A HIGH-RESOLUTION LED DISPLAY

A thin, high-resolution, two-dimensional display with X-Y addressability would have many applications in such fields as television, oscilloscopes, electronic games, micro-computer displays and alphanumeric and graphic data displays for pocket calculators and data loggers.

Experimental flat-screen displays have been made based on gaseous discharge, electrofluorescence, light-emitting diodes and liquid crystal technologies. The liquid crystal method appears to offer the greatest economy and certainly the thinnest configuration, but this display medium cannot yet change states fast enough for television applications.

The technology needed to build large-area LED displays has been available for a decade, but the high cost of the LEDs themselves and the addressing circuits they require has thus far restricted their use to military and laboratory applications. Now that low-cost visible LEDs are available, you can assemble a 16 × 10, 160-element LED display for less than $20—assuming you can procure the LEDs for less than 10¢ each.

Figure A is the circuit diagram of the array. The ten 330-ohm resistors limit current to the LEDs, providing about 10 mA to each LED if a 5-volt power supply is used.

The exact construction method employed in the assembly of the display depends on the lead arrangement of the LEDs. Figure B is a photograph of the 160-element display assembled on a perforated board with 0.1-inch hole centers and a copper solder pad at most holes (Radio Shack 276-1551 or similar).

I used yellow LEDs, but you can use red or green LEDs if you prefer. I also painted the LED side of the board black *before* installing the LEDs to enhance the display's contrast. The current-limiting resistors can be seen near the lower left of the display.

Although the electrical circuit of the array is very simple, its construction requires a good deal of patience. First, all the LEDs must be soldered to the board. That alone requires 320 separate solder connections. Then all the anodes in each horizontal row and all the cathodes in each vertical col-

umn must be connected together with bus wires. This requires 320 additional solder connections.

The resistors and output connections to the board's copper fingers require another 72 solder connections, resulting in a total of 712 solder connections! Don't be discouraged though. I was able to complete the board shown in Figure B in less than four hours—and that included plenty of short breaks to relieve eye strain.

PROJECT OF THE MONTH

(Continued)

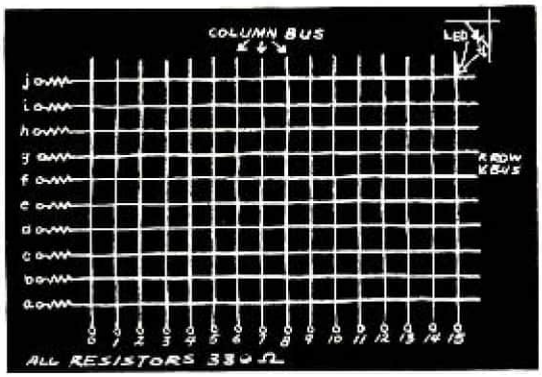

Fig. A. 10 x 16 160-element LED display.

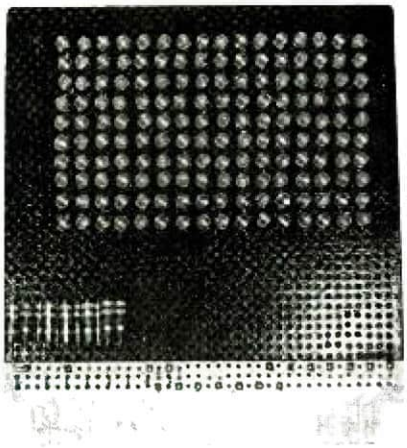

Fig. B. Prototype 160-element flat-screen LED array.

The following tips will simplify the assembly of the display board:

- Select LEDs with leads parallel to their viewing axis and make sure the leads fit the holes in the board you select.
- Test *each* LED *before* it is soldered in place. You can make a temporary test jig from a 6-volt battery, 330-ohm resistor and some clip leads.
- Install one column of ten LEDs at a time. Make sure the diodes are oriented as shown in Figure C. The cathode lead is usually indicated by a notch or flat area in the epoxy encapsulant.
- Bend the leads of each LED outward slightly on the back side of the board. Turn the board over and place it on two supports so the LEDs hang from their leads.
- Use a low-wattage iron and small-diameter solder to solder *one* lead of each LED to its copper foil pad. Turn the board over and make sure the LEDs are aligned properly. Then solder the remaining leads.

Follow these steps to solder all sixteen columns. Be sure to keep the LEDs perfectly aligned for best results. If you have trouble keeping the columns straight, tape a pencil to the board adjacent to each column while the diodes are being soldered.

Use tinned, small-diameter (e.g. No. 26) wire or stripped Wire-Wrap wire for the column and row buses. Solder the row buses first. The easiest way is to lay a wire along the anode leads in one row so the wire touches each solder pad. Then use a very small amount of solder to tack the wire to each pad. The column buses must be soldered *above* the row buses since the bus wires are uninsulated. Figure D is a small portion of the completed board.

The display board is completed by soldering lengths of Wire-Wrap wire from points a through f and 0 through 15 in Fig. A to the copper fingers on the board. Try to select an orderly pin-connection arrangement to simplify the interface to a driving circuit. The connection pattern can be considered a bus, and the bus connections for the prototype board that I built are listed according to the pin designations of a 44-terminal edge connector socket (the pin designations are marked on the socket):

LED Array Connection	S-44 Socket
0	7
1	8
2	9
3	10
4	11
5	12
6	13
7	14
8	15
9	16
10	17
11	18
12	19
13	20
14	21
15	22
a	A
b	B
c	C
d	D
e	E
f	F
g	H
h	J
i	K
j	L

This bus leaves plenty of spare lines that can be used by an array driving circuit. In the next Project of the Month, I will describe a driving circuit that uses the array as the screen of a solid-state experimental oscilloscope. ◇

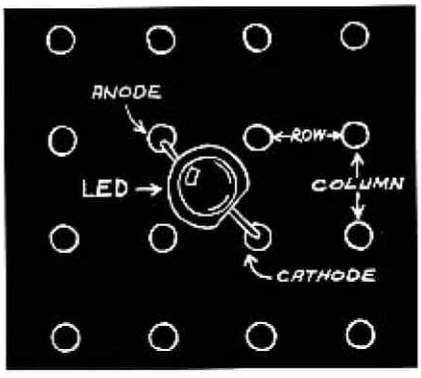

Fig. C. Orientation of individual LED in array.

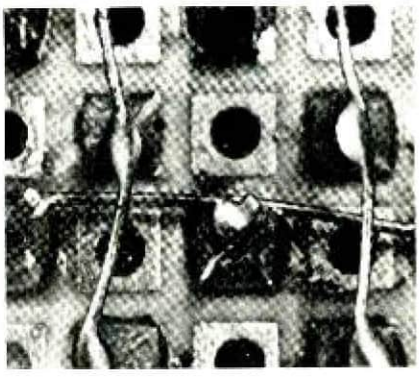

Fig. D. Row and column buses are soldered to LED leads on back of board.