

# TC74HC148AP, TC74HC148AF

## 8-to-3 Line Priority Encoder

The TC74HC148A is a high speed CMOS 8-to-3 LINE ENCODER fabricated with silicon gate C2MOS technology.

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

All data inputs and outputs of these encoders are active at the low logic level.

The encoder detects a low level of the highest order among eight input signals and outputs the corresponding signal position in binary code.

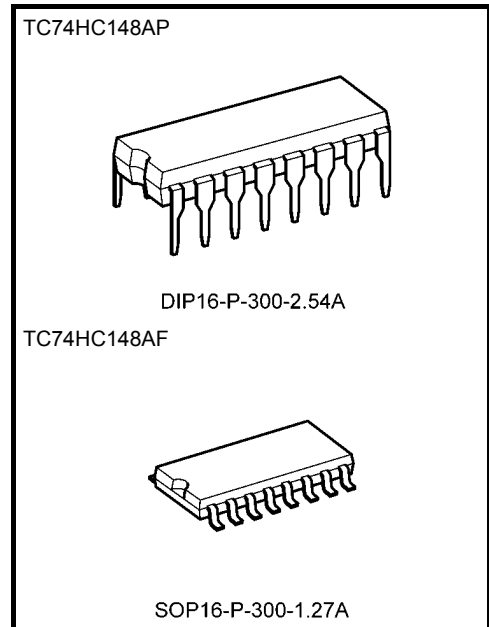
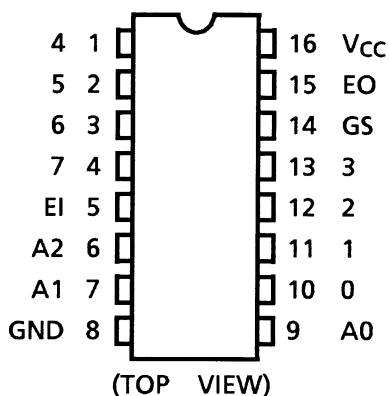
Enable Input EI and Enable Output EO are used to easily cascade without using external circuits.

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

### Features

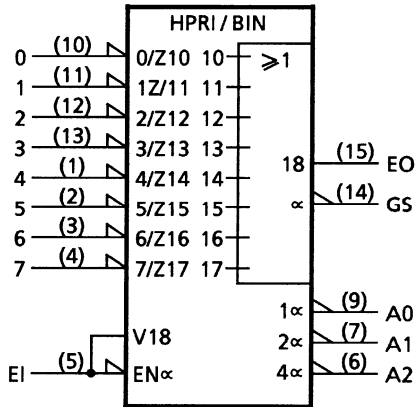
- High speed:  $t_{pd} = 15 \text{ ns (typ.)}$  at  $V_{CC} = 5 \text{ V}$
- Low power dissipation:  $I_{CC} = 4 \mu\text{A (max)}$  at  $T_a = 25^\circ\text{C}$
- High noise immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC} \text{ (min)}$
- Output drive capability: 10 LSTTL loads
- Symmetrical output impedance:  $|I_{OH}| = I_{OL} = 4 \text{ mA (min)}$
- Balanced propagation delays:  $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range:  $V_{CC} \text{ (opr)} = 2 \text{ to } 6 \text{ V}$
- Pin and function compatible with 74LS148

### Pin Assignment



Weight	
DIP16-P-300-2.54A	: 1.00 g (typ.)
SOP16-P-300-1.27A	: 0.18 g (typ.)

**IEC Logic Symbol**

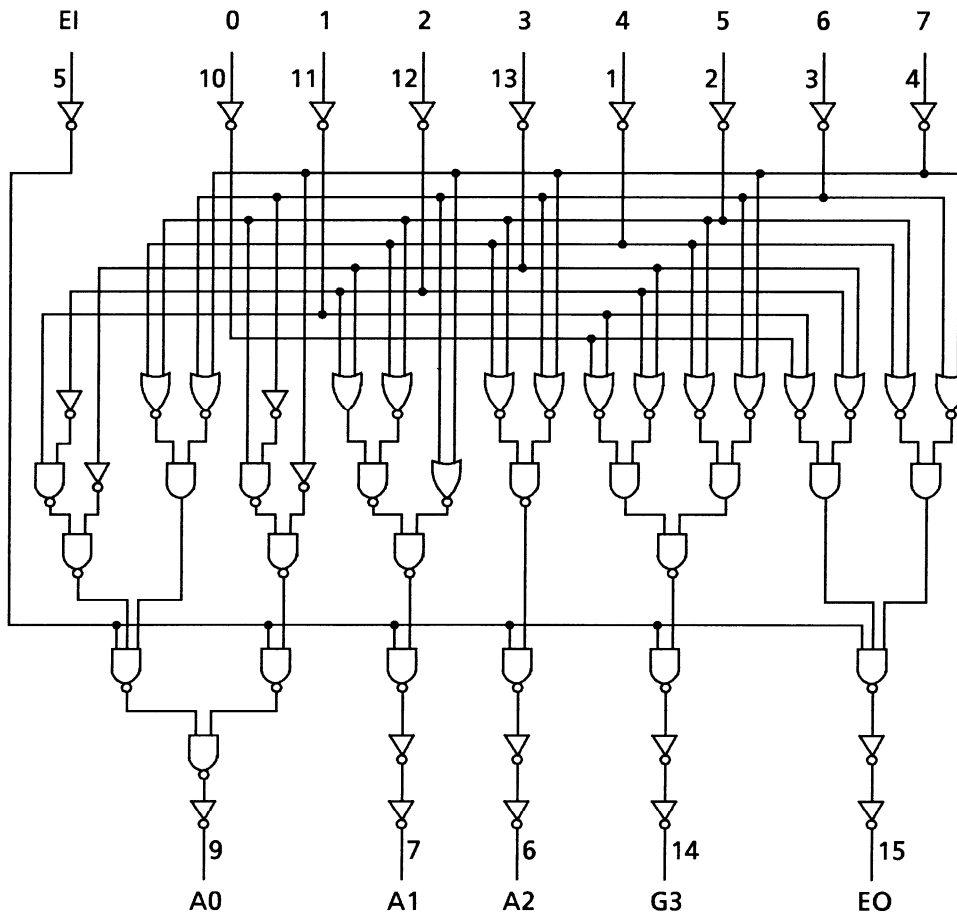


**Truth Table**

Inputs									Outputs				
E1	0	1	2	3	4	5	6	7	A2	A1	A0	GS	EO
H	X	X	X	X	X	X	X	X	H	H	H	H	H
L	H	H	H	H	H	H	H	H	H	H	H	H	L
L	X	X	X	X	X	X	X	L	L	L	L	L	H
L	X	X	X	X	X	X	L	H	L	L	H	L	H
L	X	X	X	X	L	H	H	H	L	H	L	L	H
L	X	X	X	L	H	H	H	H	H	L	L	L	H
L	X	X	L	H	H	H	H	H	H	L	H	L	H
L	X	L	H	H	H	H	H	H	H	H	L	L	H
L	L	H	H	H	H	H	H	H	H	H	H	L	H

X: Don't care

**System Diagram**



**Absolute Maximum Ratings (Note 1)**

Characteristics	Symbol	Rating	Unit
Supply voltage range	$V_{CC}$	-0.5 to 7	V
DC input voltage	$V_{IN}$	-0.5 to $V_{CC} + 0.5$	V
DC output voltage	$V_{OUT}$	-0.5 to $V_{CC} + 0.5$	V
Input diode current	$I_{IK}$	$\pm 20$	mA
Output diode current	$I_{OK}$	$\pm 20$	mA
DC output current	$I_{OUT}$	$\pm 25$	mA
DC $V_{CC}$ /ground current	$I_{CC}$	$\pm 50$	mA
Power dissipation	$P_D$	500 (DIP) (Note 2)/180 (SOP)	mW
Storage temperature	$T_{stg}$	-65 to 150	$^{\circ}C$

Note 1: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 2: 500 mW in the range of  $T_a = -40$  to  $65^{\circ}C$ . From  $T_a = 65$  to  $85^{\circ}C$  a derating factor of  $-10$  mW/ $^{\circ}C$  shall be applied until 300 mW.

## Operating Ranges (Note)

Characteristics	Symbol	Rating	Unit
Supply voltage	$V_{CC}$	2 to 6	V
Input voltage	$V_{IN}$	0 to $V_{CC}$	V
Output voltage	$V_{OUT}$	0 to $V_{CC}$	V
Operating temperature	$T_{opr}$	-40 to 85	°C
Input rise and fall time	$t_r, t_f$	0 to 1000 ( $V_{CC} = 2.0$ V) 0 to 500 ( $V_{CC} = 4.5$ V) 0 to 400 ( $V_{CC} = 6.0$ V)	ns

Note: The operating ranges must be maintained to ensure the normal operation of the device. Unused inputs must be tied to either  $V_{CC}$  or GND.

## Electrical Characteristics

### DC Characteristics

Characteristics	Symbol	Test Condition	$T_a = 25^\circ\text{C}$			$T_a = -40$ to $85^\circ\text{C}$		Unit				
			$V_{CC}$ (V)	Min	Typ.	Max	Min		Max			
High-level input voltage	$V_{IH}$	—	2.0	1.50	—	—	1.50	—	V			
			4.5	3.15	—	—	3.15	—				
			6.0	4.20	—	—	4.20	—				
Low-level input voltage	$V_{IL}$	—	2.0	—	—	0.50	—	0.50	V			
			4.5	—	—	1.35	—	1.35				
			6.0	—	—	1.80	—	1.80				
High-level output voltage	$V_{OH}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OH} = -20 \mu\text{A}$	2.0	1.9	2.0	—	1.9	—	V		
				4.5	4.4	4.5	—	4.4	—			
				6.0	5.9	6.0	—	5.9	—			
			$I_{OH} = -4 \text{ mA}$	4.5	4.18	4.31	—	4.13	—			
				6.0	5.68	5.80	—	5.63	—			
				$I_{OH} = -5.2 \text{ mA}$	4.5	—	0.0	0.1	—		0.1	
6.0	—	0.0	0.1		—	0.1						
Low-level output voltage	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 20 \mu\text{A}$		2.0	—	0.0	0.1	—	0.1	V	
				4.5	—	0.0	0.1	—	0.1			
				6.0	—	0.0	0.1	—	0.1			
$I_{OL} = 4 \text{ mA}$	4.5	—	0.17	0.26	—	0.33						
	6.0	—	0.18	0.26	—	0.33						
	Input leakage current	$I_{IN}$	$V_{IN} = V_{CC}$ or GND	6.0	—	—	$\pm 0.1$	—	$\pm 1.0$	$\mu\text{A}$		
Quiescent supply current				$I_{CC}$	$V_{IN} = V_{CC}$ or GND	6.0	—	—	4.0	—	40.0	$\mu\text{A}$

### AC Characteristics ( $C_L = 15 \text{ pF}$ , $V_{CC} = 5 \text{ V}$ , $T_a = 25^\circ\text{C}$ , input: $t_r = t_f = 6 \text{ ns}$ )

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Output transition time	$t_{TLH}$ $t_{THL}$	—	—	4	8	ns
Propagation delay time (IN-A0, A1, A2)	$t_{pLH}$ $t_{pHL}$	—	—	15	25	ns
Propagation delay time (IN-E0, GS)	$t_{pLH}$ $t_{pHL}$	—	—	15	25	ns
Propagation delay time (EI-E0)	$t_{pLH}$ $t_{pHL}$	—	—	11	19	ns
Propagation delay time (EI-GS)	$t_{pLH}$ $t_{pHL}$	—	—	11	19	ns
Propagation delay time (EI-A0, A1, A2)	$t_{pLH}$ $t_{pHL}$	—	—	11	19	ns

### AC Characteristics ( $C_L = 50 \text{ pF}$ , input: $t_r = t_f = 6 \text{ ns}$ )

Characteristics	Symbol	Test Condition	$T_a = 25^\circ\text{C}$			$T_a = -40 \text{ to } 85^\circ\text{C}$		Unit	
			$V_{CC}$ (V)	Min	Typ.	Max	Min		Max
Output transition time	$t_{TLH}$ $t_{THL}$	—	2.0	—	30	75	—	95	ns
			4.5	—	8	15	—	19	
			6.0	—	7	13	—	16	
Propagation delay time (IN-A0, A1, A2)	$t_{pLH}$ $t_{pHL}$	—	2.0	—	52	150	—	190	ns
			4.5	—	19	30	—	38	
			6.0	—	15	26	—	33	
Propagation delay time (IN-E0, GS)	$t_{pLH}$ $t_{pHL}$	—	2.0	—	52	150	—	190	ns
			4.5	—	19	30	—	38	
			6.0	—	15	26	—	33	
Propagation delay time (EI-E0)	$t_{pLH}$ $t_{pHL}$	—	2.0	—	40	115	—	145	ns
			4.5	—	14	23	—	29	
			6.0	—	11	20	—	25	
Propagation delay time (EI-GS)	$t_{pLH}$ $t_{pHL}$	—	2.0	—	40	115	—	145	ns
			4.5	—	14	23	—	29	
			6.0	—	12	20	—	25	
Propagation delay time (EI-A0, A1, A2)	$t_{pLH}$ $t_{pHL}$	—	2.0	—	40	115	—	145	ns
			4.5	—	14	23	—	29	
			6.0	—	12	20	—	25	
Input capacitance	$C_{IN}$	—	—	5	10	—	10	pF	
Power dissipation capacitance	$C_{PD}$ (Note)	—	—	55	—	—	—	pF	

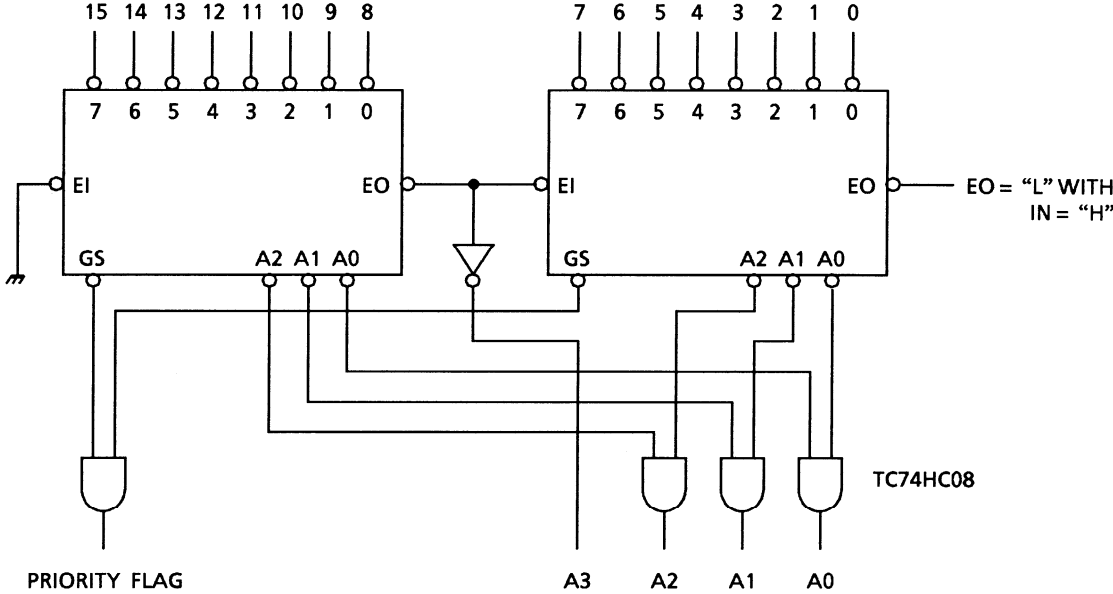
Note:  $C_{PD}$  is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation:

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

Typical Application

4-BIT CASCADE CONNECTION



## Package Dimensions

DIP16-P-300-2.54A

Unit : mm

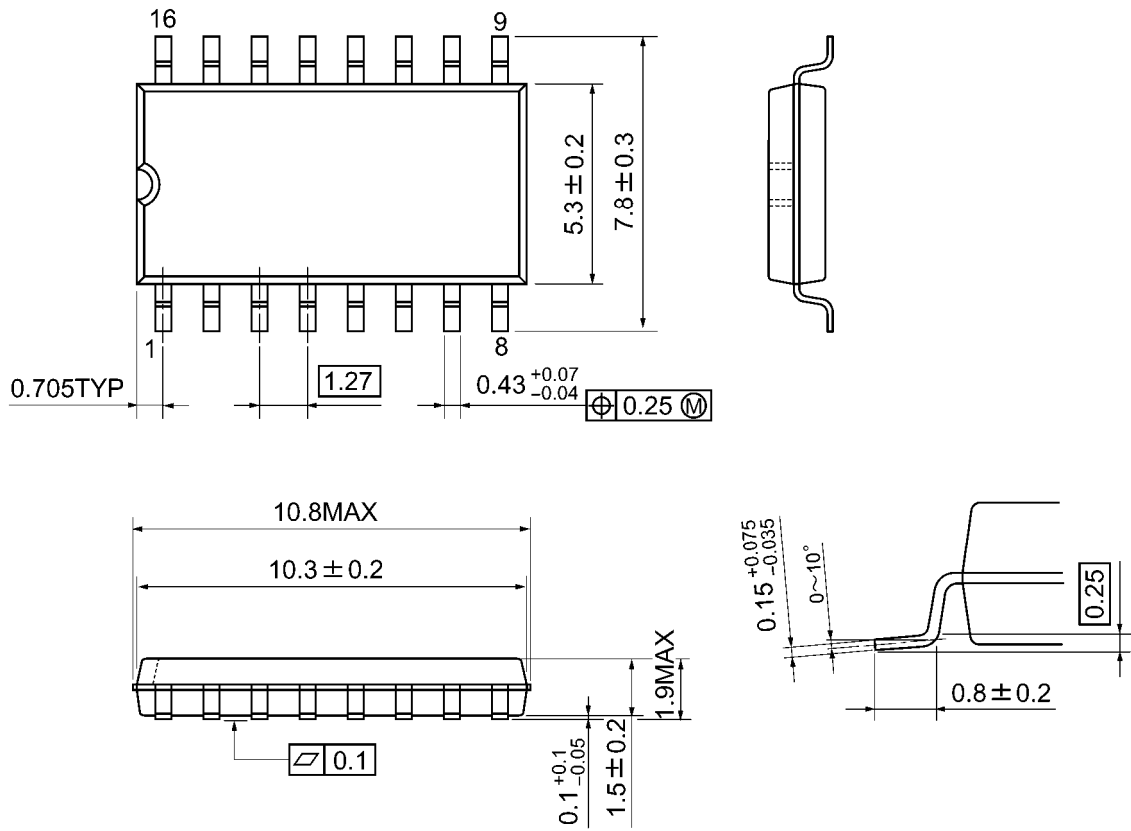


Weight: 1.00 g (typ.)

**Package Dimensions**

SOP16-P-300-1.27A

Unit: mm



Weight: 0.18 g (typ.)

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