Analog and Digital Communications EC-223

Amplitude Shift Keying

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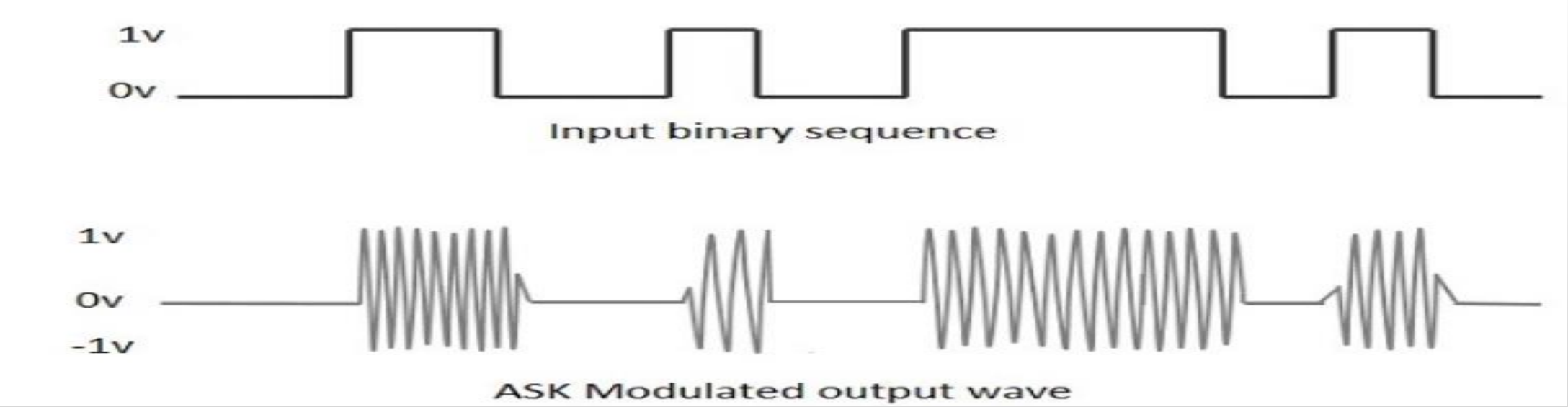
Table of Contents

Introduction To ASK

- **Amplitude Shift Keying** (ASK) is a type of Amplitude Modulation which represents the binary data in the form of variations in the amplitude of a signal.
- Any modulated signal has a high-frequency carrier. The binary signal when ASK modulated, gives a **zero** value for **Low** input while it gives the **carrier output** for **High** input.
- The following figure represents ASK modulated waveform along with its input.



ASK Modulation Techniques

- In Amplitude Shift Keying (ASK), the modulation technique involves varying the amplitude of the carrier signal to convey digital data. Here are some common modulation techniques used in ASK:

1. **On-Off Keying (OOK)**: Also known as binary ASK (BASK), in OOK, the amplitude of the carrier signal is switched between two levels: one representing binary 1 and the other representing binary 0.
2. **M-ary ASK (MASK)**: In M-ary ASK, where M is greater than 2, multiple amplitude levels are used to represent several bits of data. Each amplitude level corresponds to a unique pattern of binary digits, allowing the transmission of multiple bits simultaneously.
3. **Pulse Amplitude Modulation (PAM)**:In the context of ASK, PAM is used to describe the process of varying the amplitude of the carrier signal according to the input digital data.
4. **Continuous Amplitude Modulation (CAM)**: In CAM, the amplitude of the carrier signal is continuously varied in proportion to the modulating signal.

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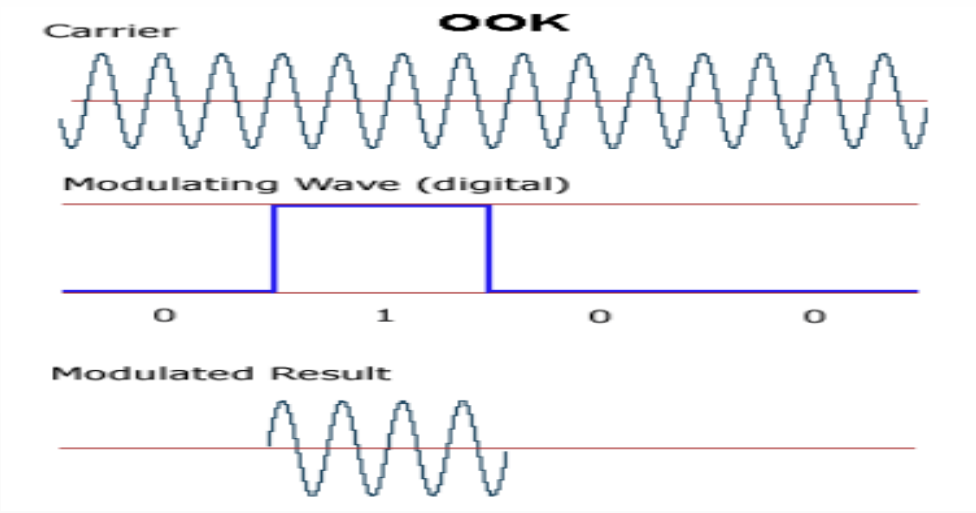


Fig.1) On-Off Keying

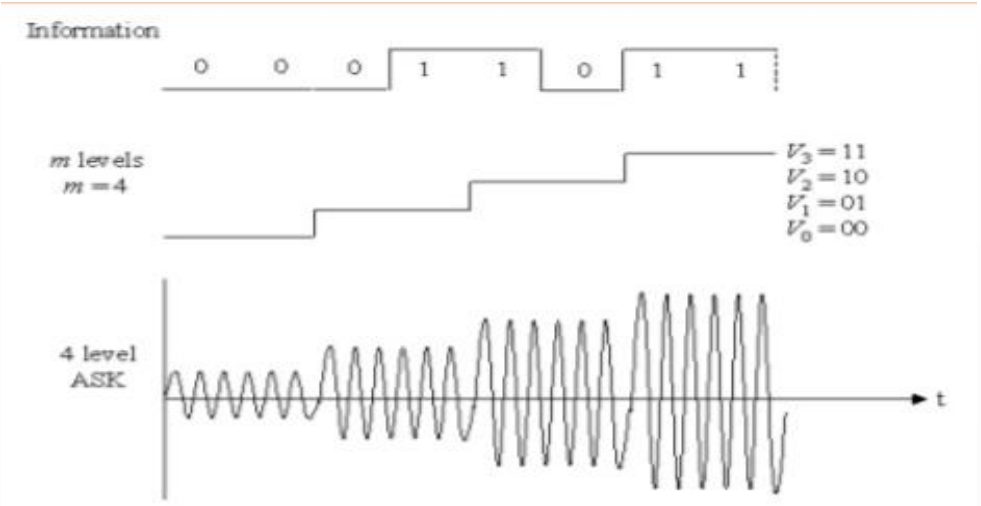


Fig.2) M-ary ASK

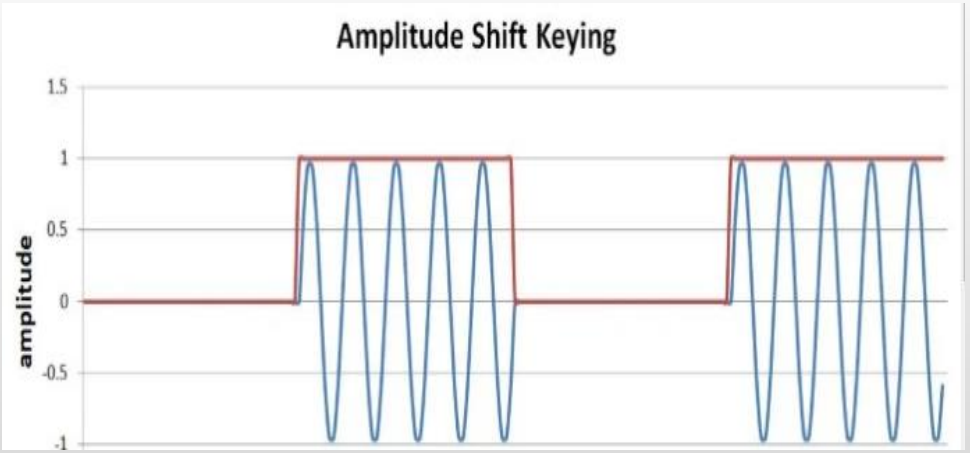
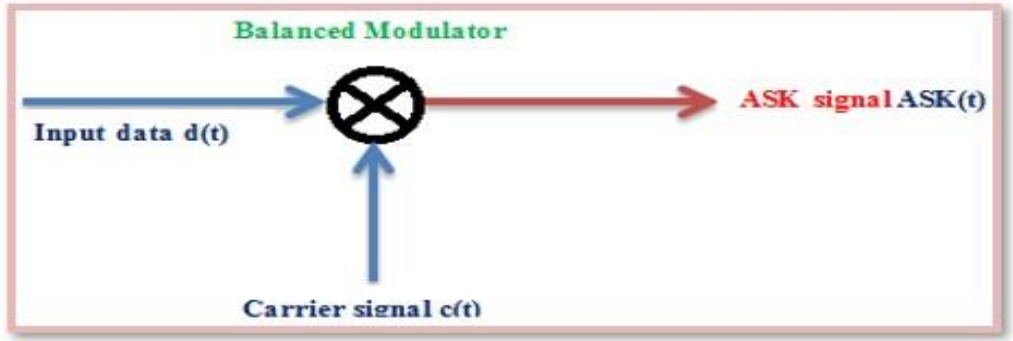
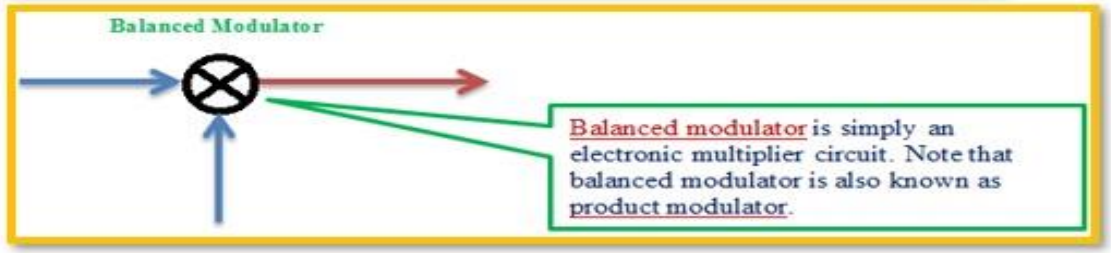


Fig.3) Pulse Amplitude Modulation in ASK

Mathematical Representation of ASK

- The mathematical representation of Amplitude Shift Keying (ASK) is f(t)=m(t)*c(t), where m(t) is the message signal and c(t) is the carrier signal. The modulated signal is the product of the message signal and the carrier signal.





$d(t) = data\ signal \longrightarrow\ consists\ of\ 1^s\ and\ 0^s$

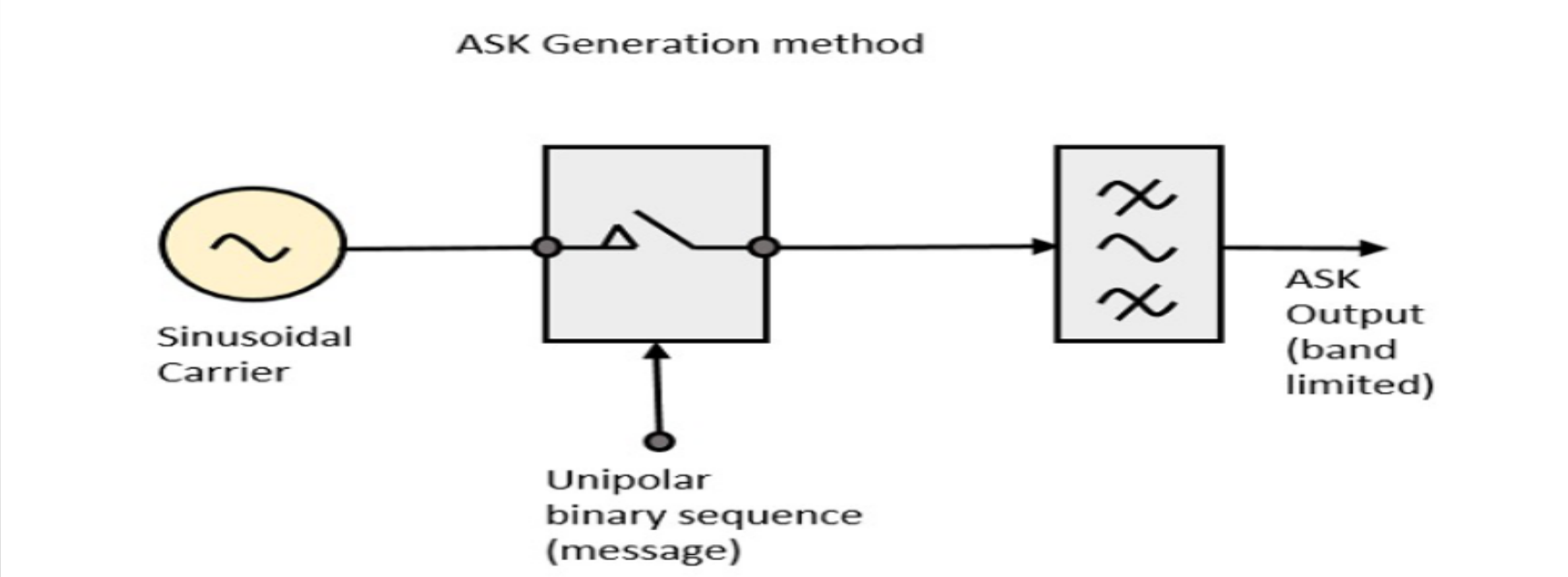
$c(t) = A_c \cos 2\pi f_c t$

Remember that balanced modulator multiplies data signal d(t) and carrier signal c(t). So,

$ASK(t) = d(t) * A_c \cos 2\pi f_c t$

ASK Generation

- The ASK modulator block diagram comprises of the carrier signal generator, the binary sequence from the message signal and the band-limited filter. Following is the block diagram of the ASK Modulator.



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- 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.

ASK Demodulator

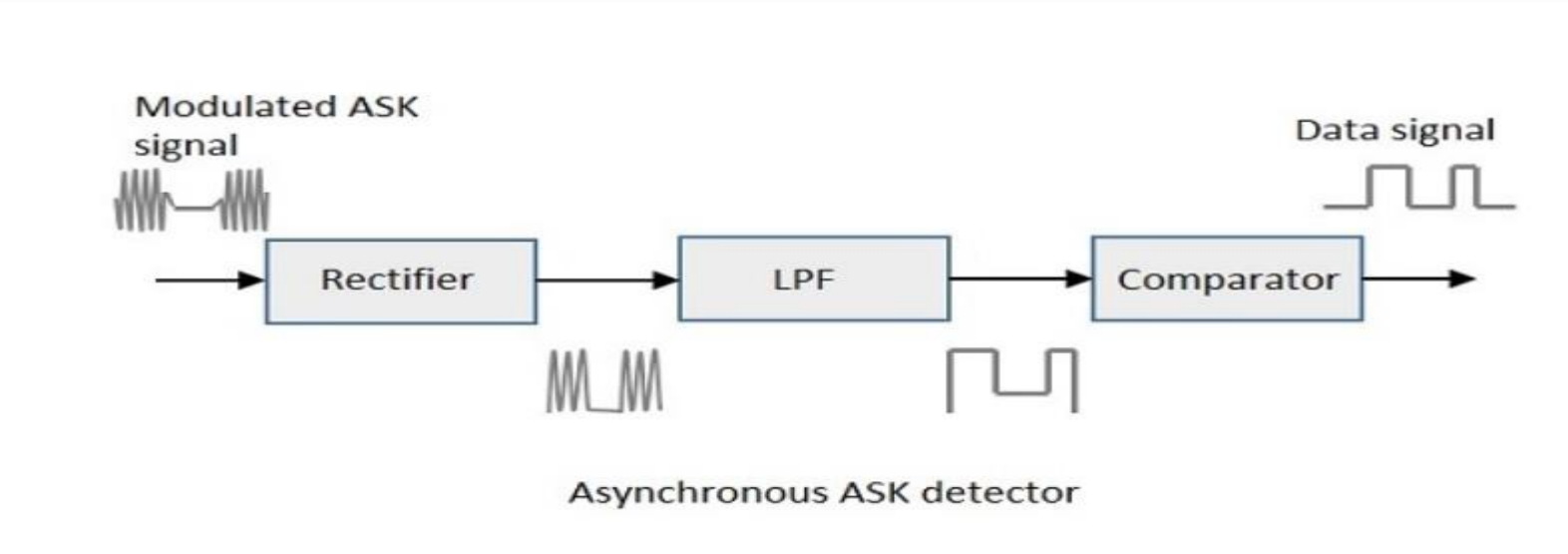
There are two types of ASK Demodulation techniques. They are −

- Asynchronous ASK Demodulation/detection
- Synchronous ASK Demodulation/detection

The clock frequency at the transmitter when matches with the clock frequency at the receiver, it is known as a **Synchronous method**, as the frequency gets synchronized. Otherwise, it is known as **Asynchronous**.

Asynchronous ASK Demodulator

The Asynchronous ASK detector consists of a **half-wave rectifier, a low pass filter, and a comparator.** Following is the block diagram for the same.

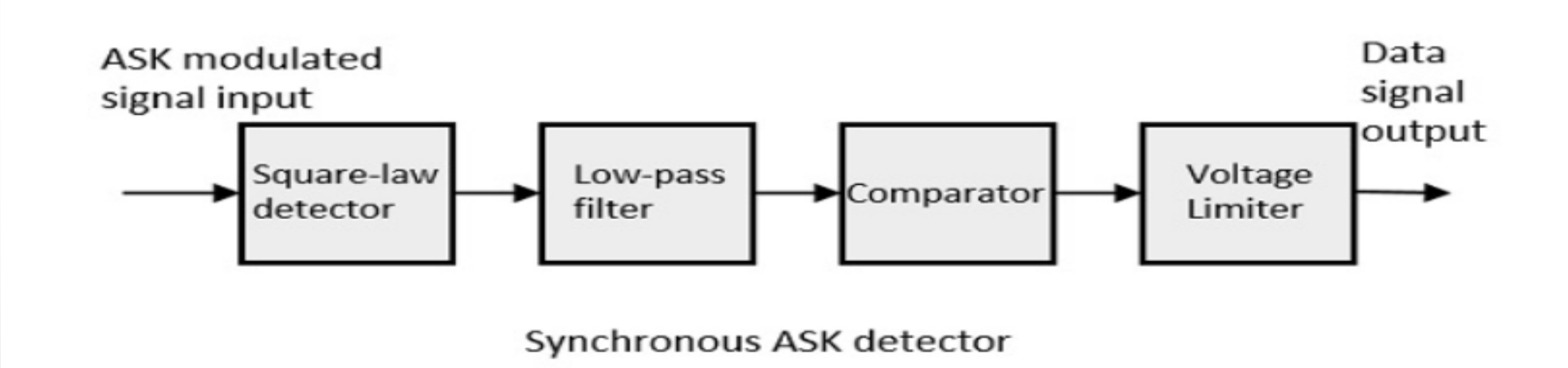


Asynchronous ASK detector

The **modulated ASK signal** is given to the half-wave rectifier, which delivers a positive half output. The low pass filter suppresses the **higher frequencies** and gives an envelope detected output from which the **comparator** delivers a digital output.

Synchronous ASK Demodulator

- Synchronous ASK detector consists of a **Square law detector, low pass filter, a comparator, and a voltage limiter.** Following is the block diagram for the same.



Synchronous ASK detector

- The **ASK modulated input** signal is given to the Square law detector. A square law detector is one whose output voltage is proportional to the square of the **amplitude** modulated input voltage. The low pass filter minimizes the **higher frequencies**. The comparator and the voltage limiter help to get a clean digital output.

Advantages Of ASK

- It can be used to transmit digital data over optical Fiber.
- It offers high bandwidth efficiency as it requires less bandwidth compared to other techniques.
- ASK is a relatively simple modulation scheme both in terms of implementation and demodulation, making it cost effective and easy to integrate into communication systems.

Disadvantages Of ASK

- It may have limitations in achieving high data rates in applications that require extremely high speed data transmission.
- ASK is less robust in the presence of multipath fading and other channel impairments. This makes it less suitable for communication channels with challenging propagation conditions.
- High power consumption

Applications Of ASK

- Low-frequency RF applications
- Home automation devices
- Industrial networks devices
- Wireless base stations
- Tyre pressuring monitoring systems

Thank You