Hugh Wells W6WTU
1411 18th Street
Manhattan Beach CA 90266-4025

Inside Digital TV/VCR Tuners

Part 3: Data receiver for testing.

The discussion on digital TV/VCR tuners is in seven parts with the first part covering the two types of digital tuners and their requirements. A short discussion was provided regarding how the synthesizer is used within the tuner for controlling the local oscillator (VCO). Part two discussed the data transmitter that I built to control and study the digital tuner.

While building the data transmitter to be used in controlling a digital tuner, it became obvious that a method was required to "observe" and test the data transmitter. The solution was to develop a data receiver that would drive a series of LED's displaying the tuner's data control bits sent by the transmitter. Sending data into a digital tuner is illusive because the tuner normally provides no direct feedback of "what's happening." Although the receiver isn't a necessary part of the test and data set, it provides visual feedback to the operator of what has been sent to the digital tuner.

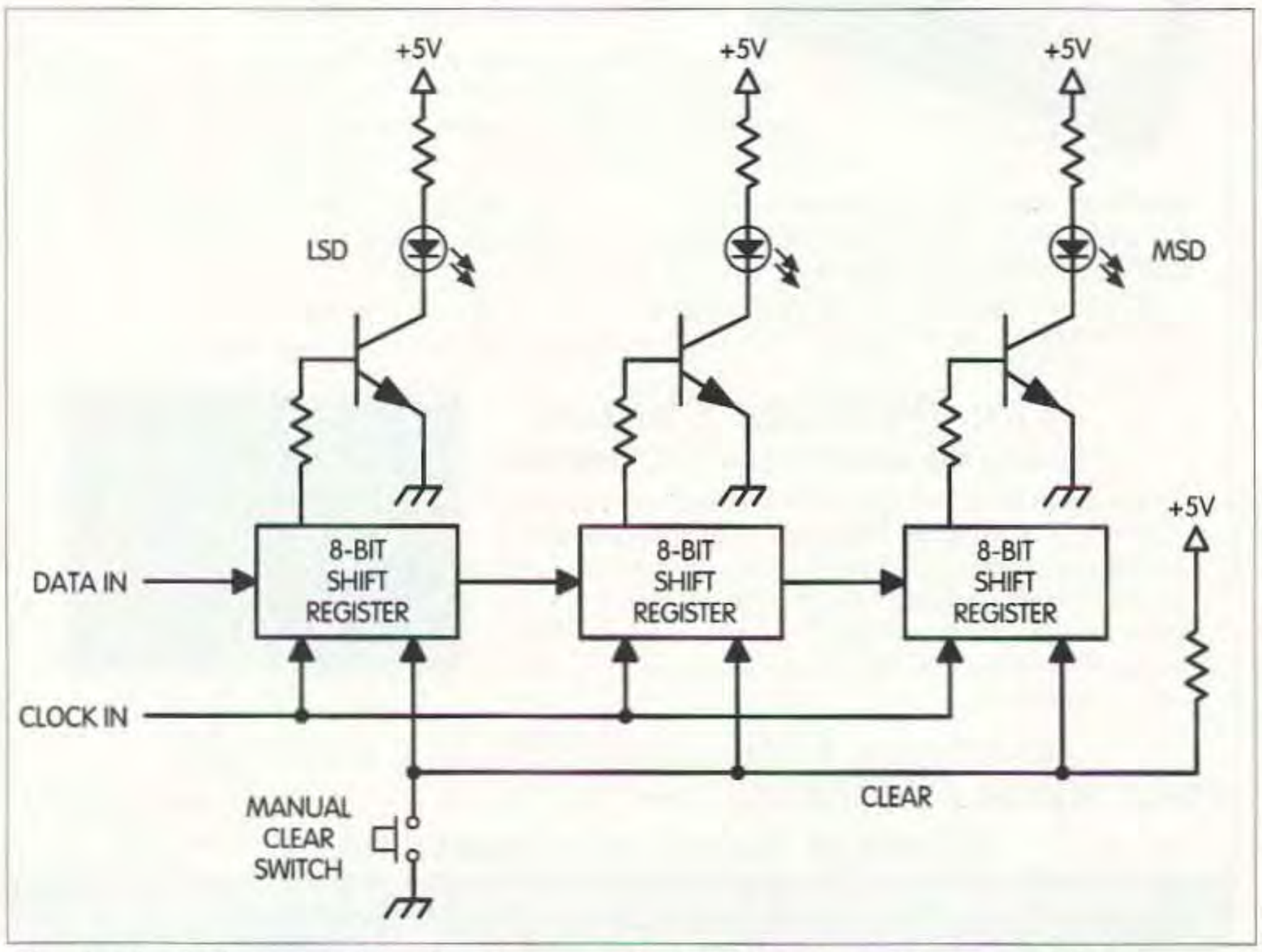

Fig. 1. Block diagram of the data receiver. Each shift register drives eight LEDs.

The theory behind the data receiver is shown as a block diagram in **Fig. 1**. Data flow through the circuit is shown by the arrow pattern. Data from the transmitter is clocked into three cascaded shift registers having 8 bits each. Each of the 24 register bits has an output that drives an LED indicating the status of the register bit. Only one LED driver is shown in the figure, but there are eight identical drivers for each register bit in the actual data receiver. Displayed data in the registers is cleared manually with a push-button.

The circuit for the receiver, shown in **Fig. 2**, uses three cascaded 74HCl64 shift registers. Again, TTL 74l64 ICs were used in the initial design, and they worked just fine — that is, until certain data patterns appeared that would glitch and turn off portions of the display. The use of the 74HC164 solved the problem without further error. Troubleshooting of the glitch condition failed to show up where the problem was occurring, but use of the 74HC164 part resolved the problem.

The 74HC164 was selected for the receiver application because it is a serial-data-in and a parallel-data-out

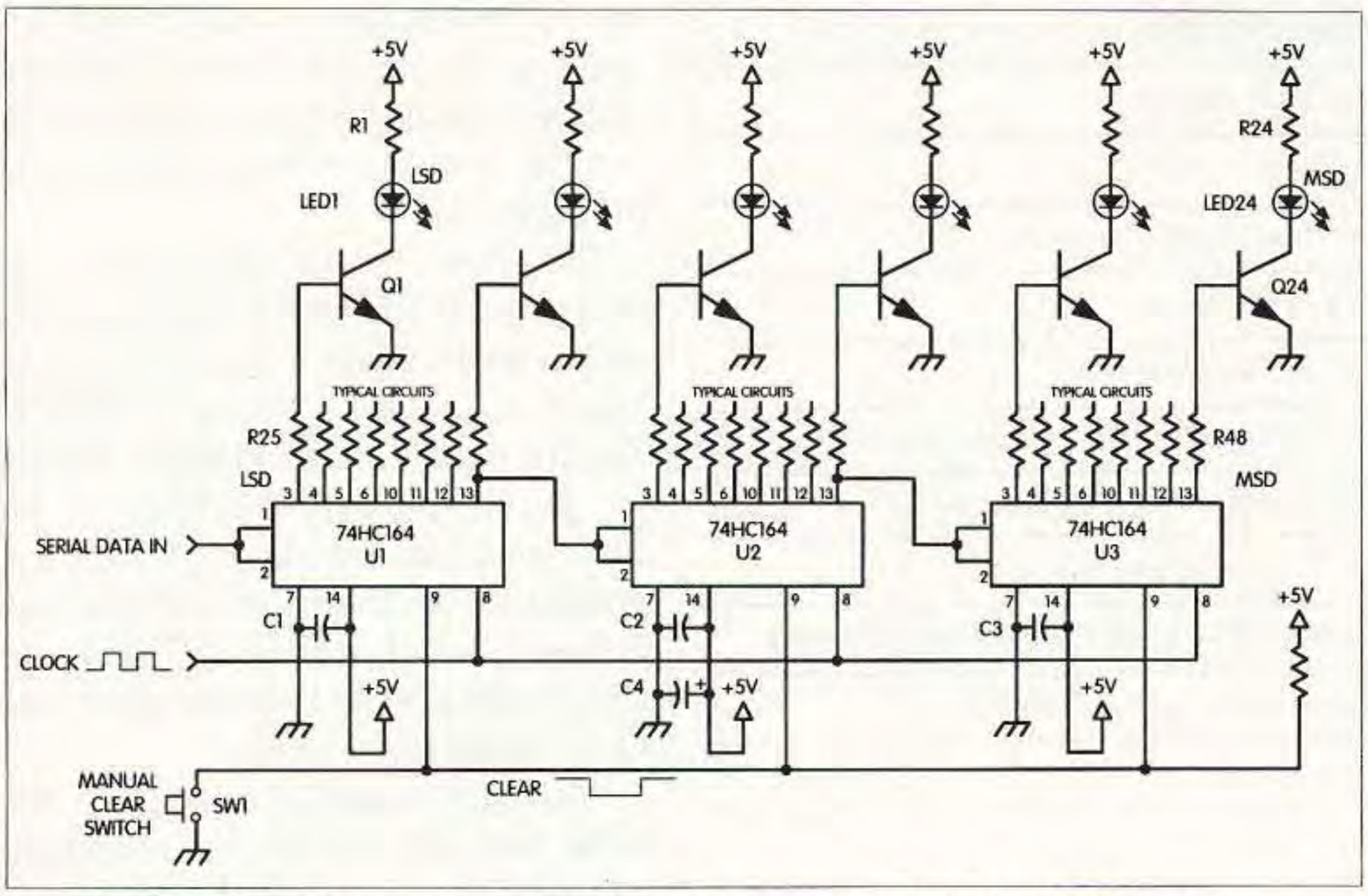

Fig. 2. 24-bit serial data receiver. Displays data sent to a digital TV/VCR tuner.

shift register. A "1" bit at a register location creates a HIGH on the respective output pin of the register.

Then, to drive an LED, a switching transistor was used as an LED driver. While in operation, it's interesting to watch the data bits move through the registers as the appropriate LEDs illuminate, making it clear to the user as to what's happening relative to the data being sent to the tuner.

Packaging

With twenty-four output circuits driving twenty-four LEDs, the mechanical space requirement for them became extensive. In order to reduce the LED crowding, the narrow flat LED package was chosen for the receiver project. TO-92 packaged transistors were selected for the LED driver application because they would stack close together. I used the equivalent of the 2N4401

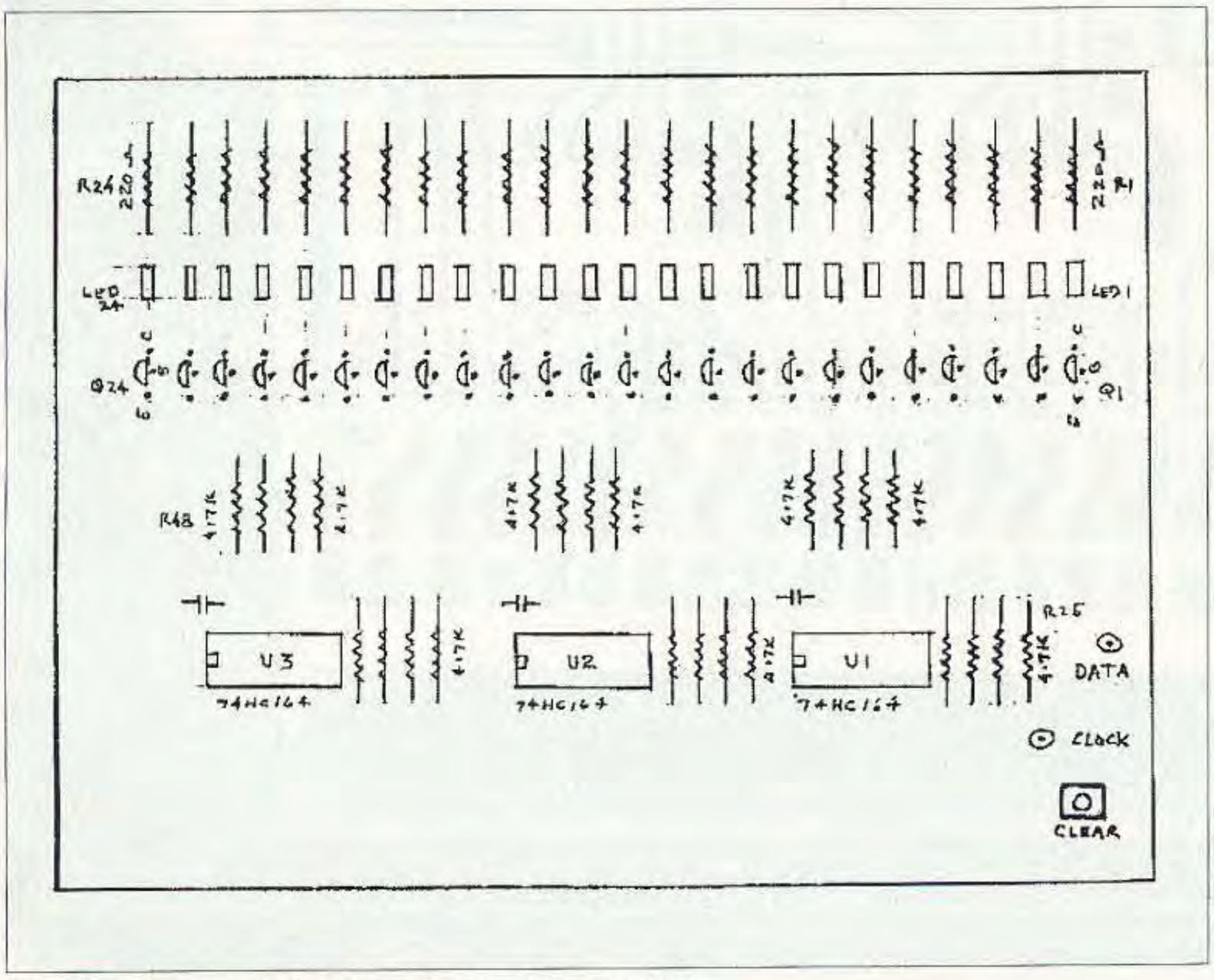

Fig. 3. Component placement for the data receiver.

Parts List for the Data Receiver	
R1–25	220Ω 1/4 W resistor
R25–49	4.7k 1/4 W resistor
C1, 2, 3	0.01 µF 50 V ceramic capacitor or equiv.
C4	100–500 µF 16 V radial capacitor or equiv.
LED 1–24	Rectangular LED (color is optional)
	Red: Mouser 606-CMD 57123, Digi-Key P437-ND (Panasonic LN242RP)
	Green: Mouser 606-CMD 54123, Digi-Key P438-ND (Panasonic LN342GP)
Q1–24	2N4401 or equiv. TO-92 or smaller case size
U1, 2, 3	74HC164 8-bit shift register: Mouser 511-M74HC164, Digi-Key 296-2097-5-ND
SW1	SPST momentary push switch, any type available
Misc.	IC sockets

Table 1. *Parts list for the data receiver.*

device as an LED driver, but almost any NPN transistor should work well in this application as long as it will fit the mechanical spacing available.

Because the "received" data is to be retained in the display, the CLEAR line is operated by a push switch located on the receiver board. Only the data and clock lines are connected in parallel with the data transmitter and the digital tuner.

The circuit of the data receiver is fairly simple and can be laid out easily on a printed circuit board as shown in **Fig. 3.** A parts list is shown in **Table 1.** Spacing of the LEDs and driver transistors are the primary controllers of the space and size of the board. Carrying a ground to the transistor emitters was accomplished by using "Z"-wires to transfer the ground from the upper side of the board to the lower.

With the exception of using the 74HC164 shift register, the remaining components used in the project appear to be noncritical as to value. I used IC sockets on my receiver board to allow switching of chips during trouble-

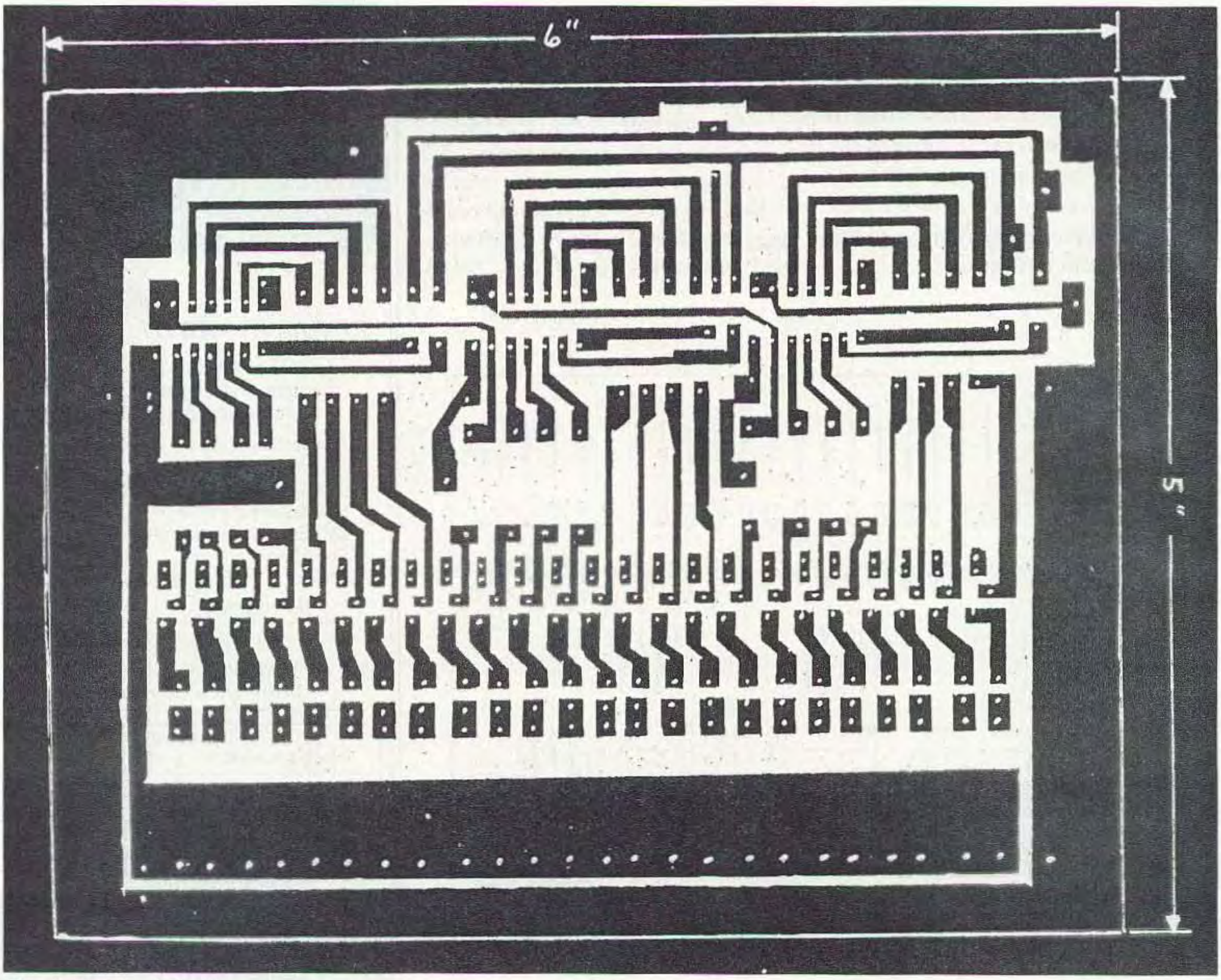

Fig. 4. *PCB top foil side.*

shooting. No apparent problems are introduced through the use of the sockets.

I used discrete resistors on my receiver board, but with a board design change it would be possible to use resistor packs. Some board real estate would be saved with the use of R-packs, should board size be of concern.

All of the logic is on the circuit side of the board, leaving the top side of the board for ground plane. Some power circuits and jumper wires are carried on the top side of the board for convenience.

A small momentary push switch is installed on the top side of the receiver board and is used for resetting the display when it is deemed desirable. Resetting of the display has no effect on the data sent to the tuner, as that is strictly under the control of the data transmitter.

What's next

Part four in this series on digital TV/VCR tuners will discuss how the tuner is to be controlled and tested. The fifth part will provide a BASIC program that may be used for the decimal to binary number conversion, since the tuner responds to a binary number format. Parts six and seven, the last sections of this series, will provide a simple technique for making printed circuit boards. 73

What happens if you get scared half to death twice?

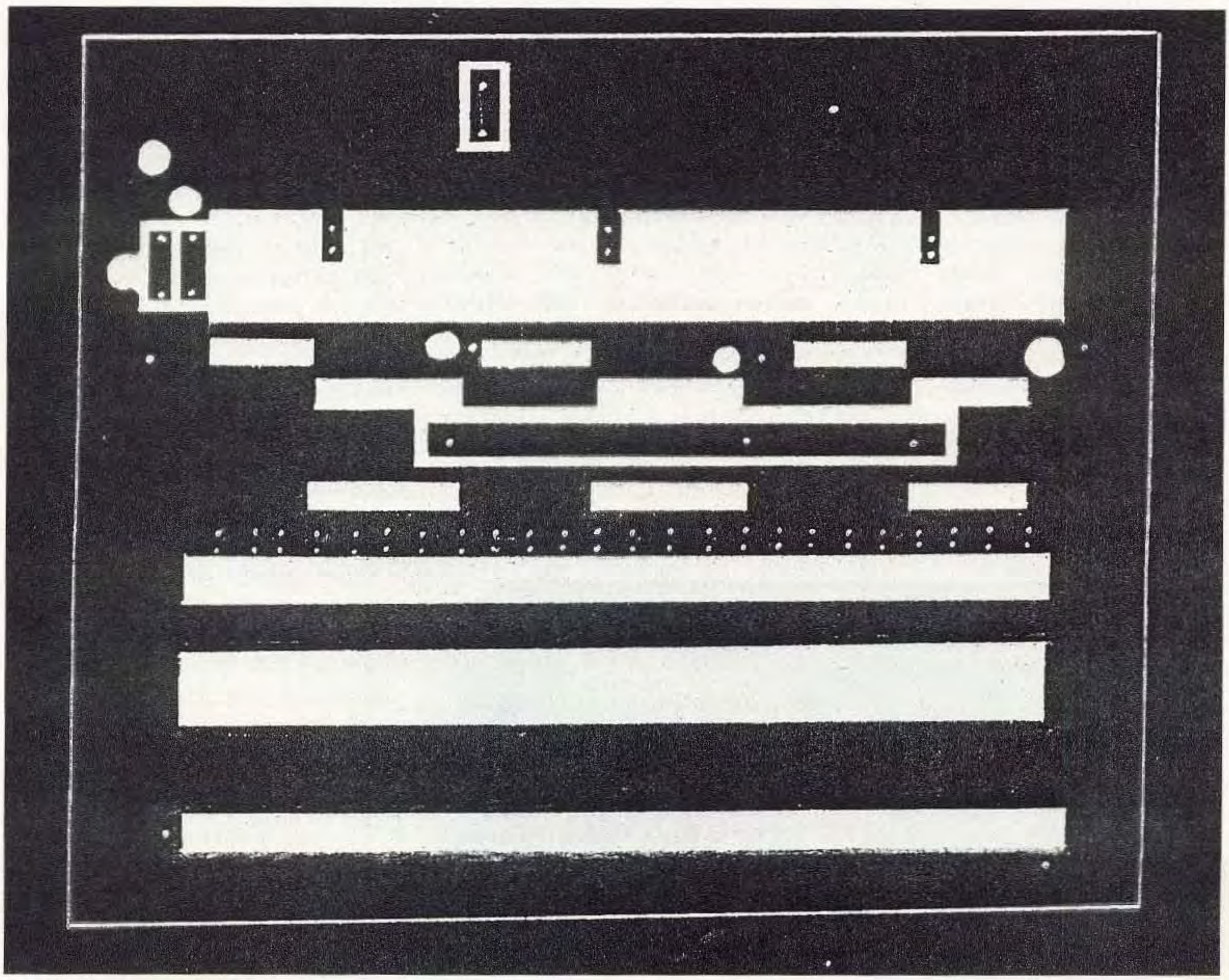

Fig. 5. PCB bottom foil side.