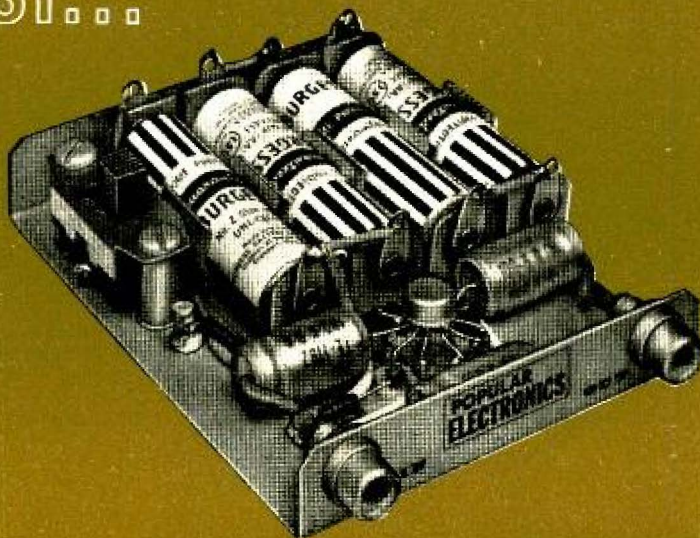


AT LAST...



By DON LANCASTER

AN INTEGRATED CIRCUIT AMPLIFIER

you can build for under \$6!

SIMPLE PROJECT OPENS DOOR TO NEW MICROCIRCUITS

HERE'S the "bargain basement" integrated circuit (IC) amplifier that hobbyists and experimenters have been waiting for. Ideally suited for use as a phonograph or dynamic microphone pre-amplifier, as a boost amplifier in a receiver i.f. or r.f. stage, as well as in practically all applications employing low-level signals, the complete IC amplifier can be built for under \$6.00. The IC, packaged in a TO-5 case, contains the equivalent of six 2N918 transistors and seven resistors, and provides a voltage gain of 40, a current gain of 120, and a power gain of nearly 5000.

Frequency response is essentially flat from 20 Hz to 30 MHz, and distortion is negligible at outputs of up to 0.7 volt peak-to-peak. Clipping occurs at output levels of 1 volt peak-to-peak and over. When assembled with the external components itemized in the Parts List, the IC amplifier has an input impedance of 3300 ohms, and an output impedance of approximately 25 ohms.

How It Works. The integrated circuit amplifier (Fig. 1) consists of two separate transistor differential amplifiers (they respond to the difference between

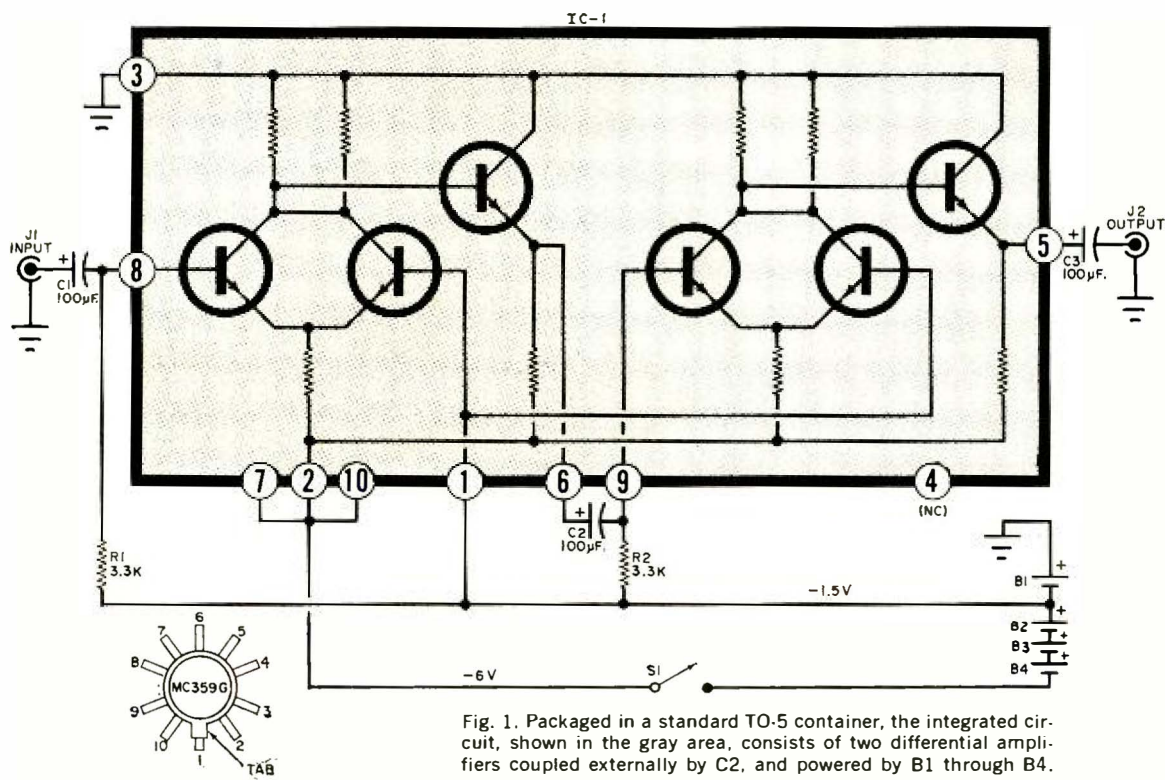


Fig. 1. Packaged in a standard TO-5 container, the integrated circuit, shown in the gray area, consists of two differential amplifiers coupled externally by C2, and powered by B1 through B4.

two voltages or currents), each coupled to an emitter follower stage. The output of the first emitter follower is applied to the base of the second differential amplifier input transistor through coupling capacitor C2.

Capacitor C1 couples the input from J1 to the base of the first amplifier which is biased through R1. Resistor R2 applies bias to the base of the second differential amplifier input transistor. The IC amplifier output is applied to J2 through C3.

Base bias for the second transistor of each amplifier pair is applied directly from a 1.5-volt tap on the 6-volt supply battery. The full supply voltage is applied to the circuit through S1.

Important: The values of capacitors C1, C2, and C3 determine the frequency response of the circuit. For low-frequency response (about 20 hertz) only, 100- μ F capacitors are used; for frequencies above 100 kHz, 0.02- μ F disc capacitors are used *instead* of the 100- μ F units. For a full frequency coverage (20 hertz to 30 MHz), parallel the two capacitor values.

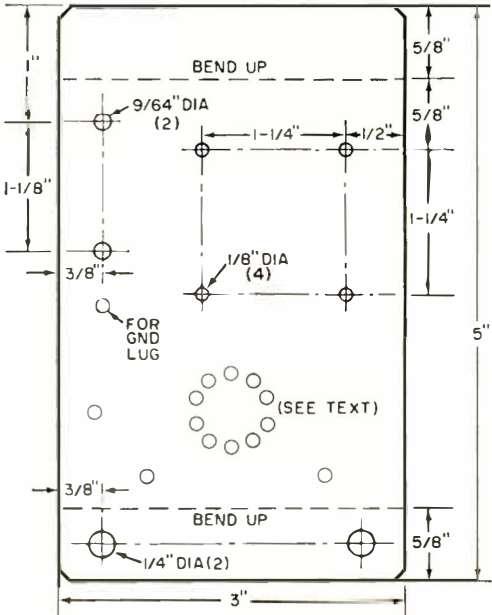


Fig. 2. The complete IC, including the battery supply, can be mounted on a small (3" x 5") aluminum plate, drilled and bent to form a chassis support.

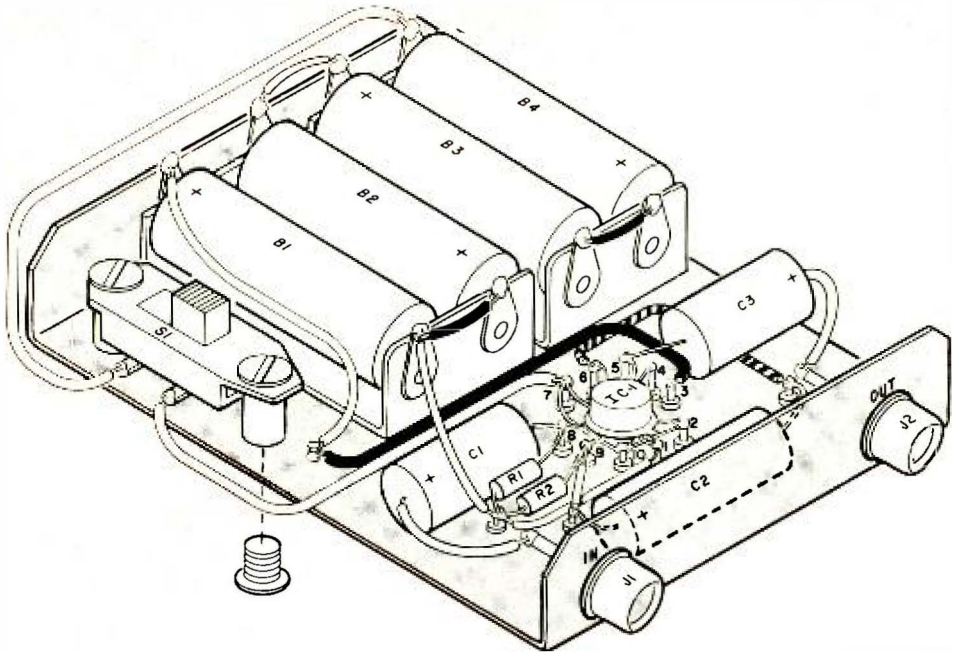


Fig. 3. Pictorial of fully assembled integrated circuit shows simplicity of layout and wiring details. The 10 teflon terminals that mount the TO-5 case can be replaced with one Sealectro IC socket.

Construction. The circuit is easily assembled on an improvised aluminum plate laid out and drilled as shown in Fig. 2. The IC socket used by the author is made up of 10 teflon press-fit standoff terminals inserted into appropriately-sized holes drilled in the plate. Then the leads from the IC case are fanned out and each soldered to a standoff.

However, it is suggested that the builder follow a much easier and efficient procedure. A single Sealectro press-fit socket (see Parts List) can be press-fitted in a $\frac{1}{2}$ " hole drilled in the plate instead of bothering with the 10 small holes.

The four $\frac{1}{8}$ "-diameter holes in the upper portion of the plate mount the two penlight battery holders that are either riveted or screwed to the plate. Slide switch *S1* is mounted on $\frac{1}{2}$ "-long spacers threaded at both ends for ≈ 6 screws, through the two $\frac{3}{16}$ "-diameter holes. The three unidentified holes in the vicinity of the IC socket accommodate press-fit standoffs that serve as tie points for

PARTS LIST

B1, B2, B3, B4—1.5-volt penlight cell
C1, C2, C3—100- μ F, 6-volt electrolytic capacitor for 20 Hz to 1.5 MHz; 0.02- μ F ceramic capacitor (10 volts or more) for 100 kHz to 30 MHz; both values in parallel for full range
IC1—Motorola dual in-line package MECL circuit (Allied Radio MC359G, \$3.70)
J1, J2—Chassis-mounting phono jack
R1, R2—3300-ohm, $\frac{1}{4}$ -watt resistor
S1—S.p.s.t. slide switch
1 Sealectro IC 10-pin socket, Part No. RTC-1010 SL (available from Joseph Kurzan, Inc., or Arroyo Electronics, Inc., both in New York City)
1—3" x 5" sheet of 1/32"-or 1/16"-thick aluminum
Misc.—Battery holders for four penlight cells (2), teflon press-fit terminals (3), ground terminal, $\frac{1}{2}$ "-long threaded spacers (2) with ≈ 6 $\frac{1}{4}$ "-long screws (4), rivets or screws for battery holder, solder, hookup wire

component leads. The input and output jacks are mounted on the raised front panel as shown in Fig. 3.

All circuit components should be mounted and wired in place before installing the IC package; but do not
(Continued on page 108)

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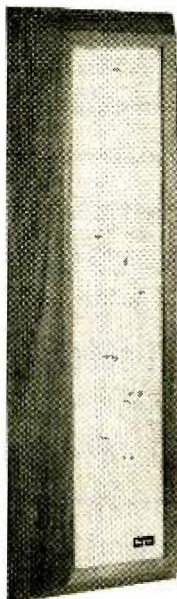
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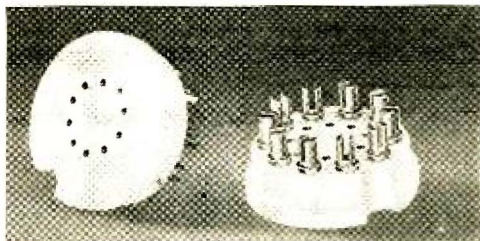
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CIRCLE NO. 4 ON READER SERVICE PAGE

INTEGRATED CIRCUIT AMPLIFIER

(Continued from page 59)



This type of press-fit socket, put out by Sealectro, can be used to simplify your project. With it you simply plug in your IC as you would a transistor.

solder the leads to the IC socket until the case is in place. When wiring this unit in the circuit, observe that the locating tab on the IC is directly over pin 1. Viewed from the top of the case, the pins are numbered counterclockwise. Also, observe that pins 2, 7, and 10 are tied together and returned to a terminal on S1.

Operating Hints. Distortion will result if too large a signal is applied to the amplifier input. For applications not requiring a wide bandpass, a step-up transformer can be used to couple the output of the first differential amplifier to the input of the second amplifier, replacing capacitor C2. However, some amount of experimentation is required to select the right transformer, since poor matching of the stages can transform your amplifier into a blocking oscillator due to the sensitivity of emitter followers to inductive loads.

For additional gain, two or more IC packages can be cascaded together. But care must be taken to keep the signal at a level low enough so that clipping will not take place.

The values of R1 and R2 have been chosen for best overall performance and circuit stability. But where it is desirable to change the amplifier input and output impedances, the value of these resistors can be raised to as high as 22,000 ohms with only a slight loss in gain and stability. One advantage of this change is that smaller values are required for C1 through C3 for any given frequency response.

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