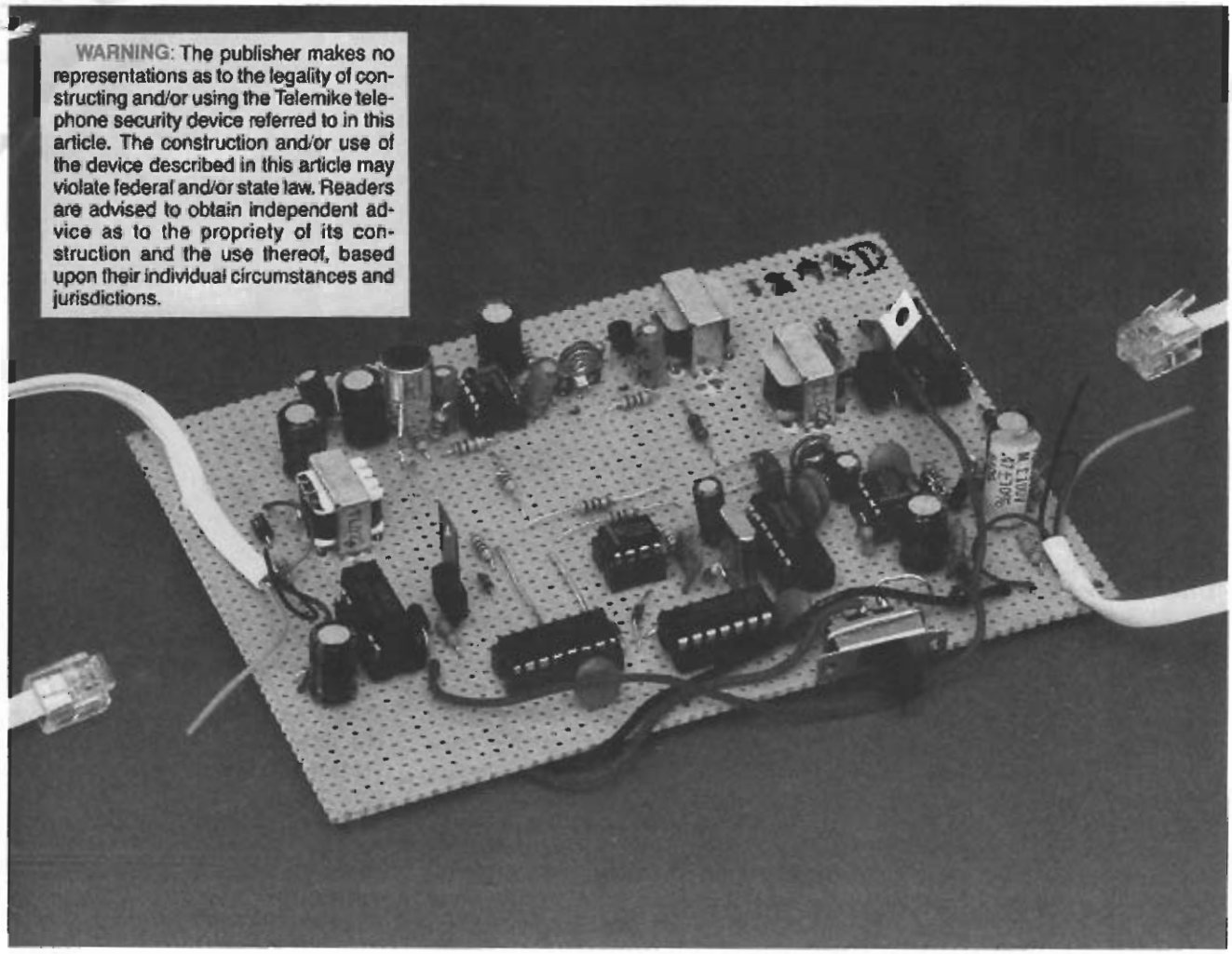

WARNING: The publisher makes no representations as to the legality of constructing and/or using the Telemike telephone security device referred to in this article. The construction and/or use of the device described in this article may violate federal and/or state law. Readers are advised to obtain independent advice as to the propriety of its construction and the use thereof, based upon their individual circumstances and jurisdictions.

TELEPHONE LINE GRABBER

This listening circuit can be called from a remote phone so you can intercept phone conversations or monitor room activities

ROBERT IANNNINI

TELEMIKE IS A TELEPHONE CIRCUIT that, when located in a room miles away, permits you to listen in on the activities that are taking place in that room. It also permits you to listen to or interrupt a conversation on a separate phone line located wherever Telemike can gain access to it.

Telemike contains a sensitive microphone which is activated by calling the telephone number assigned to the outlet where it is plugged in and entering a code. It also contains circuitry that will permit it to access a telephone on a separate line terminating in the same room or even at the place where the phone line enters the home or building. Sequential pressing of the pound (#) key cycles the circuit to the next mode, that of intercepting a second telephone line and the third mode that resets the circuit after it has been in either of its listening modes.

The "called to" telephone can be miles away, in the same home or building as Telemike, or anywhere Telemike can gain ac-

cess to the "called from" number. The Telemike circuit can be located anywhere in the room where the "called to" phone jack is located or at the entry point of the phone line—conspicuous or inconspicuous.

Figure 1 gives the number of times the pound (#) key must be pressed in sequence to initiate Telemike's two operating modes. It also shows the third key pressing needed in sequence to terminate the first two modes so the "called to phone" is not left "off hook."

In the *listen* mode 1, you can listen to conversations, music, security alarms, the sound of essential building service machinery, or even the sounds of intruders. To make use of the *intercept phone conversation* mode 2, you must have access to its phone wires or jack for plugging in the second plug from Telemike. The circuit forms a "bridge" between the two lines. Then by keying the pound (#) key twice, you will be on line with both parties of the intercepted phone line.

If you own your own business or vacation cottage that is located some distance from your home, or if you are away from your own home, an installed Telemike will let you find out if a security alarm is sounding, an essential heater or pump is working, or if unwanted persons are present in the room. It could also be useful in unobtrusive monitoring of a bed-ridden patient or child, a teenagers rock and roll party or a romantic adventure in progress.

The *intercept phone conversation* mode will permit you to interrupt a call in progress to announce a call waiting, emergency, or some other event from wherever you are located—in the house or miles away.

Adaptation required

Telemike was designed to be compatible with the AT&T Corporation's ESS electronic switching system. Consequently, there might be differences in its performance if it is installed in a telephone operating system based on a different design.

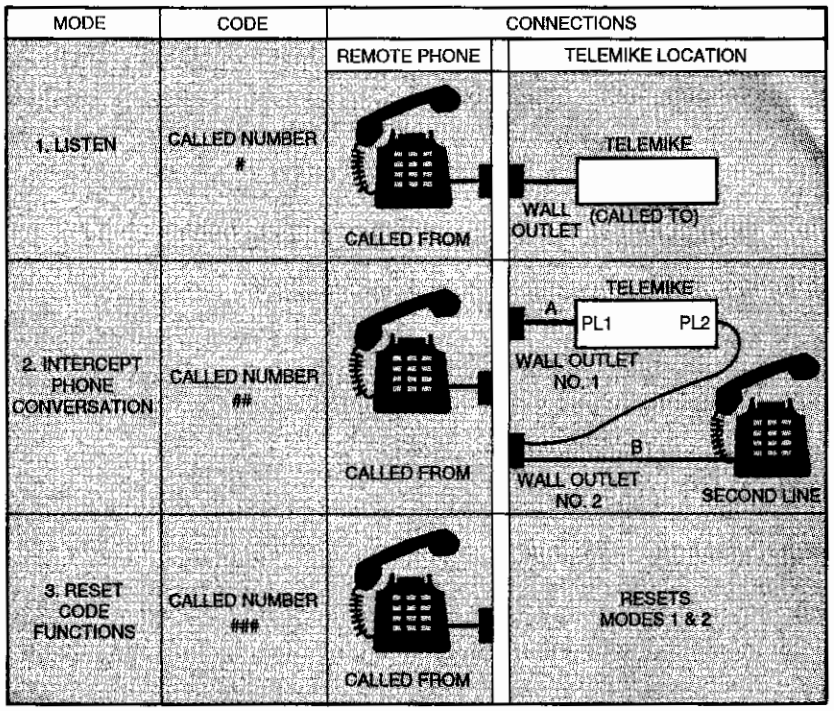

FIG. 1—CODES AND OPERATING MODE for the Telemike telephone line monitor.

This article does not provide details for packaging the Telemike circuitry. However, the circuit can be housed in any suitable metal or plastic project case with provision for mounting the on-off switch on the outside, a battery pack inside, and openings for the phone cords.

Circuit function

Refer to the schematic Fig. 2. Six volts DC is applied to the circuit by switching S1 ON. With this voltage applied, the 555 timer IC3 momentarily holds a high and resets NAND gate IC4-a to zero, "priming" the circuit.

To initiate the *listen* mode 1, call the number of the "called to" telephone line that is connected to plug PL1. A negative ring signal triggers 555 timer IC1, causing transistor Q1 to conduct. That sends current through the coil of reed relay RY1 and closes its contacts, connecting transformer T1 to the telephone line.

A tone signal initiated by pressing the pound (#) key of the "called from" phone immediately after you have keyed in the "called to" telephone initiates a response after Telemike has been primed. The tone is decoded by dual-tone multiple frequency DTMF filter/decoder MC145436 IC2. It is a silicon-gate CMOS LSI IC containing the filter and decoder for the detection of a pair of tones conforming to the DTMF standard.

The output of IC1 indexes the CD4017 decade counter IC5 to the logic 1-state, latching transistor Q1 ON. This response then turns on the 741 operational amplifier IC6.

Any sounds in the room where Telemike is located are picked up by microphone MIC1, amplified, and fed back through transformer T2 to transformer T1 from which they are sent over the phone lines. A person listening on the "called from" phone can then hear any sounds or voice within the range of the microphone. This is the *listen* mode.

The Telemike circuit can be switched to the *intercept phone conversation* mode by pressing the pound (#) key a second time. This sequence connects the "called from" phone through the to the second phone line through plug PL2 of Telemike. This permits any conversation on the second line to be interrupted or monitored from the "called from" phone.

A second pressing of the pound (#) key causes decade counter IC5 to index its count to mode 2. That sets pin 4 high

which holds Q2 in a conducting state, energizing relay RY2 and closing its contacts. This connects transformer T1 to plug PL2, the connection to the "called to" phone.

Any audible signals at plug PL2 are now connected by the telephone line at plug PL1, allowing you at the "called from " phone to interrupt a conversation on that line or just listen. Complete DC isolation between the two telephones connected to plugs PL1 and PL2 is achieved by the isolated contacts of relay RY1.

The third *reset code functions* mode is achieved by pressing the pound (#) of the "called from" phone a third time. This indexes decade counter IC4 and turns off Q2 and all other functions, restoring normal telephone operation. Diode D14, connected across RY1's coil, clips the inductive pulse that occurs when relay RY2 is turned off. *Caution*: the "terminate function" must be keyed in before hanging up the "called from" phone or the "called to" telephone might remain off-hook. The telephone company will terminate service if it is not corrected within a reasonable length of time.

If you fail to rest Telemike properly before hanging up the "called from" phone, you must reset the circuit manually by going to it and turning it off and on again. This is an obvious inconvenience if you are miles away from the "called to" telephone or its jack.

To make the most effective use of all of the three modes of Telemike, you should subscribe to a dedicated telephone line. (about $15 per month in most locations).

It is important that *initial access time* be selected properly if you intend to use only a single line. This will be discussed later in this article.

Circuit construction

Refer to the schematic Fig. 2 and the parts placement diagram Fig. 3. The components of the prototype circuit were wired point-to-point on a rectangular piece of perforated board measuring 6¼ × 4½

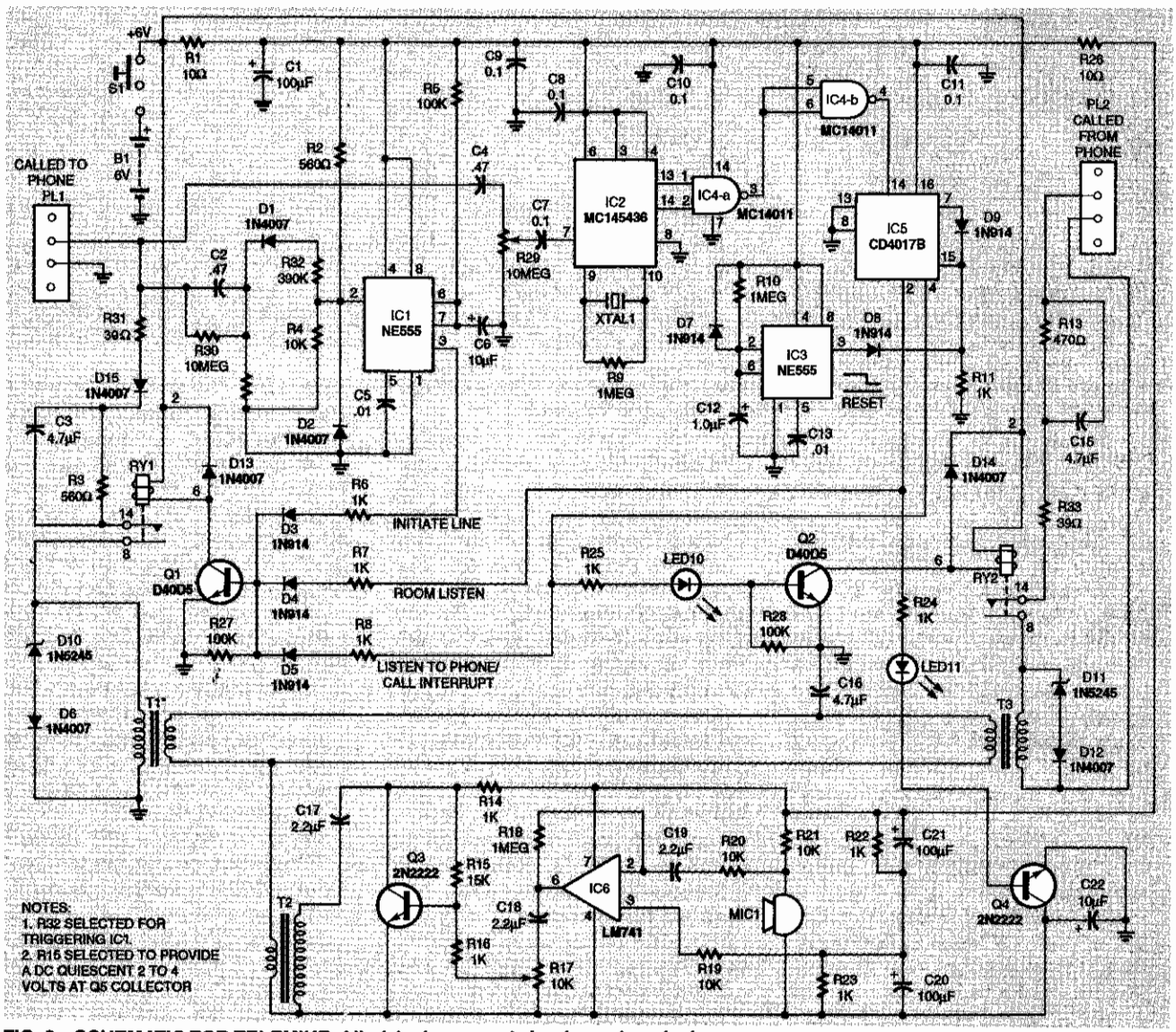

FIG. 2—SCHEMATIC FOR TELEMIKE. All of the integrated circuits and reed relays are inserted in DIP sockets.

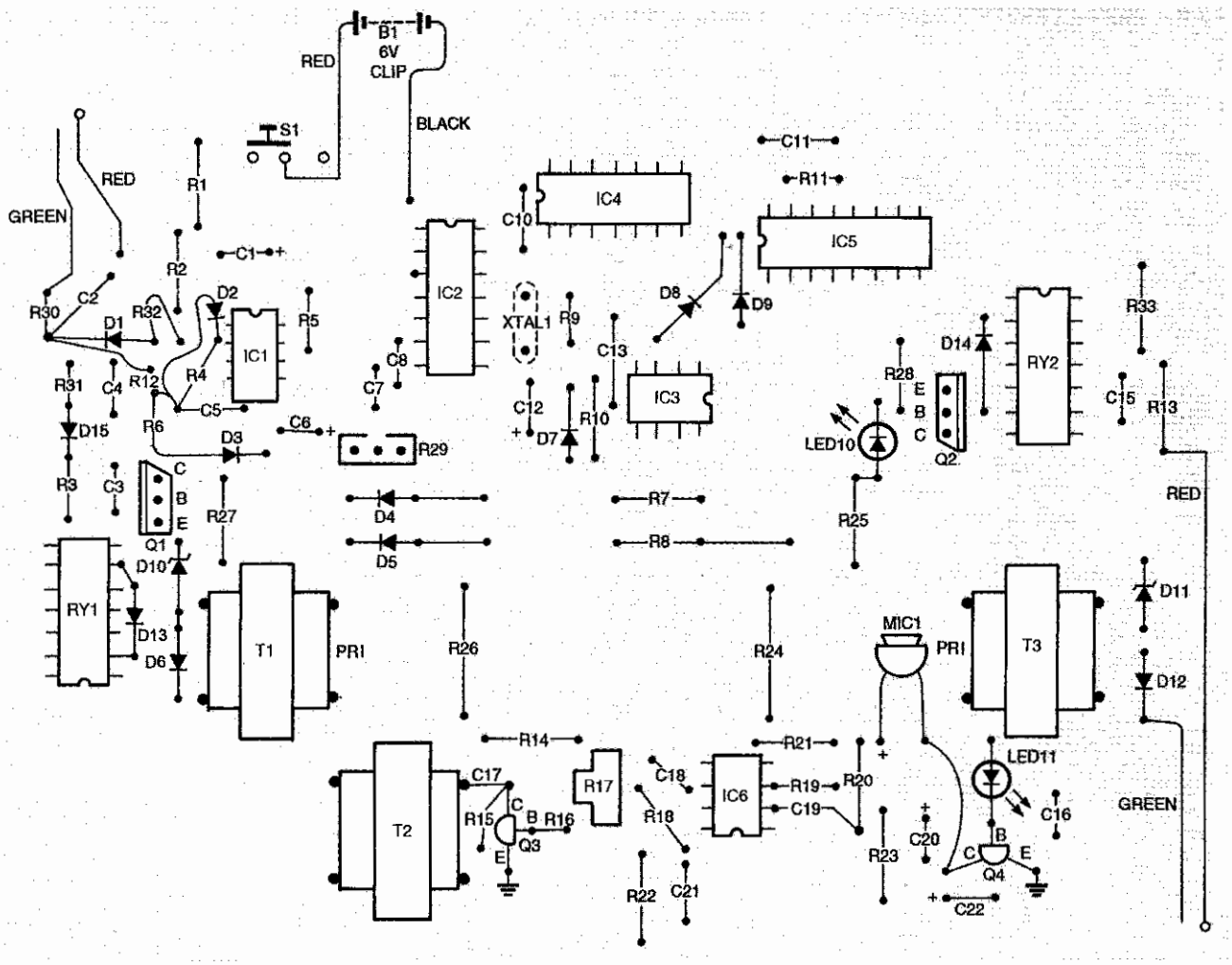

FIG. 3—PARTS PLACEMENT DIAGRAM. The entire circuit fits on a 5⅝ × 4-inch perforated circuit board. The components are interconnected by point-to-point wiring and power and ground bus wires. Switch S1 can be mounted off the board.

inches with 0.42-inch prepunched holes in a standard 0.1-inch grid.

The component positioning shown in Fig. 3 generally follows that shown in Fig. 2. The component spacing was selected to minimize the length of interconnecting wires without unnecessarily cramping the space between components. This would make the soldering operation more difficult. There are no critical component relationships in this circuit that dictate either close spacing of specific components or isolation between them.

If you want to construct the circuit on a smaller board to fit in a smaller case, you can reduce the spacing between components. However, it is recommended that component orientation remain the same.

Identify all components and set them out on a table as shown in Fig. 3. Start by positioning the seven IC sockets (for ICs and reed relays) on the board with the approximate spacing shown in Fig. 3. Place a drop of fast-drying glue under each socket to hold it in position on the board.

The circuit has three identical isolation/impedance-matching transformers T1, T2, and T3. They are rated for a primary impedance of 600 ohms and a secondary impedance of 1200 ohms at 1000 Hz. Measure the DC resistance of the windings with an ohmmeter to verify the continuity of the windings, and confirm the markings for the primary and secondary sides.

The 600-ohm secondary turns should have an approximate DC resistance of 50 ohms, and the 1200-ohm primary turns should have a DC resistance of about 75 ohms.

Insert the transformers in the board in the correct orientation, being careful not to stress the pins because that might break the winding connections, destroying the transformer.

Start inserting all passive components from left to right across the board in small clusters, noting the polarity and orientation of all diodes and polarized capacitors. (Suggestion: position some of the resistors vertically to conserve circuit board space.)

Temporarily fold the leads of all inserted components back flush with the solder side of the board so they will not fall out when the board is handled. Do not trim the leads at this time. Certain component leads will connect with adjacent component leads as part of the complete circuit.

Solder the leads of the components that have been inserted in small groups before proceeding with the next group. Form the power and ground buses from bare copper wire, and solder them as shown in Fig. 3.

Solder in the clip for the four-cell battery pack, with the red wire to plus (+) and black wire to negative (−).

Strip back the jacketing from both ends of the telephone cords to expose the multicolored wires. Strip back the insulation from the red and green wires and solder them to the proper locations on the circuit board, as shown in Fig. 3. The red wires go to the ground bus and the green wires go to the input points. Trim off the other two black and yellow wires flush with the ends of the cord jacket. Assemble the RJ-11 plugs PL1 and PL2 to the other ends of the telephone cords and crimp them in position.

Verify that all diodes, polarized capacitors and transformers have been inserted correctly with their correct orientation and polarities observed. Examine all soldered joints to be sure they are clean and shiny, and that there are no inadvertent solder bridges. Resolder any "cold" solder joints that appear as dull gray, irregular solder bonds. Trim any leads that overlap or form inadvertent short circuits.

Insert the two reed relays, RY1 and RY2, in their sockets. Insert the ICs only as directed in the circuit test procedures.

Circuit test

Measure the continuity between the following points and the circuit board ground bus.: IC1—pin 1; IC2—pin 8; IC3—pin 1; IC4—pin 7; IC5—pins 8 and 13; IC6—pin 4; emitters of transistors Q1, Q2, Q3,and Q4; T1 secondary.

Connect the four AA cells which form the 6-volt DC battery pack to the battery clip. Verify that 6 volts appears between the following test points and the ground bus with a voltmeter. (The current drawn should be 0.1 to 0.2 milliamperes):
IC1—pins 4 and 8; IC2—pins 3, 4 and 6; IC3—pins 4 and 8; IC4—pin 14; IC5—pin 16; IC6—pin 7, collectors of transistors Q1 and Q2.

Plug PL1 into a telephone jack connected to a "test" telephone. (It might be necessary to obtain a modular duplex jack such as Radio Shack's 279 386.)

Insert both the 555 timer IC1 and transistor Q1 in their sockets. Connect one lead of a voltmeter set on the 10-volt DC scale to the collector of Q1, and verify a reading of 6 volts.

Short-circuit plug P1 and observe the voltmeter scale to see if the voltage momentarily drops to near zero. Resistor R32 is specified as 390 kilohms, but it might be necessary to substitute a lower value for reliable

PARTS LIST

All resistors are ¼-watt, 10%, unless otherwise specified.
R1, R26—10 ohms
R2, R4, R19, R20, R21—10,000 ohms
R3—100 ohms
R5, R12, R27, R28—100,000 ohms
R6, R7, R8, R11, R14, R16, R22, R23, R24, R25—1000 ohms
R9, R10, R18—1 megohm
R13—470 ohms
R15—15,000 ohms
R17, R29—10 kilohms trimmer potentiometer, PCB mount
R30—10 megohms
R31, R33—39 ohms
R32—390,000 ohms
Capacitors
C1, C20, C21—100 µF, 25 volts, aluminum electrolytic, radial
C2—0.47 µF, 100 volts, polyester
C3, C15, C16—4.7µF, 100 volts, non-polarized aluminum electrolytic
C4—0.47 µF, 50 volts, film
C5, C13—0.01 µF ceramic disk
C6, C22—10 µF, 25 volts, aluminum electrolytic, radial lead
C14—deleted
C7, C8, C9, C10, C11—0.1µF, 25volts, ceramic disk
C12—1 µF, 25 volts, aluminum electrolytic, radial leaded
C17, C18, C19—2.2 µF, 25 volts, non-polarized, aluminum electrolytic, radial leaded
Semiconductors
D1, D2, D6, D12, D13, D14, D15—1N4007 silicon rectifier diode
D3, D4, D5, D7, D8, D9—1N914—silicon signal diode
D10, D11—1N5245, 16 volts, Zener
LED10, LED11—light-emitting diodes, red, T-1¾ (optional, see text)
IC1, IC3—NE555N, Philips or equiv.
IC2—MC145436P, dual-tone multiple frequency receiver, Motorola or equiv.
IC4—MC14011BCP, NAND gate, Harris or equiv.
IC5—CD4017B decode counter, Harris or equiv.
IC6—LM741CN operational amplifier, DIP package, National or equiv.
Q1, Q2—D40D5, NPN power transistor, TO-220 package, Harris or equiv.
Q3, Q4—2N2222 NPN transistor
Other components
MIC1—microphone, omnidirectional, electret, 20 to 15,000 Hz, Radio Shack 270-090 or equiv.
PL1, PL2—RJ-11 modular telephone plugs
RY1, RY2—relay, 1 form A SPST NO DIP reed, Mouser D31A310
S1—slide switch, SPST, Radio Shack 275-401 or equiv.
T1, T2, T3—transformer, audio, isolation, interstage, 1200 ohm primary, 600 ohm, Mouser TLO22 or equiv.
XTAL1—crystal, 3.579 kHz, metal, radial-leaded case, MTRON ot equiv.

Miscellaneous—perforated circuit board; project case (see text); three 8-pin DIP sockets; two 14-pin DIP sockets; one 16-pin DIP socket; holder for four AA power cells; four alkaline AA power cells; solid, tinned copper wire (22 AWG), insulated hookup wire (22 AWG), two lengths of telephone cord; 12-volt battery clip; cable ties; solder.

Note: The following items are available from Information Unlimited, P.O. Box 716, Amherst, NH 03031; phone 603-673-4730, Fax 603-672-5406:
• Complete kit including perforated board, all active and passive components, and telephone cords and plugs.—$99.50
Include $5.00 for shipping and handling. Allow two to four weeks for delivery.

triggering of IC1 via pin 2. However, make that substitution in gradual increments because if the value is too low, the reed contacts of RY 1 will chatter and the circuit will not work.

Switch off the 6 volts with switch S1, insert the DTMF decoder IC1 in its socket, and set trimmer potentiometer R29 to its midrange. Restore power with S1.

Verify that a logic high appears on pins 13 and 14 each time the pound (#) key is pressed on the connected test telephone to verify the operation of decoder IC2.

Switch off the 6 volts with S1 and insert NAND gate IC4. Restore power and verify a logic low on pin 3 each time the pound (#) key is depressed. Measure the inverted signal at pin 4 to perform this test.

Switch off the 6 volts with S1, and insert the second 555 timer IC3. Verify that there is a momentary 5 volts on pin 3 each time power is restored with S1.

Switch off the 6 volts with S1, and insert the decade counter IC5. Restore power and verify that pins 2 and 4 are at logic low and pins 3 and 15 are at logic high.

Press the pound (#) key and verify that pins 2 and 4 of IC5 show alternating logic levels, each repeating every third keying step. These tests verify the proper operation of the logic, reset digital processing, and function counter.

Switch off the 6 volts with S1, insert op-amp IC6, set trimmer potentiometer R17 to midscale, and turn on the power. Press the pound (#) key on the test telephone and listen for any sounds picked up by the microphone to verify the operation of the *listen* mode.

Connect the leads of a voltmeter to the collector pin of Q2 and ground to verify the presence of 6 volts. Press the pound (#) key of the test telephone, and observe that the voltmeter shows a momentary dip to zero. This energizes relay RY2 for the *intercept phone conversation* mode.

Press the pound (#) key of the test telephone and observe a logic high on pin 3 of IC5. This verifies the operation of the *reset code functions* mode. Pins 2 and 4 of IC5 should be at a logic low.

If all of these tests have been passed successfully, the correct functioning of all Telemike controls has been verified.

The following procedure requires two separate telephone lines in the room where the testing is performed. Line A and line B.

Plug the RJ-11 phone plug PL1 into the outlet jack of Line B. (A telephone need not be connected to this jack.) Set a voltmeter on the 100-volt DC scale and connect it to measure 50 volts across the red ring and green tip telephone wires, and look for the expected 50 volts. Switch on S1 and verify that there is no change in the 50-volt reading on the voltmeter other than a momentary drop. Repeat this step making the measurements at the plug.

Pick up the handset from the Line A test phone and key in the number of the Line B phone. It is important that you press the pound key immediately to access the line during its receptive interval. You should be able to hear low-level sounds in the room where Telemike is located clearly. Turn on a radio in the same room if you want a steady audio signal source.

Press the pound (#) key a second time, putting Telemike in its *intercept phone conversation* mode (non functioning at this time), and then key it a third time to reset the Telemike.

Intercept function

The next test requires a third telephone line (the one to be intercepted).

Plug PL2 into the jack of the third telephone line in the room so you can intercept and monitor any conversations on that line. Switch on S1 and verify that 50 volts DC appears across both ring and tip wires.

Call the Line B phone from the test Line A phone, and access the second phone line by pressing the pound key (#) twice. You should hear a dial tone from the second phone line indicating that you have gained access. This tone indicates that you have intercepted the line and will be able to hear any conversation on it.

Make arrangements for two other persons to converse over the second phone line, and then call the "called to" number and key the pound sign twice to listen in on an actual call in progress. When you are ready to quit this mode, be sure to press the pound key again to reset Telemike.

Note: The audio level on the intercepted conversation might be weak in this mode, forcing you to listen very carefully. If you intend to interrupt a conversation with a message, you might have to speak loudly to be heard.

Telephone compatibility

Not all telephones have the same encoding signal output levels. This could cause circuit unreliability when accessing a second telephone line. If that occurs, you might be able to correct the problem by setting trimmer potentiometer R29 on the Telemike.

Dedicated line

Consider leasing of a dedicated line to Telemike as part of a permanent installation. This will eliminate possible ring signal "sneak through" and the critical timing of the 555 IC1 for allowing access control. Nevertheless, it would still permit all incoming calls to be completed and would have no effect on outgoing calls.

Timer values

The initial access time established by the time constant of resistor R5 and capacitor C6 can be set in most systems to permit a normal incoming telephone call to be made. If this time is too long, and an "off-to-on" hook condition is created that will disable the connection. If it is too short, the encoding tones might not pass. This condition should not interfere with outgoing calls. In most cases, the longer time constant will assure encoding control. Ω