Build the FoxTTL Foxhunt Transmitter

Simple, inexpensive, and the end of your excuses for not trying T-hunting.

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The popularity of high-altitude amateur radio balloon launches has increased exponentially within the last seven years. A balloon launch that I organized in 1991 for the Dayton Amateur Radio Association included a veteran recovery team from Indianapolis who volunteered to participate in the chase. As luck would have it, the balloon was hijacked by the jet stream, and in less than 50 minutes, the balloon payload parachuted back to *terra firma* over 115 miles away in the Wayne National Forest—the only part of Ohio where the lines on a topographical map resemble the scan lines on a high-resolution monitor!

The signal path through the many "hollers" and ridges was so convoluted that it was just about impossible to pick up a signal from the payload resting on the forest floor. By the time a private aircraft flew over the suspected landing area, the batteries had gone dead and the package had fallen silent. For the next eight months, the payload lay undisturbed, until it was found by a turkey hunter, who obligingly called the telephone number on its exterior and claimed the reward. The package did not contain the one feature that would have meant quick retrieval: a long-term beacon operating at low power.

I immediately decided that the *next* balloon flight would contain an additional low-power beacon transmitter that would assist, if needed, in a speedier recovery. After toying with a few ideas, I built a small QRP transmitter that contained a number of useful features.

The ideal transmitter would have a low parts count and would operate on two meters FM, so almost anyone who owned a two-meter radio could participate in the recovery operation. Low power was also a requirement, to ensure that reserve battery capacity would not be a limiting factor. Extra battery time can be the difference between being lost or found. Sturdiness is also a must—a balloon payload makes a lousy place to store fragile items!

As a spin-off of the balloon recovery transmitter, I designed a similar QRP FM two-meter foxhunt transmitter, powered by a standard nine-volt battery, that has proven to be an extremely popular item; I made it available at my flea market table at the Dayton Hamvention. Simplicity, ruggedness, low power, small size and low cost are features that make this transmitter a popular choice among foxhunters who are looking for a simple transmitter for newcomer hunts in small areas. The FoxTTL is terrific for teaching foxhunting basics in a small park, or even in an auditorium. Maximum range for the FoxTTL is a half mile or so. It is easier for an instructor to demonstrate techniques, such as body shielding, and at closer ranges, the transmitter helps to scale down foxhunting to what normally takes several hundred square miles in some Southern California T-Hunts.

About the design

I designed this circuit so an FM signal with a unique stepped audio tone would be produced with an absolutely minimum number of parts. This is possible by employing a TTL clock oscillator, a 555 timer and a flashing LED. The TTL clock oscillator, designed to provide a clock signal to drive computer video displays, is used as the basic transmitter building block. Cut for 48.3 MHz, the clock oscillator used in this article is made by Cal Crystal Labs, Inc., in Anaheim, California. Using a bandpass filter consisting of four

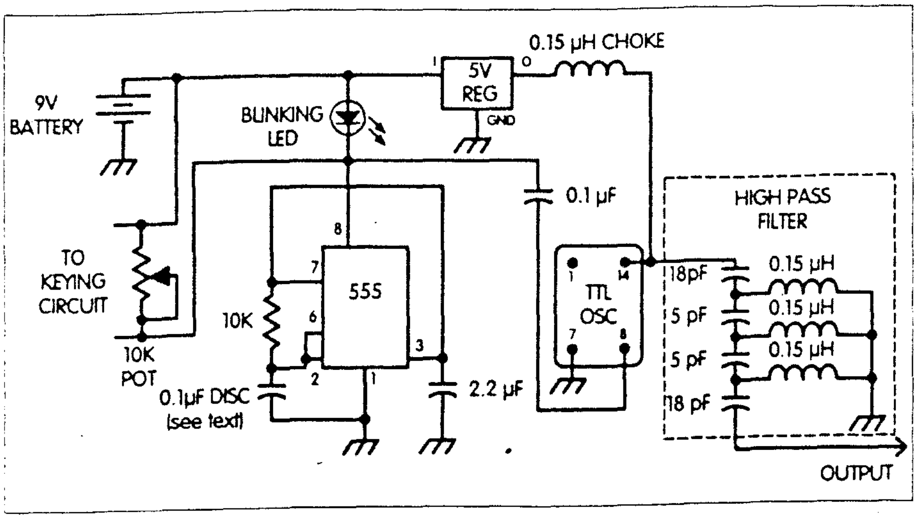

Fig. 1. Schematic of FoxTTL 2-meter transmitter.

capacitors and three RF chokes, the fundamental (48.3 MHz) and the second harmonic are suppressed, and the third harmonic, on 144.900 MHz, remains intact. Power output ends up being around five to 15 milliwatts, depending on battery voltage. The beacon consumes about 35 mA, and you can expect about 10 hours of battery life when using a nine-volt alkaline battery.

The audio oscillator section is created using a 555 timer. The configuration of the audio oscillator, by brute force, "pulls" the transmitter, causing the tones to frequency-modulate the transmitter. Aside from not staying within engineering convention on the manner in which the oscillator is configured, this design "goes outside the box" by utilizing a flashing LED as a means to cause the audio oscillator circuit to decay. The resultant tones that are created can be varied by audio frequency and cadence, with a single potentiometer. Nope, I have never seen an LED employed in this manner. By bridging the LED, an 1800 Hz tone is created and an additional IDer circuit can add an ID tone to the device by simply shorting out the flashing LED

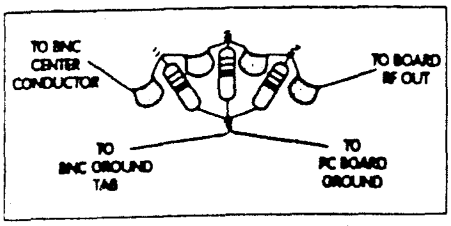

Fig. 2. Layout of the bandpass filter.

leads. This approach further reduces the overall parts count. You've seen it here first: If it works, don't knock it!

Construction

Point-to-point soldering on a small perfboard will work with this project, although I have found that deviation levels are affected, depending on parts placement and lead length. (Boards and parts available: See end of article.) The high-pass filter, consisting of four capacitors and three chokes, is not part of the PC board layout. The transmitter will function without it; however, good engineering practice requires this filter to be employed in the design. See **Fig. 2** for the layout of the high-pass filter. I built the filter separately and kept all lead lengths to an absolute minimum. The resultant "mini circuit" is bridged between the PC board and BNC connector.

Remember to observe the polarity of the flashing LED. The long lead is the positive side of the component.

The 0.1 µF disc capacitor (marked 104) (see **Sources**, below) used in this project was, oddly, the only component critical to the FoxTTL's proper operation. Substitutions of similar-value capacitors of different manufacture produced mixed results, probably due to inductance (not capacitance) that was critical to the circuit's operation. The cadence and tone adjustment potentiometer worked best with the selected disc

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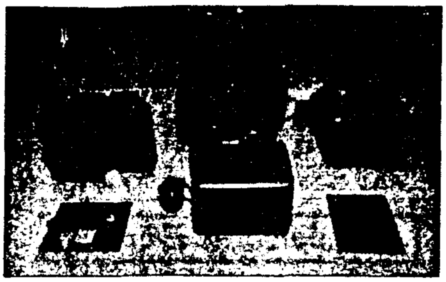

Photo A. You can have it this way, or this way …

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capacitor. Later substitutions of this component caused needless hours of head-scratching!

After assembling the high-pass filter and circuit board, I decided to go ahead and "pot" the circuit using automotive Fiberglas™ resin. Pot the circuit in Fiberglas resin? Think of it this way: You may have seen or heard about insects becoming entrapped in some tree sap that eventually turned into amber. Funny thing is, those insects look like they got stuck only yesterday, yet carbon dating indicates that they became entombed, in some cases, over 10 million years ago. Carry this idea over to protecting a circuit—and who knows? Maybe 50,000 years from now someone will power one of these circuits up and the procedure may create a new form of archeology called "fossil electronics." All joking aside, this technique will ensure that the circuit really will be indestructible in the worst possible conditions. By mixing the Fiberglas resin with a catalyst, you'll have the material hardening in about half an hour. If you elect to pot your circuit, make sure you conduct this procedure out-of-doors as the fumes will spontaneously cause you to start agreeing with everything that Wayne Green writes. Also, make sure that it is at least 70° Fahrenheit when you mix the material, as cooler temperatures will slow down the curing process. It's imperative you follow the directions listed on the Fiberglas resin container, due to the caustic nature of the material. By adding a little acrylic pigment (about 10 drops per ounce of resin) you can make the completed package look like a commercially manufactured product.

I also elected to bring out the LED in a position such that the potting material would leave it partially uncovered. The flashing LED serves a dual purpose: first, as an indication that the battery and circuit are working; and second, as a means of creating an unusual beacon tone. Also, be aware that Fiberglas resin has a tendency to infiltrate switches and potentiometers prior to curing. When in doubt, cover these components with a little bit of modeling clay to prevent any Fiberglas intrusion on possible entry points.

If your circuit board is mounted in the metal enclosure available from Midwest Surplus (see **Sources**), make sure that it does not come in contact with the side walls of the enclosure. This can be accomplished by taping the interior portion of the enclosure. As the tape is not visible once the Fiberglas is poured in, this is the best means to ensure that shorts do not develop prior to the Fiberglas setting up.

Parts List

Qty.	Description
4	.15 µH choke
1	2.2 µF 50 V electrolytic capacitor
1	0.1 µF 100 V axial capacitor
1	0.1 µF disc capacitor
2	5 pF disc capacitor
2	18 pF disc capacitor
1	10 k potentiometer
1	10 k 1/4 W resistor
1	9 V battery
1	9 V battery connector
1	SPST switch
1	BNC connector (chassis mount)
1	BNC Protecto-cap
1	battery holder
7	screws & mounting nuts
1	collet type potentiometer knob
1	PC Board
1	TTL clock oscillator (48.3 MHz fundamental)
1	555 timer
1	blinking LED

Table 1. Parts list.

Operation

When the transmitter is powered up, adjust the potentiometer for the desired cadence/tone. As a side note, when the flashing LED is exposed to bright sunlight, internal resistance changes within the LED and this may speed up the cadence of the tone—something to keep in mind if the LED is facing the sun on a partly cloudy day.

FAR Circuits has made available prepared circuit boards (etched, drilled and silk-screened). The boards are made of G-10, FR 4 material, 1 oz. copper, solder-coated, and drilled. Included is an LC network (capacitor/coil form combination) etched on this board, but that is not utilized for this particular circuit layout. See **Sources** below if you are interested in building the project using the available circuit board.

Sources

FAR Circuits
18N 640 Field Court
Dundee IL 60118
[http:www.cl.ais.net/farcir/]

The circuit boards are $4.25 each, plus $1.50 shipping and handling *per order*. Orders are accepted only by surface mail or FAX. No orders will be accepted via E-mail. All orders must be prepaid by check or money order. VISA or MasterCard. Credit card orders will include a $3.00 service charge and may be FAXed to (847) 836-9148. To order, please indicate the "ship to" address, home phone number, quantity of boards, magazine and month the article appeared.

All parts for this project, excluding circuit board, antenna and battery, can be ordered as a kit for $20.00 from

Midwest Surplus Electronics
P.O. Box 607

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