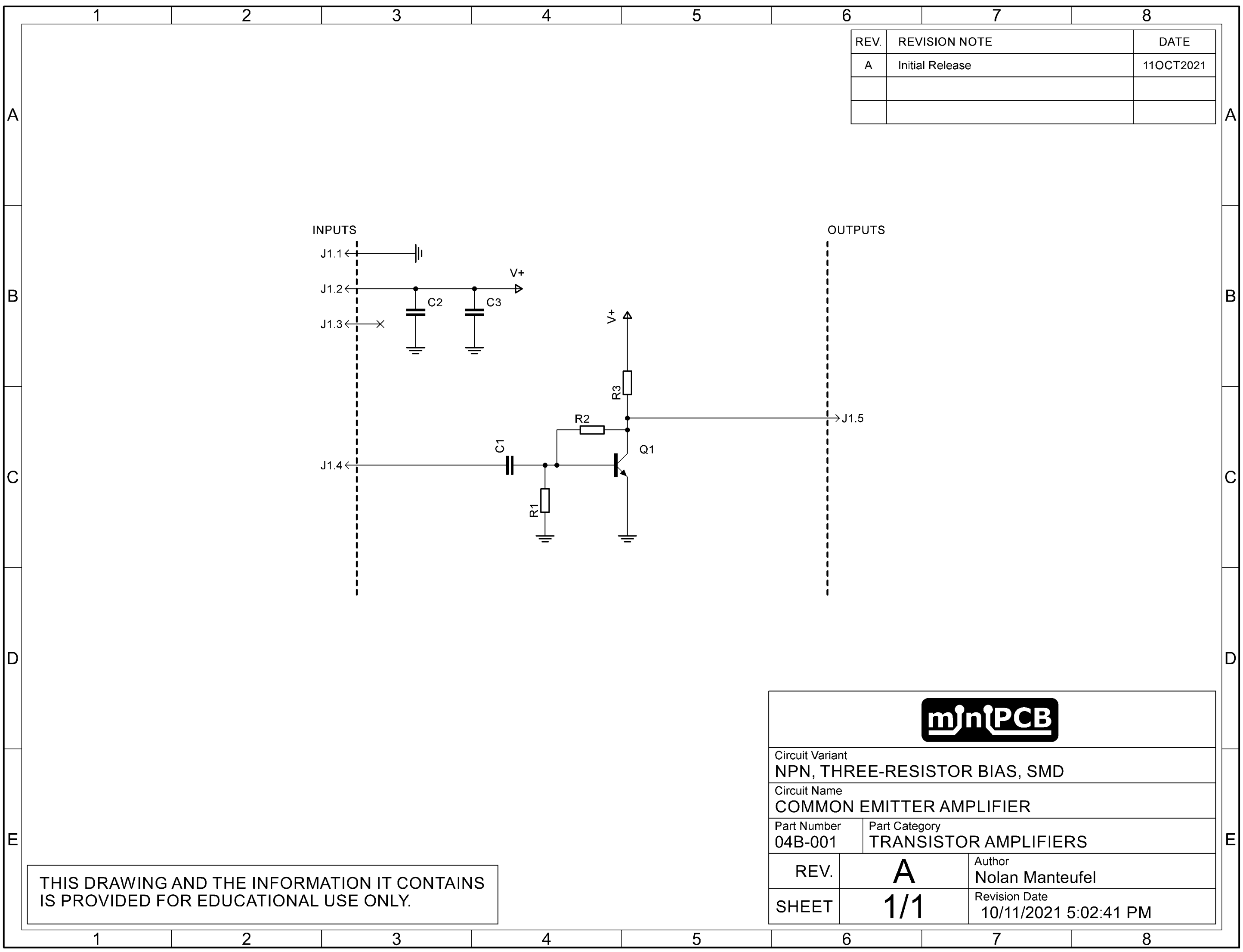
Revision Date: 27 October 2021

# Common Emitter Amplifier, #04B-001

## Introduction

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

If you want to understand the more complex transistor amplifier circuits, study this one first.



# Discussion

## Design Consideration: When to Use

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, have high supply voltage available, and allow quiescent currents above 1mA.

## Design Approach: Close Enough is Good Enough

This circuit is very susceptible to variations in the transistor's characteristics. So it doesn't make sense to use equations that take every factor into consideration when calculating values for the bias resistors: R1, R2, and R3. Because when you use a transistor from a different manufacturing lot, and you might as well have used approximate equations.

The equations presented in the design steps should be good enough. If you want to be an artist, go ahead and experiment with different values.

## Design Conclusion

If you want to use a transistor amplifier in a product design, even a slightly more complex circuit will offer more consistent performance.

## Design Steps

Step 1. Specify collector 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: $\beta$ 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 |

## Interesting History

As far as modern electronics is concerned, this circuit (04B-001) is very old. This circuit is very similar to the vacuum tube circuits shown in the U.S. patent (US879532) that claimed the invention of vacuum tubes.

Eventually I'll make miniPCBs in the 07B group that are modern equivalents of the two circuits shown in the 1908 patent; but the historical connection between those circuits and this miniPCB are worth mentioning here too.

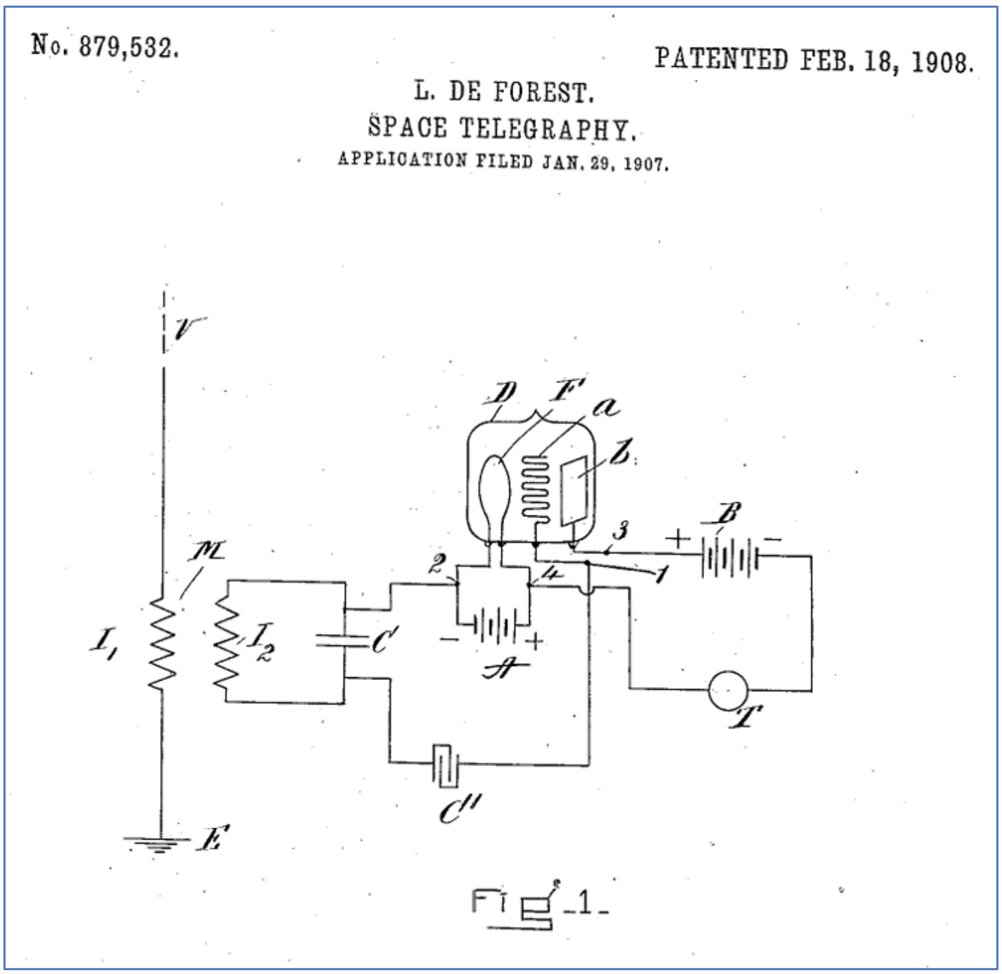



*Figure 1 - Patent US879532*

# Revision History

| Revision | Note | Date |
|---|---|---|
| **A** | Initial Release | YYYYMMDD |
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