

BCD TO 7-SEGMENT LATCH/DECODER/DRIVER

FEATURES

- Latch storage of BCD inputs
- Blanking input
- Lamp test input
- Driving common cathode LED displays
- Guaranteed 10 mA drive capability per output
- Output capability: non-standard
- I_{CC} category: MSI

GENERAL DESCRIPTION

The 74HC/HCT4511 are high-speed Si-gate CMOS devices and are pin compatible with "4511" of the "4000B" series. They are specified in compliance with JEDEC standard no. 7A.

The 74HC/HCT4511 are BCD to 7-segment latch/decoder/drivers with four address inputs (D₁ to D₄), an active LOW latch enable input (LE), an active LOW ripple blanking input (BI), an active LOW lamp test input (LT), and seven active HIGH segment outputs (Q_a to Q_g).

When $\overline{LE}$ is LOW, the state of the segment outputs (Q_a to Q_g) is determined by the data on D₁ to D₄.

When $\overline{LE}$ goes HIGH, the last data present on D₁ to D₄ are stored in the latches and the segment outputs remain stable.

When LT is LOW, all the segment outputs are HIGH independent of all other input conditions. With LT HIGH, a LOW on BI forces all segment outputs LOW. The inputs LT and BI do not affect the latch circuit.

APPLICATIONS

- Driving LED displays
- Driving incandescent displays
- Driving fluorescent displays
- Driving LCD displays
- Driving gas discharge displays

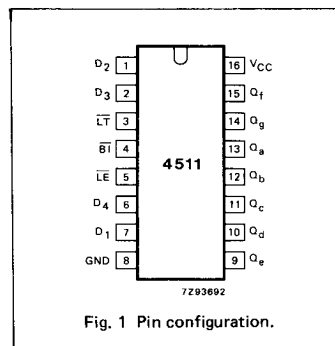


Fig. 1 Pin configuration.

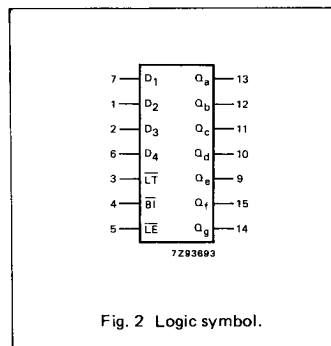


Fig. 2 Logic symbol.

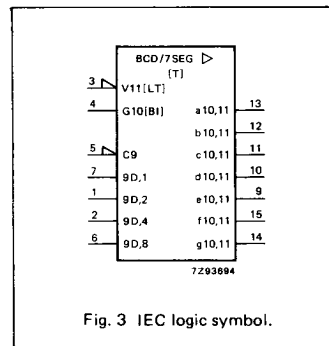


Fig. 3 IEC logic symbol.

SYMBOL	PARAMETER	CONDITIONS	TYPICAL		UNIT
			HC	HCT	
t _{PHL} / t _{PLH}	propagation delay D ₀ to Q _n	C _L = 15 pF V _{CC} = 5 V	24	24	ns
	LE to Q _n		23	24	ns
	BI to Q _n		19	20	ns
	LT to Q _n		12	13	ns
C _I	input capacitance		3.5	3.5	pF
CPD	power dissipation capacitance per latch	notes 1 and 2	64	64	pF

GND = 0 V; T_{amb} = 25 °C; t_r = t_f = 6 ns

Notes

1. CPD is used to determine the dynamic power dissipation (P_D in μW):

$$P_D = CPD \times V_{CC}^2 \times f_i + \Sigma (C_L \times V_{CC}^2 \times f_o) \text{ where:}$$

f_i = input frequency in MHz

C_L = output load capacitance in pF

f_o = output frequency in MHz

V_{CC} = supply voltage in V

Σ (C_L × V_{CC}² × f_o) = sum of outputs

2. For HC the condition is V_I = GND to V_{CC}

For HCT the condition is V_I = GND to V_{CC} - 1.5 V

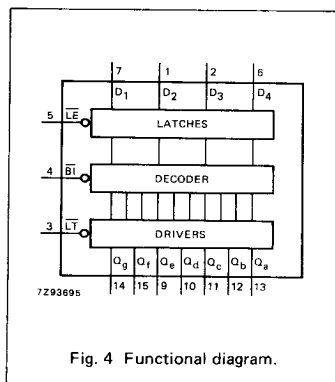
PACKAGE OUTLINES

16-lead DIL; plastic (SOT38Z).

16-lead mini-pack; plastic (SO16; SOT109A).

PIN DESCRIPTION

PIN NO.	SYMBOL	NAME AND FUNCTION
3	LT	lamp test input (active LOW)
4	BI	ripple blanking input (active LOW)
5	LE	latch enable input (active LOW)
7, 1, 2, 6	D ₁ to D ₄	BCD address inputs
8	GND	ground (0 V)
13, 12, 11, 10, 9, 15, 14	Q _a to Q _g	segments outputs
16	V _{CC}	positive supply voltage



FUNCTION TABLE

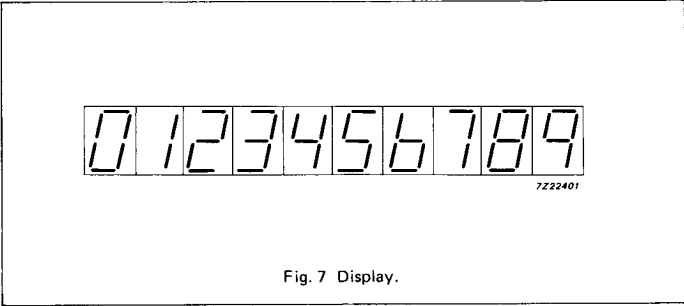
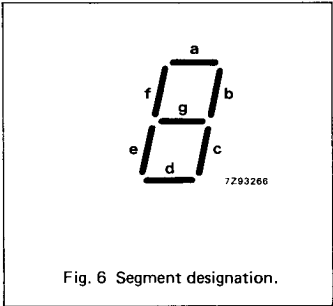
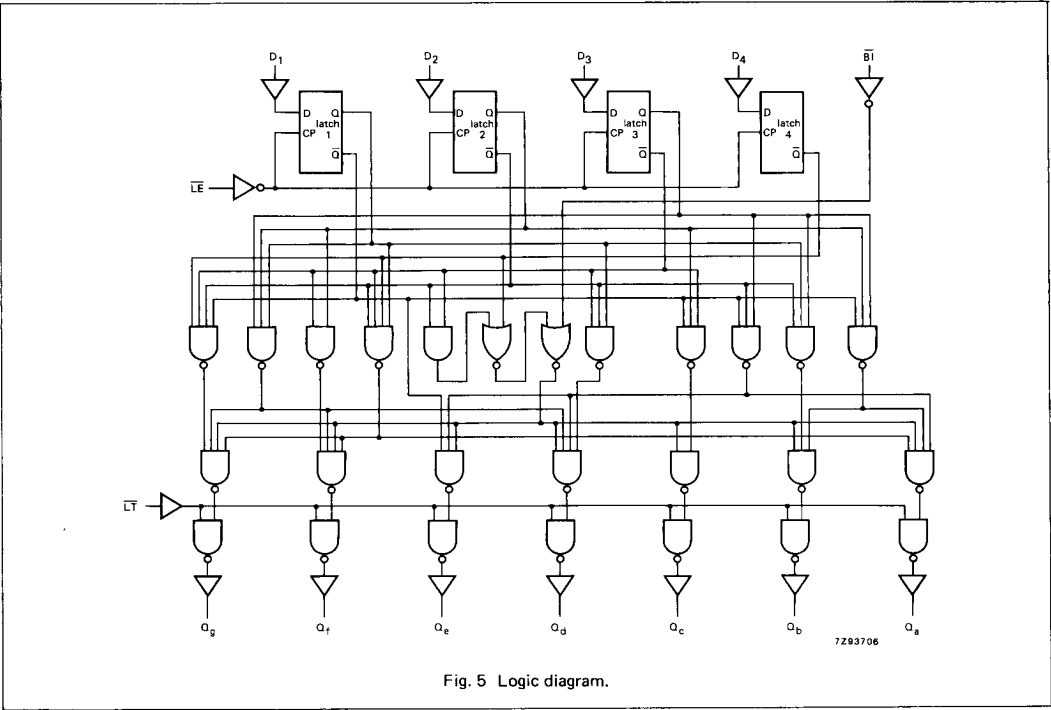
INPUTS							OUTPUTS							DISPLAY
LE	BI	LT	D ₄	D ₃	D ₂	D ₁	Q _a	Q _b	Q _c	Q _d	Q _e	Q _f	Q _g	
X	X	L	X	X	X	X	H	H	H	H	H	H	H	8
X	L	H	X	X	X	X	L	L	L	L	L	L	L	blank
L	H	H	L	L	L	L	H	H	H	H	H	H	L	0
L	H	H	L	L	L	H	L	H	H	L	L	L	L	1
L	H	H	L	L	H	H	L	H	H	L	H	L	H	2
L	H	H	L	L	H	H	H	H	H	H	L	L	H	3
L	H	H	L	H	L	L	L	H	H	L	L	H	H	4
L	H	H	L	H	H	L	H	L	L	H	H	H	H	5
L	H	H	L	H	H	H	L	H	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	L	L	L	H	L	9
L	H	H	H	L	H	L	L	L	L	L	L	L	L	blank
L	H	H	H	L	H	H	L	L	L	L	L	L	L	blank
L	H	H	H	H	L	L	L	L	L	L	L	L	L	blank
L	H	H	H	H	H	L	L	L	L	L	L	L	L	blank
L	H	H	H	H	H	H	L	L	L	L	L	L	L	blank
H	H	H	X	X	X	X	*							*

* Depends upon the BCD-code applied during the LOW-to-HIGH transition of LE.

H = HIGH voltage level

L = LOW voltage level

X = don't care



DC CHARACTERISTICS FOR 74HC

For the DC characteristics see chapter "HCMOS family characteristics", section "Family specifications".

Output capability: standard, excepting V_{OH} which is given below

I_{CC} category: MSI

Non-standard DC characteristics for 74HC

Voltages are referenced to GND (ground = 0 V)

SYMBOL	PARAMETER	T _{amb} (°C)								UNIT	TEST CONDITIONS		
		74HC									V _{CC} V	V _I	-I _O mA
		+25			-40 to +85		-40 to +125						
		min.	typ.	max.	min.	max.	min.	max.					
V _{OH}	HIGH level output voltage	3.98 3.60			3.84 3.35		3.70 3.10		V	4.5	V _{IH} or V _{IL}	7.5 10.0	
V _{OH}	HIGH level output voltage	5.60 5.48 4.80			5.45 5.34 4.50		5.35 5.20 4.20		V	6.0	V _{IH} or V _{IL}	7.5 10.0 15.0	

AC CHARACTERISTICS FOR 74HC

GND = 0 V; $t_r = t_f = 6$ ns; $C_L = 50$ pF

SYMBOL	PARAMETER	T _{amb} (°C)								UNIT	TEST CONDITIONS	
		74HC									V _{CC} V	WAVEFORMS
		+25			-40 to +85		-40 to +125					
		min.	typ.	max.	min.	max.	min.	max.				
t _{PHL} / t _{PLH}	propagation delay D _N to Q _N		77 28 22	300 60 51		375 75 64		450 90 77	ns	2.0 4.5 6.0	Fig. 8	
t _{PHL} / t _{PLH}	propagation delay LE to Q _N		74 27 22	270 54 46		330 68 58		405 81 69	ns	2.0 4.5 6.0	Fig. 9	
t _{PHL} / t _{PLH}	propagation delay BI to Q _N		61 22 18	220 44 37		275 55 47		330 66 56	ns	2.0 4.5 6.0	Fig. 10	
t _{PHL} / t _{PLH}	propagation delay LT to Q _N		41 15 12	150 30 26		190 38 33		225 45 38	ns	2.0 4.5 6.0	Fig. 8	
t _{THL} / t _{TLH}	output transition time		19 7 6	75 15 13		95 19 16		110 22 19	ns	2.0 4.5 6.0	Figs 8, 9 and 10	
t _W	latch enable pulse width LOW	80 16 14	11 4 3		100 20 17		120 24 20		ns	2.0 4.5 6.0	Fig. 9	
t _{su}	set-up time D _N to LE	60 12 10	14 5 4		75 15 13		90 18 15		ns	2.0 4.5 6.0	Fig. 11	
t _h	hold time D _N to LE	0 0 0	-11 -4 -3		0 0 0		0 0 0		ns	2.0 4.5 6.0	Fig. 11	

DC CHARACTERISTICS FOR 74HCT

For the DC characteristics see chapter "HCMOS family characteristics", section "Family specifications".

Output capability: standard, excepting V_{OH} which is given below

I_{CC} category: MSI

Non-standard DC characteristics for 74HCT

Voltages are referenced to GND (ground = 0 V)

SYMBOL	PARAMETER	T _{amb} (°C)								UNIT	TEST CONDITIONS		
		74HCT									V _{CC} V	V _I	-I _O mA
		+ 25			-40 to +85		-40 to +125						
		min.	typ.	max.	min.	max.	min.	max.					
V _{OH}	HIGH level output voltage	3.98 3.60			3.84 3.35		3.70 3.10		V	4.5	V _{IH} or V _{IL}	7.5 10.0	

Note to HCT types

The value of additional quiescent supply current (ΔI_{CC}) for a unit load of 1 is given in the family specifications. To determine ΔI_{CC} per input, multiply this value by the unit load coefficient shown in the table below.

INPUT	UNIT LOAD COEFFICIENT
$\overline{LT}$, $\overline{LE}$	1.50
$\overline{BI}$, D_n	0.30

AC CHARACTERISTICS FOR 74HCT

GND = 0 V; $t_r = t_f = 6$ ns; $C_L = 50$ pF

SYMBOL	PARAMETER	T _{amb} (°C)							UNIT	TEST CONDITIONS	
		74HCT								V _{CC} V	WAVEFORMS
		+25			−40 to +85		−40 to +125				
		min.	typ.	max.	min.	max.	min.	max.			
t _{PHL} / t _{PLH}	propagation delay D _N to Q _N		28	60		75		90	ns	4.5	Fig. 8
t _{PHL} / t _{PLH}	propagation delay LE to Q _N		27	54		68		81	ns	4.5	Fig. 9
t _{PHL} / t _{PLH}	propagation delay BI to Q _N		23	44		55		66	ns	4.5	Fig. 10
t _{PHL} / t _{PLH}	propagation delay LT to Q _N		16	30		38		45	ns	4.5	Fig. 8
t _{THL} / t _{TLH}	output transition time		7	15		19		22	ns	4.5	Figs 8, 9 and 10
t _W	latch enable pulse width LOW	16	5		20		24		ns	4.5	Fig. 9
t _{su}	set-up time D _N to LE	12	5		15		18		ns	4.5	Fig. 11
t _h	hold time D _N to LE	0	−4		0		0		ns	4.5	Fig. 11

AC WAVEFORMS

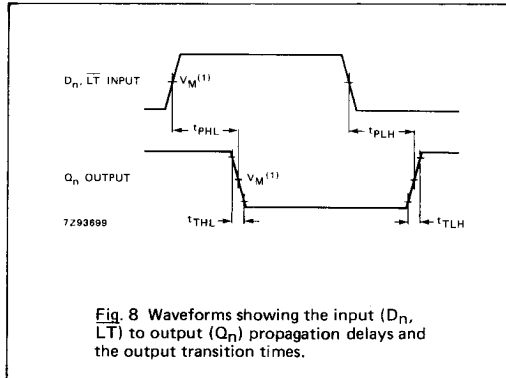


Fig. 8 Waveforms showing the input ($\overline{D_n}$, $\overline{LT}$) to output (Q_n) propagation delays and the output transition times.

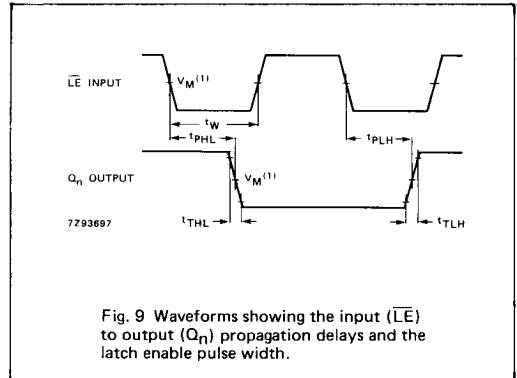


Fig. 9 Waveforms showing the input ($\overline{LE}$) to output (Q_n) propagation delays and the latch enable pulse width.

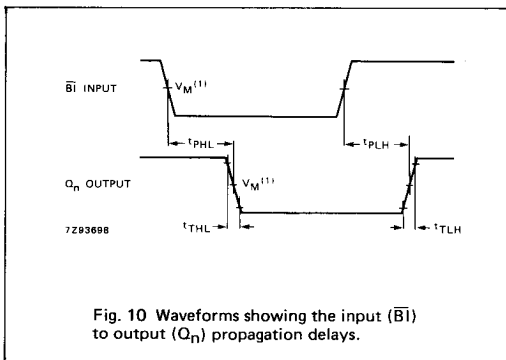


Fig. 10 Waveforms showing the input ($\overline{B_1}$) to output (Q_n) propagation delays.

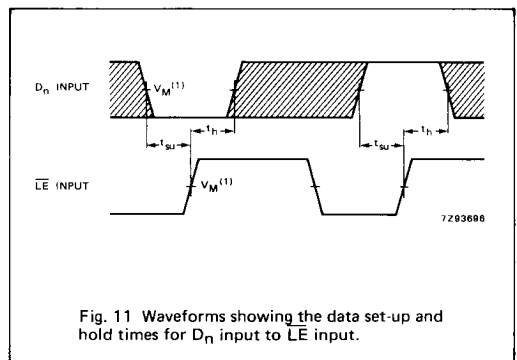


Fig. 11 Waveforms showing the data set-up and hold times for $\overline{D_n}$ input to $\overline{LE}$ input.

Note to AC waveforms

- (1) HC : $V_M = 50\%$; $V_L = \text{GND}$ to V_{CC} .
HCT: $V_M = 1.3\text{ V}$; $V_L = \text{GND}$ to 3 V .

Note to Fig. 11

The shaded areas indicate when the input is permitted to change for predictable output performance.

APPLICATION DIAGRAMS

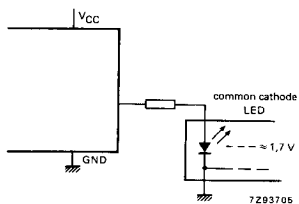


Fig. 12 Connection to common cathode LED display readout.

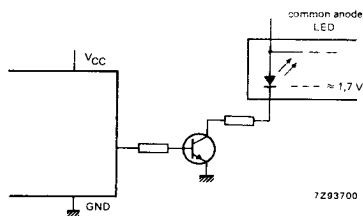
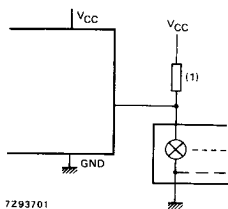


Fig. 13 Connection to common anode LED display readout.



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

Fig. 14 Connection to incandescent display readout.

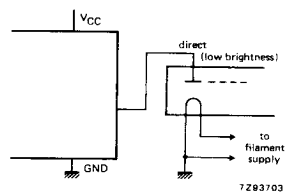


Fig. 15 Connection to fluorescent display readout.

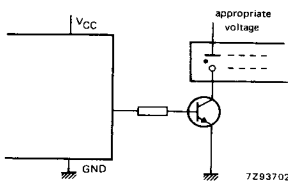


Fig. 16 Connection to gas discharge display readout.

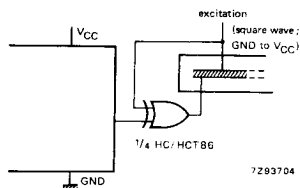


Fig. 17 Connection to LCD display readout. (Direct DC drive is not recommended as it can shorten the life of LCD displays).