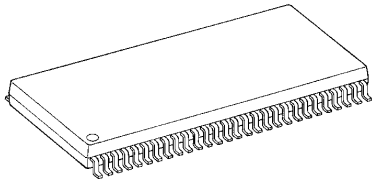
TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

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.



TSSOP56-P-0061-0.50

Weight : 0.25 g (Typ.)

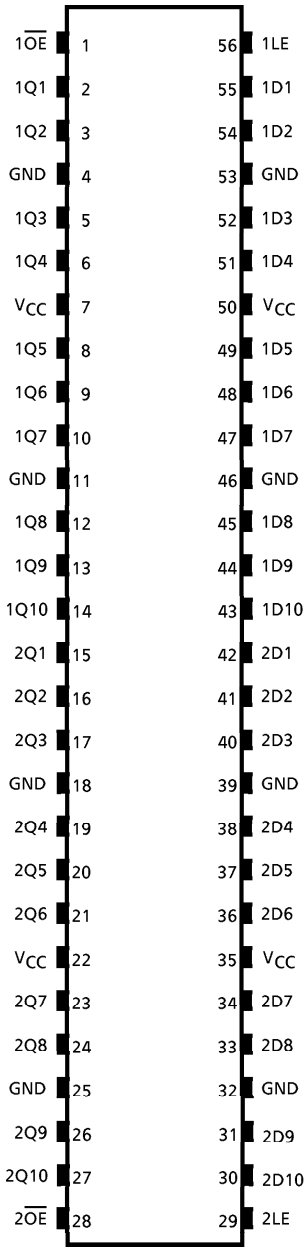
When the $\overline{OE}$ input is high, the outputs are in a high impedance state. This device is designed to be used with 3 – state memory address drivers, etc.
All inputs are equipped with protection circuits against static discharge.

FEATURES

- Low Voltage Operation : V_{CC} = 1.8~3.6 V
- High Speed Operation : t_{pd} = 3.0 ns (max) at V_{CC} = 3.0~3.6 V
  : t_{pd} = 3.4 ns (max) at V_{CC} = 2.3~2.7 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} = ±24 mA (min) at V_{CC} = 3.0 V
  : I_{OH} / I_{OL} = ±18 mA (min) at V_{CC} = 2.3 V
  : I_{OH} / I_{OL} = ±6 mA (min) at V_{CC} = 1.8 V
- Latch-up Performance : ±300 mA
- ESD Performance : Human Body Model > ±2000 V
  : Machine Model > ±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)

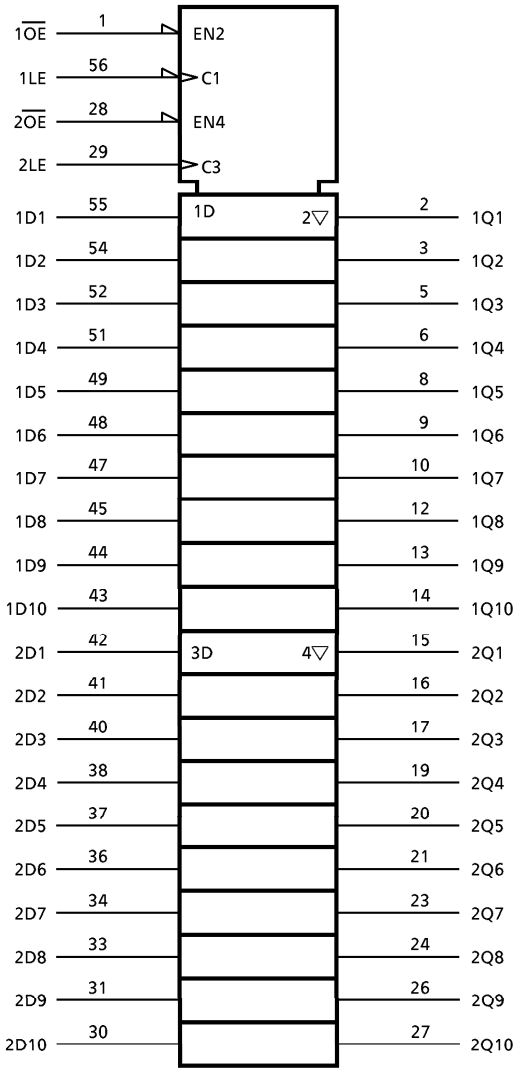
(Note 1) : To ensure the high-impedance state during power up or power down, $\overline{OE}$ should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.

PIN ASSIGNMENT



(TOP VIEW)

SYMBOL



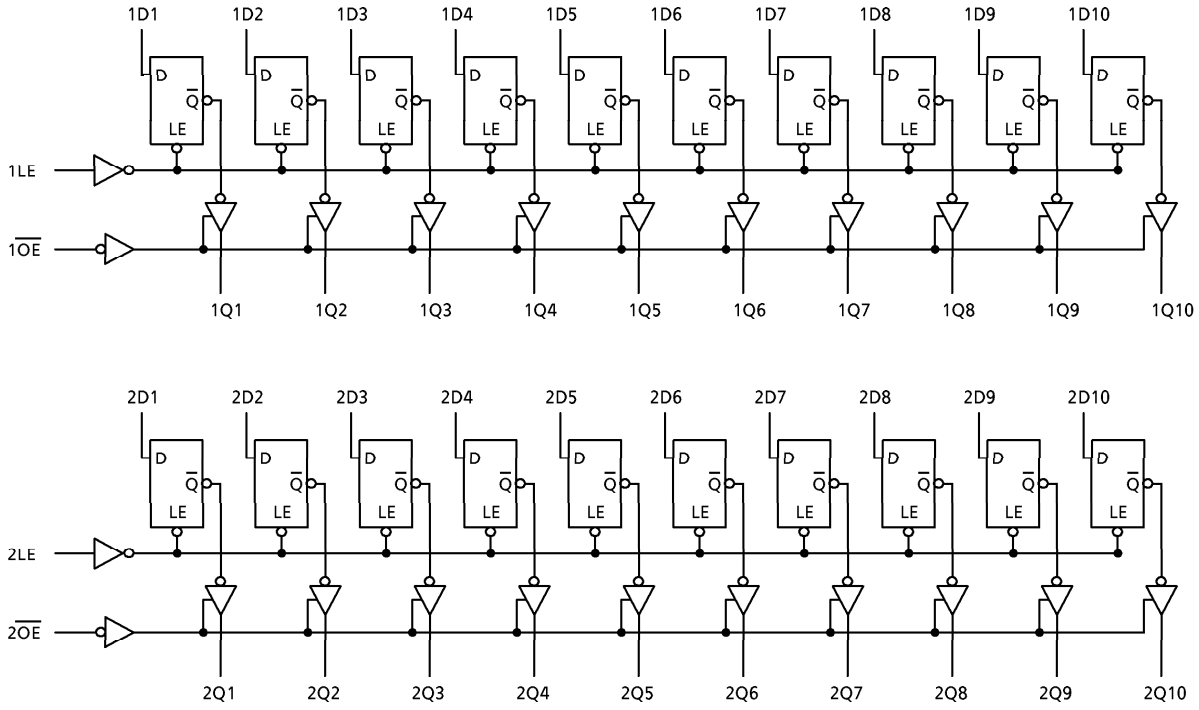
980910EBA2'

FUNCTION TABLE (each 10-bit latch)

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

X : Don't care
Z : High impedance
Qn : Q outputs are latched at the time when the LE input is taken to a low logic level.

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}	±24 (Note 7)	mA
		±18 (Note 8)	
		±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} = 3.0~3.6 V
(Note 8) : V_{CC} = 2.3~2.7 V
(Note 9) : V_{CC} = 1.8 V
(Note 10) : V_{IN} = 0.8~2.0 V, V_{CC} = 3.0 V

ELECTRICAL CHARACTERISTICS

DC characteristics (Ta = −40~85°C, 2.7 V < V_{CC} ≦ 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 μA	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 μA	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} = 0~3.6 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} = 0~3.6 V		2.7~3.6	—	±10.0	μA
Power Off Leakage Current		I_{OFF}	V_{IN}, V_{OUT} = 0~3.6 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} ≦ (V_{IN}, V_{OUT}) ≦ 3.6 V		2.7~3.6	—	±20.0	
Increase In I_{CC} Per Input		ΔI_{CC}	V_{IH} = V_{CC} − 0.6 V		2.7~3.6	—	750	μA

ELECTRICAL CHARACTERISTICS

DC characteristics (Ta = −40~85°C, 2.3 V ≦ V_{CC} ≦ 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 μA	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 μA	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} = 0~3.6 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} = 0~3.6 V		2.3~2.7	—	±10.0	μA
Power Off Leakage Current		I_{OFF}	V_{IN}, V_{OUT} = 0~3.6 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} ≦ (V_{IN}, V_{OUT}) ≦ 3.6 V		2.3~2.7	—	±20.0	

ELECTRICAL CHARACTERISTICS

DC characteristics (Ta = −40~85°C, 1.8 V ≦ 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 × V_{CC}	—	V
	"L" Level	V_{IL}			1.8~2.3	—	0.2 × 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} = −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	V
				I_{OL} = 6 mA	1.8	—	0.3	
Input Leakage Current		I_{IN}	V_{IN} = 0~3.6 V		1.8	—	±5.0	μA
3-State Output Off-State Current		I_{OZ}	V_{IN} = V_{IH} or V_{IL} V_{OUT} = 0~3.6 V		1.8	—	±10.0	μA
Power Off Leakage Current		I_{OFF}	V_{IN}, V_{OUT} = 0~3.6 V		0	—	10.0	μA
Quiescent Supply Current		I_{CC}	V_{IN} = V_{CC} or GND		1.8	—	20.0	μA
			V_{CC} ≦ (V_{IN}, V_{OUT}) ≦ 3.6 V		1.8	—	±20.0	

AC characteristics (Ta = −40~85°C, Input $t_r = t_f$ = 2.0 ns, C_L = 30 pF, R_L = 500 Ω)

PARAMETER	SYMBOL	TEST CONDITION	V_{CC} (V)	MIN	MAX	UNIT
Propagation Delay Time (D-Q)	t_{pLH} t_{pHL}	(Fig.1, 2)	1.8	1.5	6.8	ns
			2.5 ± 0.2	1.0	3.4	
			3.3 ± 0.3	0.8	3.0	
Propagation Delay Time (LE-Q)	t_{pLH} t_{pHL}	(Fig.1, 2)	1.8	1.5	8.8	ns
			2.5 ± 0.2	1.0	4.4	
			3.3 ± 0.3	0.8	3.5	
3-State Output Enable Time	t_{pZL} t_{pZH}	(Fig.1, 3)	1.8	1.5	9.8	ns
			2.5 ± 0.2	1.0	4.9	
			3.3 ± 0.3	0.8	3.8	
3-State Output Disable Time	t_{pLZ} t_{pHZ}	(Fig.1, 3)	1.8	1.5	7.6	ns
			2.5 ± 0.2	1.0	4.2	
			3.3 ± 0.3	0.8	3.7	
Minimum Pulse Width (LE)	t_w (H)	(Fig.1, 2)	1.8	4.0	—	ns
			2.5 ± 0.2	1.5	—	
			3.3 ± 0.3	1.5	—	
Minimum Set-up Time	t_s	(Fig.1, 2)	1.8	2.5	—	ns
			2.5 ± 0.2	1.5	—	
			3.3 ± 0.3	1.5	—	
Minimum Hold Time	t_h	(Fig.1, 2)	1.8	1.0	—	ns
			2.5 ± 0.2	1.0	—	
			3.3 ± 0.3	1.0	—	
Output to Output Skew	t_{osLH} t_{osHL}	(Note 11)	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 11) : 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)

PARAMETER	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 12)	1.8	0.25	V
		V_{IH} = 2.5 V, V_{IL} = 0 V (Note 12)	2.5	0.6	
		V_{IH} = 3.3 V, V_{IL} = 0 V (Note 12)	3.3	0.8	
Quiet Output Minimum Dynamic V_{OL}	V_{OLV}	V_{IH} = 1.8 V, V_{IL} = 0 V (Note 12)	1.8	−0.25	V
		V_{IH} = 2.5 V, V_{IL} = 0 V (Note 12)	2.5	−0.6	
		V_{IH} = 3.3 V, V_{IL} = 0 V (Note 12)	3.3	−0.8	
Quiet Output Minimum Dynamic V_{OH}	V_{OHV}	V_{IH} = 1.8 V, V_{IL} = 0 V (Note 12)	1.8	1.5	V
		V_{IH} = 2.5 V, V_{IL} = 0 V (Note 12)	2.5	1.9	
		V_{IH} = 3.3 V, V_{IL} = 0 V (Note 12)	3.3	2.2	

(Note 12) : Parameter guaranteed by design.

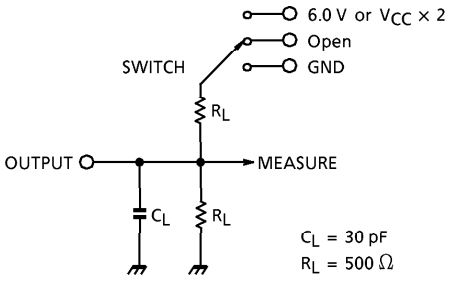
Capacitive characteristics (Ta = 25°C)

PARAMETER	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 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 :

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

TEST CIRCUIT
Fig.1



PARAMETER	SWITCH
t_{pLH}, t_{pHL}	Open
t_{pLZ}, t_{pZL}	6.0 V @V_{CC} = 3.3 ± 0.3 V V_{CC} × 2 @V_{CC} = 2.5 ± 0.2 V @V_{CC} = 1.8 V
t_{pHZ}, t_{pZH}	GND

AC WAVEFORM
Fig.2 t_{pLH}, t_{pHL}, t_W, t_s, t_h

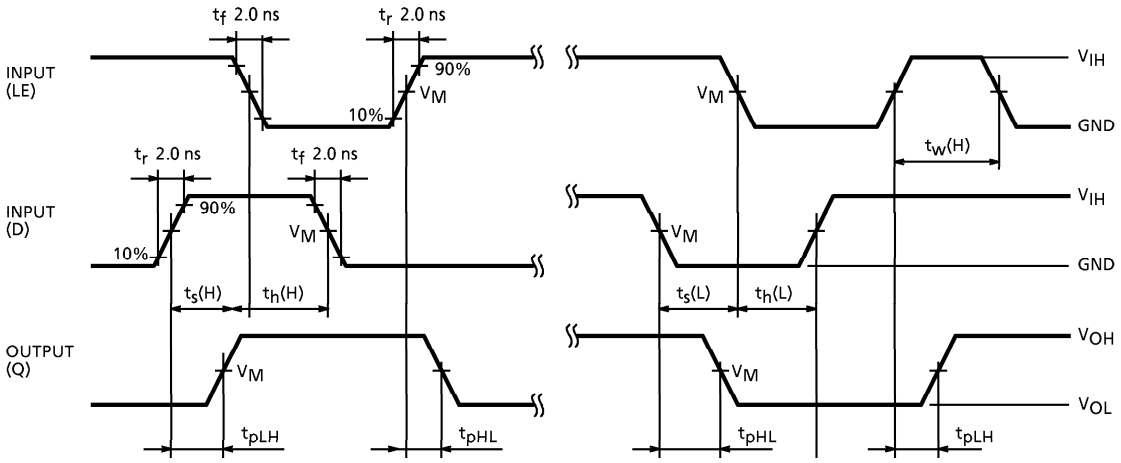
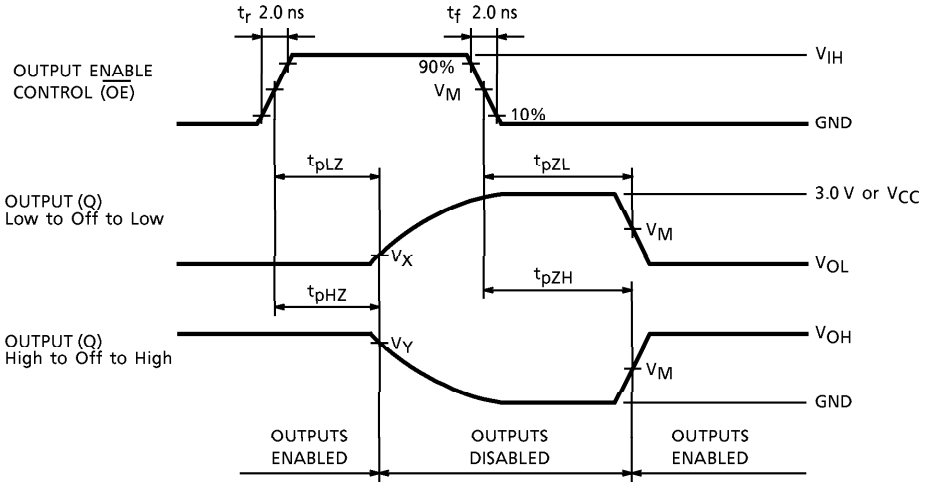


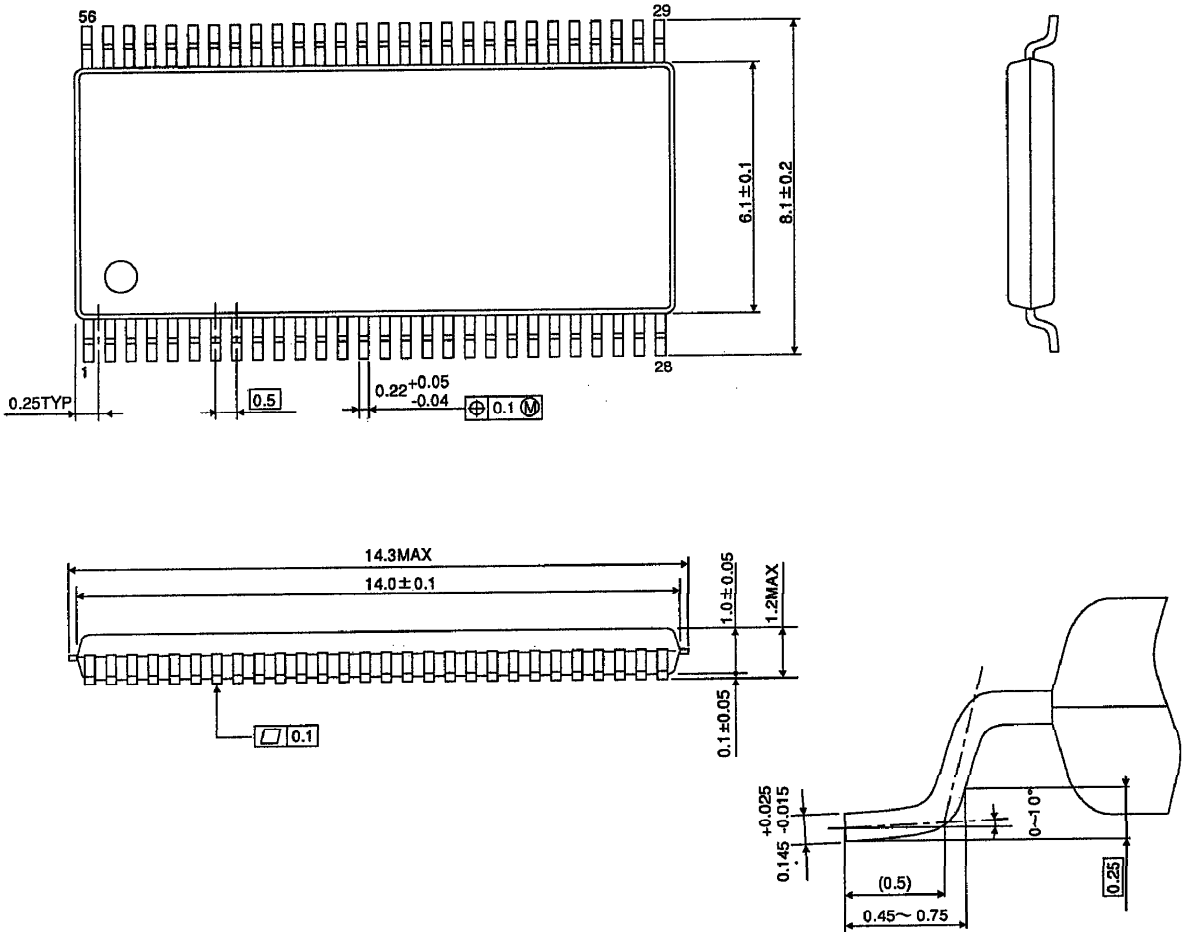
Fig.3 t_{pLZ}, t_{pHZ}, t_{pZL}, t_{pZH}



SYMBOL	V_{CC}		
	3.3 ± 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

TSSOP56-P-0061-0.50 Unit : mm



Weight : 0.25 g (Typ.)