Hex-to-ASCII Converter for your TVT-6

Simple module produces op-code display for entire computer.

BY DON LANCASTER

THE LOW-COST "Hex-to-ASCII Converter" described here allows you to simultaneously display the contents of every register, stack location, and memory slot in your microcomputer. The converter fits easily between the TVT-6 (July 1977) or most any other TVT and the μC with which it is working.

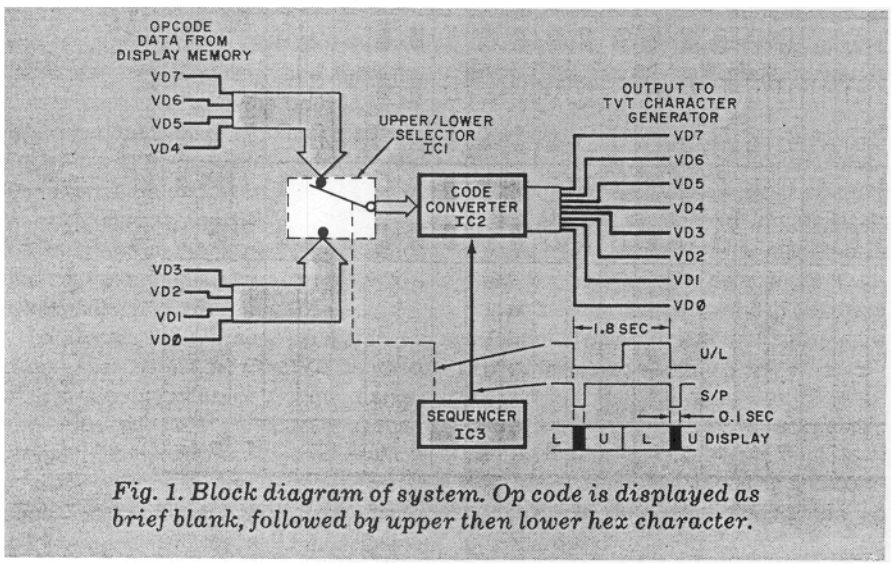


Fig. 1. Block diagram of system. Op code is displayed as brief blank, followed by upper then lower hex character.

In operation, the video monitor used in the system automatically converts and displays the hex op codes for the ASCII character set. This allows your TVT to act as a super "front panel" that permits you to check as many memory locations as there are in your system. This includes all registers, accumulator, stacks, RAM and ROM programs, I/O, or anything else connected to the system. Properly used, the converter is also an excellent debugging tool.

The complete hex-to-ASCII converter is built on a single compact printed circuit board. The circuit itself consists of three low-cost IC's and only five other parts.

About the Circuit. As shown in Fig. 1, the eight input lines from the display memory that normally drive the TVT character generator are intercepted and split into upper- and lower-case charac-

(Continued on page 51)

WORD	NOTES	8/7	7/6	6/5	5/4	4/3	3/2	2/1	1/0
0	Blank	□	□	□	□	□	■	□	□
1	"	□	□	□	□	□	■	□	□
2	"	□	□	□	□	□	■	□	□
3	"	□	□	□	□	□	■	□	□
4	"	□	□	□	□	□	■	□	□
5	"	□	□	□	□	□	■	□	□
6	"	□	□	□	□	□	■	□	□
7	"	□	□	□	□	□	■	□	□
8	"	□	□	□	□	□	■	□	□
9	"	□	□	□	□	□	■	□	□
10	"	□	□	□	□	□	■	□	□
11	"	□	□	□	□	□	■	□	□
12	"	□	□	□	□	□	■	□	□
13	"	□	□	□	□	□	■	□	□
14	"	□	□	□	□	□	■	□	□
15	"	□	□	□	□	□	■	□	□
16	0	□	□	□	□	■	■	□	□
17	1	■	□	□	□	■	■	□	□
18	2	□	■	□	□	■	■	□	□
19	3	■	■	□	□	■	■	□	□
20	4	□	□	■	□	■	■	□	□
21	5	■	□	■	□	■	■	□	□
22	6	□	■	■	□	■	■	□	□
23	7	■	■	■	□	■	■	□	□
24	8	□	□	□	■	■	■	□	□
25	9	■	□	□	■	■	■	□	□
26	A	■	□	□	□	□	□	■	□
27	B	□	■	□	□	□	□	■	□
28	C	■	■	□	□	□	□	■	□
29	D	□	□	■	□	□	□	■	□
30	E	■	□	■	□	□	□	■	□
31	F	□	■	■	□	□	□	■	□

0-WHITE;1-BLACK

Fig. 3. Truth table for PROM IC2.

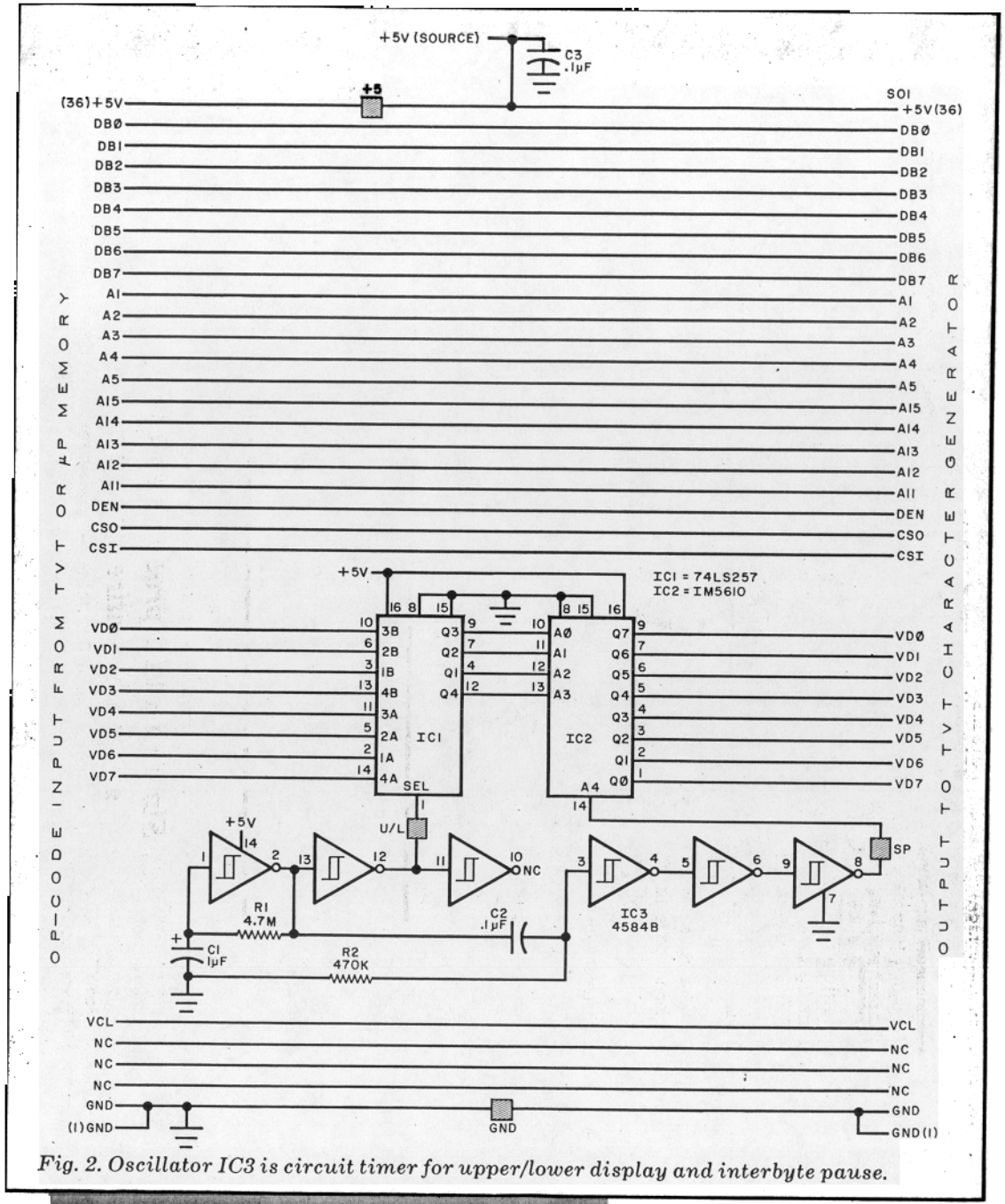
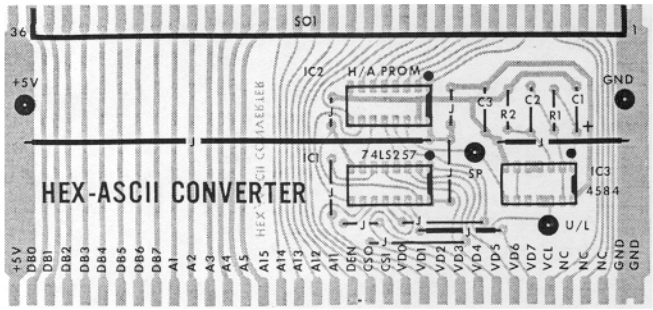


Fig. 2. Oscillator IC3 is circuit timer for upper/lower display and interbyte pause.



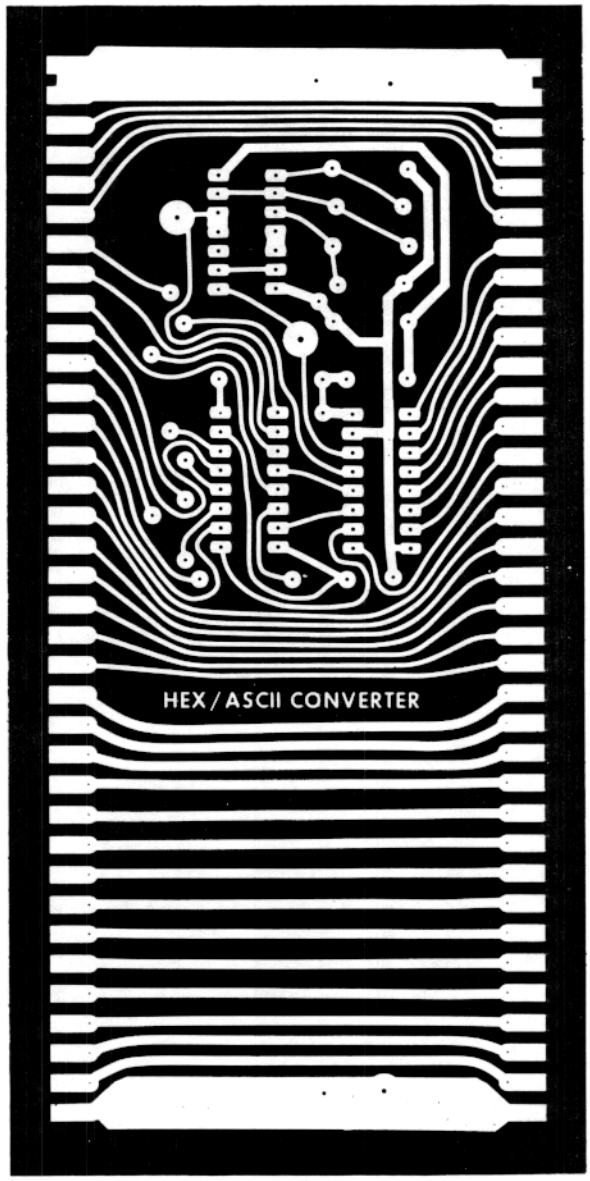


Fig. 4. Actual-size etching and drilling guide (right) and component layout (above) for the pc board. The board is connected between the TVT-6 and the KIM-1 microcomputer.

PARTS LIST

C1—1-μF, low-leakage tantalum electrolytic capacitor
C2,C3—0.1-μF Mylar capacitor
IC1—74LS257 quad 1-of-2 data selector
IC2—IM5610 or similar 32X8 bipolar tristate PROM (programmed in accordance with Fig. 3)
IC3—4584B CMOS hex Schmitt trigger
R1—4.7-megohm, ¼-watt resistor
R2—470,000-ohm, ¼-watt resistor
SO1—36-contact, single-entry edge connector with contacts located on 3.96-mm centers
Misc.—Sockets for IC's (one 14-pin, two 16-pin); press-fit test point terminals; printed circuit board; jumper wire; insulated sleeving; solder; etc.
Note: The following items are available from PAIA Electronics, Box 14359, Oklahoma City, OK 37114: No. HAC-1B etched and drilled pc board for $4; No. HAC-1P programmed IC2 for $5; No. HAC-1K complete kit of all parts for $14.95. All prices postpaid.

(Continued from page 49)

ters of four bits each. These two hex characters are alternately routed to a PROM that converts the hexidecimal input code to the equivalent ASCII output. The resultant display alternately flashes the upper hex character and then the lower hex character, with both appearing on-screen at the same location. Each character is displayed for slightly less than a second. A brief space command is sent to the PROM during the transition from the lower character of one set to the upper character of the following set.

To identify the memory locations, an overlay can be used on the CRT screen of the video monitor, or a china marker can be used to label the operating registers and other important slots with which you are working. If the TVT-6 is being used with the "Cruncher the Bear" mode in the August 1977 issue, it is possible to simultaneously display the 4096 hex characters that result from the 2048 opcode words simultaneously.

The complete schematic diagram of the converter is shown in Fig. 2 and the coding for the 32 × 8 code-converter PROM is shown in Fig. 3.

Integrated circuit *IC1* (Fig. 2) is used as a four-pole, double-throw data selector that drives *IC2*, the code converter. The hex CMOS Schmitt trigger (*IC3*) serves as a symmetrical oscillator that is used for automatically selecting the upper and lower character and to generate the brief blanking pulse that indicates a new character display.

Construction. The converter circuit is best assembled on a printed circuit board. The etching and drilling and components placement guides for the pc board are shown in Fig. 4.

Note on the components placement guide that 10 jumpers are used to interconnect various pads on the board. Only two of these jumpers, indicated by heavy lines, require insulated sleeving to be slipped over them before installation to preclude the possibility of accidental short circuits.

Install and solder into place press-fit terminals at the four test points labelled +5, GND, SP, and U/L. Then install and solder into place the three capacitors, two resistors, and the 36-contact connector. Sockets are recommended for the three IC's. Once the sockets are installed and soldered into place, install the IC's in their respective locations, taking care to properly orient them.

Checkout. To initially check out the converter, connect the TVT-6 to the KIM-1 microcomputer and use the

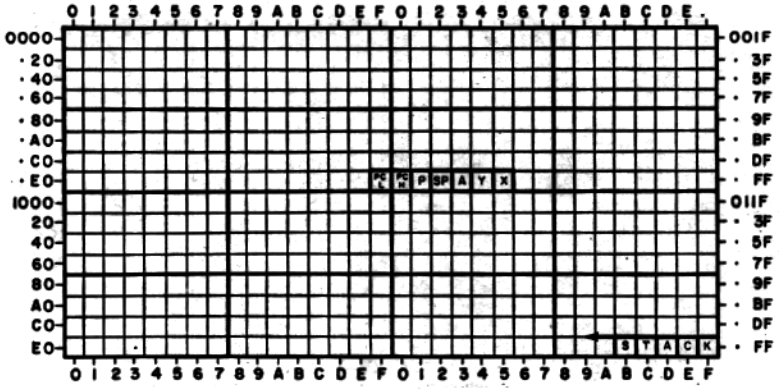


Fig. 5. Overlay mask for the KIM-1. All internal registers are displayed simultaneously with the entire stack.

512-character, page 2 and page 3 display of Table II in the August 1977 TVT-6 article. Make sure that the system is operating properly. Then remove the power and connect the hex-to-ASCII converter between the TVT-6 and μC. Power up again, reload the program, and run the computer. The original ASCII display should now appear in hexidecimal op code.

Test point U/L should have a 1.8-second square wave, while test point SP should be high for 1.7 seconds and low for 0.1 second. It is possible to "force feed" control signals into these test points. Connecting test point SP to +5 volts displays the characters; grounding SP blanks the screen. Connecting test point U/L to +5 volts displays the lower four bits, while grounding it displays the upper four bits.

Operation. If you are planning to run Table II from the August 1977 TVT-6 article, the usual display is of pages 02 and 03. This can be converted to a page 00 and 01 display by changing instruction 17AA to 82 and 17d2 to 80.

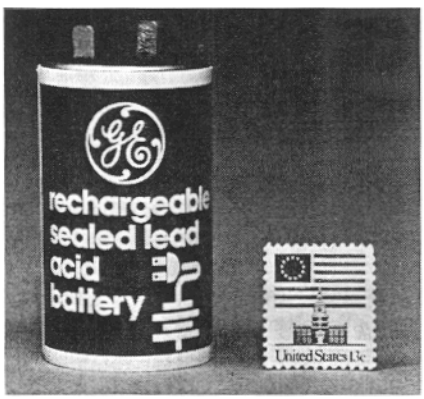
An overlay that identifies the stack and all important machine registers is shown in Fig. 5. The physical size of the overlay, of course, depends on the size of the CRT used in the monitor. A sharp china marker can alternatively be used as a low-cost, workable substitute for the overlay.

To debug a program, simply use the hex-to-ASCII converter with the KIM-1 operating system in the single-step mode. Each time the operating system returns to the keyboard display mode, all registers have their values reloaded into the proper slots shown in Fig. 5.

Hit AD 17 80, switch to SST OFF, and press GO to view the accumulator, stack pointer, program counter, status register, and the X and Y index registers simultaneously. To return to the keyboard display mode, simply press ST.

The Hex-to-ASCII converter can be used between memory and the character generator of many other TVT systems as long as an 8-bit word is used in the TVT's page memory. You can ignore the "Pass-through" lines on the converter, or you can redefine them in any way you need. The converter's processing delay is about 100 ns, which is fast enough usually to be ignored. ◇

Rechargeable Batteries for Consumer Products



THE USE of batteries to power electrical and electronic devices is on the rise. As more and more such products are introduced, the consumer is faced with the problem and cost of constant replacement of batteries.

General Electric has introduced an alternative with two new lines of rechargeable batteries and cells. A nickel-cadmium line consists of the most common-size cells and batteries used in such low- and medium-power items as hand-held calculators, photoflash camera units, and portable receivers. A sealed lead-acid (SLA) cell line is designed for devices that require medium-to-high-power, such as alarms, emergency lighting, and computer memory systems.

The new sealed lead-acid cells are designed to be completely maintenance-free. They can be used in any position without posing a problem with electrolyte spillage. The outer metal case of the cell is electrically isolated from the power-carrying plates. Both the positive and the negative terminals are at the top of the cell. A special glass fiber separator used in construction permits the cell to withstand high temperatures without suffering damage.

The discharge characteristics and cycle life of the SLA cells duplicate or exceed those of other lead-acid cells. The SLA cells are said to have a charge/discharge life of about 300 cycles, which favorably compares with the life of nickel-cadmium cells whose life is typically about 1000 cycles.

The internal resistance of the SLA cell is 10 milliohms (0.01 ohm). This low value makes possible high charge/discharge rates with minimum danger of overheating the cell. A resealable safety vent in the cell prevents cell bursting under extreme abuse.

The first of the new SLA cells to come on the market is a cylindrical D cell. It is designed to deliver 2.5 ampere-hours at a 250-mA discharge rate. The cell is capable of delivering up to 40 amperes of continuous current and 75 amperes of momentary (1-second) current. The line of SLA cells will eventually include batteries rated at 6 and 12 volts and 2.5 AH.

The rechargeable nickel-cadmium battery system consists of AA, C, and D cells and a 9-volt transistor size battery, each of which is available separately or packaged with its appropriate snap-on module that connects it to the Model BC3 miniature charger. The rechargeable NiCd cells and batteries are designed for any application where ordinary carbon-zinc batteries are used. They are directly interchangeable with other AA, C, and D cells and 9-volt transistor batteries. ◇