CMOS Digital Integrated Circuits Silicon Monolithic

74HC238D

1. Functional Description

- 3-to-8 Line Decoder

2. General

The 74HC238D 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 (Y0 - Y7) will go high.

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 the outputs go low. 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.

3. Features

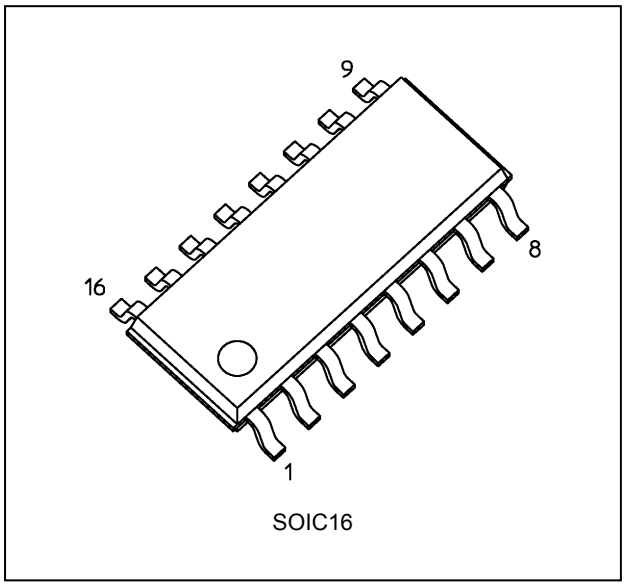
(1) High speed: t_{pd} = 14 ns (typ.) at V_{CC} = 5 V

(2) Low power dissipation: I_{CC} = 4.0 μA (max) at T_a = 25 °C

(3) Balanced propagation delays: $t_{PLH} \approx t_{PHL}$

(4) Wide operating voltage range: $V_{CC(opr)}$ = 2.0 V to 6.0 V

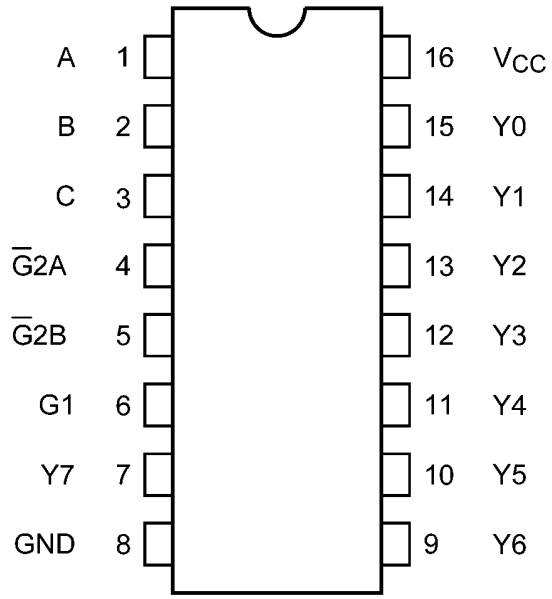
4. Packaging



SOIC16

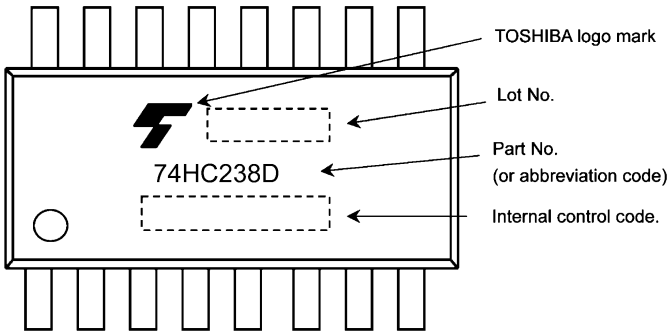
Start of commercial production
2016-04

5. Pin Assignment

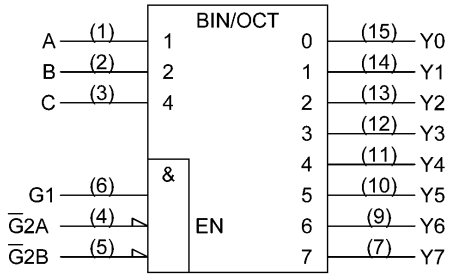


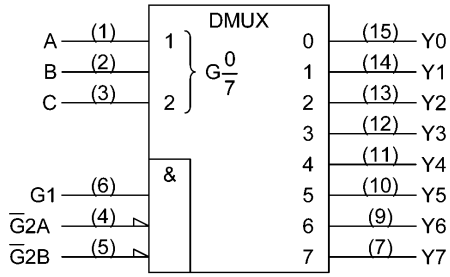
(top view)

6. Marking



7. IEC Logic Symbol



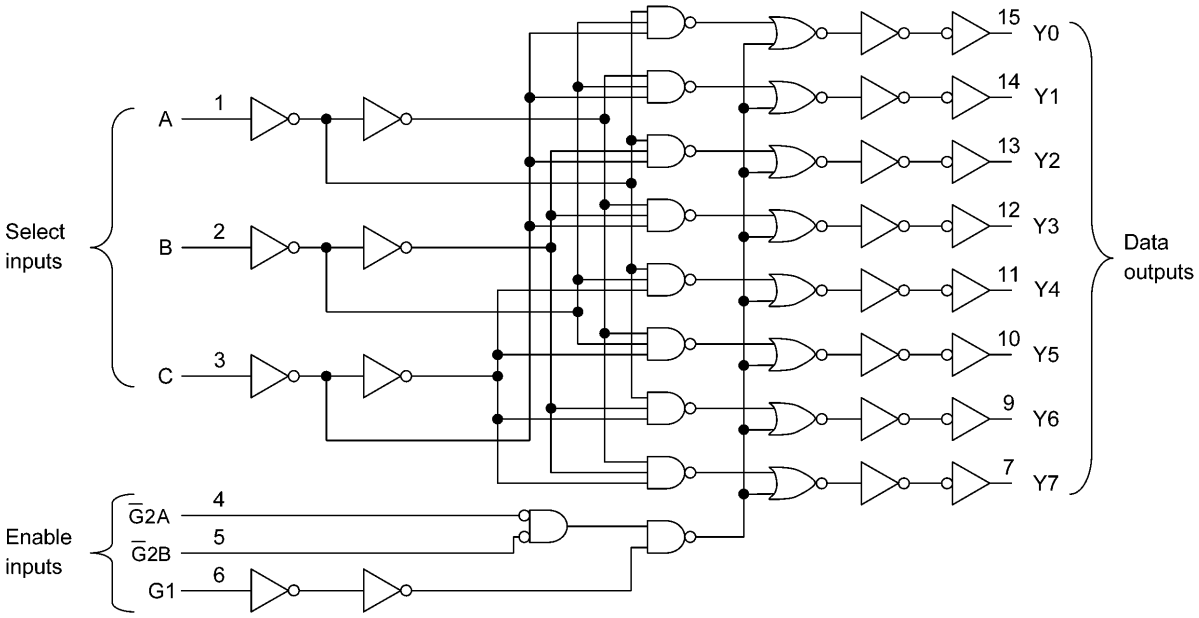


8. Truth Table

Inputs						Outputs								Selected Output
Enable			Select			Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	
G1	$\overline{G}$2A	$\overline{G}$2B	C	B	A									
L	X	X	X	X	X	L	L	L	L	L	L	L	L	None
X	H	X	X	X	X	L	L	L	L	L	L	L	L	None
X	X	H	X	X	X	L	L	L	L	L	L	L	L	None
H	L	L	L	L	L	H	L	L	L	L	L	L	L	Y0
H	L	L	L	L	H	L	H	L	L	L	L	L	L	Y1
H	L	L	L	H	L	L	L	H	L	L	L	L	L	Y2
H	L	L	L	H	H	L	L	L	H	L	L	L	L	Y3
H	L	L	H	L	L	L	L	L	L	H	L	L	L	Y4
H	L	L	H	L	H	L	L	L	L	L	H	L	L	Y5
H	L	L	H	H	L	L	L	L	L	L	L	H	L	Y6
H	L	L	H	H	H	L	L	L	L	L	L	L	H	Y7

X: Don't care

9. Logic Diagram



10. Absolute Maximum Ratings (Note)

Characteristics	Symbol	Note	Rating	Unit
Supply voltage	V_{CC}		-0.5 to 7.0	V
Input voltage	V_{IN}		-0.5 to V_{CC} + 0.5	
Output voltage	V_{OUT}		-0.5 to V_{CC} + 0.5	
Input diode current	I_{IK}		±20	mA
Output diode current	I_{OK}		±20	
Output current	I_{OUT}		±25	
V_{CC}/ground current	I_{CC}		±50	
Power dissipation	P_D	(Note 1)	500	mW
Storage temperature	T_{stg}		-65 to 150	°C

Note: 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 1: P_D derates linearly with -8 mW/°C above 85 °C

11. Operating Ranges (Note)

Characteristics	Symbol	Test Condition	Rating	Unit
Supply voltage	V_{CC}	—	2.0 to 6.0	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 times	t_r,t_f	—	0 to 50	μs

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

12. Electrical Characteristics

12.1. DC Characteristics (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Test Condition		V_{CC} (V)	Min	Typ.	Max	Unit
High-level input voltage	V_{IH}	—		2.0	1.50	—	—	V
				4.5	3.15	—	—	
				6.0	4.20	—	—	
Low-level input voltage	V_{IL}	—		2.0	—	—	0.50	V
				4.5	—	—	1.35	
				6.0	—	—	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	—	V
				4.5	4.4	4.5	—	
				6.0	5.9	6.0	—	
			I_{OH} = -4 mA	4.5	4.18	4.31	—	
			I_{OH} = -5.2 mA	6.0	5.68	5.80	—	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 20 μA	2.0	—	0.0	0.1	V
				4.5	—	0.0	0.1	
				6.0	—	0.0	0.1	
			I_{OL} = 4 mA	4.5	—	0.17	0.26	
			I_{OL} = 5.2 mA	6.0	—	0.18	0.26	
Input leakage current	I_{IN}	V_{IN} = V_{CC} or GND		6.0	—	—	±0.1	μA
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} or GND		6.0	—	—	4.0	μA

12.2. DC Characteristics (Unless otherwise specified, T_a = -40 to 85 °C)

Characteristics	Symbol	Test Condition		V_{CC} (V)	Min	Max	Unit
High-level input voltage	V_{IH}	—		2.0	1.50	—	V
				4.5	3.15	—	
				6.0	4.20	—	
Low-level input voltage	V_{IL}	—		2.0	—	0.50	V
				4.5	—	1.35	
				6.0	—	1.80	
High-level output voltage	V_{OH}	V_{IN} = V_{IH} or V_{IL}	I_{OH} = -20 μA	2.0	1.9	—	V
				4.5	4.4	—	
				6.0	5.9	—	
			I_{OH} = -4 mA	4.5	4.13	—	
			I_{OH} = -5.2 mA	6.0	5.63	—	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 20 μA	2.0	—	0.1	V
				4.5	—	0.1	
				6.0	—	0.1	
			I_{OL} = 4 mA	4.5	—	0.33	
			I_{OL} = 5.2 mA	6.0	—	0.33	
Input leakage current	I_{IN}	V_{IN} = V_{CC} or GND		6.0	—	±1.0	μA
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} or GND		6.0	—	40.0	μA

12.3. DC Characteristics (Unless otherwise specified, T_a = -40 to 125 °C)

Characteristics	Symbol	Test Condition		V_{CC} (V)	Min	Max	Unit
High-level input voltage	V_{IH}	—		2.0	1.50	—	V
				4.5	3.15	—	
				6.0	4.20	—	
Low-level input voltage	V_{IL}	—		2.0	—	0.50	V
				4.5	—	1.35	
				6.0	—	1.80	
High-level output voltage	V_{OH}	V_{IN} = V_{IH} or V_{IL}	I_{OH} = -20 μA	2.0	1.9	—	V
				4.5	4.4	—	
				6.0	5.9	—	
			I_{OH} = -4 mA	4.5	3.7	—	
			I_{OH} = -5.2 mA	6.0	5.2	—	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 20 μA	2.0	—	0.1	V
				4.5	—	0.1	
				6.0	—	0.1	
			I_{OL} = 4 mA	4.5	—	0.4	
			I_{OL} = 5.2 mA	6.0	—	0.4	
Input leakage current	I_{IN}	V_{IN} = V_{CC} or GND		6.0	—	±1.0	μA
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} or GND		6.0	—	160.0	μA

12.4. AC Characteristics (Unless otherwise specified, C_L = 15 pF, V_{CC} = 5 V, T_a = 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 - Y)	t_{PLH},t_{PHL}	—	—	14	26	
Propagation delay time (G1, $\overline{G2}$ - Y)	t_{PLH},t_{PHL}	—	—	14	26	

12.5. AC Characteristics (Unless otherwise specified, C_L = 50pF, T_a = 25 °C, Input: t_r = t_f = 6 ns)

Characteristics	Symbol	Note	V_{CC} (V)	Min	Typ.	Max	Unit
Output transition time	t_{TLH},t_{THL}		2.0	—	30	75	ns
			4.5	—	8	15	
			6.0	—	7	13	
Propagation delay time (A, B, C - Y)	t_{PLH},t_{PHL}		2.0	—	50	150	ns
			4.5	—	17	30	
			6.0	—	15	26	
Propagation delay time (G1, $\overline{G2}$ - Y)	t_{PLH},t_{PHL}		2.0	—	50	150	ns
			4.5	—	17	30	
			6.0	—	15	26	
Input capacitance	C_{IN}		—	—	3	—	pF
Power dissipation capacitance	C_{PD}	(Note 1)	—	—	22	—	pF

Note 1: 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.

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

12.6. AC Characteristics
(Unless otherwise specified, C_L = 50 pF, T_a = -40 to 85 °C, Input: $t_r = t_f$ = 6 ns)

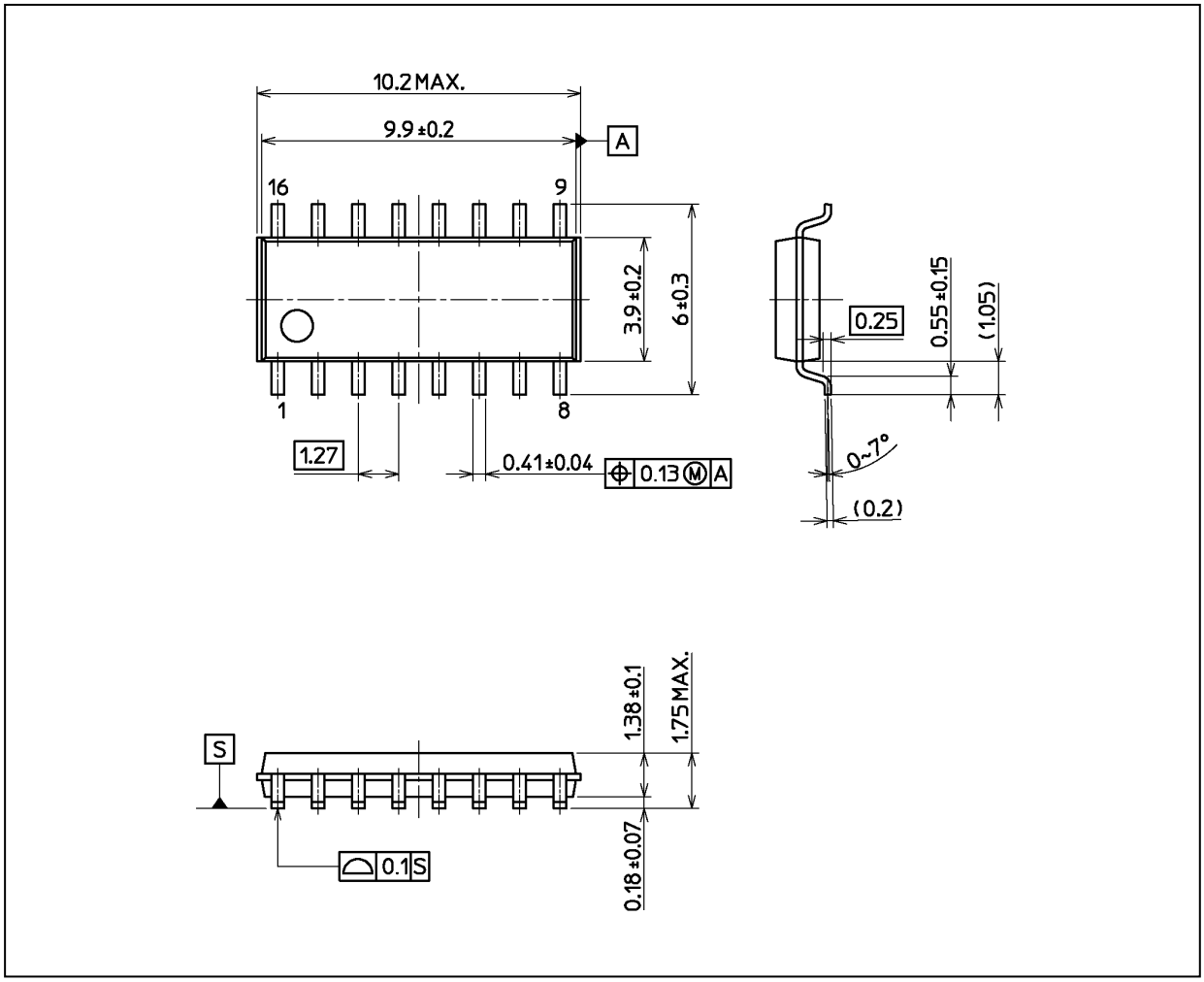
Characteristics	Symbol	V_{CC} (V)	Min	Max	Unit
Output transition time	t_{TLH},t_{THL}	2.0	—	95	ns
		4.5	—	19	
		6.0	—	16	
Propagation delay time (A, B, C -Y)	t_{PLH},t_{PHL}	2.0	—	190	ns
		4.5	—	38	
		6.0	—	32	
Propagation delay time (G1, $\overline{G2}$ - Y)	t_{PLH},t_{PHL}	2.0	—	190	ns
		4.5	—	38	
		6.0	—	32	

12.7. AC Characteristics
(Unless otherwise specified, C_L = 50 pF, T_a = -40 to 125 °C, Input: $t_r = t_f$ = 6 ns)

Characteristics	Symbol	V_{CC} (V)	Min	Max	Unit
Output transition time	t_{TLH},t_{THL}	2.0	—	110	ns
		4.5	—	22	
		6.0	—	19	
Propagation delay time (A, B, C - Y)	t_{PLH},t_{PHL}	2.0	—	225	ns
		4.5	—	45	
		6.0	—	38	
Propagation delay time (G1, $\overline{G2}$ - Y)	t_{PLH},t_{PHL}	2.0	—	225	ns
		4.5	—	45	
		6.0	—	38	

Package Dimensions

Unit: mm



Weight: 0.15 g (typ.)

Package Name(s)
Nickname: SOIC16

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