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# Inverters Formulas

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# List of 15 Inverters Formulas

## Inverters

### Series Resonant Inverter

#### 1) Maximum Output Frequency for Bidirectional Switches

$$\text{fx } f_m = \frac{1}{2 \cdot t_{\text{off}}}$$

[Open Calculator !\[\]\(de95854c7ee024cfadc48187bbb781b2\_img.jpg\)](#)

$$\text{ex } 0.25\text{Hz} = \frac{1}{2 \cdot 2\text{s}}$$

#### 2) Maximum Output Frequency for Unidirectional Switches

$$\text{fx } f_m = \frac{1}{2 \cdot \left( t_{\text{off}} + \left( \frac{\pi}{f_o} \right) \right)}$$

[Open Calculator !\[\]\(6a9b39b98eb945faa14c645ec99e4eaa\_img.jpg\)](#)

$$\text{ex } 0.234643\text{Hz} = \frac{1}{2 \cdot \left( 2\text{s} + \left( \frac{\pi}{24\text{Hz}} \right) \right)}$$



### 3) Resonant Frequency for Unidirectional Switches

[Open Calculator !\[\]\(4729e517bc6a7cd81c8025b9646574fb\_img.jpg\)](#)

$$\text{fx } f_o = \left( \left( \frac{1}{L \cdot C} \right) + \left( \frac{R^2}{4 \cdot L^2} \right) \right)^{0.5}$$

$$\text{ex } 23.86868\text{Hz} = \left( \left( \frac{1}{0.57\text{H} \cdot 0.2\text{F}} \right) + \left( \frac{(27\Omega)^2}{4 \cdot (0.57\text{H})^2} \right) \right)^{0.5}$$

### 4) Time when Current becomes Maximum for Unidirectional Switches

[Open Calculator !\[\]\(e474458956c9a37fbf9586ddb60a7fa1\_img.jpg\)](#)

$$\text{fx } t_r = \left( \frac{1}{f_o} \right) \cdot a \tan \left( \frac{f_o \cdot 2 \cdot L}{R} \right)$$

$$\text{ex } 0.033001\text{s} = \left( \frac{1}{24\text{Hz}} \right) \cdot a \tan \left( \frac{24\text{Hz} \cdot 2 \cdot 0.57\text{H}}{27\Omega} \right)$$

## Single Phase Inverters

### 5) RMS Output Voltage for RL Load

[Open Calculator !\[\]\(0d5ec72f61334709c3fc9450209b754f\_img.jpg\)](#)

$$\text{fx } E_{\text{rms}} = \sqrt{\left( \frac{2}{\frac{T}{2}} \right) \cdot \int \left( (E^2), x, 0, \frac{T}{2} \right)}$$

$$\text{ex } 296.9848\text{V} = \sqrt{\left( \frac{2}{\frac{1.148\text{s}}{2}} \right) \cdot \int \left( ((210.0\text{V})^2), x, 0, \frac{1.148\text{s}}{2} \right)}$$



## 6) RMS Output Voltage for Single Phase Inverter

$$\text{fx } V_{\text{rms}} = \frac{V_i}{2}$$

[Open Calculator !\[\]\(e78f798d4ea5c530c9db49e7d26e6b95\_img.jpg\)](#)

$$\text{ex } 112.5\text{V} = \frac{225\text{V}}{2}$$

## 7) RMS Output Voltage for SPWM Inverter

$$\text{fx } V_{o(\text{rms})} = V_i \cdot \sqrt{\sum \left( x, 1, N_p, \left( \frac{P_m}{\pi} \right) \right)}$$

[Open Calculator !\[\]\(05be7c7a8995decd503647c99211f7c2\_img.jpg\)](#)

$$\text{ex } 209.3592\text{V} = 225\text{V} \cdot \sqrt{\sum \left( x, 1, 4, \left( \frac{0.68\text{s}}{\pi} \right) \right)}$$

## 8) RMS Value of Fundamental Component of Voltage for Full Bridge

$$\text{fx } V_{0(\text{full})} = 0.9 \cdot V_i$$

[Open Calculator !\[\]\(fe3aebe81acea8d45108cd2768939da7\_img.jpg\)](#)

$$\text{ex } 202.5\text{V} = 0.9 \cdot 225\text{V}$$

## 9) RMS Value of Fundamental Component of Voltage for Half Bridge

$$\text{fx } V_{0(\text{half})} = 0.45 \cdot V_i$$

[Open Calculator !\[\]\(899d8b7697d64725bf017d3296cfcf1b\_img.jpg\)](#)

$$\text{ex } 101.25\text{V} = 0.45 \cdot 225\text{V}$$



## Three Phase Inverters

### 10) Average Transistor Current Rating

$$\text{fx } I_{\text{avg}} = \left( \frac{1}{2 \cdot \pi} \right) \cdot \int \left( \frac{V_i}{2 \cdot R}, x, 0, \frac{2 \cdot \pi}{3} \right)$$

[Open Calculator !\[\]\(74d4806277d7e73349d8e8c0897931e9\_img.jpg\)](#)

$$\text{ex } 1.388889\text{A} = \left( \frac{1}{2 \cdot \pi} \right) \cdot \int \left( \frac{225\text{V}}{2 \cdot 27\Omega}, x, 0, \frac{2 \cdot \pi}{3} \right)$$

### 11) Line to Line RMS Voltage for SPWM Inverter

$$\text{fx } V_{\text{LL}} = \sqrt{\left( \frac{2}{\pi} \right) \cdot \int \left( (V_i^2), x, 0, \left( \frac{2 \cdot \pi}{3} \right) \right)}$$

[Open Calculator !\[\]\(8bba887393ca45b761e5cb49e755e762\_img.jpg\)](#)

$$\text{ex } 259.8076\text{V} = \sqrt{\left( \frac{2}{\pi} \right) \cdot \int \left( ((225\text{V})^2), x, 0, \left( \frac{2 \cdot \pi}{3} \right) \right)}$$

### 12) Line-to-Line RMS Voltage

$$\text{fx } V_{\text{ll}} = 0.8165 \cdot V_i$$

[Open Calculator !\[\]\(0fb13ad0bfa3d86868cdd3883e5665b3\_img.jpg\)](#)

$$\text{ex } 183.7125\text{V} = 0.8165 \cdot 225\text{V}$$

### 13) Line-to-Neutral Voltage

$$\text{fx } V_{\text{ln}} = 0.4714 \cdot V_i$$

[Open Calculator !\[\]\(e50091943b385fe16d3277389202856f\_img.jpg\)](#)

$$\text{ex } 106.065\text{V} = 0.4714 \cdot 225\text{V}$$



## 14) RMS of Fundamental Component of Line-to-Line Voltage

$$\text{fx } V_{0(3\text{rms})} = 0.7797 \cdot V_i$$

[Open Calculator !\[\]\(d3fb9f94af8b26d1c844efa9a98805b0\_img.jpg\)](#)

$$\text{ex } 175.4325\text{V} = 0.7797 \cdot 225\text{V}$$

## 15) RMS Transistor Current Rating

fx

[Open Calculator !\[\]\(e1d6102fe77919492c04879c8450f1f5\_img.jpg\)](#)

$$I_{\text{rms}} = \sqrt{\left(\frac{1}{2 \cdot \pi}\right) \cdot \int \left( \left(\frac{V_i}{2 \cdot R}\right)^2, x, 0, \left(\frac{2 \cdot \pi}{3}\right) \right)}$$

$$\text{ex } 2.405626\text{A} = \sqrt{\left(\frac{1}{2 \cdot \pi}\right) \cdot \int \left( \left(\frac{225\text{V}}{2 \cdot 27\Omega}\right)^2, x, 0, \left(\frac{2 \cdot \pi}{3}\right) \right)}$$



## Variables Used

- **C** Capacitance (*Farad*)
- **E** Input Voltage for RL Load (*Volt*)
- **E<sub>rms</sub>** RMS Output Voltage For RL Load (*Volt*)
- **f<sub>m</sub>** Peak Frequency (*Hertz*)
- **f<sub>o</sub>** Resonant Frequency (*Hertz*)
- **I<sub>avg</sub>** Average Transistor Current Rating (*Ampere*)
- **I<sub>rms</sub>** RMS Transistor Current Rating (*Ampere*)
- **L** Inductance (*Henry*)
- **N<sub>p</sub>** Number of Pulse in Half-cycle
- **P<sub>m</sub>** Pulse Width (*Second*)
- **R** Resistance (*Ohm*)
- **T** Time Period (*Second*)
- **t<sub>off</sub>** Off Time of Thyristor (*Second*)
- **t<sub>r</sub>** Time (*Second*)
- **V<sub>0(3rms)</sub>** Fundamental Component RMS Voltage (*Volt*)
- **V<sub>0(full)</sub>** Fundamental Component Voltage Full Wave (*Volt*)
- **V<sub>0(half)</sub>** Fundamental Component Voltage Half Wave (*Volt*)
- **V<sub>i</sub>** Input Voltage (*Volt*)
- **V<sub>ll</sub>** Line to Line RMS Output Voltage (*Volt*)
- **V<sub>LL</sub>** Line to Line RMS Output Voltage of SPWM Inverter (*Volt*)
- **V<sub>In</sub>** Line to Neutral Voltage (*Volt*)







- $V_{o(rms)}$  RMS Output Voltage of SPWM Inverter (Volt)
- $V_{rms}$  RMS Output Voltage (Volt)








## Constants, Functions, Measurements used









- **Constant: pi**, 3.14159265358979323846264338327950288  
*Archimedes' constant*
- **Function: atan**, atan(Number)  
*Inverse tan is used to calculate the angle by applying the tangent ratio of the angle, which is the opposite side divided by the adjacent side of the right triangle.*
- **Function: int**, int(expr, arg, from, to)  
*The definite integral can be used to calculate net signed area, which is the area above the x-axis minus the area below the x-axis.*
- **Function: sqrt**, sqrt(Number)  
*A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.*
- **Function: sum**, sum(i, from, to, expr)  
*Summation or sigma ( $\Sigma$ ) notation is a method used to write out a long sum in a concise way.*
- **Function: tan**, tan(Angle)  
*The tangent of an angle is a trigonometric ratio of the length of the side opposite an angle to the length of the side adjacent to an angle in a right triangle.*
- **Measurement: Time** in Second (s)  
*Time Unit Conversion* 
- **Measurement: Electric Current** in Ampere (A)  
*Electric Current Unit Conversion* 
- **Measurement: Frequency** in Hertz (Hz)  
*Frequency Unit Conversion* 
- **Measurement: Capacitance** in Farad (F)  
*Capacitance Unit Conversion* 



- **Measurement: Electric Resistance** in Ohm ( $\Omega$ )  
*Electric Resistance Unit Conversion* 
- **Measurement: Inductance** in Henry (H)  
*Inductance Unit Conversion* 
- **Measurement: Electric Potential** in Volt (V)  
*Electric Potential Unit Conversion* 



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