

improving the readability of seven-segment displays

Seven-segment displays of various types are now the most popular format for digital display in many applications. The most common decoder-driver used with these displays is the 7446 (or 7447) which may be used with displays of the LED or Minitron type.

The results obtained with these decoders are, in general, very good, but the format of the digits 6 and 9 leaves something to be desired. These digits are decoded as shown in figure 1b and most people would agree that they are greatly improved by the addition of segments 'a' and 'd' respectively, as in figure 1c. The Japanese tend to use this presentation in their electronic calculators.

This format may be obtained with the 7446/7 by parallelling the 'a' and 'd' outputs with external transistors which are turned on when either a 6 or a 9 is displayed (see figure 2). The only problem is to derive a suitable code from the BCD input to drive the transistors. A '1' must be applied to the base of the appropriate transistor when either a 6 or a 9 is displayed.

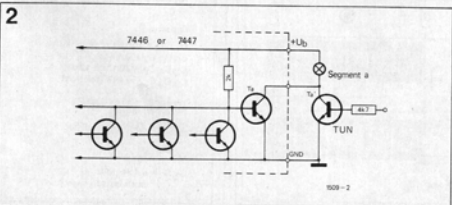
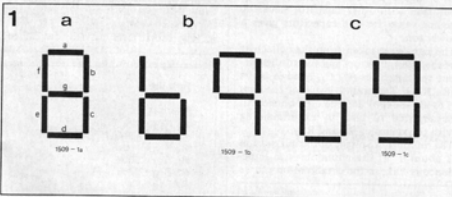
Looking at the truth table for the 7446/7 it is apparent that when a 6 is displayed columns B and C of the BCD input code are '1'. Column C cannot be used, however, for looking at the rest of this column it can be seen that column C is also a '1' for digit 4. Since 4 does not utilise segment 'a' input C cannot be used to drive the transistor for this segment. Input B may be used however since the other digits with a '1' in this column are 2, 3 and 7 which all use segment 'a'.

Turning to digit 9 it can be seen that there are '1's in columns A and D of the BCD code. A obviously cannot be used since digit 1 also has a '1' in this column but does not contain segment 'd'. Column D may be used, however, since the only other digit with a '1' in this column is 8, which contains segment 'd' anyway.

Figure 1. a. Alphabetic designation of the seven segments of a display. b. Usual format of digits 6 and 9. c. Improved format of digits 6 and 9.

Figure 2. The output stage of a 7446/7 seven-segment decoder with the external transistor in parallel.

Figure 3. The complete circuit for the improved readability display using a 7447. The 7446 has an identical pinout.



Truth table for the seven-segment decoder without the additional transistors.

Digit	D	C	B	A	a	b	c	d	e	f	g
0	0	0	0	0	0	0	0	0	0	0	1
1	0	0	0	1	0	0	1	1	1	1	1
2	0	0	1	0	0	0	1	0	0	1	0
3	0	0	1	1	0	0	0	0	1	1	0
4	0	1	0	0	1	0	0	1	1	0	0
5	0	1	0	1	0	1	0	0	1	0	0
6	0	1	1	0	1	1	0	0	0	0	0
7	0	1	1	1	0	0	0	1	1	1	1
8	1	0	0	0	0	0	0	0	0	0	0
9	1	0	0	1	0	0	0	1	1	0	0

