

Building an Inexpensive

Model Rocket Transmitter

by Richard Q. Fox

This article is the first in a series on the construction and use of an inexpensive model rocket transmitter and its associated sensors.

Part 1: The Basic Transmitter

Have you ever considered instrumenting your rocket with a telemetry transmitter that can tell you how fast your rocket is going, or how rapidly it is spinning, or how cold the atmosphere is at 1500 feet, or even where the rocket has landed, once it has flown out of sight! For about \$10, you can build the transmitter described in this series of articles, and open up a whole new experience in model rocketry.

Two and one-half years of careful research and development have led to the optimization of the design of this model rocket transmitter. The transmitter, which weighs less than two ounces, has a 100 milliwatt output on the 27 mc. citizens Band, and may be legally operated without any license. It has a range of over ½ mile, and can send back, among other things, the location of the rocket, the spin rate, the acceleration, velocity, and altitude, and the temperature of the air surrounding the rocket.

The only ground support equipment needed is a quality walkie-talkie for receiving the transmitted signals, a battery operated tape recorder, and some inexpensive calibration equipment which will be described in future articles.

Construction

This project is intended for those rocketeers who have previous experience assembling electronic circuits. It is not designed for assembly by the rank beginner.

The remainder of this first article of the series is devoted to the construction of the basic transmitter and a plug-in accessory which allows the transmission of a steady tone beacon from the rocket.

The key factors to be considered in the construction of the transmitter are mechanical strength, size, and neatness. The transmitter should be built up on perforated board, so that it can withstand the high accelerations that it will undergo in flight. The parts lay-out should follow the pictorials exactly, and the wiring should be done as carefully as possible. The transistor leads should be heat sunk with a pair of pliers when they are soldered into the circuit.

The crystal should not be soldered into

the circuit. Instead, connecting wires should be carefully wrapped around the crystal pins.

Initial Testing

To test out the assembled transmitter, first make sure that all wiring is complete, correct, and electrically sound. Check that the crystal is on the same frequency as the receiver, and that it is making good contact with the wires wrapped around its pins. Lay the transmitter down on a wooden table and stretch the antenna out to its full length. Place the battery in the battery holder observing that the polarity is correct. Plug the beacon tone module (the battery-resistor-black plug unit) into the transmitter board. Turn on the Citizens Band receiver and listen for the tone. The receiver and transmitter must be on the same frequency. Keep your body away from the transmitter. The electrical properties of your body and

any nearby metal will affect the operation of the transmitter.

Flight Operation

For best results, power the rocket that will carry the transmitter with three C6-5's, one Enerjet-8, or one D1.12-0 staged with a D1.12-6. When you are ready to launch, slide the transmitter circuit board into the payload section of the rocket. A 12" length of Estes BT-50 or Centuri ST-8 is ideal. The battery should be placed in the nose of the payload compartment, and the antenna should trail out the tail of the payload section. This arrangement will cut down on damage to the transmitter in the event of a faulty rocket flight. Once the transmitter is operating properly inside the payload of the rocket, tape the nose cone onto the top of the payload compartment, so that the transmitter will not fall out during recovery. Proceed with the launching of the rocket,

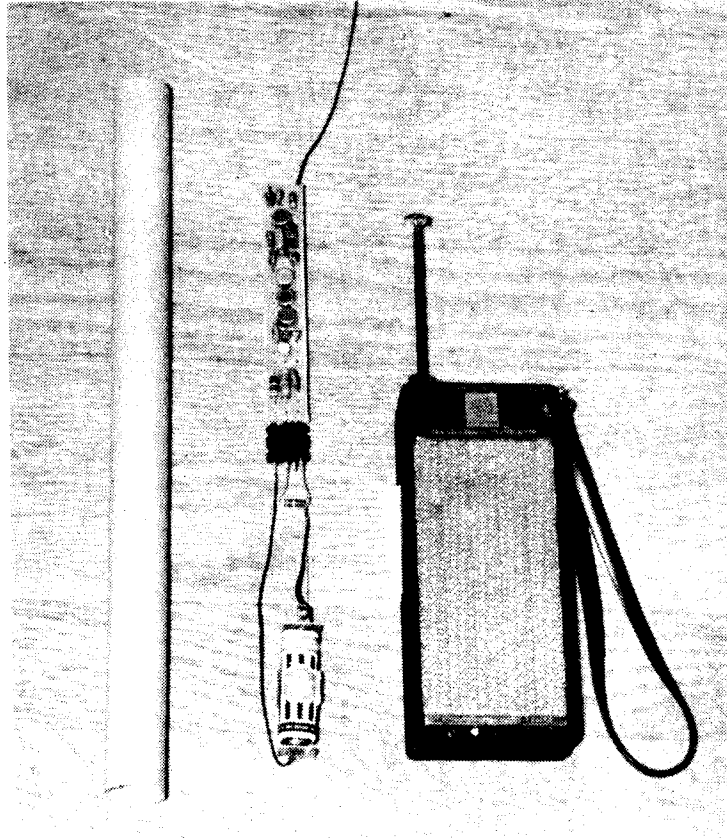
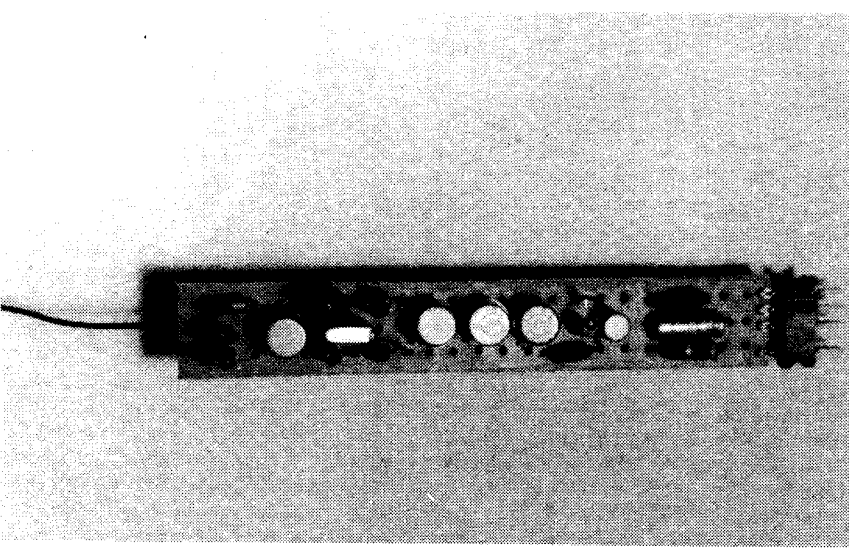
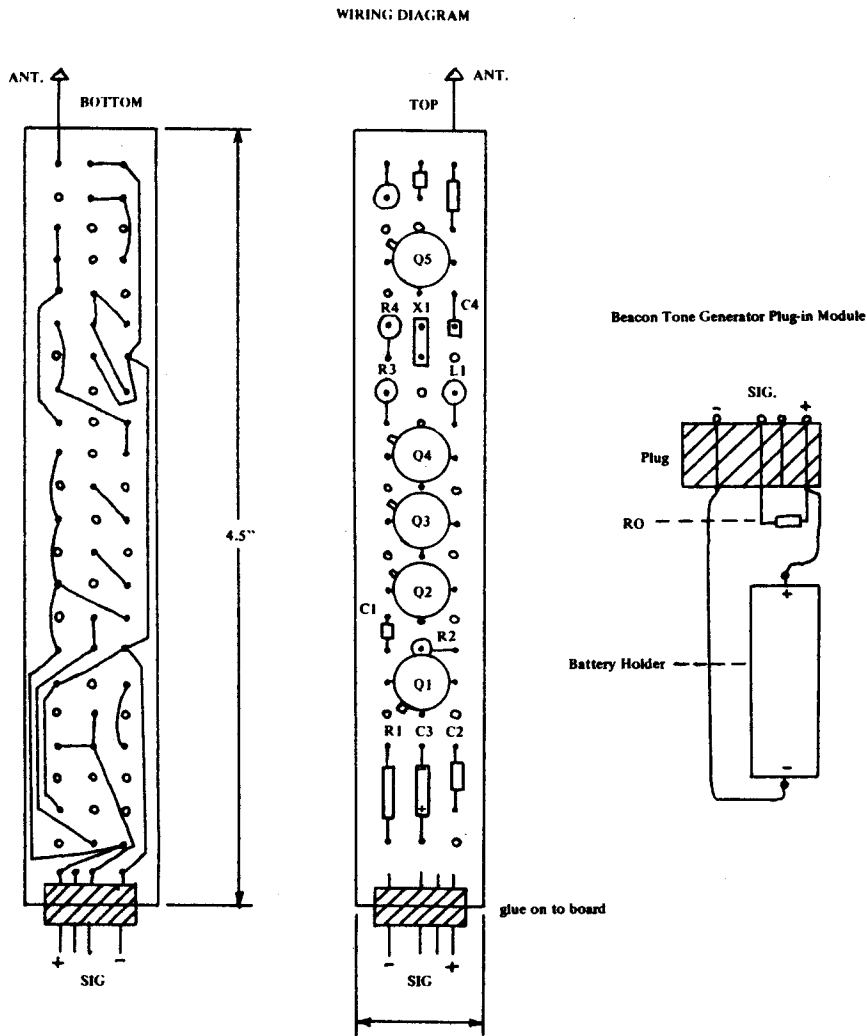


Figure showing transmitter, tone module, body tube and walkie-talkie receiver.



Sketch of wiring diagram (above) and assembled transmitter (bottom).

and recover the payload as quickly as possible. Remove the nose cone and remove the battery from its holder. The battery will run down very quickly if it is allowed to run for periods of more than a few minutes. Although these first flights of the transmitter do not send back any information on the rocket, they do allow transmitter performance to be tested.

Trouble-shooting a Faulty Transmitter No Signal Received

1. Check that the battery is plugged in properly.
2. Check that the battery is putting out full voltage under load.
3. Check that the receiver is operational and on the same frequency as the transmitter.
4. Look for loose, broken, or shorted wires.
5. Using the voltages indicated on the schematic as a guide, check the operating voltages of the transmitter with a good volt-ohm meter.
6. Place a crystal earphone from the collector to the emitter of Q1. If no tone is heard, the trouble is in the oscillator.
7. Place the earphone from the collector to the emitter of Q4. If a louder tone is not heard, the trouble is in the amplifier-modulator.
8. If the amplifier-modulator is working, but the receiver does not pick up a signal, shorten the antenna.
9. If the transmitter works only when you hold the battery, lengthen the antenna.

Weak Signal Received

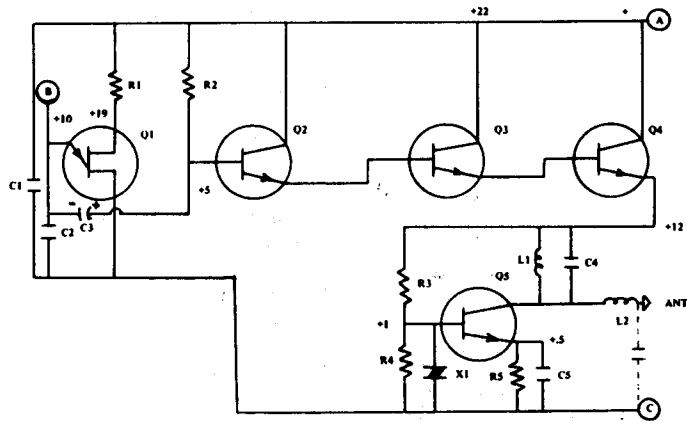
1. Check that the antenna is straight, and far away from metal, the ground, and your body.
2. Check that the battery puts out proper voltage under load.
3. Check that the transmitter and receiver are on the same frequency.
4. Get a better receiver.

Signal Received on the Ground, but Not in flight

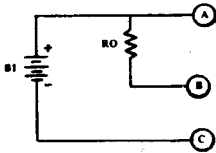
1. Clean and reform the battery holder.
2. Get a better receiver.

Next month, we will describe the construction of a temperature sensing module

27 M.C. MODEL ROCKET TRANSMITTER



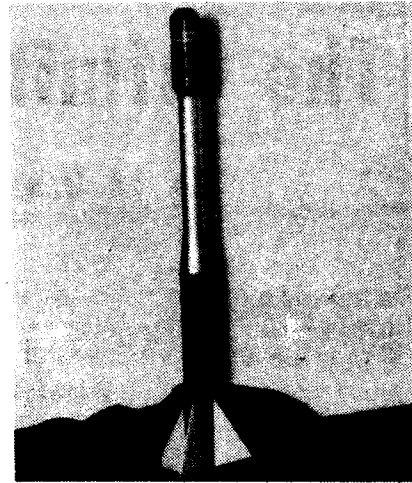
Beacon Tone Generator Plug-In Module



which will enable the transmitter to send back data on the temperature of the atmosphere. (It is about 10 degrees colder 1500 feet up.) In addition, we will describe the construction of a device for converting the tone signals sent from the transmitter into numerical data.

In future months, we will discuss the construction of a spin rate transducer and accelerometer.

The extra capacitor (dotted lines) can be used to eliminate the ground plane wire. Its value should be on the order of 3 pf.



Energet powered vehicle carrying CAMROC and XMTR.

How It Works

Unijunction transistor Q1 oscillates at a frequency determined by the combination of capacitor C2 and resistor R₀. The output of the unijunction transistor is capacitively coupled to the three transistor Darlington current amplifier Q2, Q3, Q4. This amplifier serves as a modulator for the transmitter by switching the transmitter on and off at the audio frequency determined by Q1. The R F transmitter is a modified Couplitts oscillator, using L1 C4 as an R.F. choke, and inductance L2 as a load to allow the use of a small antenna.

Model Rocket Transmitter

Parts List

R ₀	100,000 ohms	L1	27 uh R.F. Choke, Miller no. 70F275Ai
R1	220 ohms	L2	10 uh R.F. Choke, Miller no. 70F105Ai
R2	5,000,000 ohms	Q1	2N2646 unijunction transistor
R3	5,000 ohms	Q2, Q3, Q4	2N697
R4	500 ohms	Q5	40080 RCA House Transistor
R5	50 ohms	Plug	Ultra-Miniature R/C Connector, Lafayette no. 99H9091
		X1	27 m.c. crystal: Lafayette no. 42H0907C
		B1	22½ volt battery: Burgess no. Y15
		Battery Holder	Lafayette no. 34H5005
		Antenna	6'0" thin hook-up wire

All resistors ¼ watt

C1	.01 mfd
C2	.02 mfd
C3	6 mfd, electrolytic
C4	2 pfds
C5	75 pfds

All capacitors rated 25 V. or more

All parts, except those identified with Lafayette numbers, are available from Burstein-Applebee, Kansas City, Missouri.