

Simulation Steps

- Connect all components as per schematic.
- Connect the output to the oscilloscope to observe the ASK waveform.
- Run the simulation.
- Observe the waveform. We will see bursts of the sine wave when digital input is high i.e. 1 and zero (no signal) when the input is low i.e. 0

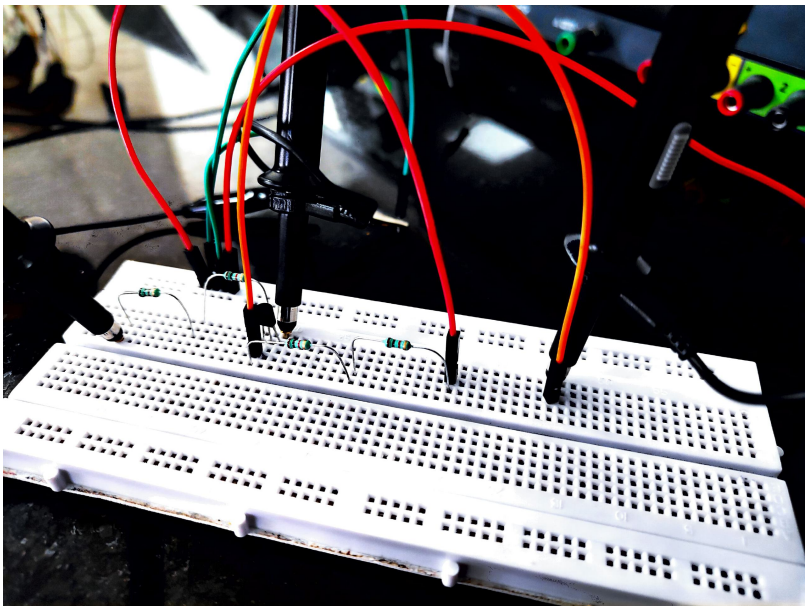


_____ : Message signal
_____: Carrier wave
_____: ASK modulated wave

Practical Implementation on Breadboard:

Components Used

- Breadboard and jumper wires
- Resistors of 2k ohm, BC547BP (NPN) transistor
- Function generator (as carrier source and digital input message)
- Power supply (±15V or as per IC spec)
- DSO (Digital Storage Oscilloscope)
- BNC to Crocodile Clips

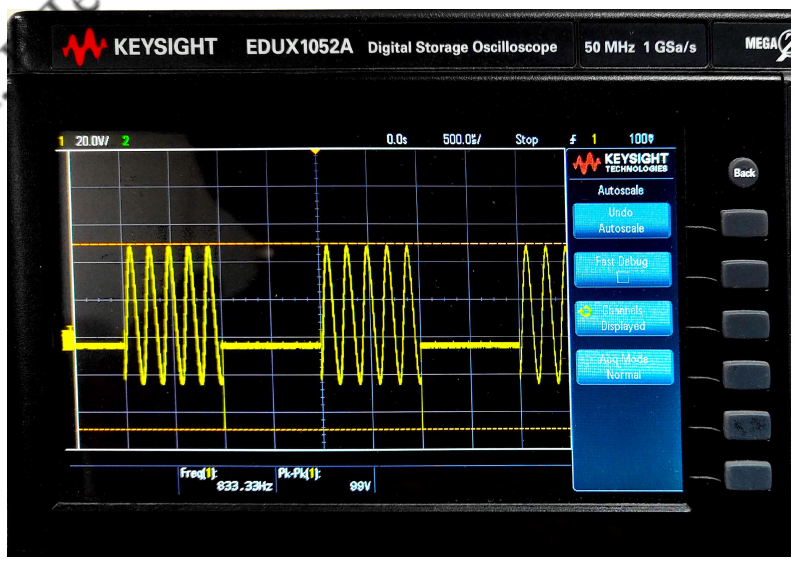


Procedure:

- Setup the breadboard circuit: Connect the sine wave (carrier) to collector of NPN transistor, Connect a square wave (binary data) to the base of the transistor after passing through a 2k ohm resistor.
- Generate the signals: Use waveform generator to generate a square wave at ~500 Hz, amplitude ~10 Vpp and generate a sine wave (carrier) at ~5 kHz, amplitude ~5 Vpp
- Connect signals: Feed square wave and sine wave into the Collector and base of transistor.
- Ground the emitter of the transistor after passing through a 2k ohm resistor.
- Observe the Output: Connect the emitter of the NPN transistor to the DSO.

Observations:

- **Input Digital Signal:** Square wave representing binary data.
- **Carrier Signal:** Continuous sine wave.
- **ASK Modulated Signal:** Sine wave present during logical 1, absent during logical 0.
- DSO showed perfect ASK modulation matching the simulation results.



Conclusion:

Amplitude Shift Keying was successfully implemented using both simulation in Multisim and practical hardware on a breadboard. The ASK signal was observed using DSO and it matched the expected waveform. This experiment helped reinforce the concept of digital modulation using analog components and visualization tools.

Advantages of ASK Modulation

Here are the benefits of using ASK modulation:

- High Bandwidth Efficiency: It requires less bandwidth compared to other modulation techniques.
- Simple Receiver Design: Demodulation of ASK signals is straightforward and requires a simple envelope detector.
- Cost-Effective and Easy to Integrate: ASK is a relatively simple modulation scheme for both implementation and demodulation.
- Energy-Efficient: Especially in scenarios where power consumption is critical, ASK allows for power amplifiers to operate in a more linear region, reducing power consumption compared to some other modulation techniques.
- Compatibility with Digital Systems: ASK integrates easily with digital systems, making it suitable for applications such as digital communication and data transfer. It's used to transmit digital data over optical fiber, and its variant, OOK (On-Off Keying), is used at radio frequencies to transmit Morse code.

Applications of ASK Modulation

- ASK is commonly used in wireless communication systems, such as keyless entry systems, remote controls, and radio frequency identification (RFID) tags.
- In optical fiber communication, ASK is used to transmit digital data over long distances.
- ASK is often used in digital broadcasting, including television and radio transmissions, for transmitting audio and video signals.
- ASK can be used for low to medium data rate communication, such as in binary data transmission over short distances.
- ASK is used in medical telemetry systems for monitoring and transmitting patient data.