RMS

Peak, frequency and period

$Xo := 40\ V$ $\omega := 3\ Hz$ $To := \frac{2 \cdot \pi}{\omega} = 2.0944\ s$

Discretize with 500 points over 6 periods

$T := \frac{6 \cdot To}{500} \cdot [0..500]$

Distance between two periodic functions and Eucliedean Norme of a function

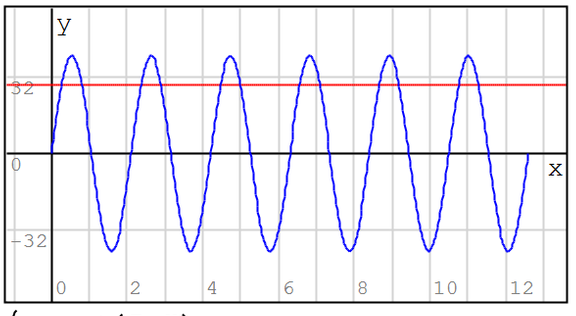
$Dot(a, b) := \frac{UoM(To)}{To} \cdot \int_0^{To} a \cdot \overline{b}\, dt$

$N(a) := \sqrt{Dot(a, a)}$

Sinusoid

$x(t) := Xo \cdot \sin(\omega \cdot t)$

$X_{rms} := N(x(t\ s))$
$X := \text{eval}\left(\overrightarrow{x(T)}\right)$
$X_{Trms} := \frac{\text{norme}(X)}{\sqrt{\text{length}(X)}}$
$X_F := \text{fft}(X)$
$X_{Frms} := \frac{\text{norme}(X_F)}{\text{length}(X_F)}$



augment (T, X)
X_{rms}

Integral, time domain, freq domain and theoric RMS values

$X_{rms} = 28.2843\ V$

$X_{Trms} = 28.256\ V$

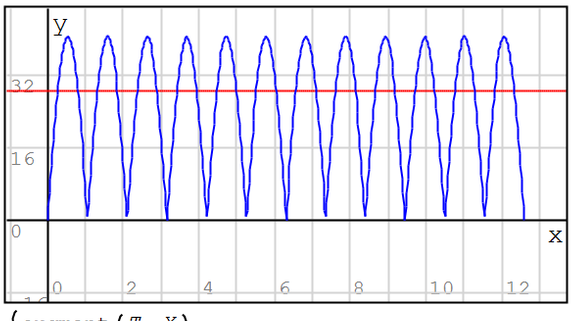
$X_{Frms} = 28.256$

$\frac{Xo}{\sqrt{2}} = 28.2843\ V$

Full rectified sinusoid

$x(t) := Xo \cdot |\sin(\omega \cdot t)|$

$X_{rms} := N(x(t\ s))$
$X := \text{eval}\left(\overrightarrow{x(T)}\right)$
$X_{Trms} := \frac{\text{norme}(X)}{\sqrt{\text{length}(X)}}$
$X_F := \text{fft}(X)$
$X_{Frms} := \frac{\text{norme}(X_F)}{\text{length}(X_F)}$



augment (T, X)
X_{rms}

$X_{rms} = 28.2843\ V$

$X_{Trms} = 28.256\ V$

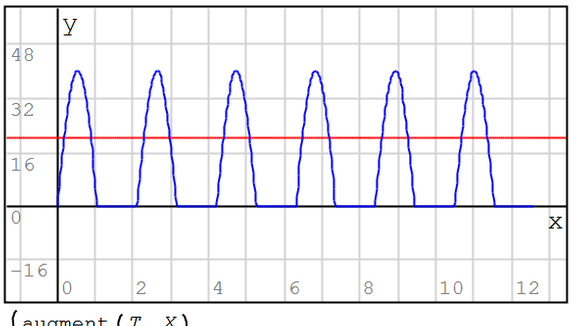
$X_{Frms} = 28.256$

$\frac{Xo}{\sqrt{2}} = 28.2843\ V$

Half rectified sin

$x(t) := Xo \cdot \sin(\omega \cdot t) \cdot (\sin(\omega \cdot t) > 0)$

$X_{rms} := N(x(t\ s))$
$X := \text{eval}\left(\overrightarrow{x(T)}\right)$
$X_{Trms} := \frac{\text{norme}(X)}{\sqrt{\text{length}(X)}}$
$X_F := \text{fft}(X)$
$X_{Frms} := \frac{\text{norme}(X_F)}{\text{length}(X_F)}$



augment (T, X)

$X_{rms} = 20\ V$

$X_{Trms} = 19.98\ V$

$X_{Frms} = 19.98$

$\frac{Xo}{2} = 20\ V$

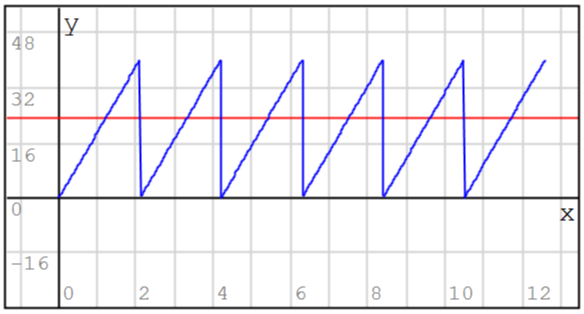
X_{rms}

Half rectified sin

$$x(t) := Xo \cdot frac\left(\frac{t}{To}\right)$$

$$frac(x) := x - \mathrm{trunc}(x)$$

$$\left| \begin{array}{l} X_{rms} := N(x(t\ s)) \\ X := \mathrm{eval}\left(\overrightarrow{x(T)}\right) \\ X_{Trms} := \dfrac{\mathrm{norme}(X)}{\sqrt{\mathrm{length}(X)}} \\ X_F := \mathrm{fft}(X) \\ X_{Frms} := \dfrac{\mathrm{norme}(X_F)}{\mathrm{length}(X_F)} \end{array} \right.$$



$\left\{ \begin{array}{l} \mathrm{augment}(T, X) \\ X_{rms} \end{array} \right.$

$X_{rms} = 23.0362\ \mathrm{V}$

$X_{Trms} = 23.1402\ \mathrm{V}$

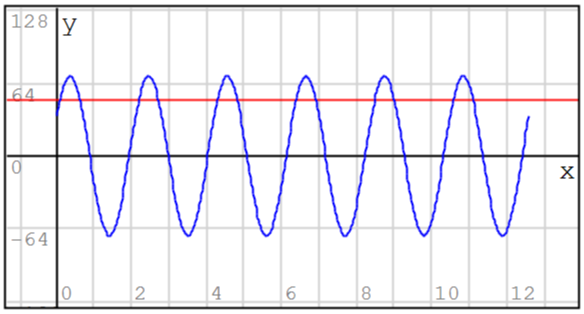
$X_{Frms} = 23.1402$

$\dfrac{Xo}{\sqrt{3}} = 23.094\ \mathrm{V}$

Fase to fase

$$x(t) := Xo \cdot \sin(\omega \cdot t) - Xo \cdot \sin\left(\omega \cdot t - \frac{2}{3} \cdot \pi\right)$$

$$\left| \begin{array}{l} X_{rms} := N(x(t\ s)) \\ X := \mathrm{eval}\left(\overrightarrow{x(T)}\right) \\ X_{Trms} := \dfrac{\mathrm{norme}(X)}{\sqrt{\mathrm{length}(X)}} \\ X_F := \mathrm{fft}(X) \\ X_{Frms} := \dfrac{\mathrm{norme}(X_F)}{\mathrm{length}(X_F)} \end{array} \right.$$



$\left\{ \begin{array}{l} \mathrm{augment}(T, X) \\ X_{rms} \end{array} \right.$

$X_{rms} = 48.9898\ \mathrm{V}$

$X_{Trms} = 48.9653\ \mathrm{V}$

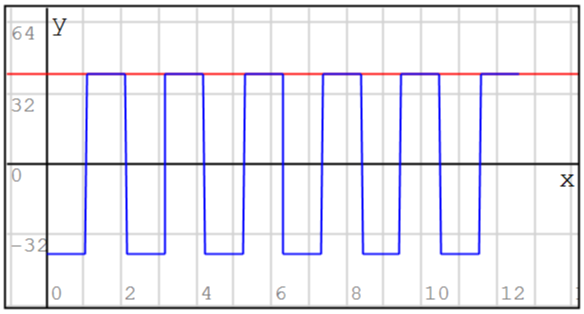
$X_{Frms} = 48.9653$

$\sqrt{\dfrac{3}{2}} \cdot Xo = 48.9898\ \mathrm{V}$

Square

$$x(t) := \begin{cases} Xo & \text{if } frac\left(\frac{t}{To}\right) > 0.5 \\ -Xo & \text{otherwise} \end{cases}$$

$$\left| \begin{array}{l} X_{rms} := N(x(t\ s)) \\ X := \mathrm{eval}\left(\overrightarrow{x(T)}\right) \\ X_{Trms} := \dfrac{\mathrm{norme}(X)}{\sqrt{\mathrm{length}(X)}} \\ X_F := \mathrm{fft}(X) \\ X_{Frms} := \dfrac{\mathrm{norme}(X_F)}{\mathrm{length}(X_F)} \end{array} \right.$$



$\left\{ \begin{array}{l} \mathrm{augment}(T, X) \\ X_{rms} \end{array} \right.$

$X_{rms} = 40\ \mathrm{V}$

$X_{Trms} = 40\ \mathrm{V}$

$X_{Frms} = 40$

$\dfrac{Xo}{1} = 40\ \mathrm{V}$

Alvaro