BCD-to-7 Segment Latch/Decoder/Driver

The TC74HC4511A is a high speed CMOS BCD-TO-7 SEGMENT LATCH/DECODER/DRIVER fabricated with silicon gate C^2MOS technology.

It achieves the high speed operation similar to equivalent LSTTL while maintaining the CMOS low power dissipation.

The segment output driver, which is of CMOS construction, has a large I_{OH} capability which permits the device to drive cathode common LED directly.

When lamp test (LT) is held low, all segment outputs will go high, and when the blanking input (BI) is held low and LT is held high, all segment outputs will go low. These functions are independent of other inputs and used to test the display.

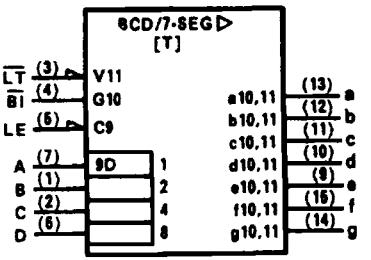
BI is used to pulse-modulate the brightness of the display.

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

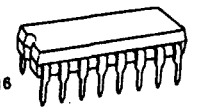
All inputs are equipped with protection circuits against static discharge or transient excess voltage.

Features

- High Speed: t_{pd} = 23ns(Typ.) at V_{CC} = 5V
- Low Power Dissipation: I_{CC} = 4μA(Max.) at Ta = 25°C
- High Noise Immunity: $V_{NIH} = V_{NIL}$ = 28%V_{CC}(Min.)
- Output Drive Capability: 10 LSTTL Loads
- Symmetrical Output Impedance: $|I_{OH}| = I_{OL}$ = 4mA(Min.)
- Balanced Propagation Delays: $t_{pLH} = t_{pHL}$
- Wide Operating Voltage Range: V_{CC}(opr) = 2V ~ 6V
- Pin and Function Compatible with 4511B



IEC Logic Symbol



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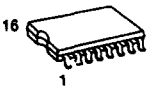

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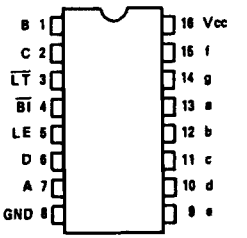
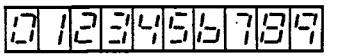
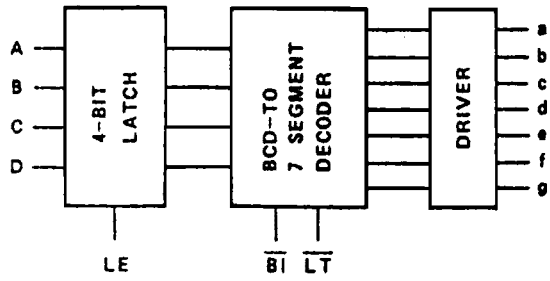


(TOP VIEW)

Pin Assignment



Display Mode

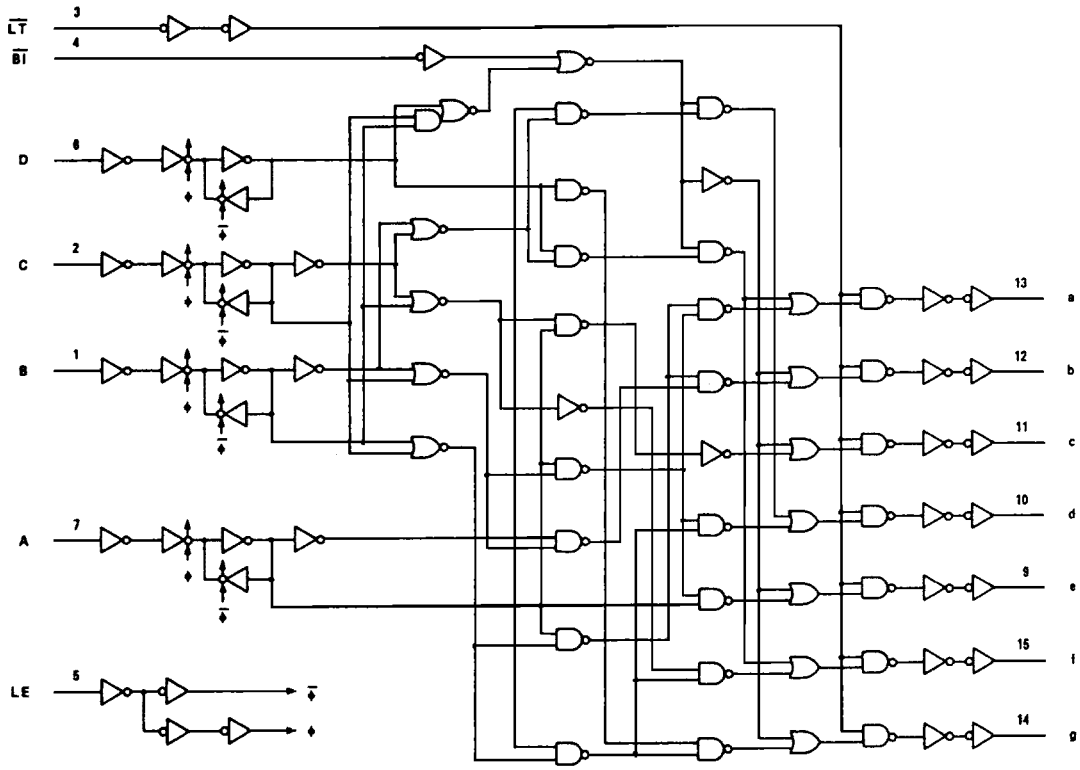


Block Diagram

Truth Table

Inputs							Output							Display Mode
LE	$\overline{BI}$	$\overline{LT}$	D	C	B	A	a	b	c	d	e	f	g	
X	X	L	X	X	X	X	H	H	H	H	H	H	H	8
X	L	H	X	X	X	X	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	X	L	L	L	L	L	L	L	Blank
L	H	H	H	H	X	X	L	L	L	L	L	L	L	Blank
H	H	H	X	X	X	Ξ	Hold the stage at the leading edge of LE							–

X: Don't care
↑: Same as above combinations
###: Depends upon the BCD code previously applied when LD ="H"



Logic Diagram

Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Supply Voltage Range	V_{CC}	-0.5 ~ 7	V
DC Input Voltage	V_{IN}	-0.5 ~ V_{CC} + 0.5	V
DC Output Voltage	V_{OUT}	-0.5 ~ V_{CC} + 0.5	V
Input Diode Current	I_{IK}	±20	mA
Output Diode Current	I_{OK}	±20	mA
DC Output Current	I_{OUT}	+25(Sinc)/-35(Source)	mA
DC V_{CC}/Ground Current	I_{CC}	+150(I_{CC})-50(I_{GND})	mA
Power Dissipation	P_D	500(DIP)*/180(SOIC)	mW
Storage Temperature	T_{stg}	-65 ~ 150	°C
Lead Temperature 10sec	T_L	300	°C

*500mW in the range of Ta = -40°C ~ 65°C. From Ta = 65°C to 85°C a derating factor of -10mW/°C shall be applied until 300mW.

Recommended Operating Conditions

Parameter	Symbol	Value	Unit
Supply Voltage	V_{CC}	2 ~ 6	V
Input Voltage	V_{IN}	0 ~ V_{CC}	V
Output Voltage	V_{OUT}	0 ~ V_{CC}	V
Operating Temperature	T_{opr}	-40 ~ 85	°C
Input Rise and Fall Time	t_r, t_f	0 ~ 1000(V_{CC} = 2.0V) 0 ~ 500(V_{CC} = 4.5V) 0 ~ 400(V_{CC} = 6.0V)	ns

DC Electrical Characteristics

Parameter	Symbol	Test Condition		V_{CC}	Ta = 25°C Min.	Ta = 25°C Typ.	Ta = 25°C Max.	Ta = -40 ~ 85°C Min.	Ta = -40 ~ 85°C Max.	Unit
High-Level Input Voltage	V_{IH}	–		2.0 4.5 6.0	1.5 3.15 4.2	– – –	– – –	1.5 3.15 4.2	– – –	V
Low-Level Input Voltage	V_{IL}	–		2.0 4.5 6.0	– – –	– – –	0.5 1.35 1.8	– – –	0.5 1.35 1.8	V
High-Level Output Voltage	V_{OH}	V_{IN} = V_{IH} or V_{IL}	I_{OH} = -20μA	2.0 4.5 6.0	1.9 4.4 5.9	2.0 4.5 6.0	– – –	1.9 4.4 5.9	– – –	V
			I_{OH} = -4 mA I_{OH} = -5.2mA I_{OH} = -7.2mA	4.5 4.5 6.0	4.18 3.20 5.68	4.31 3.80 5.80	– – –	4.13 2.90 5.63	– – –	
Low-Level Output Voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 20μA	2.0 4.5 6.0	– – –	0.0 0.0 0.0	0.1 0.1 0.1	– – –	0.1 0.1 0.1	V
			I_{OL} = 4 mA I_{OL} = 5.2mA	4.5 6.0	– –	0.17 0.18	0.26 0.26	– –	0.33 0.33	
3-State Output Off-State Current	I_{OZ}	V_{IN} = V_{IH} or V_{IL} V_{OUT} = V_{CC} or GND		6.0	–	–	±0.5	–	±5.0	μA
Input Leakage Current	I_{IN}	V_{IN} = V_{CC} or GND		6.0	–	–	±0.1	–	±1.0	
Quiescent Supply Current	I_{CC}	V_{IN} = V_{CC} or GND		6.0	–	–	4.0	–	40.0	

Timing Requirements (Input $t_r = t_f = 6ns$)

Parameter	Symbol	Test Condition		Ta = 25°C		Ta = -40 ~ 85°C	Unit
			V_{CC}	Typ.	Limit	Limit	
Minimum Pulse Width (LE)	$t_{W(L)}$	–	2.0 4.5 6.0	– – –	75 15 13	95 19 16	ns
Minimum Set-up Time	t_s	–	2.0 4.5 6.0	– – –	75 15 13	95 19 16	
Minimum Hold Time	t_h	–	2.0 4.5 6.0	– – –	0 0 0	0 0 0	

AC Electrical Characteristics ($C_L = 15pF$, $V_{CC} = 5V$, Ta = 25°C)

Parameter	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Output Transition Time	t_{TLH}	–	–	4	8	ns
Output Transition Time	t_{THL}	–	–	4	8	
Propagation Delay Time (BCD-Segment)	t_{pLH} t_{pHL}	–	–	28	45	
Propagation Delay Time ($\overline{BI}$-Segment)	t_{pLH} t_{pHL}	–	–	18	31	
Propagation Delay Time ($\overline{LT}$-Segment)	t_{pLH} t_{pHL}	–	–	12	21	
Propagation Delay Time (LE-Segment)	t_{pLH} t_{pHL}	–	–	26	44	

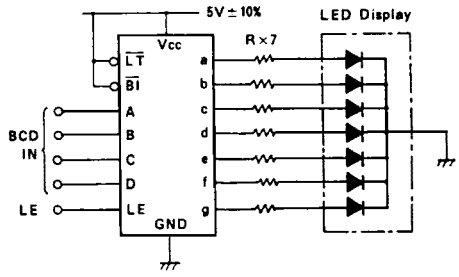
AC Electrical Characteristics (C_L = 50pF, Input $t_r = t_f$ = 6ns)

Parameter	Symbol	Test Condition		Ta = 25°C			Ta = -40 ~ 85°C		Unit
			V_{CC}	Min	Typ.	Max.	Min.	Max.	
Output Transition Time Low to High	t_{TLH}	–	2.0	–	25	60	–	75	ns
			4.5	–	7	12	–	15	
			6.0	–	6	11	–	13	
Output Transition Time High to Low	t_{THL}	–	2.0	–	30	75	–	95	
			4.5	–	8	15	–	19	
			6.0	–	7	13	–	16	
Propagation Delay Time (BCD-Segment)	t_{pLH} t_{pHL}	–	2.0	–	125	255	–	320	
			4.5	–	33	51	–	64	
			6.0	–	23	43	–	54	
Propagation Delay Time ($\overline{BI}$-Segment)	t_{pLH} t_{pHL}	–	2.0	–	70	175	–	220	
			4.5	–	22	35	–	44	
			6.0	–	17	30	–	37	
Propagation Delay Time ($\overline{LT}$-Segment)	t_{pLH} t_{pHL}	–	2.0	–	60	120	–	150	
			4.5	–	15	24	–	30	
			6.0	–	12	20	–	26	
Propagation Delay Time (LE-Segment)	t_{pLH} t_{pHL}	–	2.0	–	95	240	–	300	
			4.5	–	32	48	–	60	
			6.0	–	23	41	–	51	
Input Capacitance	C_{IN}	–		–	5	10	–	10	pF
Power Dissipation Capacitance	C_{PD}(1)	–		–	95	–	–	–	

Note (1) C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation:

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

Static Display Circuit



Recommended Resistance R

DISPLAY	COLOR	LETTER HIGHT	R
TLR358T	Red	13.4mm	390Ω
TLR362T	"	14.2	"
TLR332T	"	7.6	"
TLR342T	"	10.9	"
TLG358T	Green	13.4mm	160Ω
TLG362T	"	14.2	"
TLG332T	"	7.6	"
TLG342T	"	10.9	"

Application Circuit