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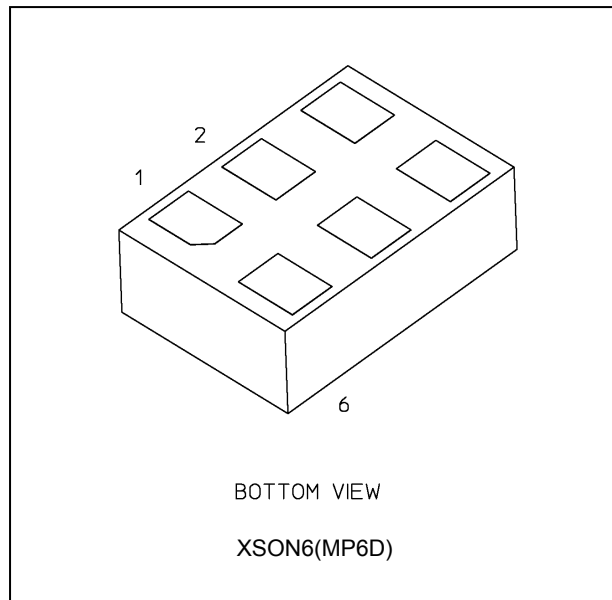
1. Functional Description

- Schmitt Inverter

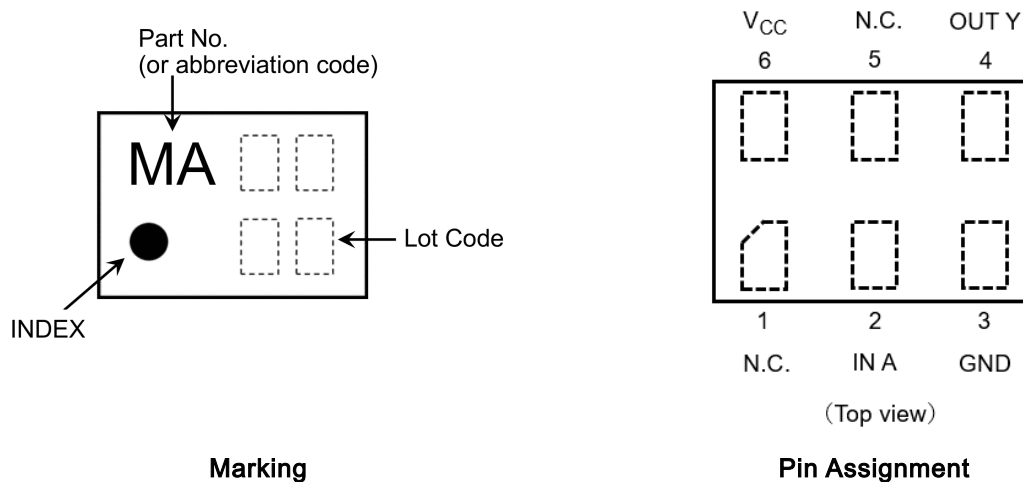
2. Features

- (1) Wide operating temperature range: $T_{opr} = -40$ to 125 °C
- (2) High output current: ± 8.0 mA (min) at $V_{CC} = 3.0$ V
- (3) Super high speed operation: $t_{pd} = 3.0$ ns (typ.) at $V_{CC} = 3.3$ V, $C_L = 15$ pF
- (4) Operating voltage range: $V_{CC} = 0.9$ to 3.6 V
- (5) 3.6 V tolerant input
- (6) 3.6 V power down protection output

3. Packaging



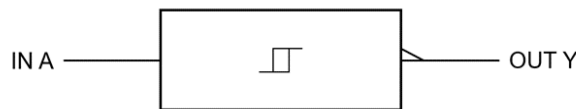
4. Marking and Pin Assignment



Start of commercial production

2024-02

5. IEC Logic Symbol



6. Truth Table

Input A	Output Y
L	H
H	L

7. Absolute Maximum Ratings (Note) (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$)

Characteristics	Symbol	Note	Rating	Unit
Supply voltage	V_{CC}		-0.5 to 4.6	V
Input voltage	V_{IN}		-0.5 to 4.6	V
DC output voltage	V_{OUT}	(Note 1)	-0.5 to 4.6	V
		(Note 2)	-0.5 to $V_{CC} + 0.5$	
Input diode current	I_{IK}		-20	mA
Output diode current	I_{OK}	(Note 3)	-20	mA
DC output current	I_{OUT}		± 25	mA
V_{CC} /ground current	I_{CC}		± 50	mA
Power dissipation	P_D		200	mW
Storage temperature	T_{stg}		-65 to 150	$^\circ\text{C}$

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: $V_{CC} = 0\text{ V}$

Note 2: High (H) or Low (L) state. I_{OUT} absolute maximum rating must be observed.

Note 3: $V_{OUT} < \text{GND}$

8. Operating Ranges (Note)

Characteristics	Symbol	Note	Test Condition	Rating	Unit
Supply voltage	V_{CC}		—	0.9 to 3.6	V
Input voltage	V_{IN}		—	0 to 3.6	V
Output voltage	V_{OUT}	(Note 1)	—	0 to 3.6	V
		(Note 2)	—	0 to V_{CC}	
Output current	I_{OH}, I_{OL}		$V_{CC} = 3.0$ to 3.6 V	± 8.0	mA
			$V_{CC} = 2.3$ to 2.7 V	± 4.0	
			$V_{CC} = 1.65$ to 1.95 V	± 3.0	
			$V_{CC} = 1.4$ to 1.6 V	± 1.7	
			$V_{CC} = 1.1$ to 1.3 V	± 0.3	
			$V_{CC} = 0.9$ V	± 0.02	
Operating temperature	T_{opr}		—	-40 to 125	°C

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.

Note 1: $V_{CC} = 0$ V

Note 2: High (H) or Low (L) state.

9. Electrical Characteristics

9.1. DC Characteristics (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Min	Typ.	Max	Unit	
Positive threshold voltage	V_P	—	0.9	—	—	0.73	V	
			1.1	—	—	0.86		
			1.4	—	—	1.07		
			1.65	—	—	1.23		
			2.3	—	—	1.66		
			3.0	—	—	2.14		
Negative threshold voltage	V_N	—	0.9	0.18	—	—	V	
			1.1	0.26	—	—		
			1.4	0.36	—	—		
			1.65	0.45	—	—		
			2.3	0.69	—	—		
			3.0	0.96	—	—		
Hysteresis voltage	V_H	—	0.9	0.15	—	0.38	V	
			1.1	0.18	—	0.41		
			1.4	0.20	—	0.48		
			1.65	0.22	—	0.60		
			2.3	0.35	—	0.76		
			3.0	0.45	—	0.93		
High-level output voltage	V_{OH}	$V_{IN} = V_{IL}$	$I_{OH} = -0.02\text{ mA}$	0.9	0.75	—	—	V
			$I_{OH} = -0.3\text{ mA}$	1.1 to 1.3	$V_{CC} \times 0.75$	—	—	
			$I_{OH} = -1.7\text{ mA}$	1.4 to 1.6	$V_{CC} \times 0.75$	—	—	
			$I_{OH} = -3.0\text{ mA}$	1.65 to 1.95	$V_{CC} - 0.45$	—	—	
			$I_{OH} = -4.0\text{ mA}$	2.3 to 2.7	2.0	—	—	
			$I_{OH} = -8.0\text{ mA}$	3.0 to 3.6	2.48	—	—	
Low-level output voltage	V_{OL}	$V_{IN} = V_{IH}$	$I_{OL} = 0.02\text{ mA}$	0.9	—	—	0.1	V
			$I_{OL} = 0.3\text{ mA}$	1.1 to 1.3	—	—	$V_{CC} \times 0.25$	
			$I_{OL} = 1.7\text{ mA}$	1.4 to 1.6	—	—	$V_{CC} \times 0.25$	
			$I_{OL} = 3.0\text{ mA}$	1.65 to 1.95	—	—	0.45	
			$I_{OL} = 4.0\text{ mA}$	2.3 to 2.7	—	—	0.4	
			$I_{OL} = 8.0\text{ mA}$	3.0 to 3.6	—	—	0.4	
Input leakage current	I_{IN}	$V_{IN} = 0\text{ to }3.6\text{ V}$	0 to 3.6	—	—	± 0.1	μA	
Power-OFF leakage current	I_{OFF}	$V_{IN} = 0\text{ to }3.6\text{ V}$, $V_{OUT} = 0\text{ to }3.6\text{ V}$	0	—	—	1.0	μA	
Quiescent supply current	I_{CC}	$V_{IN} = V_{CC}\text{ or GND}$	3.6	—	—	1.0	μA	

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

Characteristics	Symbol	Test Condition	V_{CC} (V)	Min	Max	Unit	
Positive threshold voltage	V_P	—	0.9	—	0.73	V	
			1.1	—	0.86		
			1.4	—	1.07		
			1.65	—	1.23		
			2.3	—	1.66		
			3.0	—	2.14		
Negative threshold voltage	V_N	—	0.9	0.18	—	V	
			1.1	0.26	—		
			1.4	0.36	—		
			1.65	0.45	—		
			2.3	0.69	—		
			3.0	0.96	—		
Hysteresis voltage	V_H	—	0.9	0.15	0.38	V	
			1.1	0.18	0.41		
			1.4	0.20	0.48		
			1.65	0.22	0.60		
			2.3	0.35	0.76		
			3.0	0.45	0.93		
High-level output voltage	V_{OH}	$V_{IN} = V_{IL}$	$I_{OH} = -0.02$ mA	0.9	0.75	—	V
			$I_{OH} = -0.3$ mA	1.1 to 1.3	$V_{CC} \times 0.75$	—	
			$I_{OH} = -1.7$ mA	1.4 to 1.6	$V_{CC} \times 0.75$	—	
			$I_{OH} = -3.0$ mA	1.65 to 1.95	$V_{CC} - 0.45$	—	
			$I_{OH} = -4.0$ mA	2.3 to 2.7	2.0	—	
			$I_{OH} = -8.0$ mA	3.0 to 3.6	2.48	—	
Low-level output voltage	V_{OL}	$V_{IN} = V_{IH}$	$I_{OL} = 0.02$ mA	0.9	—	0.1	V
			$I_{OL} = 0.3$ mA	1.1 to 1.3	—	$V_{CC} \times 0.25$	
			$I_{OL} = 1.7$ mA	1.4 to 1.6	—	$V_{CC} \times 0.25$	
			$I_{OL} = 3.0$ mA	1.65 to 1.95	—	0.45	
			$I_{OL} = 4.0$ mA	2.3 to 2.7	—	0.4	
			$I_{OL} = 8.0$ mA	3.0 to 3.6	—	0.4	
Input leakage current	I_{IN}	$V_{IN} = 0$ to 3.6 V	0 to 3.6	—	± 0.5	μ A	
Power-OFF leakage current	I_{OFF}	$V_{IN} = 0$ to 3.6 V, $V_{OUT} = 0$ to 3.6 V	0	—	10.0	μ A	
Quiescent supply current	I_{CC}	$V_{IN} = V_{CC}$ or GND	3.6	—	10.0	μ A	

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

Characteristics	Symbol	Test Condition	V_{CC} (V)	Min	Max	Unit	
Positive threshold voltage	V_P	—	0.9	—	0.73	V	
			1.1	—	0.86		
			1.4	—	1.07		
			1.65	—	1.23		
			2.3	—	1.66		
			3.0	—	2.14	V	
Negative threshold voltage	V_N	—	0.9	0.18	—	V	
			1.1	0.26	—		
			1.4	0.36	—		
			1.65	0.45	—		
			2.3	0.69	—		
			3.0	0.96	—		
Hysteresis voltage	V_H	—	0.9	0.15	0.38	V	
			1.1	0.18	0.41		
			1.4	0.20	0.48		
			1.65	0.22	0.60		
			2.3	0.35	0.76		
			3.0	0.45	0.93		
High-level output voltage	V_{OH}	$V_{IN} = V_{IL}$	$I_{OH} = -0.02$ mA	0.9	0.75	—	V
			$I_{OH} = -0.3$ mA	1.1 to 1.3	$V_{CC} \times 0.73$	—	
			$I_{OH} = -1.7$ mA	1.4 to 1.6	$V_{CC} \times 0.73$	—	
			$I_{OH} = -3.0$ mA	1.65 to 1.95	$V_{CC} - 0.5$	—	
			$I_{OH} = -4.0$ mA	2.3 to 2.7	1.95	—	
			$I_{OH} = -8.0$ mA	3.0 to 3.6	2.4	—	
Low-level output voltage	V_{OL}	$V_{IN} = V_{IH}$	$I_{OL} = 0.02$ mA	0.9	—	0.1	V
			$I_{OL} = 0.3$ mA	1.1 to 1.3	—	$V_{CC} \times 0.27$	
			$I_{OL} = 1.7$ mA	1.4 to 1.6	—	$V_{CC} \times 0.27$	
			$I_{OL} = 3.0$ mA	1.65 to 1.95	—	0.5	
			$I_{OL} = 4.0$ mA	2.3 to 2.7	—	0.45	
			$I_{OL} = 8.0$ mA	3.0 to 3.6	—	0.45	
Input leakage current	I_{IN}	$V_{IN} = 0$ to 3.6 V	0 to 3.6	—	± 2.0	μ A	
Power-OFF leakage current	I_{OFF}	$V_{IN} = 0$ to 3.6 V, $V_{OUT} = 0$ to 3.6 V	0	—	80.0	μ A	
Quiescent supply current	I_{CC}	$V_{IN} = V_{CC}$ or GND	3.6	—	80.0	μ A	

9.4. AC Characteristics (Unless otherwise specified, $T_a = 25\text{ }^\circ\text{C}$, Input: $t_r = t_f = 3\text{ ns}$)

Characteristics	Symbol	Note	Test Condition	V_{CC} (V)	C_L (pF)	Min	Typ.	Max	Unit
Propagation delay time	t_{PLH}, t_{PHL}		$R_L = 1\text{ M}\Omega$ See Fig. 9.7.1, Table 9.7.1	0.9	10	—	22.0	—	ns
				1.1 to 1.3		—	11.1	24.0	
				1.4 to 1.6		—	6.7	12.0	
				1.65 to 1.95		—	5.0	8.5	
				2.3 to 2.7		—	3.3	5.4	
				3.0 to 3.6		—	2.7	4.4	
Propagation delay time	t_{PLH}, t_{PHL}		$R_L = 1\text{ M}\Omega$ See Fig. 9.7.1, Table 9.7.1	0.9	15	—	24.2	—	ns
				1.1 to 1.3		—	12.1	27.0	
				1.4 to 1.6		—	7.3	13.2	
				1.65 to 1.95		—	5.5	9.3	
				2.3 to 2.7		—	3.7	5.7	
				3.0 to 3.6		—	3.0	4.6	
Propagation delay time	t_{PLH}, t_{PHL}		$R_L = 1\text{ M}\Omega$ See Fig. 9.7.1, Table 9.7.1	0.9	30	—	31.0	—	ns
				1.1 to 1.3		—	15.7	35.7	
				1.4 to 1.6		—	9.1	16.7	
				1.65 to 1.95		—	7.1	11.4	
				2.3 to 2.7		—	4.7	6.9	
				3.0 to 3.6		—	3.9	5.2	
Input capacitance	C_{IN}		—	3.6	—	—	3	—	pF
Power dissipation capacitance	C_{PD}	(Note 1)	—	0.9 to 3.6	—	—	12	—	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.

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

9.5. AC Characteristics (Unless otherwise specified, $T_a = -40\text{ to }85\text{ }^\circ\text{C}$, Input: $t_r = t_f = 3\text{ ns}$)

Characteristics	Symbol	Test Condition	V_{CC} (V)	C_L (pF)	Min	Max	Unit
Propagation delay time	t_{PLH}, t_{PHL}	$R_L = 1\text{ M}\Omega$ See Fig. 9.7.1, Table 9.7.1	0.9	10	—	—	ns
			1.1 to 1.3		1.0	35.9	
			1.4 to 1.6		1.0	12.8	
			1.65 to 1.95		1.0	8.9	
			2.3 to 2.7		1.0	5.8	
			3.0 to 3.6		1.0	4.6	
Propagation delay time	t_{PLH}, t_{PHL}	$R_L = 1\text{ M}\Omega$ See Fig. 9.7.1, Table 9.7.1	0.9	15	—	—	ns
			1.1 to 1.3		1.0	41.8	
			1.4 to 1.6		1.0	14.1	
			1.65 to 1.95		1.0	9.6	
			2.3 to 2.7		1.0	6.1	
			3.0 to 3.6		1.0	5.0	
Propagation delay time	t_{PLH}, t_{PHL}	$R_L = 1\text{ M}\Omega$ See Fig. 9.7.1, Table 9.7.1	0.9	30	—	—	ns
			1.1 to 1.3		1.0	58.1	
			1.4 to 1.6		1.0	18.0	
			1.65 to 1.95		1.0	12.0	
			2.3 to 2.7		1.0	8.1	
			3.0 to 3.6		1.0	6.1	

9.6. AC Characteristics

(Unless otherwise specified, $T_a = -40$ to 125 °C, Input: $t_r = t_f = 3$ ns)

Characteristics	Symbol	Test Condition	V_{CC} (V)	C_L (pF)	Min	Max	Unit
Propagation delay time	t_{PLH}, t_{PHL}	$R_L = 1\text{ M}\Omega$ See Fig. 9.7.1, Table 9.7.1	0.9	10	—	—	ns
			1.1 to 1.3		1.0	43.9	
			1.4 to 1.6		1.0	13.4	
			1.65 to 1.95		1.0	9.2	
			2.3 to 2.7		1.0	6.1	
			3.0 to 3.6		1.0	4.8	
Propagation delay time	t_{PLH}, t_{PHL}	$R_L = 1\text{ M}\Omega$ See Fig. 9.7.1, Table 9.7.1	0.9	15	—	—	ns
			1.1 to 1.3		1.0	51.7	
			1.4 to 1.6		1.0	14.7	
			1.65 to 1.95		1.0	9.8	
			2.3 to 2.7		1.0	6.4	
			3.0 to 3.6		1.0	5.3	
Propagation delay time	t_{PLH}, t_{PHL}	$R_L = 1\text{ M}\Omega$ See Fig. 9.7.1, Table 9.7.1	0.9	30	—	—	ns
			1.1 to 1.3		1.0	73.1	
			1.4 to 1.6		1.0	18.9	
			1.65 to 1.95		1.0	12.4	
			2.3 to 2.7		1.0	8.9	
			3.0 to 3.6		1.0	6.7	

9.7. AC Waveform

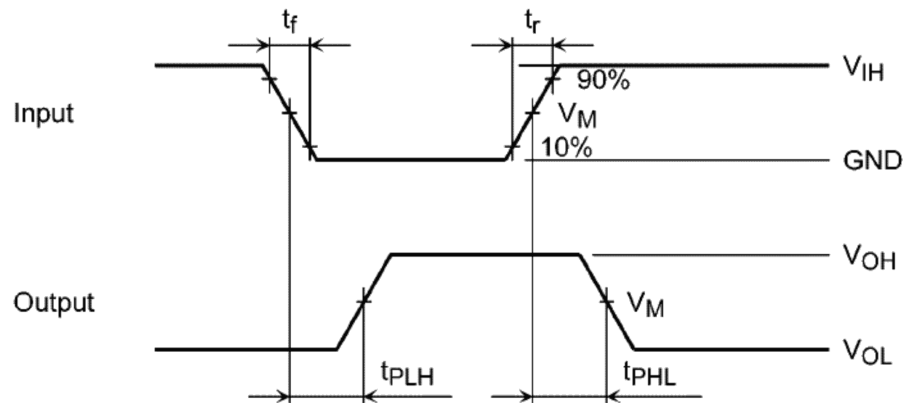


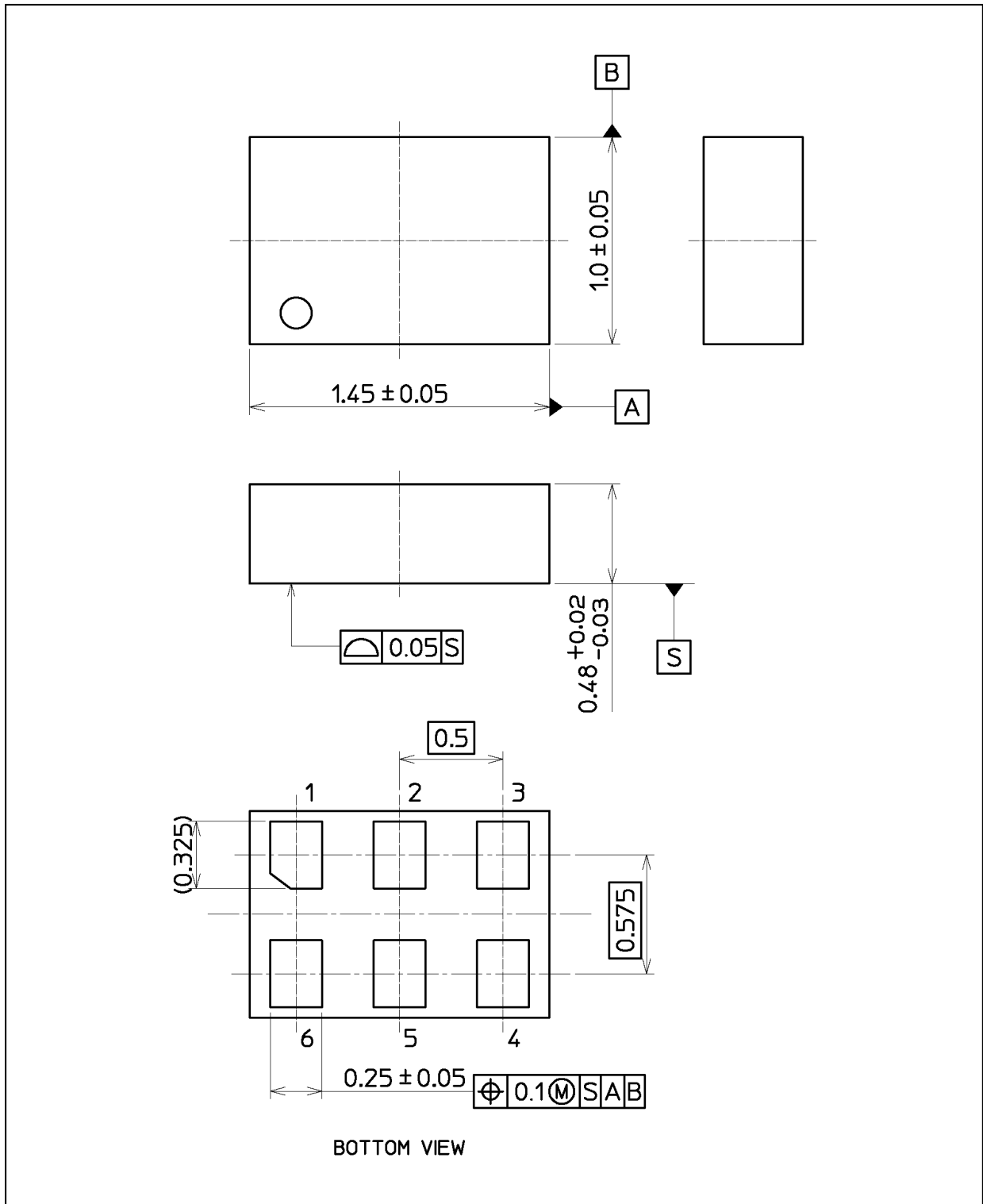
Fig. 9.7.1 t_{PLH}, t_{PHL}

Table 9.7.1 AC Waveform Symbols

	Symbol	$V_{CC} = 3.3$ $\pm 0.3\text{ V}$	$V_{CC} = 2.5$ $\pm 0.2\text{ V}$	$V_{CC} = 1.8$ $\pm 0.15\text{ V}$	$V_{CC} = 1.5$ $\pm 0.1\text{ V}$	$V_{CC} = 1.2$ $\pm 0.1\text{ V}$	$V_{CC} = 0.9\text{ V}$
Input	V_{IH}	V_{CC}	V_{CC}	V_{CC}	V_{CC}	V_{CC}	V_{CC}
	V_M	$V_{CC}/2$	$V_{CC}/2$	$V_{CC}/2$	$V_{CC}/2$	$V_{CC}/2$	$V_{CC}/2$
Output	V_M	$V_{CC}/2$	$V_{CC}/2$	$V_{CC}/2$	$V_{CC}/2$	$V_{CC}/2$	$V_{CC}/2$

Package Dimensions

Unit: mm



Weight: 0.002 g (typ.)

Package Name(s)
Nickname: XSON6(MP6D)

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