

# CD4511B Types

## CMOS BCD-to-7-Segment Latch Decoder Drivers

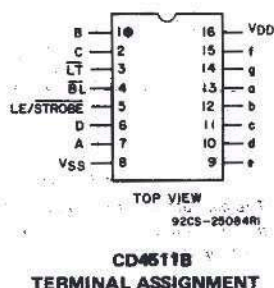
High-Voltage Types (20-Volt Rating)



■ CD4511B types are BCD-to-7-segment latch decoder drivers constructed with CMOS logic and n-p-n bipolar transistor output devices on a single monolithic structure. These devices combine the low quiescent power dissipation and high noise immunity features of RCA CMOS with n-p-n bipolar output transistors capable of sourcing up to 25 mA. This capability allows the CD4511B types to drive LED's and other displays directly.

Lamp Test (LT), Blanking (BL), and Latch Enable or Strobe inputs are provided to test the display, shut off or intensity-modulate it, and store or strobe a BCD code, respectively. Several different signals may be multiplexed and displayed when external multiplexing circuitry is used. The CD4511B is supplied in 16-lead hermetic dual-in-line ceramic packages (D and F suffixes), 16-lead dual-in-line plastic packages (E suffix), and in chip form (H suffix).

These devices are similar to the type MC14511.

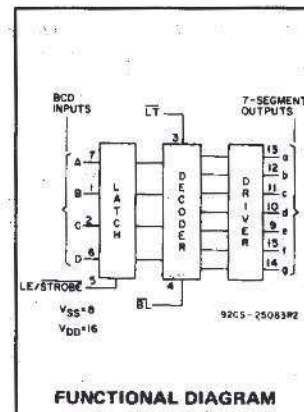


### Features:

- High-output-sourcing capability . . . . . up to 25 mA
- Input latches for BCD Code storage
- Lamp Test and Blanking capability
- 7-segment outputs blanked for BCD input codes > 1001
- 100% tested for quiescent current at 20 V
- Max. input current of 1  $\mu$ A at 18 V, over full package-temperature range, 100 nA at 18 V and 25°C
- 5-V, 10-V, and 15-V parametric ratings

### Applications:

- Driving common-cathode LED displays
- Multiplexing with common-cathode LED displays
- Driving incandescent displays
- Driving low-voltage fluorescent displays



### MAXIMUM RATINGS, Absolute-Maximum Values:

DC SUPPLY-VOLTAGE RANGE, ( $V_{DD}$ )	-.5V to +20V
Voltages referenced to $V_{SS}$ Terminal)	
INPUT VOLTAGE RANGE, ALL INPUTS	-.5V to $V_{DD}$ +0.5V
DC INPUT CURRENT, ANY ONE INPUT	$\pm 10$ mA
POWER DISSIPATION PER PACKAGE ( $P_D$ ):	
For $T_A = -55^\circ\text{C}$ to $+100^\circ\text{C}$	500 mW
For $T_A = +100^\circ\text{C}$ to $+125^\circ\text{C}$	Derate Linearly at 12 mW/ $^\circ\text{C}$ to 200 mW
DEVICE DISSIPATION PER OUTPUT TRANSISTOR	
FOR $T_A = \text{FULL PACKAGE-TEMPERATURE RANGE (All Package Types)}$	100 mW
OPERATING-TEMPERATURE RANGE ( $T_A$ )	$-55^\circ\text{C}$ to $+125^\circ\text{C}$
STORAGE TEMPERATURE RANGE ( $T_{stg}$ )	$-65^\circ\text{C}$ to $+150^\circ\text{C}$
LEAD TEMPERATURE (DURING SOLDERING):	
At distance 1/16 $\pm$ 1/32 inch (1.58 $\pm$ 0.79 mm) from case for 10s max	$+265^\circ\text{C}$

### OPERATING CONDITIONS AT $T_A = 25^\circ\text{C}$ Unless Otherwise Specified

For maximum reliability, nominal operating conditions should be selected so that operation is always within the following ranges

Characteristic	$V_{DD}$	Min.	Max.	Units
Supply Voltage Range ( $T_A$ ): (Full Package Temperature Range)	—	3	18	V
Set-Up Time ( $t_S$ )	5	150	—	ns
	10	70	—	ns
	15	40	—	ns
Hold Time ( $t_H$ )	5	0	—	ns
	10	0	—	ns
	15	0	—	ns
Strobe Pulse Width ( $t_W$ )	5	400	—	ns
	10	160	—	ns
	15	100	—	ns



# CD4511B Types

## STATIC ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	TEST CONDITIONS				LIMITS AT INDICATED TEMPERATURES (°C)							Units
	I <sub>OH</sub> (mA)	V <sub>O</sub> (V)	V <sub>IN</sub> (V)	V <sub>DD</sub> (V)	+25							
					-55	-40	+85	+125	Min.	Typ.	Max.	
Quiescent Device Current: I <sub>DD</sub> Max.	—	—	—	5	5	5	150	150	—	0.04	5	μA
	—	—	—	10	10	10	300	300	—	0.04	10	
	—	—	—	15	20	20	600	600	—	0.04	20	
	—	—	—	20	100	100	3000	3000	—	0.08	100	
Output Voltage:	—	—	0.5	5	0.05				—	0	0.05	V
Low-Level V <sub>OL</sub> Max.	—	—	0.10	10	0.05				—	0	0.05	
	—	—	0.15	15	0.05				—	0	0.05	
High-Level V <sub>OH</sub> Min.	—	—	0.5	5	4	4	4.2	4.2	4.1	4.55	—	V
	—	—	0.10	10	9	9	9.2	9.2	9.1	9.55	—	
	—	—	0.15	15	14	14	14.2	14.2	14.1	14.55	—	V
Input Low Voltage, V <sub>IL</sub> Max.	—	0.5,3.8	—	5	1.5				—	—	1.5	
	—	1.8,8	—	10	3				—	—	3	
	—	1.5,13.8	—	15	4				—	—	4	
Input High Voltage, V <sub>IH</sub> Min.	—	0.5,3.8	—	5	3.5				3.5	—	—	V
	—	1.8,8	—	10	7				7	—	—	
	—	1.5,13.8	—	15	11				11	—	—	
Output Drive Voltage: High Level V <sub>OH</sub> Min.	0	—	—	5	4.0	4.0	4.20	4.20	4.10	4.55	—	V
	5	—	—		—	—	—	—	—	4.25	—	
	10	—	—		3.80	3.80	3.90	3.90	3.90	4.10	—	
	15	—	—		—	—	3.50	3.50	—	3.95	—	
	20	—	—		3.55	3.55	3.30	—	3.40	3.75	—	
	25	—	—	10	3.40	3.40	—	—	3.10	3.55	—	V
	0	—	—		9.0	9.0	9.20	9.20	9.10	9.55	—	
	5	—	—		—	—	—	—	—	9.25	—	
	10	—	—		8.85	8.85	9.00	9.00	9.00	9.15	—	
	15	—	—		—	—	—	—	—	9.05	—	
	20	—	—	15	8.70	8.70	8.40	8.40	8.60	8.90	—	V
	25	—	—		8.60	8.60	—	—	8.30	8.75	—	
	0	—	—		14.0	14.0	14.20	14.20	14.10	14.55	—	
	5	—	—		—	—	—	—	—	14.30	—	
	10	—	—		13.90	13.90	14.0	14.0	14.0	14.20	—	
	15	—	—	15	—	—	—	—	—	14.10	—	V
	20	—	—		13.75	13.75	13.50	13.50	13.70	13.95	—	
	25	—	—		13.65	13.65	—	—	13.50	13.80	—	
		—	—		—	—	—	—	—	—	—	
Output Low (Sink) Current, I <sub>OL</sub> Min.	—	0.4	0.5	5	0.64	0.61	0.42	0.36	0.51	1	—	mA
	—	0.5	0.10	10	1.6	1.5	1.1	0.9	1.3	2.6	—	
	—	1.5	0.15	15	4.2	4	2.8	2.4	3.4	6.8	—	
Input Current, I <sub>IN</sub> Max.	—	0.18	0.18	18	±0.1	±0.1	±1	±1	—	±10 <sup>-5</sup>	±0.1	μA

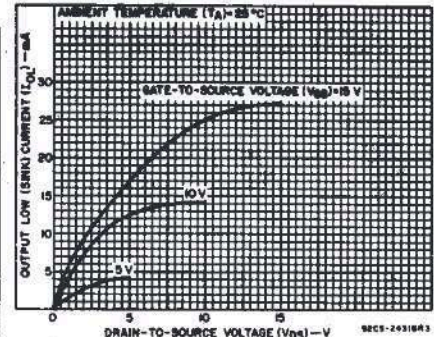


Fig. 1 - Typical output low (sink) current characteristics.

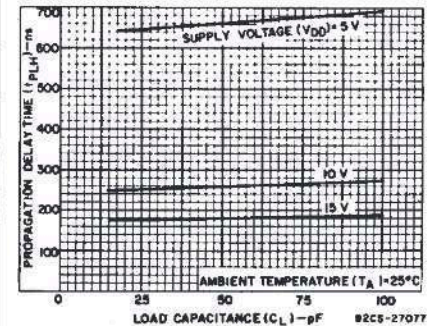


Fig. 2 - Typical data-to-output, low-to-high-level propagation delay time as a function of load capacitance.

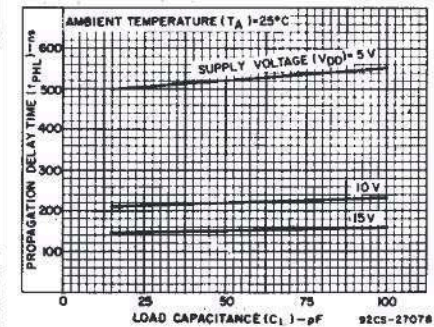


Fig. 3 - Typical data-to-output, high-to-low-level propagation delay time as a function of load capacitance.

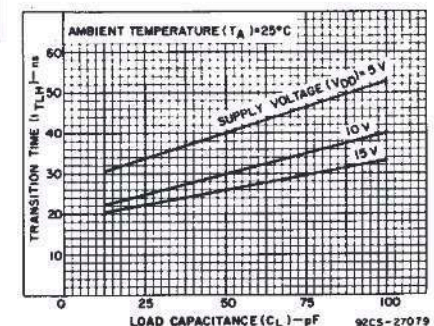


Fig. 4 - Typical low-to-high-level transition time as a function of load capacitance.

## CD4511B Types

DYNAMIC ELECTRICAL CHARACTERISTICS at  $T_A = 25^\circ\text{C}$ , Input  $t_r, t_f = 20\text{ ns}$ ,  
 $C_L = 50\text{ pF}$ ,  $R_L = 200\text{ k}\Omega$

CHARACTERISTIC	Test Conditions	LIMITS All Packages			UNITS
		$V_{DD}$ Volts	Min.	Typ.	Max.
Propagation Delay Time: (Data) High-to-Low Level, $t_{PHL}$	5	—	—	520	1040
	10	—	—	210	420
	15	—	—	150	300
Low-to-High Level, $t_{PLH}$	5	—	—	660	1320
	10	—	—	260	520
	15	—	—	180	360
Propagation Delay Time: (BL) High-to-Low Level, $t_{PHL}$	5	—	—	350	700
	10	—	—	175	350
	15	—	—	125	250
Low-to-High Level, $t_{PLH}$	5	—	—	400	800
	10	—	—	175	350
	15	—	—	150	300
Propagation Delay Time: (LT) High-to-Low Level, $t_{PHL}$	5	—	—	250	500
	10	—	—	125	250
	15	—	—	85	170
Low-to-High Level, $t_{PLH}$	5	—	—	150	300
	10	—	—	75	150
	15	—	—	50	100
Transition Time: Low-to-High Level, $t_{TLH}$	5	—	—	40	80
	10	—	—	30	60
	15	—	—	25	50
High-to-Low Level, $t_{THL}$	5	—	—	125	310
	10	—	—	75	185
	15	—	—	65	160
Minimum Set-Up Time, $t_S$	5	150	75	—	—
	10	70	35	—	—
	15	40	20	—	—
Minimum Hold Time, $t_H$	5	0	-75	—	—
	10	0	-35	—	—
	15	0	-20	—	—
Strobe Pulse Width, $t_W$	5	400	200	—	—
	10	160	80	—	—
	15	100	50	—	—
Input Capacitance, $C_{IN}$		—	5	7.5	pF

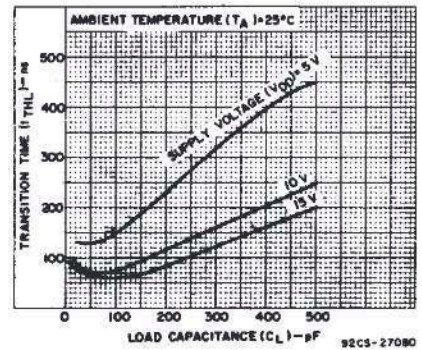


Fig. 5 - Typical high-to-low transition time as a function of load capacitance.

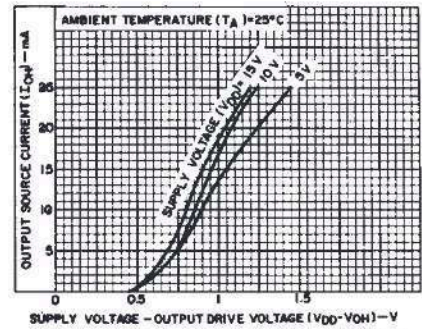


Fig. 6 - Typical voltage drop ( $V_{DD}$  to output) vs. output source current as a function of supply.

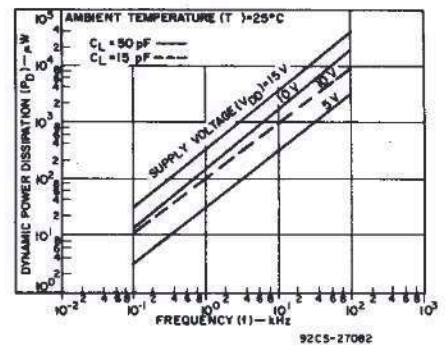


Fig. 7 - Typical dynamic power dissipation characteristics.



# CD4511B Types

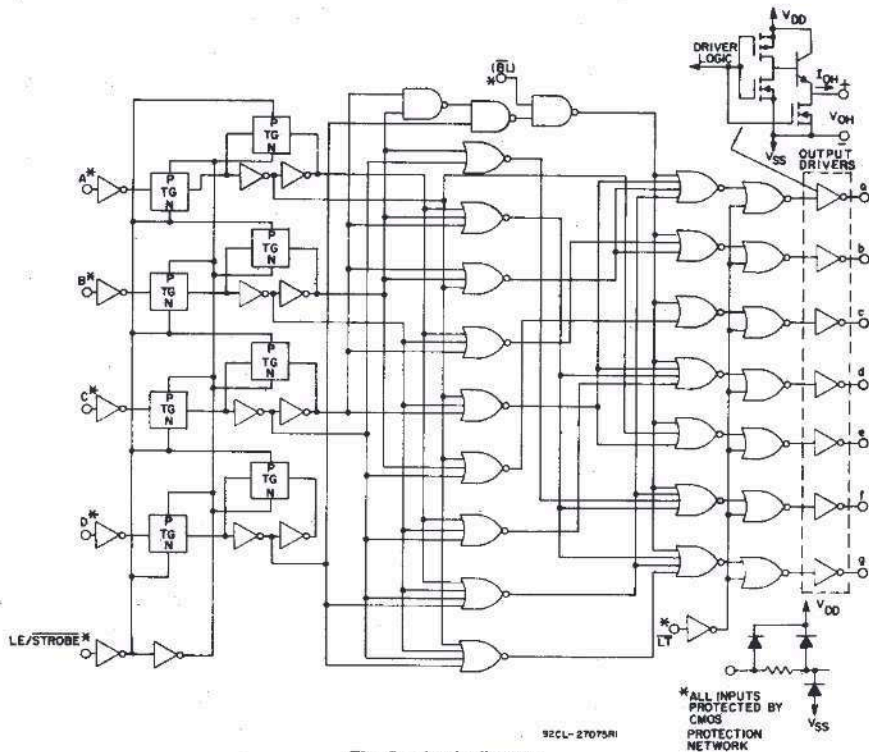


Fig. 8 - Logic diagram.

TRUTH TABLE														
LE	BI	LT	D	C	B	A	a	b	c	d	e	f	g	Display
X	X	0	X	X	X	X	1	1	1	1	1	1	1	8
X	0	1	X	X	X	X	0	0	0	0	0	0	0	Blank
0	1	1	0	0	0	0	1	1	1	1	1	1	0	0
0	1	1	0	0	0	1	0	1	1	0	0	0	0	1
0	1	1	0	0	1	0	1	1	0	1	1	0	1	2
0	1	1	0	0	1	1	1	1	1	0	0	0	1	3
0	1	1	0	1	0	0	0	1	1	0	0	1	1	4
0	1	1	0	1	0	1	1	0	1	1	0	1	1	5
0	1	1	0	1	1	0	0	0	1	1	1	1	1	6
0	1	1	0	1	1	1	1	1	0	0	0	0	0	7
0	1	1	1	0	0	0	1	1	1	1	1	1	1	8
0	1	1	1	0	0	1	1	1	0	0	1	1	1	9
0	1	1	1	0	1	0	0	0	0	0	0	0	0	Blank
0	1	1	1	0	1	1	0	0	0	0	0	0	0	Blank
0	1	1	1	1	0	0	0	0	0	0	0	0	0	Blank
0	1	1	1	1	0	1	0	0	0	0	0	0	0	Blank
0	1	1	1	1	1	0	0	0	0	0	0	0	0	Blank
1	1	1	X	X	X	X			*					*

X = Don't Care \* Depends on BCD code previously applied when LE = 0

Note: Display is blank for all illegal input codes (BCD > 1001).

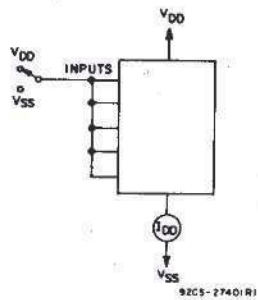


Fig. 9 - Quiescent device current.

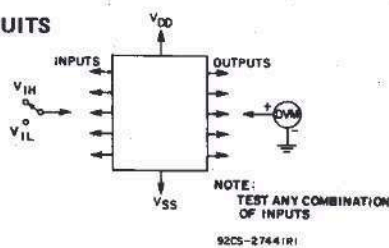


Fig. 10 - Input voltage.

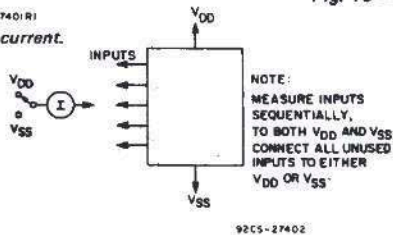


Fig. 11 - Input current.

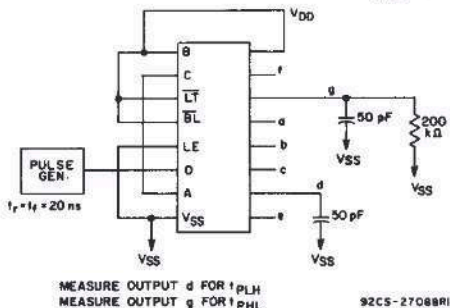


Fig. 12 - Data propagation delay.

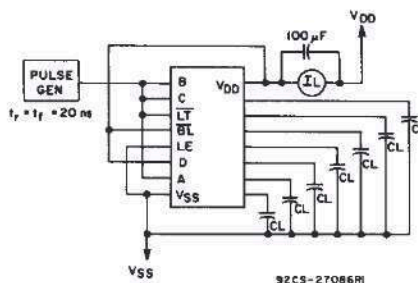


Fig. 13 - Dynamic power dissipation.

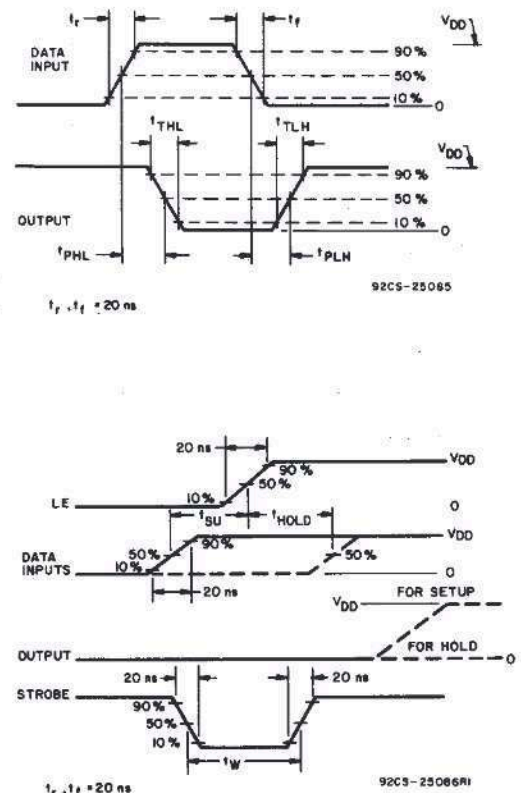
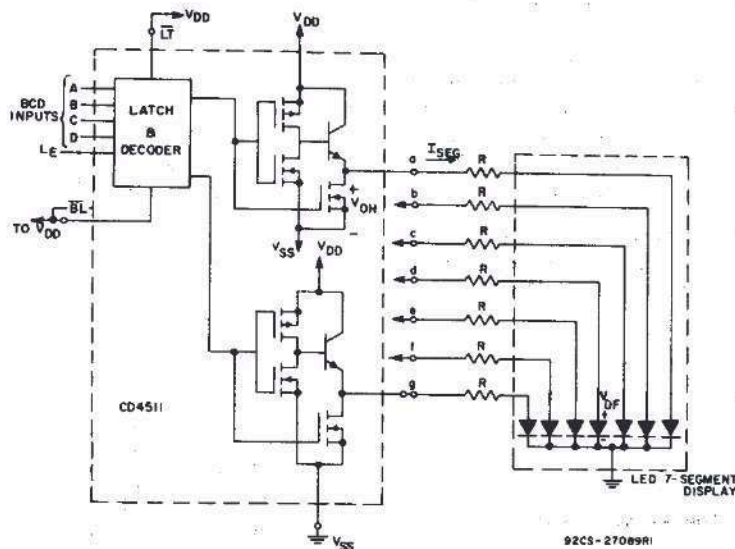


Fig. 14 - Dynamic waveforms.

## CD4511B Types

### APPLICATIONS Interfacing with Various Displays

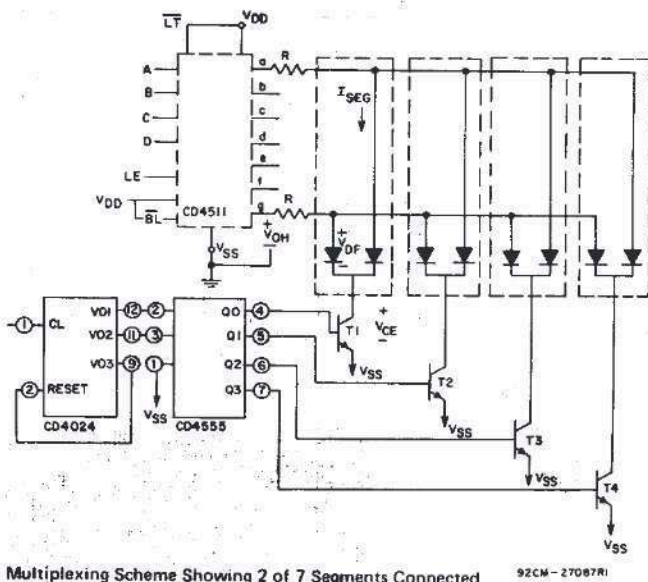


Duty Cycle = 100%

$I_{SEG} = I_{DIODE\ AVG} = 20\text{ mA at Luminous Intensity/Segment} = 250\text{ microcandles}$

$$R = \frac{V_{OH} - V_{DF}}{I_{SEG}}$$

Fig. 15 - Driving common-cathode 7-segment LED displays (example Hewlett-Packard 5082-7740).



Multiplexing Scheme Showing 2 of 7 Segments Connected

Transistors  $T_1$ – $T_4$  (RCA-2N3053 or 2N2102) have  $I_C$  Max. rating  $> 7 \times I_{SEG}$

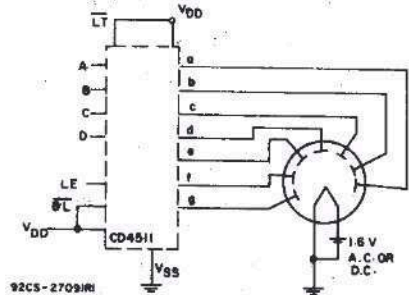
Duty Cycle = 25%

$$I_{SEG} = (I_{DIODE\ AVG}) \times 4$$

$$R = \frac{(V_{OH} - V_{DF} - V_{CE})}{I_{SEG}}$$

All unused inputs on CD4555 are connected to  $V_{DD}$  or  $V_{SS}$ .

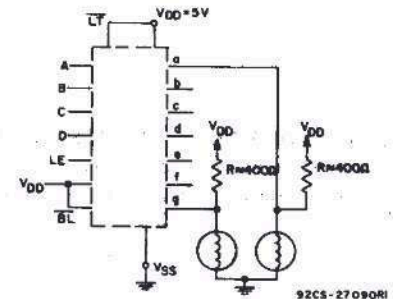
Fig. 18 - Multiplexing with common-cathode 7-segment LED displays (example Hewlett-Packard 5082-7404 4 character display or 4 discrete Monosanto Man 3 displays).



A medium-brightness intensity display can be obtained with low-voltage fluorescent displays such as the Tung-Sol Digivac S/G\*\* Series.

\*\*Trademark Tung-Sol Division Wagner Electric Co.

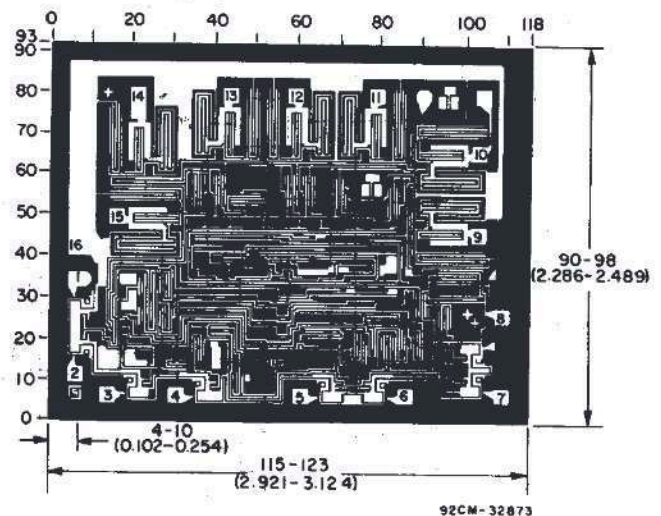
Fig. 16 - Driving low-voltage fluorescent displays.



2 of 7 Segments Shown Connected

Resistors R from  $V_{DD}$  to each 7-segment driver output are chosen to keep all Numitron segments slightly on and warm.

Fig. 17 - Driving incandescent displays (RCA Numitron DR2000 series displays).



Dimensions and pad layout for CD4511B chip.

Dimensions in parentheses are in millimeters and are derived from the basic inch dimensions as indicated. Grid graduations are in mils ( $10^{-3}$  inch).

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