TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

74HC138D

3-to-8 Line Decoder

The 74HC138D is a high speed CMOS 3-to-8 DECODER fabricated with silicon gate C^2MOS technology.

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

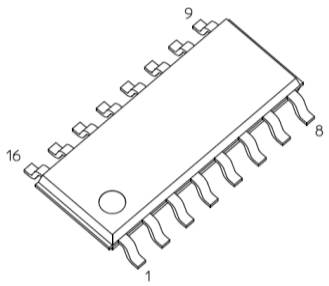
When the device is enabled, 3 Binary Select inputs (A, B and C) determine which one of the outputs ($\overline{Y}0$ - $\overline{Y}7$) will go low.

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

G1, $\overline{G}2A$, and $\overline{G}2B$ 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.

74HC138D

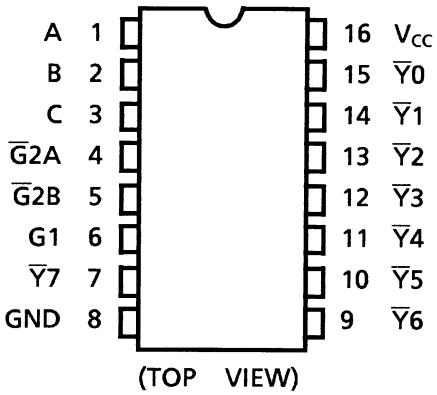


Weight
P-SOP16-0410-1.27-005 : 0.15 g (typ.)

Features

- High speed: t_{pd} = 16 ns (typ.) at V_{CC} = 5 V
- Low power dissipation: I_{CC} = 4 μA (max) at Ta = 25°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 mA (min)
- Balanced propagation delays: $t_{pLH} \simeq t_{pHL}$
- Wide operating voltage range: V_{CC} (opr) = 2 to 6 V

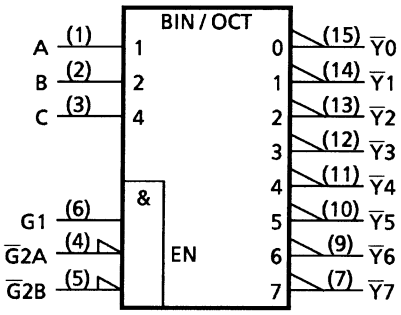
Pin Assignment

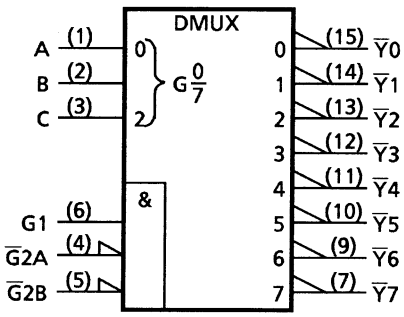


Marking

TBD

IEC Logic Symbol



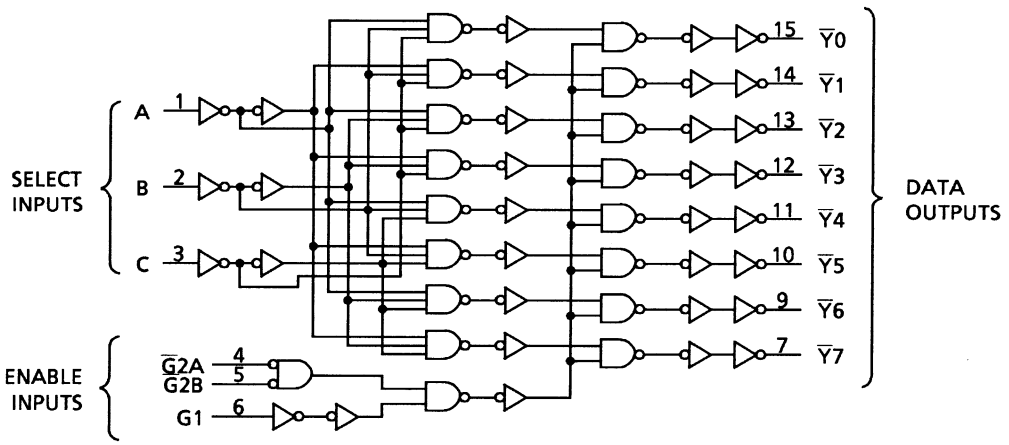


Truth Table

Inputs						Outputs								Selected Output
Enable			Select			$\overline{Y}0$	$\overline{Y}1$	$\overline{Y}2$	$\overline{Y}3$	$\overline{Y}4$	$\overline{Y}5$	$\overline{Y}6$	$\overline{Y}7$	
G1	$\overline{G}2A$	$\overline{G}2B$	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	$\overline{Y}0$
H	L	L	L	L	H	H	L	H	H	H	H	H	H	$\overline{Y}1$
H	L	L	L	H	L	H	H	L	H	H	H	H	H	$\overline{Y}2$
H	L	L	L	H	H	H	H	H	L	H	H	H	H	$\overline{Y}3$
H	L	L	H	L	L	H	H	H	H	L	H	H	H	$\overline{Y}4$
H	L	L	H	L	H	H	H	H	H	H	L	H	H	$\overline{Y}5$
H	L	L	H	H	L	H	H	H	H	H	H	L	H	$\overline{Y}6$
H	L	L	H	H	H	H	H	H	H	H	H	H	L	$\overline{Y}7$

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 Min	Ta = 25°C Typ.	Ta = 25°C Max	Ta = −40 to 85°C Min	Ta = −40 to 85°C Max	Ta = −40 to 125°C Min	Ta = −40 to 125°C Max	Unit
High-level input voltage	V_{IH}	—		2.0	1.50	—	—	1.50	—	1.50	—	V
				4.5	3.15	—	—	3.15	—	3.15	—	
				6.0	4.20	—	—	4.20	—	4.20	—	
Low-level input voltage	V_{IL}	—		2.0	—	—	0.50	—	0.50	—	0.50	V
				4.5	—	—	1.35	—	1.35	—	1.35	
				6.0	—	—	1.80	—	1.80	—	1.80	
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	4.5	4.18	4.31	—	4.13	—	3.7	—	
			I_{OH} = −5.2 mA	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	4.5	—	0.17	0.26	—	0.33	—	0.4	
			I_{OL} = 5.2 mA	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: t_r = t_f = 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- $\overline{Y}$)	t_{pLH} t_{pHL}	—	—	16	26	ns
Propagation delay time (G, $\overline{G}$ - $\overline{Y}$)	t_{pLH} t_{pHL}	—	—	15	25	ns

AC Characteristics (C_L = 50 pF, input: $t_r = t_f$ = 6 ns)

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

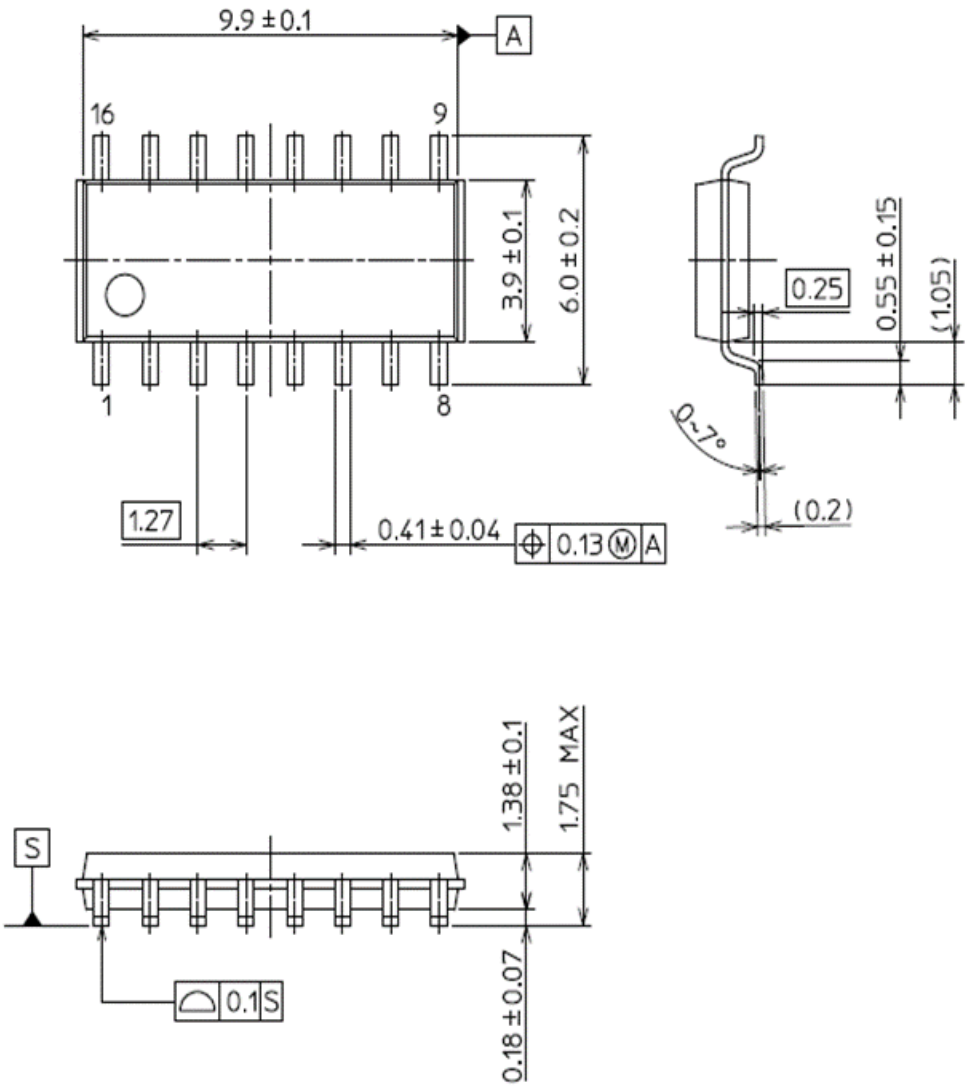
Note: C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation:

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

Package Dimensions

P-SOP16-0410-1.27-005 Unit:mm



Weight: 0.15 g (typ.)

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