CMOS Digital Integrated Circuits Silicon Monolithic

74LCX257FT

1. Functional Description

- Low-Voltage Quad 2-Channel Multiplexer (3-state) with 5-V Tolerant Inputs and Outputs

2. General

The 74LCX257FT is a high-performance CMOS multiplexer. Designed for use in 3.3 V systems, it achieves high-speed operation while maintaining the CMOS low-power dissipation.

The device is designed for low-voltage (3.3 V) V_{CC} applications, but it could be used to interface to 5 V supply environment for inputs.

It is composed of four independent 2-channel multiplexers with common select and $\overline{OE}$.

If $\overline{OE}$ is set high, the outputs are held in a high-impedance state. When SELECT is set low, "A" data inputs are enabled. Conversely, when SELECT is high, "B" data inputs are enabled.

All inputs are equipped with protection circuits against static discharge.

3. Features

(1) AEC-Q100 (Rev. H) (Note 1)

(2) Wide operating temperature range: T_{opr} = -40 to 125 °C

(3) Low-voltage operation: V_{CC} = 1.65 to 3.6 V

(4) High-speed operation: t_{pd} = 7.0 ns (max) (V_{CC} = 3.3 ± 0.3 V)

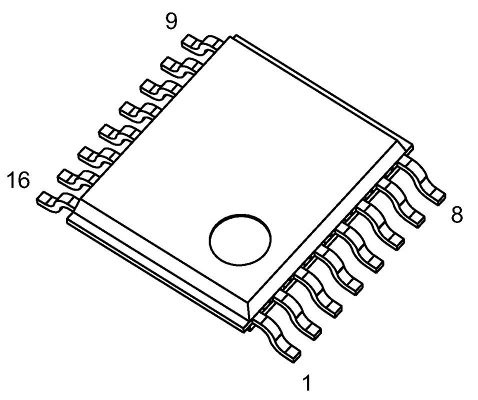
(5) Output current: $|I_{OH}|/I_{OL}$ = 24 mA (min) (V_{CC} = 3.0 V)

(6) Power-down protection provided on all inputs and outputs

(7) Pin and function compatible with the 74 series (74LVC/ALVC/ etc.) 257 type

Note 1: This device is compliant with the reliability requirements of AEC-Q100. For details, contact your Toshiba sales representative.

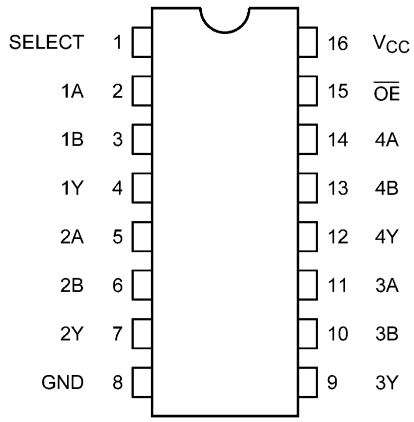
4. Packaging



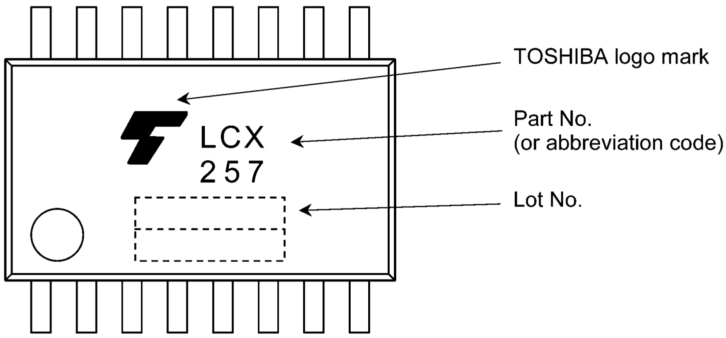
TSSOP16B

Start of commercial production
2014-11

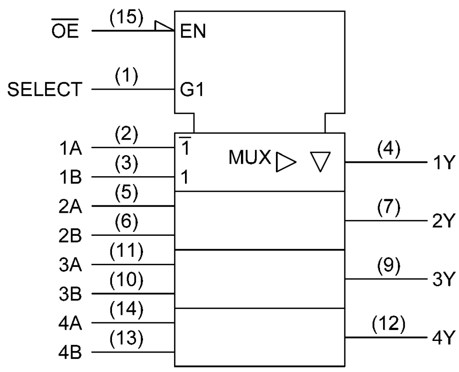
5. Pin Assignment



6. Marking



7. IEC Logic Symbol

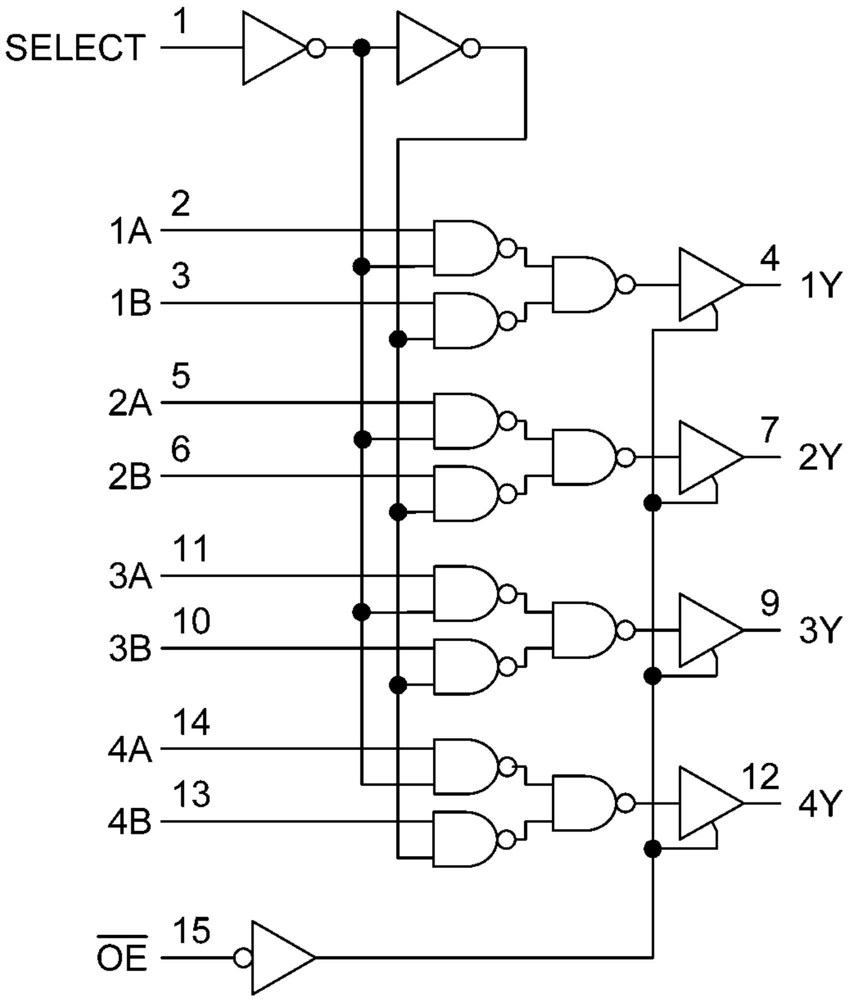


8. Truth Table

Input OE	Input SELECT	Inputs A	Inputs B	Outputs Y
H	X	X	X	Z
L	L	L	X	L
L	L	H	X	H
L	H	X	L	L
L	H	X	H	H

X: Don't care
Z: High impedance

9. System Diagram



10. Absolute Maximum Ratings (Note)

Characteristics	Symbol	Note	Rating	Unit
Supply voltage	V_{CC}		-0.5 to 6.5	V
Input voltage	V_{IN}		-0.5 to 6.5	V
Output voltage	V_{OUT}	(Note 1)	-0.5 to 6.5	V
		(Note 2)	-0.5 to V_{CC} + 0.5	
Input diode current	I_{IK}		-50	mA
Output diode current	I_{OK}	(Note 3)	±50	mA
Output current	I_{OUT}		±50	mA
Power dissipation	P_D	(Note 4)	180	mW
V_{CC}/ground current	I_{CC}/I_{GND}		±100	mA
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: Output in OFF state.
Note 2: High or Low state. I_{OUT} absolute maximum rating must be observed.
Note 3: V_{OUT} < GND, V_{OUT} > V_{CC}
Note 4: 180 mW in the range of T_a = -40 to 85 °C. From T_a = 85 to 125 °C a derating factor of -3.25 mW/°C shall be applied until 50 mW.

11. Operating Ranges (Note)

Characteristics	Symbol	Note	Rating	Unit
Supply voltage	V_{CC}		1.65 to 3.6	V
		(Note 1)	1.5 to 3.6	
Input voltage	V_{IN}		0 to 5.5	V
Output voltage	V_{OUT}	(Note 2)	0 to 5.5	V
		(Note 3)	0 to V_{CC}	
Output current	I_{OH},I_{OL}	(Note 4)	±24	mA
		(Note 5)	±12	
Operating temperature	T_{opr}		-40 to 125	°C
Input rise and fall times	dt/dv	(Note 6)	0 to 10	ns/V

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: Data retention only.
Note 2: Output in OFF state.
Note 3: High or low state
Note 4: V_{CC} = 3.0 to 3.6 V
Note 5: V_{CC} = 2.7 to 3.0 V
Note 6: V_{IN} = 0.8 to 2.0 V , V_{CC} = 3.0 V

12. Electrical Characteristics

12.1. 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}	—		1.65 to 2.3	V_{CC} × 0.9	—	V
				2.3 to 2.7	1.7	—	
				2.7 to 3.6	2.0	—	
Low-level input voltage	V_{IL}	—		1.65 to 2.3	—	V_{CC} × 0.1	V
				2.3 to 2.7	—	0.7	
				2.7 to 3.6	—	0.8	
High-level output voltage	V_{OH}	V_{IN} = V_{IH} or V_{IL}	I_{OH} = -100 μA	1.65 to 3.6	V_{CC} - 0.2	—	V
			I_{OH} = -4 mA	1.65	1.05	—	
			I_{OH} = -8 mA	2.3	1.7	—	
			I_{OH} = -12 mA	2.7	2.2	—	
			I_{OH} = -18 mA	3.0	2.4	—	
			I_{OH} = -24 mA	3.0	2.2	—	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 100 μA	1.65 to 3.6	—	0.2	V
			I_{OL} = 4 mA	1.65	—	0.45	
			I_{OL} = 8 mA	2.3	—	0.7	
			I_{OL} = 12 mA	2.7	—	0.4	
			I_{OL} = 16 mA	3.0	—	0.4	
			I_{OL} = 24 mA	3.0	—	0.55	
Input leakage current	I_{IN}	V_{IN} = 0 to 5.5 V		1.65 to 3.6	—	±5.0	μA
3-state output OFF-state leakage current	I_{OZ}	V_{IN} = V_{IH} or V_{IL} V_{OUT} = 0 to 5.5 V		1.65 to 3.6	—	±5.0	μA
Power-OFF leakage current	I_{OFF}	V_{IN}/V_{OUT} = 5.5 V		0	—	10.0	μA
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} or GND		1.65 to 3.6	—	10.0	μA
		V_{IN}/V_{OUT} = 3.6 to 5.5 V		1.65 to 3.6	—	±10.0	
Quiescent supply current	ΔI_{CC}	V_{IH} = V_{CC} - 0.6 V (per 1 input)		2.7 to 3.6	—	500	μA

12.2. 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}	—		1.65 to 2.3	V_{CC} × 0.9	—	V
				2.3 to 2.7	1.7	—	
				2.7 to 3.6	2.0	—	
Low-level input voltage	V_{IL}	—		1.65 to 2.3	—	V_{CC} × 0.1	V
				2.3 to 2.7	—	0.7	
				2.7 to 3.6	—	0.8	
High-level output voltage	V_{OH}	V_{IN} = V_{IH} or V_{IL}	I_{OH} = -100 μA	1.65 to 3.6	V_{CC} - 0.2	—	V
			I_{OH} = -4 mA	1.65	0.9	—	
			I_{OH} = -8 mA	2.3	1.55	—	
			I_{OH} = -12 mA	2.7	2.0	—	
			I_{OH} = -18 mA	3.0	2.2	—	
			I_{OH} = -24 mA	3.0	2.0	—	
Low-level output voltage	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 100 μA	1.65 to 3.6	—	0.2	V
			I_{OL} = 4 mA	1.65	—	0.65	
			I_{OL} = 8 mA	2.3	—	0.9	
			I_{OL} = 12 mA	2.7	—	0.6	
			I_{OL} = 16 mA	3.0	—	0.6	
			I_{OL} = 24 mA	3.0	—	0.75	
Input leakage current	I_{IN}	V_{IN} = 0 to 5.5 V		1.65 to 3.6	—	±20.0	μA
3-state output OFF-state leakage current	I_{OZ}	V_{IN} = V_{IH} or V_{IL} V_{OUT} = 0 to 5.5 V		1.65 to 3.6	—	±20.0	μA
Power-OFF leakage current	I_{OFF}	V_{IN}/V_{OUT} = 5.5 V		0	—	40.0	μA
Quiescent supply current	I_{CC}	V_{IN} = V_{CC} or GND		1.65 to 3.6	—	40.0	μA
		V_{IN}/V_{OUT} = 3.6 to 5.5 V		1.65 to 3.6	—	±40.0	
Quiescent supply current	ΔI_{CC}	V_{IH} = V_{CC} - 0.6 V (per 1 input)		2.7 to 3.6	—	5.0	mA

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

Characteristics	Symbol	Note	Test Condition	V_{CC} (V)	Min	Max	Unit
Propagation delay time (A,B - Y)	t_{PLH},t_{PHL}		See 12.7 AC Test Circuit, Table 12.7.1 Fig. 12.8.1, Table 12.8.1	1.8 ± 0.15	—	20.0	ns
				2.5 ± 0.2	—	7.5	
				2.7	—	6.5	
				3.3 ± 0.3	1.5	6.0	
Propagation delay time (SELECT - Y)	t_{PLH},t_{PHL}		See 12.7 AC Test Circuit, Table 12.7.1 Fig. 12.8.1, Table 12.8.1	1.8 ± 0.15	—	25.0	ns
				2.5 ± 0.2	—	9.5	
				2.7	—	8.5	
				3.3 ± 0.3	1.5	7.0	
Output enable time	t_{PZL},t_{PZH}		See 12.7 AC Test Circuit, Table 12.7.1 Fig. 12.8.2, Table 12.8.1	1.8 ± 0.15	—	30.0	ns
				2.5 ± 0.2	—	15.0	
				2.7	—	8.5	
				3.3 ± 0.3	1.5	7.0	
Output disable time	t_{PLZ},t_{PHZ}		See 12.7 AC Test Circuit, Table 12.7.1 Fig. 12.8.2, Table 12.8.1	1.8 ± 0.15	—	30.0	ns
				2.5 ± 0.2	—	15.0	
				2.7	—	6.0	
				3.3 ± 0.3	1.5	5.5	
Output skew	t_{osLH},t_{osHL}	(Note 1)	—	2.7	—	—	ns
				3.3 ± 0.3	—	1.0	

Note 1: Parameter guaranteed by design. (t_{osLH} = $|t_{PLHm}-t_{PLHn}|$, t_{osHL} = $|t_{PHLm}-t_{PHLn}|$)

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

Characteristics	Symbol	Note	Test Condition	V_{CC} (V)	Min	Max	Unit
Propagation delay time (A,B - Y)	t_{PLH},t_{PHL}		See 12.7 AC Test Circuit, Table 12.7.1 Fig. 12.8.1, Table 12.8.1	1.8 ± 0.15	—	22.0	ns
				2.5 ± 0.2	—	8.5	
				2.7	—	7.5	
				3.3 ± 0.3	1.5	7.0	
Propagation delay time (SELECT - Y)	t_{PLH},t_{PHL}		See 12.7 AC Test Circuit, Table 12.7.1 Fig. 12.8.1, Table 12.8.1	1.8 ± 0.15	—	27.5	ns
				2.5 ± 0.2	—	10.5	
				2.7	—	9.5	
				3.3 ± 0.3	1.5	8.0	
Output enable time	t_{PZL},t_{PZH}		See 12.7 AC Test Circuit, Table 12.7.1 Fig. 12.8.2, Table 12.8.1	1.8 ± 0.15	—	33.0	ns
				2.5 ± 0.2	—	16.5	
				2.7	—	9.5	
				3.3 ± 0.3	1.5	8.0	
Output disable time	t_{PLZ},t_{PHZ}		See 12.7 AC Test Circuit, Table 12.7.1 Fig. 12.8.2, Table 12.8.1	1.8 ± 0.15	—	33.0	ns
				2.5 ± 0.2	—	16.5	
				2.7	—	7.0	
				3.3 ± 0.3	1.5	6.0	
Output skew	t_{osLH},t_{osHL}	(Note 1)	—	2.7	—	—	ns
				3.3 ± 0.3	—	1.0	ns

Note 1: Parameter guaranteed by design. (t_{osLH} = |t_{PLH}m-t_{PLH}n|, t_{osHL} = |t_{PHL}m-t_{PHL}n|)

12.5. Dynamic Switching Characteristics (Unless otherwise specified, T_a = 25 °C, Input: t_r = t_f = 2.5 ns, C_L = 50 pF, R_L = 500 Ω)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Typ.	Unit
Quiet output maximum dynamic V_{OL}	V_{OLP}	V_{IH} = 3.3 V, V_{IL} = 0 V	3.3	0.8	V
Quiet output minimum dynamic V_{OL}	$\|V_{OLV}\|$	V_{IH} = 3.3 V, V_{IL} = 0 V	3.3	0.8	V

12.6. Capacitive Characteristics (Unless otherwise specified, T_a = 25 °C)

Characteristics	Symbol	Note	Test Condition	V_{CC} (V)	Typ.	Unit
Input capacitance	C_{IN}		—	3.3	7	pF
Output capacitance	C_{OUT}		—	3.3	8	pF
Power dissipation capacitance	C_{PD}	(Note 1)	f_{IN} = 10 MHz	3.3	25	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.

$I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/4$ (per 1 circuit)

12.7. AC Test Circuit

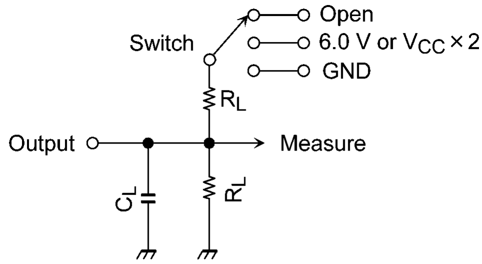


Table 12.7.1 Parameter for AC Test Circuit

Parameter	Switch	Test Condition
t_{PLH}, t_{PHL}	OPEN	—
t_{PLZ}, t_{PZL}	6.0 V	V_{CC} = 3.3 ± 0.3 V
		V_{CC} = 2.7 V
	V_{CC} × 2	V_{CC} = 2.5 ± 0.2 V
		V_{CC} = 1.8 ± 0.15 V
t_{PHZ}, t_{PZH}	GND	—

12.8. AC Waveform

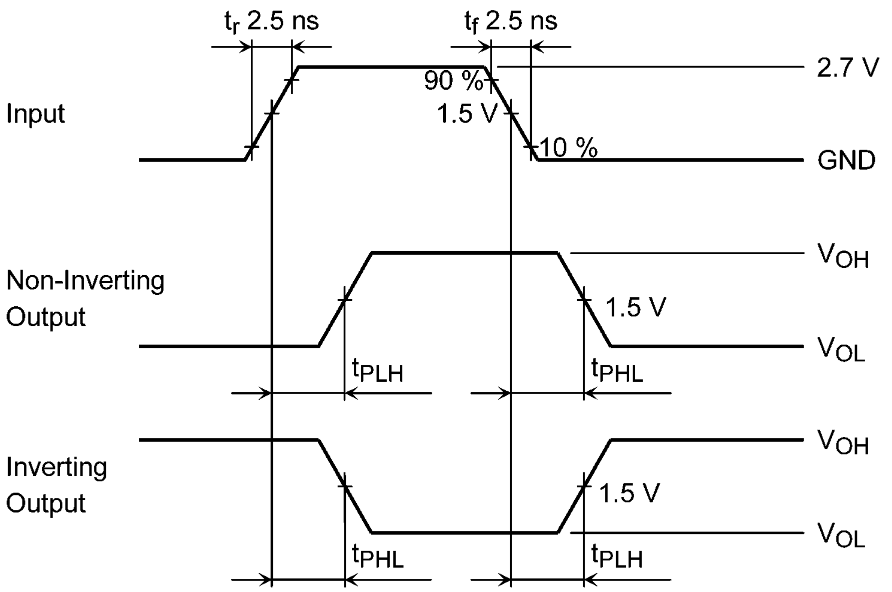


Fig. 12.8.1 t_{PLH}, t_{PHL}

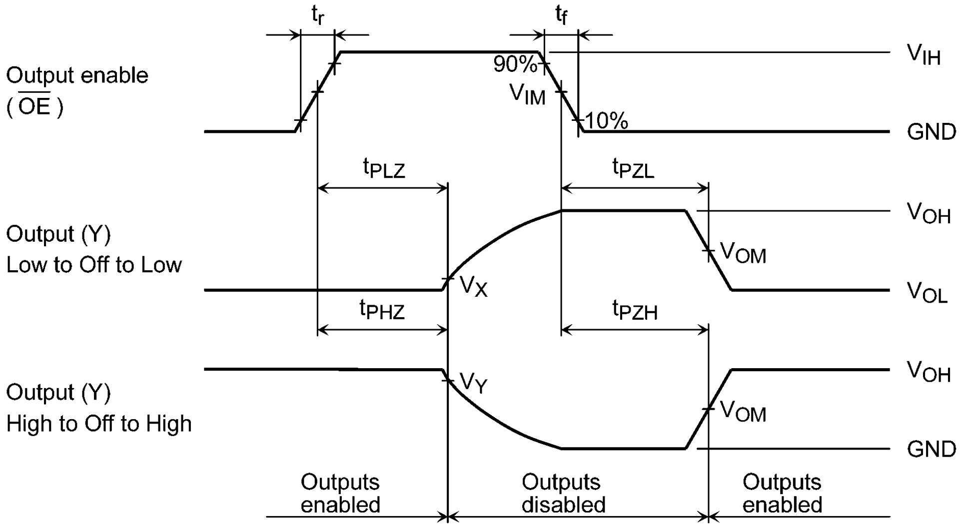


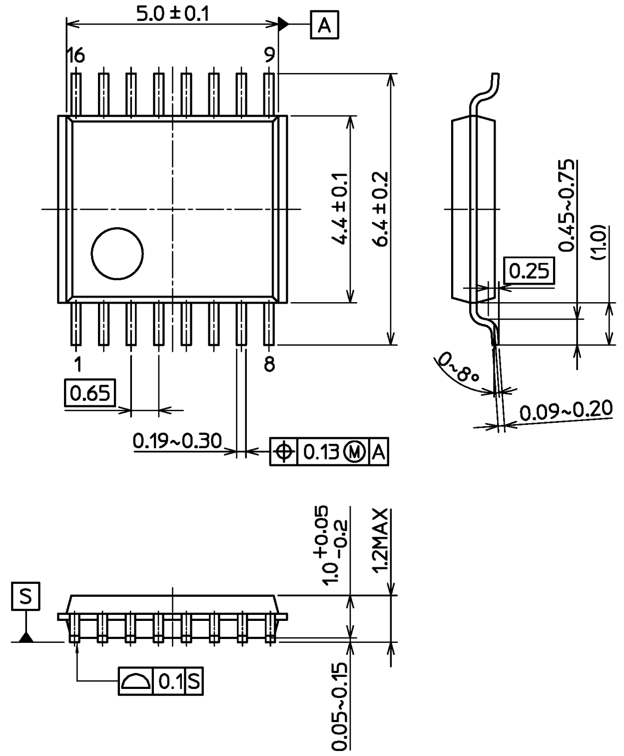
Fig. 12.8.2 t_{PLZ}, t_{PHZ}, t_{PZL}, t_{PZH}

Table 12.8.1 AC Waveform Symbols

	Symbol	V_{CC} = 3.3 ± 0.3 V V_{CC} = 2.7 V	V_{CC} = 2.5 ± 0.2 V	V_{CC} = 1.8 ± 0.15 V
Input	V_{IH}	2.7 V	V_{CC}	V_{CC}
	V_{IM}	1.5 V	$V_{CC}/2$	$V_{CC}/2$
	t_r, t_f	2.5 ns	2.0 ns	2.0 ns
Output	V_{OM}	1.5 V	$V_{OH}/2$	$V_{OH}/2$
	V_X	V_{OL} + 0.3 V	V_{OL} + 0.15 V	V_{OL} + 0.15 V
	V_Y	V_{OH} - 0.3 V	V_{OH} - 0.15 V	V_{OH} - 0.15 V
Load	C_L	50 pF	30 pF	30 pF
	R_L	500 Ω	500 Ω	1 kΩ

Package Dimensions

Unit: mm



Weight: 0.055 g (typ.)

Package Name(s)
Nickname: TSSOP16B

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