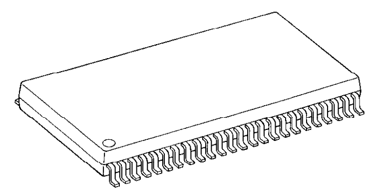
TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC74VCX162373FT

LOW-VOLTAGE 16-BIT D-TYPE LATCH WITH 3.6V TOLERANT INPUTS AND OUTPUTS

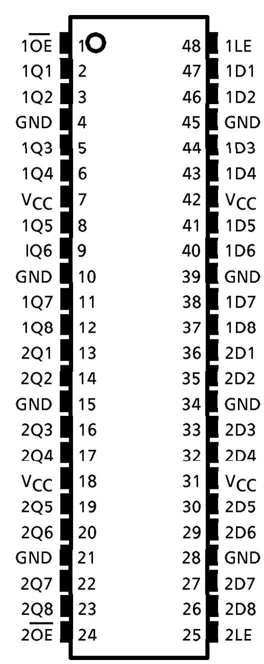
The TC74VCX162373FT is a high performance CMOS 16-bit D-TYPE LATCH. Designed for use in 1.8, 2.5 or 3.3 Volt systems, it achieves high speed operation while maintaining the CMOS low power dissipation.
It is also designed with over voltage tolerant inputs and outputs up to 3.6V.
This 16-bit D-type latch is controlled by a latch enable input (LE) and a output enable input ($\overline{OE}$) which are common to each byte. It can be used as two 8-bit latches or one 16-bit latch. When the $\overline{OE}$ input is high, the outputs are in a high impedance state.
The 26-Ω series resistor helps reducing output overshoot and undershoot without external resistor.
All inputs are equipped with protection circuits against static discharge.



TSSOP48-P-0061-0.50

Weight : 0.25g (Typ.)

PIN CONNECTION



(TOP VIEW)

FEATURES

- 26-Ω Series Resistors on Outputs.
- LowVoltage Operation : V_{CC} = 1.8~3.6V
- High Speed Operation : t_{pd} = 3.3ns (max.) at V_{CC} = 3.0~3.6V
  : t_{pd} = 4.5ns (max.) at V_{CC} = 2.3~2.7V
  : t_{pd} = 6.0ns (max.) at V_{CC} = 1.8V
- 3.6V Tolerant inputs and outputs.
- Output Current : I_{OH} / I_{OL} = ± 12mA (min.) at V_{CC} = 3.0V
  : I_{OH} / I_{OL} = ± 8mA (min.) at V_{CC} = 2.3V
  : I_{OH} / I_{OL} = ± 4mA (min.) at V_{CC} = 1.8V
- Latch-up Performance : ± 300mA
- ESD Parformance : Human Body Model > ± 2000V
  : Machine Model > 200V
- Package : TSSOP
  (Thin Shrink Small Outline Package)
- Power Down Protection is provided on all inputs and outputs.

961001EBA2

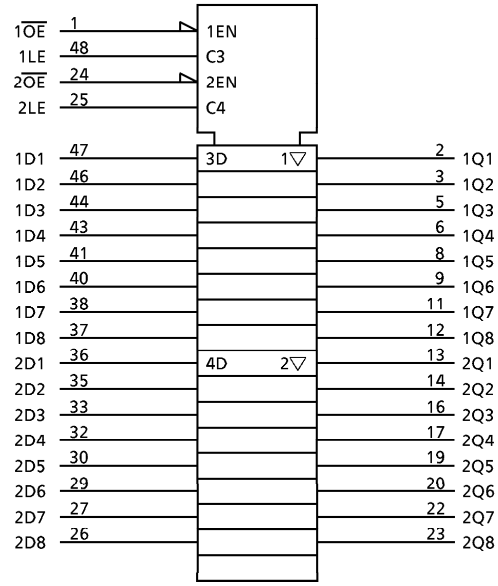
TRUTH TABLE

INPUT			OUTPUT
1$\overline{OE}$	1LE	1D1-1D8	1Q1-1Q8
H	X	X	Z
L	L	X	Qn
L	H	L	L
L	H	H	H

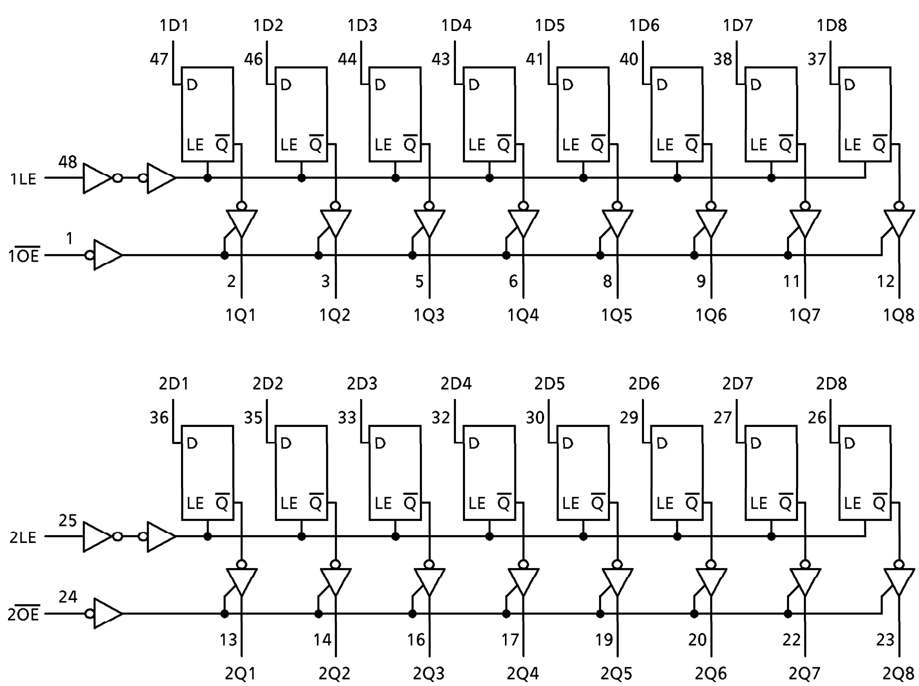
INPUT			OUTPUT
2$\overline{OE}$	2LE	2D1-2D8	2Q1-2Q8
H	X	X	Z
L	L	X	Qn
L	H	L	L
L	H	H	H

X : Don't Care
Z : High impedance
Qn : No change

IEC LOGIC SYMBOL



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} = 3.0~3.6V
(Note 8) V_{CC} = 2.3~2.7V
(Note 9) V_{CC} = 1.8V
(Note 10) V_{IN} = 0.8~2.0V, V_{CC} = 3.0V

ELECTRICAL CHARACTERISTICS

DC characteristics (Ta = −40~85°C, 2.7V < V_{CC} ≦ 3.6V)

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} = −100μA	2.7~3.6	V_{CC} −0.2	—	V
				I_{OH} = −6mA	2.7	2.2	—	
				I_{OH} = −8mA	3.0	2.4	—	
				I_{OH} = −12mA	3.0	2.2	—	
	"L" Level	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 100μA	2.7~3.6	—	0.2	V
				I_{OL} = 6mA	2.7	—	0.4	
				I_{OL} = 8mA	3.0	—	0.55	
				I_{OL} = 12mA	3.0	—	0.8	
Input Leakage Current		I_{IN}	V_{IN} = 0~3.6V		2.7~3.6	—	±5.0	μA
3-State Output Off-State Current		I_{OZ}	V_{IN} = V_{IH} or V_{IL} V_{OUT} = 0~3.6V		2.7~3.6	—	±10.0	μA
Power Off Leakage Current		I_{OFF}	V_{IN}, V_{OUT} = 0~3.6V		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}) ≦ 3.6V		2.7~3.6	—	±20.0	
Increase In I_{CC} Per Input		ΔI_{CC}	V_{IH} = V_{CC} − 0.6V		2.7~3.6	—	750	μA

ELECTRICAL CHARACTERISTICS

DC characteristics (Ta = −40~85°C, 2.3V ≦ V_{CC} ≦ 2.7V)

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} = −100μA	2.3~2.7	V_{CC} −0.2	—	V
				I_{OH} = −4mA	2.3	2.0	—	
				I_{OH} = −6mA	2.3	1.8	—	
				I_{OH} = −8mA	2.3	1.7	—	
	"L" Level	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 100μA	2.3~2.7	—	0.2	V
				I_{OL} = 6mA	2.3	—	0.4	
				I_{OL} = 8mA	2.3	—	0.6	
Input Leakage Current		I_{IN}	V_{IN} = 0~3.6V		2.3~2.7	—	±5.0	μA
3-State Output Off-State Current		I_{OZ}	V_{IN} = V_{IH} or V_{IL} V_{OUT} = 0~3.6V		2.3~2.7	—	±10.0	μA
Power Off Leakage Current		I_{OFF}	V_{IN}, V_{OUT} = 0~3.6V		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}) ≦ 3.6V_{CC}		2.3~2.7	—	±20.0	

ELECTRICAL CHARACTERISTICS

DC characteristics (Ta = −40~85°C, 1.8V ≦ V_{CC} < 2.3V)

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} = −100μA	1.8	V_{CC} −0.2	—	V
				I_{OH} = −4mA	1.8	1.4	—	
	"L" Level	V_{OL}	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 100μA	1.8	—	0.2	V
				I_{OL} = 4mA	1.8	—	0.3	
Input Leakage Current		I_{IN}	V_{IN} = 0~3.6V		1.8	—	±5.0	μA
3-State Output Off-State Current		I_{OZ}	V_{IN} = V_{IH} or V_{IL} V_{OUT} = 0~3.6V		1.8	—	±10.0	μA
Power Off Leakage Current		I_{OFF}	V_{IN}, V_{OUT} = 0~3.6V		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}) ≦ 3.6V		1.8	—	±20.0	

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

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	5.8	ns
			2.5 ± 0.2	1.0	4.5	
			3.3 ± 0.3	0.8	3.3	
Propagation Delay Time (LE-Q)	t_{pLH} t_{pHL}	(Fig.1, 2)	1.8	1.5	6.2	ns
			2.5 ± 0.2	1.0	4.9	
			3.3 ± 0.3	0.8	3.6	
3-State Output Enable Time	t_{pZL} t_{pZH}	(Fig.1, 3)	1.8	1.5	7.6	ns
			2.5 ± 0.2	1.0	5.4	
			3.3 ± 0.3	0.8	3.9	
3-State Output Disable Time	t_{pLZ} t_{pHZ}	(Fig.1, 3)	1.8	1.5	5.3	ns
			2.5 ± 0.2	1.0	4.4	
			3.3 ± 0.3	0.8	4.0	
Minimum Pulse Width (LE)	t_W (H)	(Fig.1, 2)	1.8	2.5	—	ns
			2.5 ± 0.2	1.5	—	
			3.3 ± 0.3	1.5	—	
Minimum Set-up Time	t_s	(Fig.1, 2)	1.8	1.0	—	ns
			2.5 ± 0.2	1.0	—	
			3.3 ± 0.3	1.0	—	
Minimum Hold Time	t_h	(Fig.1, 2)	1.8	3.0	—	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 $C_L = 50pF$, add approximately 300ps 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 $t_r = t_f = 2.0ns$, $C_L = 30pF$)

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

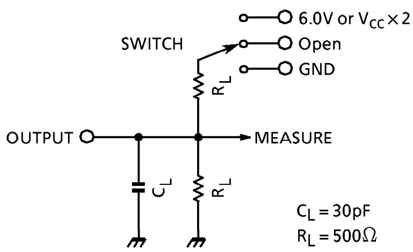
(Note 12) Parameter guaranteed by design.

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}	$f_{IN} = 10MHz$ (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 :
$I_{CC(opr.)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC} / 16$ (per bit)

Fig.1 Test circuit



PARAMETER	SWITCH
t_{pLH}, t_{pHL}	Open
t_{pLZ}, t_{pZL}	6.0V @V_{CC} = 3.3 ± 0.3V V_{CC}x2 @V_{CC} = 2.5 ± 0.2V @V_{CC} = 1.8V
t_{pHZ}, t_{pZH}	GND

AC WAVEFORM

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

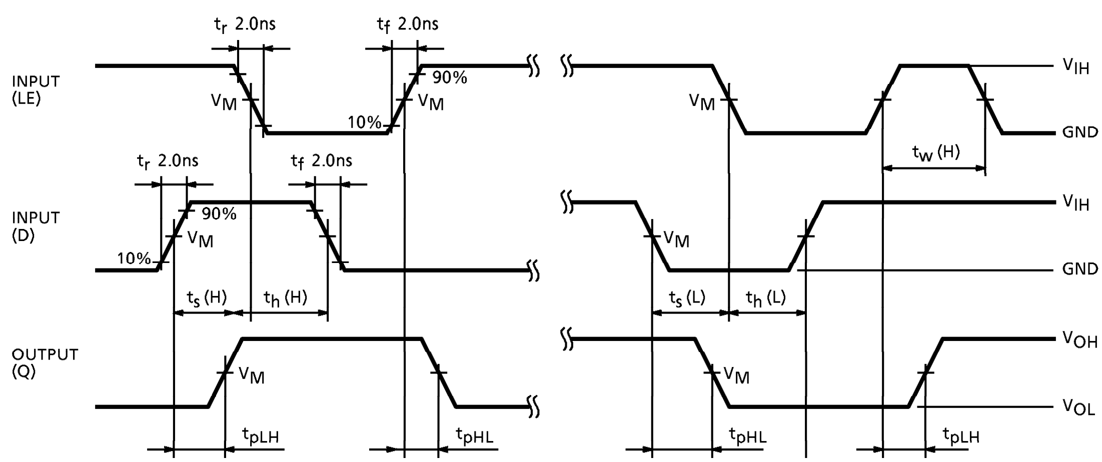
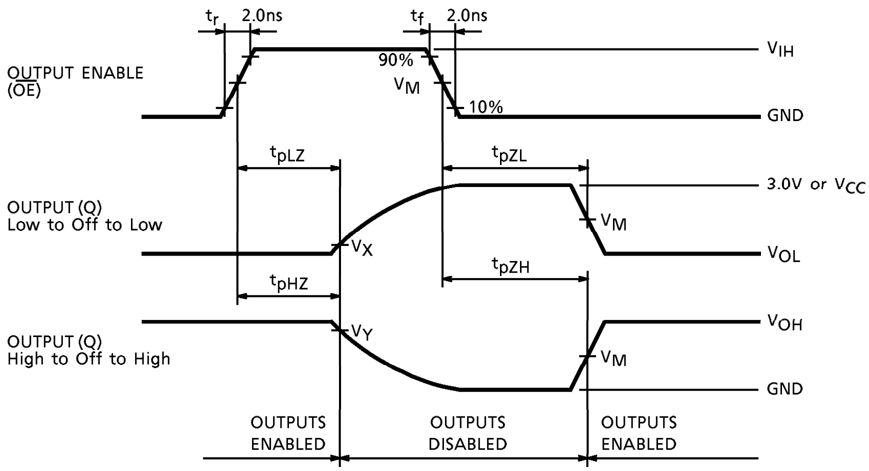


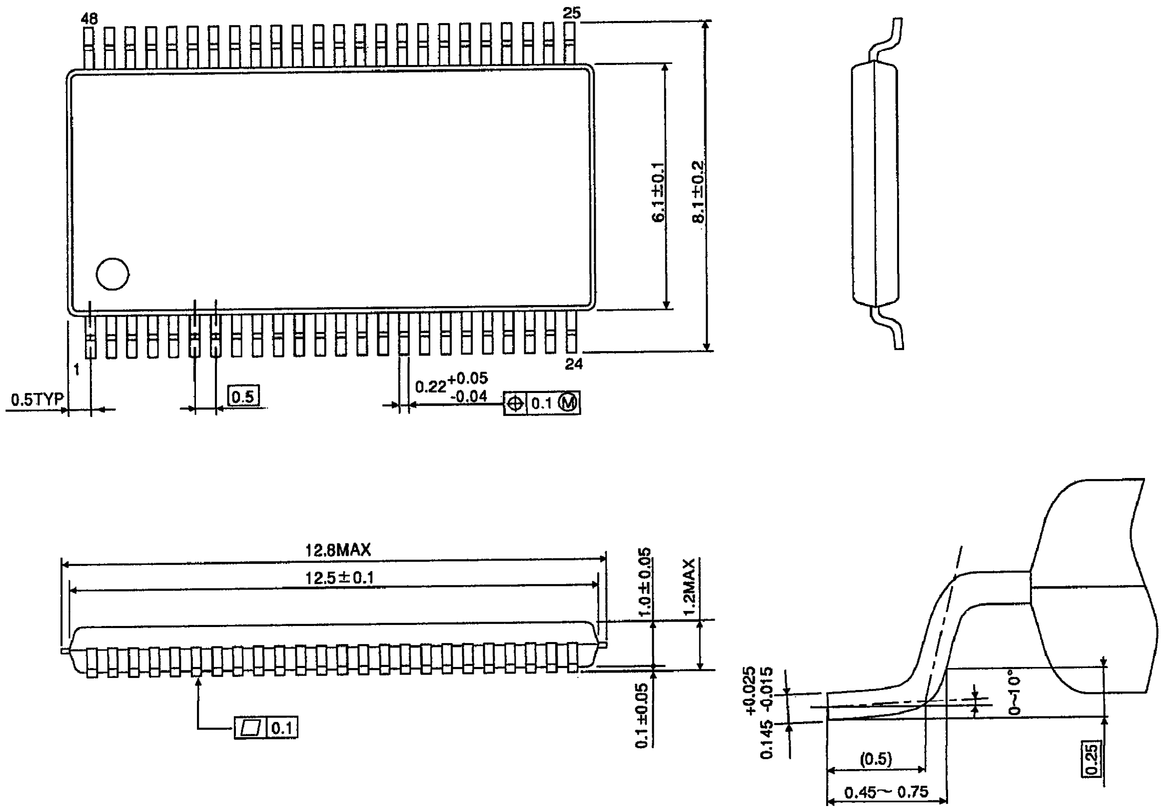
Fig.3 t_{pLZ}, t_{pHZ}, t_{pZL}, t_{pZH}



SYMBOL	V_{CC}		
	3.3 ± 0.3V	2.5 ± 0.2V	1.8V
V_{IH}	2.7V	V_{CC}	V_{CC}
V_M	1.5V	V_{CC} / 2	V_{CC} / 2
V_X	V_{OL} + 0.3V	V_{OL} + 0.15V	V_{OL} + 0.15V
V_Y	V_{OH} − 0.3V	V_{OH} − 0.15V	V_{OH} − 0.15V

OUTLINE DRAWING

TSSOP48-P-0061-0.50 Unit : mm



Weight : 0.25g (Typ.)