Telephone Call Restrictor

Computerized device prevents outgoing calls to 1-900 and 976 toll numbers

By Steve Sokolowski

Some ten years ago, the telephone company introduced a new type of service that, for a predetermined price per minute, let callers dial numbers to listen to 60-second comedy skits. This dial-it service is now thriving. Now there are a horde of phone services prefaced by "1-900" for dating, sports and what have you, as well as 976 horoscope and tarot-cart reading services and credit-card applications services. Prices for using these services, which appear on your monthly telephone bill, range from 75 cents to a whopping $30 for a call that can last as short as 2 minutes.

If you are fed up with high monthly telephone bills resulting from the abuse of dial-it services by, say, your children, fight back with our Telephone Call Restrictor. When this computerized device senses any outgoing call beginning with 1900 or 976, it disconnects the telephone instrument from the line. In addition, it also detects when the 0 button on the instrument's keypad is pressed to prevent operator-assisted connections to these services.

The Call Restrictor installs between any line to which telephone instruments are connected and the telephone line. It does not interfere with normal calling. You can easily recoup its modest cost in just a month or two of lowered phone bills.

Project Overview

The Call Restrictor makes use of an inexpensive 8031 controller chip. This chip is basically a computer squeezed into a 40-pin package whose pinouts are detailed in Fig. 1. The 8031 must be told what to do. In the case of the Call Restrictor, the 8031 must monitor the telephone line to detect dialing. If the number being dialed starts with 1900, 976 or 0, the 8031 must immediately disconnect the telephone line for about 2 seconds and then reconnect it again to wait for the next dialing sequence.

The sequence of required events are permanently stored in an EPROM. Upon power-up, the EPROM program is read into a 6264 memory chip. Once this program is read, the 8031 executes each step in the required sequence. Once the restricted numbers are sensed, the program tells the 8031 to deenergize a relay whose contacts are in series with the telephone line.

When the contacts of the relay are open, the relay acts much like a telephone hookswitch. It electrically removes the telephone instrument from across the line, simulating putting the handset back in its cradle.

After the 2-second off period has timed out, the 8031 re-energizes the relay. This action closes the contacts and re-establishes connection of the instrument to the phone line. At this time, a dialtone is once again restored. At the conclusion of these predetermined events, the 8031 rearms itself.

The Call Restrictor is designed to be placed on a line that uses only tone-dial-type instruments. The 8031 responds to the dual-tone multi-frequency, abbreviated DTMF (see Dual-Tone Multi-Frequency box elsewhere in this article) signals generated when a number is punched in-

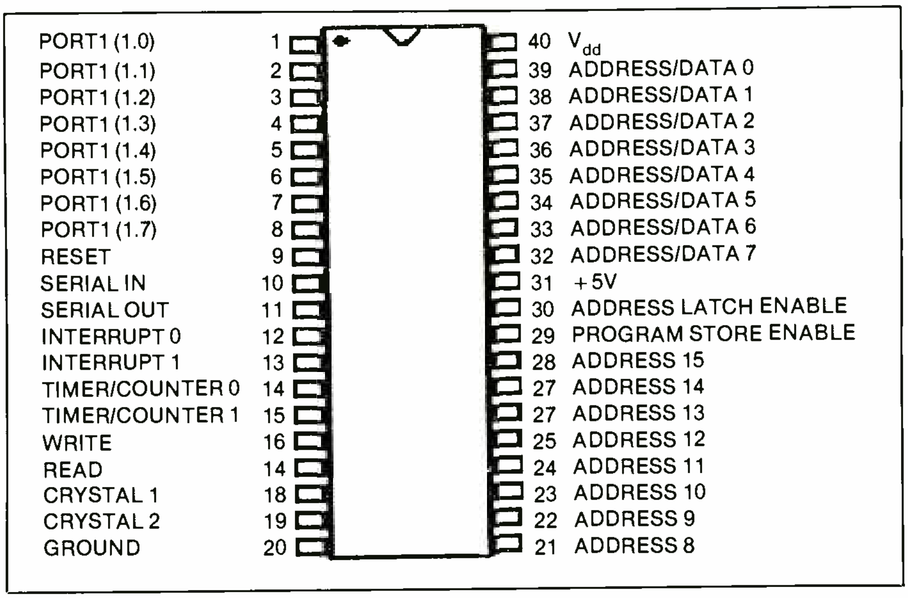


Fig. 1. Pinouts for the 8031 microcontroller used in this project.

to the instrument's keypad. By detecting and acting upon these tones, the 8031 is capable of tapping into the line via an output signal sent to the relay circuitry.

The G8870 receiver chip in the Call Restrictor is a very complicated device. Older DTMF receivers required large, bulky audio filters. The G8870, on the other hand, incorporates all the needed filtering inside an 18-pin IC. Unlike other receivers of this type, the G8870 does not need additional circuitry that would allow it to be connected directly across the telephone line.

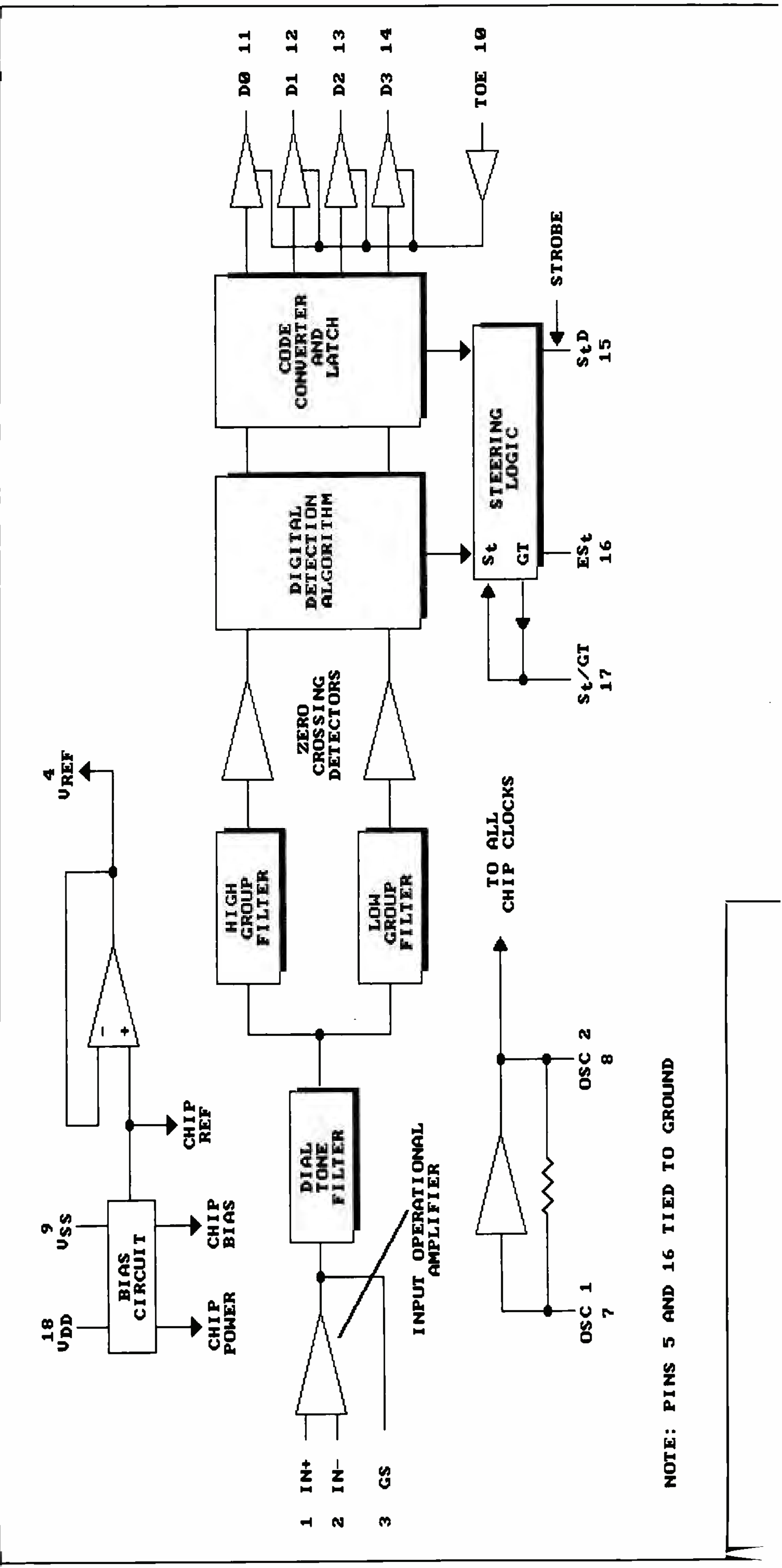
On-board the G8870 is an operational amplifier that can be wired as a differential amplifier. Details for the internal circuitry, pinouts and pin functions of this chip are shown in Fig. 2. Note that the telephone line wires across pins 1 (IN+) and 2 (IN−) through a series of resistors and capacitors that are wired to form the differential-amplifier arrangement. Internal circuitry of the G8870 divides the input dialing tones into their high and low groups, processes them and converts them into the binary table shown in the box.

Note that the G8870 chip requires a 3.58-MHz crystal for operation, while the 8031 requires a crystal that is three times higher in frequency.

About the Circuit

The Call Restrictor is a fairly complex electronic device. Because of this, the overall schematic diagram is broken into five sections, as shown in Fig. 3 (A) through (E). Section (A) illustrates the wiring required for 8031 controller *IC1*, 8K memory *IC3* and 3-to-8-line decoder *IC4* that is used to enable *IC3*, EPROM *IC5* in section (B), and DTMF receiver chip *IC6* in section (C).

Also shown in Fig. 3(C) is the transistor-driven relay (*RY1*) that interrupts and restores the telephone-line connection. Figure 3(D) shows the wiring for a second relay, *RY2*, used



Pin Functions for the G8870 DTMF Receiver/Decoder Chip

Pin	Name	Function
1	IN+	Noninverting Input
2	IN−	Inverting Input
3	GS	Gain Select—provides access to output of front-end differential amplifier for connection of feedback resistor
4	V_{ref}	Reference Voltage (nominally $V_{dd}/2$)—can be used to bias inputs to mid-rail
5	IC	Internal Connection
6	IC	Internal Connection
7	OSC1	Clock Input—3.58-MHz crystal connects between pins 7 and 8 completes internal oscillator
8	OSC2	Clock Output—see pin 7 above
9	V_{ss}	Negative power-supply voltage (normally grounded)
10	TOE	Three-state Output Enable Input—logic high enables outputs D0 through D3; internal pull-up provided on-chip
11	D0	Three-state Data Outputs—(with pins 12, 13, 14) when enabled by TOE, provide code corresponding to last tone
12	D1	See pin 11 above
13	D2	See pin 11 above
14	D3	See pin 11 above
15	StD	Delayed Steering Output—presents logic 1 when received tone pair has been registered and output latch is updated; returns to logic 0 when voltage on St/GT falls to less than V_{tst}
16	ESt	Early Steering Output—presents logic 1 immediately when digit algorithm detects recognizable tone pair; any momentary loss of signal causes ESt to return to logic 0
17	St/GT	Bidirectional Steering Input/Output Time Output—voltage greater than V_{tst} detected at St causes device to register detected tone pair and update output latch; voltage less than V_{tst} frees device to accept new tone pair; GT output resets external steering time constant, its state a function of ESt and voltage on St
18	V_{dd}	Positive power connection

Fig. 2. Details for G8870 DTMF receiver chip used in this project: (A) Block diagram of internal circuitry and (B) pin functions.

in the Call Restrictor. By placing *RY2*, a line-sense relay, in series with both the red- and green-insulated telephone-line conductors, the 8031 can intelligently detect whether or not the handset of the telephone instrument is on-hook. This is accomplished by monitoring pin 2 of *IC1* for the presence of a ground voltage.

Figure 3(E) shows the circuit details for the ac-operated power supply for the project. This is a classic full-wave bridge-rectifier arrangement with capacitive filtering and regulation to a tight + 5 volts via *IC8*.

When the Call Restrictor is in operation, the internal oscillator of *IC1* runs at 11.059200 MHz, the frequency controlled by crystal *XTAL1*. By making use of address lines A0 through A12, *IC1* can grab needed information anywhere within a range of 8,000 bits; hence, the use of 6264-15 RAM chip *IC3* in the section (A) circuitry. Although the full 8K memory locations are not used in the Call Restrictor, cost of the 6264 RAM chip is so low that no other smaller RAM need be considered.

Address lines A13, A14 and A15 are decoded into chip-enabling ground pulses with the aid of *IC4*. Binary codes generated by *IC1* at pins 26, 27 and 28 are converted into single ground control signals. By applying grounding pulses at the appropriate times with a running program, any one of eight peripheral chips can be activated simply by calling its special address. Without enabling pulses to turn on the various chips, data conflicts would occur, due to the fact that all peripheral chips are wired in parallel to the common eight-bit data bus to which pins 32 through 39 of *IC1* connect.

The Call Restrictor requires three enabling pulses. The first, at address 0 hex (0H), is used to enable program device *IC5*. With every ground pulse, *IC1* reads the program information from *IC5*. The second address is at 0E000 hex (0E000H), where the same grounding pulses are used to enable *IC6* every time you want this chip to sense the DTMF tones across the line. Because *IC6* requires a positive voltage to enable its output, one stage of hex inverter *IC7* is used to convert the ground pulses from *IC4* into the positive pulses needed by *IC6*.

The final address, at 8000 hex (8000H), uses the ground pulses to enable memory chip *IC3*. Along with the proper read and write ground pulses, *IC4* allows *IC1* to place information in and extract data from memory chip *IC3*.

Also required is the data bus over which eight-bit words are read from or written to memory. This also includes reading of program material from *IC5*. Intel uses the multiplexing technique to use pins 32 through 39 of *IC1* for both the low-order address bus and eight-bit data bus.

To extract the required address or data information at the correct time, octal D-type latch *IC2* is used. Here, pulses from −ALE pin 30 of *IC1* is used to "pulse" *IC2*. Pulsing allows the low-order address information to pass through on pins 2, 5, 6, 9, 12, 15, 16 and 19 of *IC2* while data information is stopped. Along with the enabling pulses from *IC4* and the read or write signal from *IC1*, separate address and data bus information is delivered to their appropriate chips at the proper times.

Examining sections (A) and (B) of Fig. 3, you can readily see that all address and data lines are wired in parallel with *IC3*. If not for the enabling

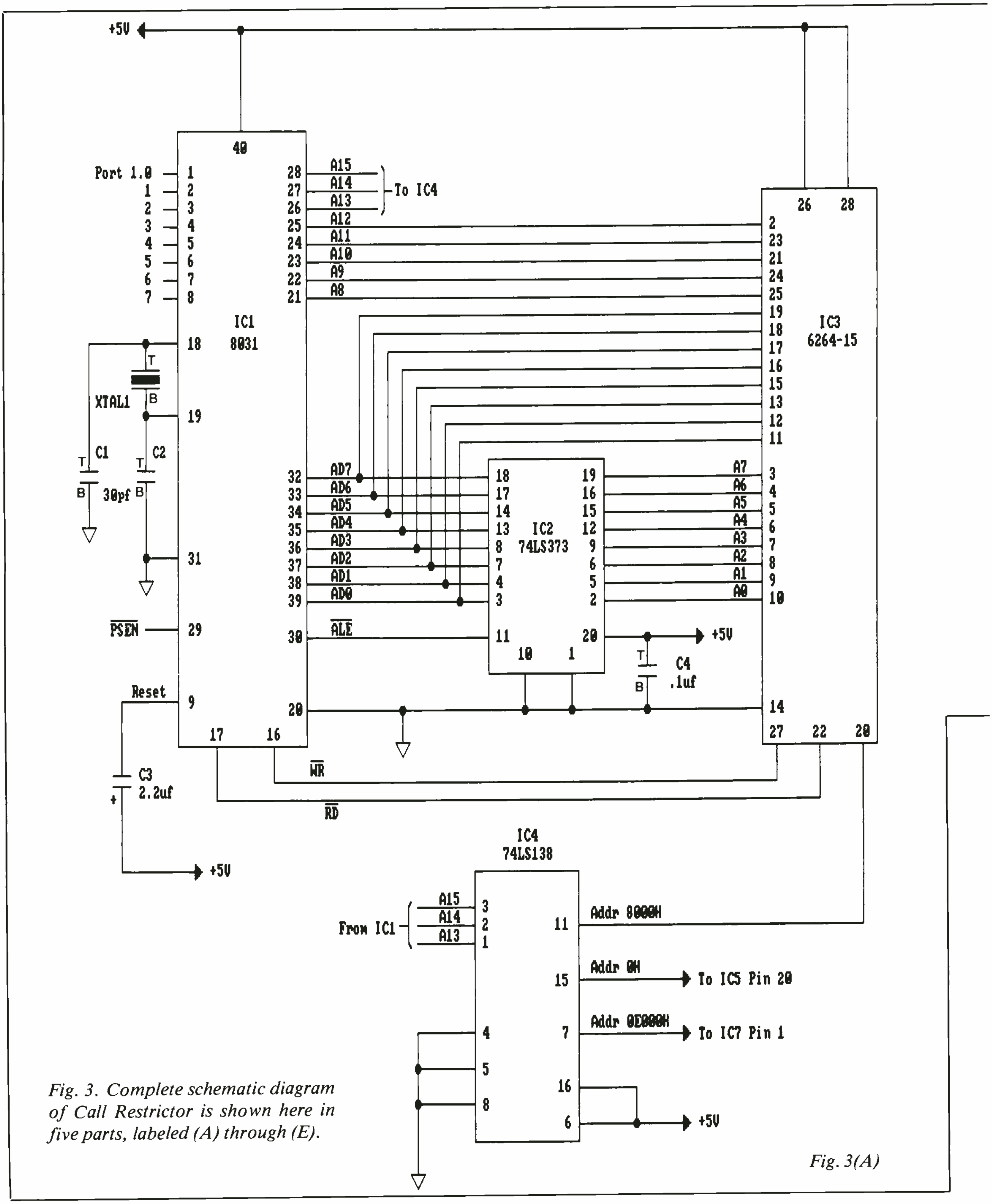


Fig. 3. Complete schematic diagram of Call Restrictor is shown here in five parts, labeled (A) through (E).

Fig. 3(A)

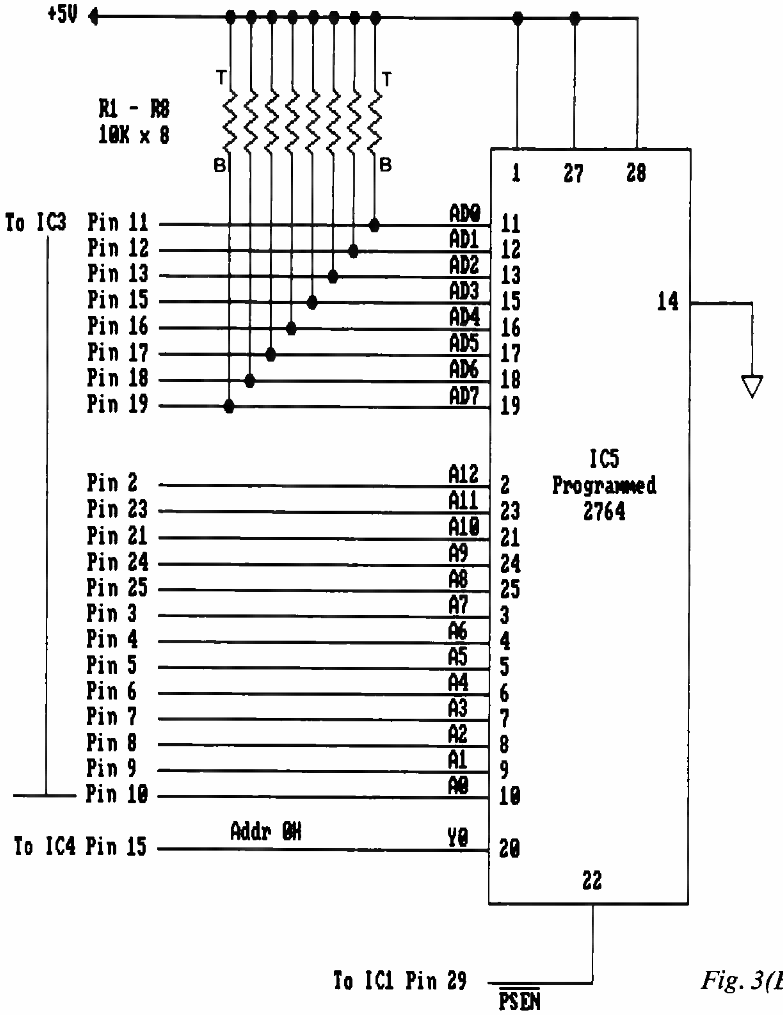


Fig. 3(B)

pulses created by *IC4*, data and address conflicts would occur between *IC4* and *IC5*. Pull-up resistors *R1* through *R8* in Fig 3(B) apply a constant +5 volts to the eight address/data lines.

Section (C) of Fig. 3 shows the interfacing required for the Call Restrictor. Points C and D connect directly across the incoming telephone line, as shown in section (D). Because of the characteristics of the differential amplifier at pins 1 and 2 of *IC6*, the direct connection between the two causes no ill effects to the telephone line. The differential amplifier also provides the FCC-mandated line-to-equipment isolation.

Note that *IC6* wires across the telephone line through *C1*, *C2*, *R9* and *R10*. Only tones generated by the telephone instrument are permitted to enter *IC6*. After processing by internal filters and converters, *IC6* outputs at D0 through D3 pins 11 through 14 the binary equivalent of the input tones. This is the data *IC1* reads and acts upon when the need arises.

Because of the way *IC6* is wired, data information is always at the data output of this chip, even when no button on the keypad of the telephone instrument is pressed. To surmount this, *IC6* is equipped with a STROBE line at pin 10, which is at logic 1 only when a valid tone pair are introduced at the input of this chip. Hence, *IC1* is programmed to accept the output from *IC6* only when pin 10 of *IC6* is high.

The 8031 has eight specially adaptable pins identified as PORT1 at pins 1 through 8 of *IC1*. Using this port, through program control, information can be read from and written to these pins. Operation is like the case with the data bus but with an exception: no enabling pulses are needed to turn on any specific chips.

By telling *IC1* to output a decimal number between 0 and 255, you can place any combination of 0s and 1s on the port pins. Also, under program control, the 8031 can be directed to read the binary code applied to these pins. Note that STROBE pin 10 of *IC6* is connected to PORT1 pin 1 (PORT1.1). In the Call Restrictor, the program in *IC5* tells *IC1* that a valid tone has been detected by *IC6* only when pin 1 of *IC1* is at logic 1. In contrast, if pin 1 of *IC1* is at logic 0, the 8031 refuses to acknowledge as usable information the binary data on the data bus.

Another section of the project that uses PORT1 is the base circuit of *Q1*. On initial start-up, pin 3 of *IC3* is at logic 1, This voltage is applied to the base of *Q1* through *R15*. At this time, *RY1* is energized and its contacts are closed. These now-closed contacts can be used as a telephone hookswitch. By wiring the contacts in series with the red-insulated telephone-line conductor, as shown in Fig. 3(D), any telephone instrument connected to the line is under control of *IC1*—not the caller.

If *IC1* senses that 1900, 976 or 0 are the first digits dialed when a call is being placed, the EPROM program instructs the 8031 to ground pin 3. This cuts off *Q1* and deenergizes *RY1*. When the relay contacts open, the telephone-line connection is automatically broken. After 2 seconds, *IC1* re-applies a logic 1 to pin 3 to reactivate the relay and restore dialtone.

Any number dialed to make an outgoing call that the project will permit is stored in memory in the Call

Restrictor. When you hang up, a means must be found to have *IC1* erase the current number before you can dial another number to avoid conflict. This is accomplished by Teltone line-sense relay *RY2* shown in Fig. 3(D) whose internal contacts close every time a telephone instrument is lifted off-hook.

By connecting one side of *RY2* to ground and the other side to PORT1 pin 2 of *IC1*, the 8031 can act upon the hang-up signal. If PORT1 senses a ground condition at pin 2, *IC1* is instructed to erase the current number from memory.

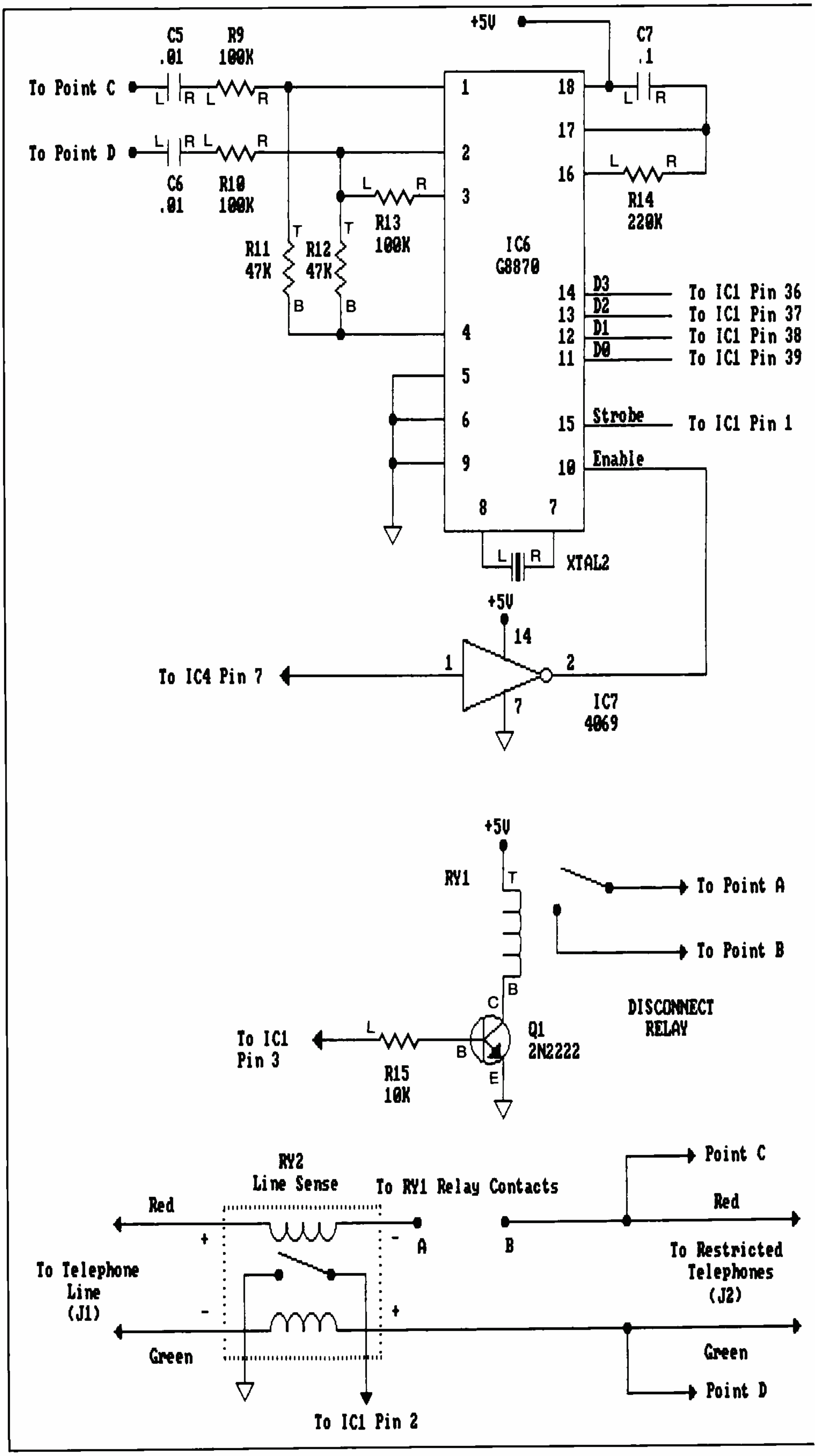
Operation of *RY2* is straightforward. This relay senses the current flow when the contacts of *RY1* are closed and the handset of the telephone instrument is taken off-hook. When both sets of contacts are closed, a conductive path is created for the dc voltage coming from the telephone line to flow. This causes *RY2* to energize and close its contacts just before a new number is dialed.

The Call Restrictor requires a 5-volt, 100-mA dc supply for operation. Circuit details for an ac-operated supply that meets these requirements are shown in Fig. 3(E). The power transformer for this supply circuit should be a plug-in wall-type unit to provide isolation between the 117-volt ac line and low-voltage circuits in the Call Restrictor.

In operation, the low-voltage ac output from the secondary side of *T1* is rectified to pulsating dc by the bridge rectifier made up of *D1* through *D4*. The pulsating dc is then filtered to pure dc by *C8*, after which it is regulated to +5 volts by *IC8* and further filtered by *C9* for delivery to the remaining circuits in the Call Restrictor.

Construction

As you can see from the multiple-section schematic diagram in Fig. 3, this is a fairly complex project. However, bear in mind that a lot of the circuitry shown represents repetitious wiring.



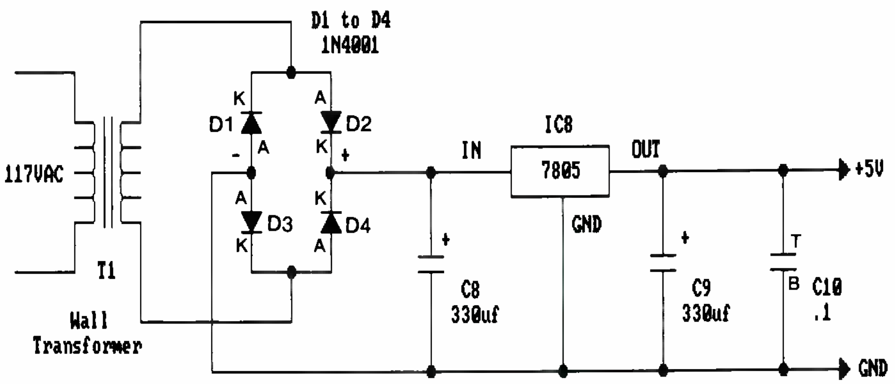


Fig. 3(E)

PARTS LIST

Semiconductors
D1 thru D4—1N4001 silicon rectifier diode
IC1—8031 microcontroller
IC2—74LS373 octal D-type latch
IC3—6264-15 SRAM memory
IC4—74LS138 3-to-8-line decoder
IC5—Programmed 2764 EPROM (see Note below)
IC6—G8870 DTMF decoder (see Note below)
IC7—CD4066 hex inverter
IC8—7805 fixed +5-volt regulator
Q1—2N2222 or similar general-purpose silicon transistor

Capacitors
C1,C2—30-pF ceramic disc
C3—2.2-μF, 16-volt electrolytic
C4,C7,C10—0.1-μF ceramic disc
C5,C6—0.01-μF ceramic disc
C8,C9—330-μF, 16-volt electrolytic

Resistors (¼-watt, 10% tolerance)
R1 thru R8,R15—10,000 ohms
R9,R10,R13—100,000 ohms
R11,R12—47,000 ohms
R14—220,000 ohms

Miscellaneous
RY1—5-volt dc spst reed relay
RY2—Teltone line-sense relay (see Note below)
T1—12.6-volt, 150-mA plug-in wall-type transformer
XTAL1—11.059200-MHz crystal
XTAL2—3.58-MHz crystal
Perforated board with holes on 0.1-inch centers and suitable Wire Wrap or soldering hardware (see text); sockets for all DIP ICs; suitable enclosure; machine hardware; hookup wire; solder; etc.

Note: The following items are available from Suncoast Technologies, P.O. Box 5835, Spring Hill, FL 34606: G8870, $10; Teltone line-sense relay, $5.75; programmed 2764 EPROM, $7; six-conductor telephone cord, $1.25; 11.059200-MHz crystal, $1.75. Add $2.50 ($3.50 in Canada) S&H per order. Florida residents, please add 6% state sales tax.

PARTS SUPPLIERS

B.G. Micro
P.O. Box 28209
Dallas, TX 75228
214-271-5546

Digi-Key Corp.
701 Brooks Ave. S.
Thief River Falls, MN 56701-0677
1-800-344-4539

JDR Microdevices
2233 Branham Lane
San Jose, CA 95124
1-800-538-5001

If you have any experience at all in building circuits, you should fairly easily build the Call Restrictor.

You can mount the components on perforated board that has holes on 0.1-inch centers, preferably with copper rings around each hole, and point-to-point wire them together with Wire Wrap or soldered connections. Your first step is to photocopy the schematic diagram sections so that you can strike off each wire run as you make it according to the Master Wiring List.

Begin construction by mounting the sockets for the various DIP ICs on the circuit board. If copper rings surround the holes on your board, solder only the four end pins into place. Use solder sparingly to avoid getting it on all but about ⅛ inch of the pin lengths. If your board does not have copper rings around each hole and the socket pins do not provide a friction fit, bend the four end pins slightly outward to hold each socket mechanically in place. Do *not* plug the ICs into the sockets until after preliminary voltage checks have been made and you are satisfied that your wiring is correct.

After mounting the IC sockets, mount the various components on the board. If you are using the Wire Wrap technique to wire the circuit, use Wire Wrap posts to hold these components (except the relays, which mount via their own pins) in place, soldering the component leads to the posts on the top of the board.

Once the components are in place, refer to the Master Wiring List and begin with the *IC1* socket to make your interconnections. As you make each wire run, trace its path on your photocopy of the schematic in a contrasting pencil or pen color. As you go, properly polarize your connections to the socket pins, electrolytic capacitors, relays and diodes.

Make sure your connections to the pins of *Q1* and *IC2* are correct. Note that the latter is the *only* IC that should be mounted on the board at

(Continued on page 71)

Master Wiring List

From		To
IC1 pin	1	IC6(15)
	2	RY2(R)
	3	R15(L)
	9	C3(−)
	16	IC3(27)
	17	IC3(22)
	18	C1(T),XTAL1(T)
	19	C2(T),XTAL1(B)
	20	IC1(31),C1(B),C2(B), R42(L),GND
	21	IC3(25)
	22	IC3(24)
	23	IC3(21)
	24	IC3(23)
	25	IC3(2)
	26	IC4(1)
	27	IC4(2)
	28	IC4(3)
	29	IC5(22)
	30	IC2(11)
	32	IC2(18),IC3(19)
	33	IC2(17),IC3(18)
	34	IC2(14),IC3(17)
	35	IC2(13),IC3(16)
	36	IC2(8),IC3(15),IC6(14)
	37	IC2(7),IC3(13),IC6(13)
	38	IC2(4),IC3(12),IC6(12)
	39	IC2(3),IC3(11),IC6(11)
	40	C3+,+5V
IC2 pin	1	IC2(10),C4(B),GND
	2	IC3(10)
	5	IC3(9)
	6	IC3(8)
	9	IC3(7)
	12	IC3(6)
	15	IC3(5)
	16	IC3(4)
	19	IC3(3)
	20	C4(T),+5V

From		To
IC3 pin	2	IC5(2)
	3	IC5(3)
	4	IC5(4)
	5	IC5(5)
	6	IC5(6)
	7	IC5(7)
	8	IC5(8)
	9	IC5(9)
	10	IC5(10)
	11	IC5(11),R8(B)
	12	IC5(12),R7(B)
	13	IC5(13),R6(B)
	14	GND
	15	IC5(15),R5(B)
	16	IC5(16),R4(B)
	17	IC5(17),R3(B)
	18	IC5(18),R2(B)
	19	IC5(17),R1(B)
	20	IC4(11)
	21	IC5(21)
	23	IC5(23)
	24	IC5(24)
	25	IC5(25)
	26	IC3(28),+5v
IC4 pin	4	IC4(5,8),GND
	6	IC4(16),+5V
	7	IC1(7)
	15	IC5(20)
IC5 pin	1	R1 thru R8(T),IC5(27, 28),+5V
	14	GND
IC6 pin	1	R9(R),R11(T)
	2	R10(R),R12(T),R13(L)
	3	R13(R)
	4	R11(B),R12(B)
	5	IC6(6,9),GND

From		To
	7	XTAL2(R)
	8	XTAL2(L)
	10	IC7(2)
	16	R14(L)
	17	R14(R),C7(R)
	18	C7(L),+5V
IC7 pin	7	GND
	14	+5V
IC8	IN	C8+,D2(K),D4(K)
	COM	C8−,C9−,C10(B), D1(A),D3(A),GND bus
	OUT	C9+,C10(T),+bus
Q1	Collector	RY1 coil(B)
	Base	R15(R)
	Emitter	GND
RY1	coil(T)	+5V
	contact 1	RY2 coil(T−)
	contact 2	C5(L),red instrument line
RY2		
	coil(T+)	Red telephone line
	coil(B−)	Green telephone line
	coil(B+)	C6(L), green instrument line
	contact 1	GND
C5		R9(L)
C6	R10(L)	

Note: Numbers in parentheses are pin designations for IC specified, and letters in parentheses indicate: A—anode (diodes only), K—cathode (diodes only), L—left, R—right, T—top and B—bottom. IC pins to which no connections are made are not listed.

this time. Include on the circuit-board assembly six extra solder-posts for wiring the telephone line, the line to the telephone instrument(s) to be monitored and the cord from the power transformer.

When you finish wiring the circuit-board assembly, including making connections to the six extra solder posts, carefully go over all your wiring, checking off the runs on the Master Wiring List. (Note: mark the function and polarity of the six extra solder posts on the board for reference later.) If you made any wiring errors, correct them now.

House the circuit-board assembly inside any enclosure that accommodates it. The enclosure can be metal, all plastic or metal and plastic. Machine the enclosure for mounting the circuit-board assembly. Then drill an entry hole for the cable the wall-mount transformer cable through one end panel and a pair of entry holes through opposite ends of the enclosure for the telephone line and the cable that goes to the telephone instrument(s) to be monitored. Finally, drill a small hole near the telephone-line and instrument cable entry holes. If you drilled any holes through metal, deburr them to remove sharp edges, and line the entry/exit holes with rubber grommets.

Mount the circuit-board assembly

Dual-Tone Multi-Frequency

Tone-dial telephones produce a special kind of DTMF—an acronym for Dual-Tone Multi-Frequency—signal developed by Bell Laboratories more than 25 years ago. DTMF uses pairs of eight specially selected audio tones that are generated by the telephone instrument. These tones are further divided into groups of four low tones and four high tones. A DTMF tone is the algebraic sum of one low-tone and one high-tone frequency.

An example of the basic tones and the combined tone is shown in Fig. A. The top waveform is the row 3 825-Hz DTMF tone, the center waveform the column 2 1,336-Hz DTMF signal, and the bottom waveform the combined row 3 and column 2 waveform as it is transmitted over the telephone line. Rows and columns refer to the conventional Touch Tone keypad layout. Rows are numbered horizontally in consecutive order from top to bottom, while columns are numbered consecutively from left to right, as illustrated in Fig. B. Note that for special communication functions, tone dials can include additional keys labeled with the letters A through D and the symbols * and #.

Each keypad key occupies a unique position in a 4 × 4 matrix. With this arrangement, the 5 button is located at the juncture of row 2 and column 5 in the matrix, the 7 button at the juncture of row 3 column 1, and so on.

Pressing any given button on the Touch Tone keypad results in generation of the algebraic sum of the tones represented by the row and column at that juncture. For the 5 button, the tone generated would be the algebraic sum of 770 Hz (low-tone group) and 1,366 (high-tone group), and for the 7 button the algebraic sum of 852 and 1,209 Hz.

When DTMF dialing was introduced in the 1960s, comparatively large capacitors and inductors were used for generation of pure sine-wave frequencies. Today, DTMF keypads use ICs that are under crystal control to generate synthesized stair-step waveforms. DTMF equipment, like the G8870 DTMF decoder used in the project described in the accompanying article, can receive and decodes these stair-step signals into its corresponding binary output, as listed in the table. It is the binary output given in the last column of the table that is directly coupled over a four-bit data bus to the 8031 microcontroller used in the project.

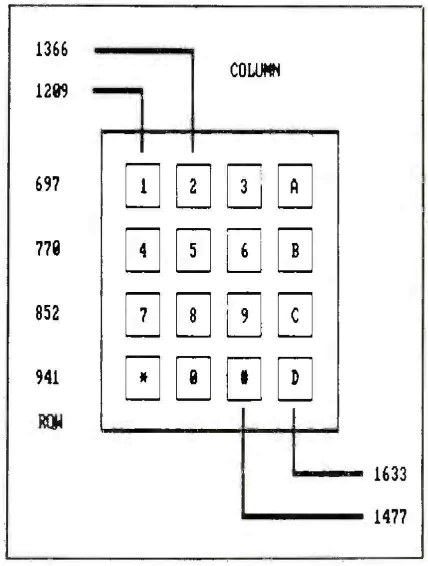


*Fig. B. Standard Touch Tone-type keypad keys can consist of a matrix of four rows and up to four (typically three) columns. Keys labeled A through D and * and # are for special-purpose communication applications. Each key generates one tone from the low and high groups to output their algebraically combined waveform.*

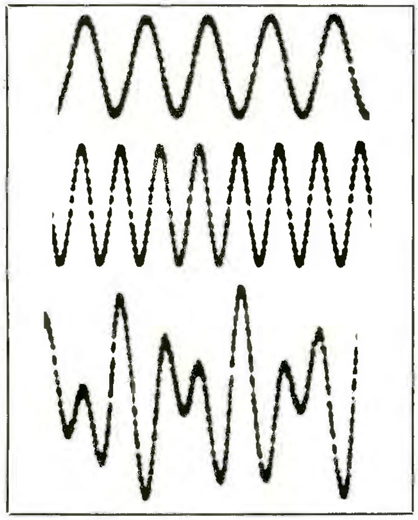


Fig. A. DTMF tone pairs generated when button 8 on a Touch Tone keypad is pressed include a row 3 852-Hz low-group (top), column 2 1,336-Hz high-group (center) and algebraically combined (bottom) tones.

Touch Tone Keypad Key Tone Frequencies and Hex Outputs

Key ID	High-Frequency Tone in Hz	Low-Frequency Tone in Hz	Output Format* 3	2	1	0
1	697	1,209	0	0	0	1
2	697	1,336	0	0	1	0
3	697	1,477	0	0	1	1
4	770	1,209	0	1	0	0
5	770	1,336	0	1	0	1
6	770	1,477	0	1	1	0
7	852	1,209	0	1	1	1
8	852	1,336	1	0	0	0
9	852	1,477	1	0	0	1
0	942	1,336	1	0	1	0
*	941	1,209	1	0	1	1
–	941	1,477	1	1	0	0
A	697	1,633	1	1	0	1
B	770	1,633	1	1	1	0
C	852	1,633	1	1	1	1
D	941	1,633	0	0	0	0

*In hexadecimal

(Continued on page 76)

 (from page 71)

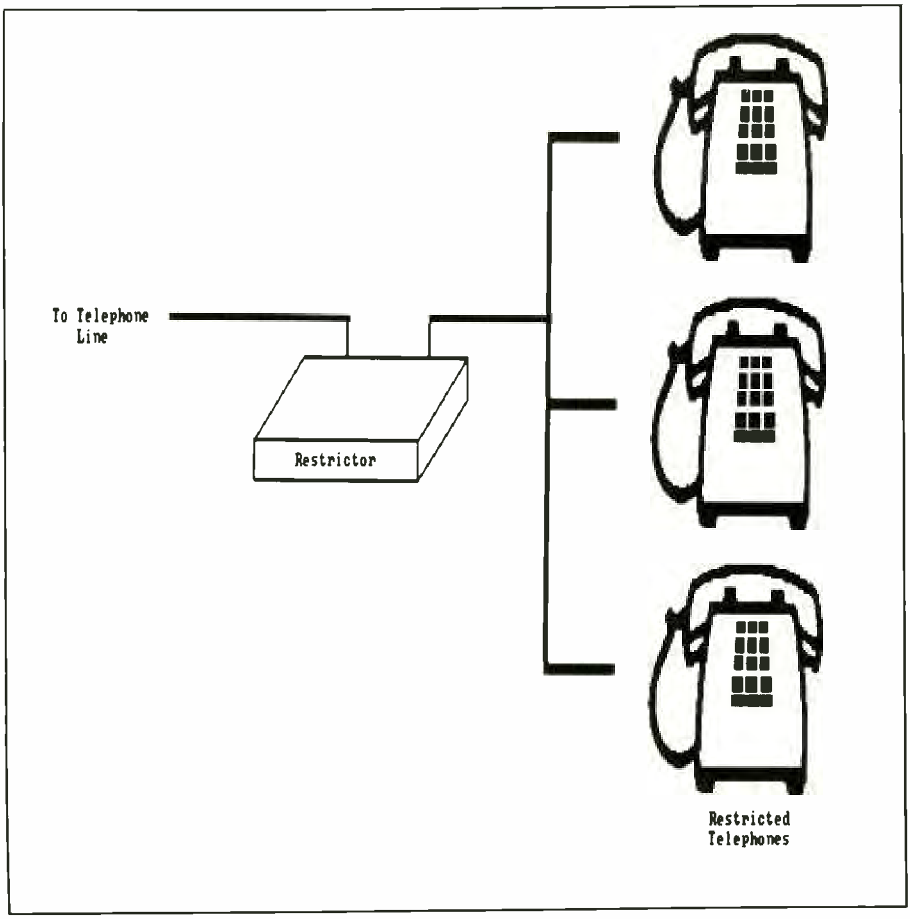


Fig. 4. Details for installing Call Restrictor into your telephone system.

in place, using suitable length spacers and machine hardware. If the cord coming from the wall-mount transformer has a plug on it, cut off and discard it. Separate the conductors of the cord a distance of 1½ inches. Strip ¼ inch of insulation from both conductors. Tightly twist together the fine wires in each conductor and sparingly tin with solder. Route this cable through one entry hole in the enclosure and tie a strain-relieving knot in it about 5 inches from the unfinished end inside the enclosure. Connect and solder the two conductors to the appropriate solder posts.

Determine where you will mount the project. Select a secure location, such as your basement, where the project is not likely to be discovered. This location must be near an ac outlet and between the incoming telephone line and any telephone instruments that are to be monitored (see Fig. 4). Cut the telephone line at the selected location. If necessary, use a telephone extension cord to effect installation.

Remove 1½ inch of outer plastic jacket from both cut ends of the telephone line. The only conductors you need for this project are those that have red and green insulation on them. If there are other conductors, clip them away close to the beginning of the remaining outer plastic jacket. Strip ¼ inch of insulation from the ends of the red- and black-insulated conductors.

Route these conductors through their respective entry holes in the enclosure and solder the free ends of the conductors to the appropriate solder posts. Make certain your connections are properly polarized. This done, use plastic cable ties to secure the cables to the enclosure with suitable machine hardware. Leave a bit of slack in the cables inside the enclosure. The ties will prevent the cables from being torn loose.

Checkout & Use

Before putting the Call Restrictor into service, it is a good idea to perform preliminary voltage checks to ascertain that you wired it correctly. For this test, you need a dc voltmeter or a multimeter set to dc volts.

Clip the common lead of the meter to a point on the circuit-board assembly that is normally supposed to be at ground potential. Convenient points for this connection are the negative (−) leads of *C8* and *C9* in the power-supply section. Make sure that the only IC on the circuit-board assembly is three-pin regulator *IC8*.

Plug the wall-mount transformer into its ac outlet. Then touch the "hot" probe of your meter to pin 40 of the *IC1* socket; pin 20 of the *IC2* socket; pins 26 and 28 of the *IC3* socket; pins 6 and 16 of the *IC4* socket; pins 1, 27 and 28 of the *IC5* socket; pin 18 of the *IC6* socket; and pin 14 of the *IC7* socket. At all locations, your reading should be +5 volts.

If you fail to obtain the proper reading at any indicated point, power down the project by unplugging its transformer from the ac outlet. Correct the problem before proceeding.

When you are certain that everything is okay with your wiring, power down the project and wait a minute or so for the charges to bleed off the electrolytic capacitors in the power supply. Then plug the DIP ICs into their respective sockets. Make sure each is properly oriented and that no pins overhang the sockets or fold under between ICs and sockets.

If you have an oscilloscope, you can make an operational check of the Call Restrictor as follows. Clip the common (ground) lead of the scope to circuit ground in the project and the "signal" lead of the scope to pin 11 of *IC1*. Power up the project by plugging its transformer into an ac outlet, and observe the scope display. If everything is okay, you should observe pulses appear on the CRT screen. These pulses last for only about 0.5 second, their presence informing you that the program data in the EPROM is being read by *IC1*.

If you fail to observe pulse activity on the screen of your oscilloscope, power down the Call Restrictor and correct the problem.

Even if you do not have access to an oscilloscope, you can test operation of the Call Restrictor. You do this simply by plugging its transformer into an ac outlet, lifting the handset from any telephone instrument connected to the line through the project and key the numbers 9, 7 and 6. As the last digit is dialed, the Call Restrictor should interrupt the line and you should hear dead silence. Then, 2 seconds later, you should hear a dialtone. Repeat this test by dialing 1900 and then 0. The line should go dead after each is dialed, and you should hear a dialtone 2 seconds or so later.

So far you have learned that the Call Restrictor will block the calls you do not want to get through. Now dial a "legitimate" number. This time, there should be no disconnect, and the call should go through as it normally would.

As an added security measure, the Call Restrictor is designed to prevent *any* call from being dialed out in the event someone accidentally or purposely unplugs the power transformer from the ac line.

The Call Restrictor will now silently stand guard over your telephone line, preventing unauthorized calls from being made to those toll services that have been inflating your monthly telephone bill. If you have been plagued by high bills for use of these services, the Call Restrictor should pay for itself in short order.