FOUR-CHANNEL SYNTHESIZER

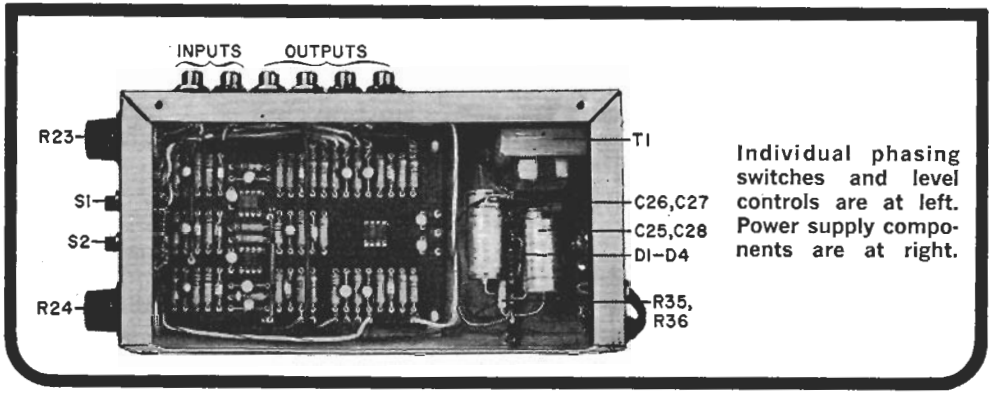
FOUR CHANNELS FROM TWO USING A NOVEL ACTIVE-ELEMENT CIRCUIT

BY JAMES BONGIORNO

THERE are many ways to achieve four-channel sound—from special decoders and special records, to a wide selection of passive four-channel synthesizers that accept a conventional two-channel input and synthesize two more new channels. Here is an opportunity to build a high-quality, low-cost four-channel synthesizer that uses active circuit elements and that, when used with a second stereo amplifier and speakers, will do an impressive job in converting two channels to four. In fact, with E-V processed records (Stereo 4), the sound is very much like an E-V decoder at work. It also does an excellent job on any stereo signal, including FM multiplex.

The synthesizer (whose schematic is shown in Fig. 1) also includes individual level controls and a set of phasing switches for the new channels so that the sound quality can be "tailored" to suit almost any listening environment and musical taste.

The specifications for the synthesizer include a noise level that is 92 dB below 1



Individual phasing switches and level controls are at left. Power supply components are at right.

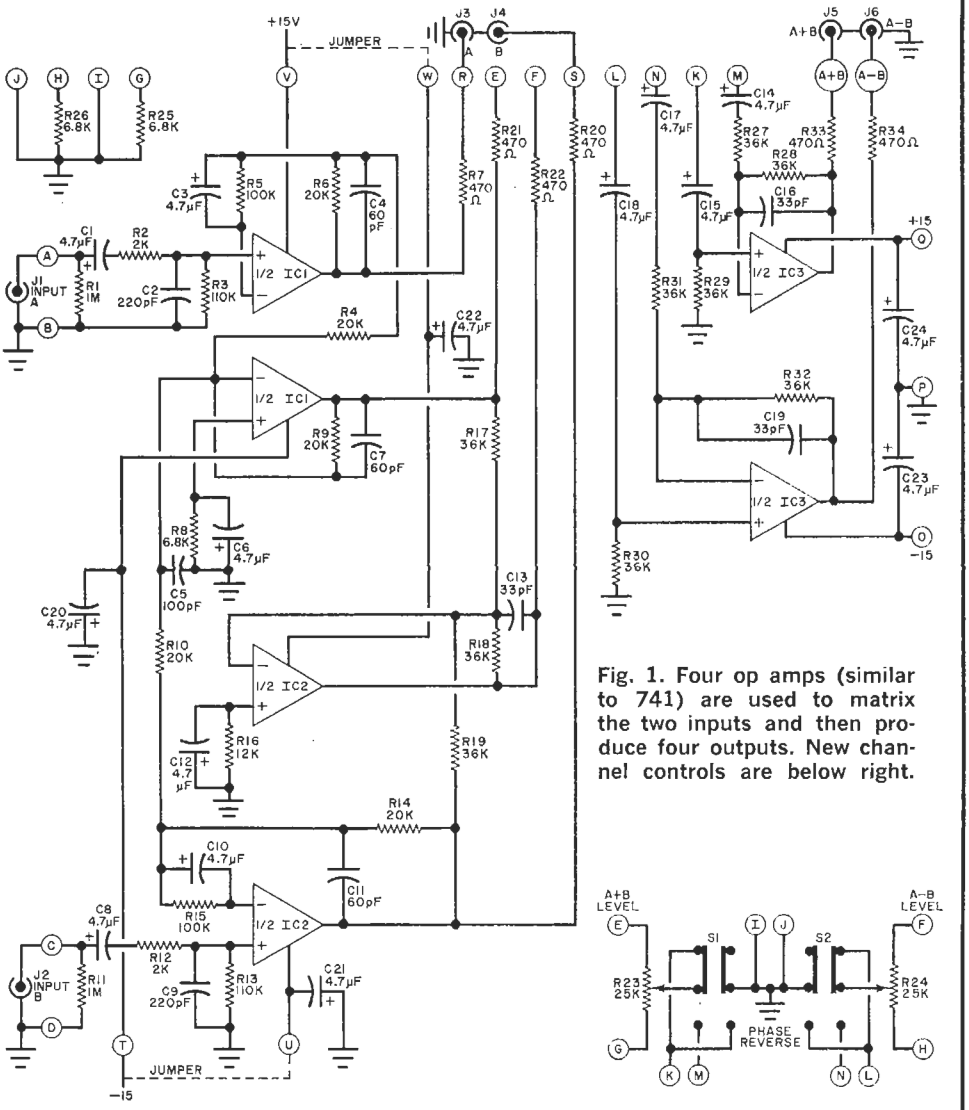


Fig. 1. Four op amps (similar to 741) are used to matrix the two inputs and then produce four outputs. New channel controls are below right.

PARTS LIST (Including Power Supply)

C1,C3,C6,C8,C10,C12,C14,C15,C17,C18,C20-C24—4.7-µF, 25-volt electrolytic capacitor
C2,C9—220-pF, 10% polystyrene capacitor
C4,C7,C11—60-pF, 5% polystyrene capacitor
C5—100-pF, 10% polystyrene capacitor
C13,C16,C19—33-pF, 5% polystyrene capacitor
C25,C26—1000-µF, 25-volt electrolytic capacitor
C27,C28—470-µF, 25-volt electrolytic capacitor
D1-D4—1N2070 silicon rectifier
I1—NE-2 neon lamp
IC1-IC3—Dual op amp (Signetics N5558V)
R1,R11—1-megohm, 10% resistor
R2,R12—2000-ohm, 10% resistor
R3,R13—110,000-ohm, 5% resistor
R4,R6,R9,R10,R14—20,000-ohm, 5% resistor
R5,R15—100,000-ohm, 5% resistor
R7,R20,R21,R22,R33,R34—470-ohm, 10% resistor
R8,R25,R26—6300-ohm, 5% resistor
R16—12,000-ohm, 5% resistor
R17-R19, R27-R32—36,000-ohm, 5% resistor
R23,R24—25,000-ohm, linear taper potentiometer
R35,R36—390-ohm, ½-watt resistor
R37—100,000-ohm, 20% resistor
S1,S2—Dpdt slide switch
T1—Power transformer; secondary: 24VCT at 85 mA (Stancor P8394)
Misc.—Suitable chassis (Bud CU-482, 4" x 8" x 2"), rubber feet, knobs, line, etc
Note: Available from Southwest Technical Products, Box 32040, San Antonio, TX 78216: PC board $2.65 pp; complete kit less chassis, $23.90 plus postage for 2 lb.

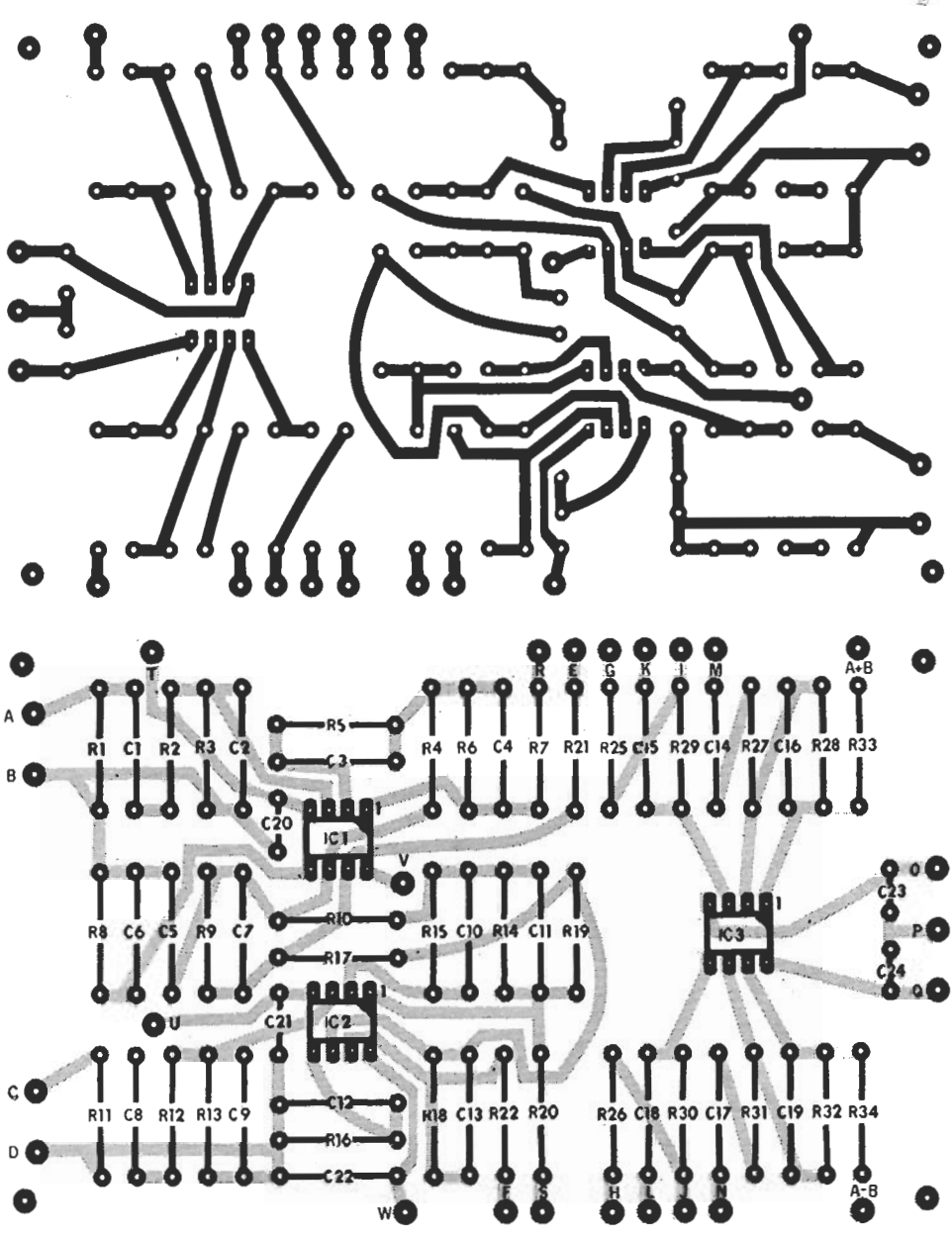


Fig. 2. The actual size foil pattern and components installation diagram for synthesizer. Use a low-power soldering iron and fine solder.

volt on any channel; distortion of 0.05% or less at 1 volt rms output; gain of +6 dB on the two front channels, controllable from −7 to +6 dB on the two new channels; and frequency response of ±0.5 dB from 20 Hz to 20 kHz at 1 volt rms output.

How It Works. The synthesizer recovers the "ambiance" that appears in most stereo recordings and uses it to create the extra channels. Two processes are used: one adding the stereo information to create a third center channel and the other subtracting the two channels to provide a difference signal.

Each of the three IC's contains two identical operational amplifiers. The first two op amps (half of *IC1* and half of *IC2*) are wired as non-inverting amplifiers with a

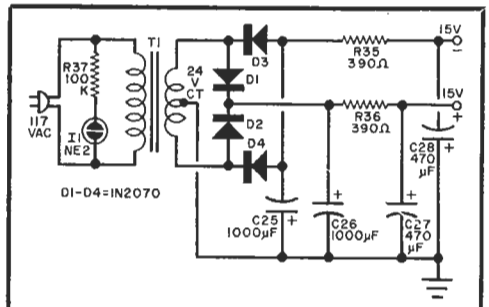


Fig. 3. Conventional power supply is wired point-to-point using terminal strips. See Fig. 1 for Parts List.

gain of two. The outputs for the front channels at *J3* and *J4* are thus twice the A and B inputs.

The second half of *IC1* is a summing amplifier whose output is A + B. The second half of *IC2* is a difference amplifier whose inputs are 2B and A + B so that its output is A − B. Thus the two new channel outputs are A + B and A − B. Level and phase-reversal controls are provided by *R23*, *R24*, *S1*, and *S2*. The signals are then fed to the two halves of *IC3*. With the associated phase-reversal switch in one position, its op amp acts as a unity gain voltage follower; and with the switch in the other position, the op amp acts as an inverting follower. Thus the switch provides a full 180° change in phase of the signal.

Construction. The synthesizer is assembled on a PC board using the foil pattern and component layout shown in Fig. 2. The power supply, whose schematic is shown in Fig. 3, is mounted separately.

The board and power supply can be assembled in a suitable chassis similar to that shown in the photograph of the prototype. The phase-reversal switches, level controls and connectors are mounted on the sides.

Operation. Connect the A and B inputs (*J1* and *J2*, respectively) to the source of conventional two-channel sound and the A and B outputs (*J3* and *J4*) to the inputs of the front-channel stereo amplifier. Connect A + B (*J5*) and A − B (*J6*) to the inputs of the stereo amplifier to be used for the extra speakers.

The speaker arrangement used is unique. The two conventional front stereo speakers should be separated a little more than usual with the A + B speaker placed between them. The A − B channel speaker is then placed at the rear of the room.

With a two-channel input, turn on the synthesizer and note that the two front channels deliver normal stereo. Adjusting the gain of the two new channels (*R23* and *R24*) should cause a signal to be heard from those speakers. The added stereo amplifier gain controls can be adjusted to obtain the desired volume level. Both the new channel level controls and the phase-reversal switches can now be set for the desired type of four-channel sound for your listening room. ◈

INEXPENSIVE TRANSISTOR POWER SUPPLY

by Frank H. Tooker

HOBBYISTS and experimenters who need a power supply for experimental setups and even finished projects should not overlook the low-cost units sold as battery eliminators for radios and the like. These little power supplies can be obtained in 6-, 9-, and 12-volt models—and they are all electronically voltage regulated. After buying a battery eliminator, fit the ends of the output cable with a pair of clips (see photo). Color code the clips for easy identification of the positive and negative leads. If the clips are equipped with rubber "boots," buy one red and one black and attach them to the positive and negative eliminator leads, respectively. Now, you have a power supply that is inexpensive, compact, and always ready for instant use.