

TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

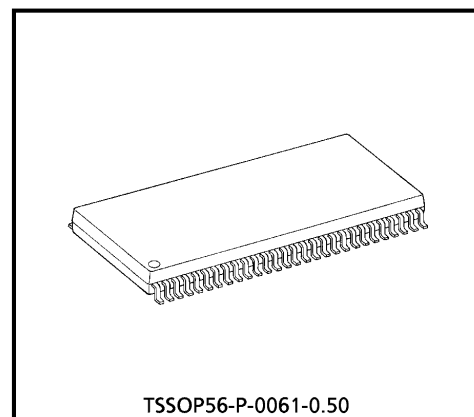
TC74VCX16827FT**LOW-VOLTAGE 20-BIT BUS BUFFER
WITH 3.6 V TOLERANT INPUTS AND OUTPUTS**

The TC74VCX16827FT is a high performance CMOS 20-bit BUS BUFFER. 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 TC74VCX16827FT is composed of two 10-bit sections with separate output-enable signals. For either 10-bit buffer section, the two output-enable ($\overline{1OE1}$ and $\overline{1OE2}$ or $\overline{2OE1}$ and $\overline{2OE2}$) inputs must both be low for the corresponding Y outputs to be active.

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.



Weight : 0.25 g (Typ.)

FEATURES

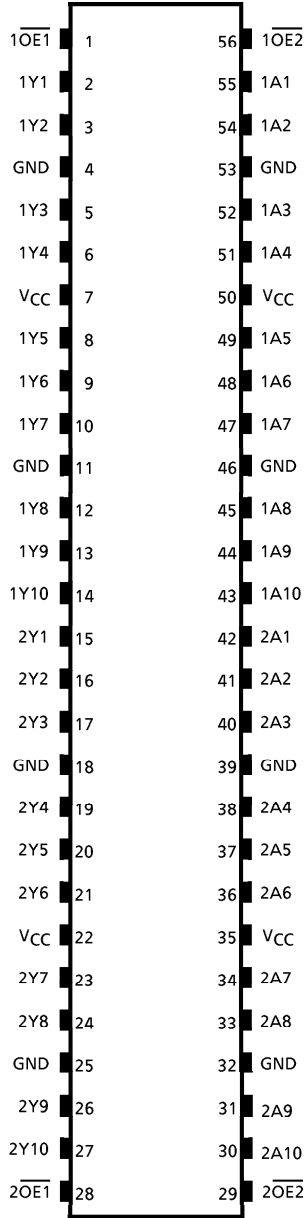
- Low Voltage Operation : $V_{CC} = 1.8\sim 3.6\text{ V}$
- High Speed Operation : $t_{pd} = 2.5\text{ ns (max) at } V_{CC} = 3.0\sim 3.6\text{ V}$
 : $t_{pd} = 3.0\text{ ns (max) at } V_{CC} = 2.3\sim 2.7\text{ V}$
 : $t_{pd} = 6.0\text{ ns (max) at } V_{CC} = 1.8\text{ V}$
- 3.6 V Tolerant inputs and 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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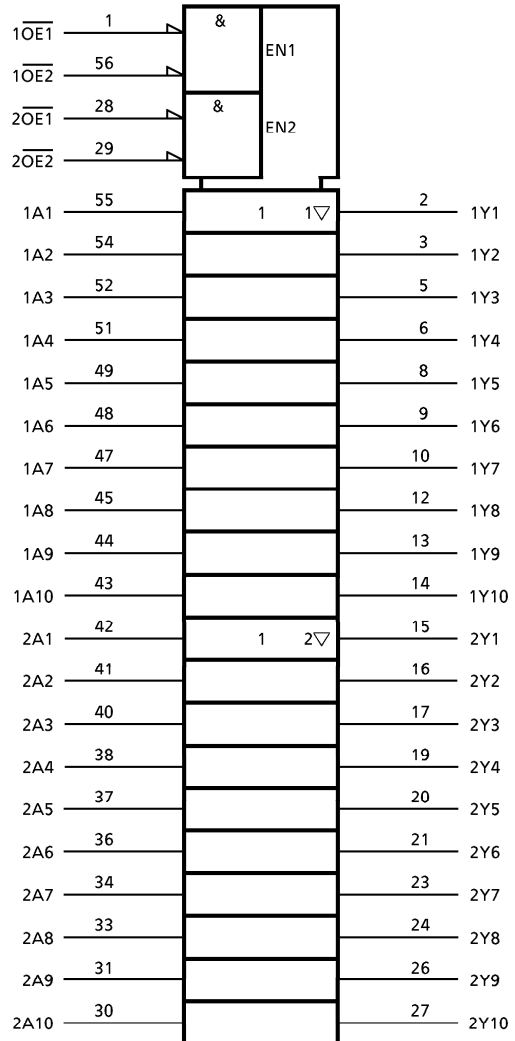
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PIN ASSIGNMENT



(TOP VIEW)

SYMBOL

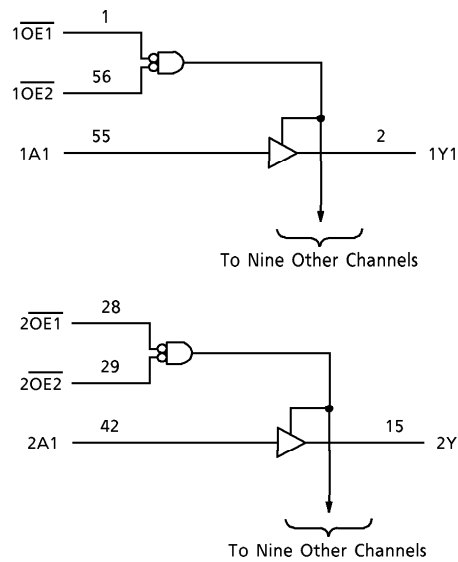


FUNCTION TABLE (each 10-bit latch)

INPUT			OUTPUT Y
$\overline{OE1}$	$\overline{OE2}$	A	
L	L	L	L
L	L	H	H
H	X	X	Z
X	H	X	Z

X : Don't care
Z : High Impedance

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	$^{\circ}C$

(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	$^{\circ}C$
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 ($T_a = -40\sim 85^\circ\text{C}$, $2.7\text{ V} < V_{CC} \leq 3.6\text{ V}$ Range)

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}	$I_{OH} = -100\ \mu\text{A}$	2.7~3.6	$V_{CC} - 0.2$	—	V
				$I_{OH} = -12\ \text{mA}$	2.7	2.2	—	
				$I_{OH} = -18\ \text{mA}$	3.0	2.4	—	
				$I_{OH} = -24\ \text{mA}$	3.0	2.2	—	
	"L" Level	V_{OL}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 100\ \mu\text{A}$	2.7~3.6	—	0.2	V
				$I_{OL} = 12\ \text{mA}$	2.7	—	0.4	
				$I_{OL} = 18\ \text{mA}$	3.0	—	0.4	
				$I_{OL} = 24\ \text{mA}$	3.0	—	0.55	
Input Leakage Current		I_{IN}	$V_{IN} = 0\sim 3.6\text{ V}$		2.7~3.6	—	± 5.0	μA
3-State Output Off-State Current		I_{OZ}	$V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = 0\sim 3.6\text{ V}$		2.7~3.6	—	± 10.0	μA
Power Off Leakage Current		I_{OFF}	$V_{IN}, V_{OUT} = 0\sim 3.6\text{ V}$		0	—	10.0	μA
Quiescent Supply Current		I_{CC}	$V_{IN} = V_{CC}$ or GND		2.7~3.6	—	20.0	μA
			$V_{CC} \leq (V_{IN}, V_{OUT}) \leq 3.6\text{ V}$		2.7~3.6	—	± 20.0	
Increase In I_{CC} Per Input		ΔI_{CC}	$V_{IH} = V_{CC} - 0.6\text{ V}$		2.7~3.6	—	750	μA

DC characteristics (Ta = -40~85°C, 2.3 V ≤ VCC ≤ 2.7 V Range)

PARAMETER		SYMBOL	TEST CONDITION		VCC (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 ≤ VCC < 2.3 V Range)

PARAMETER		SYMBOL	TEST CONDITION		VCC (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 tr = tf = 2.0 ns, CL = 30 pF, RL = 500 Ω)

PARAMETER	SYMBOL	TEST CONDITION	VCC (V)	MIN	MAX	UNIT
Propagation Delay Time	t _{pLH} t _{pHL}	(Fig.1, 2)	1.8	1.5	6.0	ns
			2.5 ± 0.2	1.0	3.0	
			3.3 ± 0.3	0.8	2.5	
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	
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 CL = 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 tr = tf = 2.0 ns, CL = 30 pF)

PARAMETER	SYMBOL	TEST CONDITION	VCC (V)	TYP.	UNIT
Quiet Output Maximum Dynamic VOL	VOLP	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 VOL	VOLV	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 VOH	VOHV	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) : PParameter guaranteed by design.

Capacitive characteristics (Ta = 25°C)

PARAMETER	SYMBOL	TEST CONDITION	VCC (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

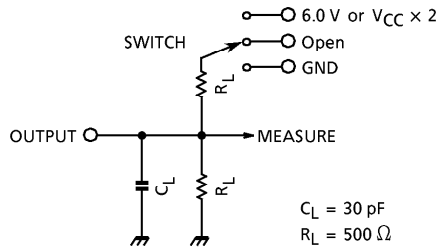
(Note 13) : C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

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

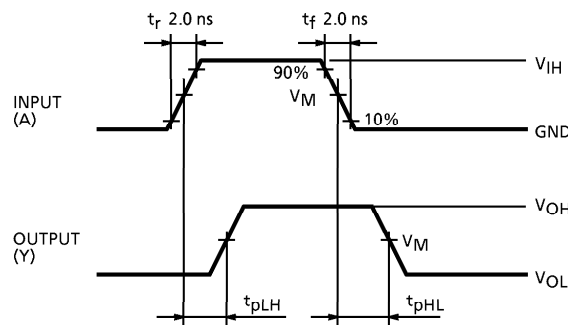
Fig.1



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

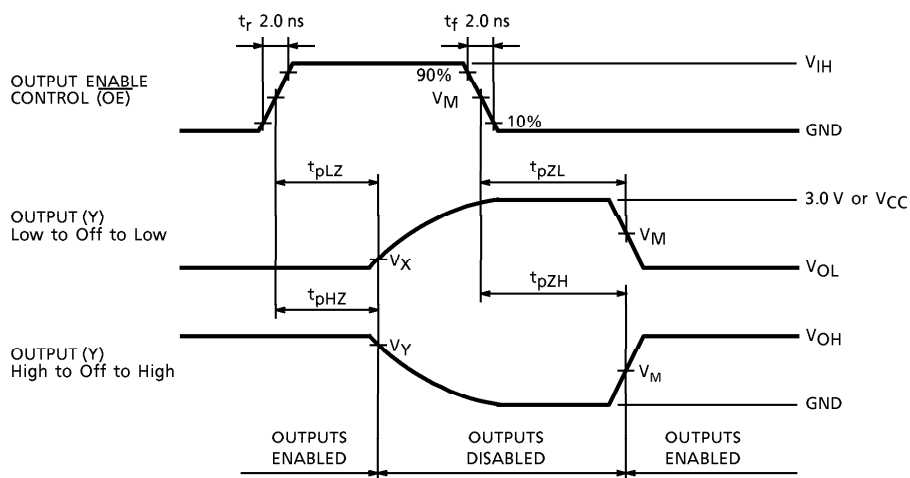
AC WAVEFORM

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

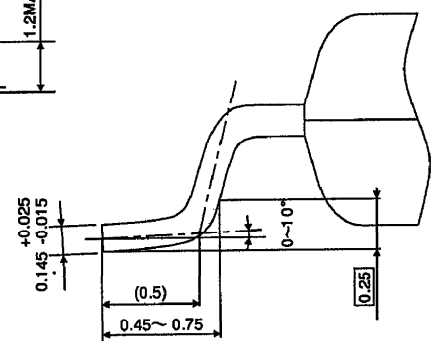
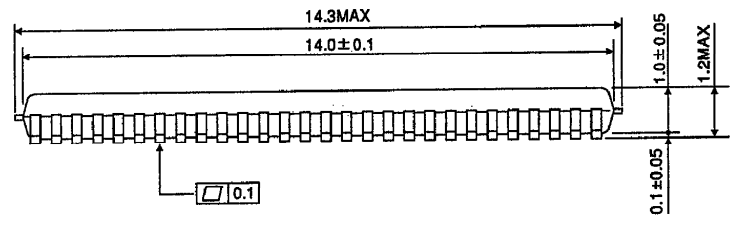
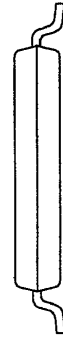
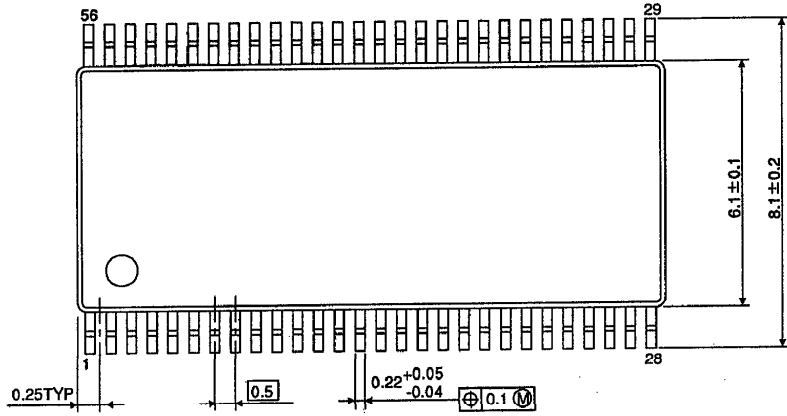
Fig.3 t_{pLZ} , t_{pHZ} , t_{pZL} , t_{pZH}



OUTLINE DRAWING

TSSOP56-P-0061-0.50

Unit : mm



Weight : 0.25 g (Typ.)