Important Output Stages and Power Amplifiers Formulas PDF

Formulas
Examples
with Units

List of 17
Important Output Stages and Power Amplifiers Formulas

1) Class A Output Stage Formulas

1.1) Bias Current of Emitter Follower Formula

Evaluate Formula

Formula

$$I_b = \text{mod}\ us\frac{\left(-V_{cc}\right)+V_{CEsat2}}{R_L}$$

Example with Units

$$2.232\,\text{mA} = \text{mod}\ us\frac{\left(-7.52\,\text{V}\right)+13.1\,\text{V}}{2.5\,\text{k}\Omega}$$

1.2) Drain Current of Class B Amplifier Formula

Evaluate Formula

Formula

$$I_d = 2\cdot\left(\frac{I_{out}}{\pi}\right)$$

Example with Units

$$0.0146\,\text{mA} = 2\cdot\left(\frac{0.023\,\text{mA}}{3.1416}\right)$$

1.3) Instantaneous Power Dissipation of Emitter-Follower Formula

Evaluate Formula

Formula

$$P_I = V_{ce}\cdot I_c$$

Example with Units

$$13.5\,\text{mW} = 2\,\text{V}\cdot 6.75\,\text{mA}$$

1.4) Load Power of Output Stage Formula

Evaluate Formula

Formula

$$P_{load} = P_s\cdot\eta_p$$

Example with Units

$$13.552\,\text{mW} = 24.2\,\text{mW}\cdot 0.56$$

1.5) Load Voltage Formula

Evaluate Formula

Formula

$$V_L = V_{in} - V_{be}$$

Example with Units

$$0.25\,\text{V} = 7.5\,\text{V} - 7.25\,\text{V}$$

1.6) Peak Output Voltage Value at Average Load Power Formula

Evaluate Formula

Formula

$$V\hat{}_o = \sqrt{2\cdot R_L\cdot P_L}$$

Example with Units

$$9.4868\,\text{V} = \sqrt{2\cdot 2.5\,\text{k}\Omega\cdot 18\,\text{mW}}$$

1.7) Power Conversion Efficiency of Class A Output Stage Formula

Evaluate Formula

Formula

$$\eta_{pA} = \frac{1}{4} \cdot \left(\frac{\hat{V}_o^{\,2}}{I_b \cdot R_L \cdot V_{cc}} \right)$$

Example with Units

$$0.5455 = \frac{1}{4} \cdot \left(\frac{9.5\,\text{V}^{\,2}}{2.2\,\text{mA} \cdot 2.5\,\text{k}\Omega \cdot 7.52\,\text{V}} \right)$$

1.8) Power Output Capability Factor Formula

Evaluate Formula

Formula

$$CF = \frac{P_{max}}{V_d \cdot I_{peak}}$$

Example with Units

$$0.9159 = \frac{1300\,\text{mW}}{15.6\,\text{V} \cdot 90.99\,\text{mA}}$$

1.9) Saturation Voltage between Collector-Emitter at Transistor 1 Formula

Evaluate Formula

Formula

$$V_{CEsat1} = V_{cc} - V_{max}$$

Example with Units

$$4.01\,\text{V} = 7.52\,\text{V} - 3.51\,\text{V}$$

1.10) Saturation Voltage between Collector-Emitter at Transistor 2 Formula

Evaluate Formula

Formula

$$V_{CEsat2} = V_{min} + V_{cc}$$

Example with Units

$$13.52\,\text{V} = 6\,\text{V} + 7.52\,\text{V}$$

1.11) Supply Power of Output Stage Formula

Evaluate Formula

Formula

$$P_{out} = 2 \cdot V_{cc} \cdot I_b$$

Example with Units

$$33.088\,\text{mW} = 2 \cdot 7.52\,\text{V} \cdot 2.2\,\text{mA}$$

2) Class B Output Stage Formulas

2.1) Efficiency of Class A Formula

Evaluate Formula

Formula

$$\eta = \frac{1}{2} \cdot \left(\frac{V_{out}}{V_{drain}} \right)$$

Example with Units

$$0.8571 = \frac{1}{2} \cdot \left(\frac{1.2\,\text{V}}{0.7\,\text{V}} \right)$$

2.2) Efficiency of Class B Output Stage Formula

Evaluate Formula

Formula

$$\eta_a = \frac{\pi}{4} \cdot \left(\frac{\hat{V}_o}{V_{cc}} \right)$$

Example with Units

$$0.9922 = \frac{3.1416}{4} \cdot \left(\frac{9.5\,\text{V}}{7.52\,\text{V}} \right)$$

2.3) Load Resistance of Class B Stage Formula

Evaluate Formula

Formula

$$R_{classB} = \frac{2 \cdot V\hat{}_o \cdot V_{cc}}{\pi \cdot P_s}$$

Example with Units

$$1.8793\,\text{kΩ} = \frac{2 \cdot 9.5\,\text{V} \cdot 7.52\,\text{V}}{3.1416 \cdot 24.2\,\text{mW}}$$

2.4) Maximum Average Power from Class B Output Stage Formula

Evaluate Formula

Formula

$$P_{maxB} = \frac{1}{2} \cdot \left(\frac{V_{cc}^2}{R_L} \right)$$

Example with Units

$$11.3101\,\text{mW} = \frac{1}{2} \cdot \left(\frac{7.52\,\text{V}^2}{2.5\,\text{kΩ}} \right)$$

2.5) Maximum Power Dissipation in Class B Stage Formula

Evaluate Formula

Formula

$$P_{Dmax} = \frac{2 \cdot V_{cc}^2}{\pi^2 \cdot R_L}$$

Example with Units

$$4.5838\,\text{mW} = \frac{2 \cdot 7.52\,\text{V}^2}{3.1416^2 \cdot 2.5\,\text{kΩ}}$$

2.6) Negative Half of Maximum Power Dissipation in Class B Stage Formula

Evaluate Formula

Formula

$$P_{DNmax} = \frac{V_{cc}^2}{\pi^2 \cdot R_L}$$

Example with Units

$$2.2919\,\text{mW} = \frac{7.52\,\text{V}^2}{3.1416^2 \cdot 2.5\,\text{kΩ}}$$

Variables used in list of Output Stages and Power Amplifiers Formulas above

- **CF** Power Output Capability Factor
- I_b Input Bias Current *(Milliampere)*
- I_c Collector Current *(Milliampere)*
- I_d Drain Current *(Milliampere)*
- I_{out} Output Current *(Milliampere)*
- I_{peak} Peak Drain Current *(Milliampere)*
- P_{Dmax} Maximum Power Dissipation *(Milliwatt)*
- P_{DNmax} Negative Maximum Power Dissipation *(Milliwatt)*
- P_I Instantaneous Power Dissipation *(Milliwatt)*
- P_L Average Load Power *(Milliwatt)*
- P_{load} Load Power of Output Stage *(Milliwatt)*
- P_{max} Maximum Output Power *(Milliwatt)*
- P_{maxB} Maximum Power in Class B *(Milliwatt)*
- P_{out} Supply Power of Output Stage *(Milliwatt)*
- P_s Supply Power *(Milliwatt)*
- R_{classB} Load Resistance of Class B *(Kilohm)*
- R_L Load Resistance *(Kilohm)*
- V_{be} Base Emitter Voltage *(Volt)*
- V_{cc} Supply Voltage *(Volt)*
- V_{ce} Collector to Emitter Voltage *(Volt)*
- V_{CEsat1} Saturation Voltage 1 *(Volt)*
- V_{CEsat2} Saturation Voltage 2 *(Volt)*
- V_d Peak Drain Voltage *(Volt)*
- V_{drain} Drain Voltage *(Volt)*
- V_{in} Input Voltage *(Volt)*
- V_L Load Voltage *(Volt)*
- V_{max} Maximum Voltage *(Volt)*
- V_{min} Minimum Voltage *(Volt)*
- V_{out} Output Voltage *(Volt)*

Constants, Functions, Measurements used in list of Output Stages and Power Amplifiers Formulas above

- constant(s): **pi**, 3.14159265358979323846264338327950288 *Archimedes' constant*
- Functions: **modulus**, modulus *Modulus of a number is the remainder when that number is divided by another number.*
- Functions: **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.*
- Measurement: **Electric Current** in Milliampere (mA) *Electric Current Unit Conversion*
- Measurement: **Power** in Milliwatt (mW) *Power Unit Conversion*
- Measurement: **Electric Resistance** in Kilohm (kΩ) *Electric Resistance Unit Conversion*
- Measurement: **Electric Potential** in Volt (V) *Electric Potential Unit Conversion*

- $\hat{V}_o$ Peak Amplitude Voltage *(Volt)*
- η Efficiency of Class A
- η_a Efficiency of Class B
- η_p Power Conversion Efficiency
- η_{pA} Power Conversion Efficiency of Class A

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