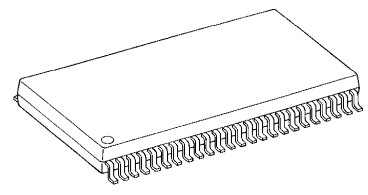
TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC74VCX16244FT

LOW-VOLTAGE 16-BIT BUS BUFFER WITH 3.6V TOLERANT INPUTS AND OUTPUTS

The TC74VCX16244FT is a high performance CMOS 16-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 3.6V.
This device is non-inverting 3 – state buffer having four active-low output enables. It can be used as four 4-bit buffers two 8-bit buffers or one 16-bit buffer. 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.



TSSOP48-P-0061-0.50

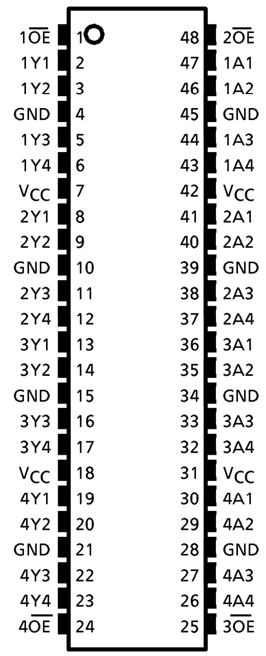
Weight : 0.25g (Typ.)

FEATURES

- Low Voltage Operation : V_{CC} = 1.8~3.6V
- High Speed Operation : t_{pd} = 2.5ns (max.) at V_{CC} = 3.0~3.6V
  : t_{pd} = 3.2ns (max.) at V_{CC} = 2.3~2.7V
  : t_{pd} = 5.7ns (max.) at V_{CC} = 1.8V
- 3.6V Tolerant inputs and outputs.
- Output Current : I_{OH} / I_{OL} = ±24mA (min.) at V_{CC} = 3.0V
  : I_{OH} / I_{OL} = ±18mA (min.) at V_{CC} = 2.3V
  : I_{OH} / I_{OL} = ±6mA (min.) at V_{CC} = 1.8V
- Latch-up Performance : ±300mA
- ESD Performance : Human Body Model > ±2000V
  : Machine Model > ±200V
- 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 CONNECTION



(TOP VIEW)

980508EBA2

TRUTH TABLE

INPUTS		OUTPUTS
1$\overline{\text{OE}}$	1A1-1A4	1Y1-1Y4
L	L	L
L	H	H
H	X	Z

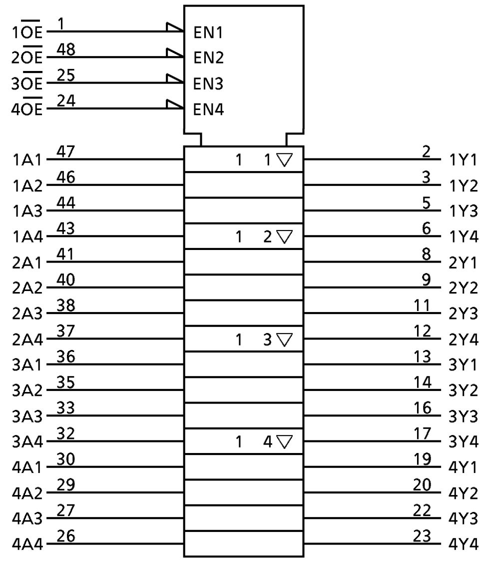
INPUTS		OUTPUTS
2$\overline{\text{OE}}$	1A1-2A4	2Y1-2Y4
L	L	L
L	H	H
H	X	Z

INPUTS		OUTPUTS
3$\overline{\text{OE}}$	3A1-3A4	3Y1-3Y4
L	L	L
L	H	H
H	X	Z

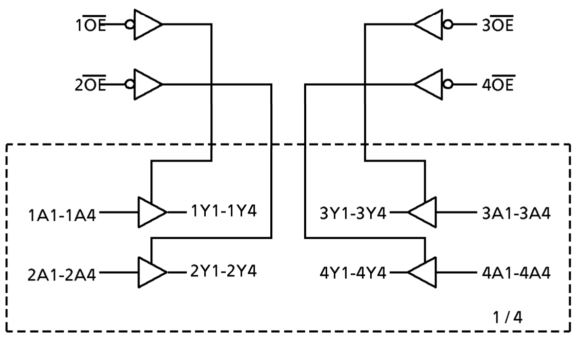
INPUTS		OUTPUTS
4$\overline{\text{OE}}$	4A1-4A4	4Y1-4Y4
L	L	L
L	H	H
H	X	Z

X : Don’t Care
Z : High impedance

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}	±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} = 3.0~3.6V
(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} = −12mA	2.7	2.2	—	
				I_{OH} = −18mA	3.0	2.4	—	
				I_{OH} = −24mA	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} = 12mA	2.7	—	0.4	
				I_{OL} = 18mA	3.0	—	0.4	
				I_{OL} = 24mA	3.0	—	0.55	
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} = −6mA	2.3	2.0	—	
				I_{OH} = −12mA	2.3	1.8	—	
				I_{OH} = −18mA	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} = 12mA	2.3	—	0.4	
				I_{OL} = 18mA	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} = −6mA	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} = 6mA	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 = 500Ω)

PARAMETER	SYMBOL	TEST CONDITION	V_{CC} (V)	MIN.	MAX.	UNIT
Propagation Delay Time	t_{pLH} t_{pHL}	(Fig.1, 2)	1.8	1.5	5.0	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	6.5	ns
			2.5 ± 0.2	1.0	4.1	
			3.3 ± 0.3	0.8	3.5	
3-State Output Disable Time	t_{pLZ} t_{pHZ}	(Fig.1, 3)	1.8	1.5	5.0	ns
			2.5 ± 0.2	1.0	3.8	
			3.3 ± 0.3	0.8	3.5	
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	0.25	V
		$V_{IH} = 2.5V$, $V_{IL} = 0V$ (Note 12)	2.5	0.6	
		$V_{IH} = 3.3V$, $V_{IL} = 0V$ (Note 12)	3.3	0.8	
Quiet Output Minimum Dynamic V_{OL}	V_{OLV}	$V_{IH} = 1.8V$, $V_{IL} = 0V$ (Note 12)	1.8	− 0.25	V
		$V_{IH} = 2.5V$, $V_{IL} = 0V$ (Note 12)	2.5	− 0.6	
		$V_{IH} = 3.3V$, $V_{IL} = 0V$ (Note 12)	3.3	− 0.8	
Quiet Output Minimum Dynamic V_{OH}	V_{OHV}	$V_{IH} = 1.8V$, $V_{IL} = 0V$ (Note 12)	1.8	1.5	V
		$V_{IH} = 2.5V$, $V_{IL} = 0V$ (Note 12)	2.5	1.9	
		$V_{IH} = 3.3V$, $V_{IL} = 0V$ (Note 12)	3.3	2.2	

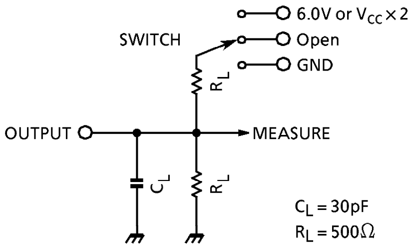
(Note 12) Parameter guaranteed by design.

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}	$f_{IN} = 10MHz$ (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 @$V_{CC} = 3.3 \pm 0.3V$ V_{CC}x2 @$V_{CC} = 2.5 \pm 0.2V$ @$V_{CC} = 1.8V$
t_{pHZ}, t_{pZH}	GND

AC WAVEFORM

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

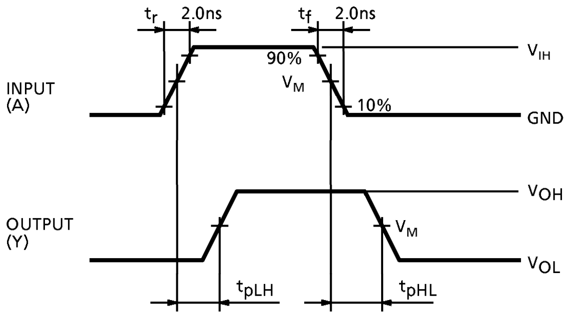
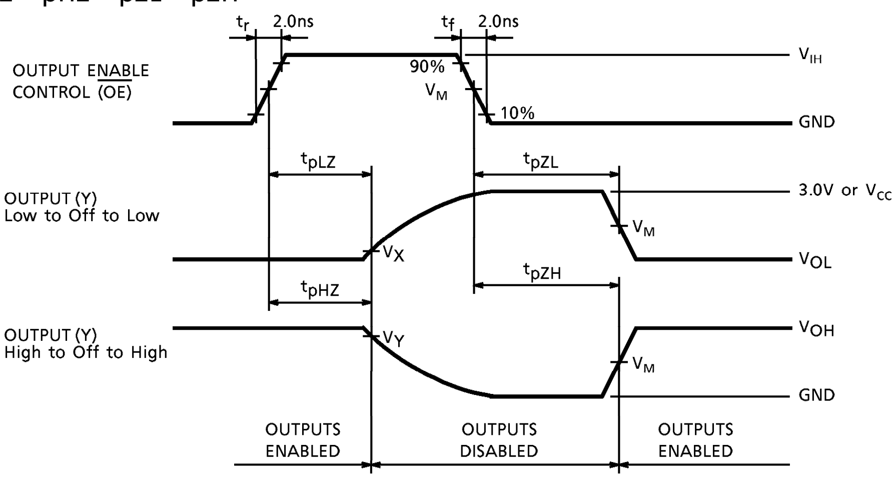
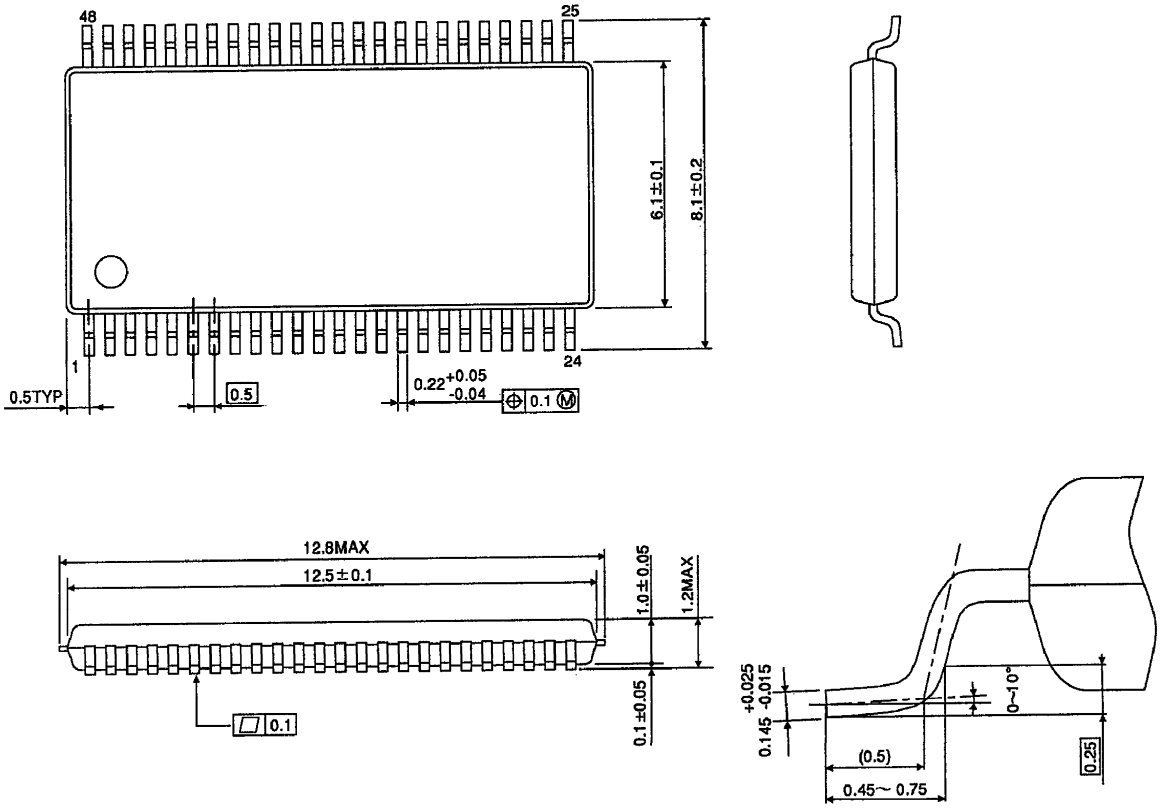


Fig.3 t_{pLZ}, t_{pHZ}, t_{pZL}, t_{pZH}



SYMBOL	V_{CC}		
	$3.3 \pm 0.3V$	$2.5 \pm 0.2V$	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.)