THE IR FINDER

Infrared radiation is widely used in security countermeasures and in scientific, military and industrial applications. You can get to know what it's all about with this simple IR detector

by FORREST MIMS

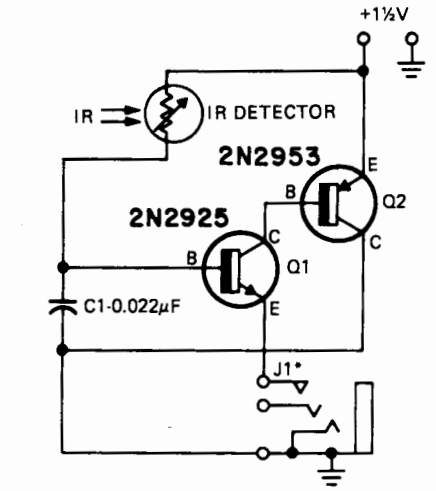
THE IR FINDER IS A SENSITIVE, VERsatile infrared detection system that can be assembled in less than an hour, once the necessary parts have been collected. A variety of infrared detectors can be used with the unit. The completed instrument has many experimental and practical applications

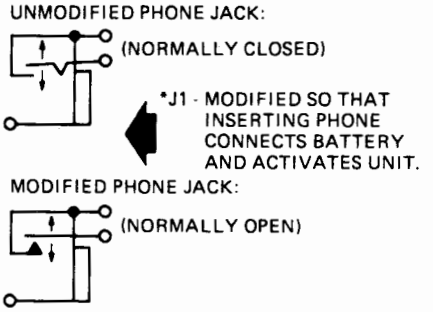
The heart of the IR Finder is a simple 2-transistor oscillator whose frequency is varied by an infrared sensitive photoconductive cell or thermistor. Infrared rays falling on the detector alters its resistance, changing the oscillator's output frequency. Normally, the output of the system is a low-frequency buzz. But when the unit is pointed toward a source of infrared, a high-pitched tone is heard.

The prototype IR Finder was installed in a small plastic flashlight case for convenience, and to take advantage of a built-in parabolic reflector. Using a parabola to collect the infrared is important for two reasons. First, it focuses more radiation on the detector. Second, a reflector is more efficient than a lens, since most kinds of glass absorb infrared. In essence, the reflector is to the detector what an antenna is to a radio.

While the flashlight I used is available from many distributors for about $1.20, the IR Finder can easily be installed in any convenient container. If you are using a flashlight case like the one in the photographs, begin construction by opening the flashlight and removing the battery contact from the top side of the back of the case. This makes room for a miniature phone jack. Leave the two battery contacts on the lower side of the case in place, as the unit's power supply cell will be inserted in this space later. Install the phone jack by carefully drilling a ¼-inch hole in the rear of the case in the space formerly occupied by the battery clip.

Following the parts layout in the photo, assemble the oscillator circuit. Solder the leads directly to one another to form a self-supporting structure. There are only three components to install, so a conventional circuit board is not necessary. Use insulation, if necessary, to prevent leads from shorting. Do *not* trim excess lead lengths from the components at this point.





CIRCUIT OF THE INFRARED DETECTOR

PARTS LIST

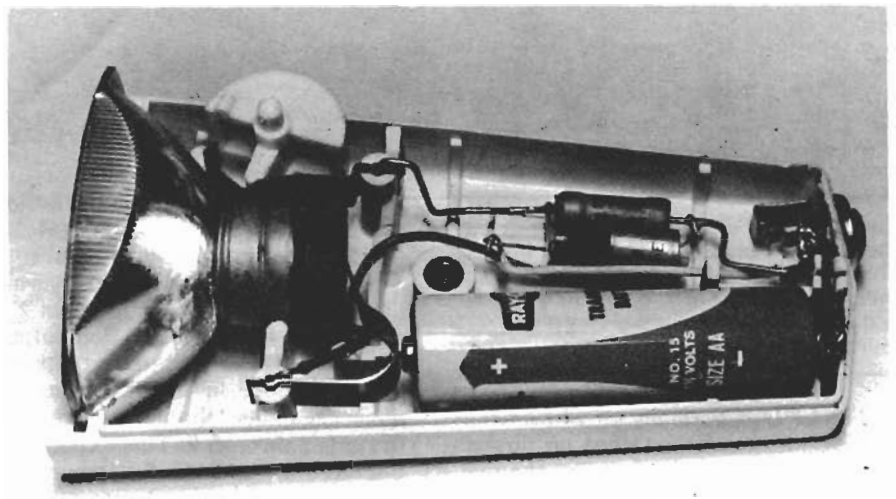
B1 — 1.5-volt AA cell
C1 — 0.022 μF
J1 — miniature phone jack
Q1 — 2N2925 or equivalent
Q2 — 2N2953 or equivalent
IR1 — Infrared detector (see text)

Magnetic earphone, hookup wire, solder, flashlight (Mallory or Radio Shack), PR-4 lamp (supplied with flashlight), etc.

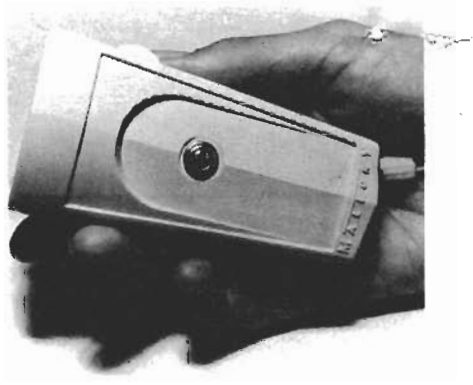
When the components are soldered together, solder 2-inch lengths of hookup wire to the appropriate leads of Q1 and Q2 so they will reach the phone jack and detector contact. Then trim all excess lead lengths except from C1. Bend the leads of C1 as shown in the photo, and insert them in the appropriate spaces in the flashlight switch and phone jack. It isn't necessary to solder the two leads inserted into the contact holes as the friction should be great enough for a good electrical contact. Complete the electrical assembly by soldering the leads connected to the negative battery terminal and phone jack.

The IR Finder is completed by installing a detector. The prototype uses a small lead sulfide (PbS) cell purchased from Radio Shack as part of an infrared detector package. The cell sensitive to a range of wavelengths extending from about 1 to 3 microns at room temperature. Other detectors can be used as well—so long as their resistance varies with temperature or infrared. For example, a thermistor with a room temperature resistance that falls somewhere between 10,000 and 100,000 ohms can be used, but its response time will be much slower than the PbS cell. For near-IR detection at about 0.75 microns, an inexpensive cadmium selenide (CdSe) detector such as the Clairex CL603, CL703, or CL903 can be used.

The parabolic reflector of the plastic flashlight makes for a convenient detector installation. Remove the PR-4 lamp from the holder, and carefully break and remove the glass bulb. Be sure to protect your eyes from flying glass. A good technique is to wrap the bulb in several layers of tissue, and crack it with gentle pressure from a pair of pliers.

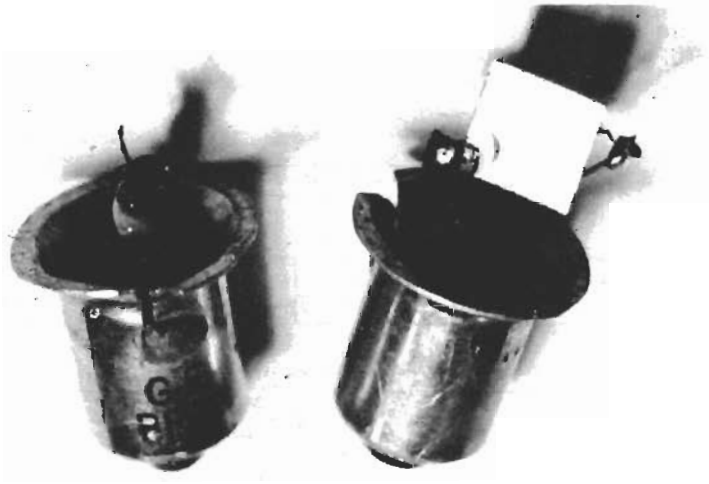


INSIDE THE IR FINDER. Battery contact is removed so earphone jack can be installed.



THE HAND-HELD IR FINDER. Pointing it at heat raises the note in the earphone.

When the glass has been removed, carefully remove the filament with tweezers, wrap the detector leads around the filament support, and solder them in place. Trim any excess lead lengths when complete. The photo shows both thermistor and lead sulfide detectors attached to PR-4 lamp bases. Both have been used in the prototype IR Finder.



TWO TYPES OF DETECTORS can be mounted equally well on the lamp base.

AUTHOR'S WIFE DEMONSTRATES with a visible source, which also emits infrared rays.

When the detector assembly is completed, insert it in the lamp receptacle in the parabolic reflector, and replace the reflector in the flashlight case. Turn on the device by pushing forward on the flashlight switch, and plugging in the earphone. When the IR Finder is pointed toward an incandescent lamp, a high-pitched tone should be heard in the earphone. The tone's frequency will vary as the IR Finder is pointed away from the lamp.

The sensitivity of the IR Finder depends on the detector used. The PbS (lead sulfide) cell, for example, will easily respond to a candle flame more than 50 feet away. The PbS and thermistor detector will also respond to a hot stove, soldering iron, and even a warm auto engine. Sensitivity of the PbS cell is outstanding, particularly since its very small active area (only about 0.1 mm^2) permits only a small amount of the IR collected by the reflector to be detected. A more efficient reflector system should improve performance considerably.

Other detectors give similar results. Cadmium sulfide and cadmium selenide cells will also detect a candle at about 50 feet, but they respond more to the flame's visible light than to the infrared. Consequently, results with these inexpensive detectors will probably be best with the room lights turned off. The PbS cell and thermistor will respond nicely to the candle flame in bright ambient illumination.

Now that you've built the IR Finder—or at least are preparing to—don't put it on the shelf after experimenting with it for a few hours. Keep it handy; it's a great gadget for locating miscellaneous warm objects (ranging from hot water pipes to overheated electronic components), and it's an interesting conversation piece to demonstrate to friends and associates who have not yet been turned on to the invisible world of infrared. **R-E**