CD4511 BCD-to-7 Segment Latch/Decoder/Driver

General Description

The CD4511 BCD-to-seven segment latch/decoder/drive r is constructed with complementary MOS (CMOS) enha ncement mode devices and NPN bipolar out-put drivers in a single monolithic structure. The circuit pro-vides the func tions of a 4-bit storage latch, an 8421 BCD-to-seven segme nt decoder, and an output drive capability.Lamp test (LT), blanking (BI), and latch enable (LE) inputs are used to t est the display, to turn-off or pulse modulate the brightne ss of the display, and to store a BCD code,respectively . It can be used with seven-segment light emit-ting diodes (LED), incandescent, fluorescent, gas discharge,or liquid cry stal readouts either directly or indirectly.

Applications include instrument (e.g., counter, DVM, etc.) display driver, computer/calculator display driver, cockpit display driver, and various clock, watch, and timer uses.

Features

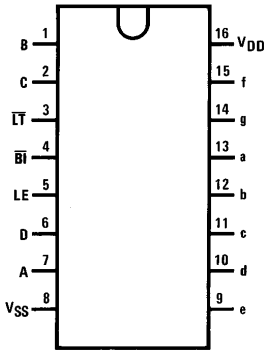
- Low logic circuit power dissipation
- High current sourcing outputs (up to 25 mA)
- Latch storage of code
- Blanking input
- Lamp test provision
- Readout blanking on all illegal input combinations
- Lamp intensity modulation capability
- Time share (multiplexing) facility
- Equivalent to Motorola MC14511

ORDERING INFORMATION

DEVICE	Package Type	MARKING	Packing	Packing Qty
CD4511BE	DIP-16L	CD4511B	TUBE	1000pcs/box
CD4511BM/TR	SOP-16L	CD4511B	REEL	2500pcs/reel

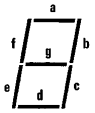
Connection Diagram

Dual-In-Line Package



DIP16/SOP16L
Top View

Segment Identification



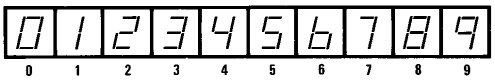
Truth Table

Inputs							Outputs							
LE	$\overline{BI}$	$\overline{LT}$	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	B
X	0	1	X	X	X	X	0	0	0	0	0	0	0	
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	1	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	1	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	
0	1	1	1	0	1	1	0	0	0	0	0	0	0	
0	1	1	1	1	0	0	0	0	0	0	0	0	0	
0	1	1	1	1	0	1	0	0	0	0	0	0	0	
0	1	1	1	1	1	0	0	0	0	0	0	0	0	
0	1	1	1	1	1	1	0	0	0	0	0	0	0	
1	1	1	X	X	X	X				*				*

X = Don't Care

*Depends upon the BCD code applied during the 0 to 1 transition of LE.

Display



Absolute Maximum Ratings

DC Supply Voltage (V_{DD})	−0.5V to +18V
Input Voltage (V_{IN})	−0.5V to V_{DD} +0.5V
Storage Temperature Range (T_S)	−65°C to +150°C
Power Dissipation (P_D)	
Dual-In-Line	700 mW
Small Outline	500 mW
Lead Temperature (T_L)	
(Soldering, 10 seconds)	260°C

Recommended Operating Conditions (Note 2)

DC Supply Voltage (V_{DD})	3V to 15V
Input Voltage (V_{IN})	0V to V_{DD}
Operating Temperature Range (T_A)	−40°C to +85°C

DC Electrical Characteristics

Symbol	Parameter	Conditions	−40°C		+25°C			+85°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
I_{DD}	Quiescent Supply Current	V_{DD} = 5V, V_{IN} = V_{DD} or V_{SS}		5			5		150	μA
		V_{DD} = 10V, V_{IN} = V_{DD} or V_{SS}		10			10		300	μA
		V_{DD} = 15V, V_{IN} = V_{DD} or V_{SS}		20			20		600	μA
V_{OL}	Output Voltage Logical "0" Level	V_{DD} = 5V		0.01		0	0.01		0.05	V
		V_{DD} = 10V		0.01		0	0.01		0.05	V
		V_{DD} = 15V		0.01		0	0.01		0.05	V
V_{OH}	Output Voltage Logical "1" Level	V_{DD} = 5V	4.1		4.1	4.57		4.1		V
		V_{DD} = 10V	9.1		9.1	9.58		9.1		V
		V_{DD} = 15V	14.1		14.1	14.59		14.1		V
V_{IL}	Low Level Input Voltage	V_{DD} = 5V, V_{OUT} = 3.8V or 0.5V		1.5		2	1.5		1.5	V
		V_{DD} = 10V, V_{OUT} = 8.8V or 1.0V		3.0		4	3.0		3.0	V
		V_{DD} = 15V, V_{OUT} = 13.8V or 1.5V		4.0		6	4.0		4.0	V
V_{IH}	High Level Input Voltage	V_{DD} = 5V, V_{OUT} = 0.5V or 3.8V	3.5		3.5	3		3.5		V
		V_{DD} = 10V, V_{OUT} = 1.0V or 8.8V	7.0		7.0	6		7.0		V
		V_{DD} = 15V, V_{OUT} = 1.5V or 13.8V	11.0		11.0	9		11.0		V
V_{OH}	Output (Source) Drive Voltage	V_{DD} = 5V, I_{OH} = 0 mA	4.1		4.1	4.57		4.1		V
		V_{DD} = 5V, I_{OH} = 5 mA				4.24				V
		V_{DD} = 5V, I_{OH} = 10 mA	3.9		3.9	4.12		3.5		V
		V_{DD} = 5V, I_{OH} = 15 mA				3.94				V
		V_{DD} = 5V, I_{OH} = 20 mA	3.4		3.4	3.75		3.0		V
		V_{DD} = 5V, I_{OH} = 25 mA				3.54				V
		V_{DD} = 10V, I_{OH} = 0 mA	9.1		9.1	9.58		9.1		V
		V_{DD} = 10V, I_{OH} = 5 mA				9.26				V
		V_{DD} = 10V, I_{OH} = 10 mA	9.0		9.0	9.17		8.6		V
		V_{DD} = 10V, I_{OH} = 15 mA				9.04				V
		V_{DD} = 10V, I_{OH} = 20 mA	8.6		8.6	8.9		8.2		V
		V_{DD} = 10V, I_{OH} = 25 mA				8.75				V
		V_{DD} = 15V, I_{OH} = 0 mA	14.1		14.1	9.58		14.1		V
		V_{DD} = 15V, I_{OH} = 5 mA				14.27				V
		V_{DD} = 15V, I_{OH} = 10 mA	14.0		14.0	14.17		13.6		V
		V_{DD} = 15V, I_{OH} = 15 mA				14.07				V
		V_{DD} = 15V, I_{OH} = 20 mA	13.6		13.6	13.95		13.2		V
		V_{DD} = 15V, I_{OH} = 25 mA				13.8				V
I_{OL}	Low Level Output Current	V_{DD} = 5V, V_{OL} = 0.4V	0.64		0.51	0.88		0.36		mA
		V_{DD} = 10V, V_{OL} = 0.5V	1.6		1.3	2.25		0.9		mA
		V_{DD} = 15V, V_{OL} = 1.5V	4.2		3.4	8.8		2.4		mA
I_{IN}	Input Current	V_{DD} = 15V, V_{IN} = 0V		−0.10		-10^{-5}	−0.10		−1.0	μA
		V_{DD} = 15V, V_{IN} = 15V		0.10		10^{-5}	0.10		1.0	μA

Note 1: Devices should not be connected with power on.

DC Electrical Characteristics

Symbol	Parameter	Conditions	−40°C		+25°C			+85°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
I_{DD}	Quiescent Supply Current	V_{DD} = 5V		20			20		150	μA
		V_{DD} = 10V		40			40		300	μA
		V_{DD} = 15V		80			80		600	μA
V_{OL}	Output Voltage Logical "0" Level	V_{DD} = 5V		0.01		0	0.01		0.05	V
		V_{DD} = 10V		0.01		0	0.01		0.05	V
		V_{DD} = 15V		0.01		0	0.01		0.05	V
V_{OH}	Output Voltage Logical "1" Level	V_{DD} = 5V	4.1		4.1	4.57		4.1		V
		V_{DD} = 10V	9.1		9.1	9.58		9.1		V
		V_{DD} = 15V	14.1		14.1	14.59		14.1		V
V_{IL}	Low Level Input Voltage	V_{DD} = 5V, V_{OUT} = 3.8V or 0.5V		1.5		2	1.5		1.5	V
		V_{DD} = 10V, V_{OUT} = 8.8V or 1.0V		3.0		4	3.0		3.0	V
		V_{DD} = 15V, V_{OUT} = 13.8V or 1.5V		4.0		6	4.0		4.0	V
V_{IH}	High Level Input Voltage	V_{DD} = 5V, V_{OUT} = 0.5V or 3.8V	3.5		3.5	3		3.5		V
		V_{DD} = 10V, V_{OUT} = 1.0V or 8.8V	7.0		7.0	6		7.0		V
		V_{DD} = 15V, V_{OUT} = 1.5V or 13.8V	11.0		11.0	9		11.0		V
V_{OH}	Output (Source) Drive Voltage	V_{DD} = 5V, I_{OH} = 0 mA	4.1		4.1	4.57		4.1		V
		V_{DD} = 5V, I_{OH} = 5 mA				4.24				V
		V_{DD} = 5V, I_{OH} = 10 mA	3.6		3.6	4.12		3.3		V
		V_{DD} = 5V, I_{OH} = 15 mA				3.94				V
		V_{DD} = 5V, I_{OH} = 20 mA	2.8		2.8	3.75		2.5		V
		V_{DD} = 5V, I_{OH} = 25 mA				3.54				V
		V_{DD} = 10V, I_{OH} = 0 mA	9.1		9.1	9.58		9.1		V
		V_{DD} = 10V, I_{OH} = 5 mA				9.26				V
		V_{DD} = 10V, I_{OH} = 10 mA	8.75		8.75	9.17		8.45		V
		V_{DD} = 10V, I_{OH} = 15 mA				9.04				V
		V_{DD} = 10V, I_{OH} = 20 mA	8.1		8.1	8.9		7.8		V
		V_{DD} = 10V, I_{OH} = 25 mA				8.75				V
		V_{DD} = 15V, I_{OH} = 0 mA	14.1		14.1	14.59		14.1		V
		V_{DD} = 15V, I_{OH} = 5 mA				14.27				V
		V_{DD} = 15V, I_{OH} = 10 mA	13.75		13.75	14.18		13.45		V
		V_{DD} = 15V, I_{OH} = 15 mA				14.07				V
		V_{DD} = 15V, I_{OH} = 20 mA	13.1		13.1	13.95		12.8		V
		V_{DD} = 15V, I_{OH} = 25 mA				13.8				V
I_{OL}	Low Level Output Current	V_{DD} = 5V, V_{OL} = 0.4V	0.52		0.44	0.88		0.36		mA
		V_{DD} = 10V, V_{OL} = 0.5V	1.3		1.1	2.25		0.9		mA
		V_{DD} = 15V, V_{OL} = 1.5V	3.6		3.0	8.8		2.4		mA
I_{IN}	Input Current	V_{DD} = 15V, V_{IN} = 0V		−0.30		-10^{-5}	−0.30		−1.0	μA
		V_{DD} = 15V, V_{IN} = 15V		0.30		10^{-5}	0.30		1.0	μA

AC Electrical Characteristics*

T_A = 25°C and C_L = 50 pF, typical temperature coefficient for all values of V_{DD} = 0.3%/°C

Symbol	Parameter	Conditions	CD4511B			Units
			Min	Typ	Max	
C_{IN}	Input Capacitance	V_{IN} = 0		5.0	7.5	pF
t_r	Output Rise Time *(Figure 1a)*	V_{DD} = 5V V_{DD} = 10V V_{DD} = 15V		40 30 25	80 60 50	ns ns ns
t_f	Output Fall Time *(Figure 1a)*	V_{DD} = 5V V_{DD} = 10V V_{DD} = 15V		125 75 65	250 150 130	ns ns ns
t_{PLH}	Turn-Off Delay Time (Data) *(Figure 1a)*	V_{DD} = 5V V_{DD} = 10V V_{DD} = 15V		640 250 175	1280 500 350	ns ns ns
t_{PHL}	Turn-On Delay Time (Data) *(Figure 1a)*	V_{DD} = 5V V_{DD} = 10V V_{DD} = 15V		720 290 195	1440 580 400	ns ns ns
t_{PLH}	Turn-Off Delay Time (Blank) *(Figure 1a)*	V_{DD} = 5V V_{DD} = 10V V_{DD} = 15V		320 130 100	640 260 200	ns ns ns
t_{PHL}	Turn-On Delay Time (Blank) *(Figure 1a)*	V_{DD} = 5V V_{DD} = 10V V_{DD} = 15V		485 200 160	970 400 320	ns ns ns
t_{PLH}	Turn-Off Delay Time (Lamp Test) *(Figure 1a)*	V_{DD} = 5V V_{DD} = 10V V_{DD} = 15V		313 125 90	625 250 180	ns ns ns
t_{PHL}	Turn-On Delay Time (Lamp Test) *(Figure 1a)*	V_{DD} = 5V V_{DD} = 10V V_{DD} = 15V		313 125 90	625 250 180	ns ns ns
t_{SETUP}	Setup Time *(Figure 1b)*	V_{DD} = 5V V_{DD} = 10V V_{DD} = 15V	180 76 40	90 38 20		ns ns ns
t_{HOLD}	Hold Time *(Figure 1b)*	V_{DD} = 5V V_{DD} = 10V V_{DD} = 15V	0 0 0	−90 −38 −20		ns ns ns
PW_{LE}	Minimum Latch Enable Pulse Width *(Figure 1c)*	V_{DD} = 5V V_{DD} = 10V V_{DD} = 15V	520 220 130	260 110 65		ns ns ns

*AC Parameters are guaranteed by DC correlated testing.

Switching Time Waveforms

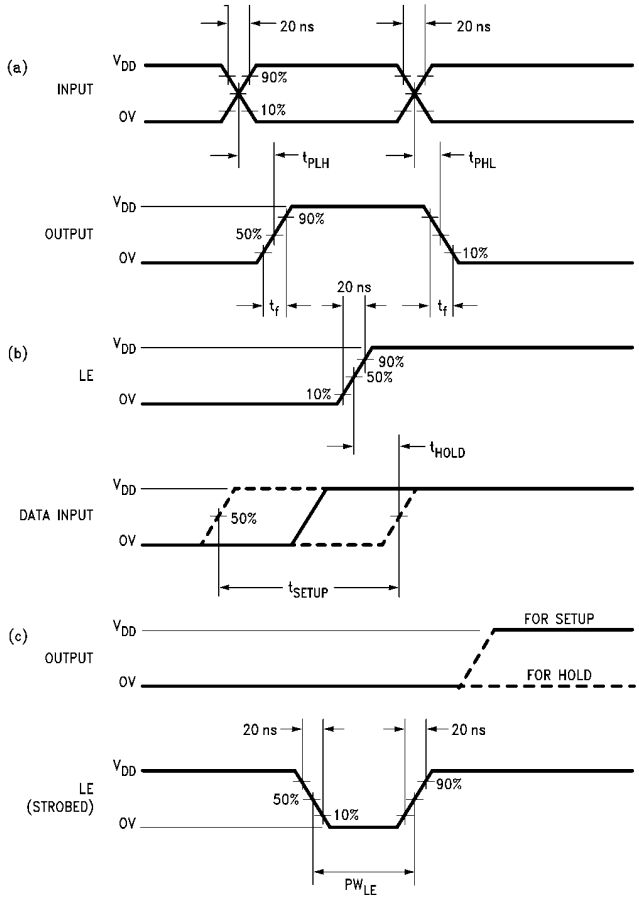
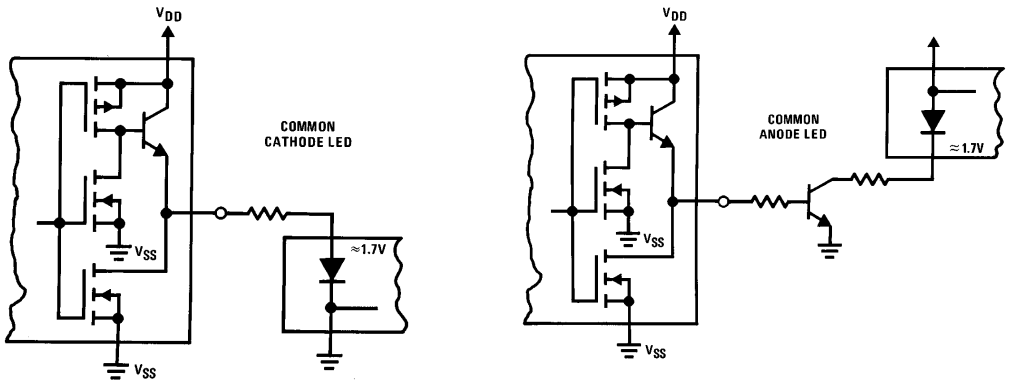


FIGURE 1

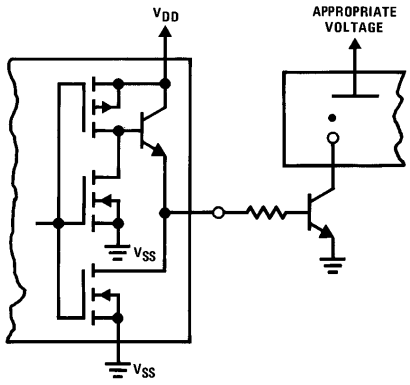
Typical Applications

Light Emitting Diode (LED) Readout

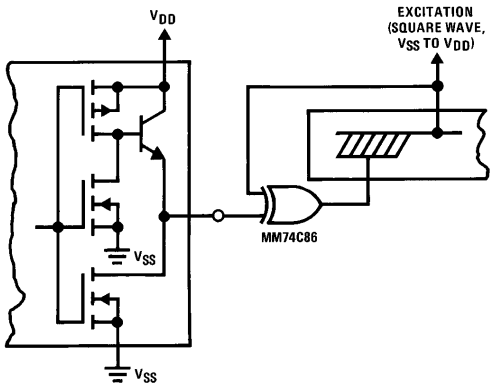


Typical Applications (Continued)

Gas Discharge Readout

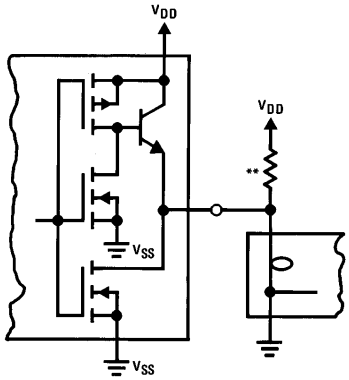


Liquid Crystal (LC) Readout



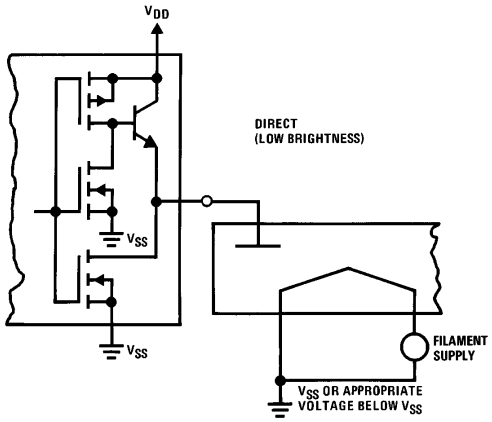
Direct DC drive of LC's not recommended for life of LC readouts.

Incandescent Readout



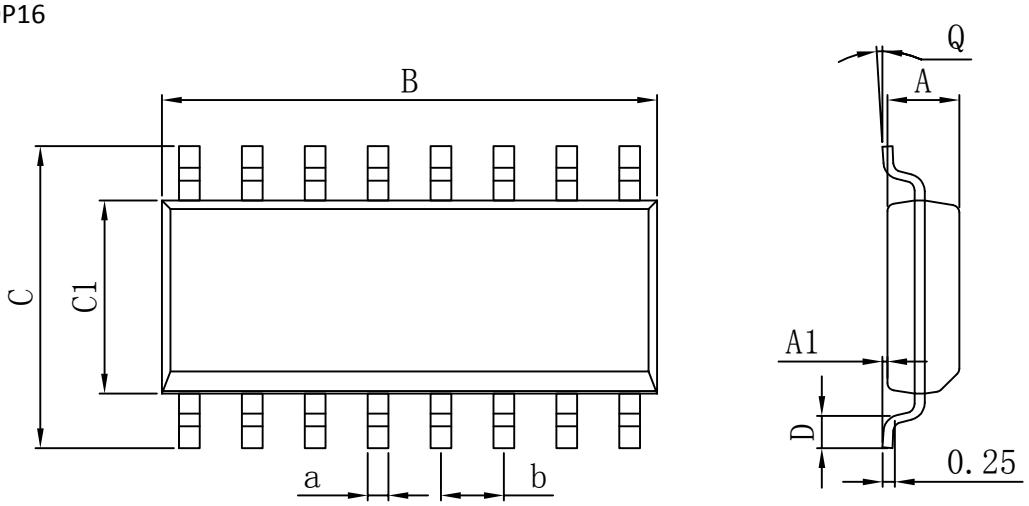
**A filament pre-warm resistor is recommended to reduce filament thermal shock and increase the effective cold resistance of the filament.

Fluorescent Readout



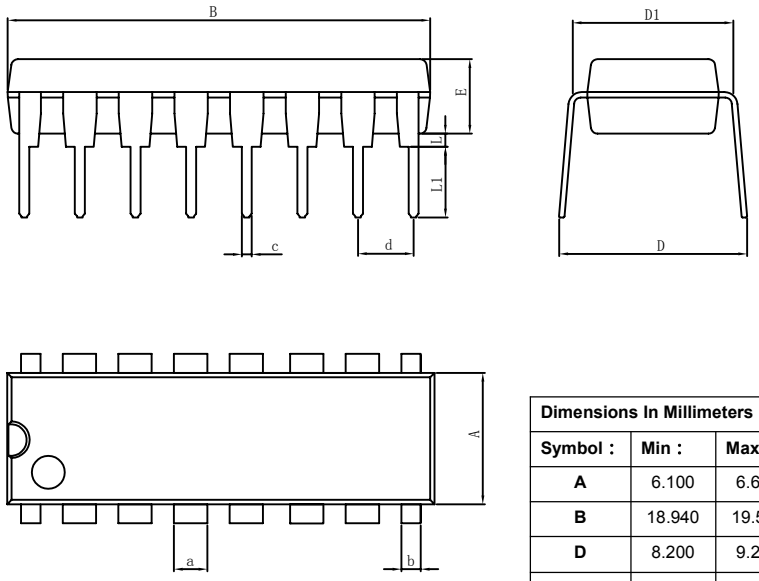
PACKAGE

SOP16



Dimensions In Millimeters					
Symbol :	Min :	Max :	Symbol :	Min :	Max :
A	1.225	1.570	D	0.400	0.950
A1	0.100	0.250	Q	0°	8°
B	9.800	10.00	a	0.420 TYP	
C	5.800	6.250	b	1.270 TYP	
C1	3.800	4.000			

DIP16



Dimensions In Millimeters					
Symbol :	Min :	Max :	Symbol :	Min :	Max :
A	6.100	6.680	L	0.500	0.800
B	18.940	19.560	a	1.524 TYP	
D	8.200	9.200	b	0.889 TYP	
D1	7.42	7.820	c	0.457 TYP	
E	3.100	3.550	d	2.540 TYP	
L	0.500	0.800			

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