The FOXBOX

A voice ID T-hunt controller.

by Rex Drake KI5GH

Do you need a simple, effective controller for use during foxhunts? I wanted such a device, but was unable to find one that fit my desires. Most controller circuits use some form of PROM chip, which I did not want to use. I did find a controller circuit[1] that used 8-bit shift registers to form a programmable memory. To get the required number of programmable bits to create the memory, the device needs 16 register chips. Buying this many chips could become expensive and the device still can only operate in CW.

I was browsing through the local Radio Shack and found a chip which intrigued me. The ISD1000A is billed as a voice record and playback IC. Even though the chip is somewhat expensive, the price is roughly equal to, or slightly cheaper than, buying a PROM or buying 16-shift register chips. The ISD1000A can be used to identify a hidden transmitter with *voice*, or in CW like the other controller circuits I discovered.

The ID Circuit

The ISD1000A comes packaged with application notes[2]. I made a few changes to the "simple record and playback" circuit. The chip has an addressable memory. I decided to use the memory to store a single message—so the addressing circuitry was not used. I obtained the microphone recommended by the application notes. The notes and the mike data differ slightly in the circuits required to power the electret mike. The data included with the mike described a simpler circuit than that included in the notes. I used the simpler approach and have encountered no problems. My final modifications were made to the speaker output of the ISD1000A. I inserted a 1k potentiometer (R11) which can be used to adjust the audio level sent to the transmitter. I also included a 1:1 audio transformer to provide isolation between the ISD1000A and the transmitter. Other than these changes, I built the circuit as described in the notes.

The Timer Circuits

Two timers are required for the FOXBOX. I used a 556 dual-timer IC to reduce the circuit size. The chip includes two separate 555

timers. Timer 1 controls the overall time period of the FOXBOX. The timer is used in the astable mode to provide a continuous repeating cycle. At the end of every timer cycle, the ID circuit is activated. The time period is adjustable by use of a potentiometer for R4. The cycle adjusts between approximately 30 and 90 seconds. A 1 megohm pot, used for R4, will allow for timer periods up to approximately 200 or 300 seconds.

The second timer is used to control the time the transmitter is held in the transmit mode. Timer 2 operates in the monostable mode. A trigger signal is needed to start the timer cycle, which runs for a set time period. The trigger signal is provided by Timer 1 at the end of each of its cycles. Timer 2's cycle adjusts via R1, providing a period of 10 to 25 seconds. The adjustable period allows keying of the transmitter only as long as the ID message lasts.

Keying Circuit

I built several radio keying circuits before I found one which works reliably in this application. I wanted to be able to key several different radios with the circuit. Therefore, the circuit could not be built specifically for any particular radio. One of the requirements I had for this device was the electrical isolation of the timer from the radio's press-to-talk (PTT) circuitry. I wanted the isolation to prevent current flow between the two circuits. I did not want audio signals interfering with the timer output. When using my HT for the fox, the mike and PTT circuits have to be placed in series.

I solved the keying problem by using an optoisolator. The optoisolator IC contains an infrared LED and an infrared phototransistor. The two components are connected only by an infrared light beam. The isolator's LED is driven by the output of the transmit timer

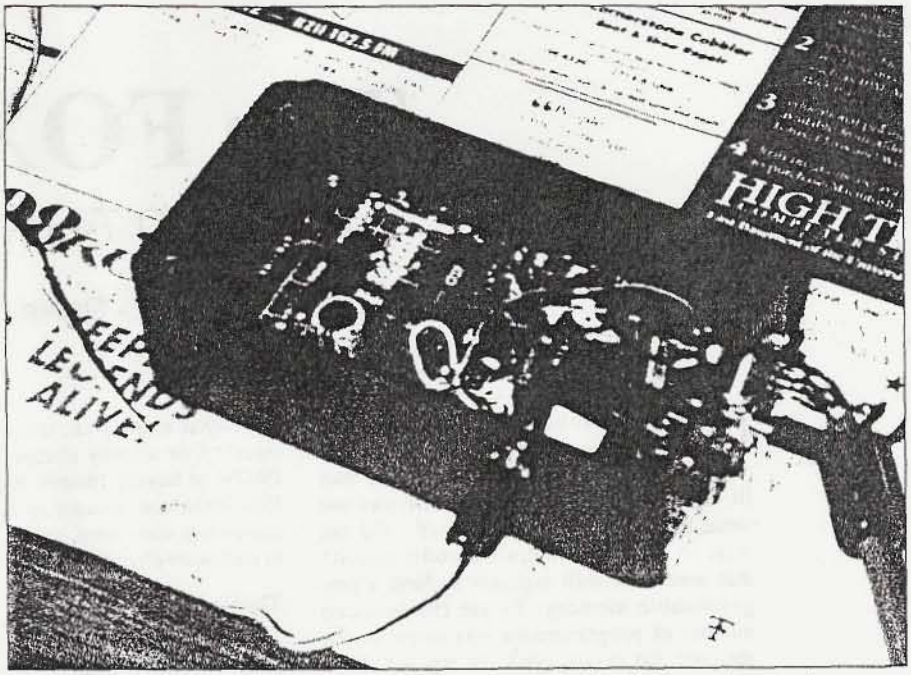

Photo A. The assembled prototype showing the external switches and connections.

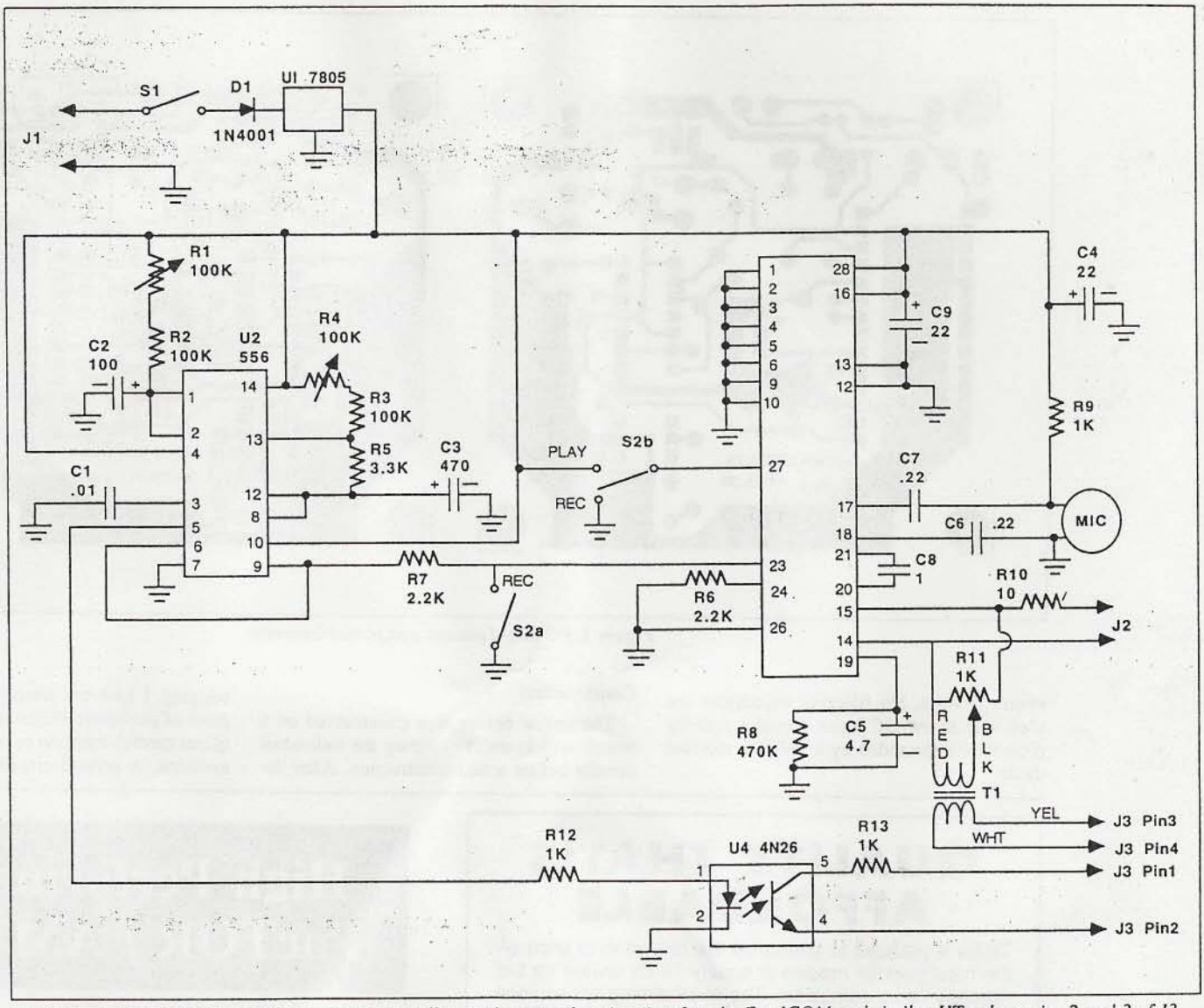

Figure 1. FOXBOX circuit schematic. Notes: All capacitance values in microfarads. For ICOM and similar HTs, short pins 2 and 3 of J3.

(Timer 2). The LED current is limited by R12. When the LED is lit, the phototransistor is turned "on," acting as a PTT switch to key the transmitter. R13 limits the current from the radio's PTT circuit to avoid destroying the phototransistor. The resistor value may need adjustment to allow reliable keying of some rigs. Ohm's Law can be used to calculate R13.

Let R equal the value of R13. V is the voltage measured at the radio's PTT pin. I is the maximum current desired to flow through R13. Try to set the current at about 20 mA. *Do not* let the current become greater than 100 mA or the optoisolator could be destroyed.

The optoisolator I used is not available at Radio Shack. To build a FOXBOX entirely from Radio Shack parts, a small 5V relay (#275-240) can be substituted for U4. R12, and R13. The relay coil is connected directly to the output of Timer 2. The relay's normally open (NO) contacts can then be used for the PTT switch.

FOXBOX Power

The FOXBOX is designed to operate from 8V to 12V battery power. The circuitry actually operates at 5V. A 7805 voltage regulator (U1) is used to achieve the nec-

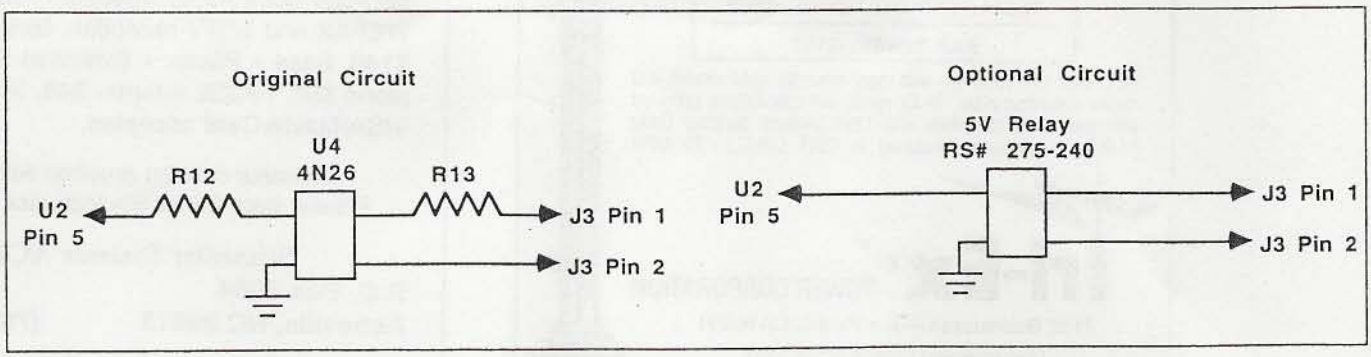

Figure 2. Original and optional keying circuits for the FOXBOX.

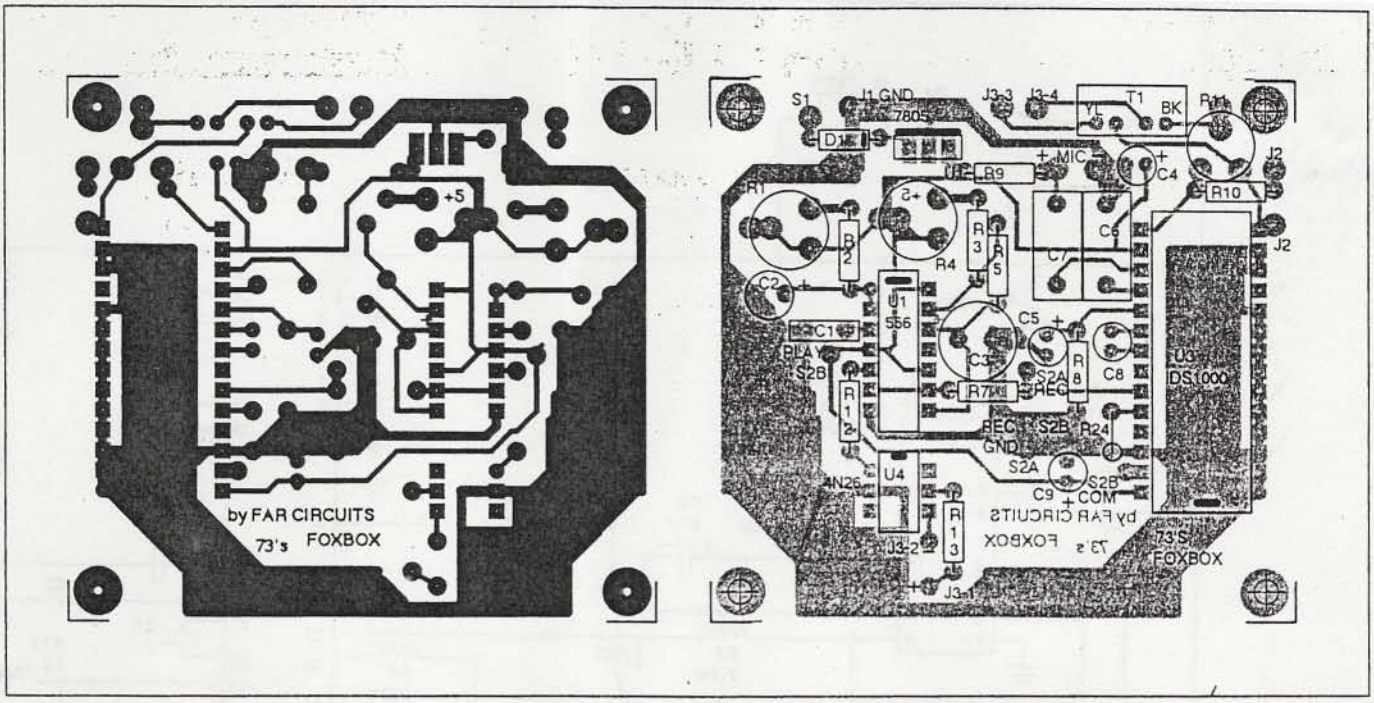

Figure 3. PC board pattern and parts placement.

essary 5 volts. No filtering capacitors are used, due to the DC input. Reverse polarity protection is provided by a 1N4001 rectifier diode.

Construction

The entire device was constructed on a breadboard in order to debug the individual circuits before actual construction. After debugging, I built the prototype on a 3" by 4" piece of perfboard. Perfboard construction requires careful attention to correct wiring connections. A printed circuit board would be

Pin Assignments for J3

Pin #	Function
1	PTT
2	PTT Ground
3	Mike
4	Mike Ground

Note: For use with ICOM or similar handhelds, jumper pins 2 and 3 together in the interface cable plug.

helpful for preventing wiring mistakes.

I mounted most of the components on the top side of the circuit board. The three adjustable resistors and the microphone were mounted on the underside of the board. The underside mounting is due to the board's location close to the inside of the case. I drilled three holes in the case in order to allow for timer and mike level adjustments to be made externally just before hiding the fox. A fourth hole was made to allow direct access to the microphone.

I chose to use a readily available ABS plastic case, even though it offers no RF shielding. To date, I have not experienced any problems with RF interference.

For hiding, I wanted to use a piece of large-diameter PVC pipe to house the FOXBOX and transmitter. The pipe would help with disguising the fox and would also provide protection to the devices inside. Because the FOXBOX was to be placed in the pipe. I wanted all of the external jacks and

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Parts List

Part	Description	RS Part #
U1	7805 5V regulator	276-1770
U2	556 dual timer	276-1728
	14-pin IC socket	276-1999
U3	ISD1000	276-1325
	28-pin IC socket	276-1997
U4	4N26 optoisolator	*Mouser #570-4N26
	8-pin IC socket	276-1995
R1,R4	100k PC mount pot.	271-284
R2,R3	100k	271-1347
R5	3.3k	271-1328
R6,R7	2.2k	271-1325
R8	470k	271-1354
R9,R12,R13	1k	271-1321
R10	10	271-1301
R11	1k PC mount pot.	271-280
C1	0.01 µF	272-131
C2	100 µF	272-1028
C3	470 µF	272-957
C4,C9	22 µF	272-1026
C5	4.7 µF	272-1024
C6,C7	0.22 µF	272-1070
C8	1 µF	272-996
D1	1N4001 rectifier	276-1101
T1	1:1 audio transformer	273-1374
S1,S2	Mini DPDT slide switch	275-407
J1	Power input	274-1563 or preference
J2	1/8" speaker jack	274-248
J3	5-pin DIN jack	274-006 or preference
Microphone	Electret type	270-090
Optional:		
Perfboard		276-162 or 276-168
Case	Size to fit	
Relay	5V SPDT micro	275-240

Note: The relay, if used, would replace U4, R12, and R13. See text.
A drilled and etched PC board for this project is available for $4.25 plus $1.50 S&H from FAR Circuits, 18N640 Field Court, Dundee IL 60118.

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switches at one end of the case. I achieved the placement goal with one exception: I did not leave enough room on the end of the timer case to place the jack for an external monitoring speaker. Placing the jack on the side of the case caused only a minor problem because the speaker would not be used when the FOXBOX was hidden. Careful attention should allow all jacks and switches to be placed on the end of the case.

Connectors and Switches

Three external connection jacks and two switches are used for the FOXBOX. For the power jack, I chose a coaxial power connector identical to the one used by my ICOM HT. The speaker uses a standard 1/8-inch phono jack. I chose to use a 5-pin DIN plug for interfacing the radio. Any 4-or-more-pin jack would have worked well here. The DIN plug was the least expensive option explored.

I wanted the switches to be low-profile slide switches. A DPDT switch is required for playback/record selection. An SPDT switch is required for power. I used two small DPDT switches because they were easily availabile.

Operation

Operating the FOXBOX is straightforward. Apply 8 to 12 VDC, then put the play/record switch (S2) into the RECORD position. Speak at a normal level into the microphone to record a message up to approximately 20 seconds long. The message *must not* be long enough to entirely fill U3's memory or message playback may not occur properly. At the end of the message, place S2 back in the PLAY position. The newly recorded message will now play back once at the end of every cycle of Timer 1.

An interface cable is required between the FOXBOX and the hidden transmitter. I want to be able to use two different radios for the hidden T. The first radio, an Alinco 570 uses a four-conductor interface cable to carry PTT, PTT ground, MIC, and MIC ground signals. The second radio, an ICOM O2-AT handheld, only needs a two-conductor cable. To use the HT, the MIC signal from the FOXBOX is placed in series with the PTT ground connection.

I had originally intended to use a third switch in the FOXBOX to accomplish the series MIC connection for HT use. I decided not to use the switch and instead just shorted the appropriate pins in the interface cable connector. The decision to eliminate the switch saves the space required to mount the switch on the case.

Conclusions

Designing and building the FOXBOX was quite fun. If the relay keying circuit is counted, I achieved my goal of building the device entirely of parts available at any Radio Shack store. Future improvements to the FOXBOX could include filters for the audio output. Addressing circuitry could be used to allow the record and playback of several short messages by the ISD1000A. The FOXBOX will serve well to control many types of hidden transmitters. If the FOX is to be hidden for a long period of time, provide plenty of battery capacity for the transmitter. The FOXBOX itself draws only a small amount of power so large batteries are not needed. Creative housings for the entire FOXBOX package will allow limitless hiding possibilities. Let the imagination fly. 73

References:

1. Moell, Joseph D., KØOV, and Thomas N. Curlee WB6UZZ. *Transmitter Hunting: Radio Direction Finding Simpified.* Blue Ridge Summit: Tab Books, 1987, p. 193.

2. Tandy Corporation. *ISD1000A Voice Record/Playback IC.* Fort Worth: Tandy Corporation, 1992.