

74HC138D

3-to-8 Line Decoder

The 74HC138D is a high speed CMOS 3-to-8 DECODER fabricated with silicon gate C²MOS technology.

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

When the device is enabled, 3 Binary Select inputs (A, B and C) determine which one of the outputs ($\bar{Y}0 - \bar{Y}7$) will go low.

When enable input G1 is held low or either $\bar{G}2A$ or $\bar{G}2B$ is held high, decoding function is inhibited and all outputs go high.

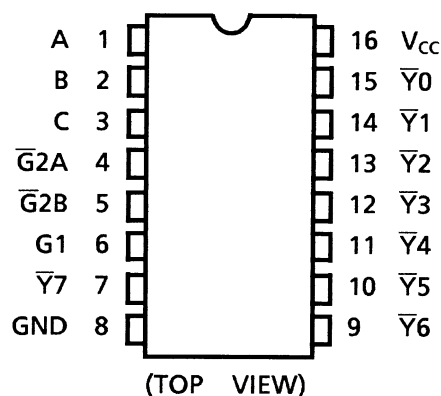
G1, $\bar{G}2A$, and $\bar{G}2B$ inputs are provided to ease cascade connection and for use as an address decoder for memory systems.

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

Features

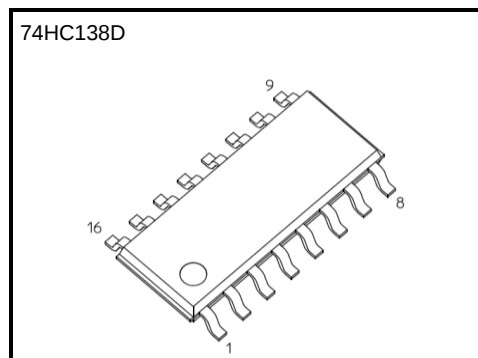
- High speed: $t_{pd} = 16 \text{ ns}$ (typ.) at $V_{CC} = 5 \text{ V}$
- Low power dissipation: $I_{CC} = 4 \mu\text{A}$ (max) at $T_a = 25^\circ\text{C}$
- High noise immunity: $V_{NIH} = V_{NIL} = 28\% V_{CC}$ (min)
- Output drive capability: 10 LSTTL loads
- Symmetrical output impedance: $|I_{OH}| = I_{OL} = 4 \text{ mA}$ (min)
- Balanced propagation delays: $t_{pLH} \approx t_{pHL}$
- Wide operating voltage range: $V_{CC} (\text{opr}) = 2 \text{ to } 6 \text{ V}$

Pin Assignment



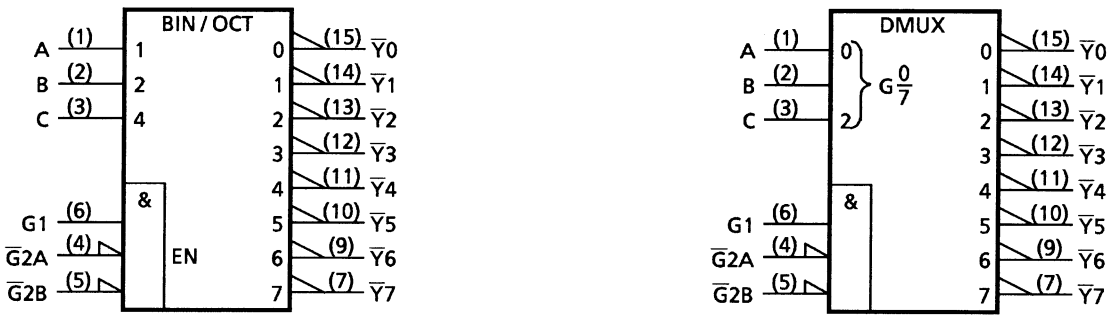
Marking

TBD



Weight
P-SOP16-0410-1.27-005 : 0.15 g (typ.)

IEC Logic Symbol

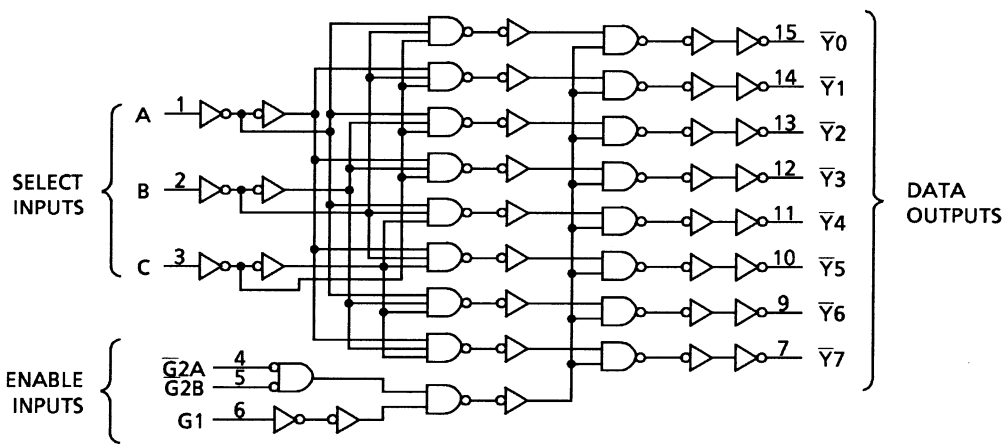


Truth Table

Inputs						Outputs								Selected Output
Enable			Select			$\bar{Y}0$	$\bar{Y}1$	$\bar{Y}2$	$\bar{Y}3$	$\bar{Y}4$	$\bar{Y}5$	$\bar{Y}6$	$\bar{Y}7$	
G1	$\bar{G}2A$	$\bar{G}2B$	C	B	A									
L	X	X	X	X	X	H	H	H	H	H	H	H	H	None
X	H	X	X	X	X	H	H	H	H	H	H	H	H	None
X	X	H	X	X	X	H	H	H	H	H	H	H	H	None
H	L	L	L	L	L	L	H	H	H	H	H	H	H	$\bar{Y}0$
H	L	L	L	L	H	H	L	H	H	H	H	H	H	$\bar{Y}1$
H	L	L	L	H	L	H	H	L	H	H	H	H	H	$\bar{Y}2$
H	L	L	L	H	H	H	H	H	L	H	H	H	H	$\bar{Y}3$
H	L	L	H	L	L	H	H	H	H	L	H	H	H	$\bar{Y}4$
H	L	L	H	L	H	H	H	H	H	H	L	H	H	$\bar{Y}5$
H	L	L	H	H	L	H	H	H	H	H	H	L	H	$\bar{Y}6$
H	L	L	H	H	H	H	H	H	H	H	H	H	L	$\bar{Y}7$

X: Don't care

Logic 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}	±20	mA
Output diode current	I _{OK}	±20	mA
DC output current	I _{OUT}	±25	mA
DC V _{CC} /ground current	I _{CC}	±50	mA
Power dissipation	P _D	180	mW
Storage temperature	T _{stg}	−65 to 150	°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.).

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 125	°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		V _{CC} (V)	Ta = 25°C			Ta = −40 to 85°C		Ta = −40 to 125°C		Unit
					Min	Typ.	Max	Min	Max	Min	Max	
High-level input voltage	V _{IH}	—		2.0 4.5 6.0	1.50 3.15 4.20	— — —	— — —	1.50 3.15 4.20	— — —	1.50 3.15 4.20	— — —	V
Low-level input voltage	V _{IL}	—		2.0 4.5 6.0	— — —	— — —	0.50 1.35 1.80	— — —	0.50 1.35 1.80	— — —	0.50 1.35 1.80	V
High-level output voltage	V _{OH}	V _{IN} = V _{IH} or V _{IL}	I _{OH} = −20 μA	2.0	1.9	2.0	—	1.9	—	1.9	—	V
				4.5	4.4	4.5	—	4.4	—	4.4	—	
				6.0	5.9	6.0	—	5.9	—	5.9	—	
			I _{OH} = −4 mA I _{OH} = −5.2 mA	4.5	4.18	4.31	—	4.13	—	3.7	—	
6.0	5.68	5.80		—	5.63	—	5.2	—				
Low-level output voltage	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 20 μA	2.0	—	0.0	0.1	—	0.1	—	0.1	V
				4.5	—	0.0	0.1	—	0.1	—	0.1	
				6.0	—	0.0	0.1	—	0.1	—	0.1	
			I _{OL} = 4 mA I _{OL} = 5.2 mA	4.5	—	0.17	0.26	—	0.33	—	0.4	
6.0	—	0.18		0.26	—	0.33	—	0.4				
Input leakage current	I _{IN}	V _{IN} = V _{CC} or GND		6.0	—	—	±0.1	—	±1.0	—	±1.0	μA
Quiescent supply current	I _{CC}	V _{IN} = V _{CC} or GND		6.0	—	—	4.0	—	40.0	—	160.0	μA

AC Characteristics (C_L = 15 pF, V_{CC} = 5 V, Ta = 25°C, input: tr = tf = 6 ns)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Output transition time	t _{TLH} t _{THL}	—	—	4	8	ns
Propagation delay time (A, B, C- $\bar{Y}$)	t _{pLH} t _{pHL}	—	—	16	26	ns
Propagation delay time (G, $\bar{G}$ - $\bar{Y}$)	t _{pLH} t _{pHL}	—	—	15	25	ns

AC Characteristics (CL = 50 pF, input: tr = tf = 6 ns)

Characteristics	Symbol	Test Condition	Ta = 25°C				Ta = −40 to 85°C		Ta = −40 to 125°C		Unit
			VCC (V)	Min	Typ.	Max	Min	Max	Min	Max	
Output transition time	tTLH	—	2.0	—	30	75	—	95	—	110	ns
	tTHL		4.5	—	8	15	—	19	—	22	
			6.0	—	7	13	—	16	—	19	
Propagation delay time (A, B, C- $\bar{Y}$)	tpLH	—	2.0	—	70	150	—	190	—	225	ns
	tpHL		4.5	—	19	30	—	38	—	45	
			6.0	—	16	26	—	32	—	38	
Propagation delay time (G, $\bar{G}$ - $\bar{Y}$)	tpLH	—	2.0	—	65	145	—	180	—	225	ns
	tpHL		4.5	—	18	29	—	36	—	45	
			6.0	—	15	25	—	31	—	38	
Input capacitance	CIN	—		—	3	—	—	—	—	—	pF
Power dissipation capacitance	CPD (Note)	—		—	23	—	—	—	—	—	pF

Note: CPD is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

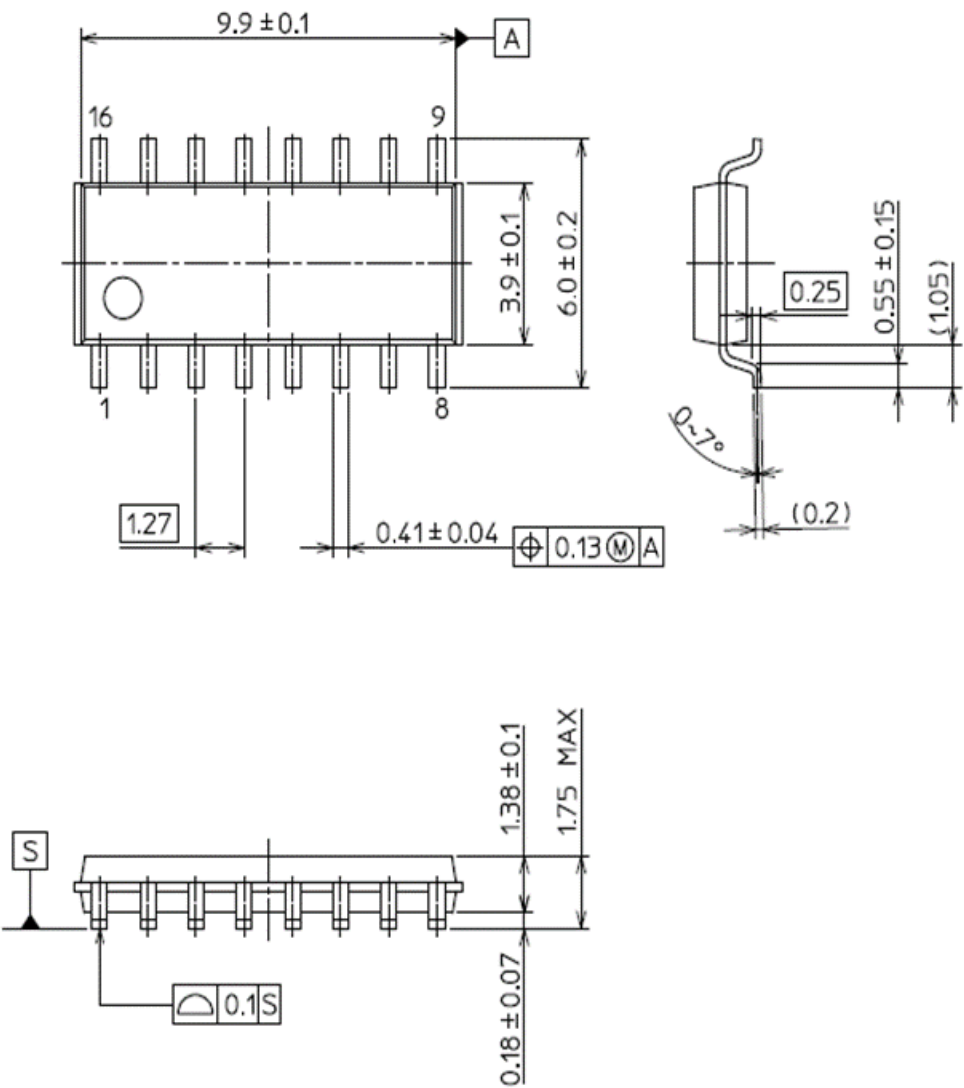
Average operating current can be obtained by the equation:

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

Package Dimensions

P-SOP16-0410-1.27-005

Unit:mm



Weight: 0.15 g (typ.)

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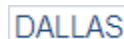
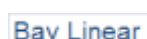
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