

TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

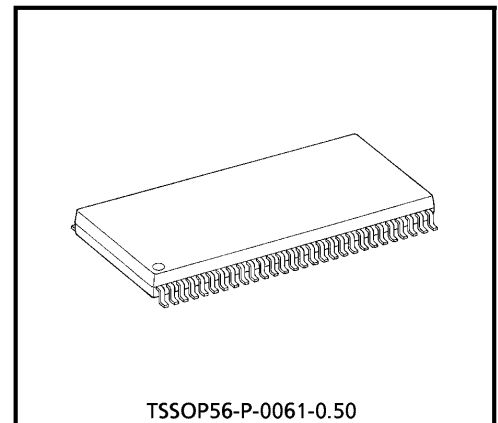
TC74VCX16834FT**LOW-VOLTAGE 18-BIT UNIVERSAL BUS DRIVER
WITH 3.6 V TOLERANT INPUTS AND OUTPUTS**

The TC74VCX16834FT is a high performance CMOS 18-bit UNIVERSAL BUS DRIVER. 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.

Data flow from A to Y is controlled by the output-enable ($\overline{OE}$) input. The device operates in the transparent mode when the latch-enable ($\overline{LE}$) input is low. When $\overline{LE}$ is high, the A data is latched if the clock (CK) input is held at a high or low logic level. If $\overline{LE}$ is high, the A data is stored in the latch / flip-flop on the low-to-high transition of CLK. When $\overline{OE}$ is high, the outputs are in the high-impedance state.

All inputs are equipped with protection circuits against static discharge.



Weight : 0.25 g (Typ.)

FEATURES

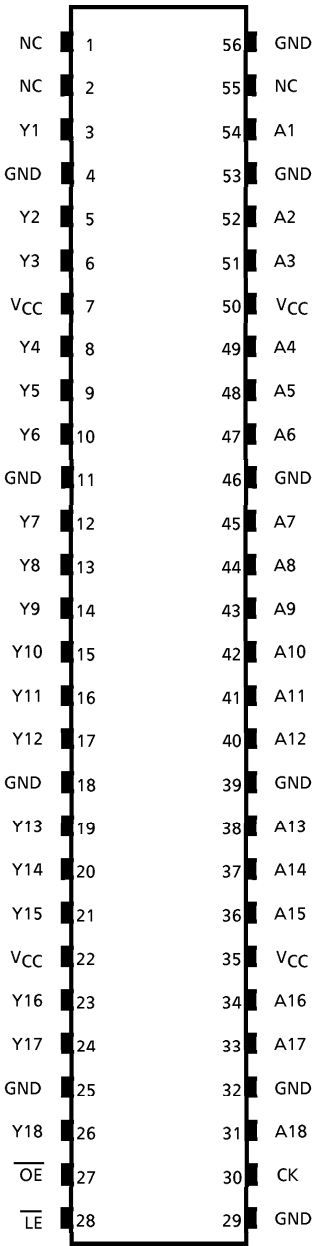
- Low Voltage Operation : $V_{CC} = 1.8 \sim 3.6 \text{ V}$
- High Speed Operation : $t_{pd} = 3.3 \text{ ns (max)}$ at $V_{CC} = 3.0 \sim 3.6 \text{ V}$
 : $t_{pd} = 4.2 \text{ ns (max)}$ at $V_{CC} = 2.3 \sim 2.7 \text{ V}$
 : $t_{pd} = 8.4 \text{ ns (max)}$ at $V_{CC} = 1.8 \text{ V}$
- 3.6 V Tolerant inputs and outputs.
- Output Current : $I_{OH} / I_{OL} = \pm 24 \text{ mA (min)}$ at $V_{CC} = 3.0 \text{ V}$
 : $I_{OH} / I_{OL} = \pm 18 \text{ mA (min)}$ at $V_{CC} = 2.3 \text{ V}$
 : $I_{OH} / I_{OL} = \pm 6 \text{ mA (min)}$ 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.

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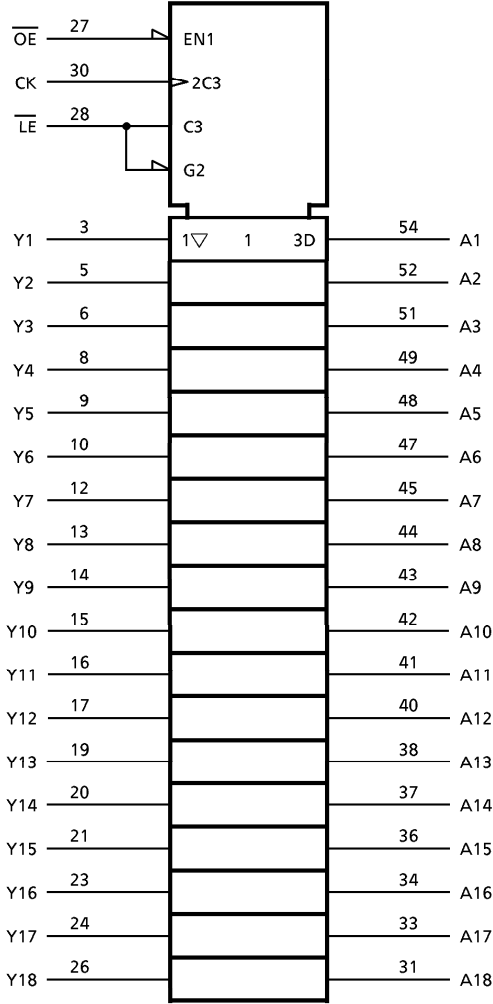
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PIN ASSIGNMENT



(TOP VIEW)

SYMBOL



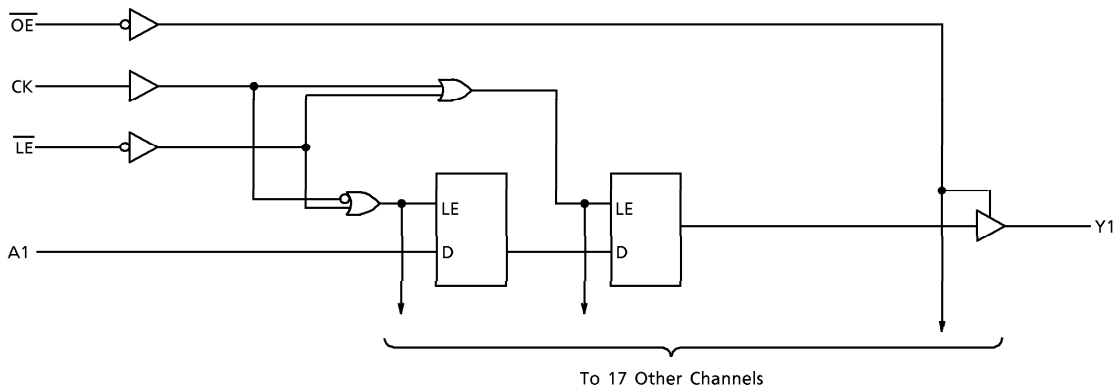
TRUTH TABLE

INPUTS				OUTPUTS Y
$\overline{OE}$	$\overline{LE}$	CK	A	
H	X	X	X	Z
L	L	X	L	L
L	L	X	H	H
L	H		L	L
L	H		H	H
L	H	H	X	Y0 *
L	H	L	X	Y0 *

X : Don't care
Z : High impedance

(*) : Output level before the indicated steady-state input conditions were established, provided that CK was high or low before $\overline{LE}$ went high.

SYSTEM DIAGRAM



MAXIMUM RATINGS

PARAMETER	SYMBOL	RATING	UNIT
Power Supply Voltage	V_{CC}	$-0.5 \sim 4.6$	V
DC Input Voltage	V_{IN}	$-0.5 \sim 4.6$	V
DC Output Voltage	V_{OUT}	$-0.5 \sim 4.6$ (Note 2) $-0.5 \sim V_{CC} + 0.5$ (Note 3)	V
Input Diode Current	I_{IK}	-50	mA
Output Diode Current	I_{OK}	± 50 (Note 4)	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}	$-65 \sim 150$	$^{\circ}\text{C}$

(Note 2) : Off-State

(Note 3) : High or Low State. I_{OUT} absolute maximum rating must be observed.(Note 4) : $V_{OUT} < GND$, $V_{OUT} > V_{CC}$

RECOMMENDED OPERATING RANGE

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V_{CC}	$1.8 \sim 3.6$ $1.2 \sim 3.6$ (Note 5)	V
Input Voltage	V_{IN}	$-0.3 \sim 3.6$	V
Output Voltage	$V_{I/O}$	$0 \sim 3.6$ (Note 6) $0 \sim V_{CC}$ (Note 7)	V
Output Current	I_{OH} / I_{OL}	± 24 (Note 8) ± 18 (Note 9) ± 6 (Note 10)	mA
Operating Temperature	T_{opr}	$-40 \sim 85$	$^{\circ}\text{C}$
Input Rise And Fall Time	dt/dv	$0 \sim 10$ (Note 11)	ns/V

(Note 5) : Data Retention Only

(Note 6) : Off-State

(Note 7) : High or Low State

(Note 8) : $V_{CC} = 3.0 \sim 3.6$ V(Note 9) : $V_{CC} = 2.3 \sim 2.7$ V(Note 10) : $V_{CC} = 1.8$ V(Note 11) : $V_{IN} = 0.8 \sim 2.0$ 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	
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		
				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	
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	
				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 ($T_a = -40 \sim 85^\circ\text{C}$, $1.8\text{ V} \leq V_{CC} < 2.3\text{ V}$)

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}	
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	
				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, $R_L = 500 \Omega$)

PARAMETER	SYMBOL	TEST CONDITION	V _{CC} (V)	MIN	MAX	UNIT
Maximum Clock Frequency	f _{MAX}	(Fig.1, 3)	1.8	100	—	MHz
			2.5 ± 0.2	200	—	
			3.3 ± 0.3	250	—	
Propagation Delay Time (An-Yn)	t _{pLH} t _{pHL}	(Fig.1, 2)	1.8	1.5	8.4	ns
			2.5 ± 0.2	0.8	4.2	
			3.3 ± 0.3	0.6	3.3	
Propagation Delay Time (CK-Yn)	t _{pLH} t _{pHL}	(Fig.1, 3)	1.8	1.5	9.2	ns
			2.5 ± 0.2	0.8	5.2	
			3.3 ± 0.3	0.6	4.2	
Propagation Delay Time ($\overline{LE}$ -Yn)	t _{pLH} t _{pHL}	(Fig.1, 4)	1.8	1.5	9.8	ns
			2.5 ± 0.2	0.8	5.5	
			3.3 ± 0.3	0.6	4.6	
Output Enable Time	t _{pZL} t _{pZH}	(Fig.1, 5)	1.8	1.5	9.8	ns
			2.5 ± 0.2	0.8	4.9	
			3.3 ± 0.3	0.6	3.8	
Output Disable Time	t _{pLZ} t _{pHZ}	(Fig.1, 5)	1.8	1.5	7.6	ns
			2.5 ± 0.2	0.8	4.5	
			3.3 ± 0.3	0.6	3.9	
Minimum Pulse Width	t _w (H) t _w (L)	(Fig.1, 3, 4)	1.8	4.0	—	ns
			2.5 ± 0.2	1.5	—	
			3.3 ± 0.3	1.5	—	
Minimum Set-up Time (An-CK, An- $\overline{LE}$)	t _s	(Fig.1, 3, 4)	1.8	2.5	—	ns
			2.5 ± 0.2	1.5	—	
			3.3 ± 0.3	1.5	—	
Minimum Hold Time (An-CK, An- $\overline{LE}$)	t _h	(Fig.1, 3, 4)	1.8	1.0	—	ns
			2.5 ± 0.2	0.6	—	
			3.3 ± 0.3	0.7	—	
Output to Output Skew	t _{osLH} t _{osHL}	(Note 12)	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 12) : 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 13)	1.8	0.35	V
		V _{IH} = 2.5 V, V _{IL} = 0 V (Note 13)	2.5	0.7	
		V _{IH} = 3.3 V, V _{IL} = 0 V (Note 13)	3.3	0.9	
Quiet Output Minimum Dynamic V _{OL}	V _{OLV}	V _{IH} = 1.8 V, V _{IL} = 0 V (Note 13)	1.8	-0.35	V
		V _{IH} = 2.5 V, V _{IL} = 0 V (Note 13)	2.5	-0.7	
		V _{IH} = 3.3 V, V _{IL} = 0 V (Note 13)	3.3	-0.9	
Quiet Output Minimum Dynamic V _{OH}	V _{OHV}	V _{IH} = 1.8 V, V _{IL} = 0 V (Note 13)	1.8	1.3	V
		V _{IH} = 2.5 V, V _{IL} = 0 V (Note 13)	2.5	1.7	
		V _{IH} = 3.3 V, V _{IL} = 0 V (Note 13)	3.3	2.0	

(Note 13) : 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 _{OUT}		1.8, 2.5, 3.3	7	pF
Power Dissipation Capacitance	C _{PD}	f _{IN} = 10 MHz (Note 14)	1.8, 2.5, 3.3	20	pF

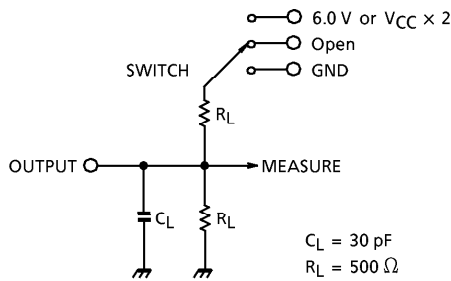
(Note 14) : C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation :

$$I_{CC}(\text{opr.}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC} / 18 \text{ (per bit)}$$

TEST CIRCUIT

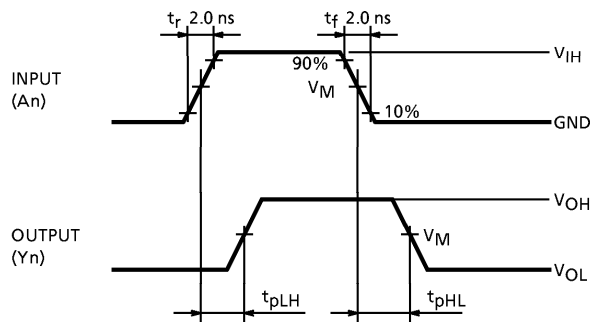
Fig.1



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

AC WAVEFORM

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



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

Fig.3 t_{pLH} , t_{pHL} , t_w , t_s , t_h

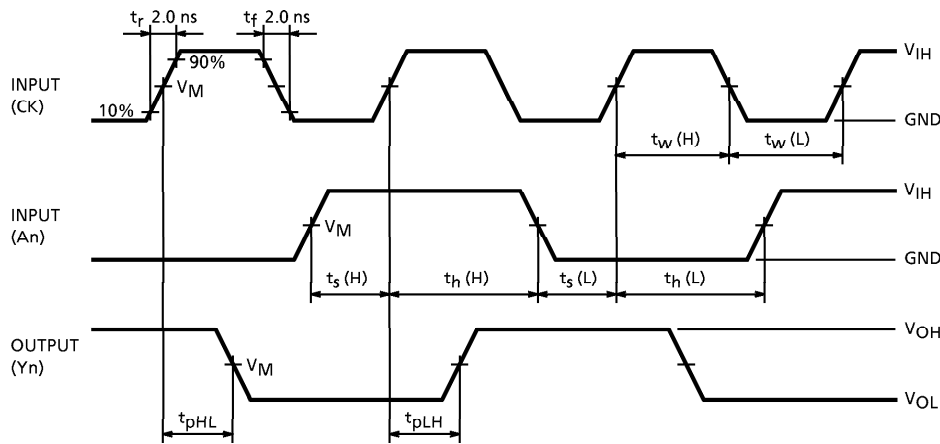


Fig.4 t_{pLH} , t_{pHL} , t_w , t_s , t_h

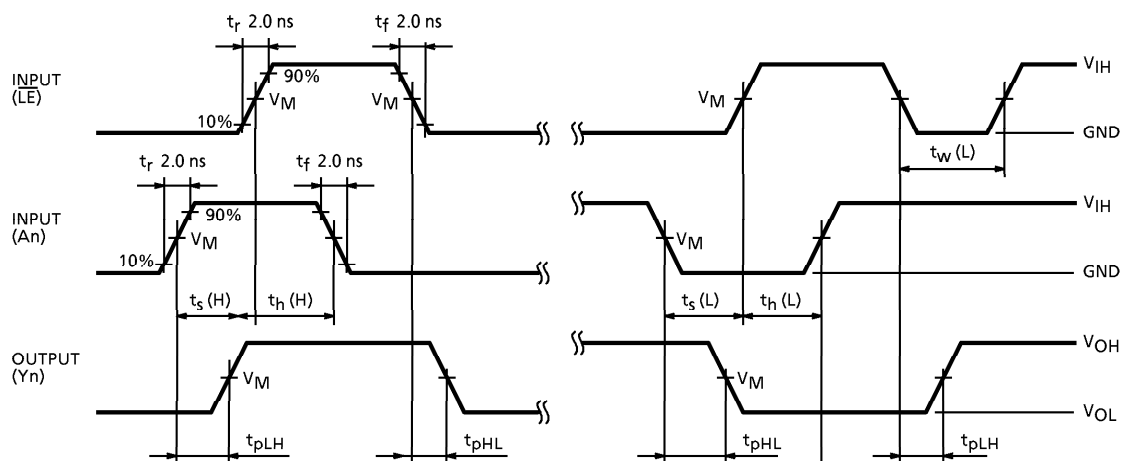
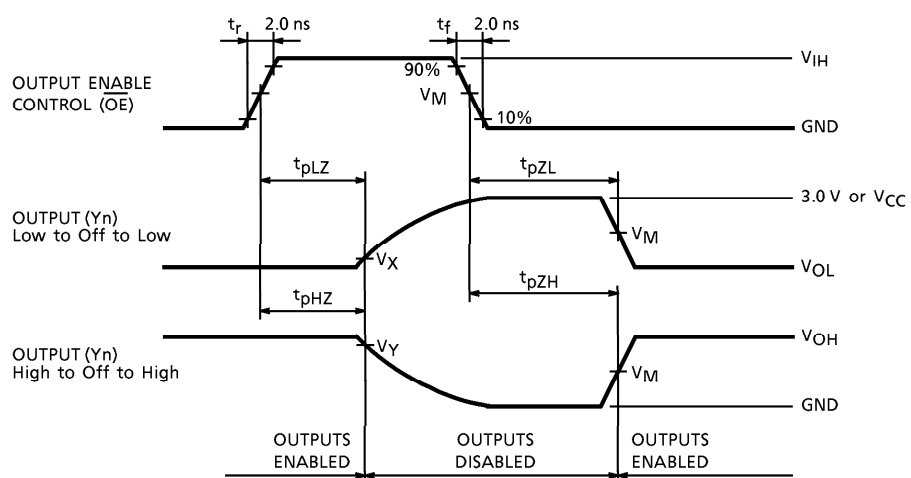
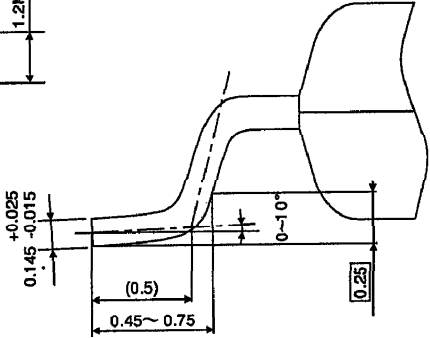
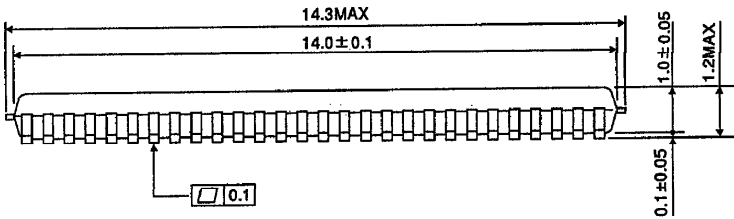
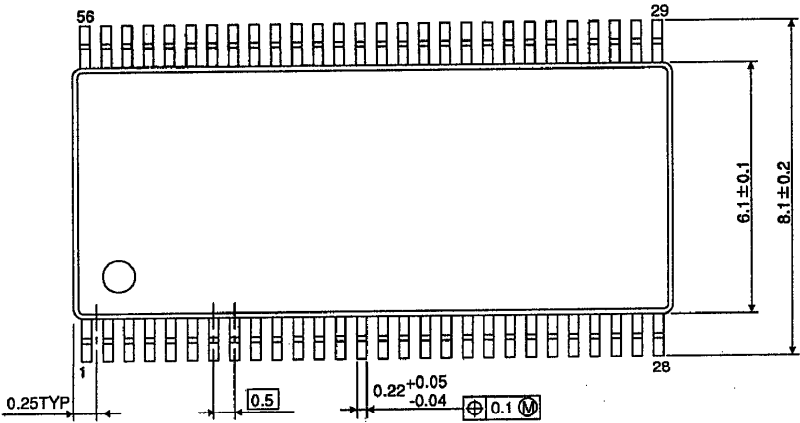


Fig.5 t_{pLZ} , t_{pHZ} , t_{pZL} , t_{pZH}



PACKAGE DIMENSIONS
TSSOP56-P-0061-0.50

Unit : mm



Weight : 0.25 g (Typ.)