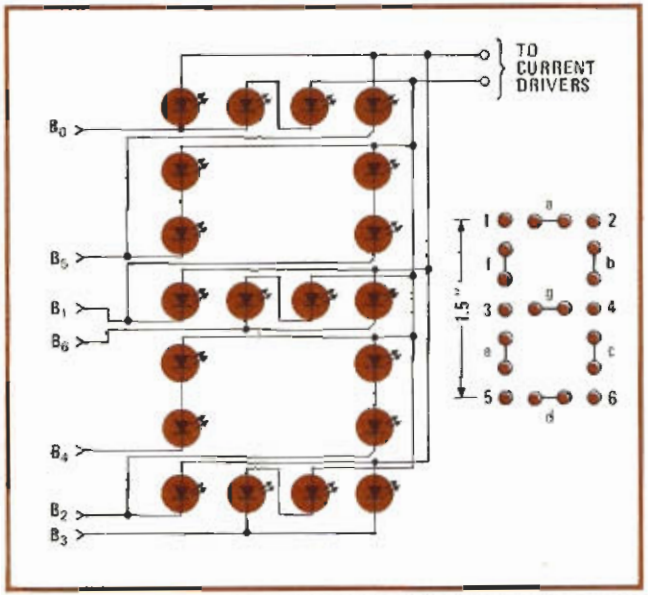
Large hexadecimal display is legible from afar

by A. J. Bryant
Manelco Electronics Ltd., Winnipeg, Manitoba

Better visibility and a wider range of alphanumeric characters result when the seven segments standard in light-emitting-diode displays are made up of two LEDs each and multiplexed with six other LEDs. The arrangement of 20 discrete LEDs described here provides 1.5-inch numerals and letters that can be read from 30 feet away with clear distinction between such "twins" as 0 and D.

The display can be particularly useful in microprocessor applications in process and machine controllers, where hexadecimal numbers representing steps or parameters must be clearly visible from distances of 10 feet or more. Commercial displays do not meet this need. The numbers 0–9 plus the letters A–F represent



1. Really big show. Twenty light-emitting diodes arranged in a ⅝-by-1½-inch array display any symbol in the hexadecimal number system. This display can be read at distances as great as 30 feet.

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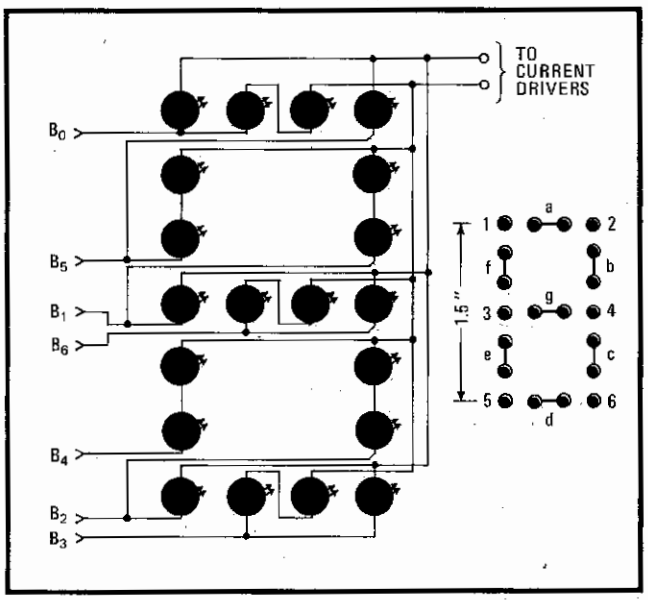

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Figure 1 shows the 20 LEDs in a 4-by-7 array. There are seven segments made up of two diodes in series and six individual diodes; the two-diode segments are labeled a, b, . . . g, as in any seven-segment display, and the six individual diodes are labeled 1, 2, . . . 6. The 13 different current paths that these segments and individual diodes provide are controlled by the outputs of a read-only memory and an on/off multiplexing voltage. So only two current drivers are required.

When a character is displayed, the multiplexing voltage causes the appropriate segments and then the appropriate individual diodes to light, but they go on and off so quickly that they appear to be on continuously.

Figure 2 shows the display-circuit arrangement and the program of the ROM. If the symbol B is to be displayed, then all of the segment LEDs and individual diodes 1, 3, and 5 must light. The program shows that for the letter B, all of the segments are 0s (low voltage). When the on/off multiplexing signal is 0, the inverter puts high voltage on the segments and they all light.

When the multiplexing signal is a 1, high voltage is applied to all of the individual diodes. The cathodes of 1, 3, and 5 have been grounded by the ROM, so those diodes light up; but the cathodes of 2, 4, and 6 are held high, so they do not light.

For representation of the hex B, the binary ROM inputs to A_3, A_2, A_1, and A_0 are 1011, and A_4 is 0 for the segments and 1 for the individual diodes. Thus the memory chip is programed so that input 01011 produces outputs 0000000 on B_6 . . . B_0, and input 11011 produces 1111000. Note that output B_7 is not used.

To provide a more even distribution of light in the multiplex mode, different current drivers can be used for the segment line and for the line to the individual diodes, or the duty cycle of the on/off signal can be changed. Most available ROMs can sink the current required by the LEDs, but a buffer may be required, depending upon the specific combination. □

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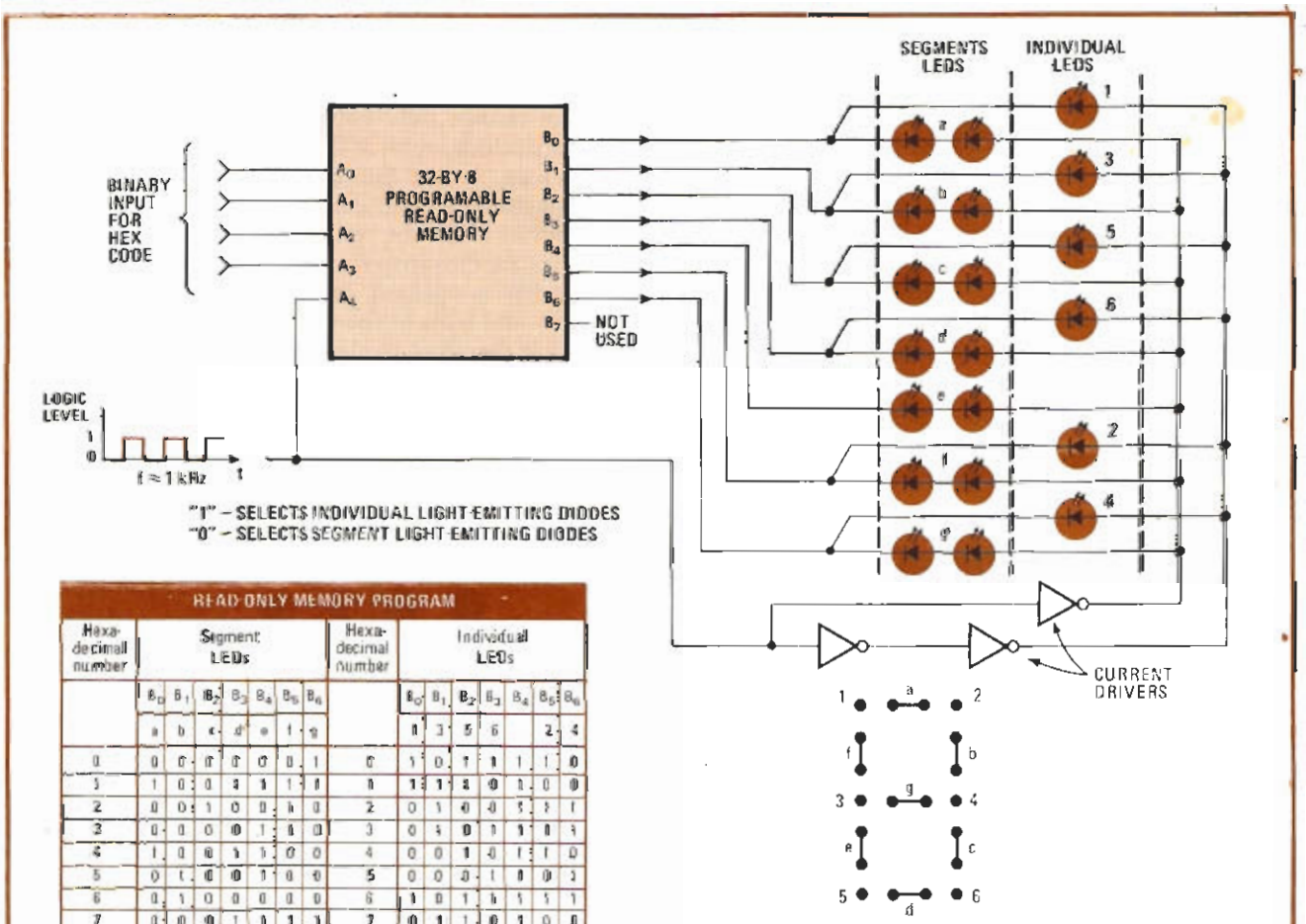

READ-ONLY MEMORY PROGRAM

Hexadecimal number	Segment LEDs							Hexadecimal number	Individual LEDs						
	B_0	B_1	B_2	B_3	B_4	B_5	B_6		B_0	B_1	B_2	B_3	B_4	B_5	B_6
	a	b	c	d	e	f	g		1	3	5	6		2	4
0	0	0	0	0	0	0	1	0	1	0	1	1	1	1	0
1	1	0	0	1	1	1	1	1	1	1	1	0	1	0	0
2	0	0	1	0	0	1	0	2	0	1	0	0	1	1	1
3	0	0	0	0	1	1	0	3	0	1	0	1	1	0	1
4	1	0	0	1	1	0	0	4	0	0	1	0	1	1	0
5	0	1	0	0	1	0	0	5	0	0	0	1	0	0	1
6	0	1	0	0	0	0	0	6	1	0	1	1	1	1	1
7	0	0	0	1	1	1	1	7	0	1	1	0	1	0	0
8	0	0	0	0	0	0	0	8	1	1	1	1	1	1	1
9	0	0	0	0	1	0	0	9	1	1	1	1	1	1	0
A	0	0	0	1	0	0	0	A	1	0	0	0	1	1	1
B	0	0	0	0	0	0	0	B	0	0	0	1	1	1	1
C	0	1	1	0	0	1	1	C	1	0	1	1	1	0	1
D	0	0	0	0	0	0	1	D	0	0	0	1	1	1	0
E	0	1	1	0	0	1	0	E	0	0	0	0	1	0	1
F	0	1	1	1	0	1	1	F	0	0	0	1	1	1	1

2. Great program. ROM and multiplexing on/off voltage cause diodes to light up and display hexadecimal symbol corresponding to binary input. Each of the 16 hex symbols uses two input words—one with A_4 high, and the other with A_4 low, the two words are rapidly interchanged by the on/off (1 or 0) signal applied to A_4. This mode of operation uses the full capability of the 32-word ROM. Any compatible ROM, driver, and LED can be used; with TTL, for example, a Signetics 8223 PROM and 5-volt signals do the job.

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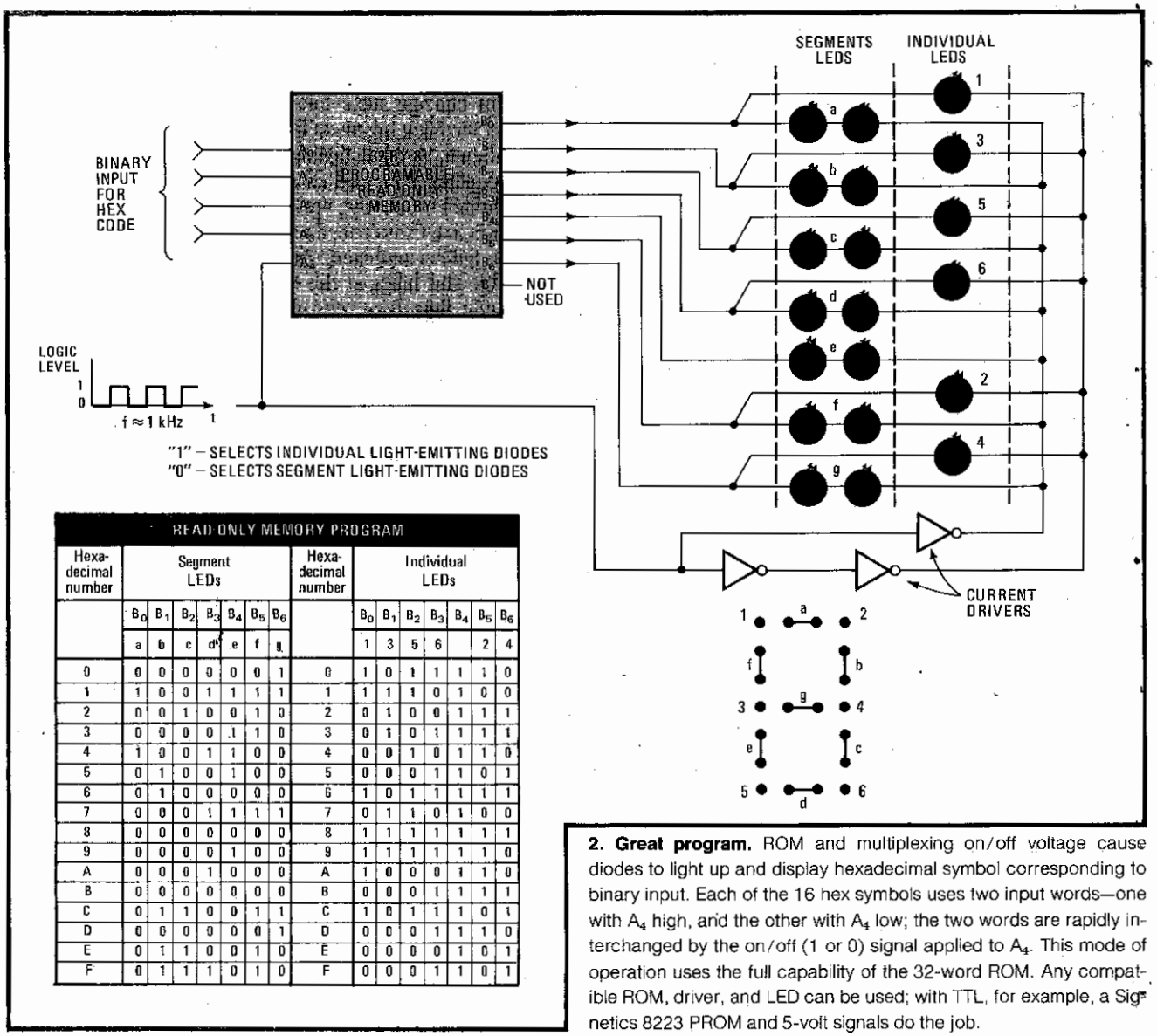

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1	1	0	0	1	1	1	1	1	1	1	1	0	1	0	0
2	0	0	1	0	0	1	0	2	0	1	0	0	1	1	1
3	0	0	0	0	1	1	0	3	0	1	0	1	1	1	1
4	1	0	0	1	1	0	0	4	0	0	1	0	1	1	0
5	0	1	0	0	1	0	0	5	0	0	0	1	1	0	1
6	0	1	0	0	0	0	0	6	1	0	1	1	1	1	1
7	0	0	0	1	1	1	1	7	0	1	1	0	1	0	0
8	0	0	0	0	0	0	0	8	1	1	1	1	1	1	1
9	0	0	0	0	1	0	0	9	1	1	1	1	1	1	0
A	0	0	0	1	0	0	0	A	1	0	0	0	1	1	0
B	0	0	0	0	0	0	0	B	0	0	0	1	1	1	1
C	0	1	1	0	0	1	1	C	1	0	1	1	1	0	1
D	0	0	0	0	0	0	1	D	0	0	0	1	1	1	0
E	0	1	1	0	0	1	0	E	0	0	0	0	1	0	1
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