

TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

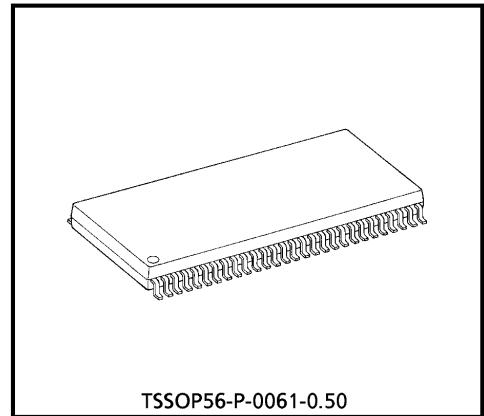
TC74VCX16841FT**LOW-VOLTAGE 20-BIT D-TYPE LATCH
WITH 3.6 V TOLERANT INPUTS AND OUTPUTS**

The TC74VCX16841FT 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 TC74VCX16841FT 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.

All inputs are equipped with protection circuits against static discharge.



TSSOP56-P-0061-0.50

Weight : 0.25 g (Typ.)

FEATURES

- Low Voltage Operation : $V_{CC} = 1.8\sim 3.6$ V
- High Speed Operation : $t_{pd} = 3.0$ ns (max) at $V_{CC} = 3.0\sim 3.6$ V
 : $t_{pd} = 3.4$ ns (max) at $V_{CC} = 2.3\sim 2.7$ V
 : $t_{pd} = 6.8$ ns (max) at $V_{CC} = 1.8$ V
- 3.6 V Tolerant inputs and outputs.
- Output Current : $I_{OH}/I_{OL} = \pm 24$ mA (min) at $V_{CC} = 3.0$ V
 : $I_{OH}/I_{OL} = \pm 18$ mA (min) at $V_{CC} = 2.3$ V
 : $I_{OH}/I_{OL} = \pm 6$ mA (min) at $V_{CC} = 1.8$ V
- Latch-up Performance : ± 300 mA
- ESD Performance : Human Body Model $> \pm 2000$ V
 : Machine Model $> \pm 200$ 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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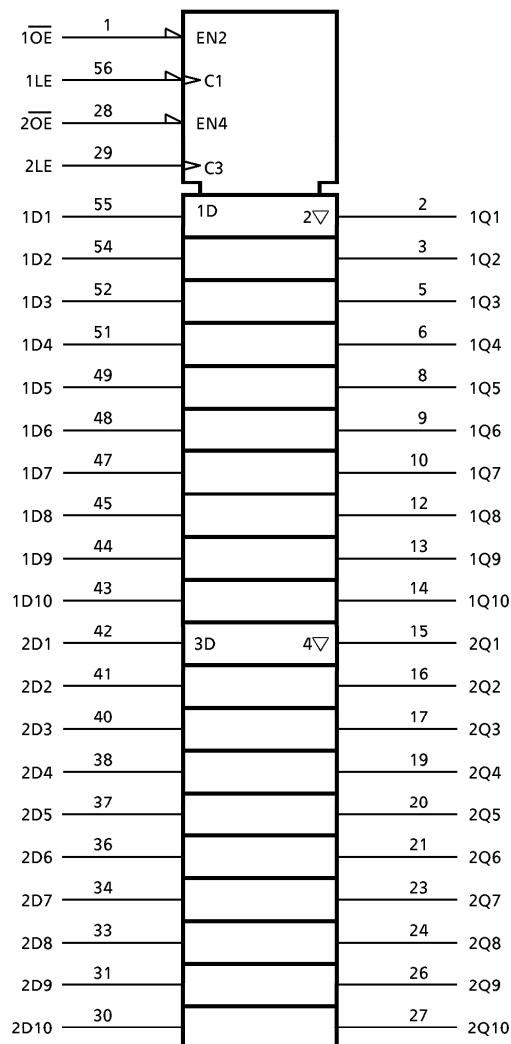
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PIN ASSIGNMENT

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



980910EBA2'

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FUNCTION TABLE (each 10-bit latch)

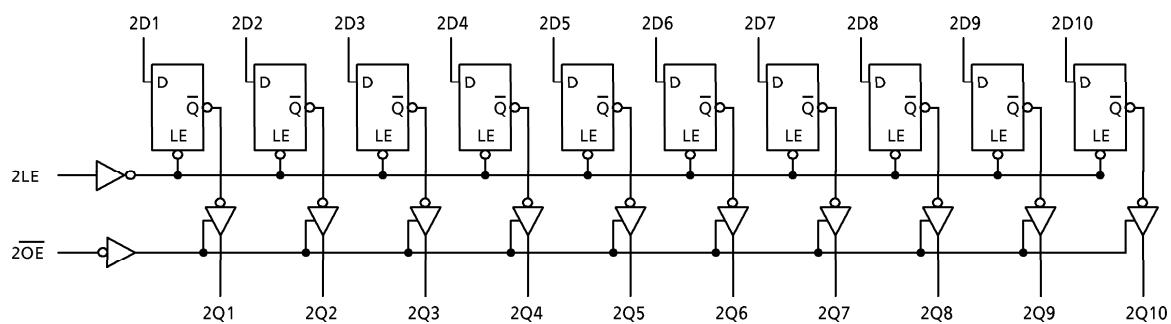
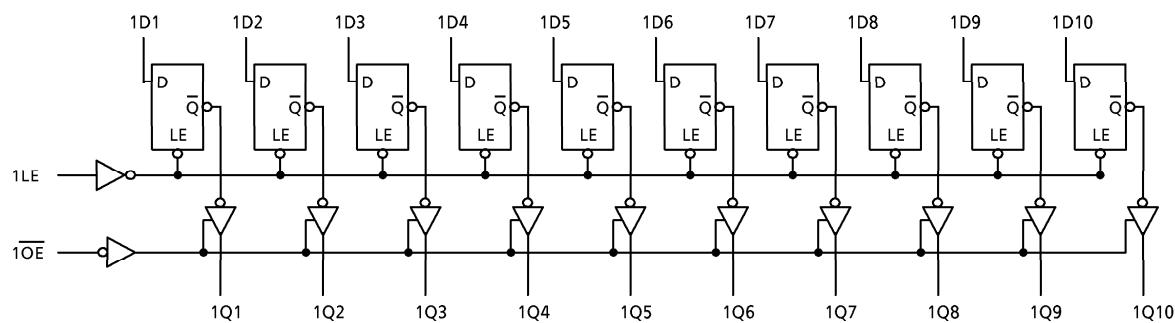
INPUT			OUTPUT Q
\overline{OE}	LE	D	
L	H	H	H
L	H	L	L
L	L	X	Qn
H	X	X	Z

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 24 (Note 7)	mA
		\pm 18 (Note 8)	
		\pm 6 (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 ($T_a = -40\sim85^\circ C$, $2.7 V < V_{CC} \leq 3.6 V$)

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}			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	
				$I_{OH} = -12 mA$	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}	$I_{OL} = 100 \mu A$	2.7~3.6	—	0.2	V	
				$I_{OL} = 12 mA$	2.7	—	0.4		
				$I_{OL} = 18 mA$	3.0	—	0.4		
				$I_{OL} = 24 mA$	3.0	—	0.55		
Input Leakage Current	I_{IN}	$V_{IN} = 0\sim3.6 V$		2.7~3.6	—	± 5.0	μA		
3-State Output Off-State Current	I_{OZ}	$V_{IN} = V_{IH}$ or V_{IL}		$V_{OUT} = 0\sim3.6 V$	2.7~3.6	—	± 10.0	μA	
Power Off Leakage Current	I_{OFF}	$V_{IN}, V_{OUT} = 0\sim3.6 V$		0	—	10.0	μA		
Quiescent Supply Current	I_{CC}	$V_{IN} = V_{CC}$ or GND		2.7~3.6	—	20.0	μA		
Increase In I_{CC} Per Input	ΔI_{CC}	$V_{IH} = V_{CC} - 0.6 V$		2.7~3.6	—	750		μA	

ELECTRICAL CHARACTERISTICSDC 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}			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	
				$I_{OH} = -6 mA$	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}	$I_{OL} = 100 \mu A$	2.3~2.7	—	0.2	V	
				$I_{OL} = 12 mA$	2.3	—	0.4		
				$I_{OL} = 18 mA$	2.3	—	0.6		
Input Leakage Current	I_{IN}	$V_{IN} = 0\sim3.6 V$		2.3~2.7	—	± 5.0	μA		
3-State Output Off-State Current	I_{OZ}	$V_{IN} = V_{IH}$ or V_{IL}		$V_{OUT} = 0\sim3.6 V$	2.3~2.7	—	± 10.0	μA	
Power Off Leakage Current	I_{OFF}	$V_{IN}, V_{OUT} = 0\sim3.6 V$		0	—	10.0	μA		
Quiescent Supply Current	I_{CC}	$V_{IN} = V_{CC}$ or GND		2.3~2.7	—	20.0	μA		
		$V_{CC} \leq (V_{IN}, V_{OUT}) \leq 3.6 V_{CC}$		2.3~2.7	—	± 20.0			

ELECTRICAL CHARACTERISTICSDC 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	
				$I_{OH} = -6 mA$	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	
				$I_{OL} = 6 mA$	1.8	—	0.3		
Input Leakage Current	I_{IN}	$V_{IN} = 0\sim3.6 V$		1.8	—	± 5.0	μA		
3-State Output Off-State Current	I_{OZ}	$V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = 0\sim3.6 V$		1.8	—	± 10.0	μA		
Power Off Leakage Current	I_{OFF}	$V_{IN}, V_{OUT} = 0\sim3.6 V$		0	—	10.0	μA		
Quiescent Supply Current	I_{CC}	$V_{IN} = V_{CC}$ or GND		1.8	—	20.0	μA		
		$V_{CC} \leq (V_{IN}, V_{OUT}) \leq 3.6 V$		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	1.5	6.8	
Propagation Delay Time (D-Q)	t_{pLH} t_{pHL}	(Fig.1, 2)	2.5 \pm 0.2	1.0	3.4	MHz
			3.3 \pm 0.3	0.8	3.0	
			1.8	1.5	8.8	
Propagation Delay Time (LE-Q)	t_{pLH} t_{pHL}	(Fig.1, 2)	2.5 \pm 0.2	1.0	4.4	ns
			3.3 \pm 0.3	0.8	3.5	
			1.8	1.5	9.8	
3-State Output Enable Time	t_{pZL} t_{pZH}	(Fig.1, 3)	2.5 \pm 0.2	1.0	4.9	ns
			3.3 \pm 0.3	0.8	3.8	
			1.8	1.5	7.6	
3-State Output Disable Time	t_{pLZ} t_{pHZ}	(Fig.1, 3)	2.5 \pm 0.2	1.0	4.2	ns
			3.3 \pm 0.3	0.8	3.7	
			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	0.25	V
		$V_{IH} = 2.5 \text{ V}, V_{IL} = 0 \text{ V}$ (Note 12)	2.5	0.6	
		$V_{IH} = 3.3 \text{ V}, V_{IL} = 0 \text{ V}$ (Note 12)	3.3	0.8	
Quiet Output Minimum Dynamic V_{OL}	V_{OLV}	$V_{IH} = 1.8 \text{ V}, V_{IL} = 0 \text{ V}$ (Note 12)	1.8	-0.25	V
		$V_{IH} = 2.5 \text{ V}, V_{IL} = 0 \text{ V}$ (Note 12)	2.5	-0.6	
		$V_{IH} = 3.3 \text{ V}, V_{IL} = 0 \text{ V}$ (Note 12)	3.3	-0.8	
Quiet Output Minimum Dynamic V_{OH}	V_{OHV}	$V_{IH} = 1.8 \text{ V}, V_{IL} = 0 \text{ V}$ (Note 12)	1.8	1.5	V
		$V_{IH} = 2.5 \text{ V}, V_{IL} = 0 \text{ V}$ (Note 12)	2.5	1.9	
		$V_{IH} = 3.3 \text{ V}, V_{IL} = 0 \text{ V}$ (Note 12)	3.3	2.2	

(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

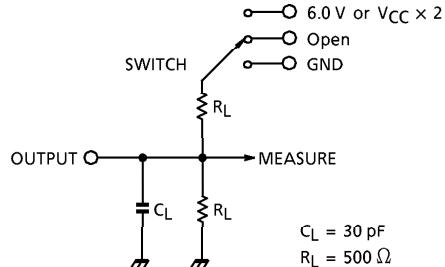
(Note 13) : C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

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

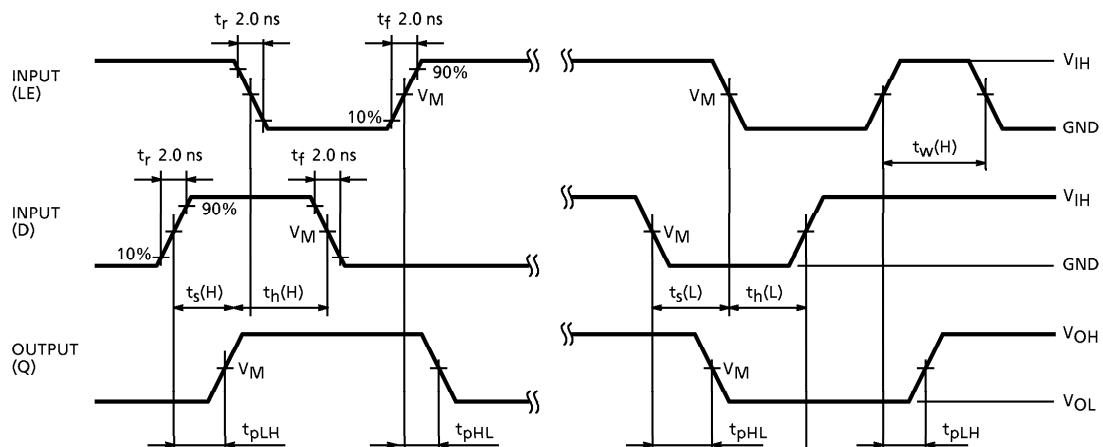
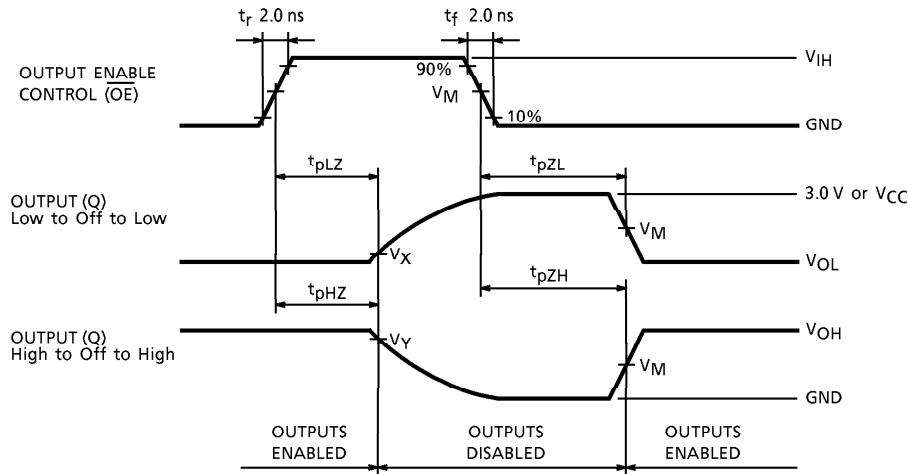
Fig.2 $t_{pLH}, t_{pHL}, t_w, t_s, t_h$ 

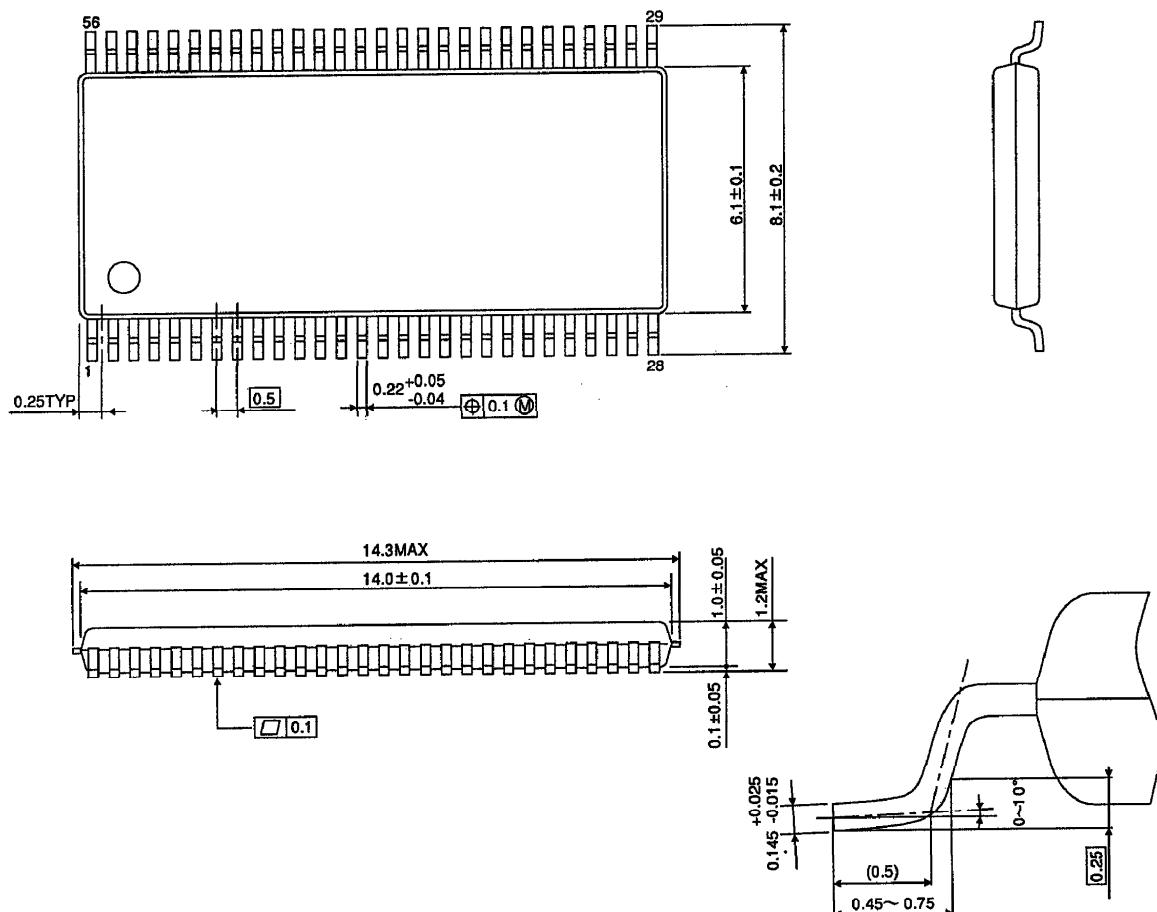
Fig.3 t_{PLZ} , t_{PHZ} , t_{PZL} , t_{PZH} 

SYMBOL	V_{CC}		
	$3.3 \pm 0.3 \text{ V}$	$2.5 \pm 0.2 \text{ V}$	1.8 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	$V_{OH} - 0.3 \text{ V}$	$V_{OH} - 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$

OUTLINE DRAWING

TSSOP56-P-0061-0.50

Unit : mm



Weight : 0.25 g (Typ.)