

## Fourier Series Example: Ramp Waveform

Problem: Consider the periodic waveform shown above.

The Fourier Series representing  $v(t)$  has been determined to be

$$v(t) = 5 - \frac{10\sin(2000\pi t)}{\pi} - \frac{10\sin(4000\pi t)}{2\pi} - \frac{10\sin(6000\pi t)}{3\pi} - \dots$$

Use MathCAD to graph  $v(t)$  as each term is added to see how this series of sinusoids will actually produce the ramp waveform shown above.

$t := 0, 0.000001 .. 0.003$  (let  $t$  vary from 0 to 3ms in order to graph 3 periods)

$$V0(t) := 5 \quad (\text{DC term only})$$

$$V1(t) := V0(t) - \frac{10}{\pi} \cdot \sin(1 \cdot 2000 \cdot \pi \cdot t) \quad (\text{DC term} + 1\text{st harmonic})$$

$$V2(t) := V1(t) - \frac{10}{2 \cdot \pi} \cdot \sin(2 \cdot 2000 \cdot \pi \cdot t) \quad (\text{DC term} + 1\text{st and 2nd harmonics})$$

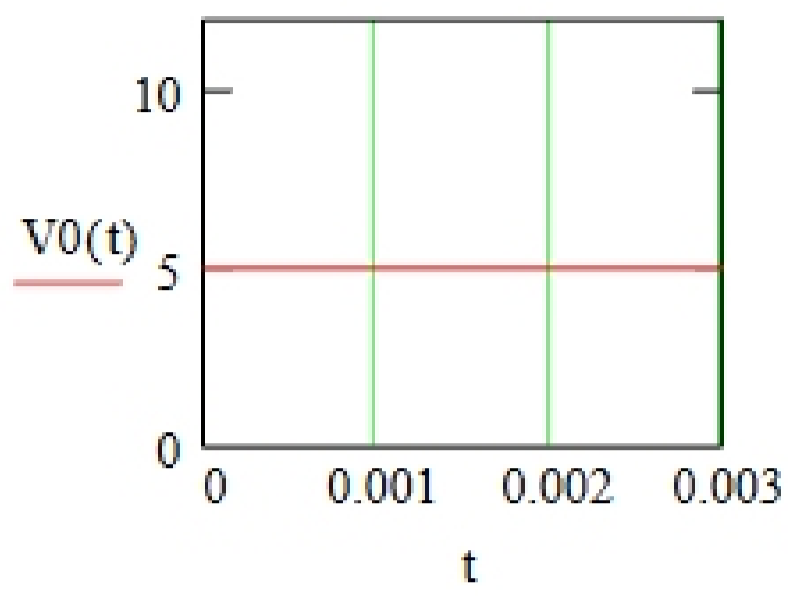
$$V3(t) := V2(t) - \frac{10}{3 \cdot \pi} \cdot \sin(3 \cdot 2000 \cdot \pi \cdot t) \quad (\text{DC term} + 1\text{st, 2nd, and 3rd harmonics})$$

$$V4(t) := V3(t) - \frac{10}{4 \cdot \pi} \cdot \sin(4 \cdot 2000 \cdot \pi \cdot t) \quad (\text{DC term} + 1\text{st} - 4\text{th harmonics})$$

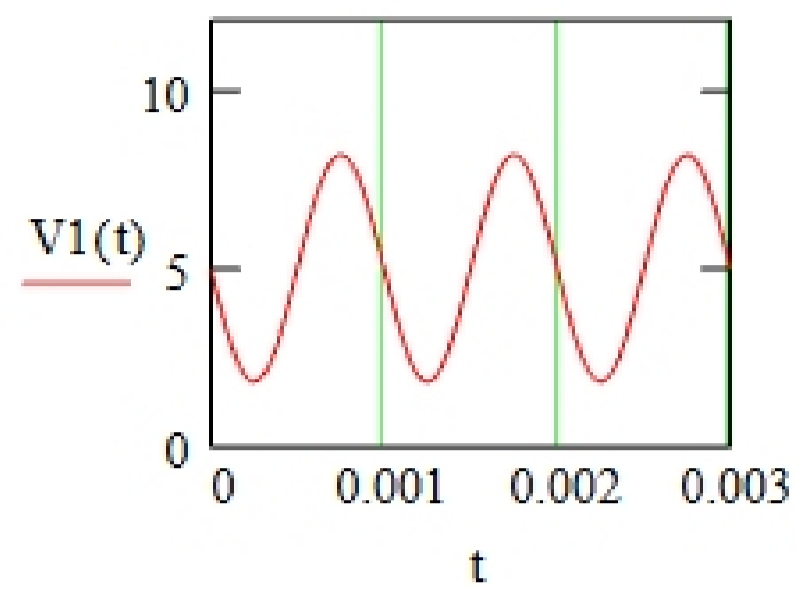
$$V5(t) := V4(t) - \frac{10}{5 \cdot \pi} \cdot \sin(5 \cdot 2000 \cdot \pi \cdot t) \quad (\text{DC term} + 1\text{st} - 5\text{th harmonics})$$

$$V100(t) := 5 - \sum_{N=1}^{100} \left( \frac{10}{N \cdot \pi} \cdot \sin(N \cdot 2000 \cdot \pi \cdot t) \right) \quad (\text{DC term} + 1\text{st} - 100\text{th harmonics})$$

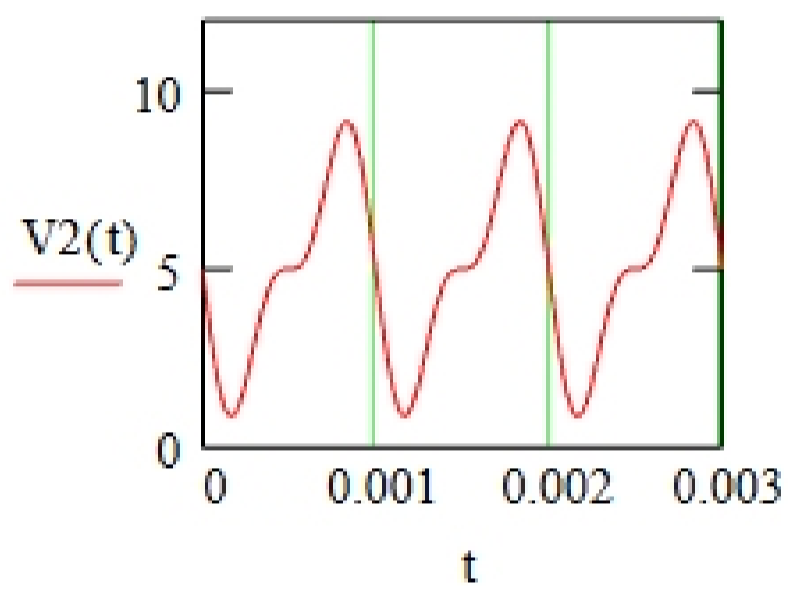
DC term only



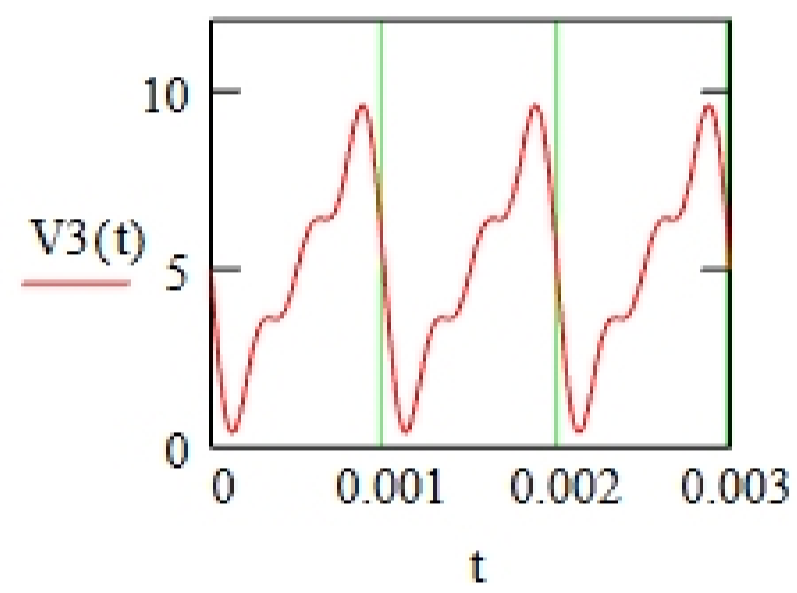
DC term + 1st harmonic



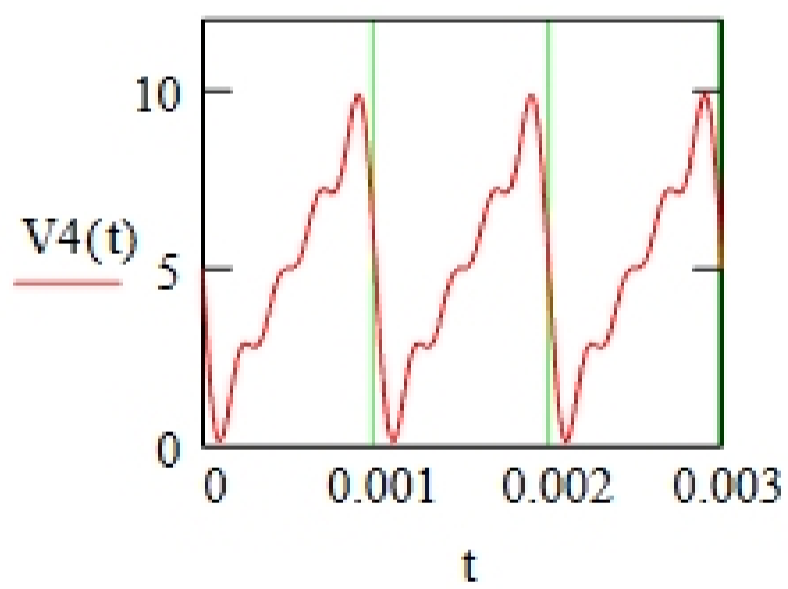
DC term + 1st and 2nd harmonics



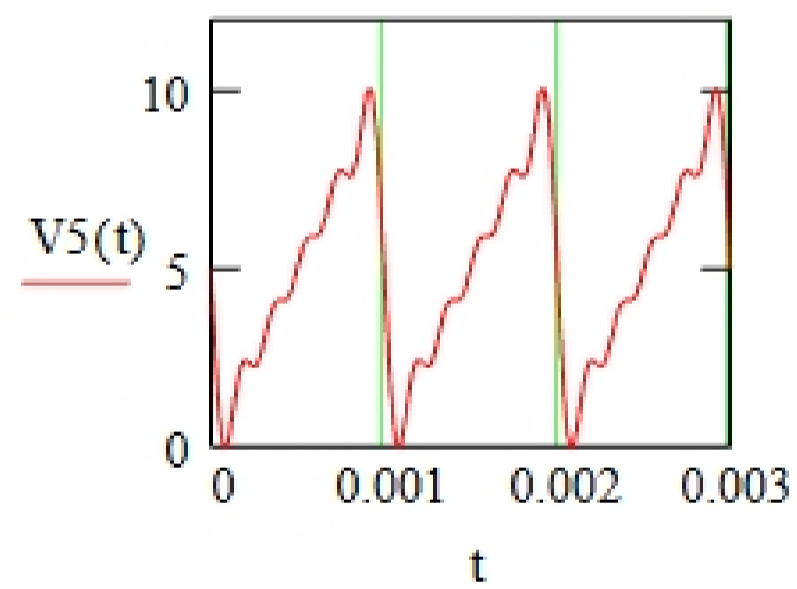
DC term + 1st, 2nd, and 3rd harmonics



DC term + 1st - 4th harmonics



DC term + 1st - 5th harmonics



DC term + 1st - 100th harmonics

