

TENTATIVE

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

TC74VCXH162244FT

Low-Voltage 16-Bit Bus Buffer with Bushold

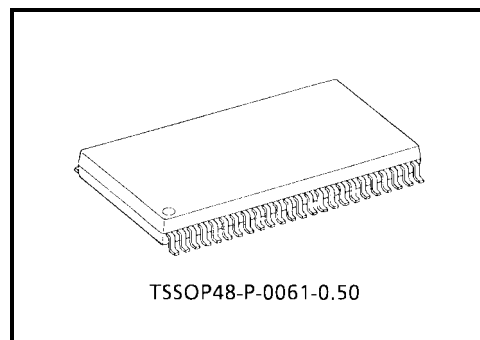
The TC74VCXH162244FT is a high-performance CMOS 16-bit bus buffer. Designed for use in 1.8-V, 2.5-V or 3.3-V systems, it achieves high-speed operation while maintaining the CMOS low power dissipation.

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 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 26- Ω series resistor helps reducing output overshoot and undershoot without external resistor.

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

All inputs are equipped with protection circuits against static discharge.

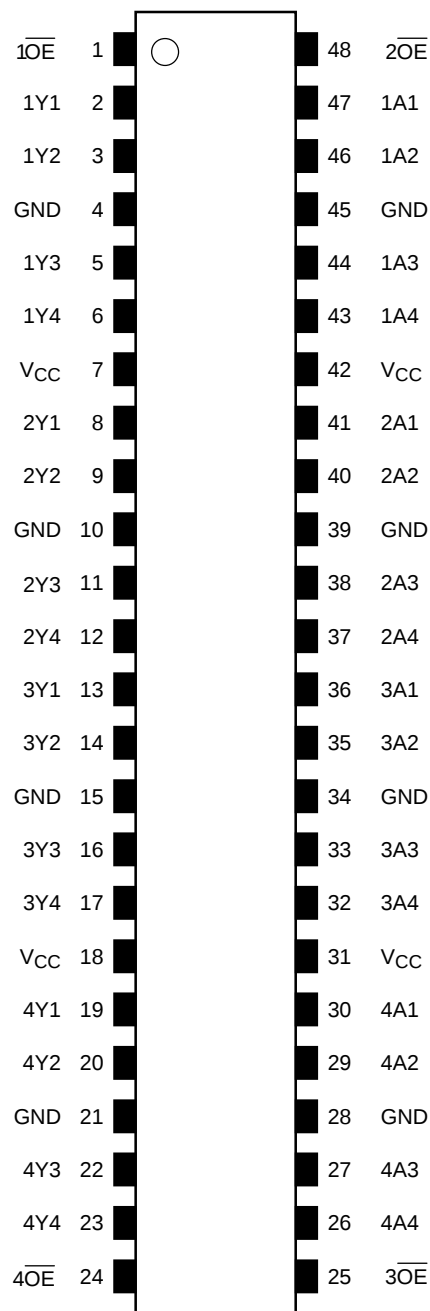


Weight: 0.25 g (typ.)

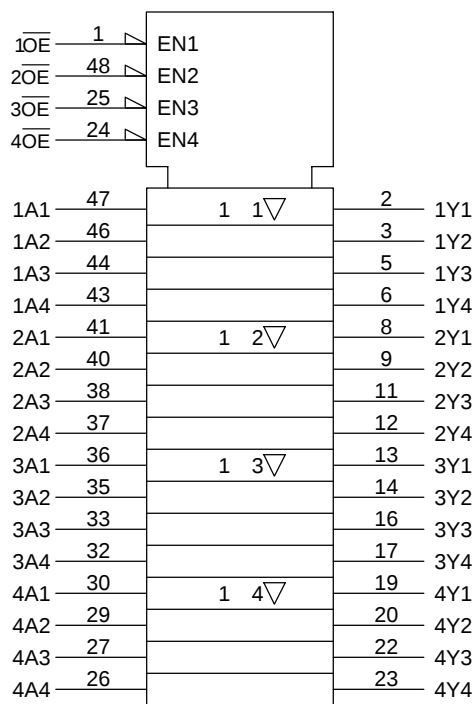
Features

- 26- Ω series resistors on outputs
- 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: $t_{pd} = 3.3$ ns (max) ($V_{CC} = 3.0$ to 3.6 V)
: $t_{pd} = 3.8$ ns (max) ($V_{CC} = 2.3$ to 2.7 V)
: $t_{pd} = 5.7$ ns (max) ($V_{CC} = 1.8$ V)
- Output current: $I_{OH}/I_{OL} = \pm 12$ mA (min) ($V_{CC} = 3.0$ V)
: $I_{OH}/I_{OL} = \pm 8$ mA (min) ($V_{CC} = 2.3$ V)
: $I_{OH}/I_{OL} = \pm 4$ mA (min) ($V_{CC} = 1.8$ V)
- Latch-up performance: ± 300 mA
- ESD performance: Machine model $> \pm 200$ V
: Human body model $> \pm 2000$ 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
$\overline{1OE}$	1A1-1A4	1Y1-1Y4
L	L	L
L	H	H
H	X	Z

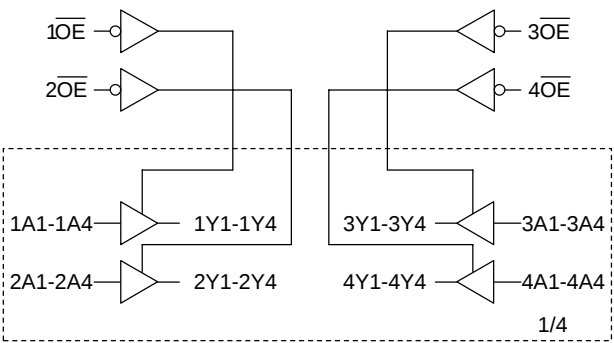
Inputs		Outputs
$\overline{2OE}$	2A1-2A4	2Y1-2Y4
L	L	L
L	H	H
H	X	Z

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

Inputs		Outputs
$\overline{4OE}$	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}	±12 (Note 8)	mA
			±8 (Note 9)	
			±4 (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 ($T_a = -40$ to 85°C , $2.7\text{ V} < V_{CC} \leq 3.6\text{ V}$)

Characteristics		Symbol	Test Condition		Min	Max	Unit
Input voltage	H-level	V_{IH}	—	V_{CC} (V) 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}	$I_{OH} = -100\text{ }\mu\text{A}$	2.7 to 3.6	$V_{CC} - 0.2$	V
				$I_{OH} = -6\text{ mA}$	2.7	2.2	
				$I_{OH} = -8\text{ mA}$	3.0	2.4	
				$I_{OH} = -12\text{ mA}$	3.0	2.2	
	L-level	V_{OL}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 100\text{ }\mu\text{A}$	2.7 to 3.6	—	
				$I_{OL} = 6\text{ mA}$	2.7	—	
				$I_{OL} = 8\text{ mA}$	3.0	—	
				$I_{OL} = 12\text{ mA}$	3.0	—	
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)	$V_{IN} = 0.8\text{ V}$	3.0	75	—	μA
			$V_{IN} = 2.0\text{ V}$	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
			$V_{CC} \leq V_{OUT} \leq 3.6\text{ V}$ (Note 14)	2.7 to 3.6	—	± 20.0	
Increase in I_{CC} per input		ΔI_{CC}	$V_{IH} = V_{CC} - 0.6\text{ V}$	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 ($T_a = -40$ to 85°C , $2.3\text{ V} \leq V_{CC} \leq 2.7\text{ V}$)

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} = -4 mA	2.3	2.0	—	
				I _{OH} = -6 mA	2.3	1.8	—	
				I _{OH} = -8 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} = 6 mA	2.3	—	0.4	
				I _{OL} = 8 mA	2.3	—	0.6	
Input leakage current	($\overline{\text{OE}}$)	I _{IIN}	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 ($T_a = -40$ to 85°C , $1.8\text{ V} \leq V_{CC} < 2.3\text{ V}$)

Characteristics		Symbol	Test Condition		V _{CC} (V)	Min	Max	Unit
Input voltage	H-level	V _{IH}	—		1.8 to 2.3	$0.7 \times V_{CC}$	—	V
	L-level	V _{IL}	—		1.8 to 2.3	—	$0.2 \times V_{CC}$	V
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} = -4 mA	1.8	1.4	—	V
	L-level	V _{OL}	V _{IN} = V _{IH} or V _{IL}	I _{OL} = 100 μA	1.8	—	0.2	V
				I _{OL} = 4 mA	1.8	—	0.3	V
Input leakage current	($\overline{\text{OE}}$)	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	μA
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	—	μA
Bushold input over-drive current to change state		I _I (OD)	(Note 12)		1.8	—	200	μA
			(Note 13)		1.8	—	-200	μA
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} $\leq$ V _{OUT} $\leq$ 3.6 V (Note 14)		1.8	—	± 20.0	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.

AC Characteristics ($T_a = -40$ to 85°C , input: $t_r = t_f = 2.0\text{ ns}$, $C_L = 30\text{ pF}$, $R_L = 500\ \Omega$)

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	5.7	ns
					2.5 ± 0.2	1.0	3.8	
					3.3 ± 0.3	0.8	3.3	
3-state output enable time		t _{pZL} t _{pZH}	Figure 1, Figure 3		1.8	1.5	6.7	ns
					2.5 ± 0.2	1.0	5.1	
					3.3 ± 0.3	0.8	3.8	
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	4.0	
					3.3 ± 0.3	0.8	3.6	
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 $C_L = 50\text{ pF}$, 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	0.15	V
		V _{IH} = 2.5 V, V _{IL} = 0 V (Note 16)	2.5	0.25	
		V _{IH} = 3.3 V, V _{IL} = 0 V (Note 16)	3.3	0.35	
Quiet output minimum dynamic V _{OL}	V _{OLV}	V _{IH} = 1.8 V, V _{IL} = 0 V (Note 16)	1.8	-0.15	V
		V _{IH} = 2.5 V, V _{IL} = 0 V (Note 16)	2.5	-0.25	
		V _{IH} = 3.3 V, V _{IL} = 0 V (Note 16)	3.3	-0.35	
Quiet output minimum dynamic V _{OH}	V _{OHV}	V _{IH} = 1.8 V, V _{IL} = 0 V (Note 16)	1.8	1.55	V
		V _{IH} = 2.5 V, V _{IL} = 0 V (Note 16)	2.5	2.05	
		V _{IH} = 3.3 V, V _{IL} = 0 V (Note 16)	3.3	2.65	

Note 16: Parameter guaranteed by design.

Capacitive Characteristics (Ta = 25°C)

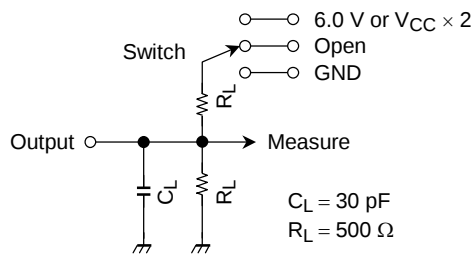
Characteristics	Symbol	Test Condition	V _{CC} (V)	Typ.	Unit
Input capacitance	C _{IN}	—	1.8, 2.5, 3.3	6	pF
Output capacitance	C _O	—	1.8, 2.5, 3.3	7	pF
Power dissipation capacitance	C _{PD}	f _{IN} = 10 MHz (Note 17)	1.8, 2.5, 3.3	20	pF

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:

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

AC Test Circuit



Parameter	Switch
t_{pLH} , t_{pHL}	Open
t_{pLZ} , t_{pZL}	6.0 V $V_{CC} \times 2$
t_{pHZ} , t_{pZH}	GND

Figure 1

AC Waveform

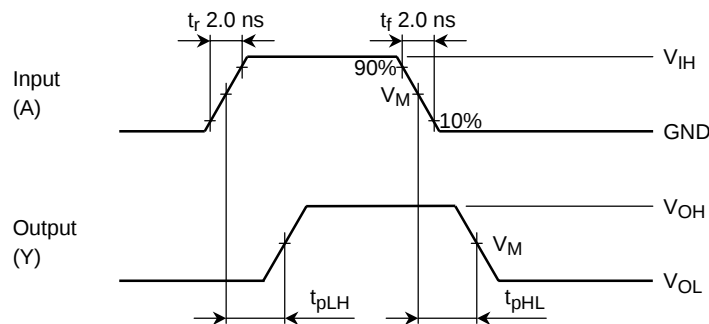


Figure 2 t_{pLH} , t_{pHL}

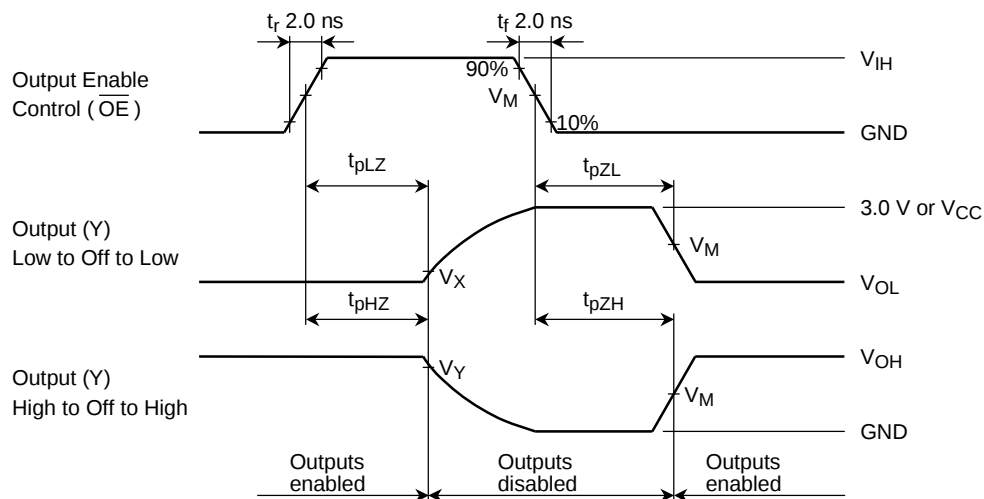


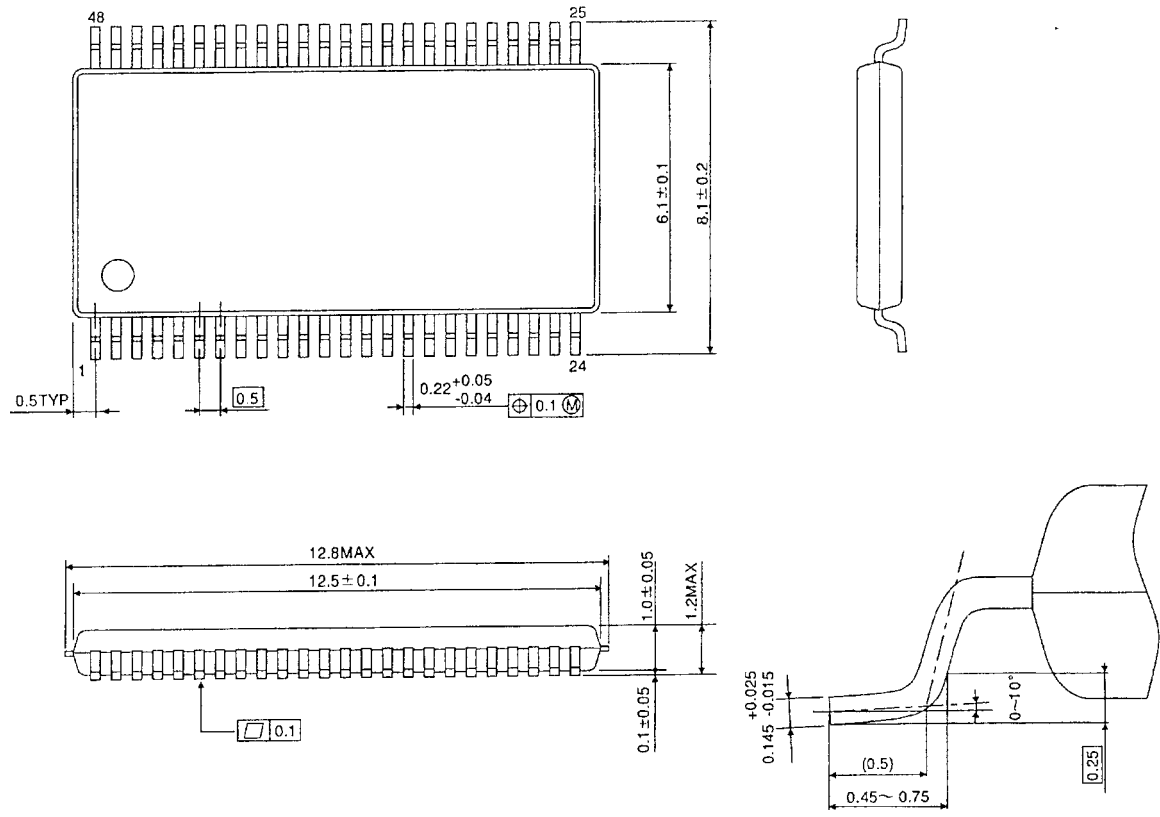
Figure 3 t_{pLZ} , t_{pHZ} , t_{pZL} , t_{pZH}

Symbol	V_{CC}		
	$3.3 \pm 0.3 \text{ V}$	$2.5 \pm 0.2 \text{ V}$	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	$V_{OL} + 0.3 \text{ V}$	$V_{OL} + 0.15 \text{ V}$	$V_{OL} + 0.15 \text{ V}$
V_Y	$V_{OH} - 0.3 \text{ V}$	$V_{OH} - 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$

Package Dimensions

TSSOP48-P-0061-0.50

Unit : mm



Weight: 0.25 g (typ.)

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