

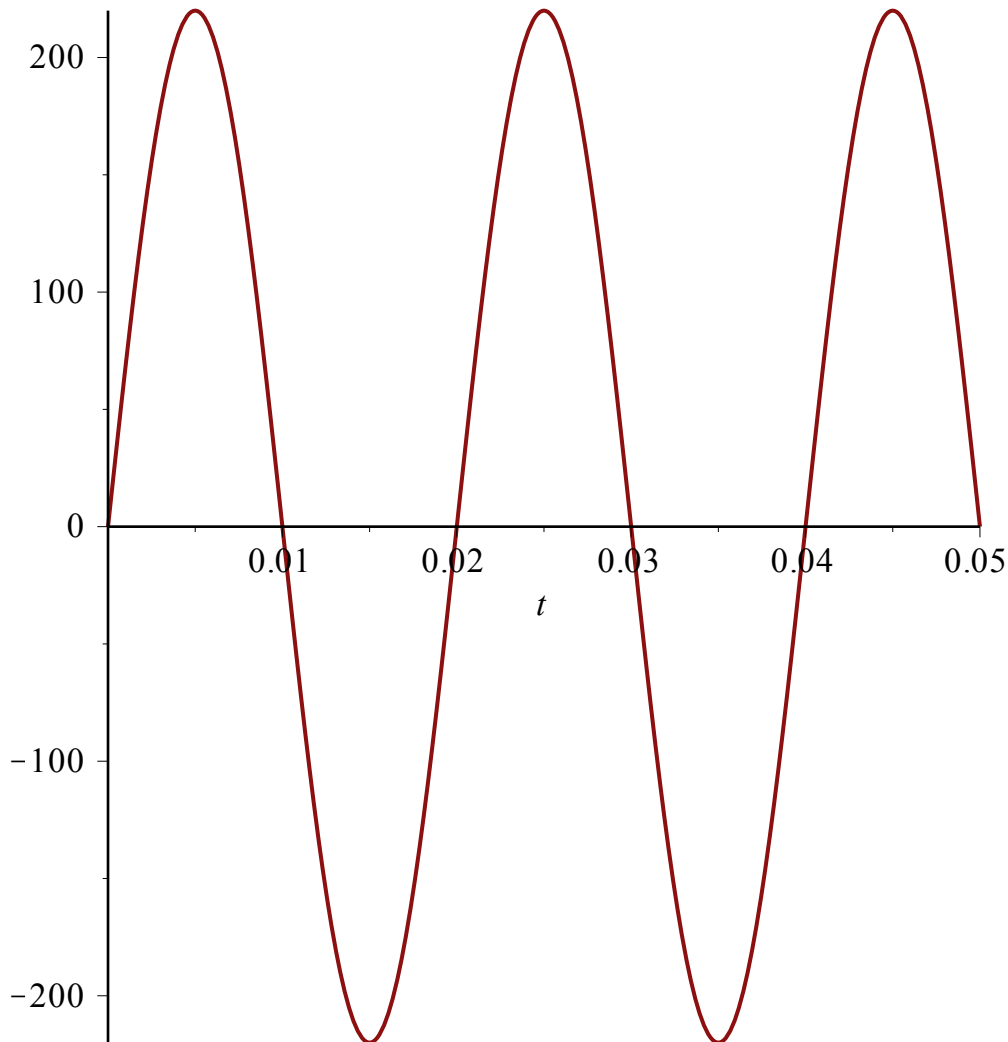
## Rectification of sinusoidal wave

```
> V := 220*sin(50*(2*Pi)*t) ;
```

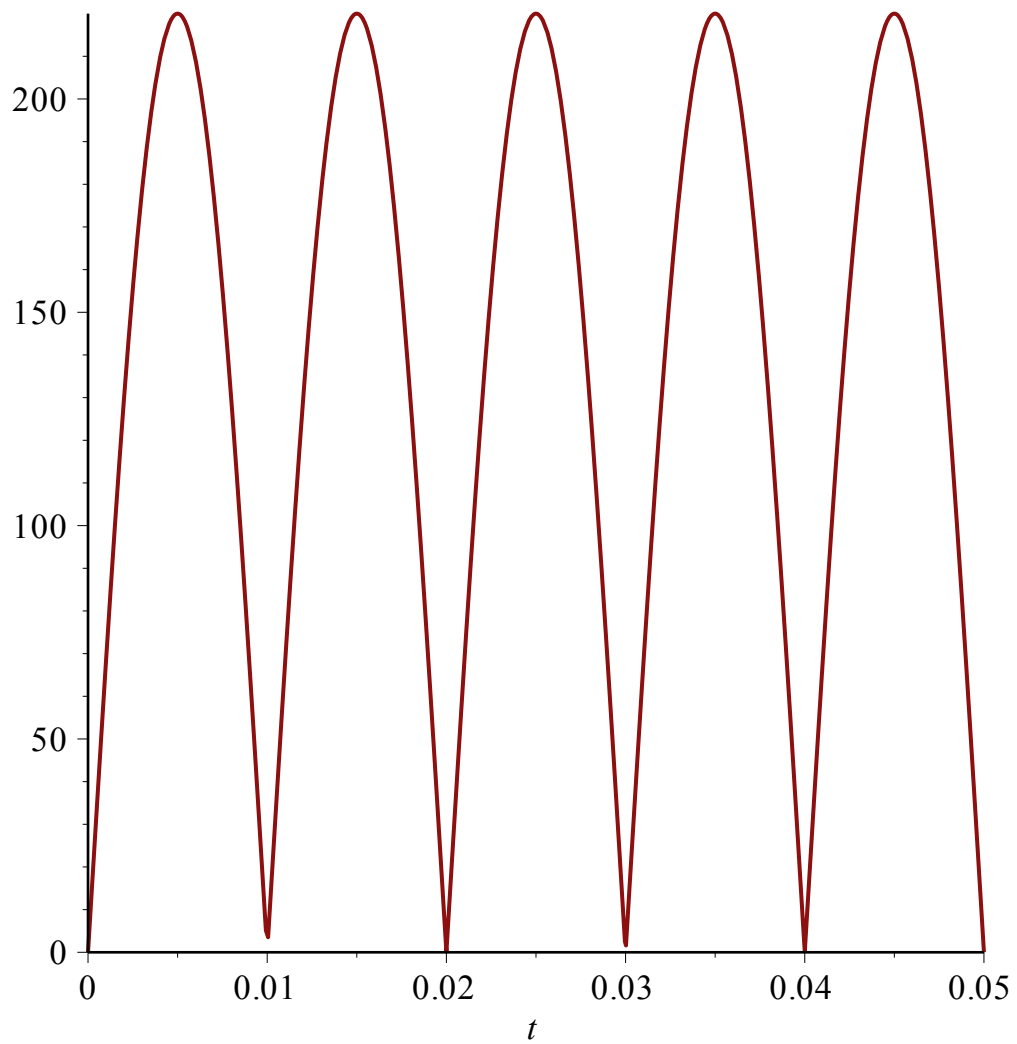
$$V := 220 \sin(100 \pi t)$$

(1)

```
> plot( V, t=0..0.05) ;
```



```
> plot( abs(V), t=0..0.05) ;
```



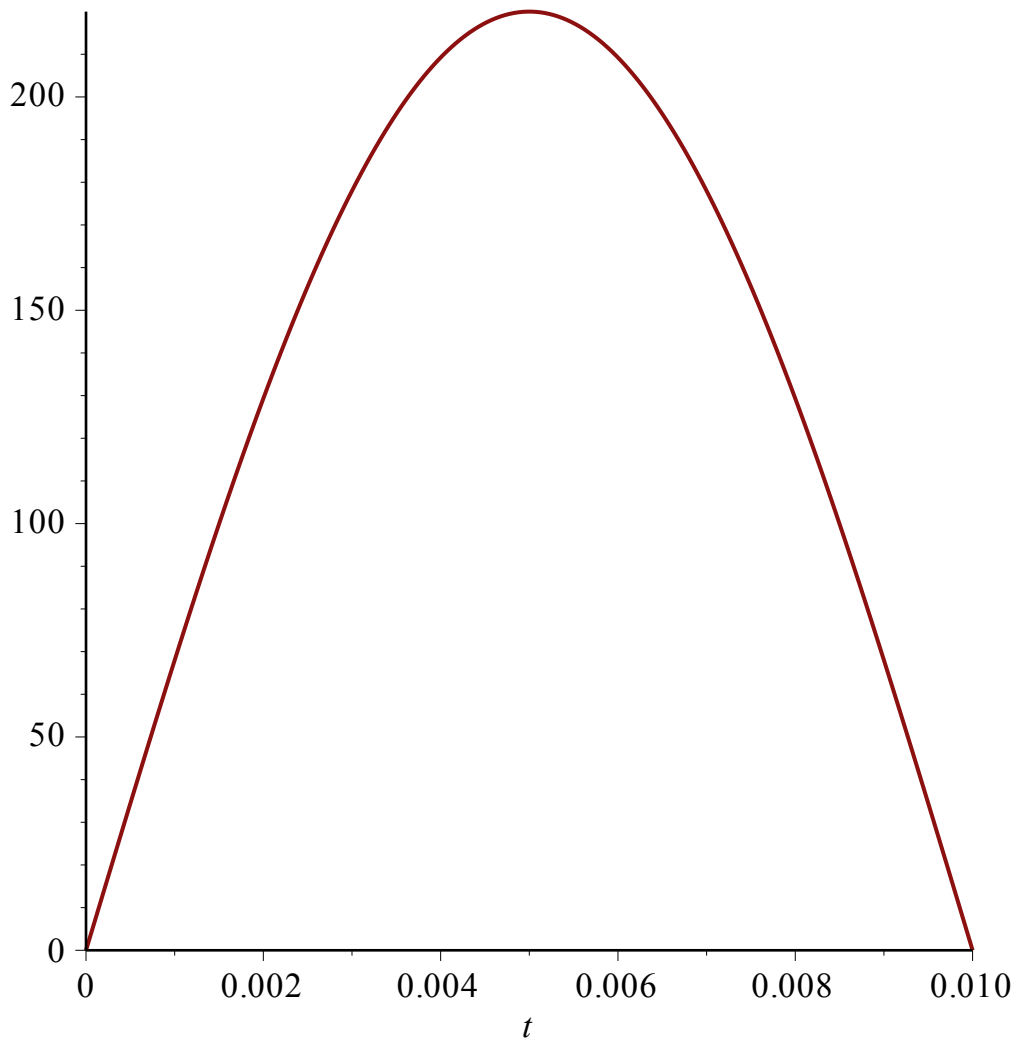
ELL = half of the period of the wave

```
> ELL := 1/200 ;
```

$$ELL := \frac{1}{200}$$

(2)

```
> plot( v, t=0..2*ELL) ;
```



Compute the coefficients of fourier

$$ELL := \frac{1}{200} \quad (3)$$

```
> a0 := (1/ELL)*int( V, t=0..2*ELL) ; evalf(%/2) ;
```

$$a0 := \frac{880}{\pi}$$

140.0563499 (4)

```
> ak := (1/ELL)*int( V*cos(k*Pi/ELL*t), t=0..2*ELL) ; simplify(%)
assuming k::integer ;
```

$$ak := -\frac{880 \cos(k \pi)^2}{\pi (4 k^2 - 1)}$$

$$-\frac{880}{\pi (4 k^2 - 1)} \quad (5)$$

```
> bk := (1/ELL)*int( V*sin(k*Pi/ELL*t), t=0..2*ELL) ; simplify(%)
assuming k::integer ;
```

$$bk := -\frac{880 \sin(k \pi) \cos(k \pi)}{\pi (4 k^2 - 1)}$$

$$0 \quad (6)$$

```
> subs(k=2000,%); evalf(%);
```

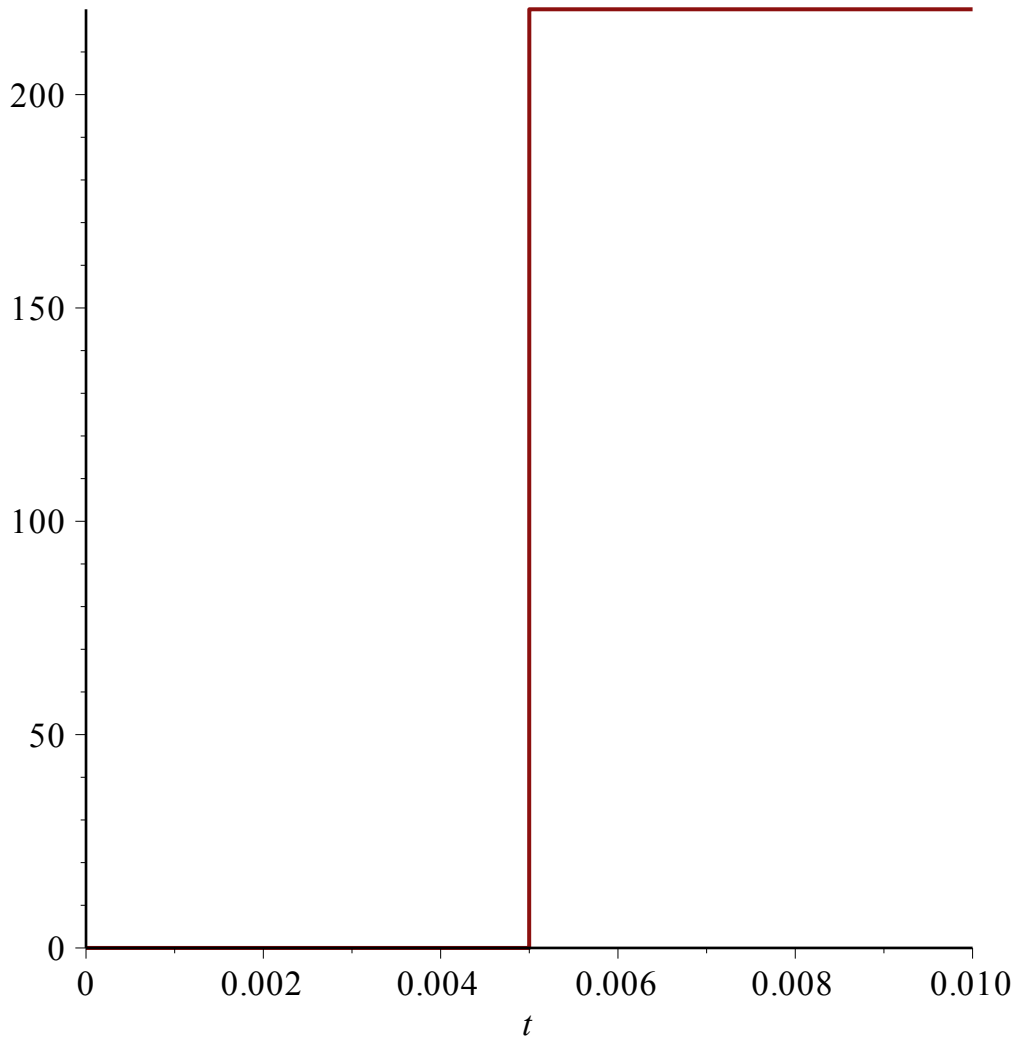
$$0 \quad (7)$$

Example of the contribution of the square wave

```
> SQ := piecewise( t < ELL, 0, 220 );
```

$$SQ := \begin{cases} 0 & t < \frac{1}{200} \\ 220 & \text{otherwise} \end{cases} \quad (8)$$

```
> plot( SQ, t=0..2*ELL );
```



```
> a0 := (1/ELL)*int( SQ, t=0..2*ELL ); evalf(%/2);
```

$$a_0 := 220$$

$$110. \quad (9)$$

```
> ak := (1/ELL)*int( SQ*cos(k*Pi/ELL*t), t=0..2*ELL ); simplify(%);
assuming k::integer;
```

$$ak := \frac{220 \sin(k\pi) (-1 + 2 \cos(k\pi))}{k\pi}$$

$$0 \quad (10)$$

```
> bk := (1/ELL)*int( SQ*sin(k*Pi/ELL*t), t=0..2*ELL) ; simplify(%)
assuming k::integer ;
```

$$bk := - \frac{220 (2 \cos(k \pi)^2 - \cos(k \pi) - 1)}{k \pi}$$

$$\frac{220 (-1 + (-1)^k)}{k \pi} \quad (11)$$

Tri phase envelop

```
> omega := 50*(2*Pi) ;
```

$$\omega := 100 \pi \quad (12)$$

```
> V1 := 380*sin(omega*t) ;
```

```
V2 := 380*sin(omega*t+2*Pi/3) ;
```

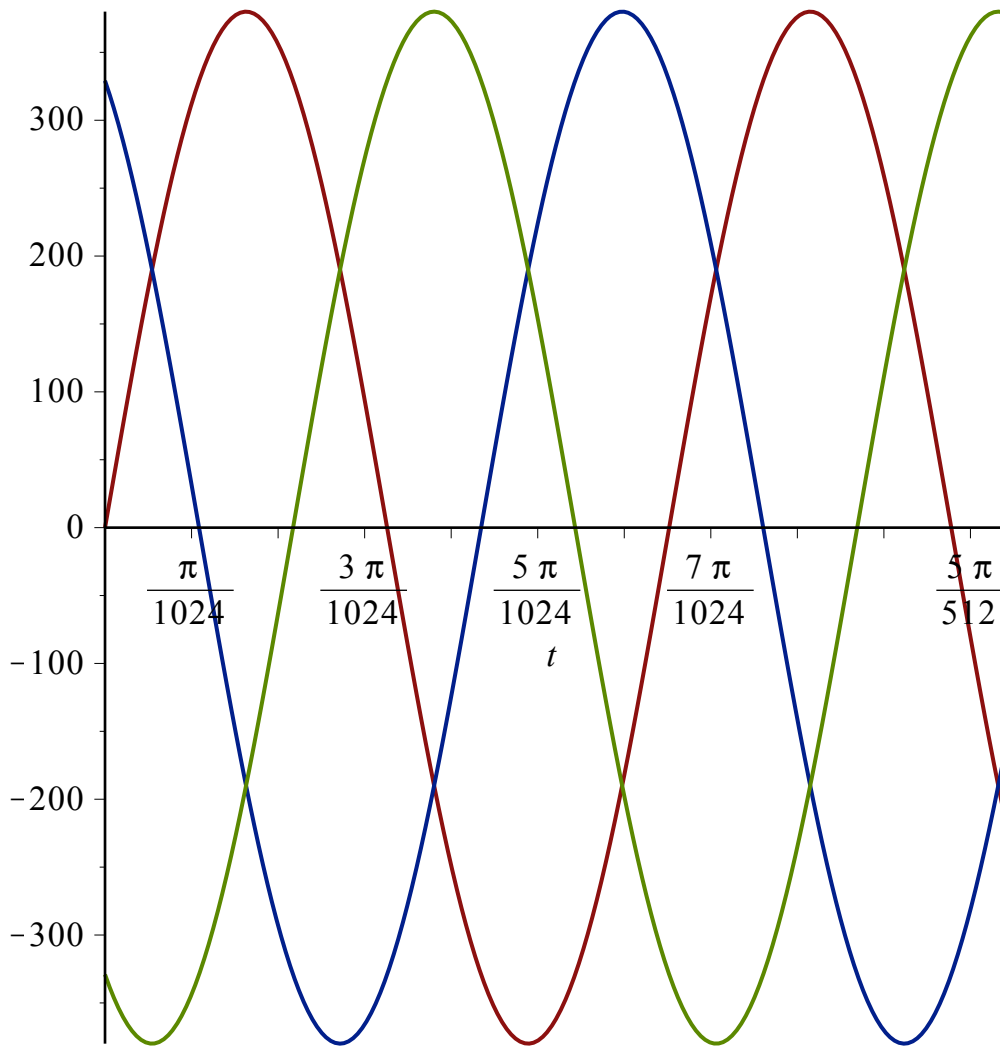
```
V3 := 380*sin(omega*t+4*Pi/3) ;
```

$$V1 := 380 \sin(100 \pi t)$$

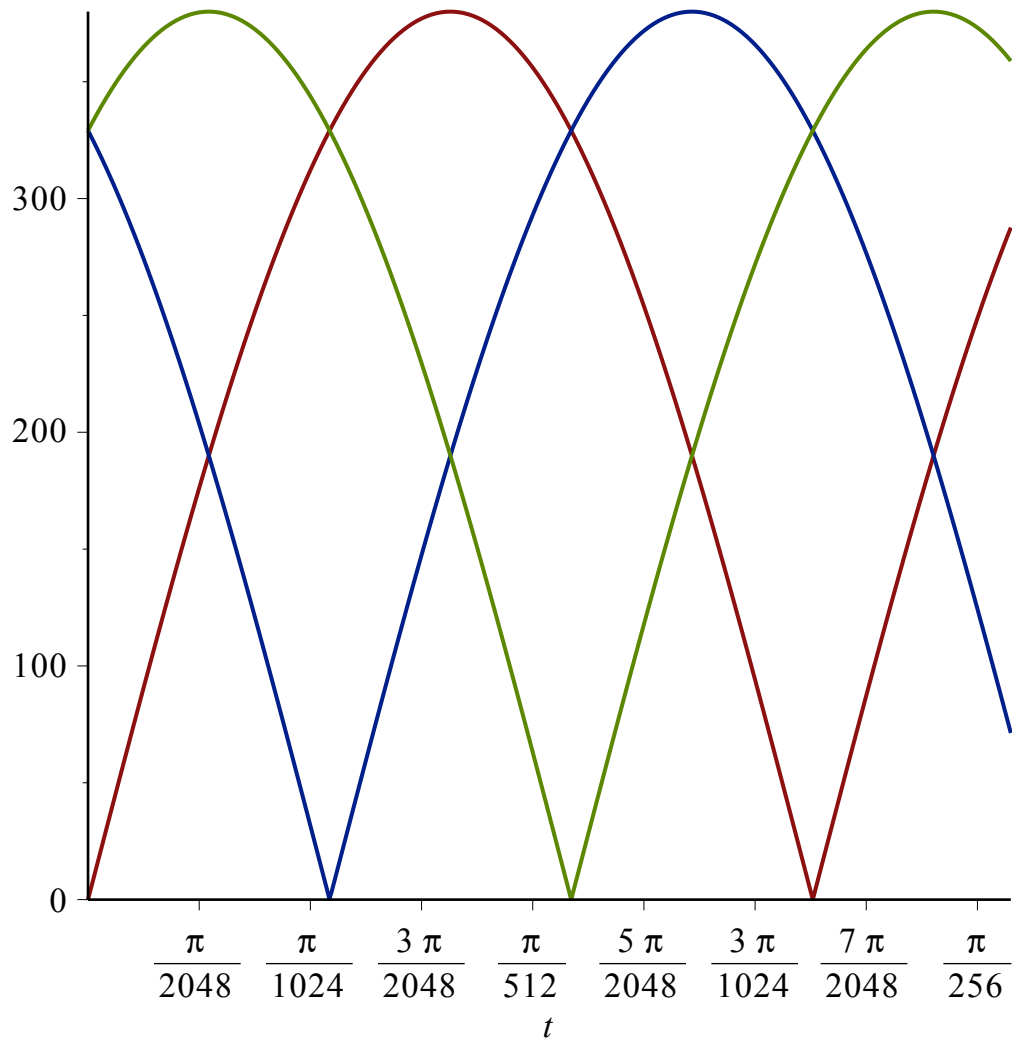
$$V2 := 380 \cos\left(100 \pi t + \frac{1}{6} \pi\right)$$

$$V3 := -380 \sin\left(100 \pi t + \frac{1}{3} \pi\right) \quad (13)$$

```
> plot( [V1,V2,V3], t=0..5*ELL) ;
```



```
> plot( [abs(V1),abs(V2),abs(V3)], t=0..2*ELL) ;
```

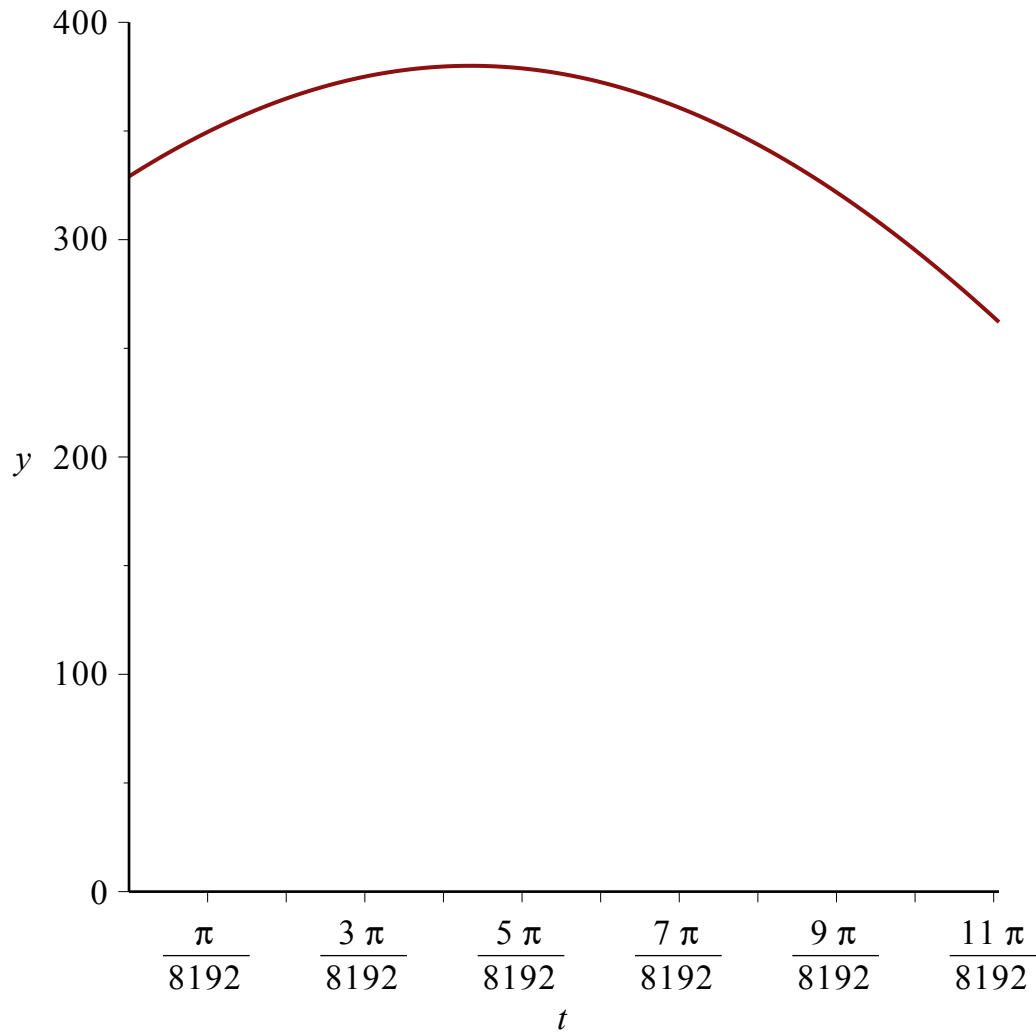


```
> ELL1 := ELL/3 ;
```

$$ELL1 := \frac{1}{150 \pi}$$

(14)

```
> plot( -V3, t=0..2*ELL1, y=0..400) ;
```



Fourier series of rectified voltage

> **RV := -V2 ;**

$$RV := -380 \cos\left(100 \pi t + \frac{1}{6} \pi\right) \quad (15)$$

> **a0 := (1/ELL1)\*int( RV, t=0..2\*ELL1) ; evalf(%/2) ;**

$$a0 := \frac{2280}{\pi} \\ 362.8732702 \quad (16)$$

> **ak := (1/ELL1)\*int( RV\*cos(k\*Pi/ELL1\*t), t=0..2\*ELL1) ; simplify(%)**  
**assuming k::integer ;**

$$ak := \frac{2280 \cos(k \pi) (6 k \sqrt{3} \sin(k \pi) - \cos(k \pi))}{\pi (36 k^2 - 1)} \\ - \frac{2280}{\pi (36 k^2 - 1)} \quad (17)$$

> **bk := (1/ELL1)\*int( RV\*sin(k\*Pi/ELL1\*t), t=0..2\*ELL1) ; simplify(%)**  
**assuming k::integer ;**



$$bk := - \frac{2280 (6 k \sqrt{3} \cos(k \pi)^2 + \sin(k \pi) \cos(k \pi) - 6 \sqrt{3} k)}{\pi (36 k^2 - 1)}$$

(18)

```
> 2280/36 ; evalf(%) ;
```

$$\frac{190}{3}$$

(19)

Ten Phase envelop

```
> restart;
```

```
> omega := 50*(2*Pi) ;
ELL := 2/omega;
```

$$\omega := 100 \pi$$

$$ELL := \frac{1}{50 \pi}$$

(20)

```
> V1 := 380*sin(omega*t) ;
V2 := 380*sin(omega*t+0.1*2*Pi) ;
V3 := 380*sin(omega*t+0.2*2*Pi) ;
V4 := 380*sin(omega*t+0.3*2*Pi) ;
V5 := 380*sin(omega*t+0.4*2*Pi) ;
V6 := 380*sin(omega*t+0.5*2*Pi) ;
V7 := 380*sin(omega*t+0.6*2*Pi) ;
V8 := 380*sin(omega*t+0.7*2*Pi) ;
V9 := 380*sin(omega*t+0.8*2*Pi) ;
V10 := 380*sin(omega*t+0.9*2*Pi) ;
```

$$V1 := 380 \sin(100 \pi t)$$

$$V2 := 380 \sin(100 \pi t + 0.2 \pi)$$

$$V3 := 380 \sin(100 \pi t + 0.4 \pi)$$

$$V4 := 380 \sin(100 \pi t + 0.6 \pi)$$

$$V5 := 380 \sin(100 \pi t + 0.8 \pi)$$

$$V6 := 380 \sin(100 \pi t + 1.0 \pi)$$

$$V7 := 380 \sin(100 \pi t + 1.2 \pi)$$

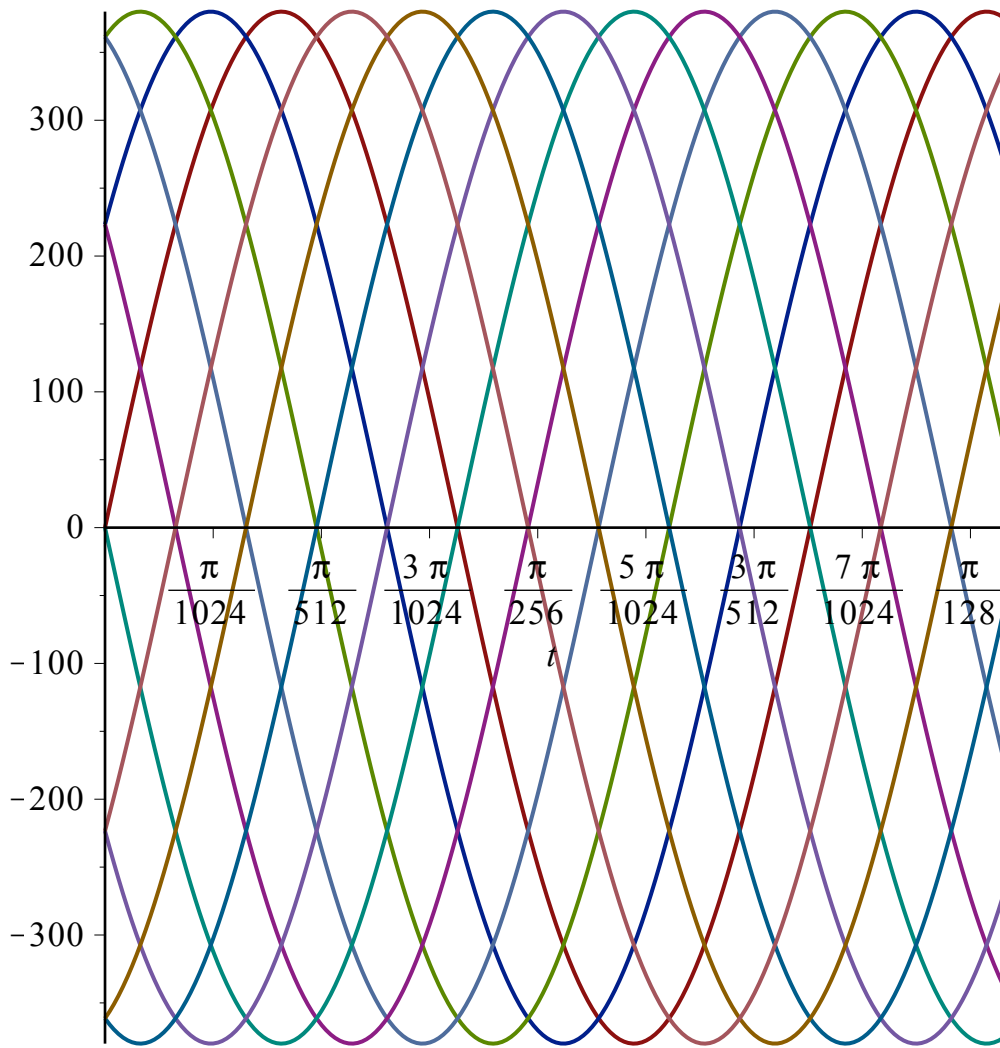
$$V8 := 380 \sin(100 \pi t + 1.4 \pi)$$

$$V9 := 380 \sin(100 \pi t + 1.6 \pi)$$

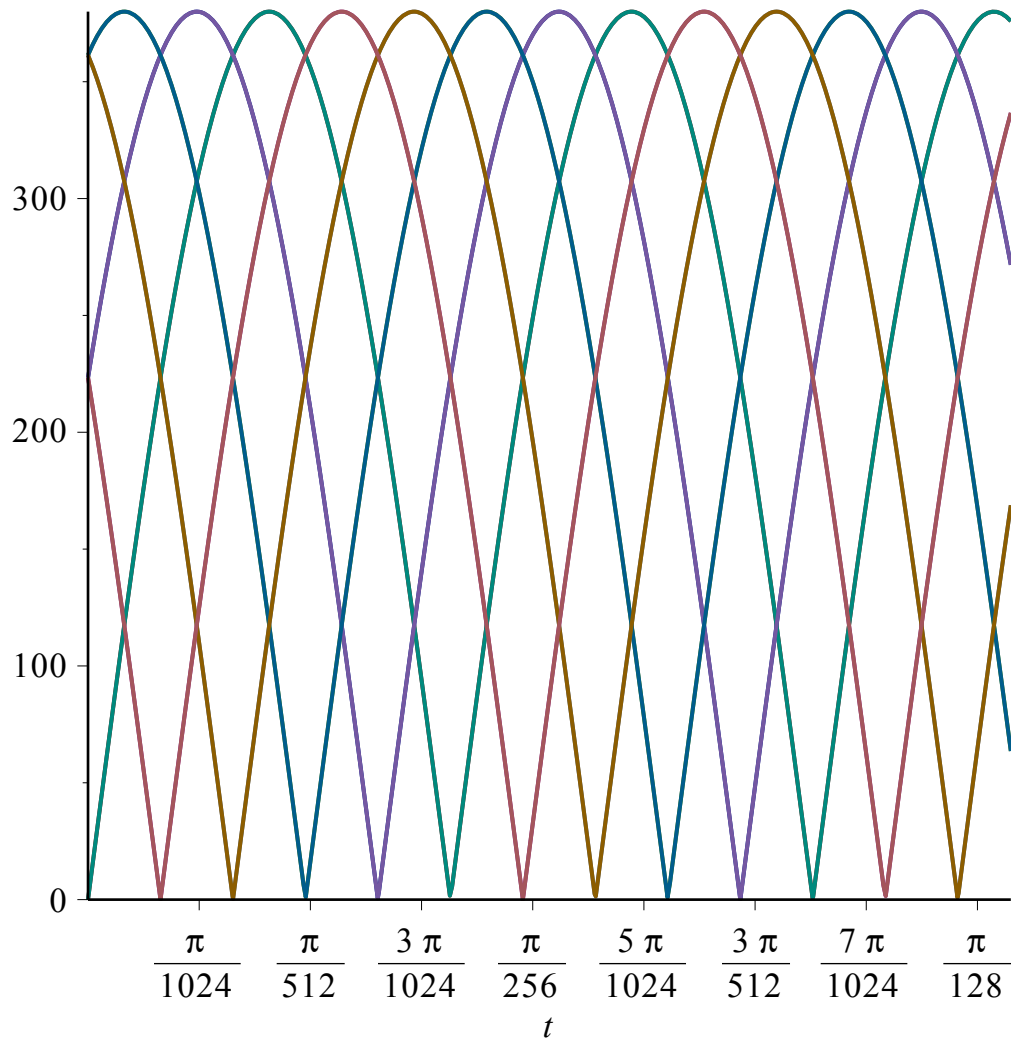
$$V10 := 380 \sin(100 \pi t + 1.8 \pi)$$

(21)

```
> plot( [V1,V2,V3,V4,V5,V6,V7,V8,V9,V10], t=0..4*ELL) ;
```



```
> plot( [abs(V1),abs(V2),abs(V3),abs(V4),abs(V5),abs(V6),abs(V7),abs(V8),abs(V9),abs(V10)], t=0..4*ELL) ;
```



```
> plot( max(abs(V1),abs(V2),abs(V3),abs(V4),abs(V5),abs(V6),abs(V7),
abs(V8),abs(V9),abs(V10)), t=0..4*ELL,y=0..400) ;
```

