

TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC74VCX162827FT

LOW-VOLTAGE 20-BIT BUS BUFFER WITH 3.6 V TOLERANT INPUTS AND OUTPUTS

The TC74VCX162827FT is a high performance CMOS 20-bit BUS BUFFER. Designed for use in 1.8, 2.5 or 3.3 Volt systems, it achieves high speed operation while maintaining the CMOS low power dissipation.

It is also designed with over voltage tolerant inputs and outputs up to 3.6 V.

The TC74VCX162827FT is composed of two 10-bit sections with separate output-enable signals. For either 10-bit buffer section, the two output-enable ($\overline{OE1}$ and $\overline{OE2}$ or $OE1$ and $OE2$) inputs must both be low for the corresponding Y outputs to be active.

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.

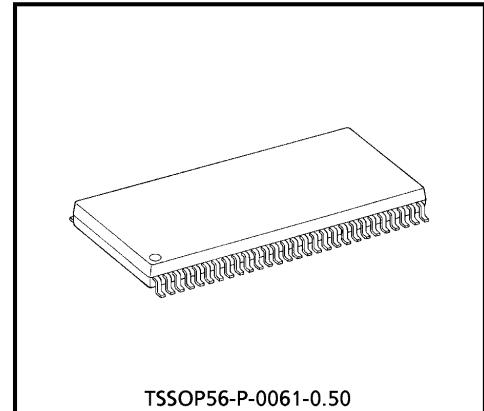
The 26Ω series resistor helps reducing output overshoot and undershoot without external resistor.

All inputs are equipped with protection circuits against static discharge.

FEATURES

- 26- Ω Series Resistors on Outputs.
- Low Voltage Operation : $V_{CC} = 1.8\sim 3.6\text{ V}$
- High Speed Operation : $t_{pd} = 3.4\text{ ns (max) at }V_{CC} = 3.0\sim 3.6\text{ V}$
 : $t_{pd} = 4.1\text{ ns (max) at }V_{CC} = 2.3\sim 2.7\text{ V}$
 : $t_{pd} = 8.2\text{ ns (max) at }V_{CC} = 1.8\text{ V}$
- 3.6 V Tolerant inputs and outputs.
- Output Current : $I_{OH}/I_{OL} = \pm 12\text{ mA (min) at }V_{CC} = 3.0\text{ V}$
 : $I_{OH}/I_{OL} = \pm 8\text{ mA (min) at }V_{CC} = 2.3\text{ V}$
 : $I_{OH}/I_{OL} = \pm 4\text{ mA (min) at }V_{CC} = 1.8\text{ V}$
- Latch-up Performance : $\pm 300\text{ mA}$
- ESD Performance : Human Body Model $> \pm 2000\text{ V}$
 : Machine Model $> \pm 200\text{ V}$
- Package : TSSOP
 (Thin Shrink Small Outline Package)
- Power Down Protection is provided on all inputs and outputs.
- Supports live insertion / withdrawal (Note 1)

(Note 1) : To ensure the high-impedance state during power up or power down, \overline{OE} should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.



TSSOP56-P-0061-0.50

Weight : 0.25 g (Typ.)

● TOSHIBA is continually working to improve the quality and the 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 observe standards of safety, and to avoid situations in which a malfunction or failure of a TOSHIBA product 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 products specifications. Also, please keep in mind the precautions and conditions set forth in the TOSHIBA Semiconductor Reliability Handbook.

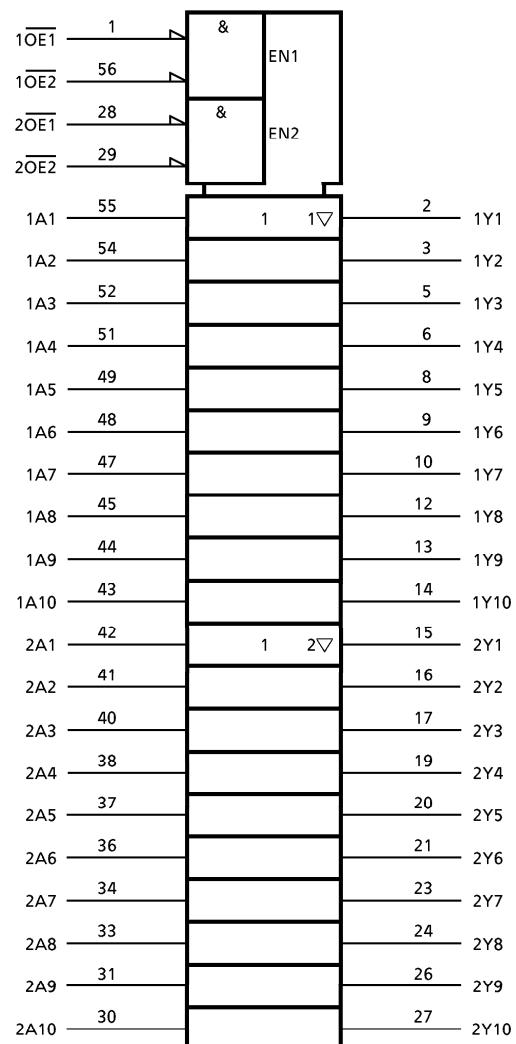
980910EBA2

PIN ASSIGNMENT

1 \overline{OE}_1	1	56	1 \overline{OE}_2
1Y1	2	55	1A1
1Y2	3	54	1A2
GND	4	53	GND
1Y3	5	52	1A3
1Y4	6	51	1A4
VCC	7	50	VCC
1Y5	8	49	1A5
1Y6	9	48	1A6
1Y7	10	47	1A7
GND	11	46	GND
1Y8	12	45	1A8
1Y9	13	44	1A9
1Y10	14	43	1A10
2Y1	15	42	2A1
2Y2	16	41	2A2
2Y3	17	40	2A3
GND	18	39	GND
2Y4	19	38	2A4
2Y5	20	37	2A5
2Y6	21	36	2A6
VCC	22	35	VCC
2Y7	23	34	2A7
2Y8	24	33	2A8
GND	25	32	GND
2Y9	26	31	2A9
2Y10	27	30	2A10
2 \overline{OE}_1	28	29	2 \overline{OE}_2

(TOP VIEW)

SYMBOL

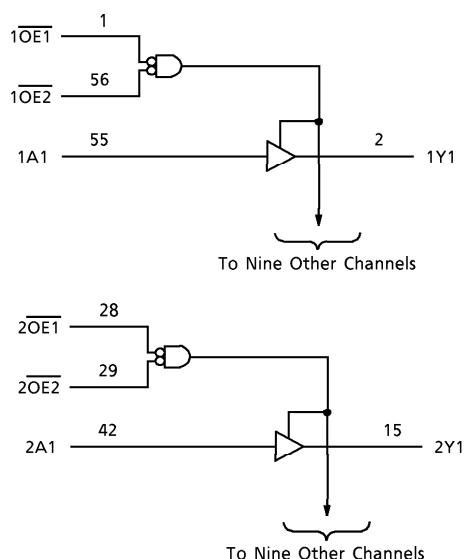


980910EBA2'

- 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.

FUNCTION TABLE (each 10-bit latch)

INPUT			OUTPUT Y
$\overline{OE1}$	$\overline{OE2}$	A	
L	L	L	L
L	L	H	H
H	X	X	Z
X	H	X	Z

SYSTEM DIAGRAM

MAXIMUM RATINGS

PARAMETER	SYMBOL	RATING	UNIT
Power Supply Voltage	V_{CC}	-0.5~4.6	V
DC Input Voltage	V_{IN}	-0.5~4.6	V
DC Output Voltage	V_{OUT}	-0.5~4.6 (Note 1)	V
		-0.5~ V_{CC} + 0.5 (Note 2)	
Input Diode Current	I_{IK}	-50	mA
Output Diode Current	I_{OK}	± 50 (Note 3)	mA
DC 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}	-65~150	°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**

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	1.8~3.6	V
		1.2~3.6 (Note 4)	
Input Voltage	V_{IN}	-0.3~3.6	V
Output Voltage	V_{OUT}	0~3.6 (Note 5)	V
		0~ V_{CC} (Note 6)	
Output Current	I_{OH} / I_{OL}	± 12 (Note 7)	mA
		± 8 (Note 8)	
		± 4 (Note 9)	
Operating Temperature	T_{opr}	-40~85	°C
Input Rise And Fall Time	dt/dv	0~10 (Note 10)	ns/V

(Note 4) : Data Retention Only

(Note 5) : Off-State

(Note 6) : High or Low State

(Note 7) : $V_{CC} = 3.0 \sim 3.6$ V(Note 8) : $V_{CC} = 2.3 \sim 2.7$ V(Note 9) : $V_{CC} = 1.8$ V(Note 10) : $V_{IN} = 0.8 \sim 2.0$ V, $V_{CC} = 3.0$ V

ELECTRICAL CHARACTERISTICSDC characteristics ($T_a = -40\text{--}85^\circ\text{C}$, $2.7\text{ V} < V_{CC} \leq 3.6\text{ V}$ Range)

PARAMETER		SYMBOL	TEST CONDITION		V_{CC} (V)	MIN	MAX	UNIT	
Input Voltage	"H" Level	V_{IH}				2.7~3.6	2.0	—	
	"L" Level	V_{IL}				2.7~3.6	—	0.8	
Output Voltage	"H" Level	V_{OH}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -100\text{ }\mu\text{A}$	2.7~3.6	$V_{CC} - 0.2$	—	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}	$I_{OL} = 100\text{ }\mu\text{A}$	2.7~3.6	—	0.2		
				$I_{OL} = 6\text{ mA}$	2.7	—	0.4		
				$I_{OL} = 8\text{ mA}$	3.0	—	0.55		
				$I_{OL} = 12\text{ mA}$	3.0	—	0.8		
Input Leakage Current	I_{IN}	$V_{IN} = 0\text{--}3.6\text{ V}$		2.7~3.6	—	± 5.0	μA		
3-State Output Off-State Current	I_{OZ}	$V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = 0\text{--}3.6\text{ V}$		2.7~3.6	—	± 10.0	μA		
Power Off Leakage Current	I_{OFF}	$V_{IN}, V_{OUT} = 0\text{--}3.6\text{ V}$		0	—	10.0	μA		
Quiescent Supply Current		I_{CC}	$V_{IN} = V_{CC}$ or GND	2.7~3.6	—	20.0	μA		
$V_{CC} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$			$V_{CC} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$	2.7~3.6	—	± 20.0			
Increase In I_{CC} Per Input	ΔI_{CC}	$V_{IH} = V_{CC} - 0.6\text{ V}$		2.7~3.6	—	750	μA		

DC characteristics ($T_a = -40\sim85^\circ\text{C}$, $2.3\text{ V} \leq V_{CC} \leq 2.7\text{ V}$ Range)

PARAMETER		SYMBOL	TEST CONDITION		V_{CC} (V)	MIN	MAX	UNIT
Input Voltage	"H" Level							
	"L" Level	V_{IL}			2.3~2.7	—	0.7	
Output Voltage	"H" Level	V_{OH}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -100\text{ }\mu\text{A}$	2.3~2.7	$V_{CC} - 0.2$	—	V
				$I_{OH} = -4\text{ mA}$	2.3	2.0	—	
				$I_{OH} = -6\text{ mA}$	2.3	1.8	—	
				$I_{OH} = -8\text{ mA}$	2.3	1.7	—	
	"L" Level	V_{OL}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 100\text{ }\mu\text{A}$	2.3~2.7	—	0.2	
				$I_{OL} = 6\text{ mA}$	2.3	—	0.4	
				$I_{OL} = 8\text{ mA}$	2.3	—	0.6	
				$V_{IN} = 0\sim3.6\text{ V}$	2.3~2.7	—	± 5.0	μA
Input Leakage Current	I_{IN}				2.3~2.7	—	± 5.0	μA
3-State Output Off-State Current	I_{OZ}		$V_{IN} = V_{IH}$ or V_{IL}		2.3~2.7	—	± 10.0	μA
Power Off Leakage Current	I_{OFF}		$V_{IN}, V_{OUT} = 0\sim3.6\text{ V}$		0	—	10.0	μA
Quiescent Supply Current	I_{CC}		$V_{IN} = V_{CC}$ or GND		2.3~2.7	—	20.0	μA
			$V_{CC} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$		2.3~2.7	—	± 20.0	

ELECTRICAL CHARACTERISTICS

DC characteristics ($T_a = -40\sim85^\circ\text{C}$, $1.8\text{ V} \leq V_{CC} < 2.3\text{ V}$ Range)

PARAMETER		SYMBOL	TEST CONDITION		V_{CC} (V)	MIN	MAX	UNIT
Input Voltage	"H" Level		V_{IH}			1.8~2.3	$0.7 \times V_{CC}$	—
	"L" Level	V_{IL}			1.8~2.3	—	$0.2 \times V_{CC}$	
Output Voltage	"H" Level	V_{OH}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -100\text{ }\mu\text{A}$	1.8	$V_{CC} - 0.2$	—	V
				$I_{OH} = -4\text{ mA}$	1.8	1.4	—	
	"L" Level	V_{OL}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 100\text{ }\mu\text{A}$	1.8	—	0.2	
				$I_{OL} = 4\text{ mA}$	1.8	—	0.3	
Input Leakage Current	I_{IN}		$V_{IN} = 0\sim3.6\text{ V}$		1.8	—	± 5.0	μA
3-State Output Off-State Current	I_{OZ}		$V_{IN} = V_{IH}$ or V_{IL}		1.8	—	± 10.0	μA
Power Off Leakage Current	I_{OFF}		$V_{IN}, V_{OUT} = 0\sim3.6\text{ V}$		0	—	10.0	μA
Quiescent Supply Current	I_{CC}		$V_{IN} = V_{CC}$ or GND		1.8	—	20.0	μA
			$V_{CC} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$		1.8	—	± 20.0	

AC characteristics ($T_a = -40\sim85^\circ C$, Input $t_r = t_f = 2.0 \text{ ns}$, $C_L = 30 \text{ pF}$, $R_L = 500 \Omega$)

PARAMETER	SYMBOL	TEST CONDITION	$V_{CC} (\text{V})$	MIN	MAX	UNIT
			1.8			
Propagation Delay Time	t_{pLH} t_{pHL}	(Fig.1, 2)	2.5 ± 0.2	1.0	4.1	ns
			3.3 ± 0.3	0.8	3.4	
			1.8	1.5	9.8	
3-State Output Enable Time	t_{pZL} t_{pZH}	(Fig.1, 3)	2.5 ± 0.2	1.0	5.9	ns
			3.3 ± 0.3	0.8	4.3	
			1.8	1.5	8.8	
3-State Output Disable Time	t_{pLZ} t_{pHZ}	(Fig.1, 3)	2.5 ± 0.2	1.0	4.9	ns
			3.3 ± 0.3	0.8	4.3	
			1.8	—	0.5	
Output To Output Skew	t_{osLH} t_{osHL}	(Note 11)	2.5 ± 0.2	—	0.5	ns
			3.3 ± 0.3	—	0.5	

For $C_L = 50 \text{ pF}$, add approximately 300 ps to the AC maximum specification.

(Note 11) : Parameter guaranteed by design.

$$(t_{osLH} = |t_{pLHm} - t_{pLHn}|, t_{osHL} = |t_{pHLm} - t_{pHLn}|)$$

Dynamic switching characteristics ($T_a = 25^\circ C$, Input $t_r = t_f = 2.0 \text{ ns}$, $C_L = 30 \text{ pF}$)

PARAMETER	SYMBOL	TEST CONDITION	$V_{CC} (\text{V})$	TYP.	UNIT
			1.8		
Quiet Output Maximum Dynamic V_{OL}	V_{OLP}	$V_{IH} = 1.8 \text{ V}, V_{IL} = 0 \text{ V}$ (Note 12)	1.8	0.15	V
		$V_{IH} = 2.5 \text{ V}, V_{IL} = 0 \text{ V}$ (Note 12)	2.5	0.25	
		$V_{IH} = 3.3 \text{ V}, V_{IL} = 0 \text{ V}$ (Note 12)	3.3	0.35	
Quiet Output Minimum Dynamic V_{OL}	V_{OLV}	$V_{IH} = 1.8 \text{ V}, V_{IL} = 0 \text{ V}$ (Note 12)	1.8	-0.15	V
		$V_{IH} = 2.5 \text{ V}, V_{IL} = 0 \text{ V}$ (Note 12)	2.5	-0.25	
		$V_{IH} = 3.3 \text{ V}, V_{IL} = 0 \text{ V}$ (Note 12)	3.3	-0.35	
Quiet Output Minimum Dynamic V_{OH}	V_{OHV}	$V_{IH} = 1.8 \text{ V}, V_{IL} = 0 \text{ V}$ (Note 12)	1.8	1.55	V
		$V_{IH} = 2.5 \text{ V}, V_{IL} = 0 \text{ V}$ (Note 12)	2.5	2.05	
		$V_{IH} = 3.3 \text{ V}, V_{IL} = 0 \text{ V}$ (Note 12)	3.3	2.65	

(Note 12) : Parameter guaranteed by design.

Capacitive characteristics ($T_a = 25^\circ C$)

PARAMETER	SYMBOL	TEST CONDITION	$V_{CC} (\text{V})$	TYP.	UNIT
			1.8, 2.5, 3.3		
Input Capacitance	C_{IN}		1.8, 2.5, 3.3	6	pF
Output Capacitance	C_{OUT}		1.8, 2.5, 3.3	7	pF
Power Dissipation Capacitance	C_{PD}	$f_{IN} = 10 \text{ MHz}$ (Note 13)	1.8, 2.5, 3.3	20	pF

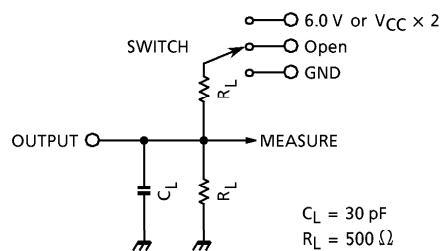
(Note 13) : C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation :

$$I_{CC (\text{opr.})} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC} / 20 \text{ (Per bit)}$$

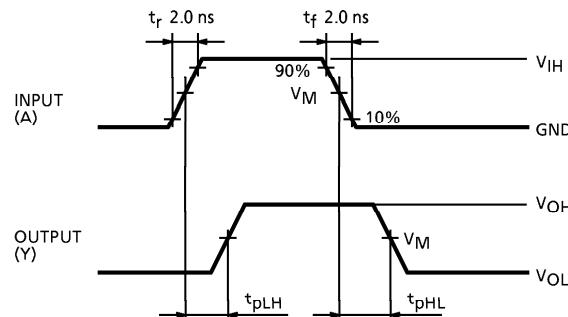
TEST CIRCUIT

Fig.1

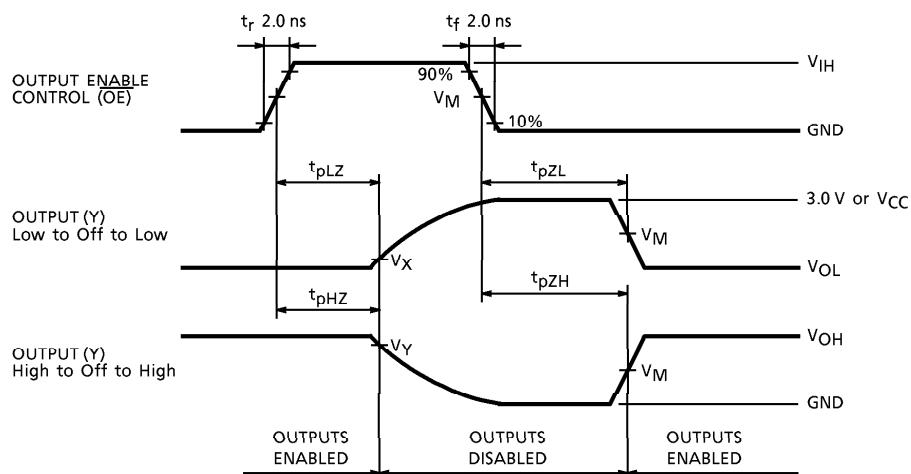


PARAMETER	SWITCH
t_{pLH}, t_{pHL}	Open
t_{pLZ}, t_{pZL}	6.0 V @ $V_{CC} = 3.3 \pm 0.3 \text{ V}$ $V_{CC} \times 2$ @ $V_{CC} = 2.5 \pm 0.2 \text{ V}$ @ $V_{CC} = 1.8 \text{ V}$
t_{pHZ}, t_{pZH}	GND

AC WAVEFORM

Fig.2 t_{pLH}, t_{pHL} 

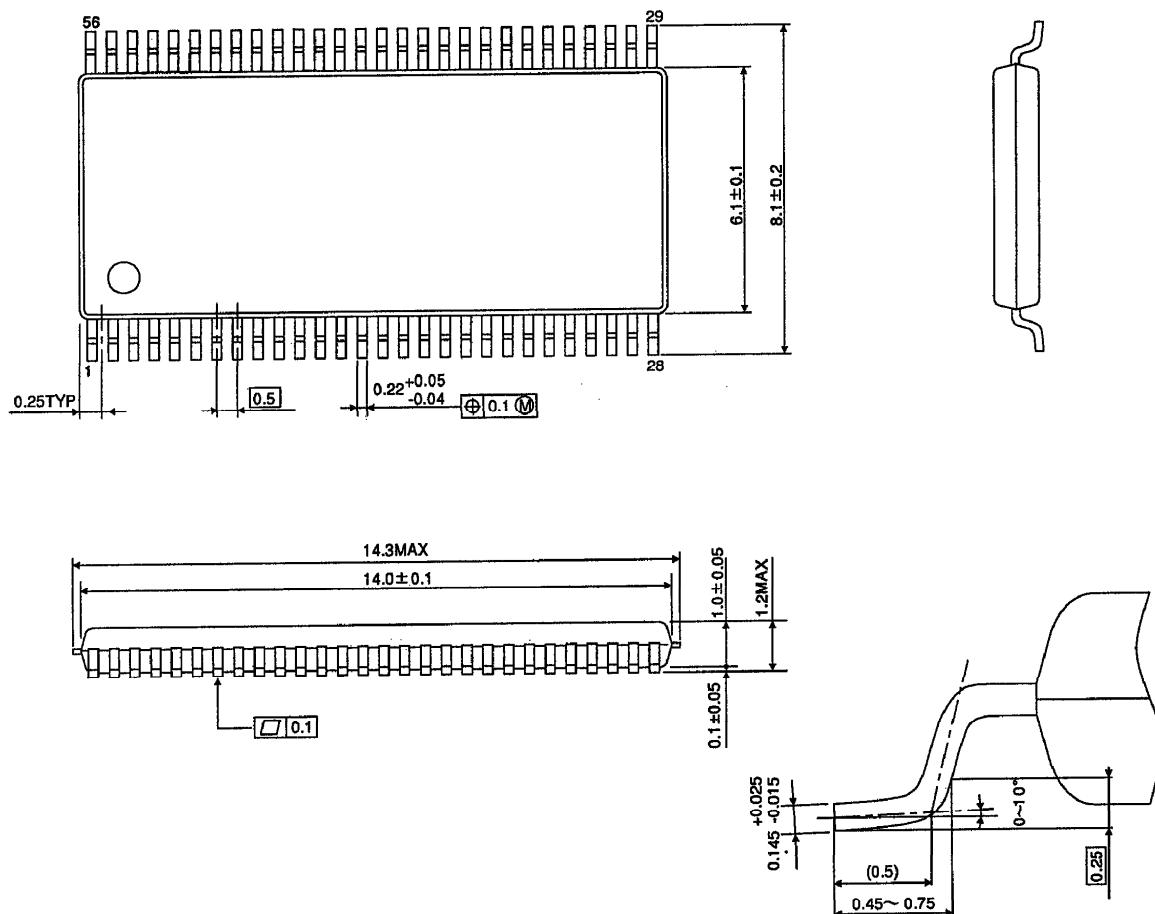
SYMBOL	V_{CC}		
	$3.3 \pm 0.3 \text{ V}$	$2.5 \pm 0.2 \text{ V}$	1.8 V
V_{IH}	2.7 V	V_{CC}	V_{CC}
V_M	1.5 V	$V_{CC}/2$	$V_{CC}/2$
V_X	$V_{OL} + 0.3 \text{ V}$	$V_{OL} + 0.15 \text{ V}$	$V_{OL} + 0.15 \text{ V}$
V_Y	$V_{OH} - 0.3 \text{ V}$	$V_{OH} - 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$

Fig.3 $t_{pLZ}, t_{pHZ}, t_{pZL}, t_{pZH}$ 

OUTLINE DRAWING

TSSOP56-P-0061-0.50

Unit : mm



Weight : 0.25 g (Typ.)