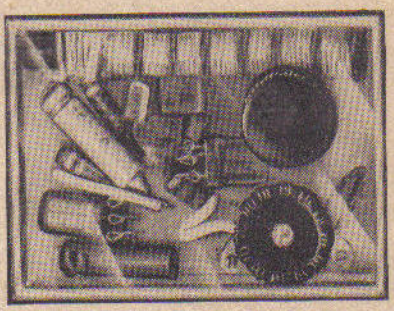
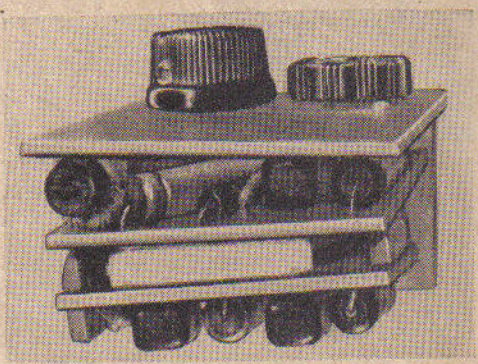
By FRANCIS J. LEYVA



BUILD a "Half-Pack"

Tiny transistorized receiver uses homemade printed circuits



Side view of the completed assembly. Note the small wooden spacers glued between the two printed-circuit chassis boards. The three sides and the bottom of the chassis are installed later.

WITH A POWER CONSUMPTION of about one milliwatt, and using the new miniature dynamic earphones, this receiver will deliver earsplitting volume on local stations. A little more than half the size of a king-size pack of cigarettes, its power supply is a single 1.3-volt mercury cell which is called on to supply about one milliampere of current at full volume. It needs no external antenna, although one can be employed in low-signal areas.

Two printed-circuit boards (*PC1* and *PC2*) are used (see parts list). Cut out the laminate to sizes shown in templates on page 49. Clean the two boards with steel wool until they are shiny. With a straightedge and compass, transfer the conducting lines to the laminate board. The width of the conductor strips should be about 1/16", and the connection points should be about 1/8" in diameter.

Use the dark areas on the templates as guides when applying the resist. To make the connection points for the transistors close together, draw a line about 1/2" long with a ball-point tube, or put down a strip of tape and divide it into three parts with a razor blade. These parts become the terminals for the transistor leads.

If you use liquid resist and a brush, or a ball-point tube, trim the lines with a razor blade after they have dried. This will improve the looks of the board, and minimize

HOW IT WORKS

The first transistor *(TR1)* is an r.f. type used as a grounded-base regenerative reflex detector. Antenna coil *L1* picks up a radio signal and induces an identical signal in the tickler coil *(L2)*. The latter feeds this signal to the emitter of *TR1*. The signal is amplified and passes through *L1*, which is in the collector (output) circuit. As a result, a large signal is induced in *L2* and the cycle repeats itself. This is what causes regeneration.

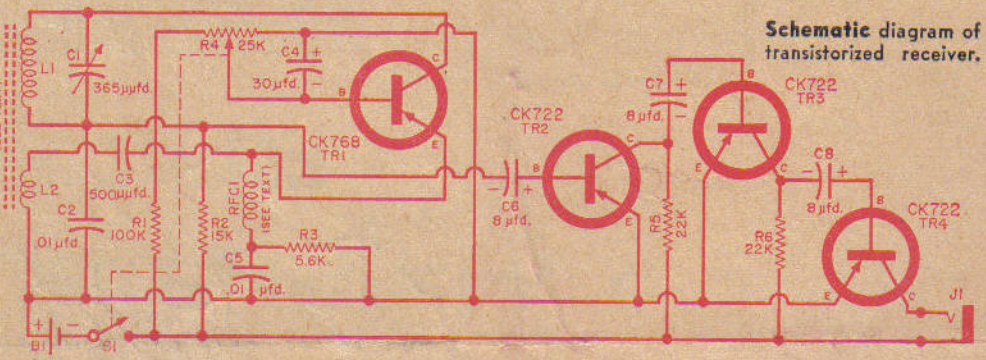
That part of the r.f. signal induced in *L2* is detected by the emitter and base junction of *TR1*. The audio voltage developed across *R3* and *C5* is reapplied to the emitter and base, amplified, and coupled to the CK722 transistor *TR2*.

TR2, *TR3* and *TR4* form a simple three-stage audio amplifier. It differs from many other transistor amplifiers in that the bases have no bias resistors. The collector leakage current and the minute current leaking through the coupling capacitors is all the bias current that is needed for the small signals that are handled.

go along. They are all mounted on the non-etched side of the board with the exception of *C1*, *R1*, and the battery holder.

Soldering. If all parts fit well, solder them in place with hot, well-tinned, small-tip soldering iron or gun. Use a special printed-circuit solder such as Print-Kote because its low melting point reduces the danger of overheating the etched board and components.

When soldering the parts in place, always hold the leads close to the parts with long-nose pliers to dissipate excessive heat. Make sure that you *don't* have the transistors in place when soldering the flea clips to the conductors. After the parts are soldered in place, clip off the excess lead with end nippers or a nail clipper.



Schematic diagram of transistorized receiver.

the danger of accidental shorts between the closely spaced conductors.

Etching and Drilling. After the resist has dried, put the boards in the etching solution. They should be ready if you use the cold etching method.*

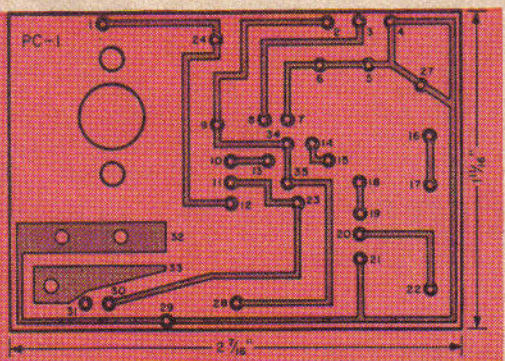
Next, drill the holes for mounting the components. All are made with a 1/16" drill, except the mounting holes for the tuning capacitor *(C1)*. Two of these holes are 1/8" in diameter and countersunk from the non-etched side of the board. The hole for the shaft of the same capacitor is 1/4" in diameter and countersunk from the etched side of the board. Although the flea clips are intended to be mounted in 3/32" holes, it is better if only the smaller bottom part is fitted into the 1/16" holes.

Follow the lists of connections (two numbers or letters indicate that a component should be connected between these two points, and a single letter designates a terminal such as one of the transistor electrodes or a battery terminal), and insert all the components in their respective positions but do *not* solder them in as you

PARTS LIST

B1—1.3-volt mercury cell (Mallory RM-630)
C1—365-µfd., single-gang, midget variable capacitor (Argonne Poly-Vari-Con)
C2, C5—0.01-µfd. subminiature capacitor (Aerovox P832)
C3—0.0005-µfd. subminiature capacitor (Centralab DM-501)
C4—30-µfd., 6-volt electrolytic capacitor
C6, C7, C8—8-µfd., 6-volt electrolytic capacitor
J1—Miniature jack (Telex 9240)
L1—50 turns of #22 s.c.e. wire on 1/4" x 2 3/8" ferrite core (Lafayette MS-331)—see text
L2—Six turns #22 s.c.e. wire on same core
L3—R.f. choke (winding from a discarded miniature i.f. transformer)
PC1, PC2—XXXP printed-circuit copper laminate board (one 2" x 4 1/4" section cut in two parts—1 1/16" x 2 7/16" for PC1 and 1 1/16" x 2 5/16" for PC2)
R1—100,000-ohm resistor, 1/2-watt resistor
R2—15,000-ohm, 1/2-watt resistor
R3—5600-ohm, 1/2-watt resistor
R4—25,000-ohm subminiature volume-regeneration potentiometer (Lafayette VC-45)
R5, R6—22,000-ohm, 1/2-watt resistor
S1—S.p.s.t. switch (on R4)
TR1—CK768 transistor
TR2, TR3, TR4—CK722 transistor
1—6-oz. bottle of etching solution (Lafayette PE3)
1—Roll of resist-tape or ball-point tube (Lafayette PRT-2 or PRTL)
12—"Flea" clips for soldering contacts
Misc. eyelets (0.062" in diameter by 0.093" long); tin, copper or brass for battery holder; plastic cabinet

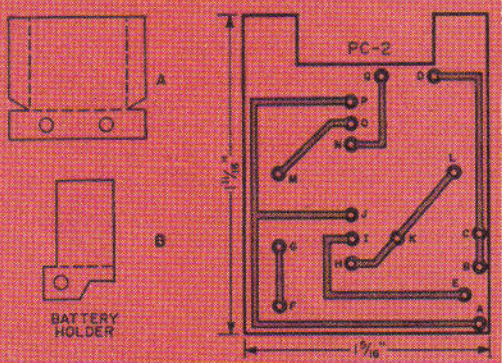
* For detailed information on making printed circuits, see "'Printed Wiring' Techniques for the Experimenter," Part 1 in the August 1956 issue of POP'tronics, and Part 2 in the September 1956 issue. Also see "Simplified Etched Circuits" in the June 1957 issue.



CONNECTIONS FOR PC1

1—Top of antenna coil
2—Bottom of antenna coil
3—Top of tickler coil
4—Bottom of tickler coil
5 and 15—R3
6 and 14—C5
7 and 34—C2
8 and 13—C3
9—Top terminal of C1
10—Emitter of TR1
11—Base of TR1
12—Collector of TR1
13 and 15—L3
16 and 18—R5
17 and 26—Jumper wire
18—2" wire to G of PC2
19—Collector of TR2
20—Base of TR2
21—Emitter of TR2
22—C6 (pos. terminal)
23—C4 (neg. terminal)
24—C1 (bottom terminal)
25 and 31—R1
25 and 35—R2
25—Wire to PC2, Point B
26—S1 (either terminal)
27—C4 (pos. terminal)
28—C6 (neg. terminal)
29—Wire to PC2, Point A
29—Right terminal of R4 (with prongs facing you)
30—R4 (center terminal)
31—Left terminal of R4 (with prongs facing you)
32—Positive terminal of battery holder (Part A) —see text
33—Negative terminal of battery holder (Part B) —see text
33—S1 (remaining terminal)

Printed-circuit boards PC1 (above) and PC2 (below) are assembled after components are mounted (right). The battery holder parts (A and B, below) are cut from sheet metal and bent as described in text; folds should be made on the dotted lines.



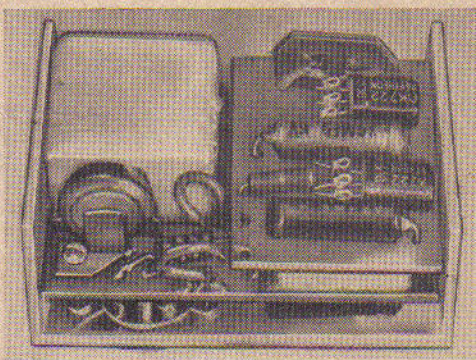
CONNECTIONS FOR PC2

A—Wire from 29 of PC1
B—Wire from 25 of PC1
C and K—R6
D—Wire to one terminal of J1
E—C7 (pos. terminal)
F—C7 (neg. terminal)
G—Wire from 18 of PC1
H—Collector of TR3
I—Base of TR3
J—Emitter of TR3
L—C8 (neg. terminal)
M—C8 (pos. terminal)
N—Collector of TR4
O—Base of TR4
P—Emitter of TR4
Q—Remaining terminal of J1

Antenna coil *L1* is wound on a piece of ferrite core which measures 2⅜" x ¼" in diameter. This coil consists of 50 turns of #22 single cotton enamel wire, and the tickler coil (*L2*) is made from six turns of the same kind of wire. Wind both coils immediately adjacent to each other and in the same direction; otherwise you won't get positive feedback and the detector won't oscillate.

The battery holder consists of two parts: part *A*, the positive terminal, connected at 32; and part *B*, the negative terminal, connected at 33. Trace the pattern of these parts as shown in the diagram (below, left) on brass, tin or copper; then cut them out. Bend them on the dotted line toward you while you hold the parts as shown. Mounting holes for the battery holder are also 1/16" in diameter, and terminals are riveted to the board using small eyelets or miniature screws and bolts.

Housing. Either a home-built or commercial cabinet may be used for the transistor radio. Pieces needed to construct your own cabinet can be cut from a clear polystyrene sheet. The front and back of the case shown measure 1⅞"x2⅝", the top



and bottom are 1"x2⅝", and the sides measure 1"x1¾". Glue the pieces together temporarily using household cement, but leave the back off.

Place the completed "Half-Pack" inside the case and mark the spots for the shaft of *C1* and the regeneration control (*R4*). Drill the ¼"-diameter hole for the shaft and another one for the starting hole of *R4*. With a ⅝" chassis punch, score a ⅝"-diameter circle in the plastic. Cut out the circle with a jigsaw and smooth the edges of the hole with a round file. The subminiature control specified in the parts list should fit snugly. Fasten it to the panel with small nuts and bolts through the on-off switch tabs.

The pieces of the box can now be cemented together permanently. Place the radio inside and drill the mounting holes for *R4* and earphone jack *J1*. —30—