Users of microprocessors sometimes need to display a hexadecimal number that represents an address or shows the status of a process [see "Large hexadecimal display is legible from afar", June 10, p. 129]. Many readers have suggested arrangements for showing hex numbers with a standard seven-segment display. A couple of interesting techniques are described in the two following articles.

PROM converts binary code for hexadecimal display

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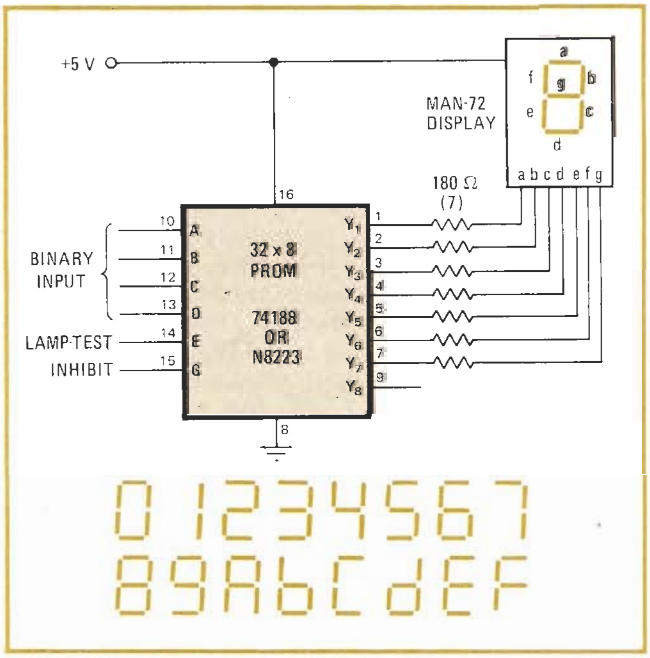
When designing and developing microcomputer systems, most engineers automatically include rows of lights to present information in binary format. However, when debugging the system, it can be frustrating and time-consuming to translate the binary data displayed into the hexadecimal format that many assemblers use. With a programable read-only memory and a seven-segment display, binary-to-hexadecimal conversion can be performed simply by hardware at very little cost over that of a binary display.

Usually, seven-segment displays are used to display only the numerals 0–9. In addition, they can also display the needed hexadecimal characters A–F; however, not all letters can be represented in upper case. The figure shows the segment patterns displayed for each hexadecimal digit. One caution that must be exercised is to note the difference between the number "6" and the letter "b".

To implement the hexadecimal-to-seven-segment decoder, a 74188 or N8223 PROM is used. Since the device has open-collector outputs, the light-emitting diodes in the display can be driven directly with a suitable current-limiting resistor. The PROM outputs should not be allowed to sink currents greater than 12 milliamperes. Each of the seven segments in the display is driven by a separate output of the PROM (one output is unused). The schematic for a single hexadecimal digit is given in the circuit diagram.

Locations 0–15 of the PROM are used to store the information that performs binary-to-hexadecimal conversion. For each word, a 0 in a bit position turns on the display segment at the output; if the bit is a 1, the segment is off. If locations 16–31 are left unprogramed (all 0s), the most significant address line performs a lamp-test function. When this line is high, a word in the range 16–31 is addressed and all segments of the display will light.

The PROM should be programed in accordance with the procedure outlined on the device's data sheet. An automatic programing machine, which reads punched cards that tell it the desired output word for each address, does the programing in seconds. The bit pattern and function table for the decoder are given in the accompanying table. □



TRUTH TABLE AND PROGRAM FOR THE HEXADECIMAL DISPLAY

INHIBIT	LAMP TEST	B8	B4	B2	B1	DISPLAY	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8
							PROGRAM IN MEMORY							
0	0	0	0	0	0	0	0	0	0	0	0	0	1	X
0	0	0	0	0	1	1	1	0	0	1	1	1	1	X
0	0	0	0	1	0	2	0	0	1	0	0	1	0	X
0	0	0	0	1	1	3	0	0	0	0	1	1	0	X
0	0	0	1	0	0	4	1	0	0	1	1	0	0	X
0	0	0	1	0	1	5	0	1	0	0	1	0	0	X
0	0	0	1	1	0	6	0	1	0	0	0	0	0	X
0	0	0	1	1	1	7	0	0	0	1	1	1	1	X
0	0	1	0	0	0	8	0	0	0	0	0	0	0	X
0	0	1	0	0	1	9	0	0	0	1	1	0	0	X
0	0	1	0	1	0	A	0	0	0	1	0	0	0	X
0	0	1	0	1	1	b	1	1	0	0	0	0	0	X
0	0	1	1	0	0	C	0	1	1	0	0	0	1	X
0	0	1	1	0	1	d	1	0	0	0	0	1	0	X
0	0	1	1	1	0	E	0	1	1	0	0	0	0	X
0	0	1	1	1	1	F	0	1	1	1	0	0	0	X
1	X	X	X	X	X	(OFF)	1	1	1	1	1	1	1	1
0	1	X	X	X	X	8	0	0	0	0	0	0	0	X

1 = HIGH   0 = LOW   X = DON'T CARE

Remember the hex symbol. Binary inputs to the PROM produce a seven-segment representation of hexadecimal-code symbols. The PROM costs about $3, and can be programed quickly at practically no cost if an automatic programing machine is available.