ASK Generation and Detection

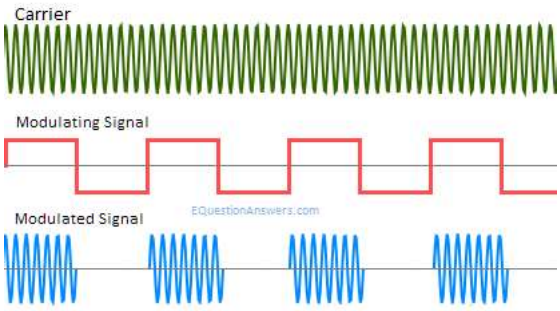
ASK GENERATION AND DETECTION

Overview

Amplitude Shift Keying belongs to one type of digital modulation. Amplitude Shift Keying or a.k.s. ASK uses an analog carier signal, sinusoidal in nature and a modultaing signal which is digital in nature. Modultaion and demodulation logic is simple thus it is a common choice for many digital equiments.

DEFINITION

Amplitude Shift Keying (ASK) is the digital modulation technique where amplitude a of the sinusoidal carrier signal Acos(ωct) is switched between the two levels, which corresponds to the levels of the baseband binary signal. The two levels of the binary signal can be 0 volt (Logic 0) and 5 volt (Logic1). This input signal or the modulating signal is in the form of digital bit streams. This modulation deals with two levels of baseband signal thus also known as binary ASK or BASK. Binary ASK modulation has the simplest modulation and demodulation logic circuits. However binary ASK gives lower bitrates. A much higher bitrate can be achieved by taking two bits at a time and modulating the amplitude in 4 different levels. This is known as Q-ASK or quadrature



Amplitude Shift Key

ASK modulation logic

ASK modulation logic circuit has a sinusoidal carier generator. This signal goes to a main modulator which is basically a switching circuit. This circuit has an input for baseband signal. This signal has two levels. Logic zero switches the output to off state and logic one makes the switch on state and thus the carier signal

ASK GENERATION ::

There are two methods of generating ASK signals.
First Method :-

In ASK generation, the base band signal F_b (t) is multiplied by any periodic signal S(t) so that the result is as follows: -

$x(t) = F_b(t)S(t)$

The product x(t) contains a series of AM waves with carrier frequencies that are harmonic multiples of the fundamental frequency f_c. A band pass filter is used to extract any of the harmonics, thus generating the ASK signal.

Second Method :-

The second form of ASK modulator utilizes a square law device which may be a diode. Here the base band signal is added to the carrier oscillations and squaring the sum gives the cross product, which is the desired modulation term. That is

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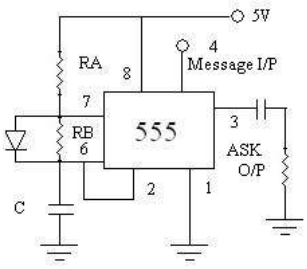
ASK Generation Using 555 Timer



Simple ways to generate ASK signal is using 555 timers as an Astable mode. The R_C network (R_A, R_B and C) will determine the Carrier frequency(i.e. $T = 1/f = 0.69.C.(R_A + R_B)$) of ASK. The principle is very simple. Here 555 timers astable mode acts as the carrier frequency generator. This carrier frequency is always feed to the ouput pin 3. We need a logic or modulator to on-off the output based on the input baseband signal. Here pin no. 4 of 555 timer is RESET bar. That means if this PIN is high the IC will be activated. Other wise if this pin is grounded output will be absent. This acts as the switching circuit or modulator. Thus Appling the message information in 4th pin we can get ASK signal on output in i.e. #3. for ASK and the reset pin uses as the modulator circuit. We

ASK demodultaion logic

ASK modulated wave has two sections where it has signal with carrier wave or it has no signal waves. In the first phase of the demodulation process it is filtered and low frequency baseband signal is extracted. Now the output of the filter can be feed to a analog comparator. Comparator will be able to produce the two levels of the digital signal.

ASK DETECTION ::

ASK detection can be of two types, either synchronous or asynchronous. Synchronous is often known as coherent and asynchronous is incoherent. Synchronous demodulators maintain precise timing (phase) of the incoming carrier. Asynchronous demodulators do not maintain this phase and essentially perform a non-linear operation on the modulating signal to retrieve the base band amplitude.

ASK synchronous demodulator

The synchronous demodulator is an example of Coherent Detection. It simply retranslates the frequencies of the incoming waveform down to the base band. This is done by multiplying or heterodyning the incoming ASK waveform with a local oscillator matched to the carrier. The output of the multiplier is,
Fb (t) {[cos(ωct)]2} = +
The low pass filter will remove the cos (2ωct) component. The output of the filter having response in ωc, which exactly matches that of the transmitter carrier oscillator.

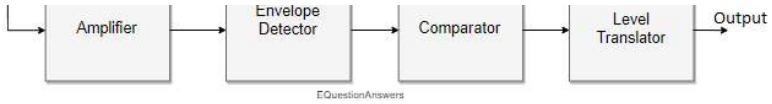
ASK asynchronous demodulator

The square law demodulator is an example of Incoherent Detection. Here a square law device is used whose output is passed through a low pass filter. The output of the filter is then fed to a non-linear device to take its square root so that the base band amplitude is retrieved.

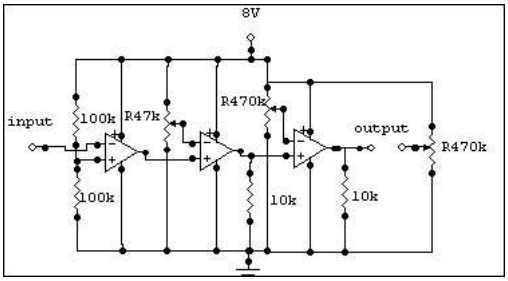
ASK Detection Using Comparator:

In practical field ASK detection, incoherent detection is more preferred than coherent detection because generating same carrier signal in the receiver side requires complicated circuitry and it adds costs to the circuit.

Receiver gets the modulated signal in very very low amplitude from the antenna. Stages of amplification is required before going for demodulation. Op-Amps and transistors are used to amplify this signal.



Now an envelop detector is sufficient to detect ASK signal. Envelop detector is a combination of a diode and a parallel RC network. Signal is then rectified in diode and the RC network is designed in such a way that it keeps the peak amplitude voltage for small amount of time for proper detection. After this comparators are used for taking decision of logic 1 or 0.



Op-Amps can be operated is differential mode. One of the input terminal is kept at reference voltage and signal is applied at the other terminal. There are two type of comparator Positive and Negative comparator. If signal is applied to Non-inverting terminal then it is Positive comparator. Positive comparator gives high when signal level is greater than reference voltage. If signal is applied to inverting terminal then it is Negative comparator. Negative comparator gives high when signal level is less than reference voltage. The operation of comparator is simple. It either works in Inverting (Positive comparator) or Non-Inverting mode (Negative comparator) with very high feed-back resistance means very high gain i.e. either is Positive saturation or Negative saturation.

Demodulator circuit uses simple envelope detector followed by three-stage magnitude comparator and a level translator. After the envelope detection signal is fed to three-stage magnitude comparator. Three-stage comparator is used for reliable signal detection and noise rejection. At the last stage a level translator is used to get output voltage in unipolar or bipolar mode.

Advantages

Modulation and demodulation logic circuit is simple. A simple circuit reduces the overall cost of the modulator and de-modulator. Since the cost is less, tt is used in many varieties of digital equipments

Disadvantages

1. This modulation uses the amplidute of the carrier signal to vary. Noice often introduced in the amplitude and causes signal bits to detect incorrectly in the de-modulator. Thus this modulation is prone to noice and often produces errors in output. A relicable media such as light, infrared, less distance RF signal is used as carrier.
2. This produces one bit per one modulation of the signal. Thus bitrate is less. An alternative to binary ASK is to move to Quadrature ASK where 2 bits of the signal can be modulated and demodulated and hencd a greater bitrate can be achieved.

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