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Electrical DC Waveform Frequency

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ABSTRACT

One wave per second is also called a Hertz (Hz) and in SI units is a reciprocal second (**s^{-1}**). The variable c is the speed of light. For the relationship to hold mathematically, if the speed of light is used in m/s, the wavelength must be in meters and the frequency in Hertz. So what would be frequency of DC waveform weather it's 0 HZ or more than 0 HZ up to 1 HZ?

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We can understand by following below illustrations.

Typical Examples of Electrical Waveform :

In electronic circuits we need to produce many different types, frequencies and shapes of **Signal Waveforms** such as Square Waves, Rectangular Waves, Triangular Waves, Saw toothed Waveforms and a variety of pulses and spikes.

These types of signal waveform can then be used for either timing signals, clock signals or as trigger pulses. However, before we can begin to look at how the different types of waveforms are produced, we firstly need to understand the basic characteristics that make up **Electrical Waveforms**.

Technically speaking, **Electrical Waveforms** are basically visual representations of the variation of a voltage or current over time. In plain English this means that if we plotted these voltage or current variations on a piece of graph paper against a base (x-axis) of time, (t) the resulting plot or drawing would represent the shape of a **Waveform** as shown. There are many different types of *electrical waveforms* available but generally they can all be broken down into two distinctive groups.

1. Uni-directional Waveforms – these electrical waveforms are always positive or negative in nature flowing in one forward direction only as they do not cross the zero axis point. Common uni-directional waveforms include Square-wave timing signals, Clock pulses and Trigger pulses.
2. Bi-directional Waveforms – these electrical waveforms are also called alternating waveforms as they alternate from a positive direction to a negative direction constantly crossing the zero axis point. Bi-directional waveforms go through periodic changes in amplitude, with the most common by far being the Sine-wave.

Whether the waveform is uni-directional, bi-directional, periodic, non-periodic, symmetrical, non-symmetrical, simple or complex, all electrical waveforms include the following three common characteristics:

Period: – This is the length of time in seconds that the waveform takes to repeat itself from start to finish. This value can also be called the *Periodic Time*, (T) of the waveform for sine waves, or the *Pulse Width*for square waves.

Frequency: – This is the number of times the waveform repeats itself within a one second time period. Frequency is the reciprocal of the time period, (f = 1/T) with the standard unit of frequency being the *Hertz*, (Hz).

Amplitude: – This is the magnitude or intensity of the signal waveform measured in volts or amps.

We are taking examples of some Periodic Waveforms.

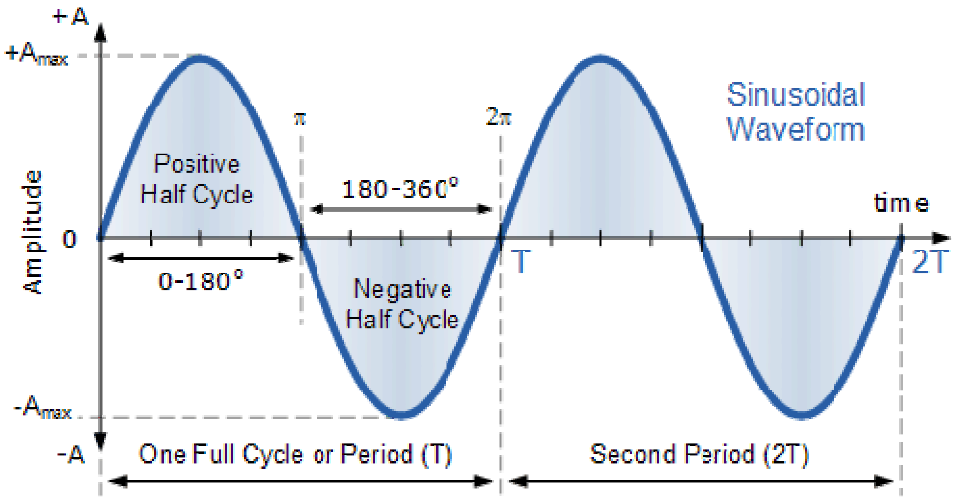
Periodic waveforms are the most common of all the electrical waveforms as it includes **Sine Waves**. The AC (Alternating Current) mains waveform in your home is a sine wave and one which constantly alternates between a maximum value and a minimum value over time.

The amount of time it takes between each individual repetition or cycle of a sinusoidal waveform is known as its "periodic time" or simply the *Period* of the waveform. In other words, the time it takes for the waveform to repeat itself.

Then this period can vary with each waveform from fractions of a second to thousands of seconds as it depends upon the frequency of the waveform. For example, a sinusoidal waveform which takes one second to complete its cycle will have a periodic time of one second. Likewise a sine wave which takes five seconds to complete will have a periodic time of five seconds and so on.

So, if the length of time it takes for the waveform to complete one full pattern or cycle before it repeats itself is known as the "period of the wave" and is measured in seconds, we can then express the waveform as a period number per second denoted by the letter T as shown below.

A Sine Wave Waveform



Units of periodic time, (T) include: Seconds (s), milliseconds (ms) and microseconds (μs).

For sine wave waveforms only, we can also express the periodic time of the waveform in either degrees or radians, as one full cycle is equal to 360^o (T = 360^o) or in Radians as 2pi, 2π (T = 2π), then we can say that 2π radians = 360^o – (Remember this!).

We now know that the time it takes for electrical waveforms to repeat themselves is known as the periodic time or period which represents a fixed amount of time. If we take the reciprocal of the period, (1/T) we end up with a value that denotes the number of times a period or cycle repeats itself in one second or cycles per second, and this is commonly known as **Frequency** with units of **Hertz, (Hz)**. Then Hertz can also be defined as "cycles per second" (cps) and 1Hz is exactly equal to 1 cycle per second.

Both period and frequency are mathematical reciprocals of each other and as the periodic time of the waveform decreases, its frequency increases and vice versa with the relationship between *Periodic time* and *Frequency* given as.

Relationship between Frequency and Periodic Time

$$\text{Frequency} = \frac{1}{\text{Periodic time}} \quad \text{or} \quad f = \frac{1}{T}\ \text{Hz}$$

$$\text{Periodic time} = \frac{1}{\text{Frequency}} \quad \text{or} \quad T = \frac{1}{f}\ \text{sec}$$

Where: f is in Hertz and T is in Seconds.

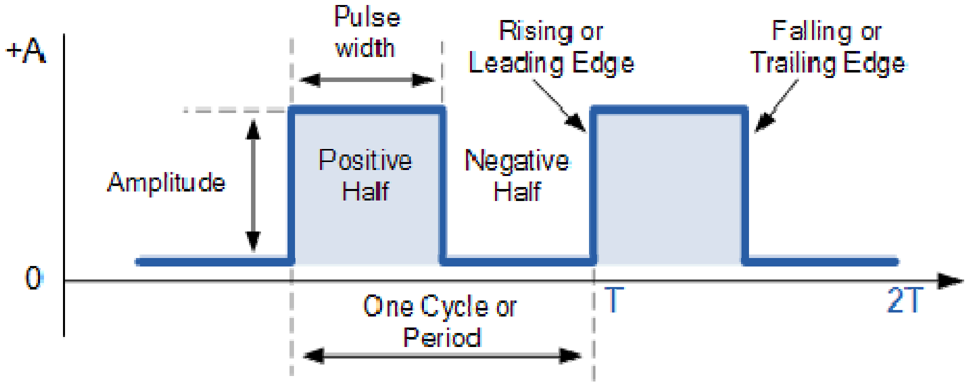
One **Hertz** is exactly equal to one cycle per second, but one hertz is a very small unit so prefixes are used that denote the order of magnitude of the waveform such as **kHz**, **MHz** and even **GHz**.

Square Wave Electrical Waveforms

Square-wave Waveforms are used extensively in electronic and micro electronic circuits for clock and timing control signals as they are symmetrical waveforms of equal and square duration representing each half of a cycle and nearly all digital logic circuits use square wave waveforms on their input and output gates.

Unlike sine waves which have a smooth rise and fall waveform with rounded corners at their positive and negative peaks, square waves on the other hand have very steep almost vertical up and down sides with a flat top and bottom producing a waveform which matches its description, – "Square" as shown below.

A Square Wave Waveform



We know that square shaped electrical waveforms are symmetrical in shape as each half of the cycle is identical, so the time that the pulse width is positive must be equal to the time that the pulse width is negative or zero. When square wave waveforms are used as "clock" signals in digital circuits the time of the positive pulse width is known as the "Duty Cycle" of the period.

Then we can say that for a square wave waveform the positive or "ON" time is equal to the negative or "OFF" time so the duty cycle must be 50%, (half of its period). As frequency is equal to the reciprocal of the period, (1/T) we can define the frequency of a square wave waveform as:

$$\text{Frequency} = \frac{1}{\text{"ON" time} + \text{"OFF" time}}$$

So, These are examples of some electronics waveforms of AC and DC supply.

Now taking some examples from oscilloscope to find out actual frequency waveform of DC supply. This will help us to understand weather actual frequency of DC waveform is 0 HZ or above 0 HZ up to 1HZ. frequency vs length chart will help us to understand about actual distance travel by waveform according to frequency.

Oscilloscope Screen Results :

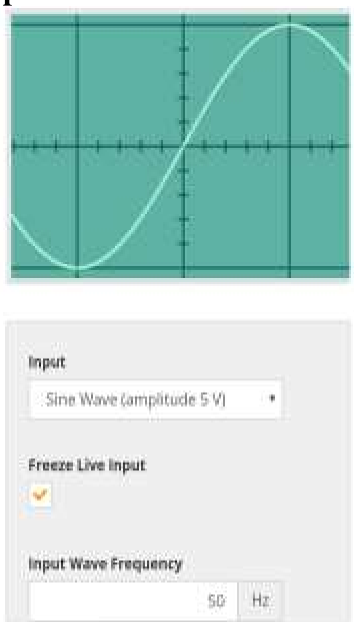
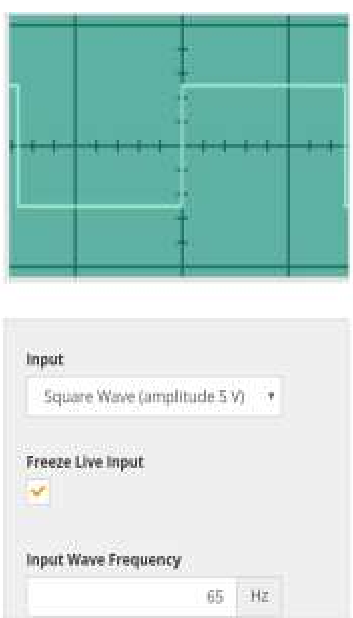
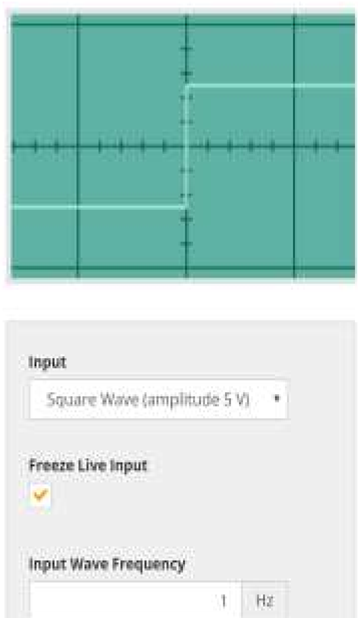


Fig (A)



Fig(B)

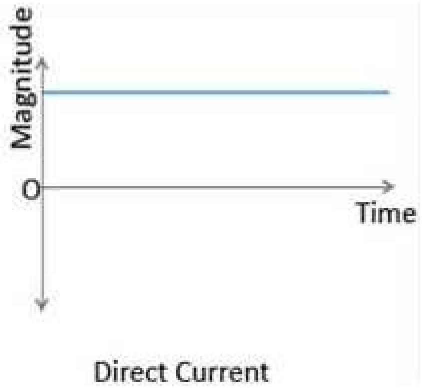


Fig(C)

Figure (A) represent Sine wave at 50 HZ frequency.
Figure (B) represent Square wave at 65 Hz frequency.
Figure (C) represent Square wave at 1 HZ frequency.

From following figure it can be understood that any wave(example sine wave or square wave) at 1 HZ frequency act as linear constant wave like DC waveform as shown in below mention figure

DC circuits have a unidirectional flow of **current** and like AC it is not changing the direction periodically. **Waveform** of **DC** is a pure sine wave. As you can see, the **voltage** is constant with respect to time.



Frequency Vs Wavelength Chart:

Frequency in Hz.	Wavelength	quarter wavelength	
0	0000.00	0000.00	Feet
1	1115.49	278.87	Feet
20	56.50	14.13	Feet
25	45.2	11.3	feet
31.5	35.87	8.97	feet
40	28.25	7.06	feet
50	22.6	5.65	feet
63	17.94	4.48	feet
80	14.13	3.53	feet
100	11.3	2.83	feet
125	9.04	2.26	feet
160	7.06	1.77	feet
200	5.45	1.41	feet
250	4.52	1.13	feet
320	3.53	0.88	feet
400	2.83	0.71	feet
500	27.12	6.78	inches
640	21.19	5.3	inches
800	16.95	4.24	inches
1000	13.56	3.39	inches
1280	10.59	2.65	inches
1600	8.48	2.12	inches
2000	6.78	1.7	inches
2560	5.3	1.32	inches
3200	4.24	1.06	inches
4000	3.39	0.85	inches
5120	2.65	0.66	inches
6400	2.12	0.53	inches
8000	1.7	0.42	inches
10240	1.32	0.33	inches
12800	1.06	0.26	inches
16000	0.85	0.21	inches
20480	0.66	0.17	inches

Conclusion:

zero frequency means basically a constant term, no wave, no peaks passing you ever. Notice that the "wave" would have infinite period and wavelength, the time between peaks become infinite.

The frequency of times you go to space is zero. A quantity oscillating with frequency equal to zero would simply be static or constant. When Time goes to infinity, it is not possible for an observer to see that the phenomenon is periodic.

Firstly, in case of DC waveform. it is constant term with Wave. DC waveform travel some distance like 340 meter at 1HZ frequency(As shown in frequency vs wavelength chart). We have some distance within specific period of time. That travelling could not be possible at 0 HZ frequency.

Secondly, Wave velocity means, distance traversed by a periodic, or cyclic, motion per unit time (in any direction). ... The velocity of a wave is equal to the product of its wavelength and frequency (number of vibrations per second) and is independent of its intensity.

One wave per second is also called a Hertz (Hz) and in SI units is a reciprocal second (**s^{-1}**). The variable c is the speed of light. For the relationship to hold mathematically, if the speed of light is used in m/s, the wavelength must be in meters and the frequency in Hertz.

If we put 0 HZ frequency in this formula, wave velocity becomes Zero. That is contra verdict to previous statement. When we Put 1 HZ or below less than 0 HZ frequency, than we can find some distance within specific period of time.

Finally, in my opinion it should not be 0 HZ, it should between 0 HZ< DC Waveform Frequency < = 1HZ frequency.