# Seven-segment indicator shows Roman I through V

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To get away from ordinary numerals for indicating time modes (or any other five-level state), here is a quickly recognizable display that uses a standard 7-segment indicator. Roman numerals I, II, III, IV, and V are displayed by turning the 7-segment indicator on its side, as shown in Fig. 1. A decoder/driver, consisting of two exclusive-OR gates and one AND gate, operates directly from BCD inputs.

The display is implemented for a MAN-4 7-segment light-emitting diode, driven by transistor decoder/drivers from the BCD output of a divide-by-6 counter, as shown in Fig. 2. Transistors Q_1, Q_2, and Q_6 correspond to gate 1 in Fig. 1; Q_4, Q_5, and Q_7 correspond to gate 2; and Q_3 corresponds to gate 3.

When the BCD outputs A and C are low, Q_1 and Q_2 are off and therefore Q_6 is off, so the I segment receives no current and does not light. When A is high and C is low, Q_2 is off, but Q_1 is on; therefore, current from the A output flows through Q_1 to turn on driver Q_6, which illuminates the I segment. The magnitude of the input
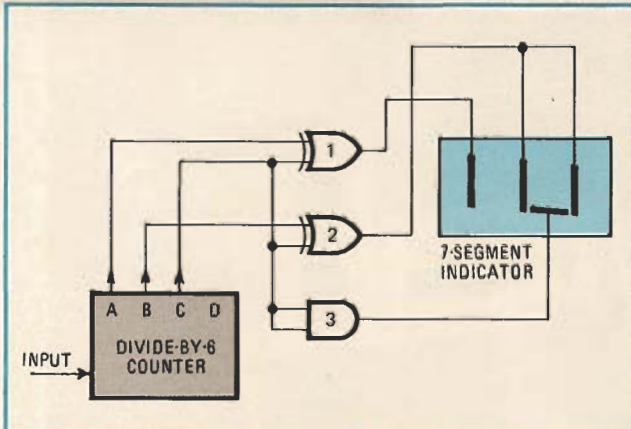
STATE	A	B	C	EX-OR GATE 1	EX-OR GATE 2	AND GATE 3	DISPLAY
0	0	0	0	0	0	0	(NONE)
1	1	0	0	1	0	0	I
2	0	1	0	0	1	0	I I
3	1	1	0	1	1	0	I I I
4	0	0	1	1	1	1	I L_I
5	1	0	1	0	1	1	L_I

1. Roman numerals. Seven-segment display element, turned on its side, provides Roman numerals I through V. Indicator is driven by two exclusive-OR gates and one AND gate, which operate directly from BCD outputs of a digital counter.
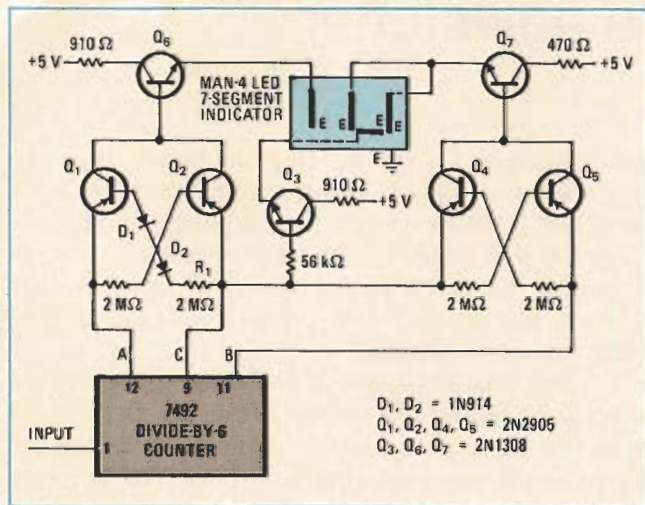
2. Circuit. Implementation of Roman-numeral indicator uses three transistors for each exclusive-OR gate and a single transistor for the AND gate. BCD data comes from divide-by-six IC. Display element is a 7-segment LED device. This novel display mode is useful for any system or situation with up to five levels or periods, such as gear positions, soccer quarters, elevator stops, and the like.

current to the driver is determined by resistor R_1. If C is high and A is low, Q_2 conducts, and again the I segment glows. When both A and C are high, Q_1 and Q_2 are both off; diodes D_1 and D_2 ensure the performance of this exclusive-OR, even when the A and C highs are unequal because of current being drawn from C to the other transistors.

The exclusive-OR gate of Q_4, Q_5, and Q_7 operates in a similar manner to illuminate the I I segments, but diodes are not needed because B and C are never high simultaneously (see truth table in Fig. 1).

The AND gate, transistor Q_3, is a direct-drive circuit that lights up the horizontal bar to convert I I to L_I, which approximates Roman numeral V. ☐