

Lab #3: Operational Amplifier Electronic Circuits

- 1) Each group will get an oscilloscope, a function generator, a solderless breadboard, a 741 operational amplifier chip, resistors and a capacitor as needed.
- 2) Build the RC circuit shown in Figure 1 and enter the code as provided in Figure 2 to cause the Boe-Bot to generate a continuously changing analog voltage signal in the shape of a triangle wave.
- 3) Using the pin-out of the 741 op amp as shown in Figure 3 and non-inverting configuration shown in Figure 4., design the circuit such that the closed loop gain is $v_o/v_i = 2$, as per the gain equation **(1)**.
- 4) Construct the operational amplifier circuit of Figure 4 for the gain that you designed from part 3) of this lab. Use the DC power supplies to power your op amp with ± 16 V.
- 5) Using the output signal of the Boe-Bot as the input signal to the op amp, display both traces on the oscilloscope simultaneously to show the gain of the op amp circuit and to verify your design.
- 6) Sketch the input and output waveforms seen with the oscilloscope.
- 7) Using the inverting operational amplifier circuit of Figure 5, design the circuit such that the closed loop gain is $v_o/v_i = -2$, as per the gain equation **(2)**.
- 8) Construct the operational amplifier circuit of Figure 5 for the gain that you designed from part 6) of this lab. Again use the DC power supplies to power your op amp with ± 16 V.
- 9) Using the output signal of the Boe-Bot as the input signal to the op amp, display both traces on the oscilloscope simultaneously to show the gain of the op amp circuit and to verify your design.
- 10) Sketch the input and output waveforms seen with the oscilloscope.

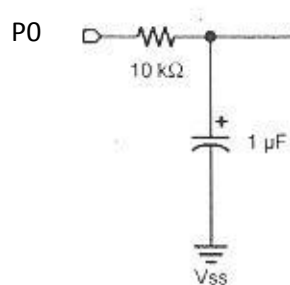


Figure 1. RC circuit

```

' {$STAMP BS2}
' {$PBASIC 2.5}

DUTY          VAR   Byte

DO
  FOR DUTY = 100 to 0 STEP 1
    PWM 0, DUTY * 255/100, 5
  NEXT
  FOR DUTY = 0 to 100 STEP 1
    PWM 0, DUTY * 255/100, 5
  NEXT
LOOP

```

Figure 2. Boe-Bot code listing

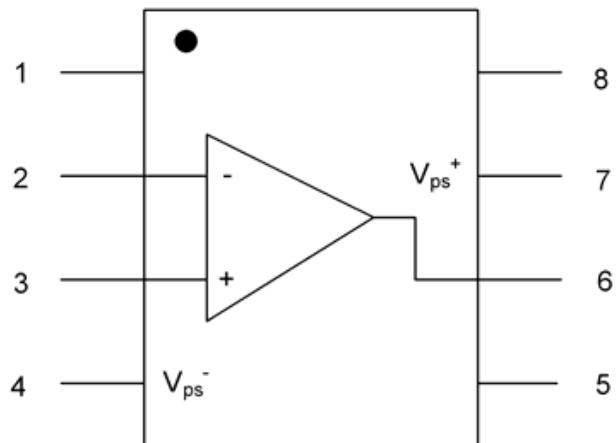


Figure 3. Pin out of the 741 operational amplifier

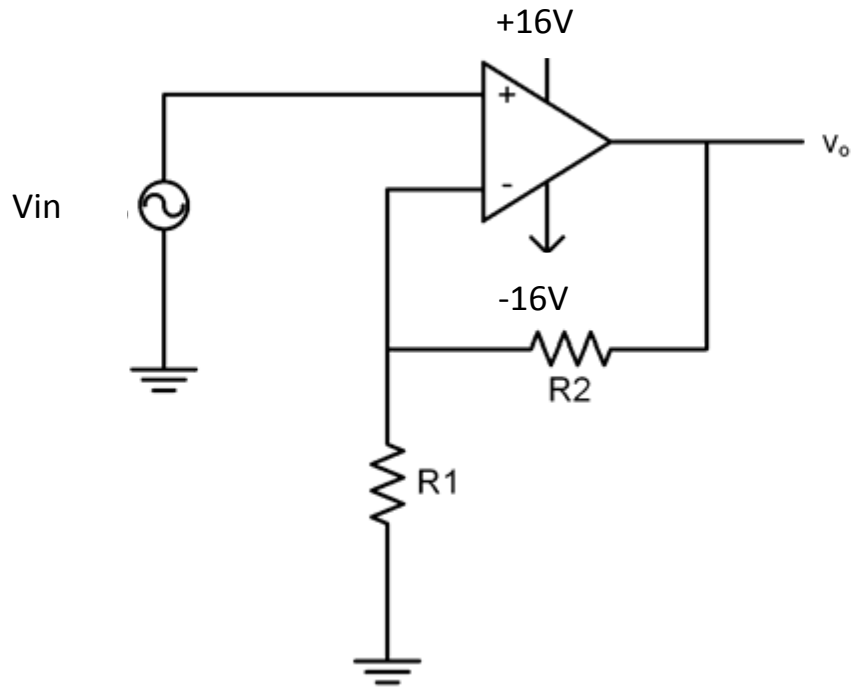


Figure 4. Non-inverting op amp configuration

Gain equation (1):

$$\frac{v_{out}}{v_{in}} = 1 + \frac{R_2}{R_1}$$

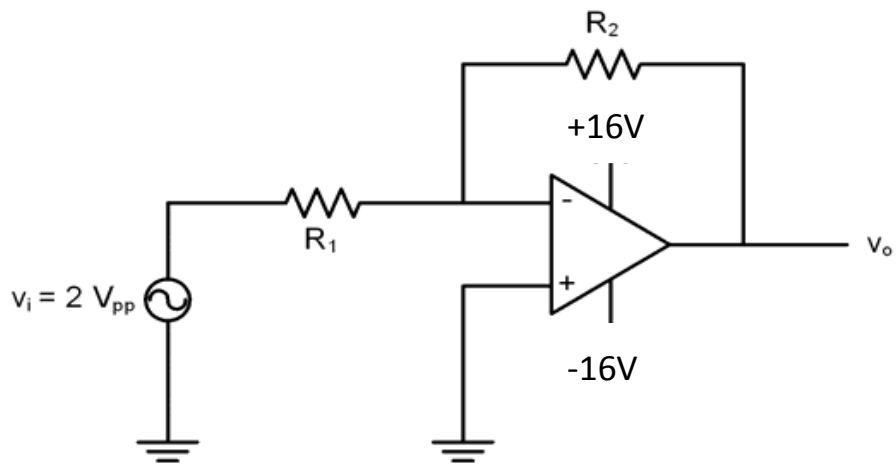


Figure 5. Inverting op amp configuration

Gain equation (2):

$$\frac{v_{out}}{v_{in}} = -\frac{R_2}{R_1}$$