BITT POLYTECHNIC, RANCHI

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Generation of PAM

- Pulse amplitude modulation is the basic form of pulse modulation in which the signal is sampled at regular and each sample is made proportional to the amplitude of the modulating signal at the sampling instant.
- The Fig1 shows the generation of PAM signal from the sampler which has two inputs i.e. modulating signal and sampling signal or carrier pulse.

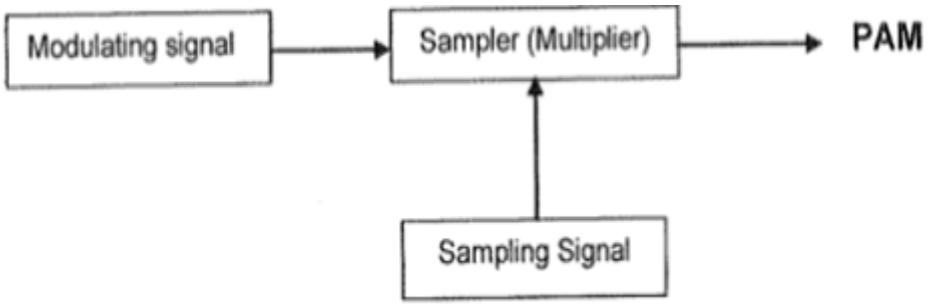

Fig1. Generation of PAM signal

- Thus the amplitude of the signal is proportional to the modulating signal through which information is carried. This is Pulse amplitude modulation signal.
- Fig2 shows the spectrum of pulse amplitude modulated signal along with the message signal and the sampling signal which is the carrier train of pulses with the help of the waveform plotted in time domain.
- Pulse Modulation may be used to transmitting analog information, such as continuous speech signal or data.

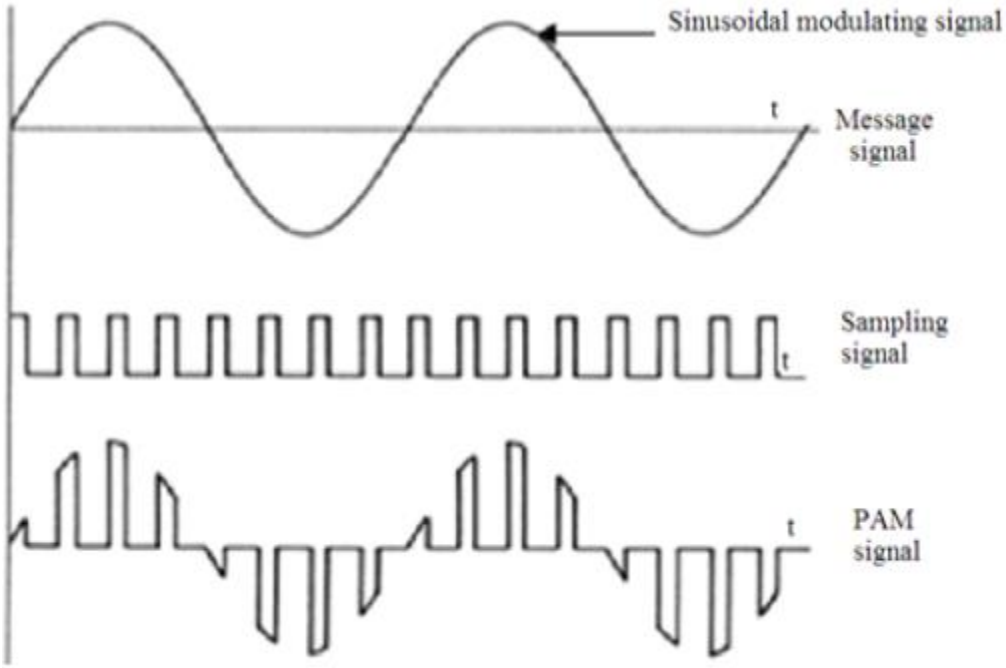

Fig2. Spectrum of PAM signal

Demodulation of PAM

- For Demodulation of the Pulse Amplitude Modulated signal, PAM is fed to the low pass filter as shown in Fig3 below.

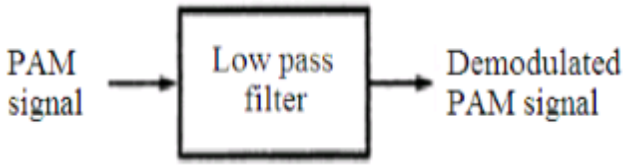

Fig3. PAM detector

- The low pass filter eliminates high frequency ripples and generates the demodulated signal which has its amplitude proportional to PAM signal at all time instant.
- This signal is then applied to an inverting amplifier to amplify its signal level to have the demodulated output with almost equal amplitude with the modulating signal.
- The Fig4 below shows the modulated and demodulated PAM signal.

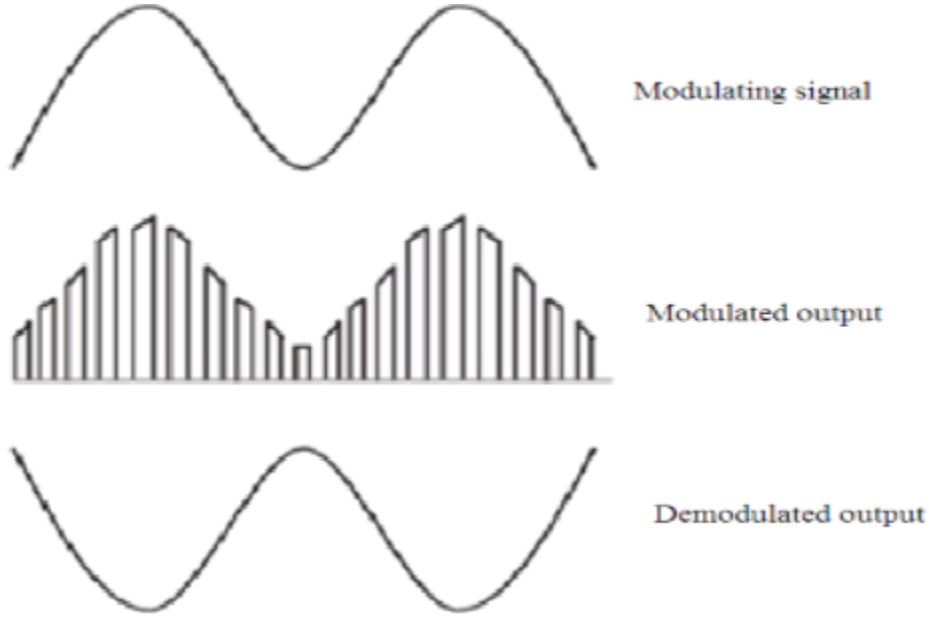

Fig4. Modulation and demodulation of PAM signal

Generation of PWM

- PWM signal can be generated by using a comparator, where modulating signal and sawtooth signal form the input of the comparator. It is the simplest method for PWM generation.
- The PWM generation is explained with the help of the Fig5 given below.

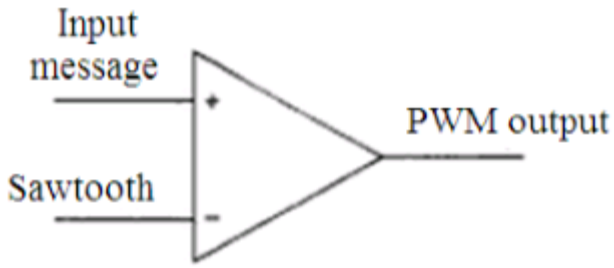

Fig5. PWM generation by a comparator

- As shown in the figure, one input of the comparator is fed by the input message or modulating signal and the other input by a sawtooth signal which operates at carrier frequency.
- Considering both ±ve sides, the maximum of the input signal should be less than that of sawtooth signal.
- The comparator will compare the two signals together to generate the PWM signal at its output as shown in the third waveform of Fig6.
- The rising edges of the PWM signal coincides with the falling edge of the sawtooth signal.

- When the sawtooth signal is at the minimum value which is less than the minimum of the input signal, then the positive input of the comparator is at higher potential which gives the comparator output as positive.
- When the sawtooth signal rises and is at the maximum value, the negative input of the comparator is at higher potential, which will produce the comparator output to be negative.
- Thus the input signal magnitude determines the comparator output and its potential, which then decides the width of the pulse generated at the output.
- In other words we can say that the width of the pulse generated signal is directly proportional to the amplitude of the modulating signal.

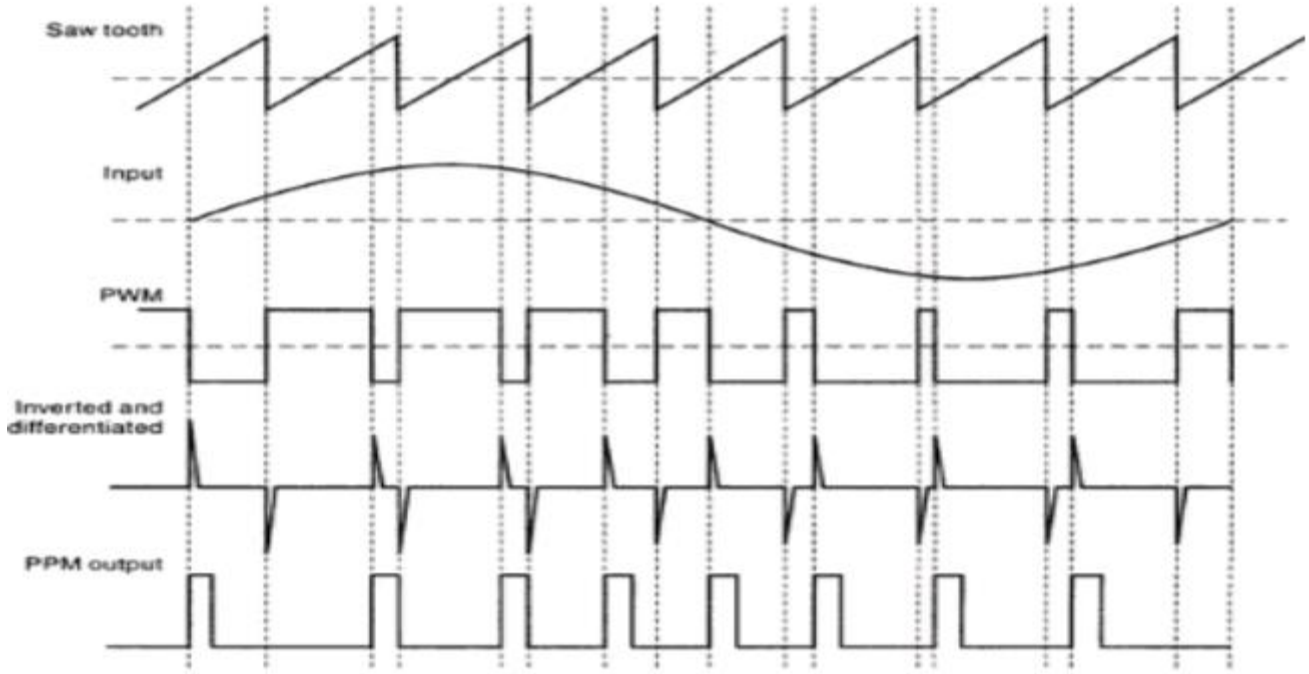

Fig6. PWM and PPM signal generation

Generation of PPM

- PPM signal can be generated with the help of PWM as shown in Fig7 below.

Fig7. PPM generation from PWM

- The PWM signal generated above is sent to an inverter which reverses the polarity of the pulses.
- This is then followed by a differentiator which generates +ve spikes for PWM signal going from High to Low and -ve spikes for Low to High transistion. The spikes generated are shown in the fourth waveform of Fig8.
- These spikes are then fed to the positive edge triggered pulse generator which generates fixed width pulses when a +ve spike appears, coinciding with the falling edge of the PWM signal.
- Thus PPM signal is generated at the output which is shown in the fifth waveform of Fig8.where pulse position carry the message information.

Demodulation of PWM and PPM

- For PWM demodulation, put a ramp at the +ve edge which will stop at the arrival of –ve edge.
- The ramp will attain different heights in each cycle since the widths are different and the heights attained are directly proportional to the pulse width and in turn the amplitude of the message signals.
- This is then passed through a low pass filter where it will follow the envelop i.e. the message signal, which produces the demodulated signal at the output.
- For PPM demodulation, ramp is used which starts at the +ve edge of the one pulse and stops at the +ve edge of the next pulse.
- Thus the height of the generated ramp is determined by the delay between the pulses which indirectly follows the amplitude of the modulating signal.
- This is then passed through a low pass filter which filters the envelop information as the demodulated signal.
- The modulation and demodulation waveforms of PWM and PPM signals are shown in Fig8.

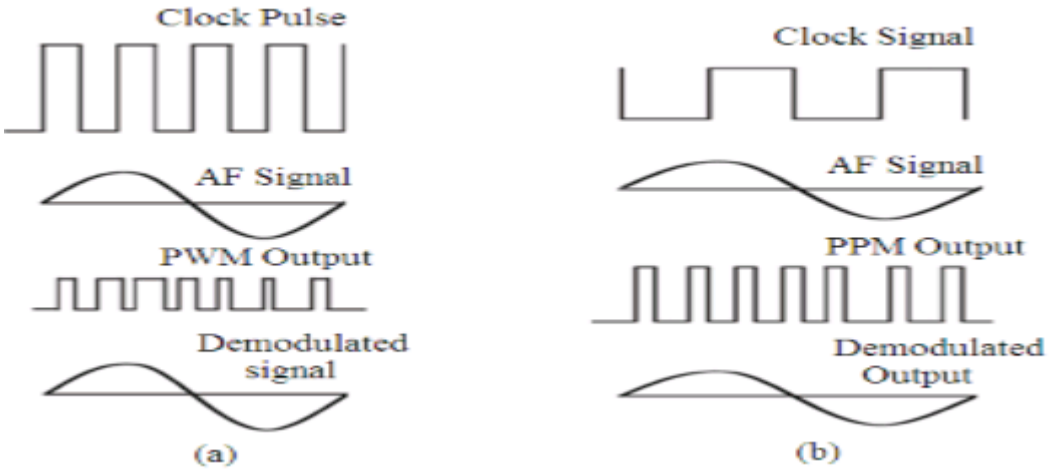

Fig8. Modulation and Demodulation of (a) PWM and (b) PPM