

040687

# HS-C<sup>2</sup>MOS™ INTEGRATED CIRCUITS

PRELIMINARY DATA

## BCD TO-7 SEGMENT L/D/D (LED)

### DESCRIPTION

The M54/74HC4511 is a high speed CMOS BCD-TO-7 SEGMENT LATCH/DECODER/DRIVER fabricated with silicon gate C<sup>2</sup>MOS technology. It enables high speed latch and decode operation with identical pin connection and function to standard CMOS 4511B.

The segment output driver, which is CMOS, fabricated in has large I<sub>OH</sub> capability which enables common cathode LEDs to be directly drivers.

When lamp test (LT) is taken "L", all segment outputs will go to "H", and when blanking (BI) is taken "L" and LT is taken "H" all segment outputs will go to "L".

These functions are regardless of other inputs and are used to test the display.

Input BI is used to pulse-modulate the brightness of the display.

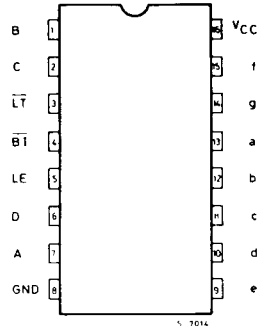
When error input code (over 10) is applied to BCD input, all segment outputs will go "L" (turn off).

All inputs are equipped with protection circuits against static discharge or transient excess voltage.

**B1** Plastic Package      **F1** Ceramic Package      **C1** Chip Carrier

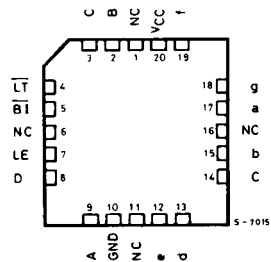
ORDERING NUMBERS: M54HC4511 F1  
M74HC4511 B1  
M74HC4511 F1  
M74HC4511 C1

### PIN CONNECTIONS (top view)



Dual in line

### CHIP CARRIER

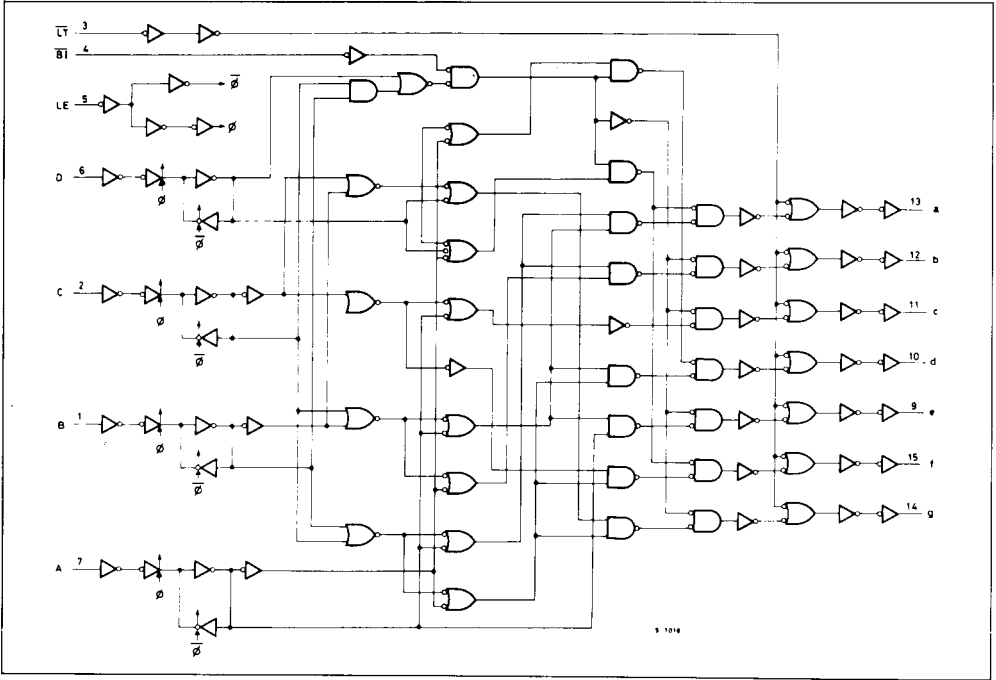


NC = No Internal Connection

### FEATURES

- High Speed  
t<sub>PD</sub> = 15 ns (Typ.) at V<sub>CC</sub> = 5V
- Low Power Dissipation  
I<sub>CC</sub> = 4 μA (Max.) at T<sub>A</sub> = 25°C
- High Noise Immunity  
V<sub>NIH</sub> = V<sub>NIL</sub> = 28% V<sub>CC</sub> (Min.)
- Output Drive Capability  
10 LSTTL Loads
- Symmetrical Output Impedance  
|I<sub>OH</sub>| = I<sub>OL</sub> = 20 mA (Min.)
- Balanced Propagation Delays  
t<sub>PLH</sub> = t<sub>PHL</sub>
- Wide Operating Voltage Range  
V<sub>CC</sub> (opr) = 2V to 6V
- Pin and Function compatible with 4511 B

LOGIC DIAGRAM



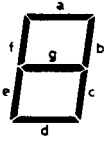
TRUTH TABLE

INPUTS							OUTPUTS							DISPLAY MODE
LE	$\overline{BI}$	$\overline{LT}$	D	C	B	A	a	b	c	d	e	f	g	
*	*	L	*	*	*	*	H	H	H	H	H	H	H	8
*	L	H	*	*	*	*	L	L	L	L	L	L	L	BLANK
L	H	H	L	L	L	L	H	H	H	H	H	H	L	0
L	H	H	L	L	L	H	L	H	H	L	L	L	L	1
L	H	H	L	L	H	L	H	H	L	H	H	L	H	2
L	H	H	L	L	H	H	H	H	H	H	L	L	H	3
L	H	H	L	H	L	L	L	H	H	L	L	H	H	4
L	H	H	L	H	L	H	H	L	H	H	L	H	H	5
L	H	H	L	H	H	L	L	L	H	H	H	H	H	6
L	H	H	L	H	H	H	H	H	H	L	L	L	L	7
L	H	H	H	L	L	L	H	H	H	H	H	H	H	8
L	H	H	H	L	L	H	H	H	H	L	L	H	H	9
L	H	H	H	L	H	*	L	L	L	L	L	L	L	BLANK
L	H	H	H	H	*	*	L	L	L	L	L	L	L	BLANK
H	H	H	*	*	*	*	Hold the stage at the leading edge of LE							

# M54HC4511

# M74HC4511

## DISPLAY MODE



INPUT CODE	A	L	H	L	H	L	H	L	H	L	H
	B	L	L	H	H	L	L	H	H	L	L
	C	L	L	L	L	H	H	H	H	L	L
	D	L	L	L	L	L	L	L	L	H	H

DISPLAY	0	1	2	3	4	5	6	7	8	9
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## ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
$V_{CC}$	Supply Voltage	-0.5 to 7	V
$V_I$	DC Input Voltage	-0.5 to $V_{CC} + 0.5$	V
$V_O$	DC Output Voltage	-0.5 to $V_{CC} + 0.5$	V
$I_{IK}$	DC Input Diode Current	$\pm 20$	mA
$I_{OK}$	DC Output Diode Current	$\pm 20$	mA
$I_O$	DC Output Source Sink Current Per Output Pin	$\pm 25$	mA
$I_{CC}$ or $I_{GND}$	DC $V_{CC}$ or Ground Current	$\pm 50$	mA
$P_D$	Power Dissipation	500 (*)	mW
$T_{stg}$	Storage Temperature	-65 to 150	$^{\circ}C$

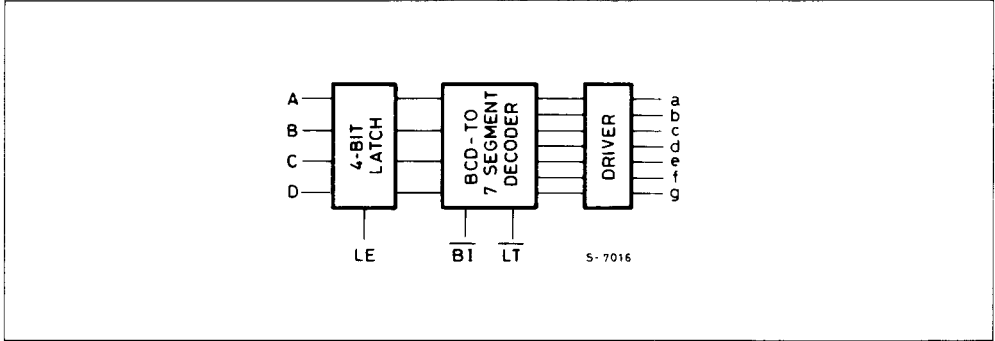
Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these condition is not implied.

(\*) 500 mW:  $\cong 65^{\circ}C$  derate to 300 mW by 10 mW/ $^{\circ}C$ :  $65^{\circ}C$  to  $85^{\circ}C$ .

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Limit	Unit
$V_{CC}$	Supply Voltage	2 to 6	V
$V_I$	Input Voltage	0 to $V_{CC}$	V
$V_O$	Output Voltage	0 to $V_{CC}$	V
$T_A$	Operating Temperature 74HC Series 54HC Series	-40 to 85 -55 to 125	$^{\circ}C$
$t_r, t_f$	Input Rise and Fall Time	$V_{CC} \begin{cases} 2 \text{ V} & 0 \text{ to } 1000 \\ 4.5 \text{ V} & 0 \text{ to } 500 \\ 6 \text{ V} & 0 \text{ to } 400 \end{cases}$	ns

**BLOCK DIAGRAM**



**DC SPECIFICATIONS**

Symbol	Parameter	V <sub>CC</sub>	Test Condition	T <sub>A</sub> = 25°C 54HC and 74HC			- 40 to 85°C 74HC		- 55 to 125°C 54HC		Unit	
				Min.	Typ.	Max.	Min.	Max.	Min.	Max.		
V <sub>IH</sub>	High Level Input Voltage	2.0 4.5 6.0		1.5 3.15 4.2	— — —	— — —	1.5 3.15 4.2	— — —	1.5 3.15 4.2	— — —	V	
V <sub>IL</sub>	Low Level Input Voltage	2.0 4.5 6.0		— — —	— — —	0.5 1.35 1.8	— — —	0.5 1.35 1.8	— — —	0.5 1.35 1.8	V	
V <sub>OH</sub>	High Level Output Voltage	2.0	V <sub>I</sub>	I <sub>O</sub>	1.9	2.0	—	1.9	—	1.9	—	V
		4.5	V <sub>IH</sub>		4.4	4.5	—	4.4	—	4.4	—	
		6.0	or		5.9	6.0	—	5.9	—	5.9	—	
		4.5	V <sub>IL</sub>		4.18	4.31	—	4.13	—	4.10	—	
4.5				3.20	3.8	—	2.90	—	2.70	—		
6.0				5.68	5.8	—	5.63	—	5.60	—		
V <sub>OL</sub>	Low Level Output Voltage	2.0	V <sub>IH</sub> or V <sub>IL</sub>	20 μA	—	0	0.1	—	0.1	—	0.1	V
		4.5			—	0	0.1	—	0.1	—	0.1	
		6.0			—	0	0.1	—	0.1	—	0.1	
		4.5			4.0 mA	—	0.17	0.26	—	0.33	—	
6.0	5.2 mA	—	0.18	0.26	—	0.33	—	0.40				
I <sub>I</sub>	Input Leakage Current	6.0	V <sub>I</sub> = V <sub>CC</sub> or GND	—	—	±0.1	—	±1		±1	μA	
I <sub>CC</sub>	Quiescent Supply Current	6.0	V <sub>I</sub> = V <sub>CC</sub> or GND	—	—	4	—	40		80	μA	

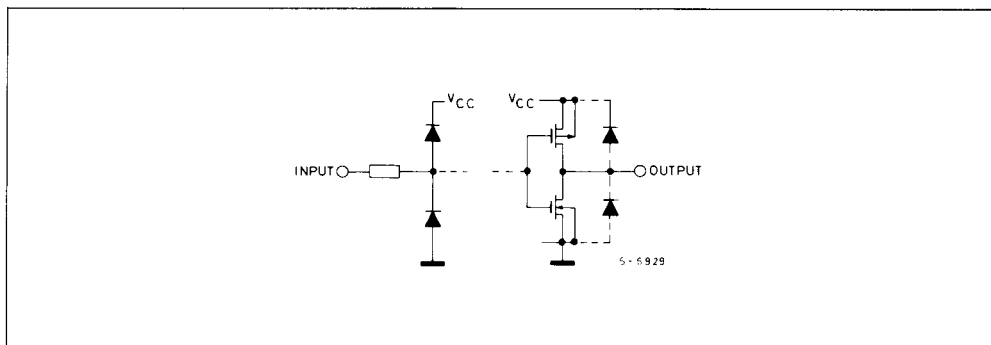
# M54HC4511

# M74HC4511

## AC ELECTRICAL CHARACTERISTICS ( $V_{CC} = 5V$ , $T_A = 25^\circ C$ , $C_L = 15pF$ , Input $t_r = t_f = 6ns$ )

Symbol	Parameter	54HC and 74HC			Unit
		MIN.	TYP.	MAX.	
$t_{TLH}$ $t_{THL}$	Output Transition Time		4	8	ns
$t_{PLH}$ $t_{PHL}$	Propagation Delay Time BCD - Segment)		46	71	ns
$t_{PLH}$ $t_{PHL}$	Propagation Delay Time $\overline{BI}$ - Segment)		28	44	ns
$t_{PLH}$ $t_{PHL}$	Propagation Delay Time $\overline{LT}$ - Segment)		16	26	ns
$t_{PLH}$ $t_{PHL}$	Propagation Delay Time $\overline{LE}$ - Segment)		46	71	ns
$t_{W(L)}$	Minimum Pulse Width (LE)		8	15	ns
$t_s$	Minimum Data Set-up Time		9	15	ns
$t_h$	Minimum Data Hold Time	—	0		ns

## INPUT AND OUTPUT EQUIVALENT CIRCUIT



**AC ELECTRICAL CHARACTERISTICS** ( $C_L = 50\text{pF}$ , Input  $t_r = t_f = 6\text{ns}$ )

Symbol	Parameter	V <sub>CC</sub>	Test Condition	T <sub>A</sub> = 25°C 54HC and 74HC			-40 to 85°C 74HC		-55 to 125°C 54HC		Unit
				Min.	Typ.	Max.	Min.	Max.	Min.	Max.	
t <sub>TLH</sub> t <sub>THL</sub>	Output Transition Time	2.0		—	30	75	—	90			ns
		4.5		—	8	15	—	18			
		6.0		—	7	13	—	16			
t <sub>PLH</sub> t <sub>PHL</sub>	Progataion Delay Time (BCD-Segment)	2.0		—	170	400	—	480			ns
		4.5		—	48	80	—	96			
		6.0		—	41	69	—	83			
t <sub>PLH</sub> t <sub>PHL</sub>	Progation Delay Time (BI - Segment)	2.0		—	92	250	—	300			ns
		4.5		—	29	50	—	60			
		6.0		—	25	43	—	52			
t <sub>PLH</sub> t <sub>PHL</sub>	Progation Delay Time (LT - Segment)	2.0		—	52	150	—	180			ns
		4.5		—	18	30	—	36			
		6.0		—	16	26	—	32			
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay Time (BI - Segment)	2.0		—	165	400	—	480			ns
		4.5		—	48	80	—	100			
		6.0		—	41	68	—	85			
t <sub>W(L)</sub>	Minimum Pulse Width (LE)	2.0		—	25	75	—	90			ns
		4.5		—	8	15	—	18			
		6.0		—	7	13	—	16			
t <sub>s</sub>	Minimum Data Set-up Time	2.0		—	35	75	—	90			ns
		4.5		—	9	15	—	18			
		6.0		—	7	13	—	16			
t <sub>h</sub>	Minimum Data Hold Time	2.0		—	—	0	—	0			ns
		4.5		—	—	0	—	0			
		6.0		—	—	0	—	0			
C <sub>IN</sub>	Input Capacitance			—	5	10	—	10			
C <sub>PD</sub> (*)	Power Dissipation Capacitance			—	136	—	—	—			pF

Note (\*) C<sub>PD</sub> is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the following equation.

$$I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$$