TENTATIVE TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC74VCXH16244FT

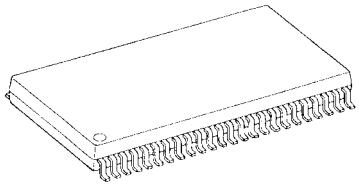
Low-Voltage 16-Bit Bus Buffer with Bushold

The TC74VCXH16244FT is a high-performance CMOS 16-bit bus buffer. Designed for use in 1.8-V, 2.5-V or 3.3-V systems, it achieves high-speed operation while maintaining the CMOS low power dissipation.

This device is non-inverting 3-state buffer having four active-low output enables. It can be used as four 4-bit buffers two 8-bit buffers or one 16-bit buffer. When the $\overline{OE}$ input is high, the outputs are in a high-impedance state. This device is designed to be used with 3-state memory address drivers, etc.

The A data inputs include active bushold circuitry, eliminating the need for external pull-up resisisors to hold unused or floating data inputs at a valid logic level.

All inputs are equipped with protection circuits against static discharge.



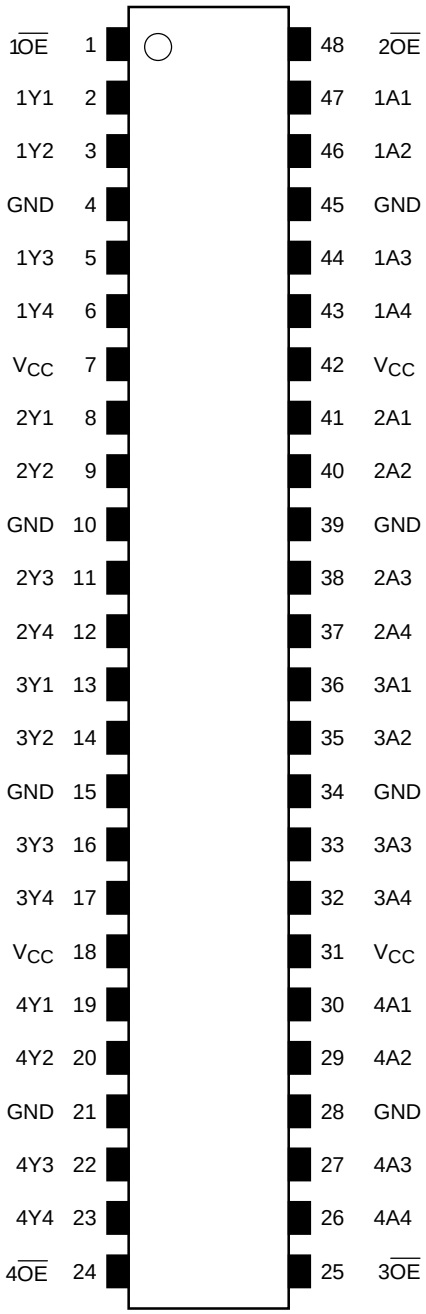
TSSOP48-P-0061-0.50

Weight: 0.25 g (typ.)

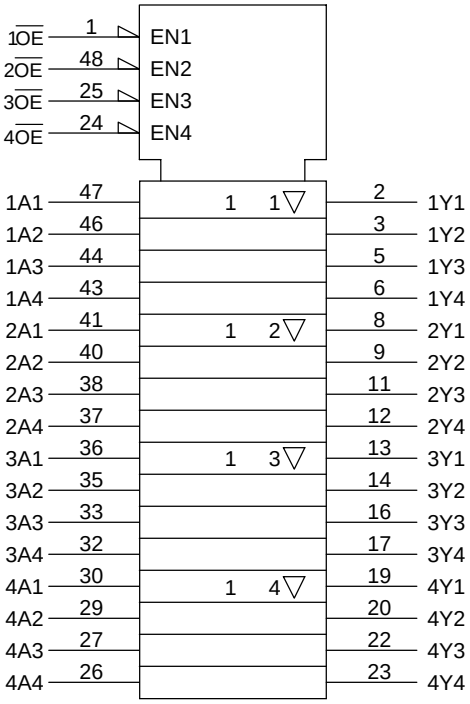
Features

- Low-voltage operation: V_{CC} = 1.8 to 3.6 V
- Bushold on data inputs eliminating the need for external pull-up/pull-down resistors
- High-speed operation: t_{pd} = 2.5 ns (max) (V_{CC} = 3.0 to 3.6 V)
  : t_{pd} = 3.0 ns (max) (V_{CC} = 2.3 to 2.7 V)
  : t_{pd} = 5.0 ns (max) (V_{CC} = 1.8 V)
- Output current: I_{OH}/I_{OL} = ±24 mA (min) (V_{CC} = 3.0 V)
  : I_{OH}/I_{OL} = ±18 mA (min) (V_{CC} = 2.3 V)
  : I_{OH}/I_{OL} = ±6 mA (min) (V_{CC} = 1.8 V)
- Latch-up performance: ±300 mA
- ESD performance: Machine model > ±200 V
  : Human body model > ±2000 V
- Package: TSSOP (thin shrink small outline package)
- 3.6-V tolerant function and power-down protection control inputs and outputs

Pin Assignment (top view)



IEC Logic Symbol



Truth Table

Inputs		Outputs
$1\overline{OE}$	1A1-1A4	1Y1-1Y4
L	L	L
L	H	H
H	X	Z

Inputs		Outputs
$2\overline{OE}$	2A1-2A4	2Y1-2Y4
L	L	L
L	H	H
H	X	Z

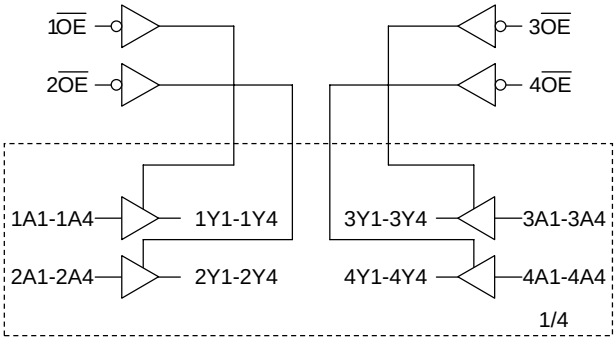
Inputs		Outputs
$3\overline{OE}$	3A1-3A4	3Y1-3Y4
L	L	L
L	H	H
H	X	Z

Inputs		Outputs
$4\overline{OE}$	4A1-4A4	4Y1-4Y4
L	L	L
L	H	H
H	X	Z

X: Don’t care

Z: High impedance

System Diagram



Maximum Ratings

Characteristics		Symbol	Rating	Unit
Power supply voltage		V_{CC}	−0.5 to 4.6	V
DC input voltage	($\overline{OE}$)	V_{IN}	−0.5 to 4.6	V
	(An)		−0.5 to V_{CC} + 0.5	
DC output voltage		V_{OUT}	−0.5 to 4.6 (Note 1)	V
			−0.5 to V_{CC} + 0.5 (Note 2)	
Input diode current		I_{IK}	−50	mA
Output diode current		I_{OK}	±50 (Note 3)	mA
Output current		I_{OUT}	±50	mA
Power dissipation		P_D	400	mW
DC V_{CC}/ground current per supply pin		I_{CC}/I_{GND}	±100	mA
Storage temperature		T_{stg}	−65 to 150	°C

Note 1: OFF state

Note 2: High or low state. I_{OUT} absolute maximum rating must be observed.

Note 3: $V_{OUT} < GND$, $V_{OUT} > V_{CC}$

Recommended Operating Range (Note 4)

Characteristics		Symbol	Rating	Unit
Power supply voltage		V_{CC}	1.8 to 3.6	V
			1.2 to 3.6 (Note 5)	
Input voltage	($\overline{OE}$)	V_{IN}	−0.3 to 3.6	V
	(An)		0 to V_{CC}	
Output voltage		V_{OUT}	0 to 3.6 (Note 6)	V
			0 to V_{CC} (Note 7)	
Output current		I_{OH}/I_{OL}	±24 (Note 8)	mA
			±18 (Note 9)	
			±6 (Note 10)	
Operating temperature		T_{opr}	−40 to 85	°C
Input rise and fall time		dt/dv	0 to 10 (Note 11)	ns/V

Note 4: Floating or unused control inputs must be held high or low.

Note 5: Data retention

Note 6: OFF state

Note 7: High or low state

Note 8: V_{CC} = 3.0 to 3.6 V

Note 9: V_{CC} = 2.3 to 2.7 V

Note 10: V_{CC} = 1.8 V

Note 11: V_{IN} = 0.8 to 2.0 V, V_{CC} = 3.0 V

Electrical Characteristics

DC Characteristics (Ta = –40 to 85°C, 2.7 V < V_{CC} ≦ 3.6 V)

Characteristics		Symbol	Test Condition		V_{CC} (V)	Min	Max	Unit
Input voltage	H-level	V_{IH}	—		2.7 to 3.6	2.0	—	V
	L-level	V_{IL}	—		2.7 to 3.6	—	0.8	
Output voltage	H-level	V_{OH}	V_{IN} = V_{IH} or V_{IL}	I_{OH} = –100 μA	2.7 to 3.6	V_{CC} – 0.2	—	V
				I_{OH} = –12 mA	2.7	2.2	—	
				I_{OH} = –18 mA	3.0	2.4	—	
				I_{OH} = –24 mA	3.0	2.2	—	
	L-level	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 100 μA	2.7 to 3.6	—	0.2	
				I_{OL} = 12 mA	2.7	—	0.4	
				I_{OL} = 18 mA	3.0	—	0.4	
				I_{OL} = 24 mA	3.0	—	0.55	
Input leakage current	($\overline{OE}$)	I_{IN}	V_{IN} = 0 to 3.6 V		2.7 to 3.6	—	±5.0	μA
	(An)		V_{IN} = V_{CC} or GND		2.7 to 3.6	—	±5.0	
Bushold input minimum drive hold current		$I_{I (HOLD)}$	V_{IN} = 0.8 V		3.0	75	—	μA
			V_{IN} = 2.0 V		3.0	–75	—	
Bushold input over-drive current to change state		$I_{I (OD)}$	(Note 12)		3.6	—	450	μA
			(Note 13)		3.6	—	–450	
3-state output OFF state current		I_{OZ}	V_{IN} = V_{IH} or V_{IL} V_{OUT} = 0 to 3.6 V		2.7 to 3.6	—	±10.0	μA
Power-off leakage current		I_{OFF}	V_{OUT} = 0 to 3.6 V		0	—	10.0	μA
Quiescent supply current		I_{CC}	V_{IN} = V_{CC} or GND		2.7 to 3.6	—	20.0	μA
			V_{CC} ≦ V_{OUT} ≦ 3.6 V	(Note 14)	2.7 to 3.6	—	±20.0	
Increase in I_{CC} per input		ΔI_{CC}	V_{IH} = V_{CC} – 0.6 V		2.7 to 3.6	—	750	μA

Note 12: An external driver must source at least the specified current to switch LOW-to-HIGH.

Note 13: An external driver must sink at least the specified current to switch HIGH-to-LOW.

Note 14: Outputs high impedance only.

DC Characteristics (Ta = –40 to 85°C, 2.3 V ≦ V_{CC} ≦ 2.7 V)

Characteristics		Symbol	Test Condition		V_{CC} (V)	Min	Max	Unit
Input voltage	H-level	V_{IH}	—		2.3 to 2.7	1.6	—	V
	L-level	V_{IL}	—		2.3 to 2.7	—	0.7	
Output voltage	H-level	V_{OH}	V_{IN} = V_{IH} or V_{IL}	I_{OH} = –100 μA	2.3 to 2.7	V_{CC} – 0.2	—	V
				I_{OH} = –6 mA	2.3	2.0	—	
				I_{OH} = –12 mA	2.3	1.8	—	
				I_{OH} = –18 mA	2.3	1.7	—	
	L-level	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 100 μA	2.3 to 2.7	—	0.2	
				I_{OL} = 12 mA	2.3	—	0.4	
				I_{OL} = 18 mA	2.3	—	0.6	
Input leakage current	($\overline{OE}$)	I_{IN}	V_{IN} = 0 to 3.6 V		2.3 to 2.7	—	±5.0	μA
	(An)		V_{IN} = V_{CC} or GND		2.3 to 2.7	—	±5.0	
Bushold input minimum drive hold current		$I_{I (HOLD)}$	V_{IN} = 0.7 V		2.3	45	—	μA
			V_{IN} = 1.6 V		2.3	–45	—	
Bushold input over-drive current to change state		$I_{I (OD)}$	(Note 12)		2.7	—	300	μA
			(Note 13)		2.7	—	–300	
3-state output OFF state current		I_{OZ}	V_{IN} = V_{IH} or V_{IL} V_{OUT} = 0 to 3.6 V		2.3 to 2.7	—	±10.0	μA
Power-off leakage current		I_{OFF}	V_{OUT} = 0 to 3.6 V		0	—	10.0	μA
Quiescent supply current		I_{CC}	V_{IN} = V_{CC} or GND		2.3 to 2.7	—	20.0	μA
			V_{CC} ≦ V_{OUT} ≦ 3.6 V	(Note 14)	2.3 to 2.7	—	±20.0	

Note 12: An external driver must source at least the specified current to switch LOW-to-HIGH.

Note 13: An external driver must sink at least the specified current to switch HIGH-to-LOW.

Note 14: Outputs high impedance only.

DC Characteristics (Ta = –40 to 85°C, 1.8 V ≦ V_{CC} < 2.3 V)

Characteristics		Symbol	Test Condition		V_{CC} (V)	Min	Max	Unit
Input voltage	H-level	V_{IH}	—		1.8 to 2.3	0.7 × V_{CC}	—	V
	L-level	V_{IL}	—		1.8 to 2.3	—	0.2 × V_{CC}	
Output voltage	H-level	V_{OH}	V_{IN} = V_{IH} or V_{IL}	I_{OH} = –100 μA	1.8	V_{CC} – 0.2	—	V
				I_{OH} = –6 mA	1.8	1.4	—	
	L-level	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 100 μA	1.8	—	0.2	
				I_{OL} = 6 mA	1.8	—	0.3	
Input leakage current	($\overline{OE}$)	I_{IN}	V_{IN} = 0 to 3.6 V		1.8	—	±5.0	μA
	(An)		V_{IN} = V_{CC} or GND		1.8	—	±5.0	
Bushold input minimum drive hold current		$I_{I (HOLD)}$	V_{IN} = 0.36 V		1.8	25	—	μA
			V_{IN} = 1.26 V		1.8	–25	—	
Bushold input over-drive current to change state		$I_{I (OD)}$	(Note 12)		1.8	—	200	μA
			(Note 13)		1.8	—	–200	
3-state output OFF state current		I_{OZ}	V_{IN} = V_{IH} or V_{IL} V_{OUT} = 0 to 3.6 V		1.8	—	±10.0	μA
Power-off leakage current		I_{OFF}	V_{OUT} = 0 to 3.6 V		0	—	10.0	μA
Quiescent supply current		I_{CC}	V_{IN} = V_{CC} or GND		1.8	—	20.0	μA
			V_{CC} ≦ V_{OUT} ≦ 3.6 V	(Note 14)	1.8	—	±20.0	

Note 12: An external driver must source at least the specified current to switch LOW-to-HIGH.

Note 13: An external driver must sink at least the specified current to switch HIGH-to-LOW.

Note 14: Outputs high impedance only.

AC Characteristics (Ta = –40 to 85°C, input: t_r = t_f = 2.0 ns, C_L = 30 pF, R_L = 500 Ω)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Min	Max	Unit
Propagation delay time	t_{pLH} t_{pHL}	Figure 1, Figure 2	1.8	1.5	5.0	ns
			2.5 ± 0.2	1.0	3.0	
			3.3 ± 0.3	0.8	2.5	
3-state output enable time	t_{pZL} t_{pZH}	Figure 1, Figure 3	1.8	1.5	6.5	ns
			2.5 ± 0.2	1.0	4.1	
			3.3 ± 0.3	0.8	3.5	
3-state output disable time	t_{pLZ} t_{pHZ}	Figure 1, Figure 3	1.8	1.5	5.0	ns
			2.5 ± 0.2	1.0	3.8	
			3.3 ± 0.3	0.8	3.5	
Output to output skew	t_{osLH} t_{osHL}	(Note 15)	1.8	—	0.5	ns
			2.5 ± 0.2	—	0.5	
			3.3 ± 0.3	—	0.5	

For C_L = 50 pF, add approximately 300 ps to the AC maximum specification.

Note 15: Parameter guaranteed by design.
(t_{osLH} = $|t_{pLHm} - t_{pLHn}|$, t_{osHL} = $|t_{pHLm} - t_{pHLn}|$)

Dynamic Switching Characteristics (Ta = 25°C, input: $t_r = t_f = 2.0$ ns, $C_L = 30$ pF)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Typ.	Unit
Quiet output maximum dynamic V_{OL}	V_{OLP}	V_{IH} = 1.8 V, V_{IL} = 0 V (Note 16)	1.8	0.25	V
		V_{IH} = 2.5 V, V_{IL} = 0 V (Note 16)	2.5	0.6	
		V_{IH} = 3.3 V, V_{IL} = 0 V (Note 16)	3.3	0.8	
Quiet output minimum dynamic V_{OL}	V_{OLV}	V_{IH} = 1.8 V, V_{IL} = 0 V (Note 16)	1.8	−0.25	V
		V_{IH} = 2.5 V, V_{IL} = 0 V (Note 16)	2.5	−0.6	
		V_{IH} = 3.3 V, V_{IL} = 0 V (Note 16)	3.3	−0.8	
Quiet output minimum dynamic V_{OH}	V_{OHV}	V_{IH} = 1.8 V, V_{IL} = 0 V (Note 16)	1.8	1.5	V
		V_{IH} = 2.5 V, V_{IL} = 0 V (Note 16)	2.5	1.9	
		V_{IH} = 3.3 V, V_{IL} = 0 V (Note 16)	3.3	2.2	

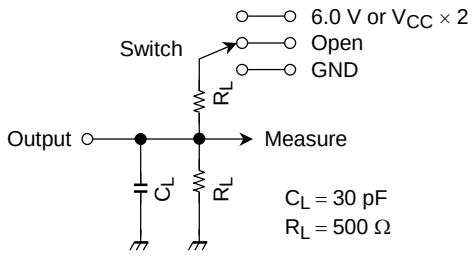
Note 16: Parameter guaranteed by design.

Capacitive Characteristics (Ta = 25°C)

Characteristics	Symbol	Test Condition	V_{CC} (V)	Typ.	Unit
Input capacitance	C_{IN}	—	1.8, 2.5, 3.3	6	pF
Output capacitance	C_O	—	1.8, 2.5, 3.3	7	pF
Power dissipation capacitance	C_{PD}	f_{IN} = 10 MHz (Note 17)	1.8, 2.5, 3.3	20	pF

Note 17: 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:
$I_{CC\ (opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/16$ (per bit)

AC Test Circuit



Parameter	Switch	
t_{pLH}, t_{pHL}	Open	
t_{pLZ}, t_{pZL}	6.0 V $V_{CC} \times 2$	@V_{CC} = 3.3 ± 0.3 V @V_{CC} = 2.5 ± 0.2 V @V_{CC} = 1.8 V
t_{pHZ}, t_{pZH}	GND	

Figure 1

AC Waveform

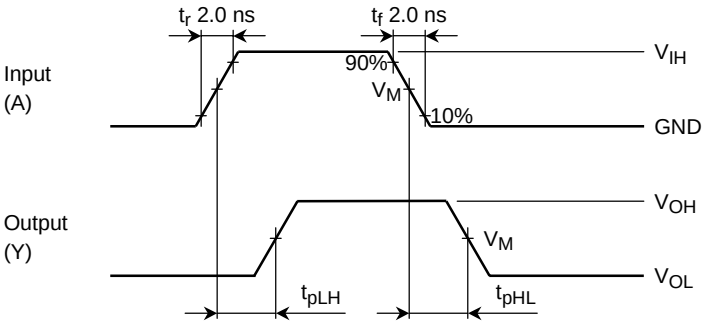


Figure 2 t_{pLH}, t_{pHL}

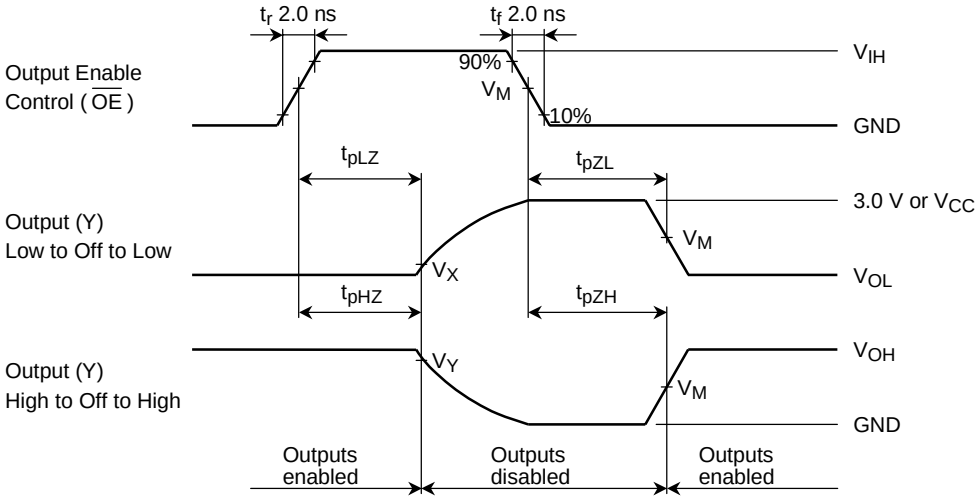
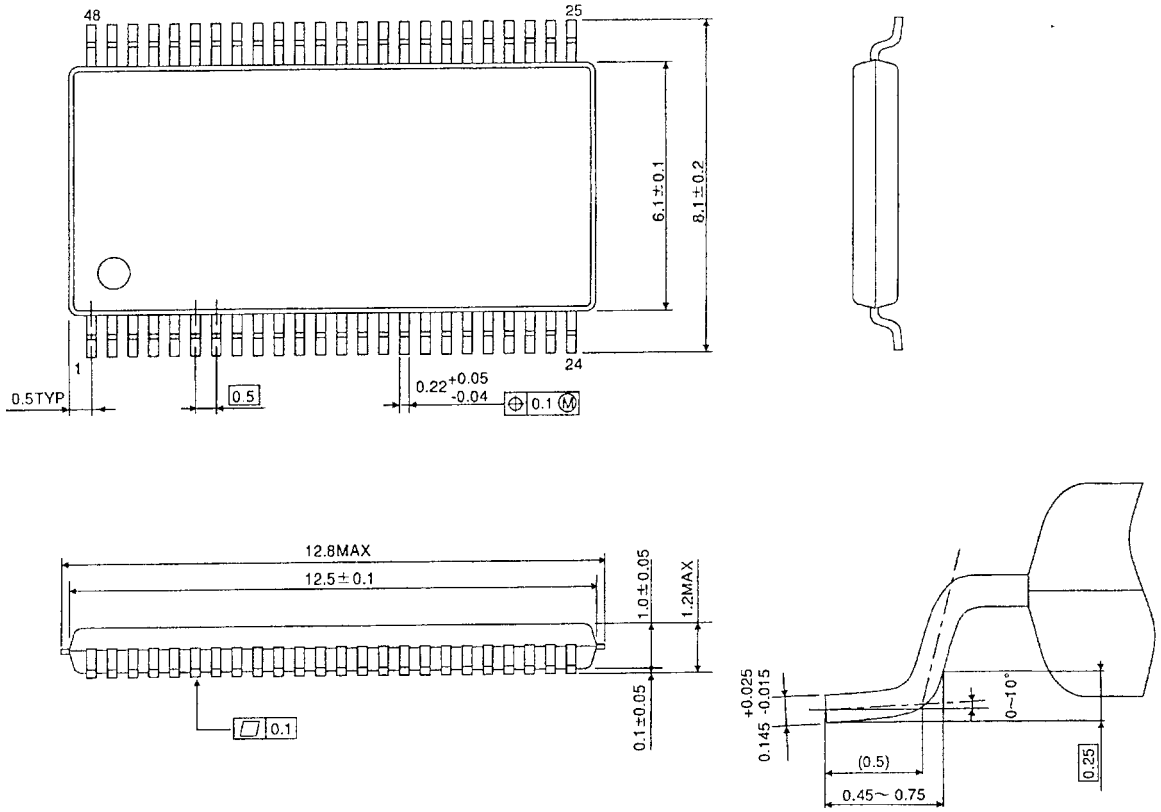


Figure 3 t_{pLZ}, t_{pHZ}, t_{pZL}, t_{pZH}

Symbol	V_{CC}		
	3.3 ± 0.3 V	2.5 ± 0.2 V	1.8 V
V_{IH}	2.7 V	V_{CC}	V_{CC}
V_M	1.5 V	V_{CC}/2	V_{CC}/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

Package Dimensions

TSSOP48-P-0061-0.50 Unit : mm



Weight: 0.25 g (typ.)

RESTRICTIONS ON PRODUCT USE

000707EBA

- TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property.
  In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the “Handling Guide for Semiconductor Devices,” or “TOSHIBA Semiconductor Reliability Handbook” etc..
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury (“Unintended Usage”). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in this document shall be made at the customer’s own risk.
- The products described in this document are subject to the foreign exchange and foreign trade laws.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA CORPORATION for any infringements of intellectual property or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any intellectual property or other rights of TOSHIBA CORPORATION or others.
- The information contained herein is subject to change without notice.