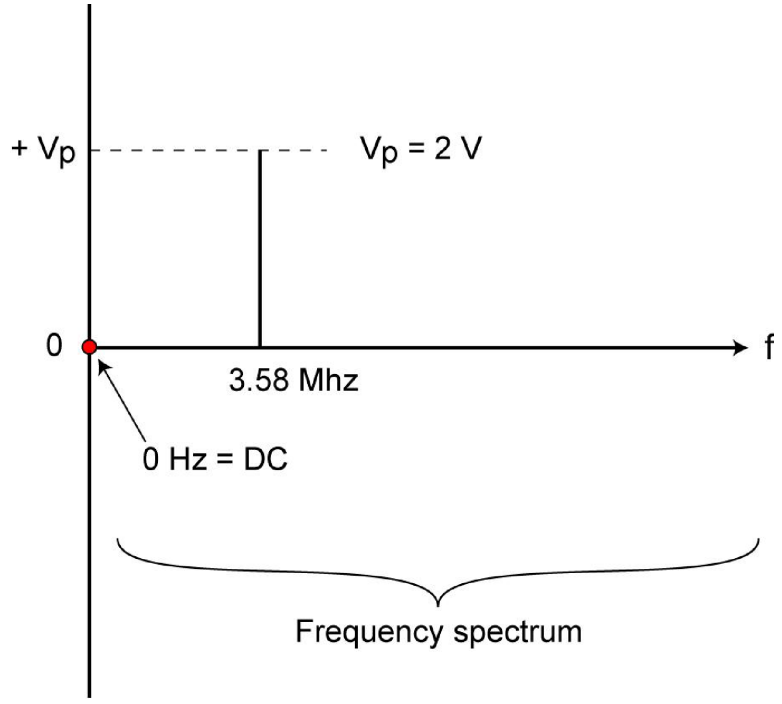
The Frequency Domain

Introducing the Frequency Domain



f = frequency in Mhz (cycles/second)

A discussion of this graphic is presented in the pages that follow. You can print this graphic for study purposes before going on.

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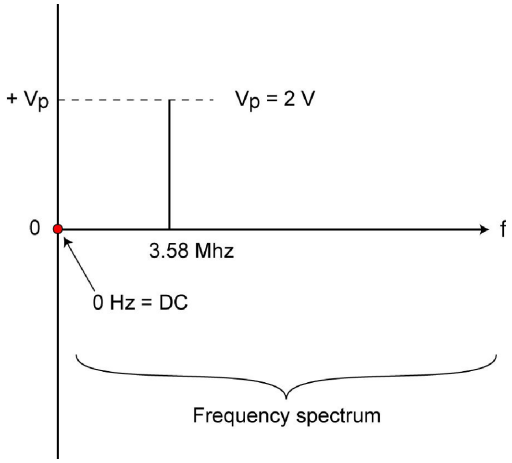
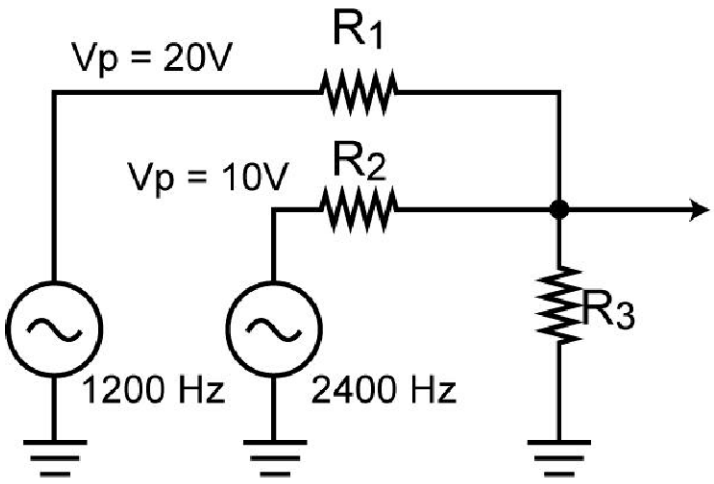


f = frequency in Mhz (cycles/second)

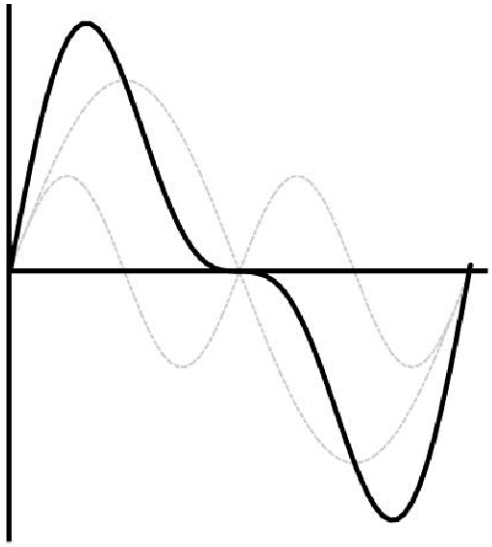
When a sine wave is represented in the frequency domain, the horizontal axis is the frequency from 0 Hz (DC) to some upper frequency. The range of frequencies shown is called the frequency spectrum.

The sine wave is represented by a single vertical line at its frequency (in this case, 3.58 MHz). The amplitude of the vertical line can be either the peak value, the peak-to-peak value of voltage, or even the power of the sine wave in a load. In this example, the amplitude is the peak value (V_p).

Frequency Domain Example



Linear mixer



Complex, non-sinusoidal wave

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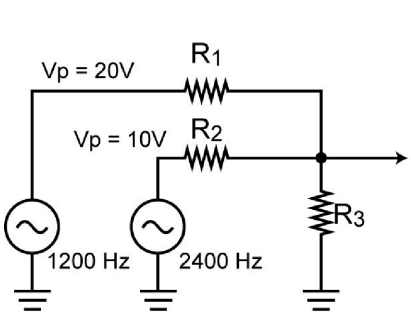
Frequency Domain Example



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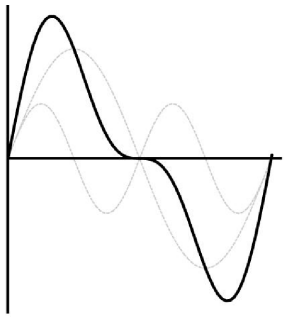
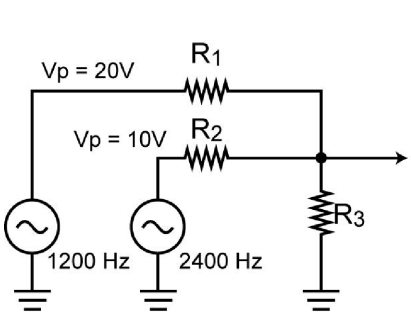


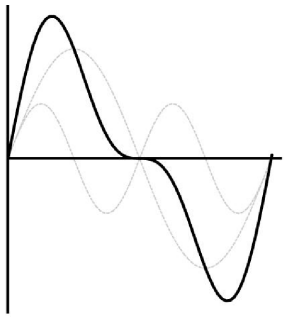
Complex, non-sinusoidal wave

In electronics, many signals are not sine waves. They are complex signals that are made up of many different sine waves added together. Voice and music signals are an example. The figure above shows a simple example of an audio signal made up of a 1200 Hz sine wave and a 2400 Hz sine wave added together algebraically. This could be done with the simple circuit shown. The time domain waveform across the load R3 is the sum of the individual waveforms. A time domain waveform can be seen on an oscilloscope.

Frequency Domain Example (cont.)



Linear mixer



Complex, non-sinusoidal wave

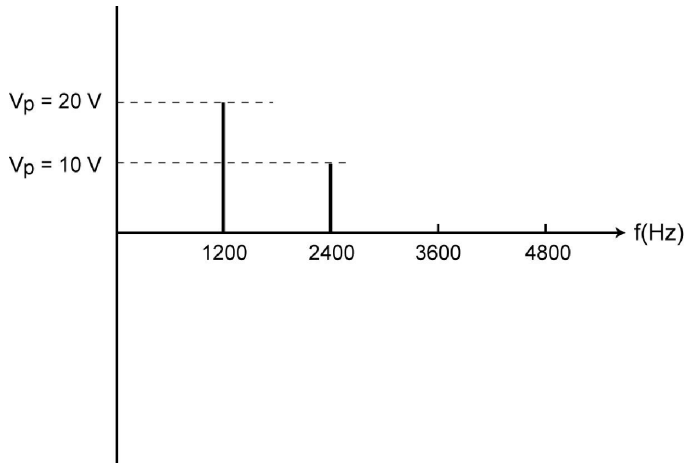
If the peak value of the 1200 Hz wave is 20 volts and the 2400 Hz peak value is 10 volts, the mathematical expression for this signal would be

$$v = 20 \sin [2\pi(1200)t] + 10 \sin [2\pi(2400)t]$$

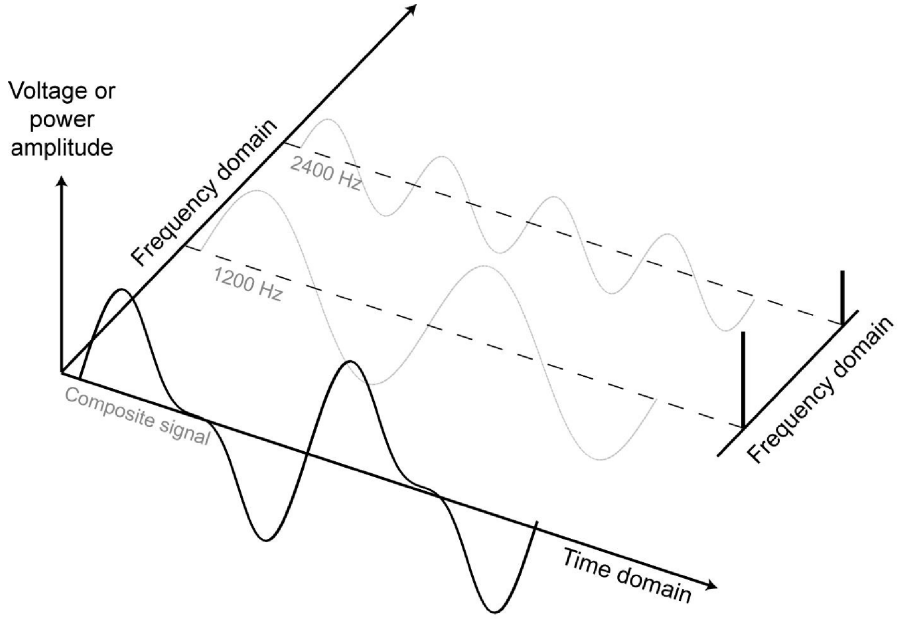
The new composite wave is not a sine wave but its frequency at 1200 Hz. Adding in the lower amplitude 2400 Hz signal distorts the 1200 Hz sine wave.

Frequency Spectrum of the Composite Signal

The frequency domain view of this composite signal can be plotted and shown as



The Relationship Between the Time and Frequency Domains



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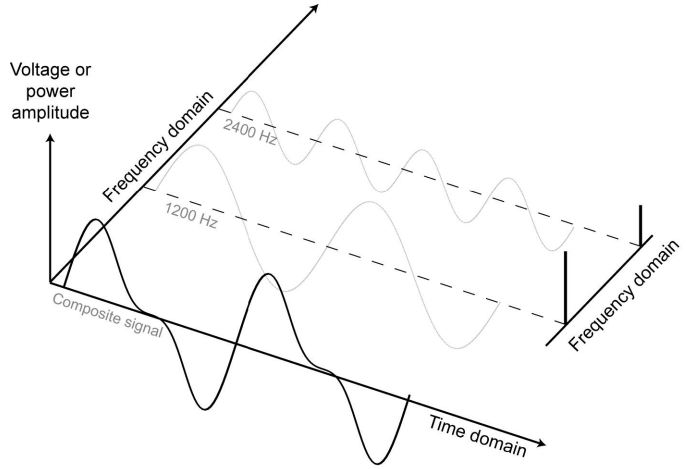

The figure above shows one way to view the relationship between the time and frequency domain presentations of a signal. The vertical axis is always amplitude. The time and frequency axes are at 90° to one another.

Spectrum Analyzer

A spectrum analyzer is a test instrument similar to an oscilloscope; however, it provides a frequency domain output display. The signal is connected to the analyzer with a probe and the frequency domain plot is displayed on the face of the cathode ray tube (CRT).

Test your knowledge

Fourier Theory Knowledge Probe 2

The Frequency Domain

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Then choose **Knowledge Probe 2**.