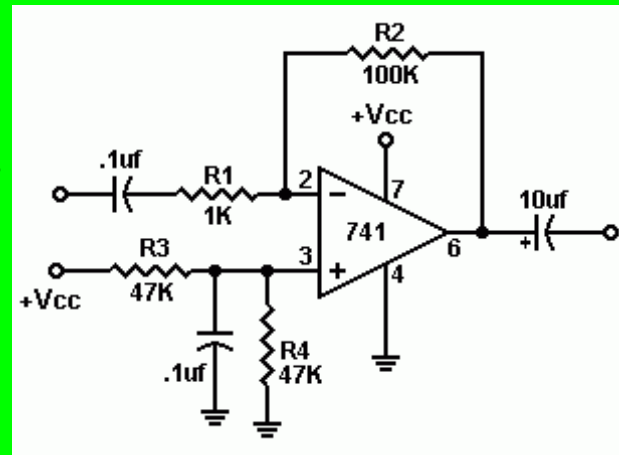


## Design Guidelines for Op Amp Audio Preamplifier Circuits

By Mike Martell  
N1HFX

### Operational Amplifier Design

Operational amplifiers are simple to use, inexpensive and offer a very large amount of gain. These IC's come in a variety of packages with 1, 2 or 4 complete Op Amps in a single IC. Op Amps have two inputs called the non-inverting and the inverting designated by the plus and minus sign, respectively. Op Amps are actually differential amplifiers because they amplify the difference between the inverting and the non-inverting inputs. Op amps will normally operate from any supply voltage in the 6 to 15 volt range.



### Single Power Supply Operation

While intended for dual power supply operation, Op Amps can be easily configured to a single power supply by the use of a resistor network. In the above example, resistors R3 and R4 place a voltage of 1/2 of the supply voltage across the non-inverting input which causes the output voltage to also be 1/2 of the supply voltage forming a sort of bias voltage. Resistors R3 and R4 can be any value from 1K to 100K but in all cases they should be equal. An additional .1uF capacitor has been added to the non-inverting input to reduce noise caused by this configuration. The use of coupling capacitors for input and output is required for this configuration.

### Setting The Gain of The Op Amp

The gain of this circuit is determined by resistors R1 and R2 and is calculated by the following equation:

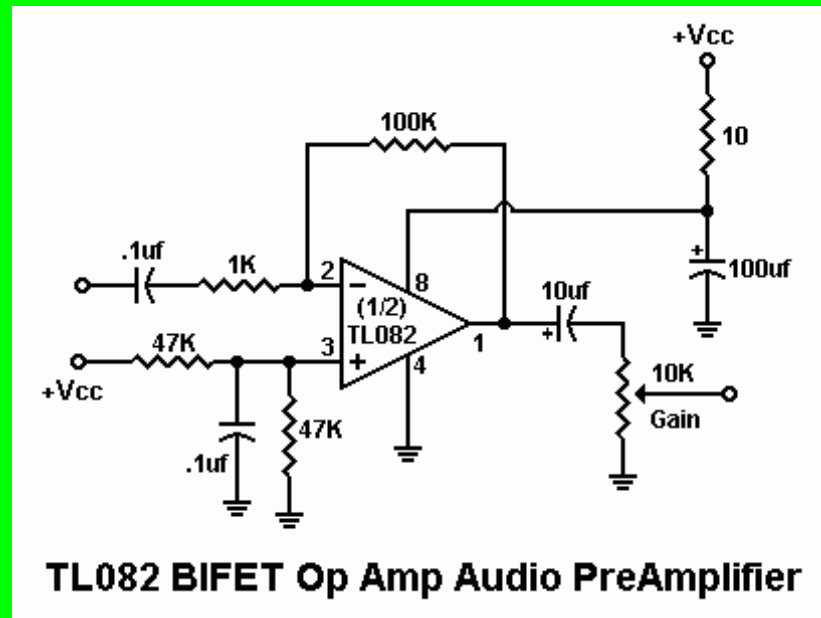
$$\text{Voltage Gain} = R2 / R1$$

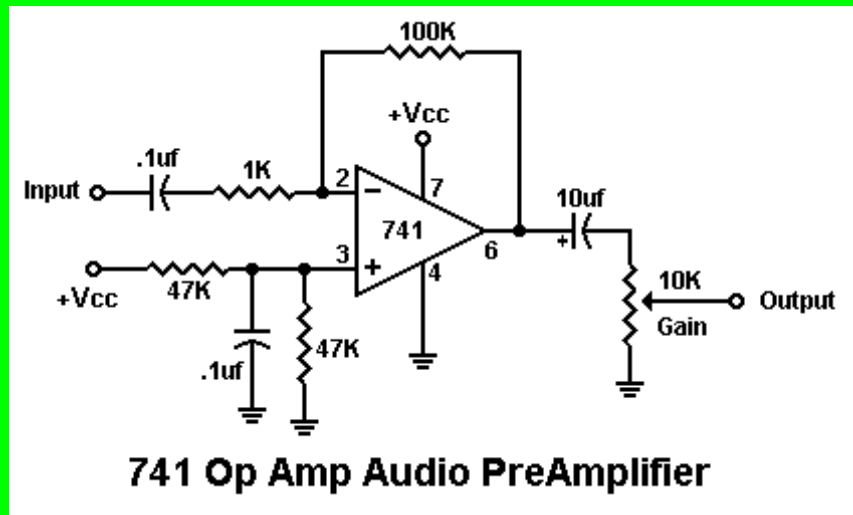
R1 can be any value from 470 to 10K. Because Op Amps have input impedances as high as several hundred thousand ohms or greater, any input power lost through R1 is insignificant. R2 can be any value from 10K to 1M. R2 actually limits the gain of the Op Amp by providing a form of negative feedback. Op Amps typically have voltage gains between 20,000 to 200,000. In no case should the voltage gain set by  $R2 / R1$  be greater than 1,000. The voltage gain is essentially independent of the

supply voltage.

### Preventing Oscillations

Because of the extremely high gain afforded by operational amplifiers, precautions are often needed when very high gains (greater than 100) are used. The use of 1 to 10 ohm resistor and a 100uf capacitor connected to the  $V_{cc}$  terminal of the Op Amp will isolate the power source and prevent oscillations.





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