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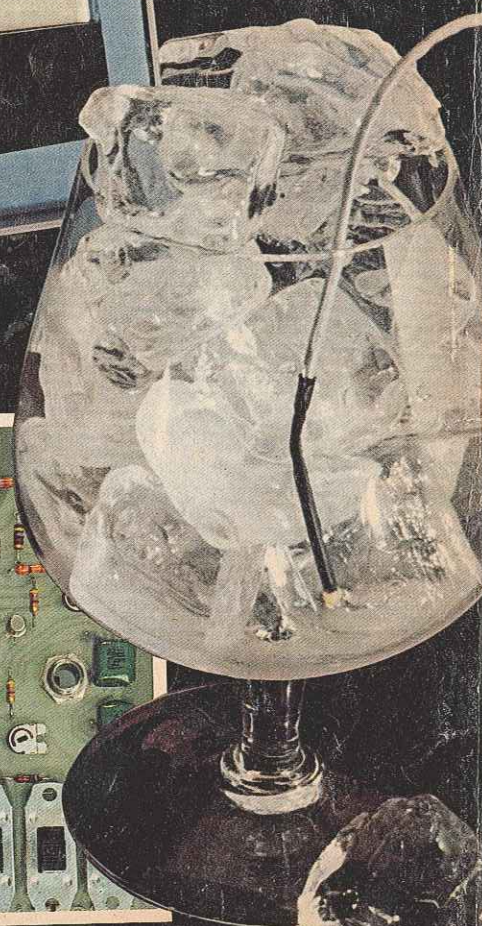
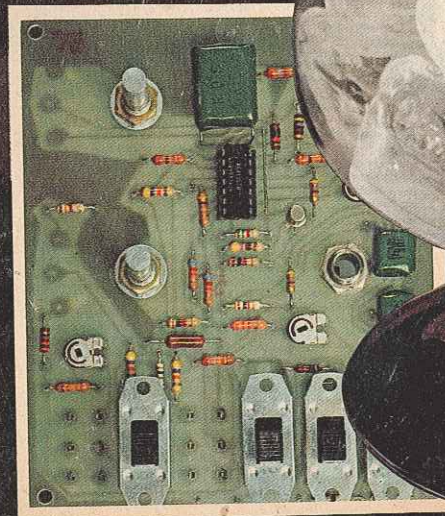
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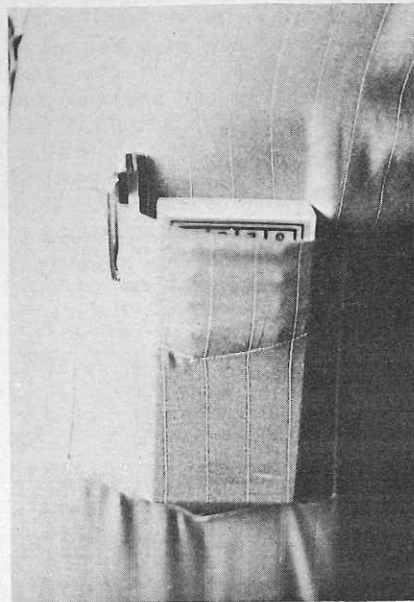
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GERNSBACK PUBLICATION

Build This Pocket Data Terminal



by CHARLES EDWARDS

LAST MONTH WE DESCRIBED THE POCKET Data Terminal in detail, with block diagram, complete schematic and parts list. This month will show how to construct and program it, and will also give a little information on the advantages of the *Touch-Tone** system of signalling.

Construction

The Pocket Data Terminal is built on three double-sided glass epoxy PC boards with plated-through holes. Board 1, the Main Frame and Keyboard, is etched with the number 789 in the upper center on the component side. It measures 1.95 x 3.15 inches. Board 2 is the Auto-Dial option board and is etched with a 788 in the upper center on the component side. It measures 1.9 x 2 inches. Board 3 is the Memory Board and is etched with 787 in the upper center of the solder side. This board measures 1.9 x 2 inches and is programmable with diodes to remember any 7-digit telephone number. All PC boards plug together with pins and sockets; no soldering or de-soldering is required to assemble or disassemble the three boards.

Because the keyboard contacts are etched into the Main Frame PC board and because of the unit's compactness, it is recommended that the unit be built using only PC boards. As was pointed out last month, the construction of double-sided plated-through holes is beyond the capabilities of most home constructors. A set of PC boards (as well as a complete set of parts) is available from Executive Devices, 740 South Locan Avenue, Fresno, CA 93727. The PC boards with drilled and plated-through holes are available for \$5.95 each. Order PC boards 788, 789, 790. See Parts List last month for information on ordering complete kits or parts or assembled units.

Caution: The *Touch-Tone** Generating Chip (IC1) is MOS and is likely to be zapped by static electricity if not left in its protective conductive black foam holder

*Trademark of American Telephone and Telegraph Co.

until ready to be installed in the PC board. To be doubly safe, before removing the IC4 from the conductive foam, cut a 1 inch square of kitchen-type aluminum foil and form it over the top of the IC so that all 16 leads touch the aluminum foil. Wrap it around the body of the IC to hold in place. Pull the IC out of the protective foam and, holding the IC through the foil, insert it into the PC board. Leave the foil on the IC until after all soldering on the PC board is finished. The above MOS IC should be the last component put on the PC board; all other components should have been inserted and soldered before IC1 is installed. Besides keeping all leads shorted together so a static charge won't ruin an expensive IC, the aluminum foil also helps protect the IC from the heat of soldering by acting as a heat sink.

Refer to the component layout (January, 1976 issue) for parts locations. Observe diode and electrolytic capacitor polarities. Also double-check to make sure the IC's are installed with the end notch in the correct direction before soldering. The numbers and letters in circles and on large pads in the component layout are PC board interconnect pin numbers.

Adding the Auto-Dial option requires that the interconnect pins be added to the Main Frame board; follow these steps to assure proper alignment of pins and sockets.

1. Insert and solder into place all components and jumper wires on the Auto-Dial board.
2. Hold Auto-Dial board with component side facing up. Insert 11 each mini-jacks from component side (with the open end of the jack visible from the component side of the board) into holes 1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 13. (Don't solder yet!)
3. Insert the long end (end farthest from the swaged shoulder on pin) of a long pin in each of the sockets. Be sure it is fully seated.

PART II

Use it to access a computer with a sound input, and with the optional plug-in memory, it can automatically dial a 7-digit telephone number.

4. Place Main Frame PC Board (component side down) over Auto-Dial board (component side up); guide the pins through matching holes in Main Frame board. Be sure boards are 0.250 inch apart all the way around, measured from the face of the component side of one to the face of the component side of the other. Insert temporary spacers made from small washers or wood blocks to keep boards parallel while soldering is done.
5. Solder (using a very small amount of solder) pins on solder side only of Main Frame board. Cut off pins even with surface of PC board on solder side of board. This keeps the pins from interfering with the operation of the keyboard.
6. Flip assembly over and solder sockets from solder side of Auto-Dial board.
7. Boards now may be un-plugged and re-mated, but be careful to keep the boards as parallel as possible while plugging and unplugging, to keep from bending the pins or sockets.

Follow a similar procedure to assure correct alignment of pins and sockets between Auto-Dial board and Memory board:

1. With Auto-Dial board laying on table with component side down, insert 15 each sockets from solder side (with open end of socket facing solder side of board) into holes 1', 2', 3', 4', 5', 6', 7', 8', A, B, B, D, E, F, G. (Don't solder yet!)
2. Insert the short end (.050 from end of pin to shoulder) of the short pins supplied with the Memory board into each of the sockets.
3. Overlay a Memory board (with programming diodes already in place) with diode side down over Auto-Dial Board and guide pins through

matching holes in Memory board. Be sure the boards are a maximum of 0.125-inch apart, measured from the face of solder side of the Auto-Dial Board to the face of the diode side of the Memory board. Insert temporary 0.125-inch thick spacers between the boards as above if necessary to make them parallel until after soldering is done.

4. Solder pins on solder side of Memory board and cut off pins flush with top of solder.
5. Flip assembly over and solder sockets on component side of Auto-Dial board.

Rather than using a PROM (Programmable Read Only Memory) which is more expensive and requires a special programming unit, the Pocket Data Terminal Auto-Dial Memory card can be programmed with 14 each low-cost silicon diodes. Almost any diode will work including IN914 or IN4148 silicon diodes, advertised in the back of **R-E** at from 4¢ to 7¢ each, or IN270 germanium diodes. Using diodes with a higher than specified forward conducting voltage drop will result in a lower volume from the speaker, while using the more expensive (12¢ to 15¢) IN270 germanium diodes will result in a higher speaker volume. Under normal conditions, silicon diodes have been found to provide a sufficient volume level out of the speaker to work into a telephone handset microphone or two-way radio microphone, providing the speaker



PRESSING THE LEFT BUTTON on the Pocket Data Terminal starts it into Auto-Dial operation—pressing the right button boosts the output volume level. Hold both buttons down until the sequence is complete.

hole in the back of the Pocket Data Terminal is centered on and makes contact with the handset's microphone.

Programming a number

The Pocket Data Terminal generates, with its crystal-controlled LSI integrated circuit, all the eight *Touch-Tone* frequencies used by the telephone company. These are used, two at a time, to identify which one of the 16 buttons (four more than on a standard *Touch-Tone* telephone) is being pressed. See Table I.

Memory boards programmed for a phone number are shown (see January, 1976 issue). Each digit generated by the Auto-Dial unit requires two diodes (one for each tone). To dial the number 1, for

TABLE 1—Touch-Tone* Frequencies

Button	Frequencies (Hertz)
1	697 (L1) + 1209 (H1)
2	697 (L1) + 1336 (H2)
3	697 (L1) + 1477 (H3)
4	770 (L2) + 1209 (H1)
5	770 (L2) + 1336 (H2)
6	770 (L2) + 1477 (H3)
7	852 (L3) + 1209 (H1)
8	852 (L3) + 1336 (H2)
9	852 (L3) + 1477 (H3)
0	941 (L4) + 1336 (H2)
*	941 (L4) + 1209 (H1)
#	941 (L4) + 1477 (H3)
A	697 (L1) + 1633 (H4)
B	770 (L2) + 1633 (H4)
C	852 (L3) + 1633 (H4)
D	941 (L4) + 1633 (H4)

*Trademark of American Telephone and Telegraph Co.

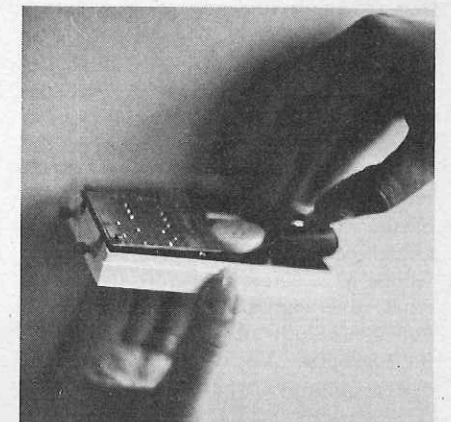
example, requires 697 Hertz (L1) and 1209 Hertz (H1). In the first diagram, diodes connect the vertical conductor 1 with the horizontal conductors (on the other side



USING THE POCKET DATA TERMINAL with a telephone. Be sure the nickel-plated grommet on the rear of the unit is centered over and touches the microphone of the phone (or two-way radio). The gain of the system receiving the signal determines whether the volume boost (right top button) should be used.

of the board) L1 and H1. Dialing a 7 requires L3 and H1, and it can be seen that the last (seventh) vertical conductor is connected to those frequencies. Thus the number 123-4567 will be dialed. The second component layout produces an output that is not a telephone number, but might be used in a control or other operation.

To change numbers in Memory simply move the diodes around to a new configuration, or order several more spare Memory board kits, available for \$6.95 from Executive Devices, 740 South Locan Avenue, Fresno, California 93727. The Memory board kit (Part MEM-700K) includes a double-sided epoxy-glass Memory PC board with plated-through holes, 15 diodes (2 each required for a 7-digit telephone number) plus a spare diode and 10 each



BATTERY CHANGE PROCEDURE. Grasp the unit about one-third the way down. Pull halves apart, keeping them as parallel as possible when separating. Lift battery up and out at connector end, as shown above.

mini-pins, used to plug the Memory board into the sockets on the Auto-Dial board. By having several spare Memory boards on hand, the telephone number may be conveniently changed.

The two systems

Touch-Tone was developed by Bell Labs as a replacement for dialing with rotary dial pulses. A rotary telephone dial puts out a series of pulses (two pulses for a 2; eight pulses for an 8, etc.). The telephone number 999-9999 thus takes much longer to dial than 111-1111. To dial 999-9999 requires 63 digital pulses; 111-1111 requires only 7. Each dial pulse is 100 milliseconds long with a 650 ms pause between digits. To dial the shortest possible 7-digit telephone number would take 4,600 ms or 4.6 seconds.

With *Touch-Tone* signalling it takes the same time to send a 1, a 9 or any other number. Each digit is made by a combination of two tones, as shown in the Table. Both tones must be present for a minimum of 40 ms and there must be a 4-ms (minimum) pause between digits. Thus the minimum time required to send any 7-digit number is 480 ms, or just under 0.5 second, over 20 times as fast as it takes to send the fastest phone number by the old rotary dial. **R-E**