

through the speaker and feeding it back provides better speaker damping than obtainable with voltage-drive systems.

Note the unusual grounded output pin on the NE5534 op amp. When the input to the amplifier is positive, the power supply supplies current through the TIP32 and the load to ground. Conversely, with a negative input the TIP31 supplies current through the load to ground. The gain in this case is set to about 15 (gain = $SPKR\ 8\ \Omega / 0.5\ \Omega$ feedback). The $0.22\text{-}\mu\text{F}$ capacitor across the speaker rolls off its response beyond the frequencies of interest. Using the $0.22\text{-}\mu\text{F}$ capacitor specified, the amplifier output is 3 dB down at 90 kHz where the speaker impedance is about $20\ \Omega$. The Quiescent output stage collector current is determined by the

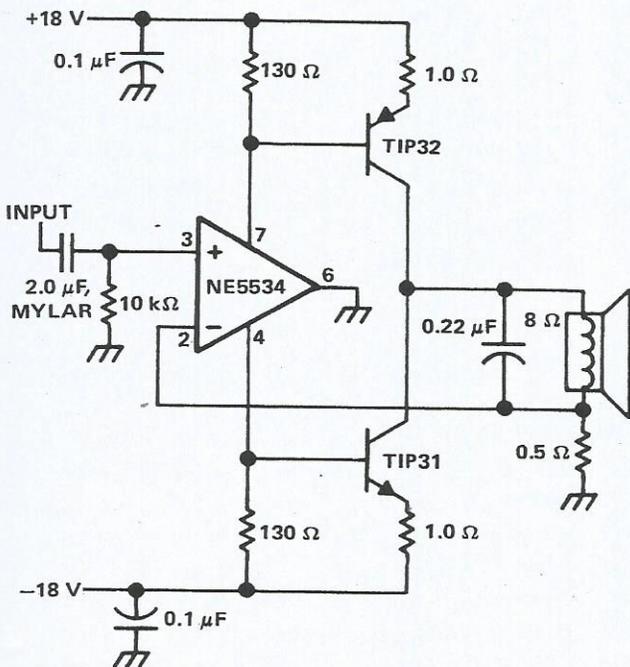


Figure 3-33. Audio Power Amplifier

$130\text{-}\Omega$ resistors that connect each transistor base to the appropriate supply rail, the output transistor V_{BE} , and the $1\text{-}\Omega$ emitter resistors. To set the recommended class "A" output collector current, adjust the value of either $130\text{-}\Omega$ resistor. An output current of 50 to 100 mA will provide a good operating midpoint between the best crossover distortion and power dissipation.

The $0.1\ \mu$ bypass capacitors on each rail may be mylar or ceramic disk. The $2.0\ \mu\text{F}$ should be a nonpolarized capacitor while the $0.22\ \mu\text{F}$ across the speaker should be mylar.

Figure 3-34 shows the frequency response of the amplifier with a $2.0\text{-}\mu\text{F}$ input capacitor. This response is very flat with the -3.0-dB point on the low frequency end at 45 Hz. The -3.0-dB point at the high frequency end occurs at 80 kHz. Total Harmonic Distortion (THD) is 0.01% at 6.25 W rms output into an $8\text{-}\Omega$ load with $\pm 18\ \text{V}$ on the supply rails.

This amplifier circuit uses few components, has low total harmonic distortion, excellent frequency response and is easily duplicated. It works well up to 12 W peak output before clipping is noted. The TIP31 and TIP32 output transistors are complementary power transistors in the TO-220 package. Both transistors are rated at 3.0 A continuous collector current.

OSCILLATORS AND GENERATORS

AUDIO OSCILLATOR CIRCUIT DESCRIPTION

A Wein bridge oscillator can be used to produce sinewaves with very low distortion level. The Wein bridge oscillator produces zero phase shift at only one frequency ($f = 1/2\ \pi RC$) which will be the oscillation frequency. In the configuration shown in Figure 3-35, stable oscillation can occur only if the loop gain remains at unity at the oscillation frequency.

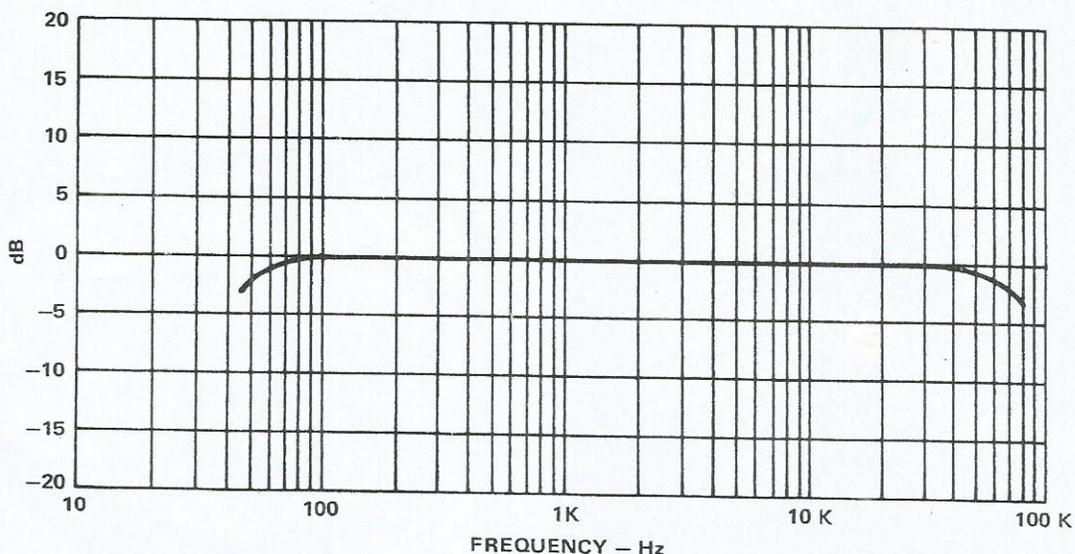


Figure 3-34. Audio Power Amplifier Frequency Response

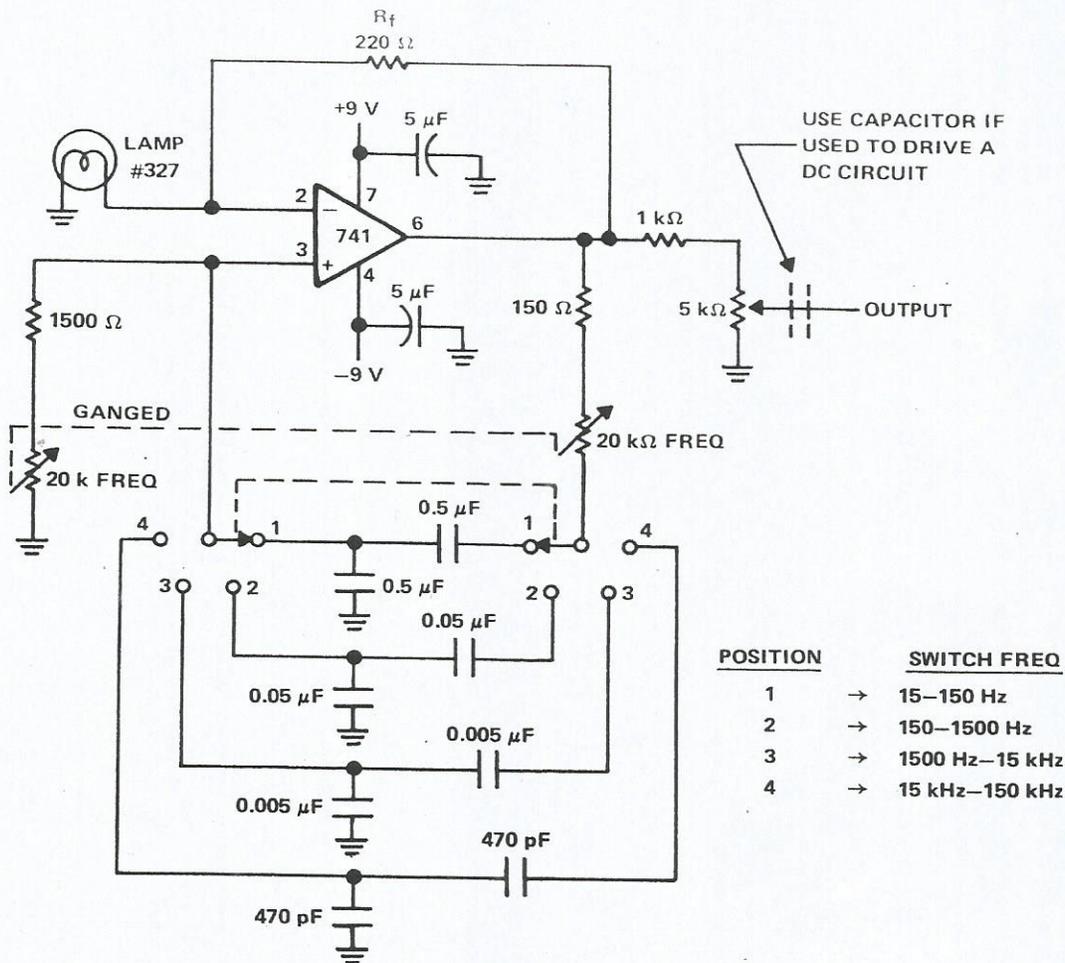


Figure 3-35. Audio Oscillator

The circuit achieves this control by using the positive temperature coefficient of a small lamp to regulate gain (R_f/R_{LAMP}) as the oscillator attempts to vary its output. This is a classic technique for achieving low distortion that has been used by numerous circuit designers for about 40 years. The smooth limiting action of the bulb, in combination with the Wein network's near-ideal characteristics, yields very high performance. In this circuit a 741 op amp is used with ± 9 V power supplies. The tungsten lamp is a type #327 miniature which has a standard bayonet base. This lamp is rated at 28.0 V and 40 mA. For mass production of these oscillators, the lamps are burned in for a predetermined number of hours to stabilize the characteristics of the filament.

The oscillator shown here has four frequency bands covering about 15 Hz to 150 kHz. The frequency is continuously variable within each frequency range with ganged 20-k Ω potentiometers. The oscillator draws only about 4.0 mA from the 9-V batteries. Its output is from 4 to 5 V with a 10-k Ω load and the R_f (feedback resistor) is set at about 5% below the point of clipping. As shown, the center arm of the 5-k Ω output potentiometer is the output terminal. It should be noted that if you couple the oscillator to a dc type circuit, a capacitor should be inserted in series with the output lead.

THE BASIC MULTIVIBRATOR

A basic multivibrator may be constructed using an operational amplifier and a few external components, as shown in Figure 3-36. When this circuit is turned on, the natural offset of the devices serves as an automatic starting voltage. Assume the output voltage V_o goes positive and the positive feedback through R_2 and R_1 forces the output to saturate. The high-voltage level at V_o , then charges C through R_3 until the voltage at the inverting input exceeds that at the noninverting input. As the inverting input exceeds

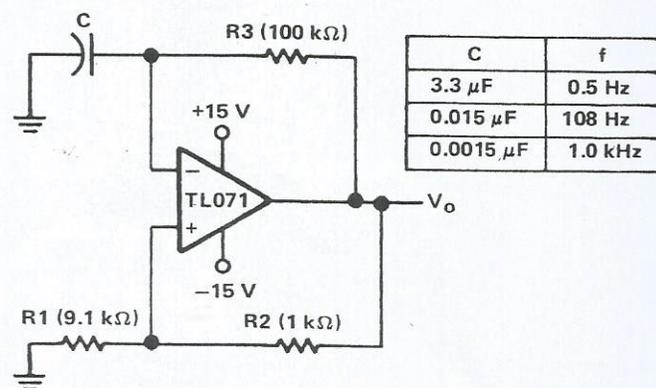


Figure 3-36. Basic Multivibrator