

TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

**TC74VCX162841FT****LOW-VOLTAGE 20-BIT D-TYPE LATCH  
WITH 3.6 V TOLERANT INPUTS AND OUTPUTS**

The TC74VCX162841FT is a high performance CMOS 20-bit D-TYPE LATCH. 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 TC74VCX162841FT can be used as two 10-bit latches or one 20-bit latch. The 20 latches are transparent D-type latches. The device has noninverting data (D) inputs and provides true data at its outputs. While the latch-enable (1LE or 2LE) input is high, the Q outputs of the corresponding 10-bit latch follow the D inputs. When LE is taken low, the Q outputs are latched at the levels set up at the D inputs.

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  $26\text{-}\Omega$  series resistor helps reducing output overshoot and undershoot without external resistor. All inputs are equipped with protection circuits against static discharge.

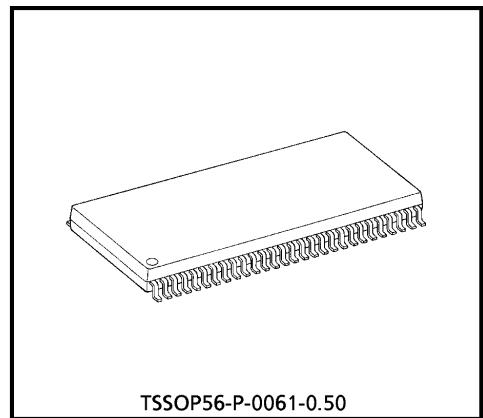
**FEATURES**

- 26- $\Omega$  Series Resistors on Outputs.
- Low Voltage Operation :  $V_{CC} = 1.8\sim 3.6\text{ V}$
- High Speed Operation :  $t_{pd} = 3.9\text{ ns (max)} \text{ at } V_{CC} = 3.0\sim 3.6\text{ V}$   
                                  :  $t_{pd} = 4.8\text{ ns (max)} \text{ at } V_{CC} = 2.3\sim 2.7\text{ V}$   
                                  :  $t_{pd} = 9.6\text{ ns (max)} \text{ at } V_{CC} = 1.8\text{ V}$
- 3.6 V Tolerant inputs and outputs.
- Output Current :  $I_{OH}/I_{OL} = \pm 12\text{ mA (min)} \text{ at } V_{CC} = 3.0\text{ V}$   
                                  :  $I_{OH}/I_{OL} = \pm 8\text{ mA (min)} \text{ at } V_{CC} = 2.3\text{ V}$   
                                  :  $I_{OH}/I_{OL} = \pm 4\text{ mA (min)} \text{ at } V_{CC} = 1.8\text{ V}$
- 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.

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- 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.



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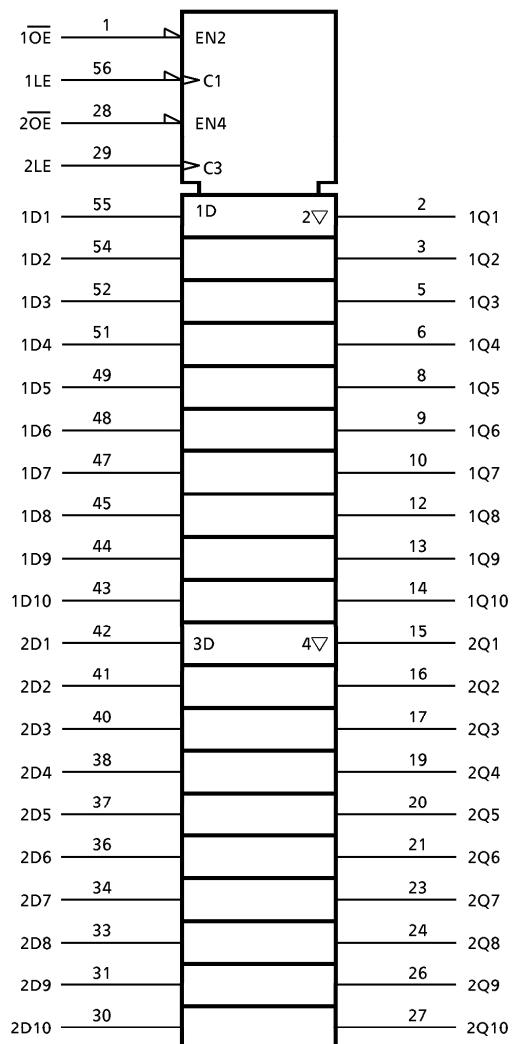
Weight : 0.25 g (Typ.)

## PIN ASSIGNMENT

1 $\overline{OE}$	1	56 1LE
1Q1	2	55 1D1
1Q2	3	54 1D2
GND	4	53 GND
1Q3	5	52 1D3
1Q4	6	51 1D4
VCC	7	50 VCC
1Q5	8	49 1D5
1Q6	9	48 1D6
1Q7	10	47 1D7
GND	11	46 GND
1Q8	12	45 1D8
1Q9	13	44 1D9
1Q10	14	43 1D10
2Q1	15	42 2D1
2Q2	16	41 2D2
2Q3	17	40 2D3
GND	18	39 GND
2Q4	19	38 2D4
2Q5	20	37 2D5
2Q6	21	36 2D6
VCC	22	35 VCC
2Q7	23	34 2D7
2Q8	24	33 2D8
GND	25	32 GND
2Q9	26	31 2D9
2Q10	27	30 2D10
2 $\overline{OE}$	28	29 2LE

(TOP VIEW)

## SYMBOL



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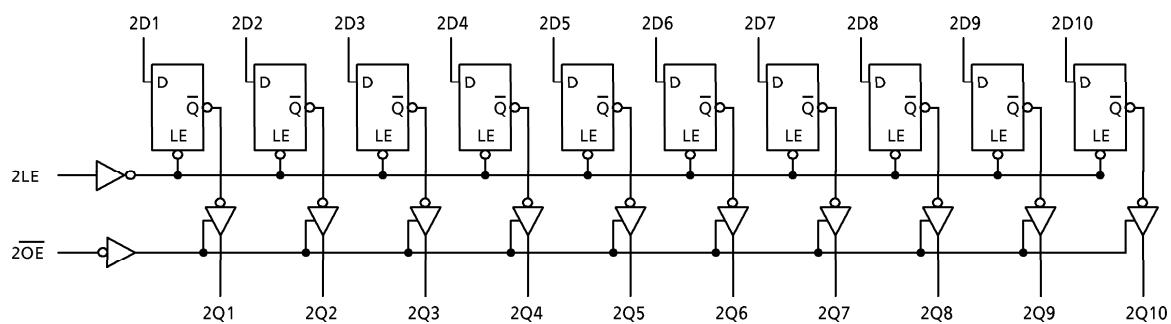
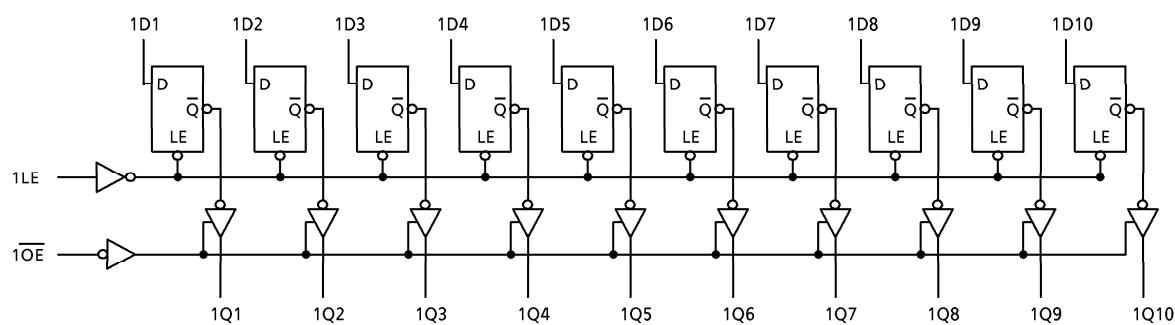
**FUNCTION TABLE** (each 10-bit latch)

INPUT			OUTPUT Q
$\overline{OE}$	LE	D	
L	H	H	H
L	H	L	L
L	L	X	Qn
H	X	X	Z

X : Don't care

Z : High impedance

Qn : No change

**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	$I_{OK}$	$\pm$ 50 (Note 3)	mA
DC Output Current	$I_{OUT}$	$\pm$ 50	mA
Power Dissipation	$P_D$	400	mW
DC $V_{CC}$ / Ground Current Per Supply Pin	$I_{CC}/I_{GND}$	$\pm$ 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	$I_{OH}/I_{OL}$	$\pm$ 12 (Note 7)	mA
		$\pm$ 8 (Note 8)	
		$\pm$ 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 CHARACTERISTICS**DC characteristics ( $T_a = -40\sim85^\circ C$ ,  $2.7 V < V_{CC} \leq 3.6 V$ )

PARAMETER		SYMBOL	TEST CONDITION		$V_{CC}$ (V)	MIN	MAX	UNIT			
Input Voltage	"H" Level	$V_{IH}$				2.7~3.6	2.0	—	V		
	"L" Level	$V_{IL}$			$V_{IN} = V_{IH}$ or $V_{IL}$	2.7~3.6	—	0.8	V		
Output Voltage	"H" Level	$V_{OH}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OH} = -100 \mu A$		2.7~3.6	$V_{CC} - 0.2$	—	V		
				$I_{OH} = -6 mA$		2.7	2.2	—			
				$I_{OH} = -8 mA$		3.0	2.4	—			
				$I_{OH} = -12 mA$		3.0	2.2	—			
	"L" Level	$V_{OL}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 100 \mu A$		2.7~3.6	—	0.2	V		
				$I_{OL} = 6 mA$		2.7	—	0.4			
				$I_{OL} = 8 mA$		3.0	—	0.55			
				$I_{OL} = 12 mA$		3.0	—	0.8			
Input Leakage Current	$I_{IN}$	$V_{IN} = 0\sim3.6 V$		2.7~3.6		—	$\pm 5.0$	$\mu A$			
3-State Output Off-State Current	$I_{OZ}$	$V_{IN} = V_{IH}$ or $V_{IL}$		2.7~3.6		—	$\pm 10.0$	$\mu A$			
Power Off Leakage Current	$I_{OFF}$	$V_{IN}, V_{OUT} = 0\sim3.6 V$		0		—	10.0	$\mu A$			
Quiescent Supply Current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND		2.7~3.6		—	20.0	$\mu A$			
		$V_{CC} \leq (V_{IN}, V_{OUT}) \leq 3.6 V$		2.7~3.6		—	$\pm 20.0$				
Increase In $I_{CC}$ Per Input	$\Delta I_{CC}$	$V_{IH} = V_{CC} - 0.6 V$		2.7~3.6		—	750	$\mu A$			

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

PARAMETER		SYMBOL	TEST CONDITION		$V_{CC}$ (V)	MIN	MAX	UNIT			
Input Voltage	"H" Level	$V_{IH}$				2.3~2.7	1.6	—	V		
	"L" Level	$V_{IL}$			$V_{IN} = V_{IH}$ or $V_{IL}$	2.3~2.7	—	0.7	V		
Output Voltage	"H" Level	$V_{OH}$	$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OH} = -100 \mu A$		2.3~2.7	$V_{CC} - 0.2$	—	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 $V_{IL}$	$I_{OL} = 100 \mu A$		2.3~2.7	—	0.2	V		
				$I_{OL} = 6 mA$		2.3	—	0.4			
				$I_{OL} = 8 mA$		2.3	—	0.6			
Input Leakage Current	$I_{IN}$	$V_{IN} = 0\sim3.6 V$		2.3~2.7		—	$\pm 5.0$	$\mu A$			
3-State Output Off-State Current	$I_{OZ}$	$V_{IN} = V_{IH}$ or $V_{IL}$		2.3~2.7		—	$\pm 10.0$	$\mu A$			
Power Off Leakage Current	$I_{OFF}$	$V_{IN}, V_{OUT} = 0\sim3.6 V$		0		—	10.0	$\mu A$			
Quiescent Supply Current	$I_{CC}$	$V_{IN} = V_{CC}$ or GND		2.3~2.7		—	20.0	$\mu A$			
		$V_{CC} \leq (V_{IN}, V_{OUT}) \leq 3.6 V$		2.3~2.7		—	$\pm 20.0$				

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

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

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	1.5	9.6	
Propagation Delay Time (D-Q)	$t_{pLH}$ $t_{pHL}$	(Fig.1, 2)	2.5 $\pm$ 0.2	0.8	4.8	ns
			3.3 $\pm$ 0.3	0.6	3.9	
			1.8	1.5	9.8	
Propagation Delay Time (LE-Q)	$t_{pLH}$ $t_{pHL}$	(Fig.1, 2)	2.5 $\pm$ 0.2	0.8	5.8	ns
			3.3 $\pm$ 0.3	0.6	4.4	
			1.8	1.5	9.8	
3-State Output Enable Time	$t_{pZL}$ $t_{pZH}$	(Fig.1, 3)	2.5 $\pm$ 0.2	0.8	5.9	ns
			3.3 $\pm$ 0.3	0.6	4.3	
			1.8	1.5	8.8	
3-State Output Disable Time	$t_{pLZ}$ $t_{pHZ}$	(Fig.1, 3)	2.5 $\pm$ 0.2	0.8	4.9	ns
			3.3 $\pm$ 0.3	0.6	4.3	
			1.8	4.0	—	
Minimum Pulse Width (LE)	$t_w (\text{H})$	(Fig.1, 2)	2.5 $\pm$ 0.2	1.5	—	ns
			3.3 $\pm$ 0.3	1.5	—	
			1.8	2.5	—	
Minimum Set-up Time	$t_s$	(Fig.1, 2)	2.5 $\pm$ 0.2	1.5	—	ns
			3.3 $\pm$ 0.3	1.5	—	
			1.8	1.0	—	
Minimum Hold Time	$t_h$	(Fig.1, 2)	2.5 $\pm$ 0.2	1.0	—	ns
			3.3 $\pm$ 0.3	1.0	—	
			1.8	—	0.5	
Output to Output Skew	$t_{osLH}$ $t_{osHL}$	(Note 11)	2.5 $\pm$ 0.2	—	0.5	ns
			3.3 $\pm$ 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 ( $T_a = 25^\circ\text{C}$ , Input  $t_r = t_f = 2.0 \text{ ns}$ ,  $C_L = 30 \text{ pF}$ )

PARAMETER	SYMBOL	TEST CONDITION	$V_{CC} (\text{V})$	TYP.	UNIT
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 ( $T_a = 25^\circ\text{C}$ )

PARAMETER	SYMBOL	TEST CONDITION	$V_{CC} (\text{V})$	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	$C_{PD}$	$f_{IN} = 10 \text{ MHz}$ (Note 13)	1.8, 2.5, 3.3	20	pF

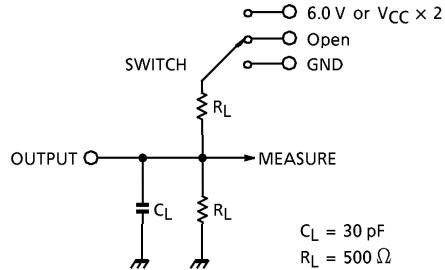
(Note 13) :  $C_{PD}$  is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

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

## AC WAVEFORM

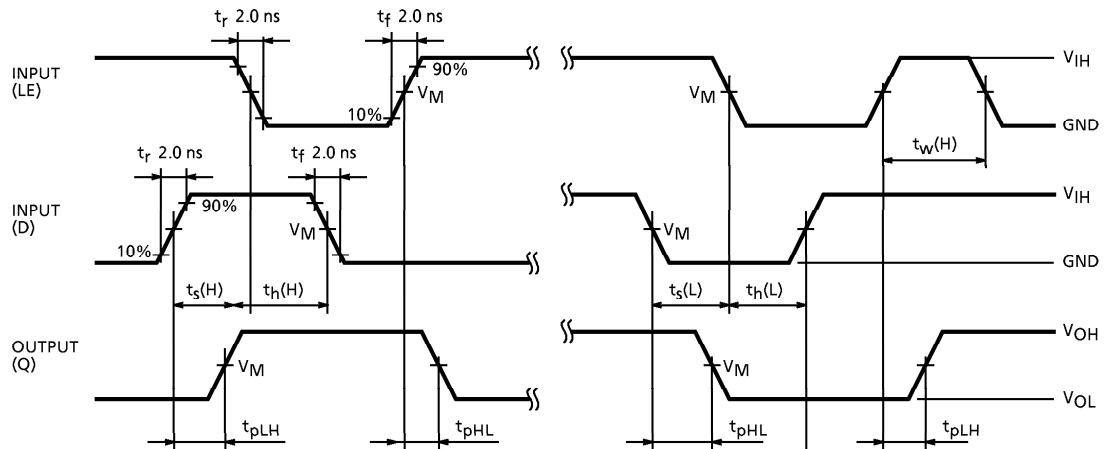
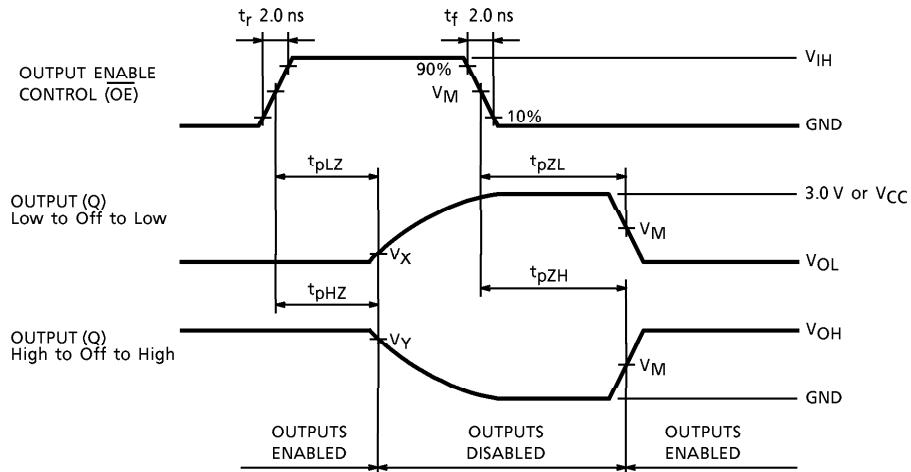
Fig.2  $t_{pLH}, t_{pHL}, t_w, t_s, t_h$ 

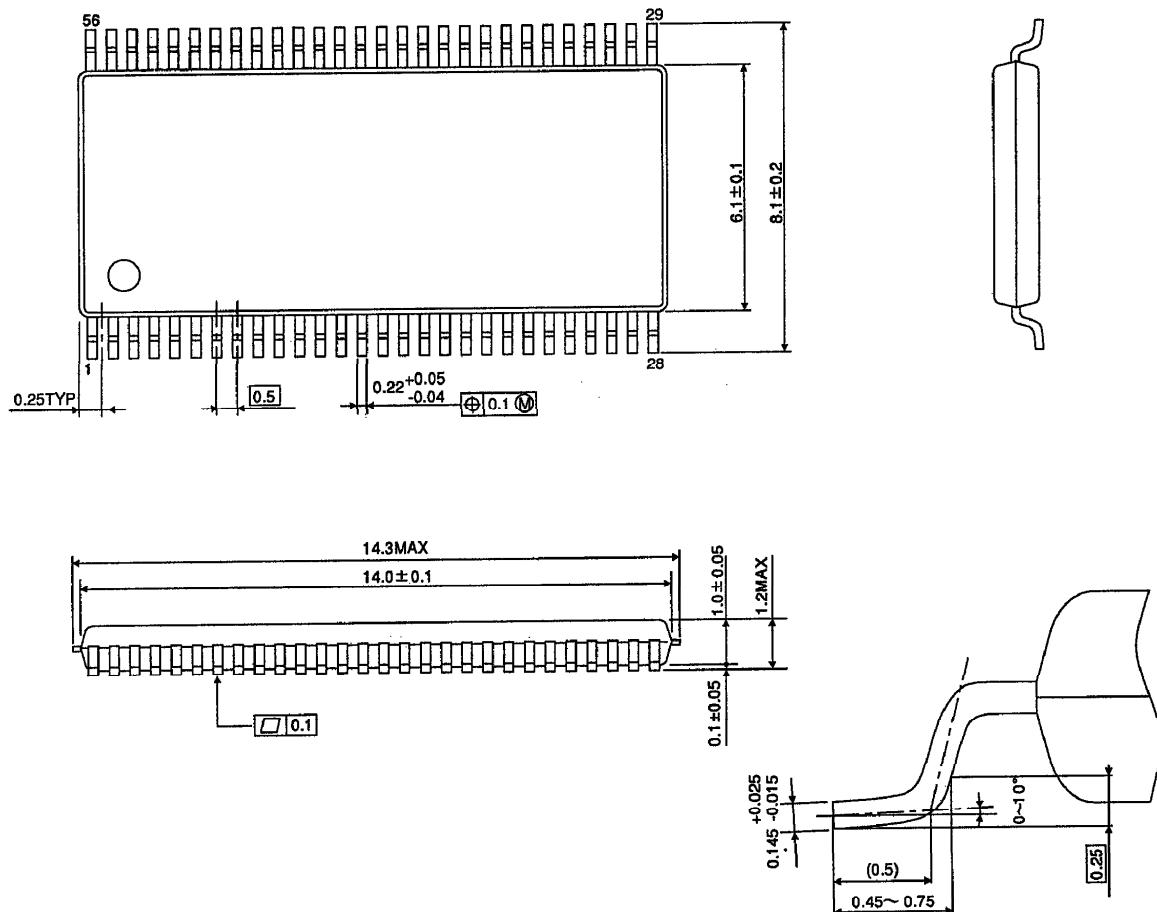
Fig.3  $t_{PLZ}$ ,  $t_{PHZ}$ ,  $t_{PZL}$ ,  $t_{PZH}$ 

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

## OUTLINE DRAWING

TSSOP56-P-0061-0.50

Unit : mm



Weight : 0.25 g (Typ.)