

# "Sniff" Out Transmitters with the RF Informant

*Do more than search for transmitters with this pocket-sized RF-strength meter.*

RICK DUKER

Mention the phrase "transmitter detector" and the first image that comes to mind is probably one of searching for hidden surveillance microphones, or "bugs". However, there is a use for such "bug sniffers" beyond the scope of the standard "James Bond" scenario. Examples of using an RF detector on the test bench include checking the operation of devices such as two-way transceivers, ham radios, cellular and cordless telephones, and baby-room monitors. Yet another some-

what unique and interesting application for this device is checking microwave ovens for leakage.

The pocket-sized RF Informant presented here is just such a device. Technically, it can be described as an AM/FM near-field radio-frequency receiver. The relative field strength of any RF signal that is in close proximity to the RF Informant's antenna is monitored, with the field strength displayed on a row of nine LEDs. An audio output is provided for earphone monitoring of the received signals.

The RF Informant operates in two reception modes — *wideband* and *highband*. In the wideband mode, the receiver is un-tuned and will detect practically any RF frequency from the low AM

band below 500 kHz into the microwave range above 2 GHz. In the highband mode, the receiver is optimized for operation in the FM broadcast band.

And yes, the RF Informant can locate hidden transmitter surveillance "bugs".

**Circuit Description.** The schematic diagram for the RF Informant is shown in Fig. 1. RF signals arriving at ANT1 are coupled by C5 to the detection circuit. A high-impedance ground connection for wideband reception is provided by R3. With S1 switched into the circuit by S2, the circuit is optimized for the FM band.

Diodes D1 and D2 do detection and demodulation. The detected signal is fed to the non-inverting input of IC1. That op-amp is configured as a non-inverting amplifier with a fixed gain of about 450. The particular device specified uses junction field-effect transistors (JFETs) on the inputs; that increases sensitivity due to their high impedance. Potentiometer R9 is a squelch control that adjusts the offset of IC1. The amplified detector output that appears on pin 6 of IC1 is fed to J1. A suitable high-impedance ear-

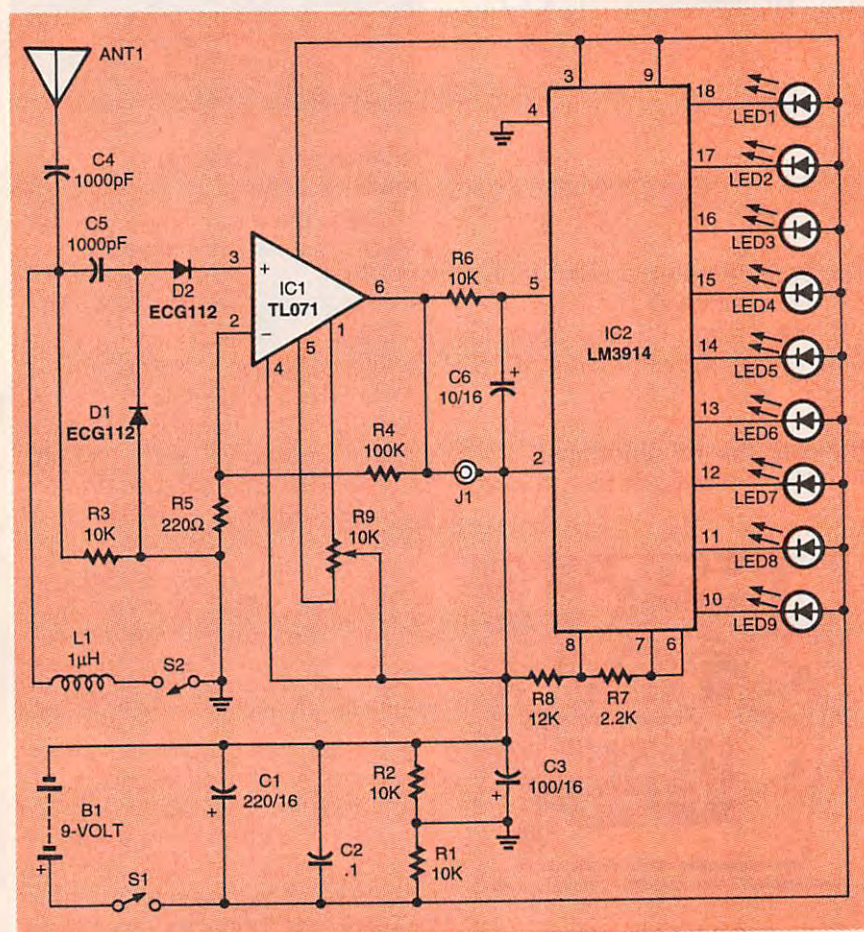


Fig. 1. The RF Informant is a wideband receiver that can show the relative strength of the received signal on a series of LEDs. An earphone can also be used to listen to the received signal. Closing S2 can enhance sensitivity in the FM band.

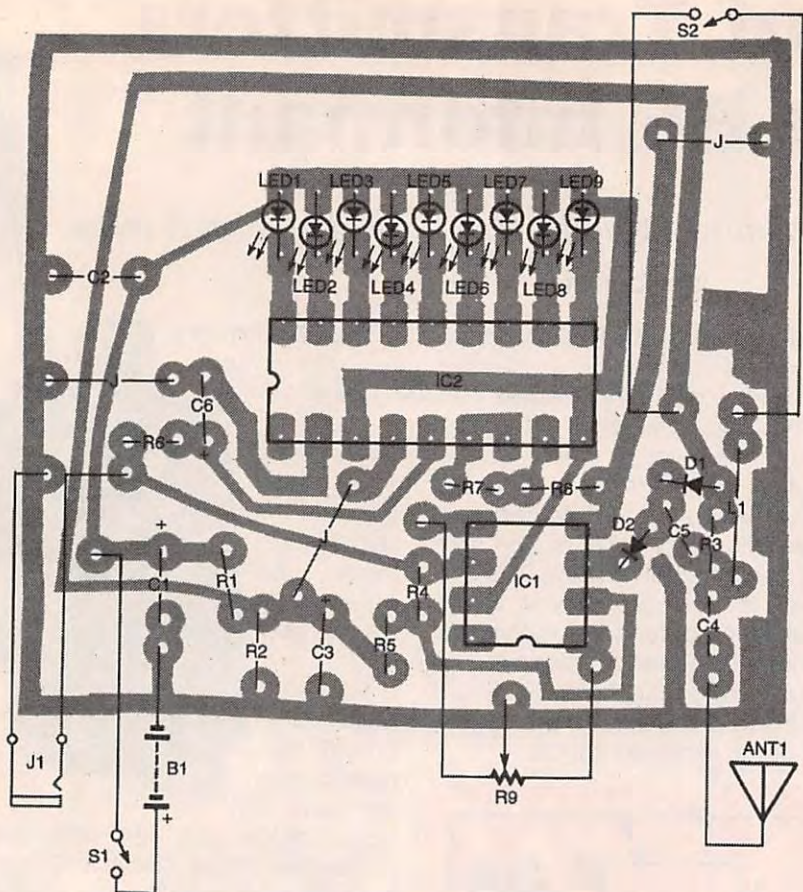


Fig. 2. The RF Informant must be built on a PC board; use this parts-placement diagram if you are using the foil pattern provided in this article. Don't forget to install the jumpers where indicated.

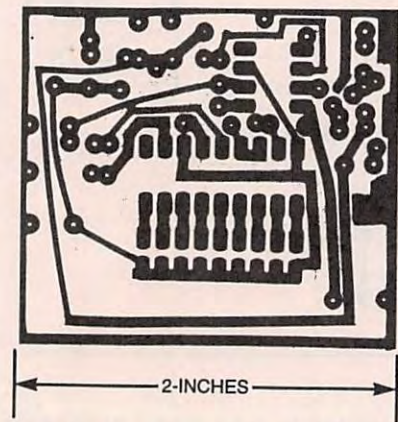
phone can be connected to J1 if you need to listen to the detected signal. Additionally, R6 and C6 smooth the signal.

The smoothed signal is then applied to the input of IC2, an LM3914 dot/bar display. That chip contains a resistor network and a set of comparators. Depending on the input voltage applied to pin 5, one or more LEDs will be turned on to display the relative voltage level. In the RF Informant, a bar display is selected by tying pin 3 to the positive supply voltage; at the lowest voltage, only LED9 will be illuminated. As the voltage increases, each LED comes on in turn until, at the highest voltage level, all nine devices are glowing. Resistors R7 and R8 set the reference voltage for a full-scale reading. Note that there are no current-limiting resistors for the LEDs; R7 and R8 limit the LED current as well.

Since IC1 requires a split power supply, R1, R2, and C3 create a

"ground" reference. Even though power is supplied by B1, a 9-volt battery, C1 and C2 filter any noise that might stray into the supply lines.

**Building the RF Informant.** Since the RF Informant uses high frequen-



Here's the foil pattern for the RF Informant. Using a single-sided board makes the board easy to etch and the project easy to build.

## PARTS LIST FOR THE RF INFORMANT

### SEMICONDUCTORS

- IC1—TL071 operational amplifier, integrated circuit
- IC2—LM3914 Dot/bar display driver, integrated circuit
- DI, D2—ECG112 or similar silicon diode
- LED1-LED9—Light-emitting diode, red subminiature

### RESISTORS

- (All resistors are 1/4-watt, 5% units unless otherwise noted.)
- R1-R3, R6—10,000-ohm
  - R4—100,000-ohm
  - R5—220-ohm
  - R7—2200-ohm
  - R8—12,000-ohm
  - R9—10,000-ohm potentiometer, panel mount (see text)

### CAPACITORS

- C1—220- $\mu$ F, 16-WVDC, electrolytic
- C2—0.1- $\mu$ F, ceramic-disc
- C3—100- $\mu$ F, 16-WVDC, electrolytic
- C4, C5—1000-pF, ceramic-disc
- C6—10- $\mu$ F, 16-WVDC, electrolytic

### ADDITIONAL PARTS AND MATERIALS

- L1—1- $\mu$ H inductor
- S1—Single-pole, single-throw switch (see text)
- S2—Single-pole, single-throw switch
- J1—Subminiature phone jack
- B1—9-volt battery
- ANT1—Telescoping antenna

**Note:** The following items are available from Quantum Research, 17919 77<sup>th</sup> Ave., Edmonton, AB, CA T5T 2S1: Etched and drilled PC board, \$10.00; Kit of all parts, enclosure, and PC board, \$69.95; Assembled RF Informant, \$99.95. Please add \$5.00 for shipping. All prices are in US dollars. Canadian residents must add appropriate PST and GST.

cies, a printed-circuit board must be used. A foil pattern has been included for making your own board. If you don't want to etch a board, one is available from the source given in the Parts List.

Follow the parts-placement diagram shown in Fig. 2 for the locations of the various components. While there is no necessary order when installing the parts, it is best to always

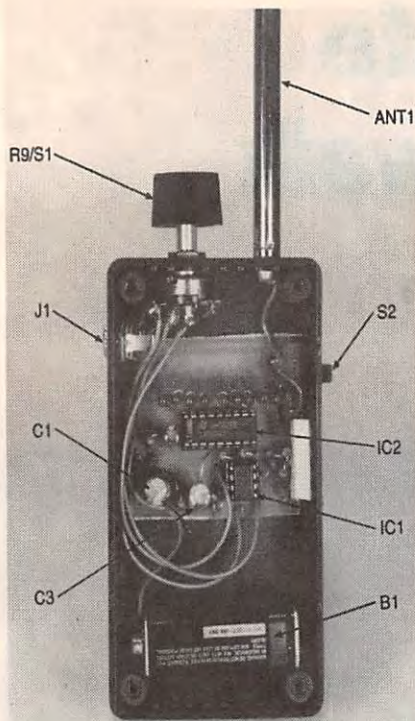


Fig. 3. The completed RF Informant fits in a case that's comfortable to hold. Note that in the author's prototype shown here, R9 and S1 are combined into a single unit. That way, a single control can be used for both switching the RF Informant on and off as well as adjusting the gain of IC1—a method used on almost all radios.

start with the smallest ones first; heat- and static-sensitive devices, such as semiconductors, should be saved for last. In light of that, start with the jumper wires. You can clip a short piece of lead from a resistor for use as a jumper. If you want to use sockets for the ICs, they should be mounted at this time, also.

The capacitors, resistors, and L1 are all mounted vertically. Note that C1, C3, and C6 are polarized components; double-check their orientation before installing them.

We are now ready for the semiconductors. Watch the orientation with those; be sure that they are facing the correct way before soldering them to the board. After mounting D1 and D2, install LED1-LED9. The light-emitting diodes must be mounted high enough off of the board so that they can be seen through the case cover. Most diodes have leads that will let you mount them so that the tips of the components are about 1 inch above the board. Keep them as long as possible.

Prepare the enclosure by drilling

holes for S1, S2, R9, J1, and ANT1. An example arrangement is shown in Fig. 3. Note that in that example (the author's prototype), R9 and S1 are one physical component. Using a switched potentiometer like that gives the RF Informant the operational feel of a standard radio. Install those components in the enclosure. If you absolutely can't locate a switched potentiometer, separate components could be used.

A window is needed on the cover for the LEDs. An easy way to "mill" a slot is to mark the location for the "window" and drill a row of holes across the cover. Once the holes are drilled, file the rough edges so that a slot is created. With the PC board temporarily placed in the case and the cover on, the LEDs should be visible through the slot.

Insulated wires are used to connect the rest of the components to the board. When everything is connected, the board is fixed in place with double-sided foam tape or a couple of dabs of silicone adhesive.

Finally, install the ICs in their sockets, making sure that they are plugged in the right way around. Snap a fresh 9-volt battery in place, and the RF Informant is ready for testing.

**Testing and Use.** Plug an earphone into J1 and turn on S1. Select S2 for wideband reception. With the antenna extended, you should hear some sounds, and one or more LEDs will probably be lit. Rotate R9 and note the behavior of the display; you will note that you can control whether the LEDs are on or off. With LED1 just at the point of turning on, the receiver is adjusted for maximum sensitivity.

To test the unit further you will need an RF transmitter such as a cellular phone, cordless phone, baby-room monitor, FM wireless mike, walkie-talkie, or any other similar device. Hold the RF Informant away from yourself with the antenna vertical. Sweep the unit in an arc. You will see that there are two directions that have the strongest reading. If the signal gains strength as you move in the direction of the signal, you should be getting closer to the signal source. If the signal

weakens, reverse your direction.

Adjust R9 for a reading on the LEDs that is not "pegged" to the limit. Continue to head in the direction of the strongest signal. You might need to correct your heading by sweeping the RF Informant in an arc to get a new bearing. You should also monitor the signal with an earphone plugged into J1. You might need to adjust the antenna length to pinpoint the RF source if it is quite strong.

If you are getting too much interference on the wideband setting, selecting the highband setting with S2 will usually give better reception—especially from an FM transmitter. Note that sources of interference can include light dimmers and fluorescent lighting.

Experience is the key to effectively using the RF Informant. Practice with hidden transmitters so that you can become familiar with the controls and monitoring techniques. You'll be amazed at how many sources of RF there are around you!  $\Omega$

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