74HC4511; 74HCT4511

BCD to 7-segment latch/decoder/driver

Rev. 3 — 15 November 2016 Product data sheet

1. General description

The 74HC4511; 74HCT4511 is a BCD to 7-segment latch/decoder/driver with four address inputs (A, B, C, D), a latch enable input ($\overline{LE}$), a ripple blanking input ($\overline{BI}$), a lamp test input ($\overline{LT}$), and seven segment outputs (a to g). When $\overline{LE}$ is LOW, the state of the segment outputs (a to g) is determined by the data on A to D. When $\overline{LE}$ goes HIGH, the last data present on A to D are stored in the latches and the segment outputs remain stable. When $\overline{LT}$ is LOW, all the segment outputs are HIGH independent of all other input conditions. With $\overline{LT}$ HIGH, a LOW on $\overline{BI}$ forces all segment outputs LOW. The inputs $\overline{LT}$ and $\overline{BI}$ do not affect the latch circuit. Inputs include clamp diodes. This enables the use of current limiting resistors to interface inputs to voltages in excess of V_{CC}.

2. Features and benefits

- Complies with JEDEC standard no. 7A
- Input levels:
  - For 74HC4511: CMOS level
  - For 74HCT4511: TTL level
- Latch storage of BCD inputs
- Blanking input
- Lamp test input
- Driving common cathode LED displays
- Guaranteed 10 mA drive capability per output
- ESD protection:
  - HBM JESD22-A114F exceeds 2000 V
  - MM JESD22-A115-A exceeds 200 V
- Specified from –40 °C to +85 °C and –40 °C to +125 °C

3. Ordering information

Table 1. Ordering information

Type number	Package			
	Temperature range	Name	Description	Version
74HC4511D	–40 °C to +125 °C	SO16	plastic small outline package; 16 leads; body width 3.9 mm	SOT109-1
74HCT4511D				

4. Functional diagram

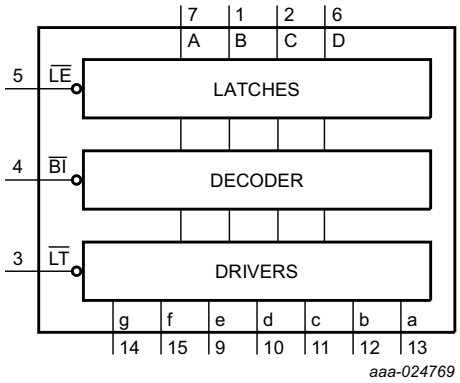


Fig 1. Functional diagram

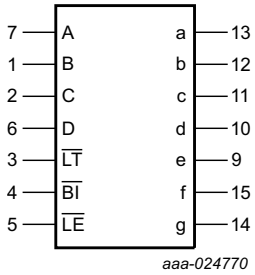


Fig 2. Logic symbol

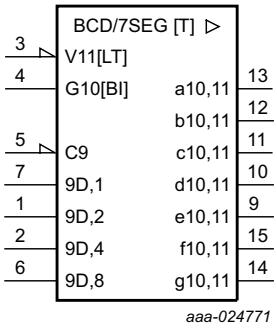


Fig 3. IEC logic symbol

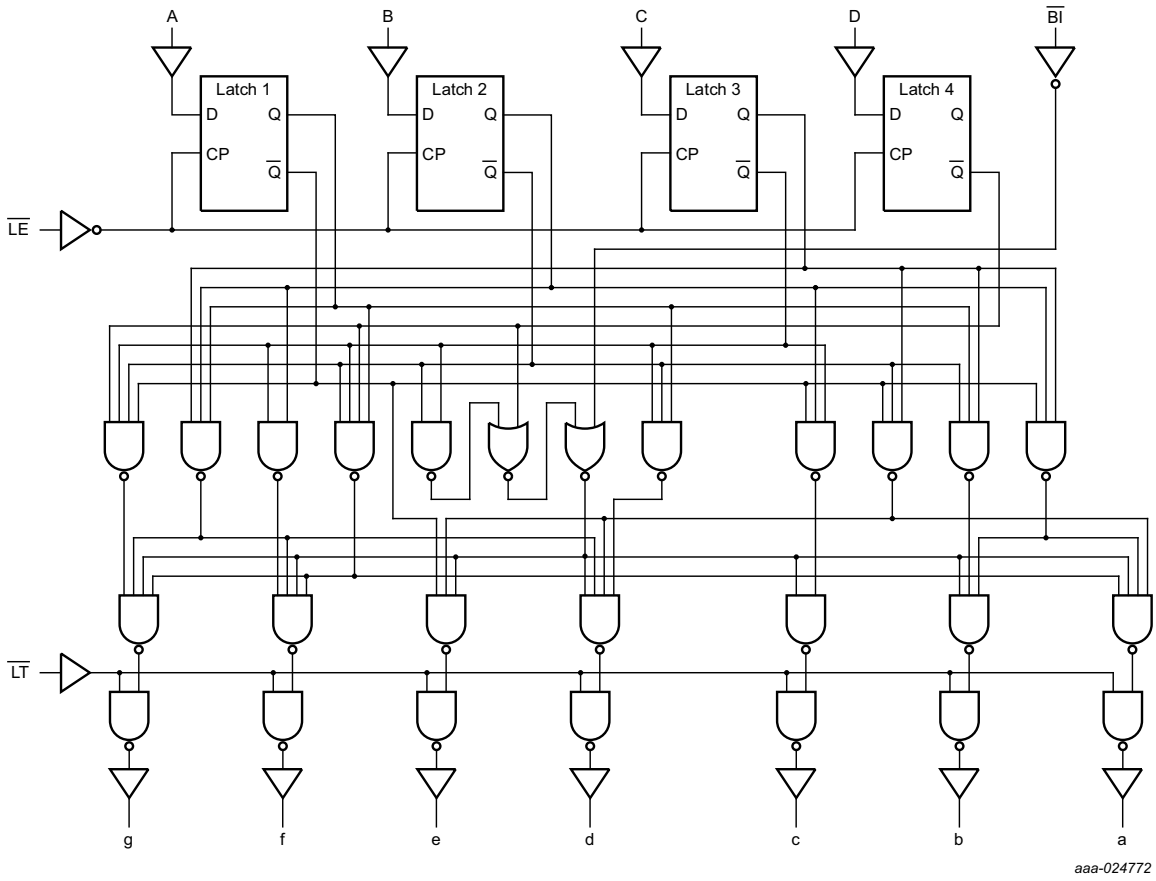


Fig 4. Logic diagram

5. Pinning information

5.1 Pinning

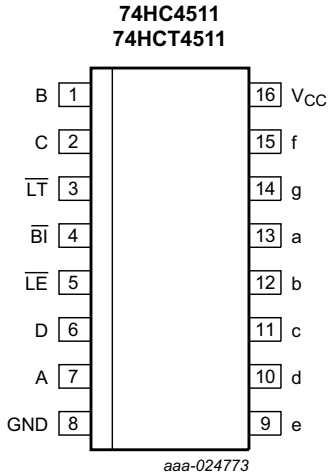


Fig 5. Pin configuration SO16

5.2 Pin description

Table 2. Pin description

Symbol	Pin	Description
$\overline{LT}$	3	lamp test input (active LOW)
$\overline{BI}$	4	ripple blanking input (active low)
$\overline{LE}$	5	latch enable input (active low)
A, B, C, D	7, 1, 2, 6	BCD address inputs
GND	8	ground (0 V)
a, b, c, d, e, f, g	13, 12, 11, 10, 9, 15, 14	segments outputs
V_{CC}	16	supply voltage

6. Functional description

Table 3. Function table[1]

Inputs							Outputs							Display
$\overline{LE}$	$\overline{BI}$	$\overline{LT}$	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	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	L	H	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	[2]							[2]

[1] H = HIGH voltage level;
L = LOW voltage level;
X = don't care

[2] Depends upon the BCD-code applied during the LOW-to-HIGH transition of $\overline{LE}$.

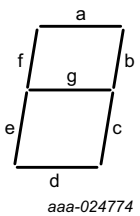


Fig 6. Segment designation

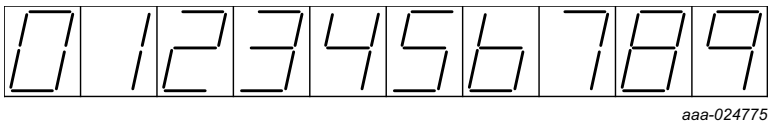


Fig 7. Display

7. Limiting values

Table 4. Limiting values

In accordance with the Absolute Maximum Rating System (IEC 60134). Voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	Min	Max	Unit
V_{CC}	supply voltage		−0.5	+7.0	V
I_{IK}	input clamping current	$V_I < -0.5$ V or $V_I > V_{CC} + 0.5$ V	-	±20	mA
I_{OK}	output clamping current	$V_O < -0.5$ V or $V_O > V_{CC} + 0.5$ V	-	±20	mA
I_O	output current	-0.5 V $< V_O < V_{CC} + 0.5$ V	-	±25	mA
I_{CC}	supply current		-	+50	mA
I_{GND}	ground current		−50	-	mA
T_{stg}	storage temperature		−65	+150	°C
P_{tot}	total power dissipation	SO16 package [1]	-	500	mW

[1] For SO16 packages: above 70 °C the value of P_{tot} derates linearly at 8 mW/K.

8. Recommended operating conditions

Table 5. Recommended operating conditions

Voltages are referenced to GND (ground = 0 V)

Symbol	Parameter	Conditions	74HC4511			74HCT4511			Unit
			Min	Typ	Max	Min	Typ	Max	
V_{CC}	supply voltage		2.0	5.0	6.0	4.5	5.0	5.5	V
V_I	input voltage		0	-	V_{CC}	0	-	V_{CC}	V
V_O	output voltage		0	-	V_{CC}	0	-	V_{CC}	V
T_{amb}	ambient temperature		−40	+25	+125	−40	+25	+125	°C
$\Delta t/\Delta V$	input transition rise and fall rate	V_{CC} = 2.0 V	-	-	625	-	-	-	ns/V
		V_{CC} = 4.5 V	-	1.67	139	-	1.67	139	ns/V
		V_{CC} = 6.0 V	-	-	83	-	-	-	ns/V

9. Static characteristics

Table 6. Static characteristics

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	25 °C			–40 °C to +85 °C		–40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
74HC4511										
V_{IH}	HIGH-level input voltage	V_{CC} = 2.0 V	1.5	1.2	-	1.5	-	1.5	-	V
		V_{CC} = 4.5 V	3.15	2.4	-	3.15	-	3.15	-	V
		V_{CC} = 6.0 V	4.2	3.2	-	4.2	-	4.2	-	V
V_{IL}	LOW-level input voltage	V_{CC} = 2.0 V	-	0.8	0.5	-	0.5	-	0.5	V
		V_{CC} = 4.5 V	-	2.1	1.35	-	1.35	-	1.35	V
		V_{CC} = 6.0 V	-	2.8	1.8	-	1.8	-	1.8	V
V_{OH}	HIGH-level output voltage	V_I = V_{IH} or V_{IL}								
		I_O = –7.5 mA; V_{CC} = 4.5 V	3.98	-	-	3.84	-	3.7	-	V
		I_O = –10 mA; V_{CC} = 4.5 V	3.6	-	-	3.35	-	3.1	-	V
		I_O = –7.5 mA; V_{CC} = 6.0 V	5.6	-	-	5.45	-	5.35	-	V
		I_O = –10 mA; V_{CC} = 6.0 V	5.48	-	-	5.34	-	5.2	-	V
		I_O = –15 mA; V_{CC} = 6.0 V	4.8	-	-	4.5	-	4.2	-	V
V_{OL}	LOW-level output voltage	V_I = V_{IH} or V_{IL}								
		I_O = 20 μA; V_{CC} = 2.0 V	-	0	0.1	-	0.1	-	0.1	V
		I_O = 20 μA; V_{CC} = 4.5 V	-	0	0.1	-	0.1	-	0.1	V
		I_O = 20 μA; V_{CC} = 6.0 V	-	0	0.1	-	0.1	-	0.1	V
		I_O = 4.0 mA; V_{CC} = 4.5 V	-	0.15	0.26	-	0.33	-	0.4	V
		I_O = 5.2 mA; V_{CC} = 6.0 V	-	0.16	0.26	-	0.33	-	0.4	V
I_I	input leakage current	V_I = V_{CC} or GND; V_{CC} = 6.0 V	-	-	±0.1	-	±1.0	-	±1.0	μA
I_{CC}	supply current	V_I = V_{CC} or GND; I_O = 0 A; V_{CC} = 6.0 V	-	-	8.0	-	80	-	160	μA
C_I	input capacitance		-	3.5	-	-	-	-	-	pF

Table 6. Static characteristics *…continued*

At recommended operating conditions; voltages are referenced to GND (ground = 0 V).

Symbol	Parameter	Conditions	25 °C			–40 °C to +85 °C		–40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
74HCT4511										
V_{IH}	HIGH-level input voltage	V_{CC} = 4.5 V to 5.5 V	2.0	1.6	-	2.0	-	2.0	-	V
V_{IL}	LOW-level input voltage	V_{CC} = 4.5 V to 5.5 V	-	1.2	0.8	-	0.8	-	0.8	V
V_{OH}	HIGH-level output voltage	V_I = V_{IH} or V_{IL}; V_{CC} = 4.5 V								
		I_O = –7.5 mA	3.98	-	-	3.84	-	3.7	-	V
		I_O = –10 mA	3.6	-	-	3.35	-	3.1	-	V
V_{OL}	LOW-level output voltage	V_I = V_{IH} or V_{IL}; V_{CC} = 4.5 V								
		I_O = 20 μA	-	0	0.1	-	0.1	-	0.1	V
		I_O = 4.0 mA	-	0.15	0.26	-	0.33	-	0.4	V
I_I	input leakage current	V_I = V_{CC} or GND; V_{CC} = 5.5 V	-	-	±0.1	-	±1.0	-	±1.0	μA
I_{CC}	supply current	V_I = V_{CC} or GND; V_{CC} = 5.5 V; I_O = 0 A	-	-	8.0	-	80	-	160	μA
ΔI_{CC}	additional supply current	per input pin; V_{CC} = 4.5 V to 5.5 V; V_I = V_{CC} – 2.1 V; I_O = 0 A; other inputs at V_{CC} or GND								
		$\overline{LT}$, $\overline{LE}$ inputs	-	150	540	-	675	-	735	μA
		$\overline{BI}$, A, B, C, D inputs	-	30	108	-	135	-	147	μA
C_I	input capacitance		-	3.5	-	-	-	-	-	pF

10. Dynamic characteristics

Table 7. Dynamic characteristics

Voltages are referenced to GND (ground = 0 V); C_L = 50 pF unless otherwise specified; for test circuit see Figure 12.

Symbol	Parameter	Conditions	25 °C			–40 °C to +85 °C		–40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
74HC4511										
t_{pd}	propagation delay	A-D to a-g; see Figure 8 [1]								
		V_{CC} = 2.0 V	-	77	300	-	375	-	450	ns
		V_{CC} = 4.5 V	-	28	60	-	75	-	90	ns
		V_{CC} = 5.0 V; C_L = 15 pF	-	24	-	-	-	-	-	ns
		V_{CC} = 6.0 V	-	22	51	-	64	-	77	ns
		$\overline{LE}$ to a-g; see Figure 9								
		V_{CC} = 2.0 V	-	74	270	-	330	-	405	ns
		V_{CC} = 4.5 V	-	27	54	-	68	-	81	ns
		V_{CC} = 5.0 V; C_L = 15 pF	-	23	-	-	-	-	-	ns
		V_{CC} = 6.0 V	-	22	46	-	58	-	69	ns
		$\overline{BI}$ to a-g; see Figure 10								
		V_{CC} = 2.0 V	-	61	220	-	275	-	330	ns
		V_{CC} = 4.5 V	-	22	44	-	55	-	66	ns
		V_{CC} = 5.0 V; C_L = 15 pF	-	19	-	-	-	-	-	ns
		V_{CC} = 6.0 V	-	18	37	-	47	-	56	ns
		$\overline{LT}$ to a-g; see Figure 8								
		V_{CC} = 2.0 V	-	41	150	-	190	-	225	ns
		V_{CC} = 4.5 V	-	15	30	-	38	-	45	ns
		V_{CC} = 5.0 V; C_L = 15 pF	-	12	-	-	-	-	-	ns
		V_{CC} = 6.0 V	-	12	26	-	33	-	38	ns
t_t	transition time	see Figure 8, Figure 9 and Figure 10 [2]								
		V_{CC} = 2.0 V	-	19	75	-	95	-	110	ns
		V_{CC} = 4.5 V	-	7	15	-	19	-	22	ns
		V_{CC} = 6.0 V	-	6	13	-	16	-	19	ns
t_W	pulse width	$\overline{LE}$ LOW; see Figure 9								
		V_{CC} = 2.0 V	80	11	-	100	-	120	-	ns
		V_{CC} = 4.5 V	16	4	-	20	-	24	-	ns
		V_{CC} = 6.0 V	14	3	-	17	-	20	-	ns
t_{su}	set-up time	A-D to $\overline{LE}$; see Figure 11								
		V_{CC} = 2.0 V	60	14	-	75	-	90	-	ns
		V_{CC} = 4.5 V	12	5	-	15	-	18	-	ns
		V_{CC} = 6.0 V	10	4	-	13	-	15	-	ns

Table 7. Dynamic characteristics *...continued*

Voltages are referenced to GND (ground = 0 V); C_L = 50 pF unless otherwise specified; for test circuit see Figure 12.

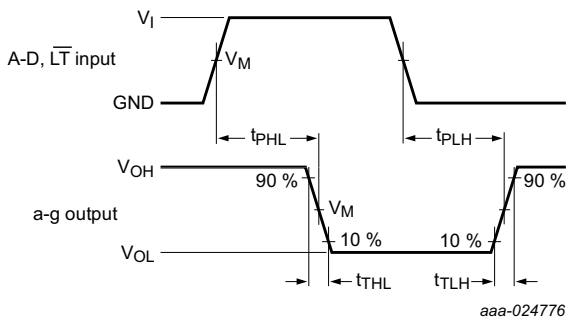
Symbol	Parameter	Conditions	25 °C			–40 °C to +85 °C		–40 °C to +125 °C		Unit
			Min	Typ	Max	Min	Max	Min	Max	
t_h	hold time	A-D to $\overline{LE}$; see Figure 11								
		V_{CC} = 2.0 V	0	–11	-	0	-	0	-	ns
		V_{CC} = 4.5 V	0	–4	-	0	-	0	-	ns
		V_{CC} = 6.0 V	0	–3	-	0		0	-	ns
C_{PD}	power dissipation capacitance	V_I = GND to V_{CC}; V_{CC} = 5 V; f_i = 1 MHz [3]	-	64	-	-	-	-	-	pF
74HCT4511										
t_{pd}	propagation delay	A-D to a-g; see Figure 8 [1]								
		V_{CC} = 4.5 V	-	28	60	-	75	-	90	ns
		V_{CC} = 5.0 V; C_L = 15 pF	-	24	-	-	-	-	-	ns
		$\overline{LE}$ to a-g; see Figure 9								
		V_{CC} = 4.5 V	-	27	54	-	68	-	81	ns
		V_{CC} = 5.0 V; C_L = 15 pF	-	24	-	-	-	-	-	ns
		$\overline{BI}$ to a-g; see Figure 10								
		V_{CC} = 4.5 V	-	23	44	-	55	-	66	ns
		V_{CC} = 5.0 V; C_L = 15 pF	-	20	-	-	-	-	-	ns
		$\overline{LT}$ to a-g; see Figure 8								
		V_{CC} = 4.5 V	-	16	30	-	38	-	45	ns
		V_{CC} = 5.0 V; C_L = 15 pF	-	13	-	-	-	-	-	ns
t_t	transition time	see Figure 8, Figure 9 and Figure 10 [2]								
		V_{CC} = 4.5 V	-	7	15	-	19	-	22	ns
t_W	pulse width	$\overline{LE}$ LOW; see Figure 9								
		V_{CC} = 4.5 V	16	5	-	20	-	24	-	ns
t_{su}	set-up time	A-D to $\overline{LE}$; see Figure 11								
		V_{CC} = 4.5 V	12	5	-	15	-	18	-	ns
t_h	hold time	A-D to $\overline{LE}$; see Figure 11								
		V_{CC} = 4.5 V	0	–4	-	0	-	0	-	ns
C_{PD}	power dissipation capacitance	V_I = GND to V_{CC} – 1.5 V; V_{CC} = 5 V; f_i = 1 MHz [3]	-	64	-	-	-	-	-	pF

[1] t_{pd} is the same as t_{PHL} and t_{PLH}.

[2] t_t is the same as t_{THL} and t_{TLH}.

[3] C_{PD} is used to determine the dynamic power dissipation (P_D in μW):
$P_D = C_{PD} \times V_{CC}^2 \times f_i \times N + \Sigma(C_L \times V_{CC}^2 \times f_o)$ where:
f_i = input frequency in MHz;
f_o = output frequency in MHz;
C_L = output load capacitance in pF;
V_{CC} = supply voltage in V;
N = number of inputs switching;
$\Sigma(C_L \times V_{CC}^2 \times f_o)$ = sum of outputs.

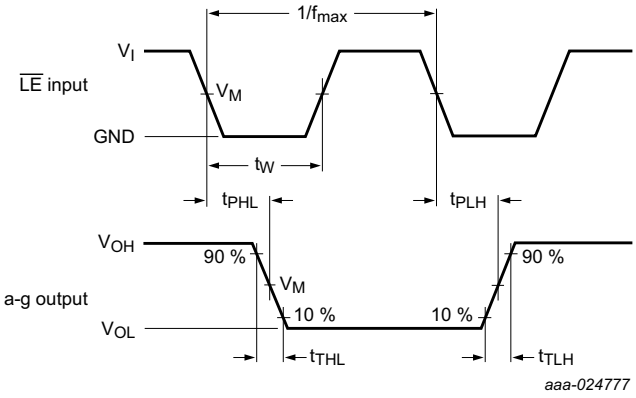
11. Waveforms



Measurement points are given in Table 8.

Logic levels V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

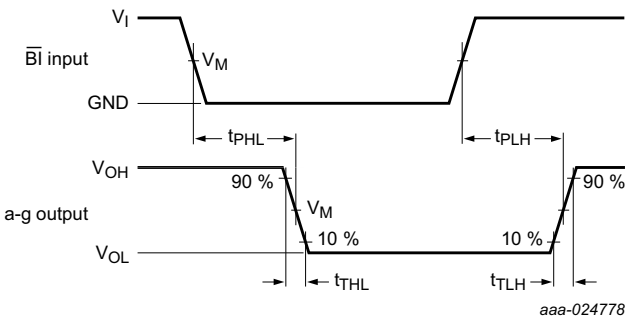
Fig 8. Waveforms showing the input (A-D, $\overline{LT}$) to output (a-g) propagation delays and the output transition times



Measurement points are given in Table 8.

Logic levels V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

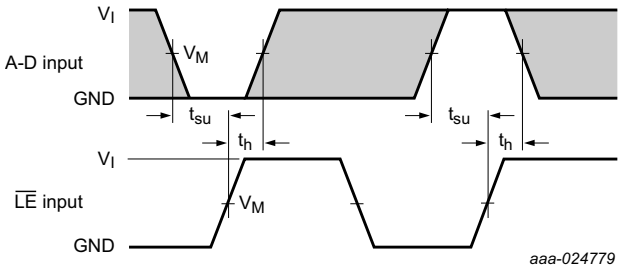
Fig 9. Waveforms showing the input ($\overline{LE}$) to output (a-g) propagation delays; the latch enable pulse width and the output transition times



Measurement points are given in Table 8.

Logic levels V_{OL} and V_{OH} are typical output voltage levels that occur with the output load.

Fig 10. Waveforms showing the input ($\overline{BI}$) to output (a-g) propagation delays and the output transition times



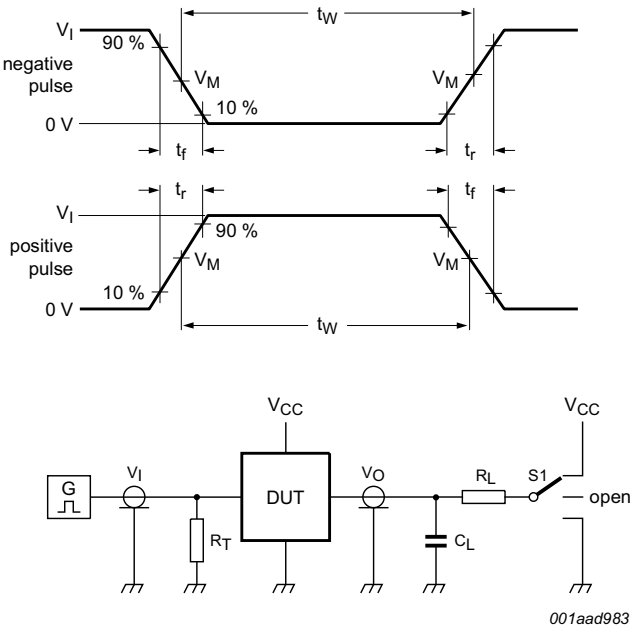
Measurement points are given in Table 8.

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

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

Table 8. Measurement points

Type	Input		Output
	V_M	V_I	V_M
74HC4511	$0.5 \times V_{CC}$	GND to V_{CC}	$0.5 \times V_{CC}$
74HCT4511	1.3 V	GND to 3 V	1.3 V



Test data is given in Table 9.

Test circuit definitions:

R_T = Termination resistance should be equal to output impedance Z_o of the pulse generator

C_L = Load capacitance including jig and probe capacitance

R_L = Load resistance.

S1 = Test selection switch

Fig 12. Test circuit for measuring switching times

Table 9. Test data

Type	Input		Load		S1 position
	V_I	t_r, t_f	C_L	R_L	t_{PHL}, t_{PLH}
74HC4511	V_{CC}	6 ns	15 pF, 50 pF	1 kΩ	open
74HCT4511	3 V	6 ns	15 pF, 50 pF	1 kΩ	open

12. Application information

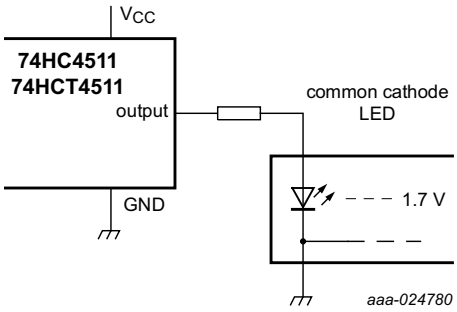


Fig 13. Connection to common cathode LED display readout

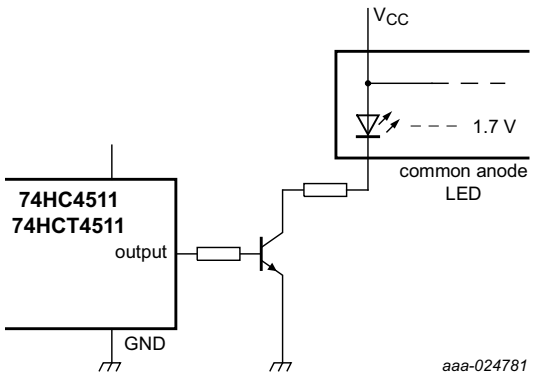
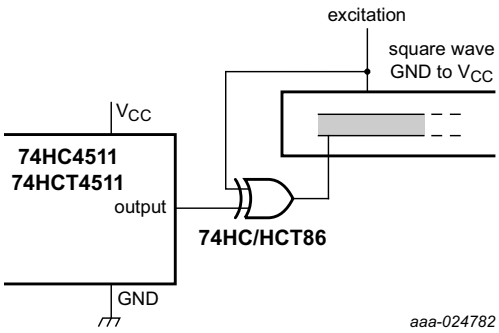


Fig 14. Connection to common anode LED display readout

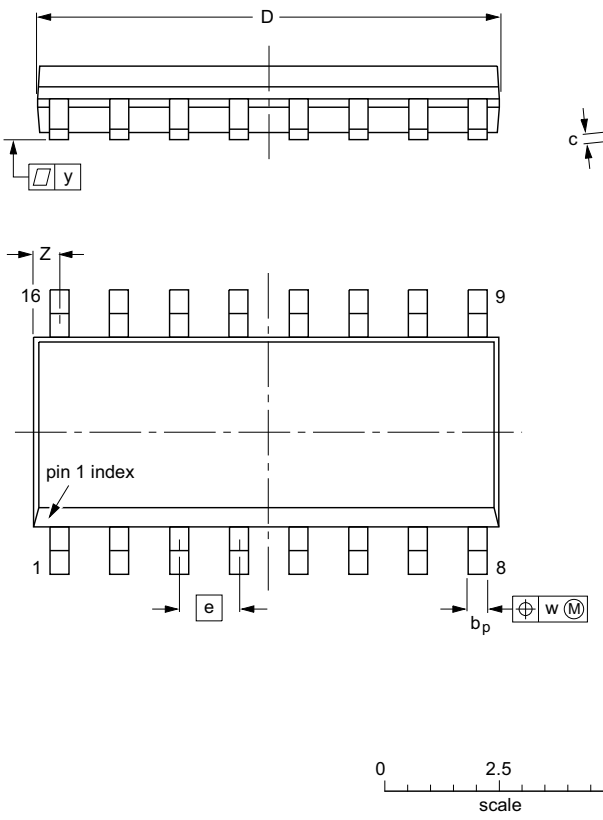


Direct DC drive is not recommended as it can shorten the life of LCD displays

Fig 15. Connection to LCD display readout

13. Package outline

SO16: plastic small outline package; 16 leads; body width 3.9 mm **SOT109-1**



DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	$D^{(1)}$	$E^{(1)}$	e	H_E	L	L_p	Q	v	w	y	$Z^{(1)}$	θ
mm	1.75	0.25 0.10	1.45 1.25	0.25	0.49 0.36	0.25 0.19	10.0 9.8	4.0 3.8	1.27	6.2 5.8	1.05	1.0 0.4	0.7 0.6	0.25	0.25	0.1	0.7 0.3	8^o 0^o
inches	0.069	0.010 0.004	0.057 0.049	0.01	0.019 0.014	0.0100 0.0075	0.39 0.38	0.16 0.15	0.05	0.244 0.228	0.041	0.039 0.016	0.028 0.020	0.01	0.01	0.004	0.028 0.012	

Note

1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	JEITA			
SOT109-1	076E07	MS-012				~~99-12-27~~ 03-02-19

Fig 16. Package outline SOT109-1 (SO16)

14. Abbreviations

Table 10. Abbreviations

Acronym	Description
CMOS	Complementary Metal-Oxide Semiconductor
DUT	Device Under Test
ESD	ElectroStatic Discharge
HBM	Human Body Model
MM	Machine Model
TTL	Transistor-Transistor Logic

15. Revision history

Table 11. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
74HC_HCT4511 v.3	20161115	Product data sheet	-	74HC_HCT4511 v.2
Modifications:	• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors. • Legal texts have been adapted to the new company name where appropriate. • Type numbers 74HC4511N, 74HCT4511N removed.			
74HC_HCT4511 v.2	19901201	Product specification	-	-

16. Legal information

16.1 Data sheet status

Document status[1][2]	Product status[3]	Definition
Objective [short] data sheet	Development	This document contains data from the objective specification for product development.
Preliminary [short] data sheet	Qualification	This document contains data from the preliminary specification.
Product [short] data sheet	Production	This document contains the product specification.

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

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18. Contents

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Date of release: 15 November 2016
Document identifier: 74HC_HCT4511