HGSEMI
HuaGuan Semiconductor

# CD4511BM/CD4511BC BCD-to-7 Segment Latch/Decoder/Driver

General Description

The CD4511BM/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

Connection Diagram

Dual-In-Line Package

Pin		Pin	
1	B	16	V_{DD}
2	C	15	f
3	$\overline{LT}$	14	g
4	$\overline{BI}$	13	a
5	LE	12	b
6	D	11	c
7	A	10	d
8	V_{SS}	9	e

TL/F/5991–1

Top View

Order Number CD4511B
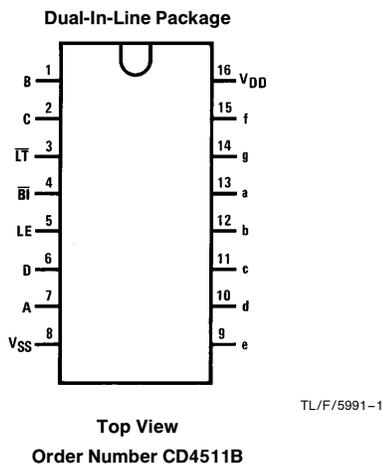
Segment Identification

TL/F/5991–3
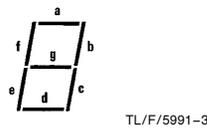
Truth Table

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

TL/F/5991–2
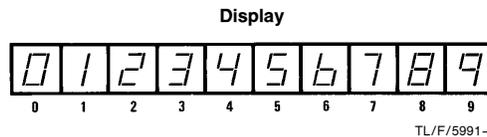
Absolute Maximum Ratings (Notes 1 & 2)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

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)	
CD4510BM, CD4516BM	$-55°C$ to $+125°C$
CD4510BC, CD4516BC	$-40°C$ to $+85°C$

DC Electrical Characteristics CD4511BM

Symbol	Parameter	Conditions	$-55°C$		$+25°C$			$+125°C$		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 CD4511BC

Symbol	Parameter	Conditions	−55°C		+25°C			+85°C		Units
			Min	Max	Min	Typ	Max	Min	Max	
I_{DD}	Quiescent Supply Current	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		20 40 80			20 40 80		150 300 600	μA μA μA
V_{OL}	Output Voltage Logical "0" Level	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$		0.01 0.01 0.01		0 0 0	0.01 0.01 0.01		0.05 0.05 0.05	V V V
V_{OH}	Output Voltage Logical "1" Level	$V_{DD} = 5V$ $V_{DD} = 10V$ $V_{DD} = 15V$	4.1 9.1 14.1		4.1 9.1 14.1	4.57 9.58 14.59		4.1 9.1 14.1		V V V
V_{IL}	Low Level Input Voltage	$V_{DD} = 5V, V_{OUT} = 3.8V$ or $0.5V$ $V_{DD} = 10V, V_{OUT} = 8.8V$ or $1.0V$ $V_{DD} = 15V, V_{OUT} = 13.8V$ or $1.5V$		1.5 3.0 4.0		2 4 6	1.5 3.0 4.0		1.5 3.0 4.0	V V V
V_{IH}	High Level Input Voltage	$V_{DD} = 5V, V_{OUT} = 0.5V$ or $3.8V$ $V_{DD} = 10V, V_{OUT} = 1.0V$ or $8.8V$ $V_{DD} = 15V, V_{OUT} = 1.5V$ or $13.8V$	3.5 7.0 11.0		3.5 7.0 11.0	3 6 9		3.5 7.0 11.0		V V V
V_{OH}	Output (Source) Drive Voltage	$V_{DD} = 5V, I_{OH} = 0$ mA $V_{DD} = 5V, I_{OH} = 5$ mA $V_{DD} = 5V, I_{OH} = 10$ mA $V_{DD} = 5V, I_{OH} = 15$ mA $V_{DD} = 5V, I_{OH} = 20$ mA $V_{DD} = 5V, I_{OH} = 25$ mA	4.1 3.6 2.8 		4.1 3.6 2.8 	4.57 4.24 4.12 3.94 3.75 3.54		4.1 3.3 2.5 		V V V V V V
		$V_{DD} = 10V, I_{OH} = 0$ mA $V_{DD} = 10V, I_{OH} = 5$ mA $V_{DD} = 10V, I_{OH} = 10$ mA $V_{DD} = 10V, I_{OH} = 15$ mA $V_{DD} = 10V, I_{OH} = 20$ mA $V_{DD} = 10V, I_{OH} = 25$ mA	9.1 8.75 8.1 		9.1 8.75 8.1 	9.58 9.26 9.17 9.04 8.9 8.75		9.1 8.45 7.8 		V V V V V V
		$V_{DD} = 15V, I_{OH} = 0$ mA $V_{DD} = 15V, I_{OH} = 5$ mA $V_{DD} = 15V, I_{OH} = 10$ mA $V_{DD} = 15V, I_{OH} = 15$ mA $V_{DD} = 15V, I_{OH} = 20$ mA $V_{DD} = 15V, I_{OH} = 25$ mA	14.1 13.75 13.1 		14.1 13.75 13.1 	14.59 14.27 14.18 14.07 13.95 13.8		14.1 13.45 12.8 		V V V V V V
I_{OL}	Low Level Output Current	$V_{DD} = 5V, V_{OL} = 0.4V$ $V_{DD} = 10V, V_{OL} = 0.5V$ $V_{DD} = 15V, V_{OL} = 1.5V$	0.52 1.3 3.6		0.44 1.1 3.0	0.88 2.25 8.8		0.36 0.9 2.4		mA mA mA
I_{IN}	Input Current	$V_{DD} = 15V, V_{IN} = 0V$ $V_{DD} = 15V, V_{IN} = 15V$		−0.30 0.30		-10^{-5} 10^{-5}	−0.30 0.30		−1.0 1.0	μA 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	CD4511BX			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
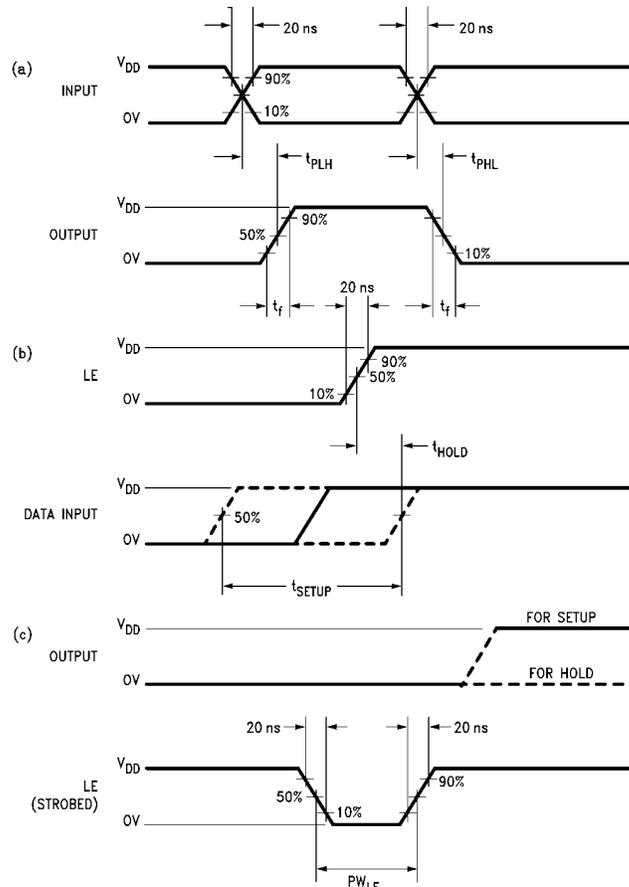
FIGURE 1

TL/F/5991–4

Typical Applications

Light Emitting Diode (LED) Readout

COMMON CATHODE LED

≈1.7V

TL/F/5991–5

COMMON ANODE LED

≈1.7V
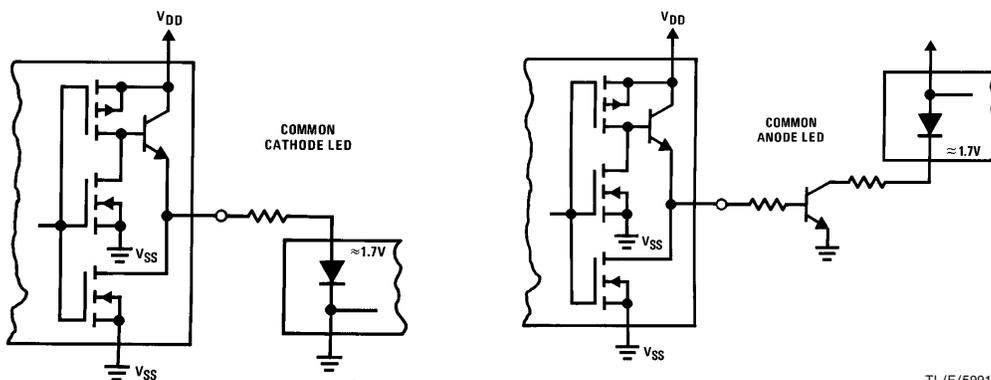
TL/F/5991–6

Typical Applications (Continued)

Gas Discharge Readout

TL/F/5991–7

Liquid Crystal (LC) Readout
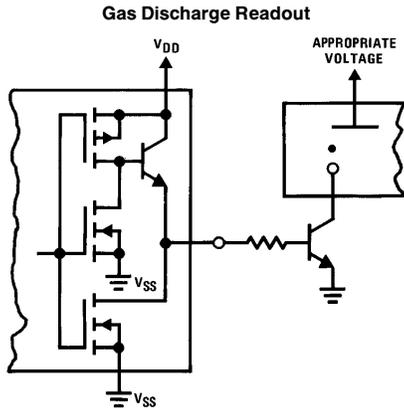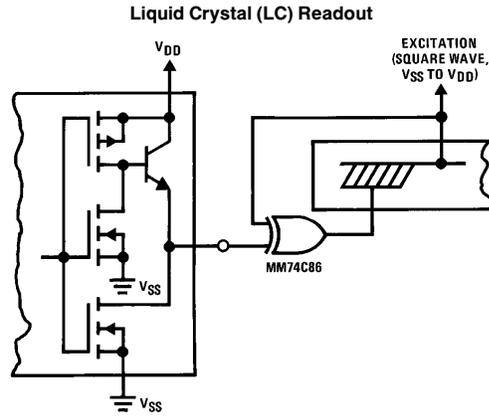
TL/F/5991–8

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

Incandescent Readout
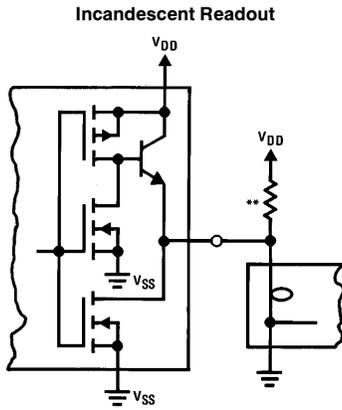
TL/F/5991–9

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

Fluorescent Readout
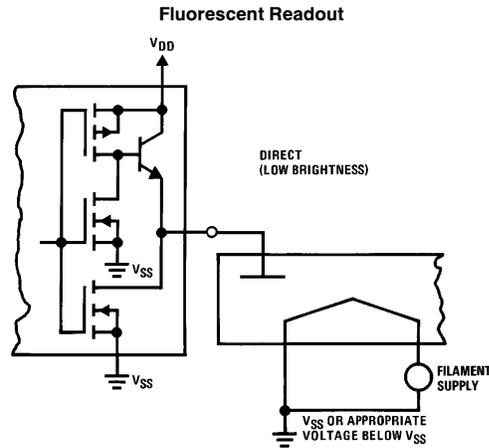
TL/F/5991–10

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