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BJT Differential Amplifiers Formulas

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List of 19 BJT Differential Amplifiers Formulas

BJT Differential Amplifiers

Current and Voltage

1) Base Current of Input Differential BJT Amplifier

Open Calculator

fx $$i_B = \frac{i_E}{\beta + 1}$$

ex $$0.272353\text{mA} = \frac{13.89\text{mA}}{50 + 1}$$

2) Base Current of Input Differential BJT Amplifier given Emitter Resistance

Open Calculator

fx $$i_B = \frac{V_{id}}{2 \cdot R_E \cdot (\beta + 1)}$$

ex $$0.270329\text{mA} = \frac{7.5\text{V}}{2 \cdot 0.272\text{k}\Omega \cdot (50 + 1)}$$

3) Collector Current of BJT Differential Amplifier given Emitter Current

Open Calculator

fx $$i_c = \alpha \cdot i_E$$

ex $$23.613\text{mA} = 1.7 \cdot 13.89\text{mA}$$

4) Collector Current of BJT Differential Amplifier given Emitter Resistance

Open Calculator

$$i_c = \frac{\alpha \cdot V_{id}}{2 \cdot R_E}$$

$$23.4375\text{mA} = \frac{1.7 \cdot 7.5\text{V}}{2 \cdot 0.272\text{k}\Omega}$$

5) Emitter Current of BJT Differential Amplifier

Open Calculator

$$i_E = \frac{V_{id}}{2 \cdot r_E + 2 \cdot R_{CE}}$$

$$13.88889\text{mA} = \frac{7.5\text{V}}{2 \cdot 0.13\text{k}\Omega + 2 \cdot 0.14\text{k}\Omega}$$

6) First Collector Current of BJT Differential Amplifier

Open Calculator

$$i_{C1} = \frac{\alpha \cdot i}{1 + e^{\frac{-V_{id}}{V_{th}}}}$$

$$934.9792\text{mA} = \frac{1.7 \cdot 550\text{mA}}{1 + e^{\frac{-7.5\text{V}}{0.7\text{V}}}}$$

7) First Emitter Current of BJT Differential Amplifier

Open Calculator

$$i_{E1} = \frac{i}{1 + e^{\frac{-V_{id}}{V_{th}}}}$$

$$549.9878\text{mA} = \frac{550\text{mA}}{1 + e^{\frac{-7.5\text{V}}{0.7\text{V}}}}$$

8) Input Bias Current of Differential Amplifier

Open Calculator

$$I_{Bias} = \frac{i}{2 \cdot (\beta + 1)}$$

$$5.392157\text{mA} = \frac{550\text{mA}}{2 \cdot (50 + 1)}$$

9) Maximum Input Common-Mode Range Voltage of BJT Differential Amplifier

Open Calculator

$$V_{cm} = V_i + (\alpha \cdot 0.5 \cdot i \cdot R_C)$$

$$78.3\text{V} = 3.5\text{V} + (1.7 \cdot 0.5 \cdot 550\text{mA} \cdot 0.16\text{k}\Omega)$$

10) Second Collector Current of BJT Differential Amplifier

Open Calculator

$$i_{C2} = \frac{\alpha \cdot i}{1 + e^{\frac{V_{id}}{V_{th}}}}$$

$$0.02078\text{mA} = \frac{1.7 \cdot 550\text{mA}}{1 + e^{\frac{7.5\text{V}}{0.7\text{V}}}}$$

11) Second Emitter Current of BJT Differential Amplifier

Open Calculator

fx $$i_{E2} = \frac{i}{1 + e^{\frac{V_{id}}{V_{th}}}}$$

ex $$0.012224\text{mA} = \frac{550\text{mA}}{1 + e^{\frac{7.5\text{V}}{0.7\text{V}}}}$$

DC Offset

12) Common Mode Gain of BJT Differential Amplifier

Open Calculator

fx $$A_{cm} = \frac{V_{od}}{V_{id}}$$

ex $$2.133333 = \frac{16\text{V}}{7.5\text{V}}$$

13) Common Mode Rejection Ratio of BJT Differential Amplifier in dB

Open Calculator

fx $$CMRR = 20 \cdot \log 10\left(\text{modulus}\left(\frac{A_d}{A_{cm}}\right)\right)$$

ex $$-18.381975\text{dB} = 20 \cdot \log 10\left(\text{modulus}\left(\frac{0.253\text{dB}}{2.1}\right)\right)$$

14) Input Offset Current of Differential Amplifier

Open Calculator

fx $$I_{os} = \text{modulus}(I_{B1} - I_{B2})$$

ex $$5\text{mA} = \text{modulus}(15\text{mA} - 10\text{mA})$$

15) Input Offset Voltage of BJT Differential Amplifier

Open Calculator

fx $$V_{os} = V_{th} \cdot \left(\frac{\Delta R_c}{R_C} \right)$$

ex $$0.00875\text{V} = 0.7\text{V} \cdot \left(\frac{0.002\text{k}\Omega}{0.16\text{k}\Omega} \right)$$

Resistance

16) Differential Input Resistance of BJT Amplifier

Open Calculator

fx $$R_{id} = \frac{V_{id}}{i_B}$$

ex $$27.77778\text{k}\Omega = \frac{7.5\text{V}}{0.27\text{mA}}$$

17) Differential Input Resistance of BJT Amplifier given Common-Emitter Current Gain

Open Calculator

fx $$R_{id} = (\beta + 1) \cdot (2 \cdot R_E + 2 \cdot \Delta R_c)$$

ex $$27.948\text{k}\Omega = (50 + 1) \cdot (2 \cdot 0.272\text{k}\Omega + 2 \cdot 0.002\text{k}\Omega)$$

18) Differential Input Resistance of BJT Amplifier given Small-Signal Input Resistance

Open Calculator

fx $$R_{id} = 2 \cdot R_{BE}$$

ex $$27.76\text{k}\Omega = 2 \cdot 13.88\text{k}\Omega$$

19) Transconductance of Small Signal Operation of BJT Amplifier

Open Calculator

fx $$g_m = \frac{i_c}{V_{th}}$$

ex $$32.85714\text{mS} = \frac{23\text{mA}}{0.7\text{V}}$$

Variables Used

- A_{cm} Common Mode Gain
- A_d Differential Gain *(Decibel)*
- **CMRR** Common Mode Rejection Ratio *(Decibel)*
- g_m Transconductance *(Millisiemens)*
- **i** Current *(Milliampere)*
- i_B Base Current *(Milliampere)*
- I_{B1} Input Bias Current 1 *(Milliampere)*
- I_{B2} Input Bias Current 2 *(Milliampere)*
- I_{Bias} Input Bias Current *(Milliampere)*
- i_c Collector Current *(Milliampere)*
- i_{C1} First Collector Current *(Milliampere)*
- i_{C2} Second Collector Current *(Milliampere)*
- i_E Emitter Current *(Milliampere)*
- i_{E1} First Emitter Current *(Milliampere)*
- i_{E2} Second Emitter Current *(Milliampere)*
- I_{os} Input Offset Current *(Milliampere)*
- R_{BE} Base Emitter Input Resistance *(Kilohm)*
- R_C Collector Resistance *(Kilohm)*
- R_{CE} Collector Emitter Resistance *(Kilohm)*
- r_E Base Emitter Resistance *(Kilohm)*
- R_E Emitter Resistance *(Kilohm)*

- R_{id} Differential Input Resistance *(Kilohm)*
- V_{cm} Maximum Common Mode Range *(Volt)*
- V_i Input Voltage *(Volt)*
- V_{id} Differential Input Voltage *(Volt)*
- V_{od} Differential Output Voltage *(Volt)*
- V_{os} Input Offset Voltage *(Volt)*
- V_{th} Threshold Voltage *(Volt)*
- α Common Base Current Gain
- β Common Emitter Current Gain
- ΔR_c Change in Collector Resistance *(Kilohm)*

Constants, Functions, Measurements used

- Constant: **e**, 2.71828182845904523536028747135266249
  Napier's constant
- Function: **log10**, log10(Number)
  Common logarithm function (base 10)
- Function: **modulus**, modulus
  Modulus of number
- Measurement: **Electric Current** in Milliampere (mA)
  Electric Current Unit Conversion
- Measurement: **Noise** in Decibel (dB)
  Noise Unit Conversion
- Measurement: **Electric Resistance** in Kilohm (kΩ)
  Electric Resistance Unit Conversion
- Measurement: **Electric Conductance** in Millisiemens (mS)
  Electric Conductance Unit Conversion
- Measurement: **Electric Potential** in Volt (V)
  Electric Potential Unit Conversion

Check other formula lists

- **BJT Differential Amplifiers Formulas**
- **Feedback Amplifiers Formulas**

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