Chapter 1-3

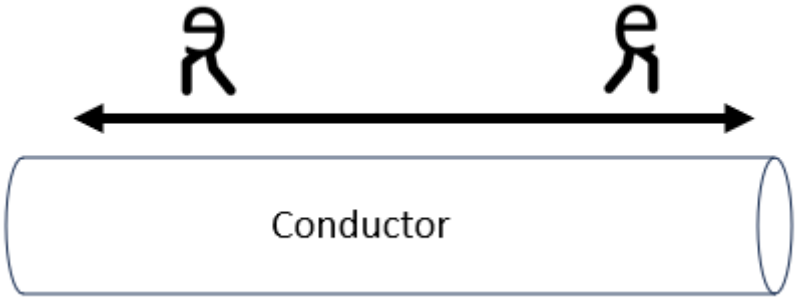
FREQUENCY and WAVELENGTH

ACMA Foundation Syllabus 3.3, 3.8, 3.9, 3.11, 3.12, 3.13 and 3.14

Contents

Alternating Current

Alternating current is where the directional flow of electrons, in a conductor, switches back and forth at regular intervals or cycles. This flow over time is shown as a sinusoidal wave. The number of cycles back and forth is termed the frequency (f) and is measured in Hertz (Hz).



Sinusoidal (Sine) Wave

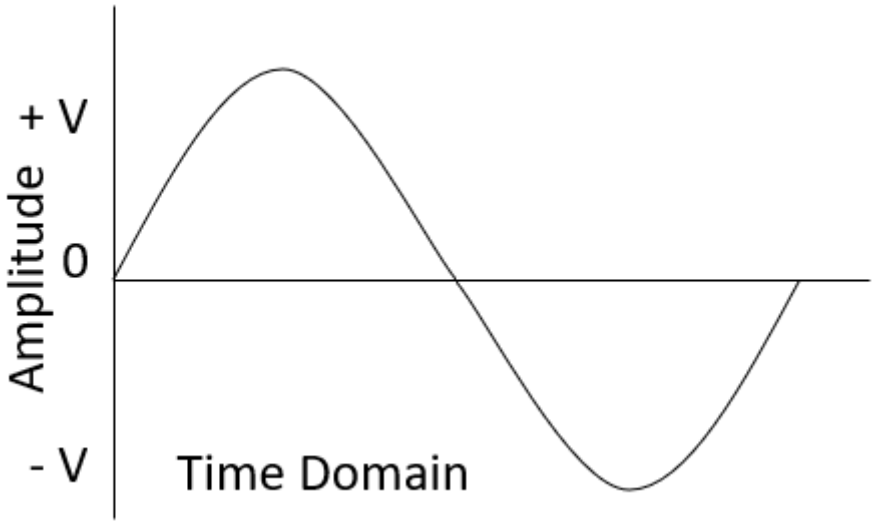


Figure 1

The **peak value** is the highest value reached in either direction.

Peak to peak value is the difference between the positive peak and the negative peak.

Frequency

Frequency is defined as the rate at which something occurs over a second and measured in Hertz (Hz).

One cycle, as in Figure 1, is measured from the point where the wave crosses the zero line, goes positive then goes negative and back to the zero line. If there are 1million (M) cycles in a second, the frequency is 1 MHz.

Period

The Period (P) is the time taken for one cycle. Using the example of 1 MHz, the Period is 1 second divided by 1,000,00 or 1 microsecond (uS).

Calculate

Frequency (f) is measurement of cycles per second .

$$f = \frac{1}{P}$$

Example : P = 0.02 seconds f = 1 / 0.02 = 50 Hz

Frequencies

Humans can hear in a range of 20 to 20,000 Hz. These are defined as audio frequencies (AF).

The radio frequency (RF) range spans from around 20 kHz to 300 GHz. This carrier range is divided into several bands, each with specific applications, such as AM/FM radio, television broadcasting, and mobile communications.

Tones transmitted on carries used by amateurs include the following.

- RTTY is still the traditional 45.45 bauds with a shift of 850 Hz, using tone frequencies of 2125 and 2975 Hz or the alternative "low tones" 1275 / 2125 Hz.
- Packet Radio allowed faster data rates than RTTY, while using a narrower bandwidth (500 Hz for a 300 baud packet signal, as opposed to 1.2 kHz for a 50 baud RTTY signal).

Radio Frequency Spectrum

Amateur operators can only use the frequencies allocated to them. However, the frequency spectrum is broken into ranges all based on the number 3 for easy memory.

	Classification	Range from	Range to
VLF	Very low Frequency	3 kHz	30 kHz
LF	Low frequency	30 kHz	300 kHz
MF	Medium Frequency	300 kHz	3 MHz
HF	High Frequency	3 MHz	30 MHz
VHF	Very High Frequency	30 MHz	300 MHZ
UHF	Ultra-High Frequency	300 MHz	3 GHz
SHF	Super High Frequency	3 GHz	30 GHz
EHF	Extremely High Frequency	30 GHz	300 GHz

The audio hearing frequency range is 20 Hz to 20,000 Hz. Telephones and communications used a limited frequency range of 300 hertz to 3.4 Kilohertz for over 100 years. While the frequency spectrum of the human speaking voice ranges from about 50 Hertz to 8 Kilohertz, speech remains quite intelligible when transmitted at this very limited bandwidth.

Foundation Frequencies

Operators with a foundation licence can operate on the following bands (wavelengths). **Know these frequencies.**

Foundation (6 bands)

Band	Freq in MHz	Mode
80m	3.5 – 3.7	Any mode
40m	7 – 7.3	
15m	21 – 21.45	
10m	28 – 29.7	
2m	144 – 148	
70cm	430 - 450	

Wavelength

Waves travel at the speed of light unless constrained. The distance a wave, of a given frequency, would travel in one cycle, is called the wavelength.

Imagine a stick and the wave came out of that stick. The distance from the stick that one cycle would travel is the wavelength. Low frequencies have long wavelengths and high frequencies have short wave lengths.

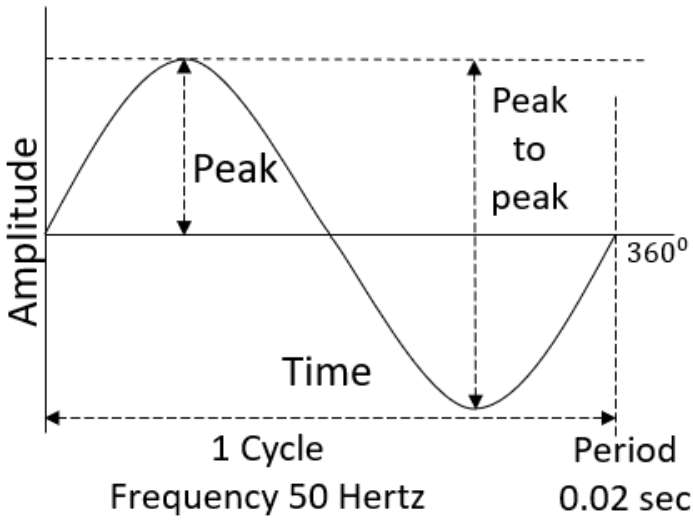
The wavelength is measured in metres and has the symbol lambda (λ)

$$\lambda = c/f$$

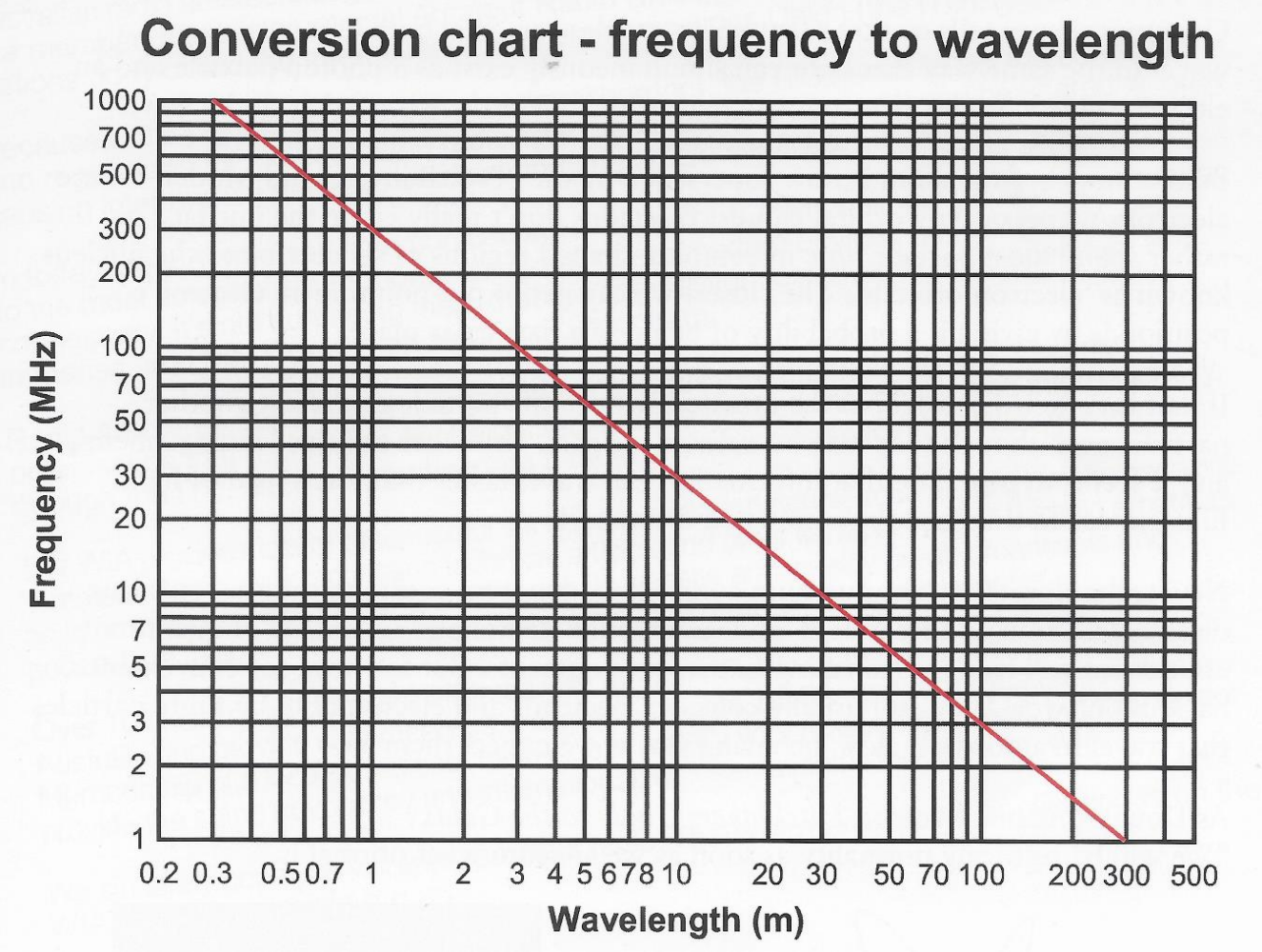
$\lambda = Wavelengh$
C = constant 300 x 10^6 metres per second (This is the rounded value for the speed of light.)
f = frequency in Hz

Example: What is the wavelength if the frequency is 144 MHz
Wavelength λ = 300,000,000 / 144,000,000 = 2 metres

Looking at Figure 2, this is a sinewave depiction of the Australian mains power.



The graph below gives a quick conversion between frequency and wavelength.



Go to Chapter 1-3 Questions.

Have fun and stay safe.

