of IC2 to pin 9. In that type of an intermittent display, the LED's will light for four cycles, go blank for four cycles, and the sequence then repeats.

Figure 8 shows a visually attractive 4-LED, 5-step sequencer. Initially, all four LED's are on, and then turn off sequentially until they're all off in the fifth step, as shown in the accompanying table. The LED's are effectively in series, and the basic circuit can't drive over four LED's.

Figure 9 shows another version; here, the CD4017B does a 10-step sequence, with LED 1 on from steps "0"–"3," LED 2 on for "4"–"6," LED 3 on for "7" and "8," and LED 4 on for step "9." The display will accelerate from LED 1–LED 4, not just sweeping smoothly from one LED to the next, and the cycle then repeats ad infinitum.

Figure 10 shows such a circuit modified to produce an intermittent display, where the visual acceleration occurs for 10 clock cycles, the LED's all blank for 20 cycles, and then the counting cycle repeats. When IC2 is in a ÷10 mode as shown in Figs. 9 and 10, pin 12 (CARRY OUT) produces an output each time IC2 does a decade count, which is used to clock IC3 (which is connected in ÷3 mode), with its "0" output fed to Q1.

For the first 10 cycles of a sequence, the "0" output of IC3 is high, and Q1 is biased on, so IC2 acts as shown in Fig. 9, with the LED's turning on sequentially through Q1. After the 10th clock pulse, the "0" output of IC3 goes low, turning Q1 off; the LED's can no longer light, but IC2 keeps counting. After the 30th clock pulse, the "0" output of IC3 again goes high and turns Q1 on, reenabling the display.

Figure 11 is a simple multiplexed display, where IC3 and Q3 enable or disable a bank of LED's. Figure 11 is yet another example of a multiplexed display, which uses three lines of six intermittently-sequenced LED's. They're each sequentially enabled via IC3 and individual gating transistors, only one line at a time; if you want, you can expand this version still further to control a 10-line, 100-LED, matrix display.

Figure 12 shows a 4-bank, 5-step, 20-LED chaser; the four LED's are in series in each of the five CD4017B outputs, so four LED's are lit at any one time. Each lit LED drops about 2 volts

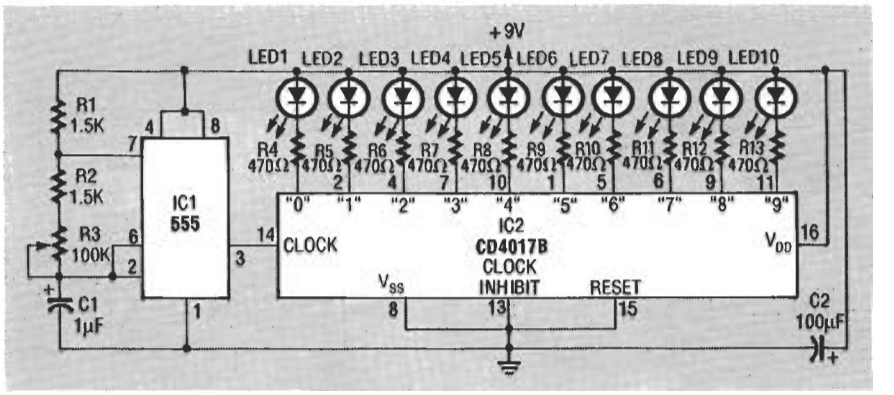


FIG. 6—A 10-LED "MOVING-HOLE" DISPLAY.

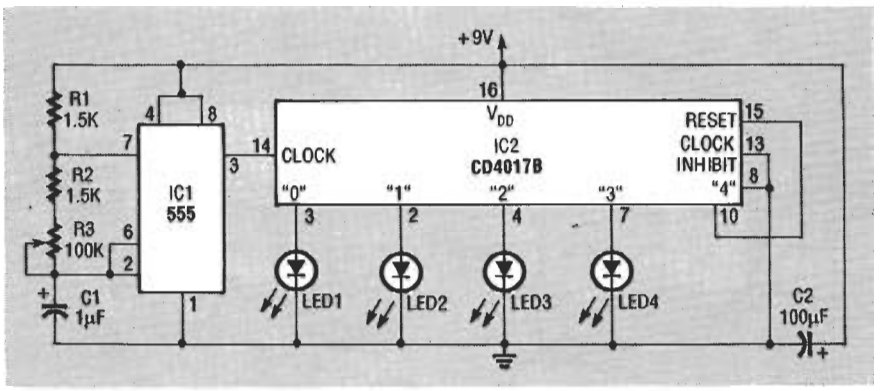
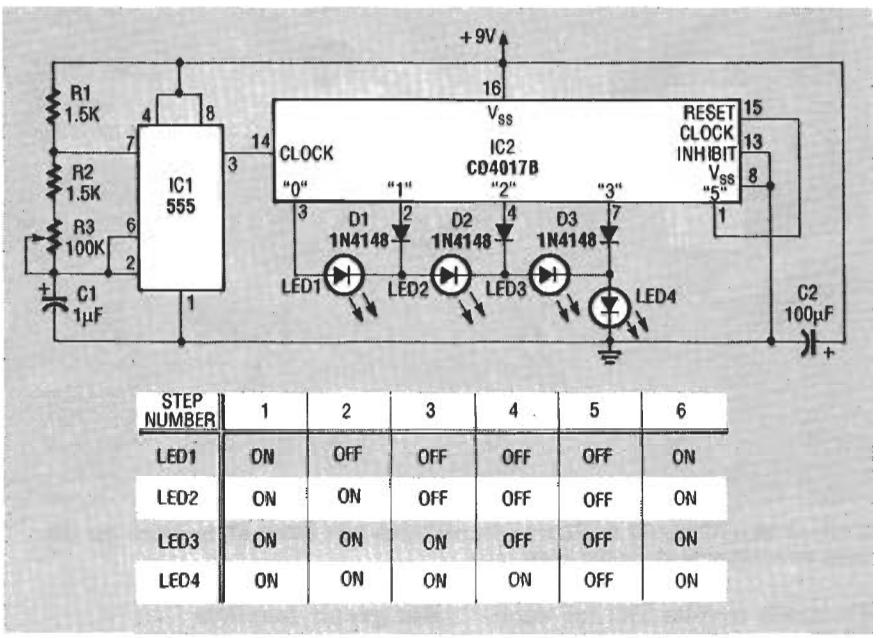


FIG. 7—A 4-LED CONTINUOUS "MOVING-DOT" DISPLAY. To get an intermittent "moving-dot" display using a 50% "blanking" period, just change pin 10 (or output "4") to pin 9 (or output "8").



STEP NUMBER	1	2	3	4	5	6
LED1	ON	OFF	OFF	OFF	OFF	ON
LED2	ON	ON	OFF	OFF	OFF	ON
LED3	ON	ON	ON	OFF	OFF	ON
LED4	ON	ON	ON	ON	OFF	ON

FIG. 8—A 4-LED, 5-STEP SEQUENTIAL TURN-OFF DISPLAY.

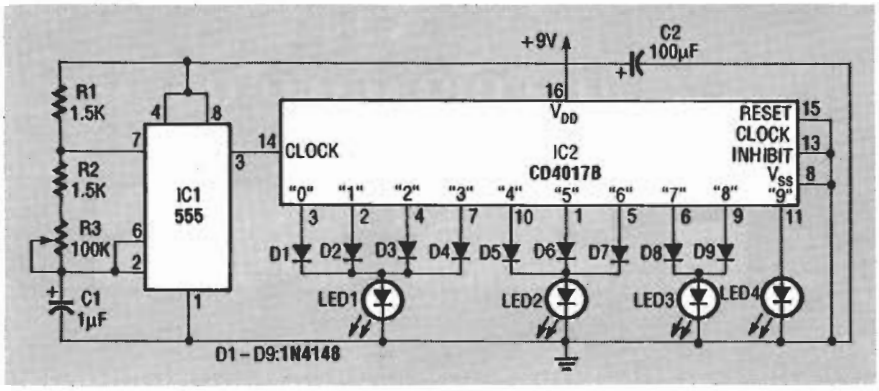


FIG. 9—A 4-LED CONTINUOUS "ACCELERATOR" DISPLAY, where the pattern of the dots appears to accelerate from left to right.

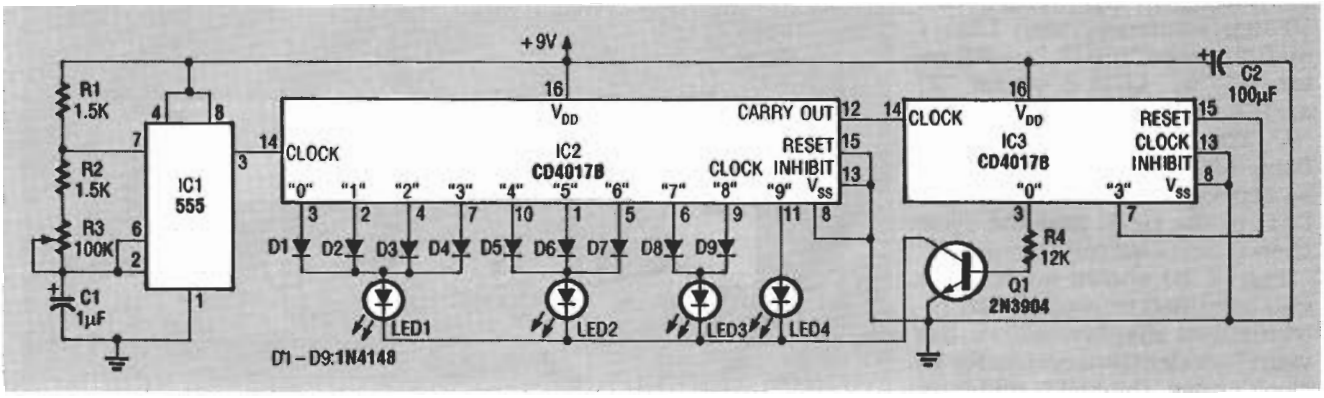


FIG. 10—A 4-LED INTERMITTENT "ACCELERATOR" DISPLAY, where the "acceleration" occurs for 10 out of every 30 clock steps.

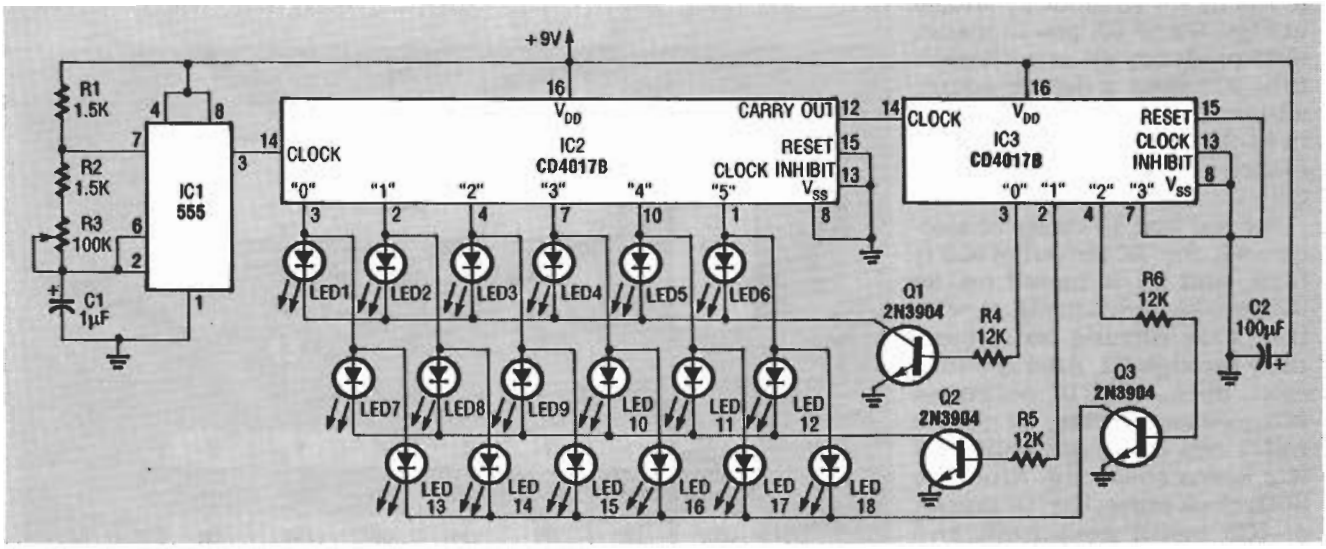


FIG. 11—A MULTIPLEXED 6-LED × 3-LINE MOVING-DOT DISPLAY, in which the dot moves intermittently along the lines.

DC; that's 8 volts DC for each LED bank that's on, so the supply voltage must be greater than that for the circuit to work. A greater number of LED's can be used in each LED bank if the supply voltage is correspondingly increased to handle the added load.

Bar-graph displays

Another multi-LED indicator circuit is the analog version, which drives a chain of linearly-spaced LED's. The number of LED's that are lit is proportional to the voltage applied to the LED-driver, so the circuit acts like an analog voltmeter. You can use the LED's as either a bar- or dot-graph display. In a bar-graph display, the input value is indicated by the total number of LED's that are lit. In the dot display, the input value is indicated by the relative position of just one lit LED.

Special IC's are available for building LED analog displays, the most useful examples being the U2X7B family from AEG, and the LM3914 family from National Semiconductors. The U2X7B family consists of simple, dedicated devices, which can be usefully cascaded to drive up to 10 LED's in bar-graph mode only, the members being the U237B, U247B, U257B, and U267B. The LM3914 family is more complex and versatile by comparison, and are easily cascaded to drive up to 100 LED's in either bar-graph or dot-graph mode. Both varieties of IC's are considered to be bar-graph drivers.