FAIRCHILD SEMICONDUCTOR™

October 1987
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CD4511BC
BCD-to-7 Segment Latch/Decoder/Driver

General Description

The CD4511BC BCD-to-seven segment latch/decoder/driver is constructed with complementary MOS (CMOS) enhancement mode devices and NPN bipolar output drivers in a single monolithic structure. The circuit provides the functions of a 4-bit storage latch, an 8421 BCD-to-seven segment decoder, and an output drive capability. Lamp test (LT), blanking (BI), and latch enable (LE) inputs are used to test the display, to turn-off or pulse modulate the brightness of the display, and to store a BCD code, respectively. It can be used with seven-segment light emitting diodes (LED), incandescent, fluorescent, gas discharge, or liquid crystal 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

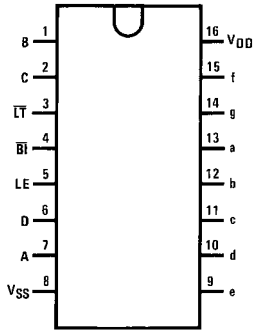
Ordering Code:

Order Number	Package Number	Package Description
CD4511BCWM	M16B	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide
CD4511BCN	N16E	16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide

Devices also available in Tape and Reel. Specify by appending suffix letter "X" to the ordering code.

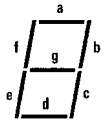
Connection Diagrams

Pin Assignments for SOIC and DIP



Top View

Segment Identification

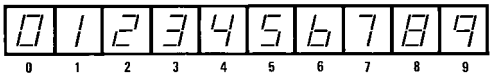


Truth Table

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(Note 1)

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

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

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	V_{DD} = 5V		20			20		150	µA
	Supply Current	V_{DD} = 10V		40			40		300	µA
		V_{DD} = 15V		80			80		600	µA
V_{OL}	Output Voltage	V_{DD} = 5V		0.01		0	0.01		0.05	V
	Logical “0”	V_{DD} = 10V		0.01		0	0.01		0.05	V
	Level	V_{DD} = 15V		0.01		0	0.01		0.05	V
V_{OH}	Output Voltage	V_{DD} = 5V	4.1		4.1	4.57		4.1		V
	Logical “1”	V_{DD} = 10V	9.1		9.1	9.58		9.1		V
	Level	V_{DD} = 15V	14.1		14.1	14.59		14.1		V
V_{IL}	LOW Level	V_{DD} = 5V, V_{OUT} = 3.8V or 0.5V		1.5		2	1.5		1.5	V
	Input Voltage	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	V_{DD} = 5V, V_{OUT} = 0.5V or 3.8V	3.5		3.5	3		3.5		V
	Input Voltage	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	V_{DD} = 5V, I_{OH} = 0 mA	4.1		4.1	4.57		4.1		V
	(Source) Drive	V_{DD} = 5V, I_{OH} = 5 mA				4.24				V
	Voltage	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	V_{DD} = 5V, V_{OL} = 0.4V	0.52		0.44	0.88		0.36		mA
	Output Current	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 (Note 2)

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

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

Note 2: AC Parameters are guaranteed by DC correlated testing.

Switching Time Waveforms

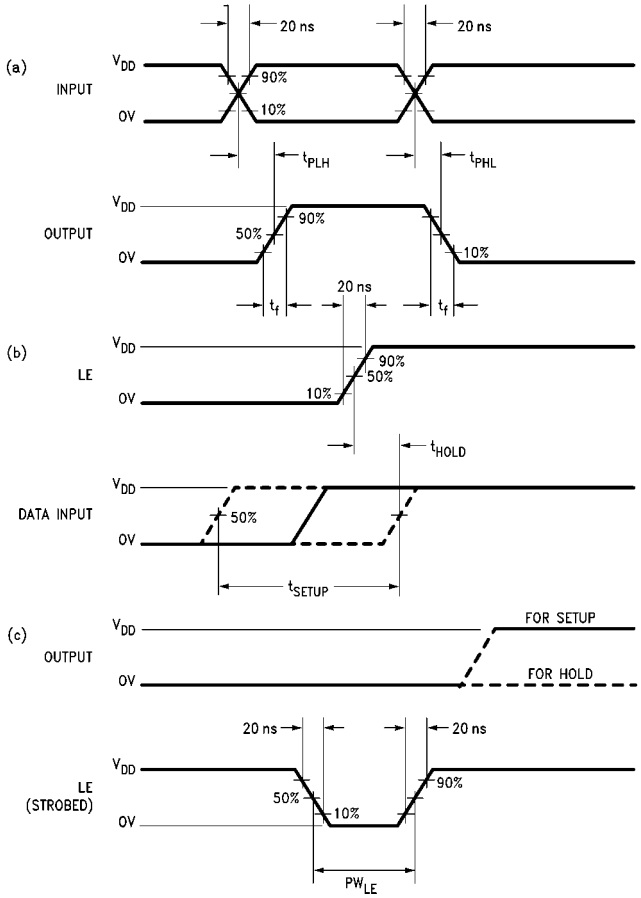
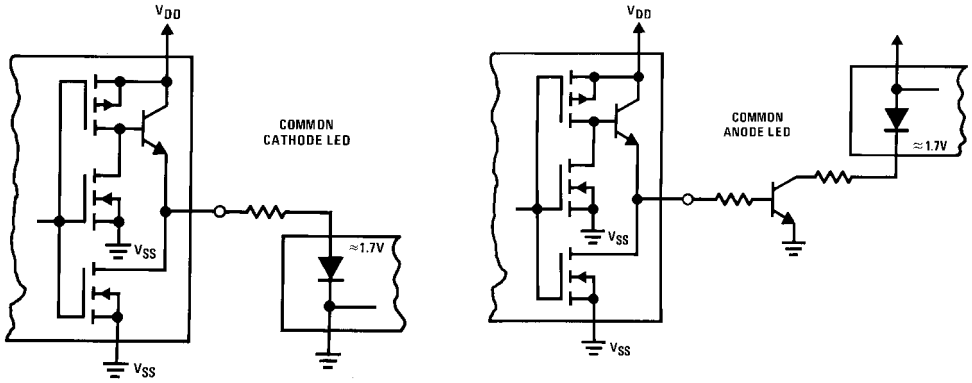


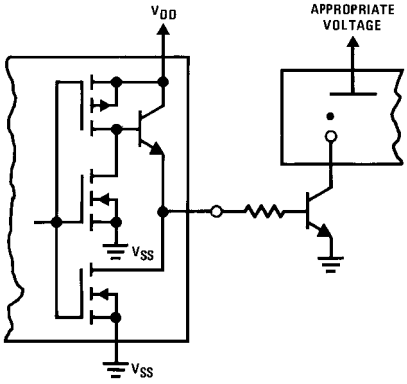
FIGURE 1.

Typical Applications

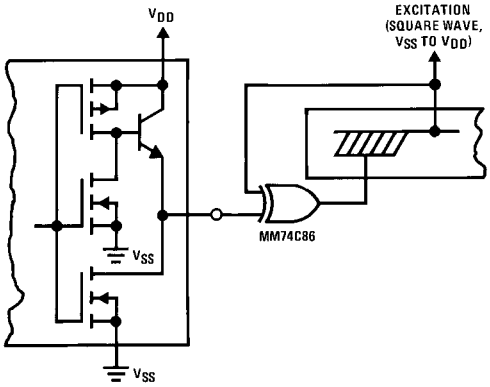
Light Emitting Diode (LED) Readout



Gas Discharge Readout

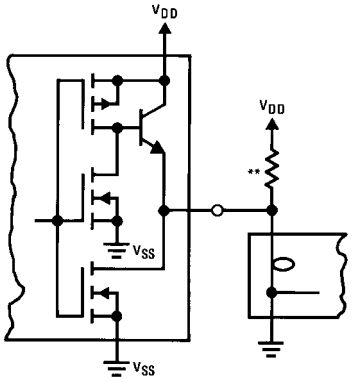


Liquid Crystal (LC) Readout



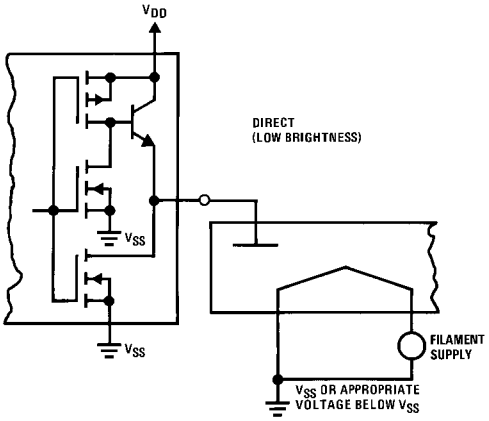
Direct DC drive of LC's not recommended for life of LC readouts.

Incandescent Readout

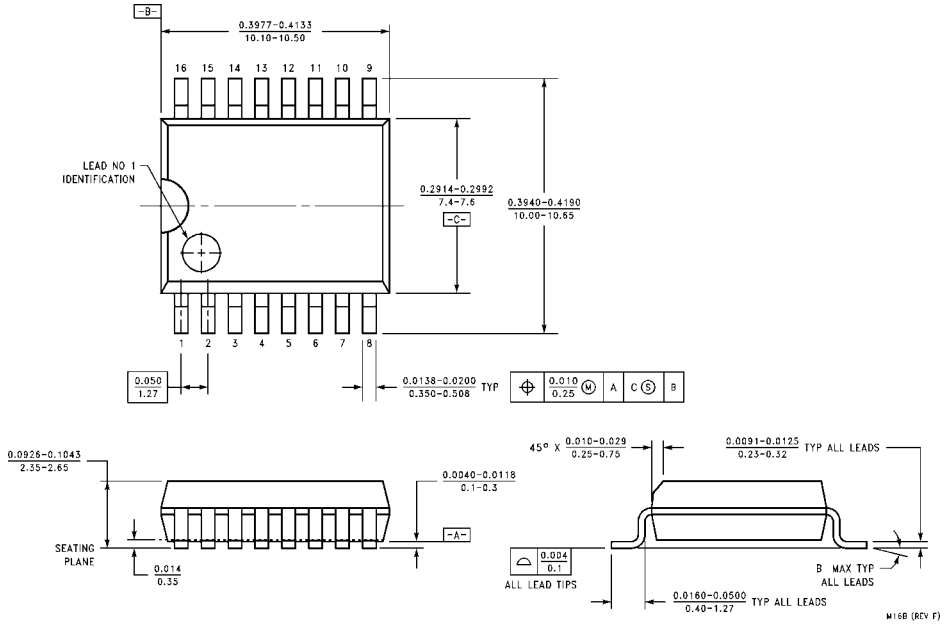


**A filament pre-warm resistor is recommended to reduce filament thermal shock and increase the effective cold resistance of the filament.

Fluorescent Readout

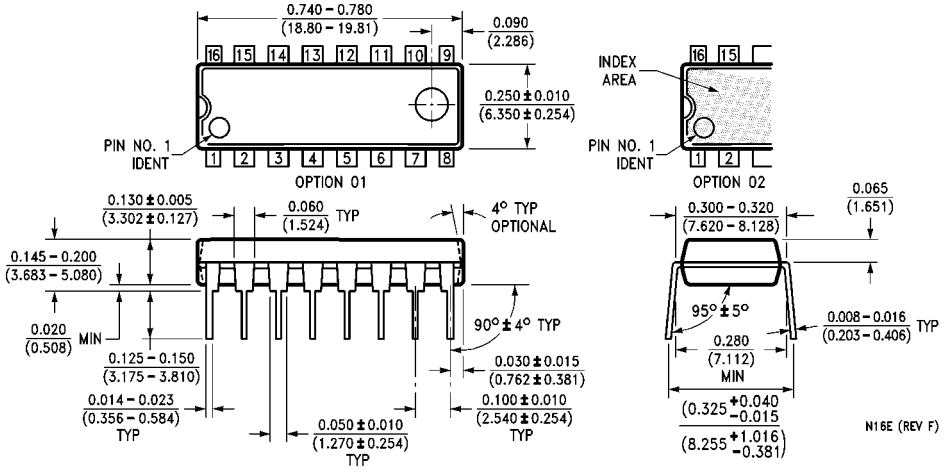


Physical Dimensions inches (millimeters) unless otherwise noted



16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-013, 0.300" Wide
Package Number M16B

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide
Package Number N16E