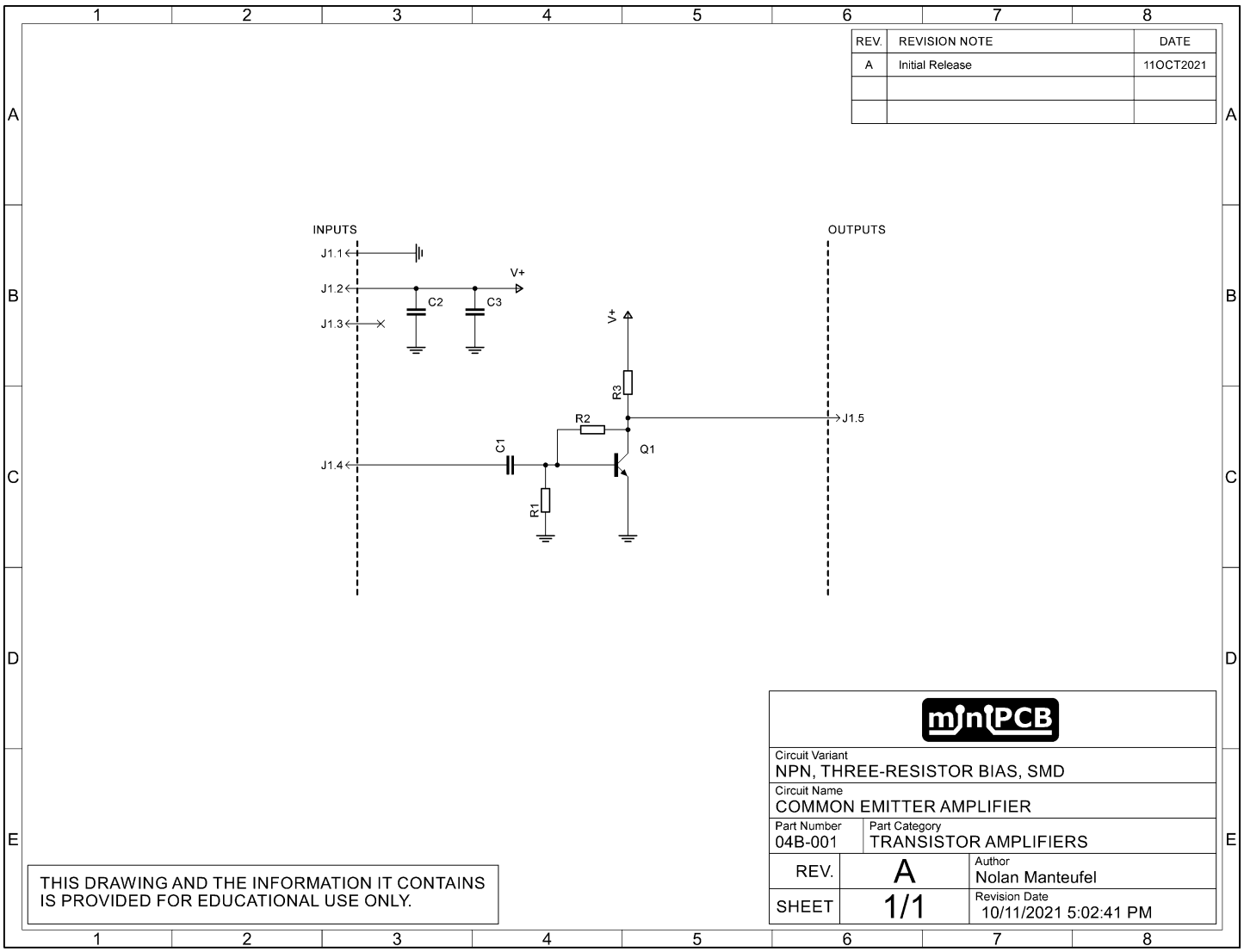
Common Emitter Amplifier

Design Application

- Microphone amplifier

miniPCB



Discussion

When to Use

This circuit is the “Hello World” of transistor amplifiers. It’s simple, easy to calculate, and easy to build.

If you want to understand the more complex circuits, study this one first. If you want to use a transistor amplifier in a product design, use a more complex circuit.

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Do not consider this circuit if you are trying to design an amplifier with precise gain or low quiescent currents.

Consider this circuit if you are trying to design a low frequency amplifier (i.e. microphone amplifier) for applications that are cost sensitive, space limited, has high supply voltage available, and allows quiescent currents above 1mA.

Close Enough is Good Enough

This circuit is more art than science. The transistor’s characteristics vary so much, it doesn’t make sense to use ultra-precise equations to calculate values for the bias resistors, R1, R2, and R3. So the equations presented in the design steps are approximations that should get you in the ball park.

If time and budget allow, during development it may be worth experimenting with various resistor values to optimize performance. But, for this circuit, it’s probably not worth the effort. This circuit is very susceptible to variations in the transistor’s characteristics. So lot-to-lot transistor variations will be a nightmare over the life of the product.

Design Steps

Step 1. Specify collector (drain) current, I_c.

Step 2. Specify supply voltage, V_s.

Step 3. Look up your BJT transistor's current gain, β. In some datasheets, this is labeled H_{fe}.

Step 4. Look up your BJT transistor's base-emitter voltage, V_{be}.

Step 5. Calculate required resistor values.

Eq. 1. $$R3 = \frac{V_s}{2 \cdot I_c}$$

Note: V_s is the supply voltage, and I_c is the collector current.

Eq. 2. $$R2 = \left[\left(\frac{V_s}{2}\right) - V_{be}\right] \cdot \left[\frac{11+\beta}{I_c}\right] \div 11$$

Note: β is the BJT transistor's current gain.

Eq. 3. $$R1 = \left(\frac{11}{10}\right) \cdot \left[\frac{V_{be} \cdot R2}{\left(\frac{V_s}{2}\right) - V_{be}}\right]$$

Note: $V_{be}$is the BJT transistor's base-emitter voltage.

Step 6. Select resistor values that are commonly manufactured.

Design Outputs

Parameter	Min	Target Value	Max	Unit
Collector Current				mA
Supply Voltage				V
Q1 Part Number	N/A		N/A	MFG PN
Q1 Beta				A/A
R3				Ω
R2				Ω
R1				Ω

Revision History

Revision	Note	Date
A	Initial Release	YYYYMMDD

