Pulse width modulation

Pulse width modulation reduces the average power delivered by an electrical signal by converting the signal into discrete parts. In the PWM technique, the signal's energy is distributed through a series of pulses rather than a continuously varying (analogue) signal.

How is a Pulse Width Modulation Signal generated?

A pulse width modulating signal is generated using a comparator. The modulating signal forms one part of the input to the comparator, while the non-sinusoidal wave or sawtooth wave forms the other part of the input. The comparator compares two signals and generates a PWM signal as its output waveform.

Important Parameters associated with PWM signal

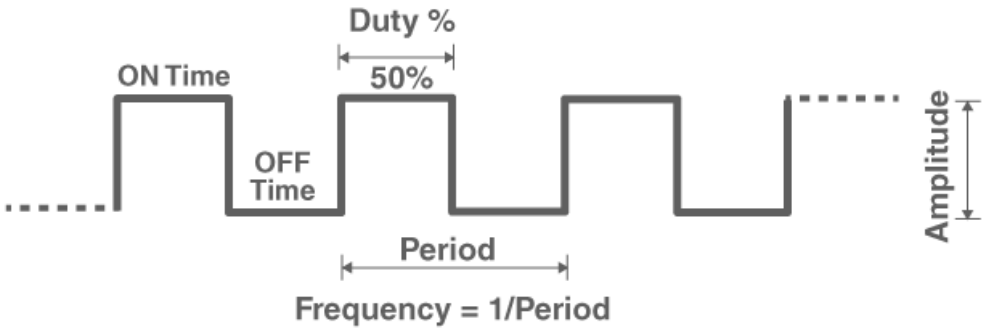
Duty Cycle of PWM

As we know, a PWM signal stays "ON" for a given time and stays "OFF" for a certain time. The percentage of time for which the signal remains "ON" is known as the duty cycle. If the signal is always "ON," then the signal must have a 100 % duty cycle. The formula to calculate the duty cycle is given as follows:

The average value of the voltage depends on the duty cycle. As a result, the average value can be varied by controlling the width of the "ON" of a pulse.

Frequency of PWM

Duty Cycle of Pulse Width Modulation



The frequency of PWM determines how fast a PWM completes a period. The frequency of a pulse is shown in the figure above.

The frequency of PWM can be calculated as follows:

Frequency = 1/Time Period

Time Period = On Time + OFF time

Output Voltage of PWM signal

The output voltage of the PWM signal will be the percentage of the duty cycle. For example, for a 100% duty cycle, if the operating voltage is 5 V then the output voltage will also be 5 V. If the duty cycle is 50%, then the output voltage will be 2.5 V.

Types of Pulse Width Modulation Technique

There are three conventional types of pulse width modulation technique and they are named as follows:

- Trail Edge Modulation – In this technique, the signal's lead edge is modulated, and the trailing edge is kept fixed.
- Lead Edge Modulation – In this technique, the signal's lead edge is fixed, and the trailing edge is modulated.
- Pulse Center Two Edge Modulation – In this technique, the pulse centre is fixed and both edges of the pulse are modulated.

Applications of Pulse Width Modulation

Due to the high efficiency, low power loss, and the PWM technique's ability to precisely control the power, the technique is used in a variety of power applications. Some of the applications of PWM are as follows:

- The pulse width modulation technique is used in telecommunication for encoding purposes.
- The PWM helps in voltage regulation and therefore is used to control the speed of motors.
- The PWM technique controls the fan inside a CPU of the computer, thereby successfully dissipating the heat.
- PWM is used in Audio/Video Amplifiers.