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Jameco Part Number 13493ISL

CMOS BCD-to-7-Segment Latch Decoder Drivers

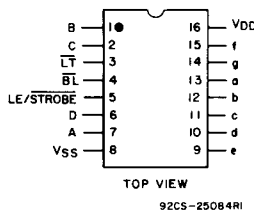
High-Voltage Types (20-Volt Rating)



■ 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 (\overline{LT}), Blanking (\overline{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.



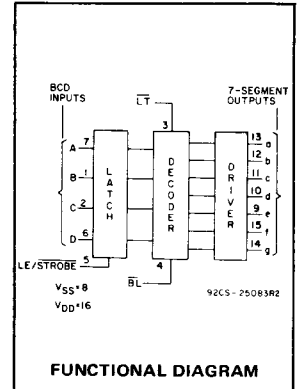
CD4511B
TERMINAL ASSIGNMENT

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 $1 \mu\text{A}$ 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})	
Voltages referenced to V_{SS} Terminal)	-0.5V to +20V
INPUT VOLTAGE RANGE, ALL INPUTS	-0.5V to $V_{DD} + 0.5V$
DC INPUT CURRENT, ANY ONE INPUT	$\pm 10\text{mA}$
POWER DISSIPATION PER PACKAGE (P_D):	
For $T_A = -55^\circ\text{C}$ to $+100^\circ\text{C}$	500mW
For $T_A = +100^\circ\text{C}$ to $+125^\circ\text{C}$	Derate Linearly at 12mW/ $^\circ\text{C}$ to 200mW
DEVICE DISSIPATION PER OUTPUT TRANSISTOR	
FOR $T_A = \text{FULL PACKAGE-TEMPERATURE RANGE (All Package Types)}$	100mW
OPERATING-TEMPERATURE RANGE (T_A)	-55°C to $+125^\circ\text{C}$
STORAGE TEMPERATURE RANGE (T_{stg})	-65°C to $+150^\circ\text{C}$
LEAD TEMPERATURE (DURING SOLDERING):	
At distance $1/16 \pm 1/32$ inch ($1.59 \pm 0.79\text{mm}$) 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

3
COMMERCIAL CMOS
HIGH VOLTAGE ICs

CD4511B Types

STATIC ELECTRICAL CHARACTERISTICS

CHARACTERISTIC	TEST CONDITIONS				LIMITS AT INDICATED TEMPERATURES (°C)							Units	
	I_{OH} (mA)	V_o (V)	V_{IN} (V)	V_{DD} (V)	-55	-40	+85	+125	+25				
									Min.	Typ.	Max.		
Quiescent Device Current: I_{DD} 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: Low Level V_{OL} Max.	-	-	0.5	5	0.05				-	0	0.05	V	
	-	-	0.10	10	0.05				-	0	0.05		
	-	-	0.15	15	0.05				-	0	0.05		
High Level V_{OH} 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	-		
Input Low Voltage, V_{IL} Max.	-	0.5, 3.8	-	5	1.5				-	-	1.5	V	
	-	1.8, 8	-	10	3				-	-	3		
Input High Voltage, V_{IH} Min.	-	0.5, 3.8	-	5	3.5				3.5	-	-	V	
	-	1.8, 8	-	10	7				7	-	-		
Output Drive Voltage: High Level V_{OH} 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	3.90	4.10		-
	15	-	-		-	-	3.50	3.50	-	-	3.95		-
	20	-	-		3.55	3.55	3.30	-	-	3.40	3.75		-
	25	-	-		3.40	3.40	-	-	-	3.10	3.55		-
	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	-	-	8.70	8.70	8.40	8.40	8.60	8.90	-	-		
	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	-	-	-	-	-	-	-	-	14.10	-		
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_{OL} 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_{IN} Max.	-	0.18	0.18	18	± 0.1	± 0.1	± 1	± 1	-	$\pm 10^{-5}$	± 0.1	μA	

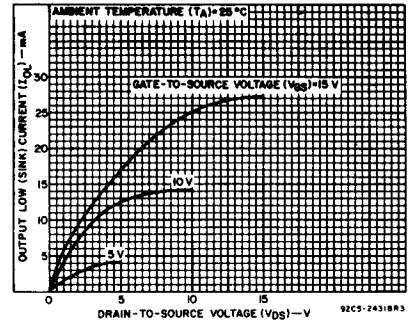


Fig. 1 - Typical output low (sink) current characteristics.

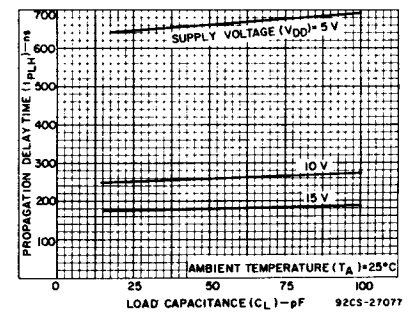


Fig. 2 - Typical data-to-output, low-to-high-level propagation delay time as a function of load capacitance.

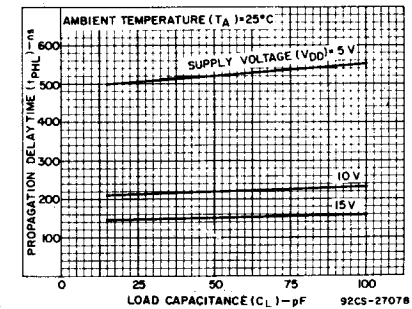


Fig. 3 - Typical data-to-output, high-to-low-level propagation delay time as a function of load capacitance.

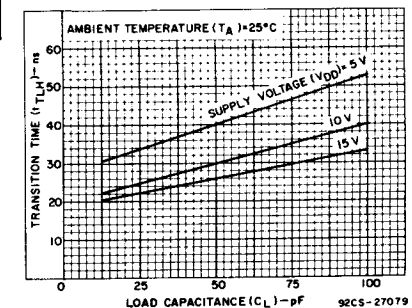


Fig. 4 - Typical low-to-high-level transition time as a function of load capacitance.

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

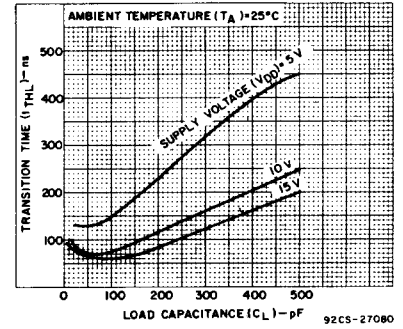


Fig. 5 – Typical high-to-low transition time as a function of load capacitance.

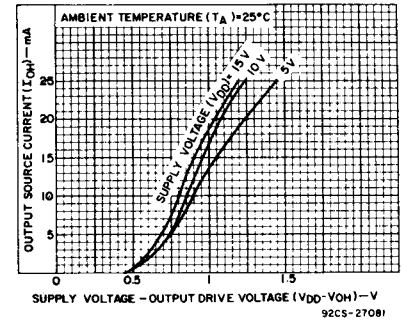


Fig. 6 – Typical voltage drop (V_{DD} to output) vs. output source current as a function of supply.

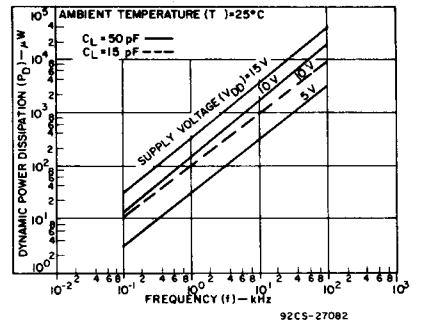


Fig. 7 – Typical dynamic power dissipation characteristics.

3
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 HIGH VOLTAGE ICs

CD4511B Types

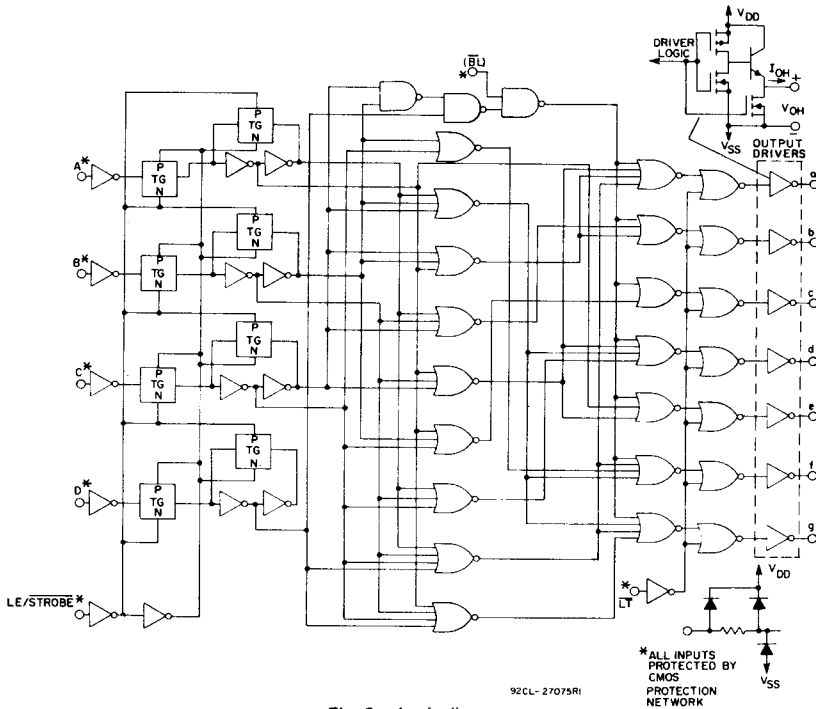


Fig. 8 - Logic diagram.

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	1	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	1	0	0	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
0	1	1	1	1	1	1	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).

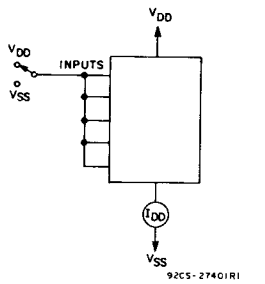


Fig. 9 - Quiescent device current.

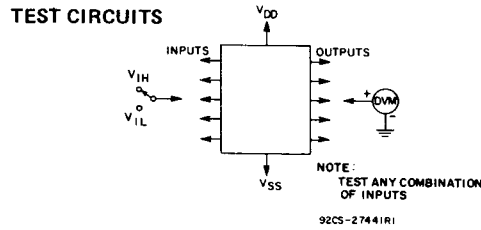


Fig. 10 - Input voltage.

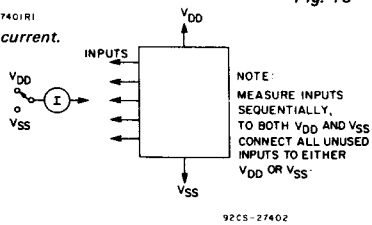


Fig. 11 - Input current.

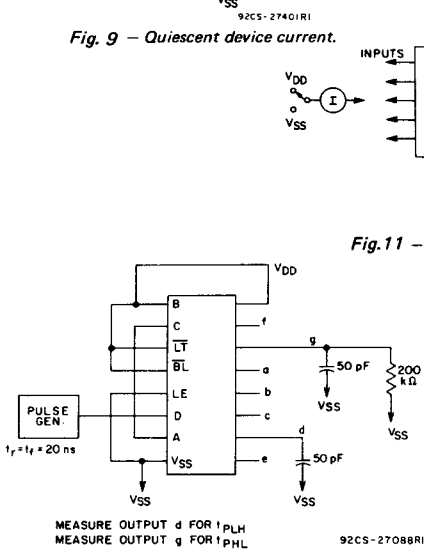


Fig. 12 - Data propagation delay.

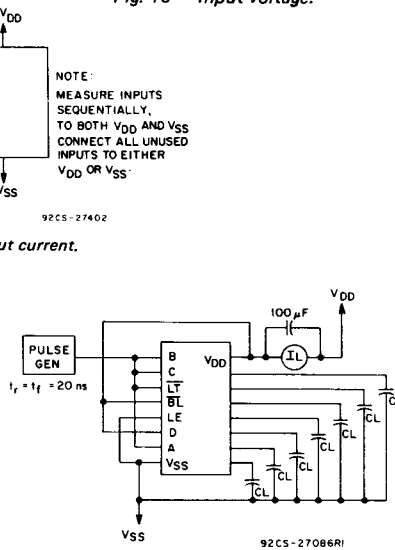


Fig. 13 - Dynamic power dissipation.

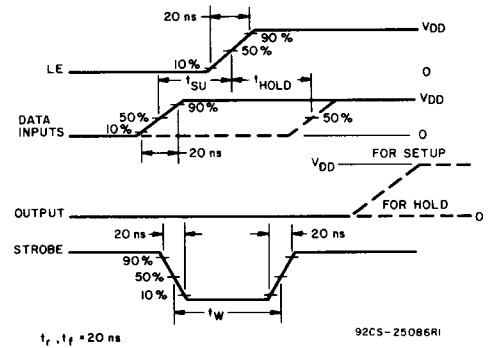
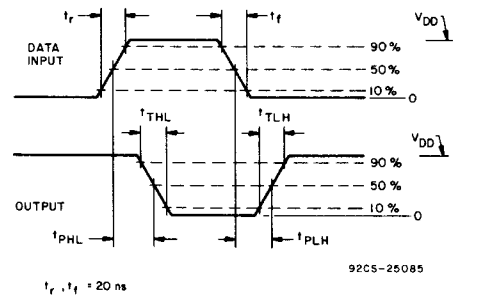
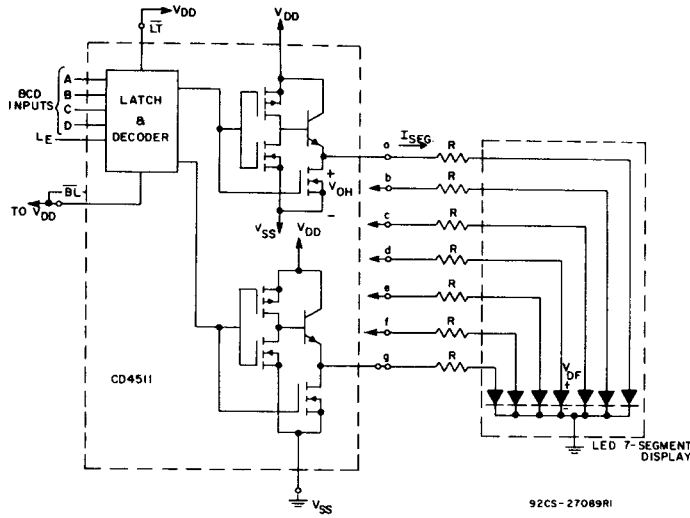


Fig. 14 - Dynamic waveforms.

CD4511B Types

APPLICATIONS Interfacing with Various Displays

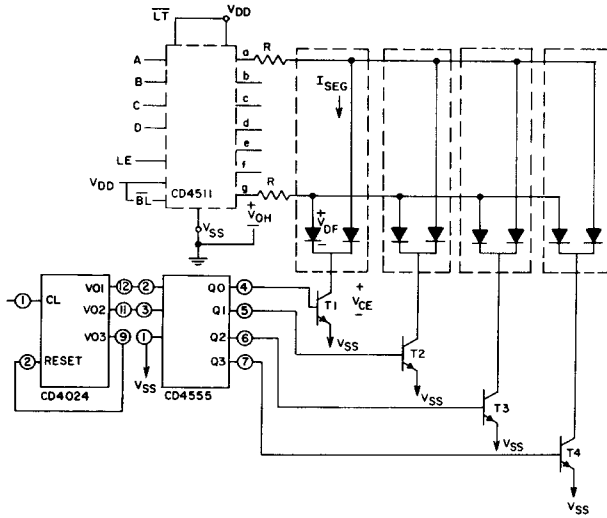


Duty Cycle = 100%

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

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

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



Multiplexing Scheme Showing 2 of 7 Segments Connected
Transistors T₁-T₄ (RCA-2N3053 or 2N2102) have I_C Max. rating > 7x I_{SEG}

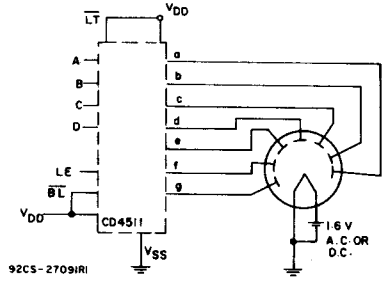
Duty Cycle = 25%

$$I_{SEG} = [I_{DIODEAVG}] \times 4$$

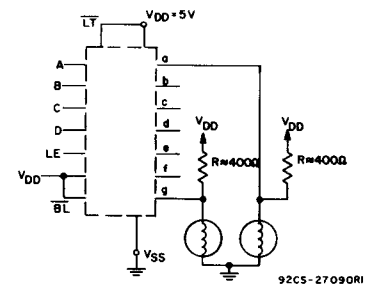
$$R = \frac{(V_{OH} - V_{DF} - V_{CE})}{I_{SEG}}$$

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

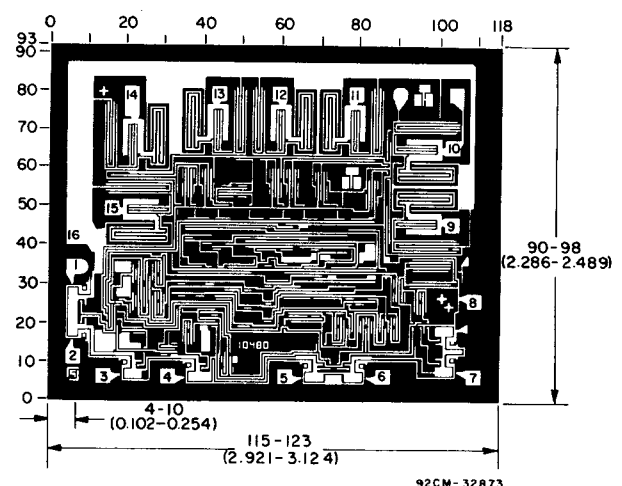
Fig. 18 - Multiplexing with common-cathode 7-segment LED displays (example Hewlett-Packard 5082-7404 4 character display or 4 discrete Monosanto Man 3 displays).



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.

3
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