

Answer on Question #80197 - Physics - Electric Circuits

A signal is measured to have a peak voltage of 4v and a VRMS of 2.3 v.
Is it a sinusoidal square wave or triangular wave signal?

Solution

Find the ratio between the peak voltage V_P and the V_{RMS} :

$$k = \frac{V_P}{V_{RMS}} = \frac{4}{2.3} = 1.73913$$

and compare it with RMS of square wave:

$$V_{SW}(t) = \frac{4V_P}{\pi} \left(\sin(2\pi ft) + \frac{1}{3}\sin(6\pi ft) + \frac{1}{5}\sin(10\pi ft) + \frac{1}{7}\sin(14\pi ft) + \frac{1}{9}\sin(18\pi ft) \right),$$

$$\begin{aligned} V_{RMS.SW} &= \sqrt{\left(\frac{4V_P}{\pi\sqrt{2}}\right)^2 + \left(\frac{4V_P}{3\pi\sqrt{2}}\right)^2 + \left(\frac{4V_P}{5\pi\sqrt{2}}\right)^2 + \left(\frac{4V_P}{7\pi\sqrt{2}}\right)^2 + \left(\frac{4V_P}{9\pi\sqrt{2}}\right)^2} = \\ &= \sqrt{\left(\frac{4 \cdot 4}{\pi\sqrt{2}}\right)^2 + \left(\frac{16}{3\pi\sqrt{2}}\right)^2 + \left(\frac{16}{5\pi\sqrt{2}}\right)^2 + \left(\frac{16}{7\pi\sqrt{2}}\right)^2 + \left(\frac{16}{9\pi\sqrt{2}}\right)^2} = 3.92 \text{ V} \end{aligned}$$

Compare 2.3 V with RMS of triangle signal:

$$V_{TW}(t) = V_P \left(\frac{1}{2} - \frac{1}{\pi} \left(\sin(2\pi ft) + \frac{1}{2}\sin(4\pi ft) + \frac{1}{3}\sin(6\pi ft) + \frac{1}{4}\sin(8\pi ft) + \frac{1}{5}\sin(10\pi ft) \right) \right),$$

$$\begin{aligned} V_{RMS.TW} &= \sqrt{\left(\frac{V_P}{2}\right)^2 + \left(\frac{V_P}{\pi\sqrt{2}}\right)^2 + \left(\frac{V_P}{2\pi\sqrt{2}}\right)^2 + \left(\frac{V_P}{3\pi\sqrt{2}}\right)^2 + \left(\frac{V_P}{4\pi\sqrt{2}}\right)^2 + \left(\frac{V_P}{5\pi\sqrt{2}}\right)^2} = \\ &= \sqrt{2^2 + \left(\frac{4}{\pi\sqrt{2}}\right)^2 + \left(\frac{4}{2\pi\sqrt{2}}\right)^2 + \left(\frac{4}{3\pi\sqrt{2}}\right)^2 + \left(\frac{4}{4\pi\sqrt{2}}\right)^2 + \left(\frac{4}{5\pi\sqrt{2}}\right)^2} = 2.28 \text{ V}. \end{aligned}$$

The signal has triangle waveform.

Answer

Triangle wave signal

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