

Two-Tone Audio Generator



Exterior view of the two-tone audio generator.

A TWO-TONE AUDIO GENERATOR

The audio frequency generator shown above makes a very convenient signal source for testing the linearity of a single-sideband transmitter. To be suitable for transmitter evaluation, a generator of this type must produce two non-harmonically related tones of equal amplitude. The level of harmonic and intermodulation distortion must be sufficiently low so as not to confuse the measurement. The frequencies used in this generator are 700 and 1900 Hz, both well inside the normal audio passband of an SSB transmitter.

Spectral analysis and practical application with many different transmitters has shown this generator to meet all of the requirements mentioned above. While designed specifically for transmitter testing it is also useful any time a fixed-frequency, low-level audio tone is needed. Details on distortion measurement and the two-tone test can be found in Chapter 18.

Circuit Details

Each of the two tones is generated by a separate Wein bridge oscillator, U1B and U2B. The oscillators are followed by RC active low-pass filters, U1A and U2A. Because the filters require nonstandard capacitor values, provisions have been made on the circuit board for placing two capacitors in parallel in those cases where standard values cannot be used. The oscillator and filter capacitors should be polystyrene or Mylar film types if available. Two tones are combined at op amp U3A. This amplifier has a variable resistor, R4, in its feedback loop which serves as the output LEVEL control. While R4 varies both tones together, R3, the BALANCE control, allows the level of tone A to be changed without affecting the level of tone B. This is necessary because some transmitters do not have equal audio response at both frequencies. Following the summing amplifier is a step attenuator; S3 controls the output level in 10-dB steps. The use of two output level controls, R4 and S3, allows the output to cover a wide range and still be easy to set to a specific level.

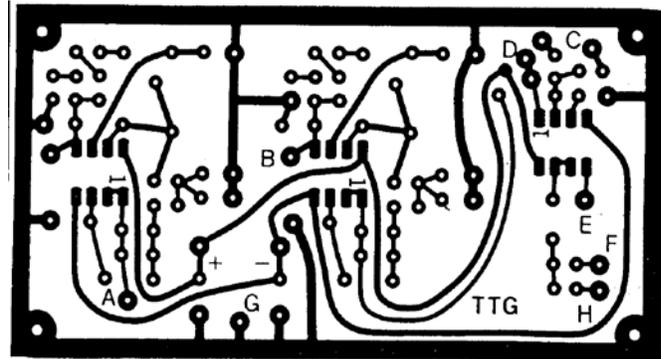
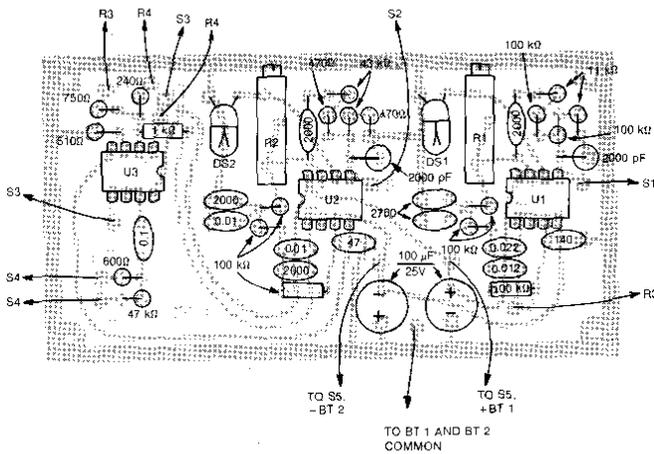
The remaining op amp, U3B is connected as a voltage follower and serves to buffer the output while providing a high-impedance load for the

step attenuator. Either high or low output impedance can be selected by S4. The values shown are suitable for most transmitters using either high- or low- impedance microphones.

Construction and Adjustment

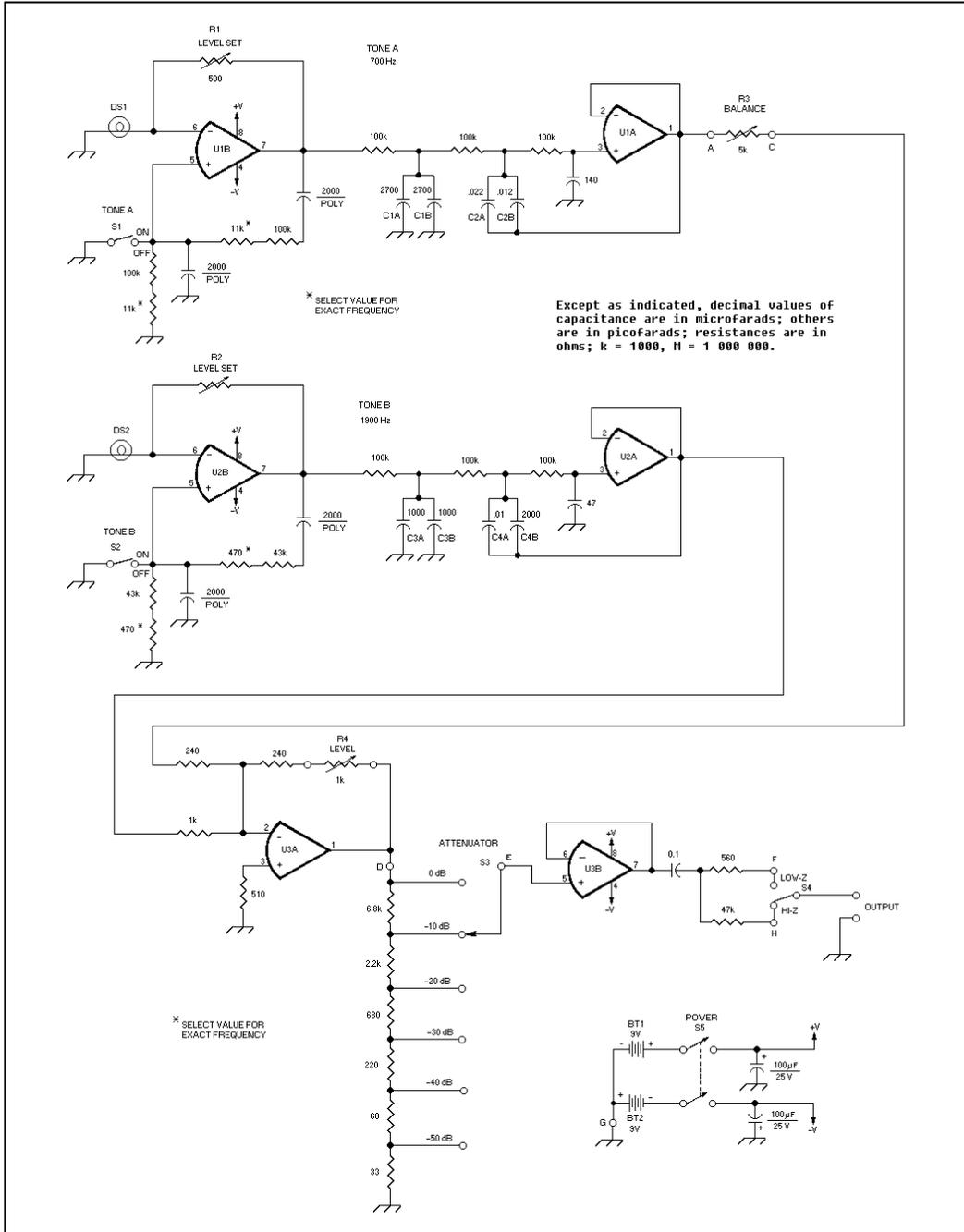
Component layout and wiring are not critical, and any type of construction can be used with good results. For those who wish to use a printed-circuit board, a parts placement guide is shown on the next page. Because the generator will normally be used near a transmitter, it should be enclosed in some type of metal case for shielding. Battery power was chosen to reduce the possibility of RF entering the unit through the ac line. With careful shielding and filtering, the builder should be able to use an ac power supply in place of the batteries.

The only adjustment required before use is the setting of the oscillator feedback trimmers, R1 and R2. These should be set so that the output of each oscillator, measured at pin 7 of U1 and U2, is about 0.5 volt RMS. A VTVM or oscilloscope can be used for this measurement. If neither of these is available, the feedback should be adjusted to the minimum level that allows the oscillators to start reliably and stabilize quickly. When the oscillators are first turned on, they take a few seconds before they will have stable output amplitude. This is caused by the lamps, DS1 and DS2, used in the oscillator feedback circuit. This is normal and should cause no difficulty. The connection to the transmitter should be through a shielded cable.



Parts-placement diagram for the two-tone audio generator, shown from the component side of the board.

Printed-circuit board etching pattern, shown from the foil side of the board.



Schematic diagram of the two-tone audio generator. All resistors are 1/4-W carbon film.

BT1, BT2--9V Alkaline.

C1A, B--Total capacitance of $0.0054 \mu\text{F} \pm 5\%$

C2A, B--Total capacitance of $0.034 \mu\text{F} \pm 5\%$

C3A, B--Total capacitance of $0.002 \mu\text{F} \pm 5\%$

C4A, B--Total capacitance of $0.012 \mu\text{F} \pm 5\%$

DS1, DS2--12V, 25mA lamp.

R1, R2-- 500Ω , 10-turn trim potentiometer.

R3-- 500Ω , panel-mount potentiometer.

R4-- $1k \Omega$, panel-mount potentiometer.

S1, S2--SPST toggle switch.

S3--Single-pole, 6-position rotary switch.

S4--SPDT toggle switch.

S5--DPDT toggle switch.

U1, U2, U3--Dual JFET op amp, type LF353N or TL082.

