

General Description

The SN74HC/HCT147 9-input priority encoders accept data from nine active LOW inputs (A_0 to A_8) and provide a binary representation on the four active LOW outputs (\bar{Y}_0 to \bar{Y}_3). A priority is assigned to each input so that when two or more inputs are simultaneously active, the input with the highest priority is represented on the output, with input line \bar{A}_8 having the highest priority.

The devices provide the 10-line to 4-line priority encoding function by use of the implied decimal “zero”. The “zero” is encoded when all nine data inputs are HIGH, forcing all four outputs HIGH.

Features

- Input levels:
For SN74HC147: CMOS level
For SN74HCT147: TTL level
- Encodes 10-line decimal to 4-line BCD
- Useful for 10-position switch encoding
- Used in code converters and generators
- Specified from -40°C to $+125^{\circ}\text{C}$
- Packaging information: DIP16/SOP16/TSSOP16

Ordering Information

Product Model	Package Type	Marking	Packing	Packing Qty
XBLW SN74HC147N	DIP-16	74HC147N	Tube	1000Pcs/Box
XBLW SN74HC147DTR	SOP-16	74HC147	Tape	2500Pcs/Reel
XBLW SN74HC147TDTR	TSSOP-16	74HC147	Tape	3000Pcs/Reel
XBLW SN74HCT147N	DIP-16	74HCT147N	Tube	1000Pcs/Box
XBLW SN74HCT147DTR	SOP-16	74HCT147	Tape	2500Pcs/Reel
XBLW SN74HCT147TDTR	TSSOP-16	74HCT147	Tape	3000Pcs/Reel

Block Diagram And Pin Description

Block Diagram

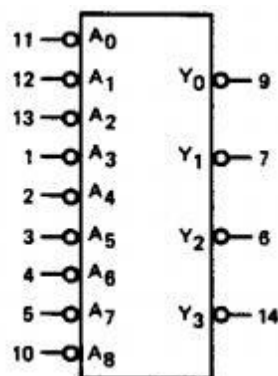


Figure 1. Logic symbol

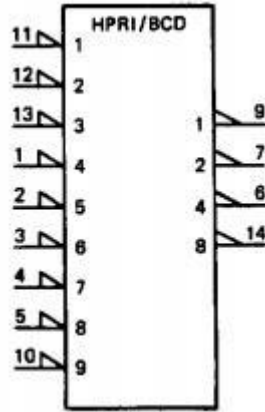


Figure 2. IEC logic symbol

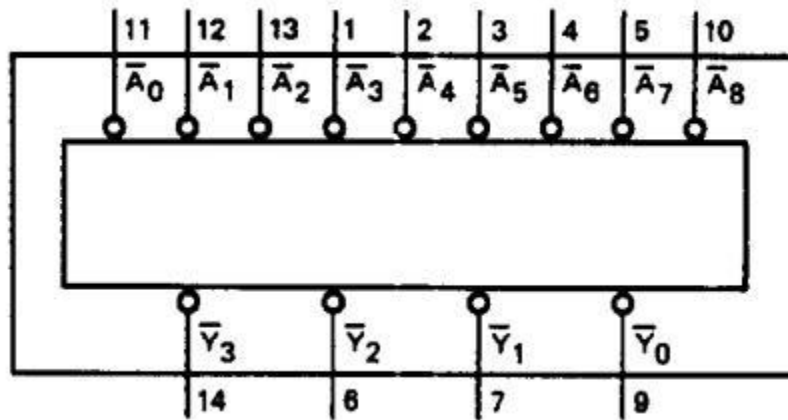


Figure 3. Functional diagram

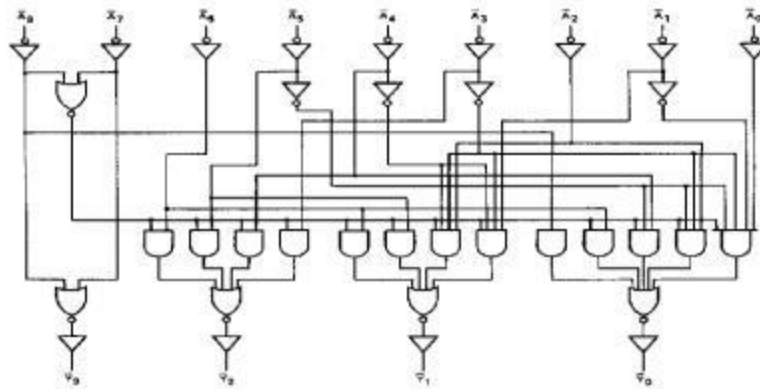
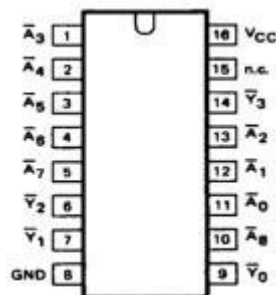


Figure 4. Logic diagram

Pin Configurations



Pin Description

Pin No.	Pin Name	Description
1	$\bar{A}3$	decimal data input (active LOW)
2	$\bar{A}4$	decimal data input (active LOW)
3	$\bar{A}5$	decimal data input (active LOW)
4	$\bar{A}6$	decimal data input (active LOW)
5	$\bar{A}7$	decimal data input (active LOW)
6	$\bar{Y}2$	BCD address output (active LOW)
7	$\bar{Y}1$	BCD address output (active LOW)
8	GND	ground (0V)
9	$\bar{Y}0$	BCD address output (active LOW)
10	$\bar{A}8$	decimal data input (active LOW)
11	$\bar{A}0$	decimal data input (active LOW)
12	$\bar{A}1$	decimal data input (active LOW)
13	$\bar{A}2$	decimal data input (active LOW)
14	$\bar{Y}3$	BCD address output (active LOW)
15	n.c.	not connected
16	V _{CC}	supply voltage

Note: H=HIGH voltage level; L=LOW voltage level; X = don't care.

Function Table

Input									Output			
$\bar{A}0$	$\bar{A}1$	$\bar{A}2$	$\bar{A}3$	$\bar{A}4$	$\bar{A}5$	$\bar{A}6$	$\bar{A}7$	$\bar{A}8$	$\bar{Y}3$	$\bar{Y}2$	$\bar{Y}1$	$\bar{Y}0$
H	H	H	H	H	H	H	H	H	H	H	H	H
X	X	X	X	X	X	X	X	L	L	H	H	L
X	X	X	X	X	X	X	L	H	L	H	H	H
X	X	X	X	X	X	L	H	H	H	L	L	L
X	X	X	X	X	L	H	H	H	H	L	L	H
X	X	X	X	L	H	H	H	H	H	L	H	L
X	X	X	L	H	H	H	H	H	H	L	H	H
X	X	L	H	H	H	H	H	H	H	H	L	L
X	L	H	H	H	H	H	H	H	H	H	L	H
L	H	H	H	H	H	H	H	H	H	H	H	L

Electrical Parameter

Absolute Maximum Ratings

(Voltages are referenced to GND (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Max.	Unit
supply voltage	V_{CC}	-	-0.5	+7.0	V
input clamping current	I_{IK}	$V_I < -0.5V$ or $V_I > V_{CC}+0.5V$	-	± 20	mA
output clamping current	I_{OK}	$V_O < -0.5V$ or $V_O > V_{CC}+0.5V$	-	± 20	mA
output current	I_O	$-0.5V < V_O < V_{CC}+0.5V$	-	± 25	mA
supply current	I_{CC}	-	-	+50	mA
ground current	I_{GND}	-	-50	-	mA
storage temperature	T_{stg}	-	-65	+150	°C
total power dissipation	P_{tot}	-	-	500	mW
soldering temperature	T_L	10s	DIP	245	°C
			SOP/TSSOP	260	

Note:

[1] For DIP16 packages: above 70°C the value of P_{tot} derates linearly with 12mW/K.

[2] For SOP16 packages: above 70°C the value of P_{tot} derates linearly with 8mW/K.

[3] For (T)SSOP16 packages: above 60°C the value of P_{tot} derates linearly with 5.5mW/K.

Recommended Operating Conditions

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
SN74HC147						
supply voltage	V_{CC}	-	2.0	5.0	6.0	V
input voltage	V_I	-	0	-	V_{CC}	V
output voltage	V_O	-	0	-	V_{CC}	V
input transition rise and fall rate	$\Delta t/\Delta V$	$V_{CC}=2.0V$	-	-	625	ns/V
		$V_{CC}=4.5V$	-	1.67	139	ns/V
		$V_{CC}=6.0V$	-	-	83	ns/V
ambient temperature	T_{amb}	-	-40	-	+125	°C
SN74HCT147						
supply voltage	V_{CC}	-	4.5	5.0	5.5	V
input voltage	V_I	-	0	-	V_{CC}	V
output voltage	V_O	-	0	-	V_{CC}	V
input transition rise and fall rate	$\Delta t/\Delta V$	$V_{CC}=4.5V$	-	1.67	139	ns/V
ambient temperature	T_{amb}	-	-40	-	+125	°C

Electrical Characteristics

DC Characteristics 1

($T_{amb}=25^{\circ}\text{C}$, voltages are referenced to GND (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
SN74HC147							
HIGH-level input voltage	V_{IH}	$V_{CC}=2.0\text{V}$	1.5	1.2	-	V	
		$V_{CC}=4.5\text{V}$	3.15	2.4	-	V	
		$V_{CC}=6.0\text{V}$	4.2	3.2	-	V	
LOW-level input voltage	V_{IL}	$V_{CC}=2.0\text{V}$	-	0.8	0.5	V	
		$V_{CC}=4.5\text{V}$	-	2.1	1.35	V	
		$V_{CC}=6.0\text{V}$	-	2.8	1.8	V	
HIGH-level output voltage	V_{OH}	$V_I=V_{IH}$ or V_{IL}	$I_O=-20\mu\text{A}; V_{CC}=2.0\text{V}$	1.9	2.0	-	V
			$I_O=-20\mu\text{A}; V_{CC}=4.5\text{V}$	4.4	4.5	-	V
			$I_O=-20\mu\text{A}; V_{CC}=6.0\text{V}$	5.9	6.0	-	V
			$I_O=-4.0\text{mA}; V_{CC}=4.5\text{V}$	3.98	4.32	-	V
			$I_O=-5.2\text{mA}; V_{CC}=6.0\text{V}$	5.48	5.81	-	V
LOW-level output voltage	V_{OL}	$V_I=V_{IH}$ or V_{IL}	$I_O=20\mu\text{A}; V_{CC}=2.0\text{V}$	-	0	0.1	V
			$I_O=20\mu\text{A}; V_{CC}=4.5\text{V}$	-	0	0.1	V
			$I_O=20\mu\text{A}; V_{CC}=6.0\text{V}$	-	0	0.1	V
			$I_O=4.0\text{mA}; V_{CC}=4.5\text{V}$	-	0.15	0.26	V
			$I_O=5.2\text{mA}; V_{CC}=6.0\text{V}$	-	0.16	0.26	V
input leakage current	I_I	$V_I=V_{CC}$ or GND; $V_{CC}=6.0\text{V}$	-	-	± 1.0	μA	
supply current	I_{CC}	$V_I=V_{CC}$ or GND; $I_O=0\text{A}; V_{CC}=6.0\text{V}$	-	-	8.0	μA	
input capacitance	C_i	-	-	3.5	-	pF	
SN74HCT147							
HIGH-level input voltage	V_{IH}	$V_{CC}=4.5\text{V}$ to 5.5V	2.0	1.6	-	V	
LOW-level input voltage	V_{IL}	$V_{CC}=4.5\text{V}$ to 5.5V	-	1.2	0.8	V	
HIGH-level output voltage	V_{OH}	$V_I=V_{IH}$ or $V_{IL}; V_{CC}=4.5\text{V}$	$I_O=-20\mu\text{A}$	4.4	4.5	-	V
			$I_O=-4.0\text{mA}$	3.98	4.32	-	V
LOW-level output voltage	V_{OL}	$V_I=V_{IH}$ or $V_{IL}; V_{CC}=4.5\text{V}$	$I_O=20\mu\text{A}$	-	0	0.1	V
			$I_O=4.0\text{mA}$	-	0.16	0.26	V
input leakage current	I_I	$V_I=V_{CC}$ or GND; $V_{CC}=5.5\text{V}$	-	-	± 1.0	μA	
supply current	I_{CC}	$V_I=V_{CC}$ or GND; $I_O=0\text{A}; V_{CC}=5.5\text{V}$	-	-	8.0	μA	
additional supply current	ΔI_{CC}	$V_I=V_{CC}-2.1\text{V};$ other inputs at V_{CC} or GND; $I_O=0\text{A};$ $V_{CC}=4.5\text{V}$ to 5.5V	-	100	360	μA	
input capacitance	C_i	-	-	3.5	-	pF	

DC Characteristics 2

 ($T_{amb} = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$, voltages are referenced to GND (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
SN74HC147							
HIGH-level input voltage	V_{IH}	$V_{CC}=2.0\text{V}$	1.5	-	-	V	
		$V_{CC}=4.5\text{V}$	3.15	-	-	V	
		$V_{CC}=6.0\text{V}$	4.2	-	-	V	
LOW-level input voltage	V_{IL}	$V_{CC}=2.0\text{V}$	-	-	0.5	V	
		$V_{CC}=4.5\text{V}$	-	-	1.35	V	
		$V_{CC}=6.0\text{V}$	-	-	1.8	V	
HIGH-level output voltage	V_{OH}	$V_I = V_{IH}$ or V_{IL}	$I_o = -20\mu\text{A}; V_{CC}=2.0\text{V}$	1.9	-	-	V
			$I_o = -20\mu\text{A}; V_{CC}=4.5\text{V}$	4.4	-	-	V
			$I_o = -20\mu\text{A}; V_{CC}=6.0\text{V}$	5.9	-	-	V
			$I_o = -4.0\text{mA}; V_{CC}=4.5\text{V}$	3.84	-	-	V
			$I_o = -5.2\text{mA}; V_{CC}=6.0\text{V}$	5.34	-	-	V
LOW-level output voltage	V_{OL}	$V_I = V_{IH}$ or V_{IL}	$I_o = 20\mu\text{A}; V_{CC}=2.0\text{V}$	-	-	0.1	V
			$I_o = 20\mu\text{A}; V_{CC}=4.5\text{V}$	-	-	0.1	V
			$I_o = 20\mu\text{A}; V_{CC}=6.0\text{V}$	-	-	0.1	V
			$I_o = 4.0\text{mA}; V_{CC}=4.5\text{V}$	-	-	0.33	V
			$I_o = 5.2\text{mA}; V_{CC}=6.0\text{V}$	-	-	0.33	V
input leakage current	I_I	$V_I = V_{CC}$ or GND; $V_{CC}=6.0\text{V}$	-	-	± 1.0	μA	
supply current	I_{CC}	$V_I = V_{CC}$ or GND; $I_o = 0\text{A}; V_{CC}=6.0\text{V}$	-	-	80	μA	
SN74HCT147							
HIGH-level input voltage	V_{IH}	$V_{CC}=4.5\text{V}$ to 5.5V	2.0	-	-	V	
LOW-level input voltage	V_{IL}	$V_{CC}=4.5\text{V}$ to 5.5V	-	-	0.8	V	
HIGH-level output voltage	V_{OH}	$V_I = V_{IH}$ or $V_{IL}; V_{CC}=4.5\text{V}$	$I_o = -20\mu\text{A}$	4.4	-	-	V
			$I_o = -4.0\text{mA}$	3.84	-	-	V
LOW-level output voltage	V_{OL}	$V_I = V_{IH}$ or $V_{IL}; V_{CC}=4.5\text{V}$	$I_o = 20\mu\text{A}$	-	-	0.1	V
			$I_o = 4.0\text{mA}$	-	-	0.33	V
input leakage current	I_I	$V_I = V_{CC}$ or GND; $V_{CC}=5.5\text{V}$	-	-	± 1.0	μA	
supply current	I_{CC}	$V_I = V_{CC}$ or GND; $I_o = 0\text{A}; V_{CC}=5.5\text{V}$	-	-	80	μA	
additional supply current	ΔI_{CC}	$V_I = V_{CC} - 2.1\text{V};$ other inputs at V_{CC} or GND; $I_o = 0\text{A};$ $V_{CC}=4.5\text{V}$ to 5.5V	-	-	450	μA	

DC Characteristics 3

 (T_{amb}=-40°C to +125°C, voltages are referenced to GND (ground=0V), unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
SN74HC147							
HIGH-level input voltage	V _{IH}	V _{CC} =2.0V	1.5	-	-	V	
		V _{CC} =4.5V	3.15	-	-	V	
		V _{CC} =6.0V	4.2	-	-	V	
LOW-level input voltage	V _{IL}	V _{CC} =2.0V	-	-	0.5	V	
		V _{CC} =4.5V	-	-	1.35	V	
		V _{CC} =6.0V	-	-	1.8	V	
HIGH-level output voltage	V _{OH}	V _I =V _{IH} or V _{IL}	I _O =-20μA; V _{CC} =2.0V	1.9	-	-	V
			I _O =-20μA; V _{CC} =4.5V	4.4	-	-	V
			I _O =-20μA; V _{CC} =6.0V	5.9	-	-	V
			I _O =-4.0mA; V _{CC} =4.5V	3.7	-	-	V
			I _O =-5.2mA; V _{CC} =6.0V	5.2	-	-	V
LOW-level output voltage	V _{OL}	V _I =V _{IH} or V _{IL}	I _O =20μA; V _{CC} =2.0V	-	-	0.1	V
			I _O =20μA; V _{CC} =4.5V	-	-	0.1	V
			I _O =20μA; V _{CC} =6.0V	-	-	0.1	V
			I _O =4.0mA; V _{CC} =4.5V	-	-	0.4	V
			I _O =5.2mA; V _{CC} =6.0V	-	-	0.4	V
input leakage current	I _I	V _I =V _{CC} or GND; V _{CC} =6.0V	-	-	±1.0	μA	
supply current	I _{CC}	V _I =V _{CC} or GND; I _O =0A; V _{CC} =6.0V	-	-	160	μA	
SN74HCT147							
HIGH-level input voltage	V _{IH}	V _{CC} =4.5V to 5.5V	2.0	-	-	V	
LOW-level input voltage	V _{IL}	V _{CC} =4.5V to 5.5V	-	-	0.8	V	
HIGH-level output voltage	V _{OH}	V _I =V _{IH} or V _{IL} ; V _{CC} =4.5V	I _O =-20μA	4.4	-	-	V
			I _O =-4.0mA	3.7	-	-	V
LOW-level output voltage	V _{OL}	V _I =V _{IH} or V _{IL} ; V _{CC} =4.5V	I _O =20μA	-	-	0.1	V
			I _O =4.0mA	-	-	0.4	V
input leakage current	I _I	V _I =V _{CC} or GND; V _{CC} =5.5V	-	-	±1.0	μA	
supply current	I _{CC}	V _I =V _{CC} or GND; I _O =0A; V _{CC} =5.5V	-	-	160	μA	
additional supply current	ΔI _{CC}	V _I =V _{CC} -2.1V; other inputs at V _{CC} or GND; I _O =0A; V _{CC} =4.5V to 5.5V	-	-	490	μA	

AC Characteristics 2

 (T_{amb}=-40°C to +85°C, GND=0V, t_r=t_f=6ns, C_L=50pF, unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit		
SN74HC147								
$\bar{A}n$ to $\bar{Y}n$ propagation delay	t _{pd}	see Figure 6 ^[1]	V _{CC} =2.0V	-	-	200	ns	
			V _{CC} =4.5V	-	-	40	ns	
			V _{CC} =6.0V	-	-	34	ns	
transition time	t _t	see Figure 6 ^[2]	V _{CC} =2.0V	-	-	95	ns	
			V _{CC} =4.5V	-	-	19	ns	
			V _{CC} =6.0V	-	-	16	ns	
SN74HCT147								
$\bar{A}n$ to $\bar{Y}n$ propagation delay	t _{pd}	see Figure 6 ^[1]	V _{CC} =4.5V		-	-	44	ns
transition time	t _t	V _{CC} =4.5V; see Figure 6 ^[2]		-	-	19	ns	

Note:

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

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

3.3.6、AC Characteristics 3

 (T_{amb}=-40°C to +125°C, GND=0V, t_r=t_f=6ns, C_L=50pF, unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit		
SN74HC147								
$\bar{A}n$ to $\bar{Y}n$ propagation delay	t _{pd}	see Figure 6 ^[1]	V _{CC} =2.0V	-	-	240	ns	
			V _{CC} =4.5V	-	-	48	ns	
			V _{CC} =6.0V	-	-	41	ns	
transition time	t _t	see Figure 6 ^[2]	V _{CC} =2.0V	-	-	110	ns	
			V _{CC} =4.5V	-	-	22	ns	
			V _{CC} =6.0V	-	-	19	ns	
SN74HCT147								
$\bar{A}n$ to $\bar{Y}n$ propagation delay	t _{pd}	see Figure 6 ^[1]	V _{CC} =4.5V		-	-	53	ns
transition time	t _t	V _{CC} =4.5V; see Figure 6 ^[2]		-	-	22	ns	

Note:

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

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

AC Characteristics 1

 (T_{amb}=25°C, GND=0V, t_r=t_f=6ns, C_L=50pF, unless otherwise specified.)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit	
SN74HC147							
An to Yn propagation delay	t _{pd}	see Figure 6 ^[1]	V _{CC} =2.0V	-	50	160	ns
			V _{CC} =4.5V	-	18	32	ns
			V _{CC} =5.0V; C _L =15pF	-	15	-	ns
			V _{CC} =6.0V	-	14	27	ns
transition time	t _t	see Figure 6 ^[2]	V _{CC} =2.0V	-	19	75	ns
			V _{CC} =4.5V	-	7	15	ns
			V _{CC} =6.0V	-	6	6	ns
power dissipation capacitance	C _{PD}	V _I =GND to V _{CC} ^[3]	-	30	-	pF	
SN74HCT147							
An to Yn propagation delay	t _{pd}	see Figure 6 ^[1]	V _{CC} =4.5V	-	20	35	ns
			V _{CC} =5.0V; C _L =15pF	-	17	-	ns
transition time	t _t	V _{CC} =4.5V; see Figure 6 ^[2]	-	7	15	ns	
power dissipation capacitance	C _{PD}	V _I =GND to V _{CC} -1.5V ^[3]	-	33	-	pF	

Note:

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

 [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 uW).

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

 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;

 $\sum (C_L \times V_{CC}^2 \times f_o)$ =sum of outputs.

Testing Circuit

AC Testing Circuit

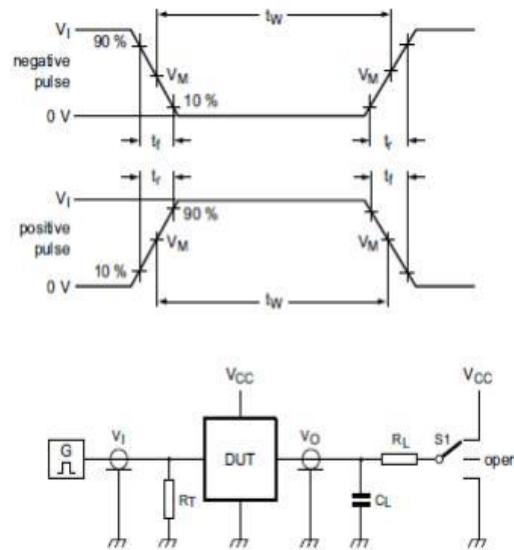


Figure 5. Test circuit for measuring switching times

Definitions for test circuit:

C_L =Load capacitance including jig and probe capacitance.

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

S1=Test selection switch

AC Testing Waveforms

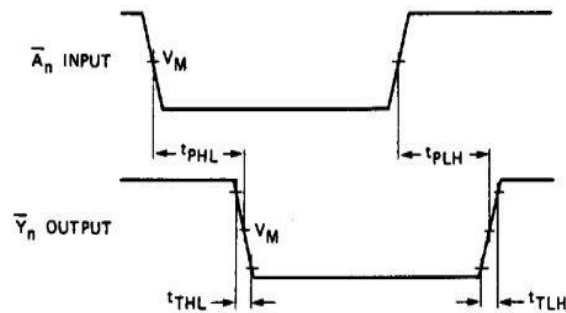


Figure 6. Input (A_n) to output (Y_n) propagation delays and output transition times

Measurement Points

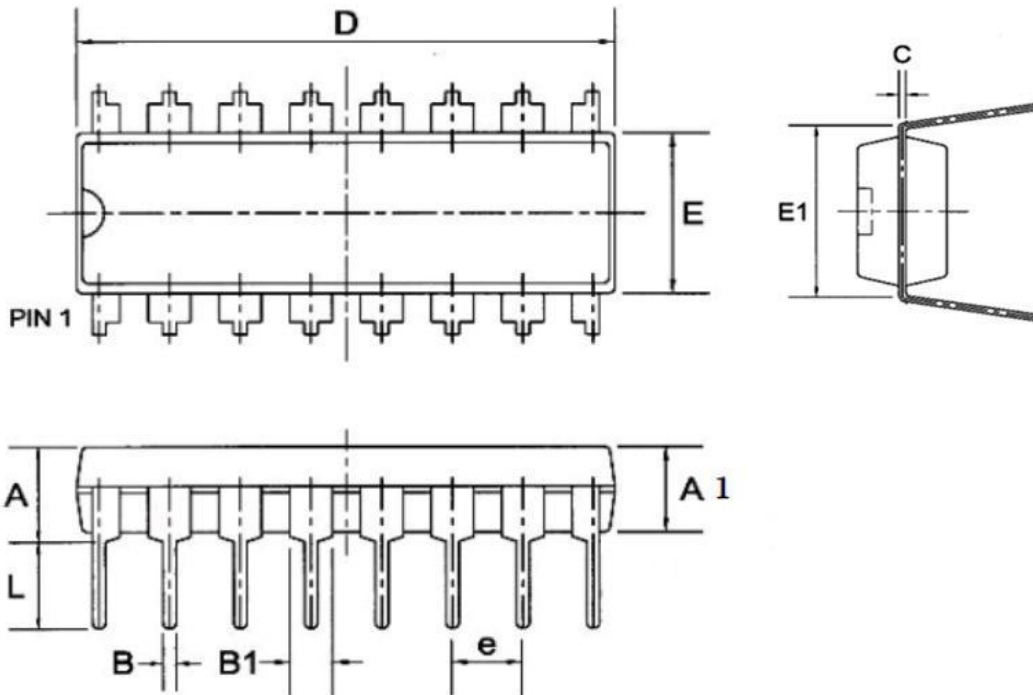
Type	Input		Output	
	V_M	V_M	V_x	V_y
SN74HC147	$0.5 \times V_{CC}$	$0.5 \times V_{CC}$	$0.1 \times V_{CC}$	$0.9 \times V_{CC}$
SN74HCT147	1.3V	1.3V	$0.1 \times V_{CC}$	$0.9 \times V_{CC}$

4.4、 Test Data

Type	Input		Load		S1 position
	V_I	t_r, t_f	C_L	R_L	t_{PLH}, t_{PHL}
SN74HC147	V_{CC}	6ns	15pF, 50pF	1k Ω	open
SN74HCT147	3V	6ns	15pF, 50pF	1k Ω	open

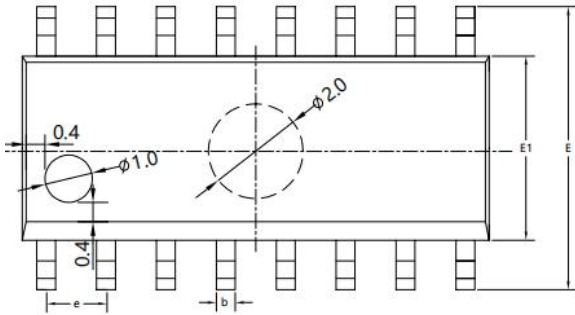
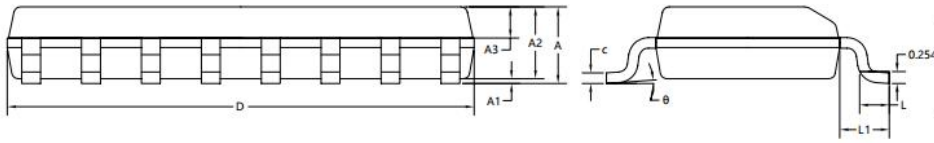
Package Information

DIP16



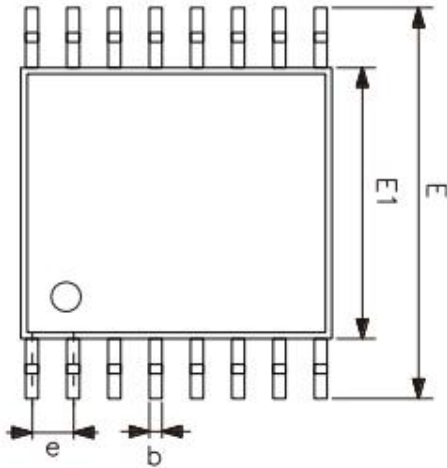
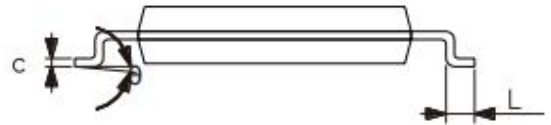
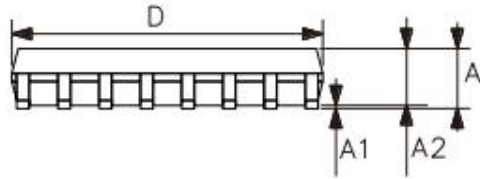
Symbol	Dimensions in Millimeters		
	Min	Nom	Max
A	--	--	4.31
A1	3.15	3.30	3.65
B	--	0.50	--
B1	--	1.6	--
C	--	0.27	--
D	19.00	19.20	19.60
E	6.20	6.50	6.60
E1	--	8.0	--
e	--	2.3	--
L	3.00	3.20	3.60

SOP16



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	1.50	1.60	1.70
A1	0.10	0.15	0.25
A2	1.40	1.45	1.50
A3	0.60	0.65	0.70
b	0.30	0.40	0.50
c	0.15	0.20	0.25
D	9.80	9.90	10.00
E	5.80	6.00	6.20
E1	3.85	3.90	3.95
e	1.27BSC		
L	0.50	0.60	0.70
L1	1.05BSC		
θ	0°	4°	8°

TSSOP16



Symbol	Dimensions (mm)	
	Min.	Max.
A	-	1.20
A1	0.05	0.15
A2	0.80	1.05
b	0.19	0.30
c	0.09	0.20
D	4.90	5.10
E1	4.30	4.50
E	6.20	6.60
e	0.65	
L	0.45	0.75
θ	0°	8°



Statement:

- ✧ Shenzhen xinbole electronics co., ltd. reserves the right to change the product specifications, without notice! Before placing an order, the customer needs to confirm whether the information obtained is the latest version, and verify the integrity of the relevant information.
- ✧ Any semiconductor product is liable to fail or malfunction under certain conditions, and the buyer shall be responsible for complying with safety standards in the system design and whole machine manufacturing using Shenzhen xinbole electronics co., ltd products, and take appropriate security measures to avoid the potential risk of failure may result in personal injury or property losses of the situation occurred!
- ✧ This document is for reference only, and the actual use should be based on the application test results.
- ✧ Product performance is never ending, Shenzhen xinbole electronics co., ltd will be dedicated to provide customers with better performance, better quality of integrated circuit products.