BUILD R-E's VOCAL STRIPPER

Build this lead vocal filter and test your singing ability.

TERRY J. WEEDER

ALMOST EVERYONE ENJOYS LISTENING TO music, and just about as many people enjoy singing along to their favorite songs. If you're one of the many people who loves to sing, you may be interested in a clever audio device that filters out lead vocals from a stereo recording, leaving just the background . For under $50.00, you can build this unique audio filtering device. Impress your friends with this *Karaoke*-like audio system and enjoy hours of singing pleasure.

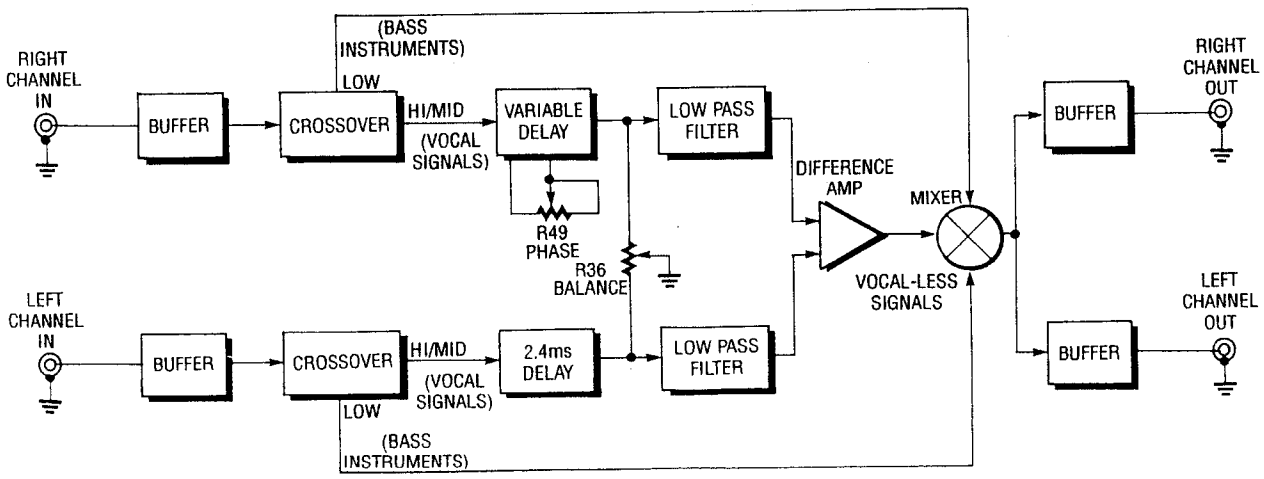
Filtering out the vocal tracks from a recording is not as simple as merely eliminating the midrange frequencies. Along with the vocals, the midrange frequencies contain a large portion of the music. Vocal filtering is quite easy, however, if you take advantage of the way stereo recordings are mixed.

Stereo mixing

When mixing is done in a studio, each instrument or voice is assigned a position relative to left (L) and right (R) channels. Some instruments are recorded at higher levels on the right channel so that their sounds seem to come from the right side of the stage. Others are recorded on the left channel for the opposite effect. Lead vocals and instruments such as the bass drum and bass guitar are usually recorded at the same level on both channels so they seem to come from center stage. That is what makes lead vocal filtering possible.

Vocal signals, which consist primarily of mid-high range frequencies, can be filtered out by a series of filtering stages shown in Fig. 1. Bass instruments, corresponding to a lower frequency range, can be diverted to a final mixing stage so that the music is not filtered out along with the vocals.

A signal from one channel is inverted and subtracted from the



F. BLOCK DIAGRAM OF FILTER NETWORK. Right channel signal is inverted and subtracted from the left channel, cancelling the lead vocals. Low frequencies are bypassed by an active crossover and remixed with the difference signal, without the vocals.

other (L−R), which causes the lead vocals that are common to both channels to cancel out. The music common to the left and right channel remains unchanged. Unfortunately, along with the lead vocals, all low frequencies are common to both channels and must bypass the cancellation circuit. A simple active crossover removes the low frequencies so that they can be remixed with the vocal-less signal at a later stage.

From the active crossover stage, all midrange and high frequencies pass through a variable delay stage, which is used to align the left and right channel signals so that they are exactly 180° out of phase with each other. Proper signal cancellation is achieved only when both signals are 180° out of phase. The low-pass filter stage filters out unwanted high frequencies from the variable delay stage. The output of the low-pass filter enters a difference amp, where the lead vocal signals cancel, and is then remixed with the low frequencies at the final mixing stage.

Here's how it works

The schematic of the lead vocal filter is shown in Fig. 2. The left and right channel signals are coupled through C1 and C2 to buffer amps IC4-a and IC4-b. From the buffer amps, the left and right channel signals pass through active crossovers IC5-a and IC5-b, sending all low frequencies to a final mixer IC6-c, and all middle and high frequencies to analog delay lines IC1 and IC2, RD5106 256-sample bucket-brigades. Integrated circuit IC2 delays the left channel signal by

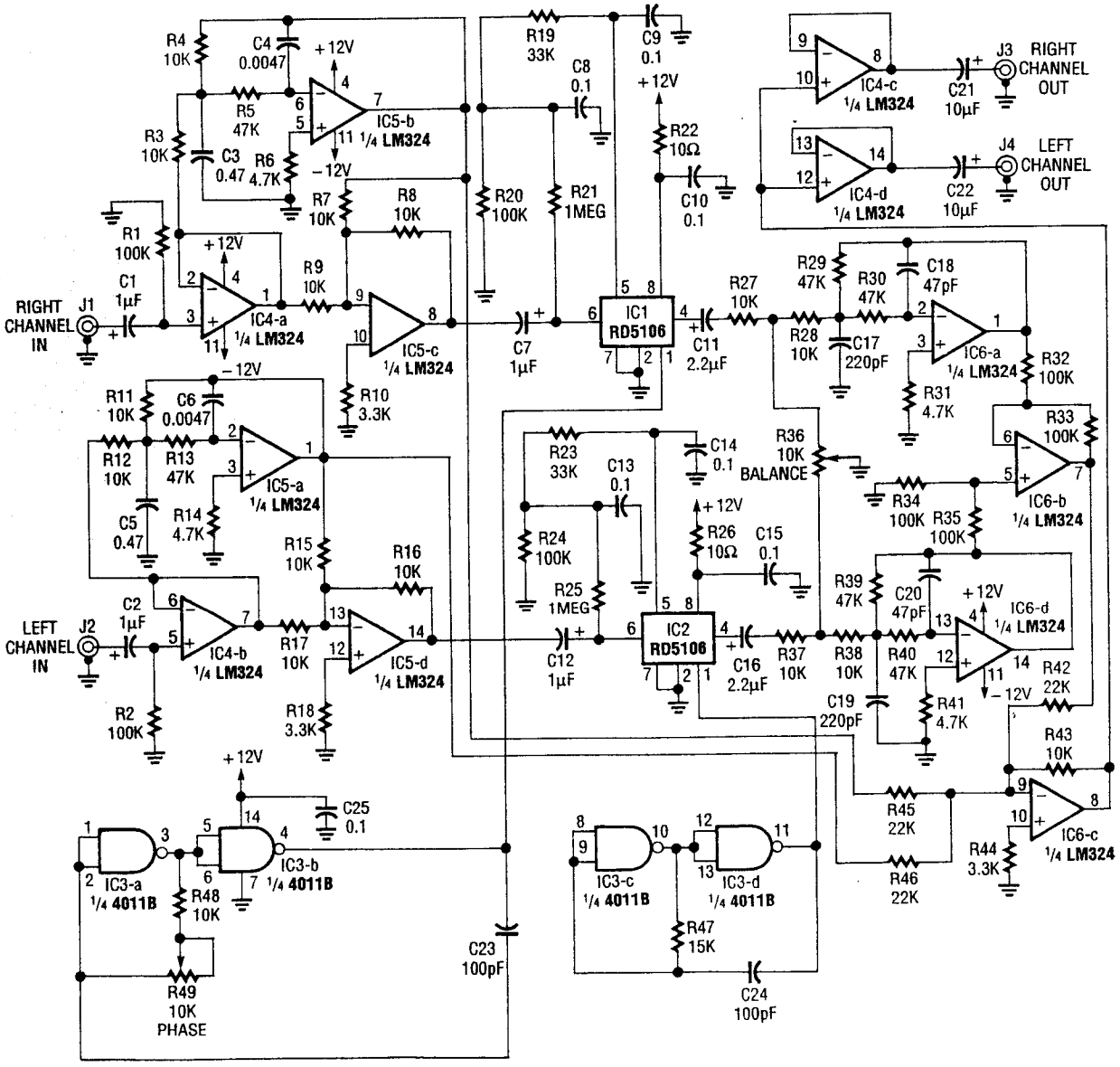


FIG. 2—SCHEMATIC OF LEAD VOCAL FILTER. Right and left channel signals pass through IC4-a and -b buffer amps into active crossover IC5; low frequencies are sent to IC6-c mixer, middle and high frequencies are sent to analog delay lines of IC1 and IC2. That output passes through IC6-a and -d to filter high frequency sample steps. IC6-b signals are remixed with low frequencies by IC6-c and are sent to final output via IC4-c and -d buffers.

2.4 ms, set by the fixed-frequency clock generated by ½-IC3, R47, d C24. The right channel sig- is delayed by IC1 with a varia- -e-frequency clock generated by ½-IC3, R48, R49, and C23. Potentiometer R49 is used for phase adjustment.

The output of each delay line from IC1 and IC2 passes through low-pass-filters IC6-a and -d, and their associated parts, to filter out high-frequency sample-steps produced by IC1 and IC2. Balance control R36 is adjusted for equal amplitude of the left and right channels. IC6-b is a difference amplifier which cancels all lead vocals that are common to both channels. The resulting signal from IC6-b is remixed with low frequencies by IC6-c and is then sent to the output via buffers IC4-c and IC4-d.

All resistors are ¼-watt, 5%, unless otherwise indicated.

R1, R2, R20, R24, R32, R33–R35—100,000 ohms
R3, R4, R7–R9, R11, R12, R15, R16, R17, R27, R28, R37, R38, R43, R48—10,000 ohms
R5, R13, R29, R30, R39, R40—47,000 ohms
R6, R14, R31, R41—4700 ohms
R10, R18, R44—3300 ohms
R19, R23—33,000 ohms
R21, R25—1 megohm
R22, R26—10 ohms
R36, R49—10,000 ohms, potentiometer
R42, R45, R46—22,000 ohms
R47—15,000 ohms

Capacitors

C1, C2, C7, C12—1 µF tantalum
C3,C5—0.47 µF tantalum
C4, C6—0.0047 µF Mylar
C8, C9, C10, C13, C14, C15, C25—0.1 µF Mylar
C11, C16—2.2 µF tantalum
C17, C19—220 pF ceramic disc
C18, C20—47 pF ceramic disc
C21, C22—10 µF electrolytic
C23, C24—100 pF ceramic disc

Semiconductors

IC1, IC2—RD5106 256-sample bucket-brigade analog delay line, EG & G-Reticon
IC3—4011 quad two-input NAND gate
IC4–IC6—LM324 quad op-amp

Miscellaneous: Perforated circuit board, standoffs, mounting hardware, hookup wire, shielded cable, 18-AWG power supply cord, strain relief, and four RCA jacks for J1–J4.

Power supply parts

F1—0.5 amp fuse and fuseholder
T1—24 VAC center-tapped transformer
BR1—1.5-amp bridge rectifier, 100 PIV
C1, C2—1000 µF, 25 volts, electrolytic
C3, C4—10 µF, 16 volts, electrolytic
C5, C6— 0.1 µF, ceramic disc
D1, D2—12-volt Zener diode
R1, R2—220 ohms
R3—1000 ohms
S1—SPST switch, 1 amp
LED1—light emitting diode, any color

Note: The following are available from Weeder Technologies, 14773 Lindsey Rd., Mt. Orab, Ohio 45154: An etched, drilled, and plated PC board, $15.00; a basic parts kit including all resistors, capacitors and semiconductors (not including power-supply components), $29.00. Please include $2.00 for shipping and handling in the U.S., $3.00 in Canada. Ohio residents add 5.5% sales tax. Allow 4 to 6 weeks for delivery.

Construction

The easiest way to go about constructing the vocal filter circuit is to use a PC board. An etched and drilled PC board is available from the source in the Parts List or you can make your own from the foil pattern provided here. Mount the vocal filter components as shown in the parts placement diagram, Fig. 3. Use shielded wire to connect the RCA jacks, and ground them properly, either by mounting them to a grounded chassis or by soldering ground wires to their cases. The DC power supply leads from the power-supply board should be twisted to reduce noise transmission.

If you don't use PC mounted potentiometers for R49 and R36, be sure to keep their connecting leads short and twist them to re-

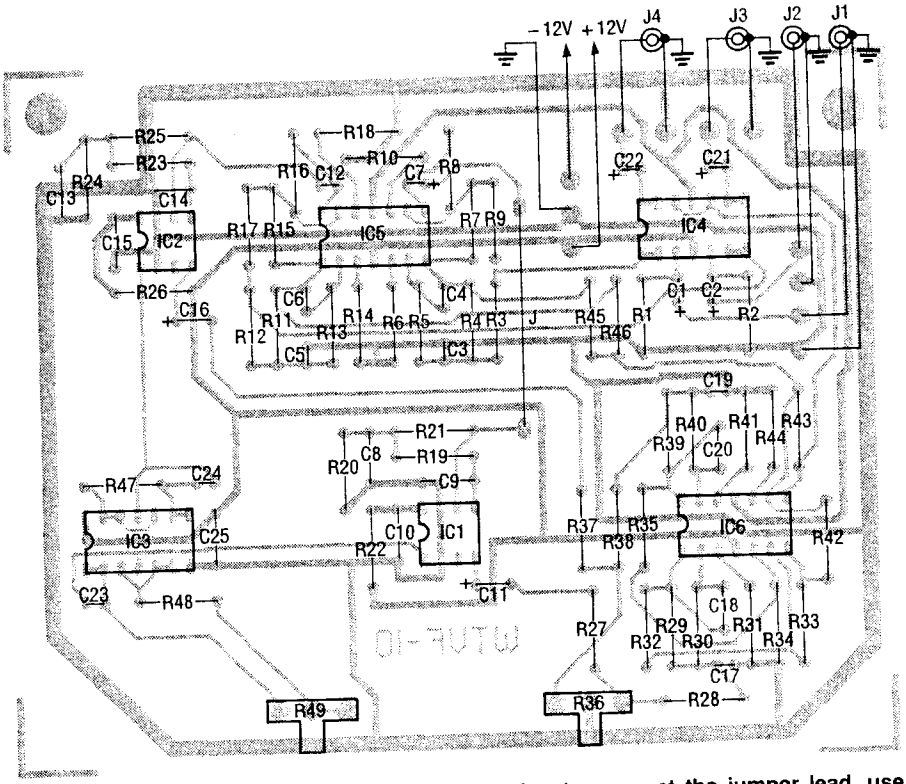


FIG. 3—PARTS PLACEMENT DIAGRAM. Remember to connect the jumper lead, use shielded cables for the RCA jacks and twist the supply leads before soldering to the LED and main PC board.

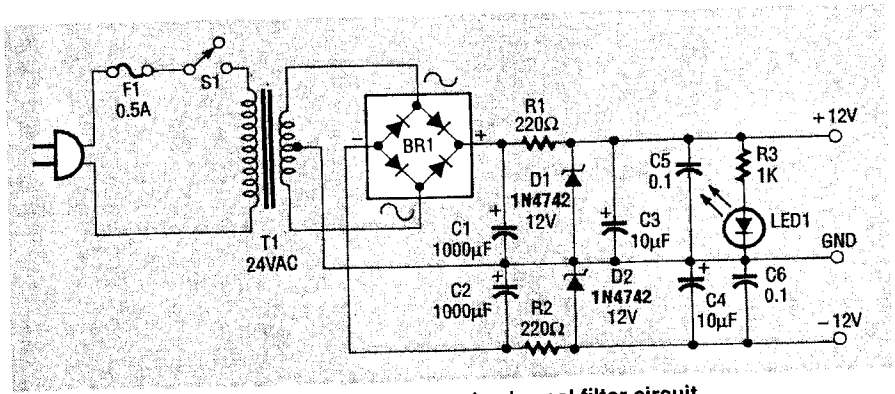


FIG. 4—POWER SUPPLY SCHEMATIC for the lead vocal filter circuit.

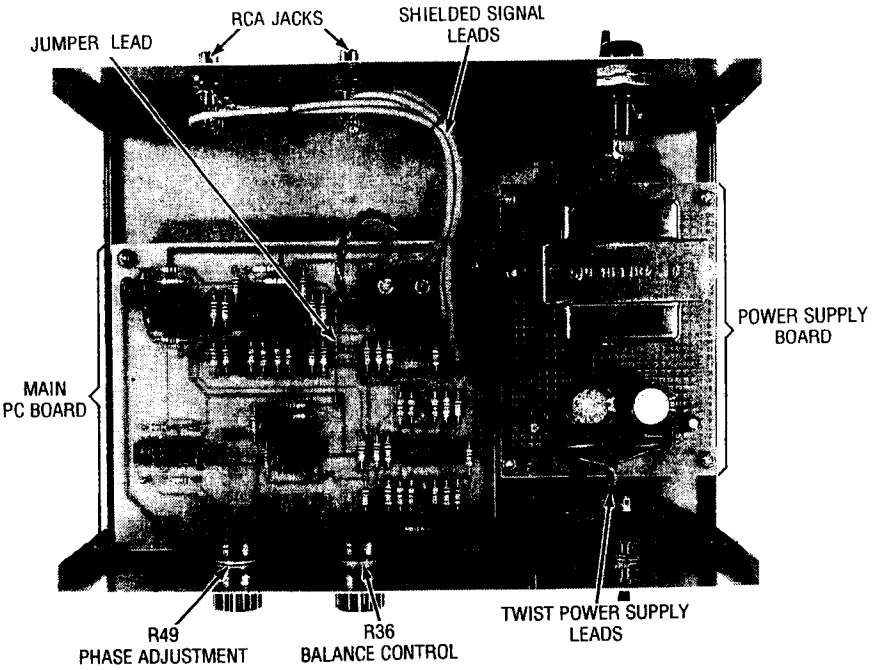
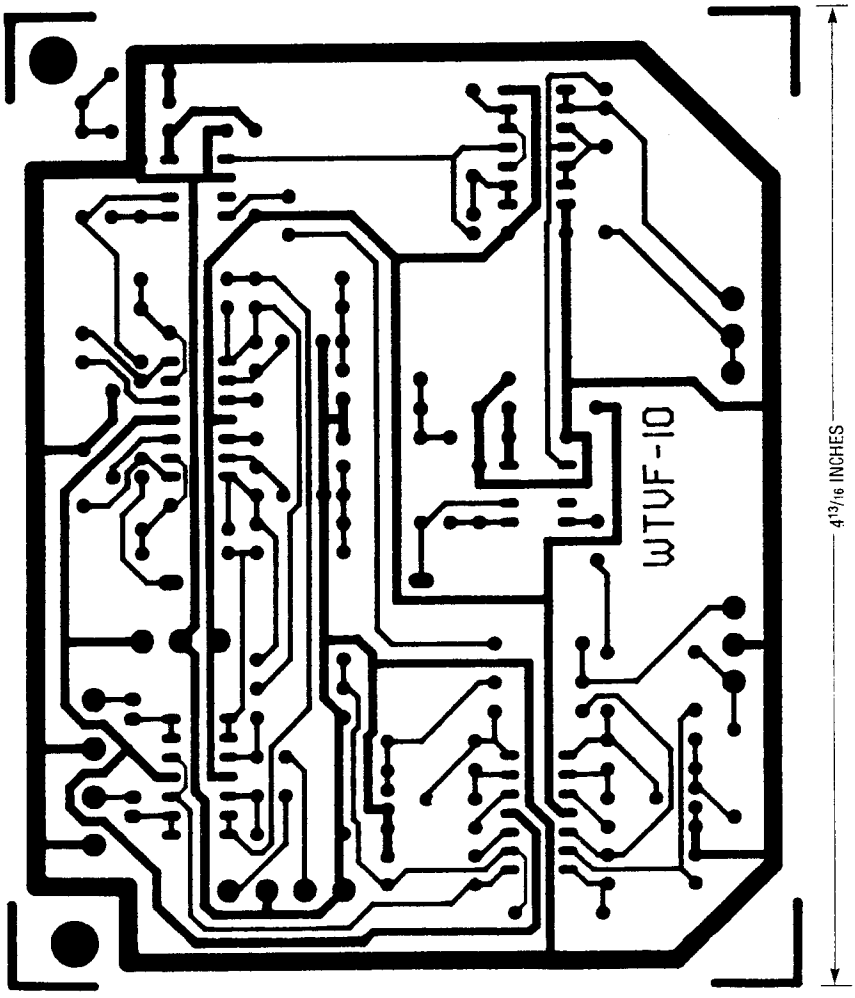


FIG. 5—AN INTERNAL VIEW OF THE LEAD VOCAL FILTER.



duce noise and hum pickup. It is preferable, though, to use shielded leads for these connections. These potentiometers should be grounded by mounting to a grounded chassis.

A simple power supply, like the one shown in Fig. 4, may be used for this device. The power supply can be mounted on a perforated circuit board, as long as you closely follow the component connections shown on the schematic. Although optimum performance is obtained with a ±12 volt supply, the vocal filter gives good results using two 9-volt batteries connected in series.

The power supply and main PC board should be adequately enclosed before operating the vocal filter. A metal enclosure is recommended, as a 120-volt line potential is exposed in the power supply circuit (see Fig. 5).

Hook up and operation

The vocal filter should be connected into the tape loop of your stereo system. Use shielded cables with phono connectors to connect inputs J1 and J2 to the "record" tape monitor jacks on your stereo, and outputs J3 and J4 to the "play" side. To use the vocal filter with a tape deck that normally uses tape monitor jacks, plug the output "play" jacks of the tape deck into J1 and J2 of the vocal filter. Plug J3 and J4 into the input or "play" jacks of the stereo. Make sure you apply power to the vocal filter before turning on the stereo; sensitive components in the vocal filter may be damaged if a signal is applied before power is turned on.

Set R36 to its middle position, play a stereo sound track or tune in an FM stereo broadcast, and switch in the tape monitor. Adjust R49 for minimum lead vocals, then adjust R36. Repeat that process until the lead vocals are suppressed.

If you think the vocal filter is not working, tune in to a mono FM broadcast. If you can't find one, tune to a stereo station, and adjust the tuning knob either way, just enough so the stereo light goes off. If the vocal filter operates properly, you should be able to adjust R36 and R49 to filter out all music except low frequencies.

With a little help from **Radio Electronics**, you now have the know-how to build a fairly simple audio filtering device in just a few short evenings. Once completed, you can use this system to practice singing alone, or be creative and have all your friends over for a *Karaoke* party! R-E