

February 1988

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

General Description

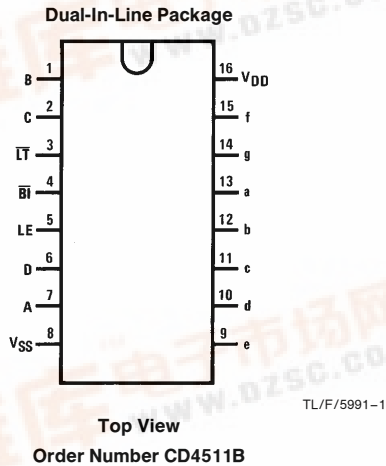
The CD4511BM/CD4511BC BCD-to-seven segment latch/decoder/driver is constructed with complementary MOS (CMOS) enhancement mode devices and NPN bipolar output drivers in a single monolithic structure. The circuit provides the functions of a 4-bit storage latch, an 8421 BCD-to-seven segment decoder, and 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.

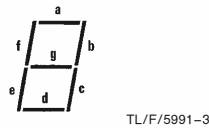
Features

- 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



Segment Identification



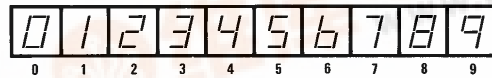
Truth Table

Inputs							Outputs							
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	B
X	0	1	X	X	X	X	0	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	1	1	0	0	1	2
0	1	1	0	1	0	0	0	1	1	0	0	1	1	3
0	1	1	0	1	0	1	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	
0	1	1	1	1	1	1	1	0	0	0	0	0	0	*

X = Don't Care

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

Display



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



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	$V_{DD} = 5V, I_{OH} = 0\text{ mA}$	4.1		4.1	4.57		4.1		V
		$V_{DD} = 5V, I_{OH} = 5\text{ mA}$				4.24				V
		$V_{DD} = 5V, I_{OH} = 10\text{ mA}$	3.9		3.9	4.12		3.5		V
		$V_{DD} = 5V, I_{OH} = 15\text{ mA}$				3.94				V
		$V_{DD} = 5V, I_{OH} = 20\text{ mA}$	3.4		3.4	3.75		3.0		V
		$V_{DD} = 5V, I_{OH} = 25\text{ mA}$				3.54				V
		$V_{DD} = 10V, I_{OH} = 0\text{ mA}$	9.1		9.1	9.58		9.1		V
		$V_{DD} = 10V, I_{OH} = 5\text{ mA}$				9.26				V
		$V_{DD} = 10V, I_{OH} = 10\text{ mA}$	9.0		9.0	9.17		8.6		V
		$V_{DD} = 10V, I_{OH} = 15\text{ mA}$				9.04				V
		$V_{DD} = 10V, I_{OH} = 20\text{ mA}$	8.6		8.6	8.9		8.2		V
		$V_{DD} = 10V, I_{OH} = 25\text{ mA}$				8.75				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
		$V_{DD} = 5V, V_{IN} = 0V$		-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		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 _{OH}	Output (Source) Drive Voltage	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*

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

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

*AC Parameters are guaranteed by DC correlated testing.

Switching Time Waveforms

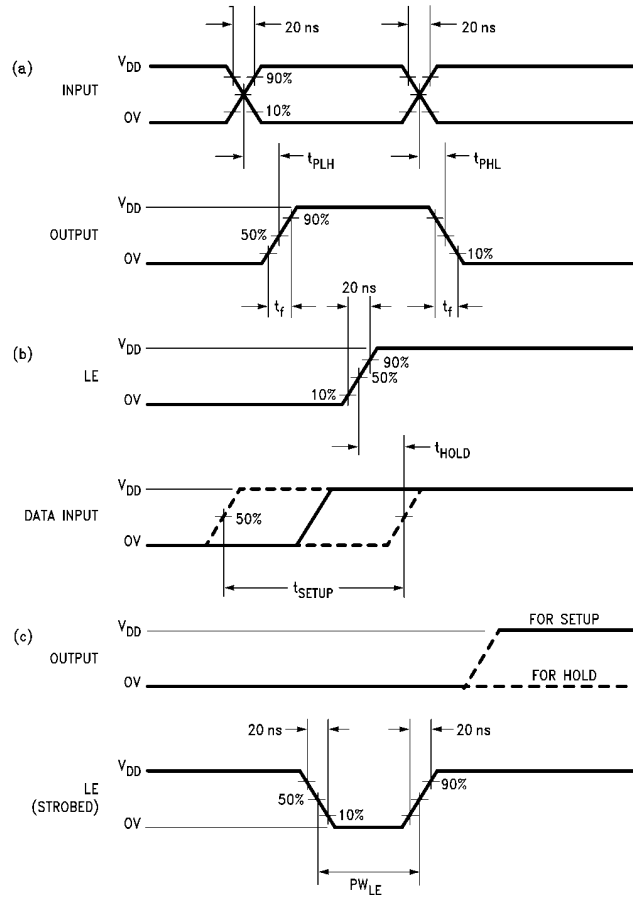
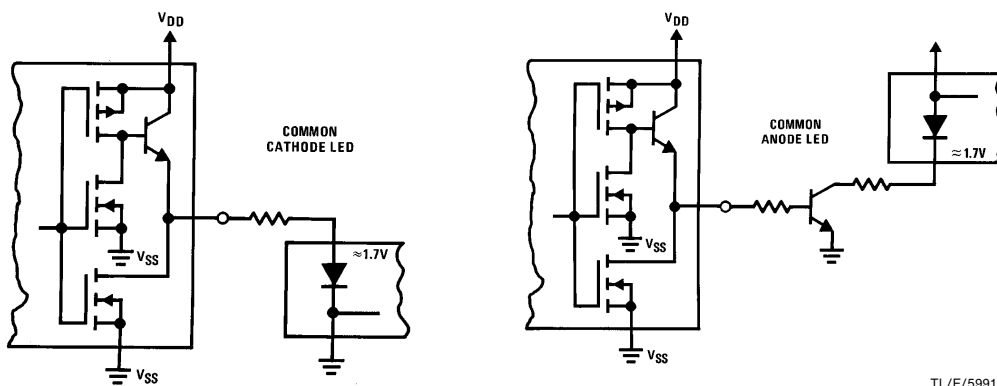


FIGURE 1

TL/F/5991-4

Typical Applications

Light Emitting Diode (LED) Readout

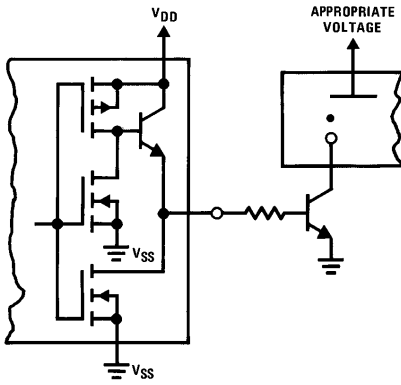


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TL/F/5991-6

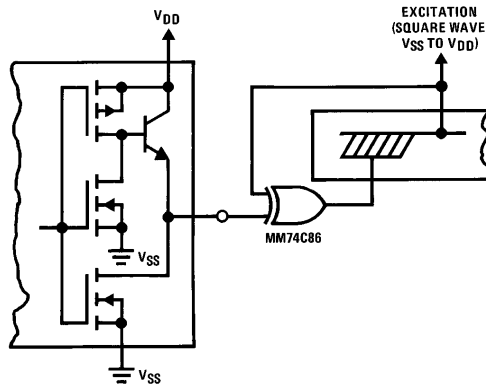
Typical Applications (Continued)

Gas Discharge Readout



TL/F/5991-7

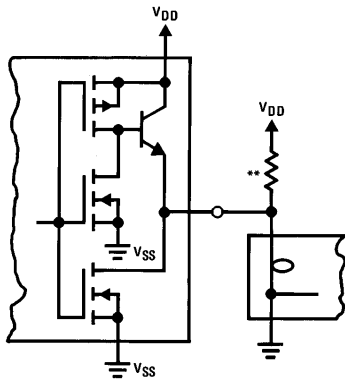
Liquid Crystal (LC) Readout



TL/F/5991-8

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

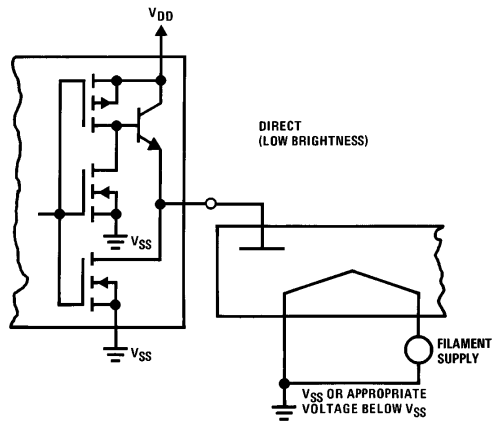
Incandescent Readout



TL/F/5991-9

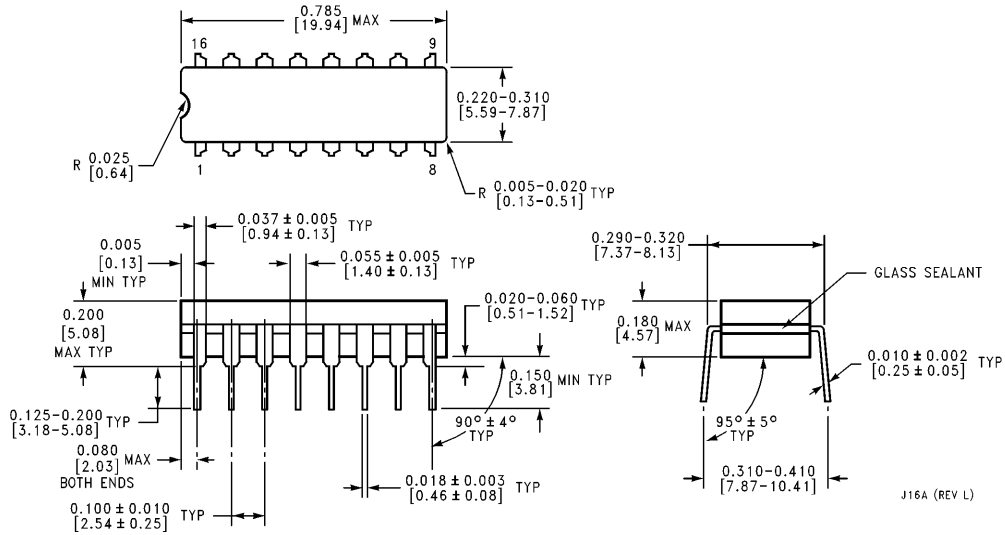
**A filament pre-warm resistor is recommended to reduce filament thermal shock and increase the effective cold resistance of the filament.

Fluorescent Readout



TL/F/5991-10

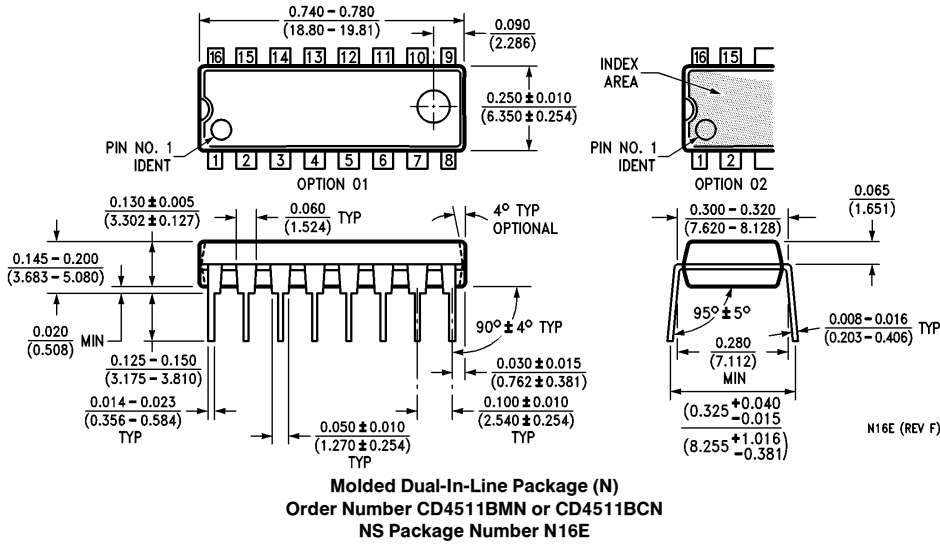
Physical Dimensions inches (millimeters)



Ceramic Dual-In-Line Package (J)
Order Number CD4511BMJ or CD4511BCJ
NS Package Number J16A

J16A (REV L)

Physical Dimensions inches (millimeters) (Continued)



LIFE SUPPORT POLICY

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.



National Semiconductor Corporation
 1111 West Bardin Road
 Arlington, TX 76017
 Tel: 1(800) 272-9959
 Fax: 1(800) 737-7018

National Semiconductor Europe
 Fax: (+49) 0-180-530 85 86
 Email: cnjwge@tevm2.nsc.com
 Deutsch Tel: (+49) 0-180-530 85 85
 English Tel: (+49) 0-180-532 78 32
 Français Tel: (+49) 0-180-532 93 58
 Italiano Tel: (+49) 0-180-534 16 80

National Semiconductor Hong Kong Ltd.
 13th Floor, Straight Block,
 Ocean Centre, 5 Canton Rd.
 Tsimshatsui, Kowloon
 Hong Kong
 Tel: (852) 2737-1600
 Fax: (852) 2736-9960

National Semiconductor Japan Ltd.
 Tel: 81-043-299-2309
 Fax: 81-043-299-2408