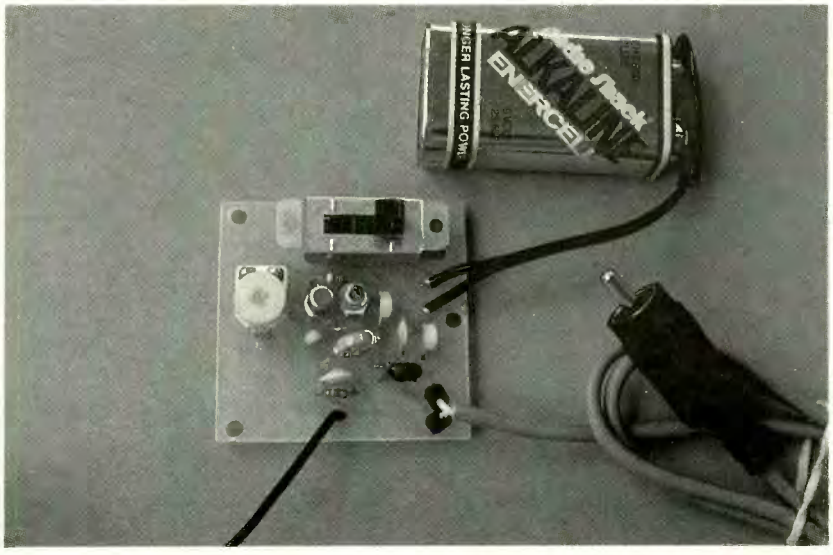
# An Experimenter's Aviation-Band Receiver

## *Low-cost project lets you tune in on airport and airborne radio activity*

**By Dan Becker**




If you live within 20 miles of a busy airport, you have an opportunity to tune in on some exciting radio activity. With the Experimenter's Aviation Band Receiver to be described, you can listen to aircraft and tower communications in the 118-to-135.95-MHz band assigned to aviation activities, including the 121.5-MHz world-wide emergency channel.

Channels are divided into increments of 50 kHz each, with each assigned to a different type of service. Some channels are used by air traffic controllers who continuously give course and altitude instructions to pilots aloft. Other channels are used while an airplane is on the ground. These service channels carry maintenance, fuel status, weather (including wind speed and direction and temperature aloft) and personal requests by pilots enroute. Much of what you can hear is routine, but in times of emergency, you can get first-hand information before the news media report it.

### *About the Circuit*

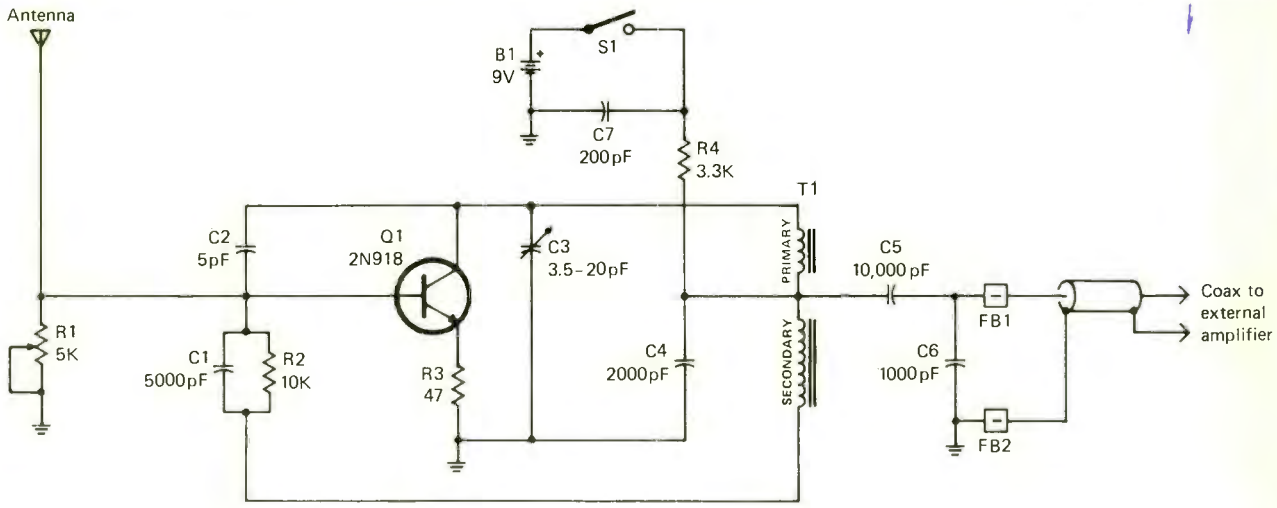
Shown in Fig. 1 is the complete schematic diagram of the Experimenter's Aviation Band Receiver. It is built around a single transistor, identified as *Q1*, which operates as both and r-f amplifier and a detector. The output of this transistor is coupled to an external audio amplifier via a coaxial (shielded) audio cable. Almost any epitaxial transistor rated for vhf service will work in this circuit.

Because aviation communication is via amplitude-modulated (AM) signals, the value of the dc collector current of *Q1* can be made to vary in direct proportion to these signals. This requires an input signal amplitude of greater than 10 millivolts. In addition, any variation in the dc collector current must be extracted and amplified.

Two functions are performed by the Aviation Band Receiver. One is its operation as a Hartley oscillator in which the approximately 120-MHz operating signal frequency is governed by *T1*, *C2* and *C3*. This greatly amplifies the microvolt-level signals that appear at the antenna and feeds them back to the base of *Q1* with an amplitude greater than the 10-mV minimum level needed by the circuit for proper operation.

In the second function, any variation in the dc collector current will appear as a variation in the emitter-collector voltage, measured at the collector side of *R4*. It is here that the audio information is extracted and sent off to the audio amplifier.

Capacitors *C1*, *C4*, *C6* and *C7* by-




**PARTS LIST**

**Semiconductors**
Q1—2N918 npn transistor
**Capacitors**
C1—5,000-pF ceramic disc
C2—5-pF, high-Q ceramic disc
C3—3.5-to-20-pF trimmer
C4,C7—2,000-pF ceramic disc
C5—10,000-pF Mylar
C6—1,000-pF disc
**Resistors** (¼-watt, 5% tolerance)
R2—10,000 ohms
R3—47 ohms
R4—3,300 ohms
R1—5,000-ohm trimmer potentiometer

**Miscellaneous**
B1—9-volt battery
FB1, FB2—Vhf ferrite bead
S1—Spst slide or toggle switch
T1—Hand-wound transformer
Printed-circuit board; suitable enclosure; T-25-0 powdered-iron toroid core and 30-gauge enameled wire for T1; 1-meter length of hookup wire for antenna; connector for B1; coaxial audio cable; machine hardware; hookup wire; solder; etc.

**Note**: A kit of all parts including pc board, all components and audio cable (but not enclosure) is available for $8.95 plus $1.00 S&H from: Dan Becker, 101 Highland Dr., Chapel Hill, NC 27514.

*Fig. 1. Complete schematic diagram of Experimenter's Aviation Band Receiver.*

pass radio frequencies. Potentiometer *R1* and resistors *R2*, *R3* and *R4* establish a quiescent dc collector current of approximately 1 mA. In addition, regenerative control *R1* permits the gain to be adjusted to establish oscillation and *C3* permits fine tuning of the operating frequency. Ferrite beads *FB1* and *FB2* in series with the audio output help isolate the audio cable from r-f signals. The antenna is made from a 1-meter or shorter length of hookup wire.

Power for the circuit is supplied by ordinary 9-volt battery *B1*. It is applied to the circuit via spst switch *S1*.

## Construction

The very simple circuit of the Experimenter's Aviation Bank Receiver is readily assembled on a 2″ × 2″ piece of perforated board, using appropriate soldering hardware. Alternatively, you can fabricate a printed-circuit board using the actual-size etching-and-drilling guide shown in Fig. 2. A third alternative is to assemble the circuit on a ready-to-wire pc board supplied in the kit of parts from the source given in the Note following the Parts List.

If you elect pc construction, wire the board exactly as shown in the components-placement and orientation diagram given in Fig. 3. (You can also use Fig. 3 as a rough guide to component layout if you use perfboard construction.) When wiring the board, be sure to keep all lead lengths as short as possible.

All components for this project, except *T1*, are readily available from parts suppliers ready for installation. The only component you are not likely to find is the transformer, which you must wind yourself. This is not difficult. All you need are a powdered-iron toroid core (see Parts List) and some 30-gauge enameled wire. Begin by winding four turns of the wire onto the core to make the primary. Without cutting the wire, form a 2″ loop and continue winding eight more turns to make the secondary winding. Wind all turns in the same direction.

When all turns have been wound

on the toroid core, cut the loop and the ends of the wire so that there are four equal-length leads. Carefully scrape away the enamel from all four leads for a distance of about ½". Then lightly tin with solder the exposed metal of each lead. Inspect the solder. If there are any gaps or the solder has blobbed instead of evenly coating the leads, you missed some of the enamel while scraping. Re-scrape any lead that appears to be suspicious and retin.

Install and solder into place first *S1* and then the transformer as shown in Fig. 3. Then install the resistors and capacitors. When you install transistor *Q1*, adjust its height above the board's surface to 3/16". Then wire the battery connector to the appropriate pads. Keep the battery connector's leads to just a few inches in length and arrange them as far away from the rest of the circuit as possible.

If your coaxial audio cable has phono plugs at both ends, snip off one from either end. Then remove 1" of outer insulation from the cut end. Be careful to avoid cutting through the shield conductors as you do this. Depending on whether the shield is braided or spirally wound, separate the fine conductors so that they can be twisted into a tight bundle. Then strip ¼" of insulation from the inner conductor. Very lightly tin with solder the inner conductor and tightly twisted shield wires. Exercise care soldering to avoid melting the insulation and causing a short circuit.

Slip a ferrite bead over the cable's shield wires and the inner conductor. Then install and solder into place the two conductors in the appropriate holes in the board.

Prepare a suitably sized metal enclosure to accommodate the circuit board by drilling three mounting holes for 6-32 machine hardware. Use the board itself as a template for determining where to drill the holes. Then cut a slot for *S1*'s toggle, drill access holes for *R1* and *C3*, and drill small holes through which the antenna lead and audio cable are to exit the box. Make sure the hole for the antenna wire is exactly in line with the antenna hole on the pc board. Line the antenna and audio cable holes with rubber grommets to protect the wire and cable from chafing and shorting out against the metal box.

Mount the board in place with spacers and 6-32 machine hardware. You can mount *B1* either with a standard metal battery clip fastened to the box with machine hardware or with double-sided foam tape to any wall where it will not interfere with the circuit board.

## Adjustment and Use

Set trimmer control *R1* to about three-quarters of its travel clockwise and trimmer capacitor *C3* to approximately minimum capacitance. Place the circuit board on a table near an audio amplifier and plug the Aviation Band Receiver's audio cable into the amplifier's auxiliary (AUX) or microphone (MIC) input jack. Position the project's antenna up and away from the circuit board. Use a thumb tack to hold it against a wall.

Plug a 9-volt transistor battery into the battery connector and turn on the project and the amplifier. Set the amplifier's volume control about half-way up and the tone controls for minimum treble to reduce the hiss from the oscillator.

Adjust the setting of *R1* until you hear a distinct hissing sound coming from the amplifier's speaker(s). This hiss indicates that the circuit is oscillating. In addition, you can vary the settings of both *R1* and *C3* to tune in different segments of the Aviation Band.

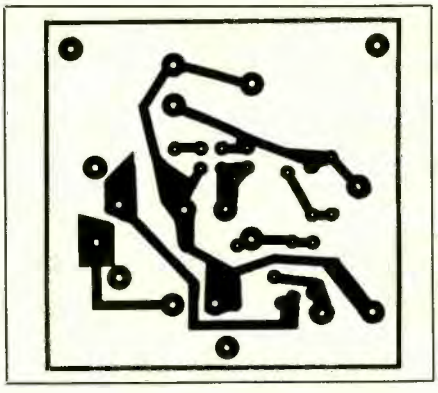


*Fig. 2. Actual-size etching-and-drilling guide for receiver's printed-circuit board.*

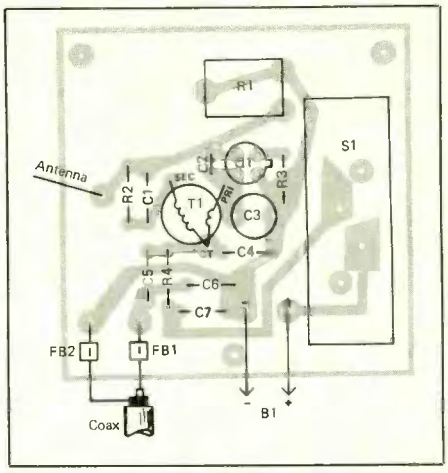



*Fig. 3. Components-placement/orientation diagram.*

## In closing

If you are an avid listener, you will likely want to keep your Experimenter's Aviation Band Receiver on at all times. Therefore, you might consider building a dedicated audio amplifier and separate ac-operated power supply to use instead of the battery for continuous monitoring. You can find projects for these options in past issues of *Modern Electronics*. You can also use an amplifier module with its own battery power supply and speaker for portable operation. In this case, you will undoubtedly want to equip your receiver with a transfer jack that will switch back in th *B1* battery supply when ac power is removed when operating in the portable mode. Happy listening. **ME**