Variable Pulse Width

Fixed Pulse Width

 Principle of PWM
How PWM Works

The diagram illustrates the principle of Pulse Width Modulation (PWM). When the command signal is greater than the carrier, the output stays high as long as the command signal is high. The PWM signal is compared with a carrier signal, and the output is high as long as the PWM signal is high. This process is repeated continuously, creating a wave-like output that is proportional to the command signal.
Sinusoidal PWM
V_{01} = m_a V_{dc,m} \leq 1

m_a \leq 1

\text{Linear Modulation Range}

\frac{f_{out}}{f_s} = \frac{m_a}{f_s}

\text{Frequency Modulation Ratio}

\frac{\Delta f_{out}}{\Delta f_{in}} = m_a

\text{Amplitude Modulation Ratio}

Bipolar PWM

\text{Diode Bridge Circuit}

\text{Switching Circuits}

\text{Rectifier Circuit}
Higher frequencies result in a shift of the harmonic components. As the wave is characterized by the harmonics, the frequency in the Fourier series becomes

\[
\xrightarrow{\text{Harmonics of } L_n}
\]

The frequency in the Fourier series becomes

\[
\text{Harmonics of } L_n
\]

\[
\begin{align*}
\text{Freq.} & = \frac{1}{2\pi} \left( \frac{1}{2} + \frac{1}{2} \right) \\
\text{Basic wave} & = \frac{1}{2} \\
\text{Harmonic wave} & = \frac{1}{2} \\
\text{Total wave} & = \frac{1}{2} + \frac{1}{2} \\
\end{align*}
\]

The fundamental frequency is

\[
\frac{1}{2} \text{ fundamental}
\]

The frequency is

\[
\text{Freq.} = \frac{1}{2}\left( \frac{1}{2} + \frac{1}{2} \right)
\]

\[
\text{Harmonic waves}
\]

\[
\text{Total waves}
\]

The frequency is

\[
\frac{1}{2} + \frac{1}{2}
\]

The frequency is

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\frac{1}{2}
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The frequency is

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\text{Freq.} = \frac{1}{2}
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