

TOSHIBA**TC74VCX2125FT**

TOSHIBA CMOS DIGITAL INTEGRATED CIRCUIT SILICON MONOLITHIC

TC74VCX2125FT
**LOW-VOLTAGE QUAD BUS BUFFER
WITH 3.6 V TOLERANT INPUTS AND OUTPUTS**

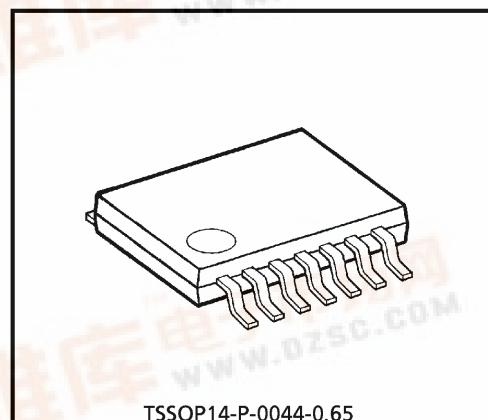
The TC74VCX2125FT is a high performance CMOS QUAD BUS BUFFER. Designed for use in 1.8, 2.5 or 3.3 Volt systems, it achieves high speed operation while maintaining the CMOS low power dissipation.

It is also designed with over voltage tolerant inputs and outputs up to 3.6V.

This device requires the 3-state control input \overline{OE} to be set high to place the output into the high impedance state.

The $26\text{-}\Omega$ series resistor helps reducing output overshoot and undershoot without external resistor.

All inputs are equipped with protection circuits against static discharge.



TSSOP14-P-0044-0.65

Weight : 0.06 g (Typ.)

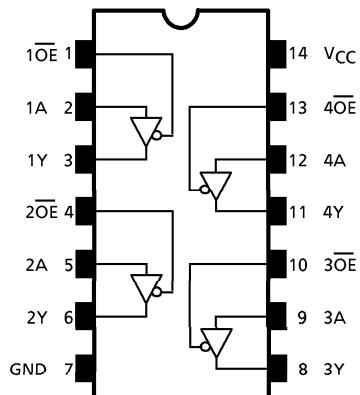
FEATURES

- 26- Ω Series Resistors on Outputs
- Low Voltage Operation: $V_{CC} = 1.8\sim 3.6$ V
- High Speed Operation : $t_{pd} = 3.7$ ns (max) at $V_{CC} = 3.0\sim 3.6$ V
 $t_{pd} = 4.8$ ns (max) at $V_{CC} = 2.3\sim 2.7$ V
 $t_{pd} = 9.6$ ns (max) at $V_{CC} = 1.8$ V
- 3.6V Tolerant inputs and outputs.
- Output Current : $I_{OH}/I_{OL} = \pm 12$ mA (min) at $V_{CC} = 3.0$ V
 $I_{OH}/I_{OL} = \pm 8$ mA (min) at $V_{CC} = 2.3$ V
 $I_{OH}/I_{OL} = \pm 4$ mA (min) at $V_{CC} = 1.8$ V
- Latch-up Performance : ± 300 mA
- ESD Performance : Human Body Model $> \pm 2000$ V
Machine Model $> \pm 200$ V
- Package : TSSOP
(Thin Shrink Small Outline Package)
- Power Down Protection is provided on all inputs and outputs.
- Supports live insertion/withdrawal (Note 1)

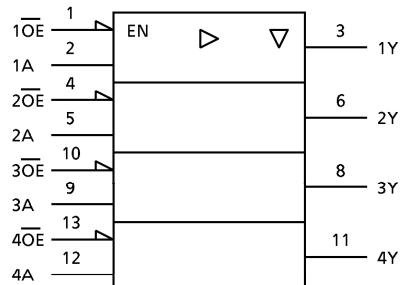
(Note 1) : To ensure the high-impedance state during power up or power down, \overline{OE} should be tied to V_{CC} through a pullup resistor; the minimum value of the resistor is determined by the current-sourcing capability of the driver.

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PIN ASSIGNMENT

(TOP VIEW)

IEC LOGIC SYMBOL**TRUTH TABLE**

INPUTS		OUTPUTS
OE	A	Y
H	X	Z
L	L	L
L	H	H

X : Don't Care

Z : High Impedance

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	180	mW
DC V _{CC} / Ground Current	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) : $V_{CC} = 3.0\sim 3.6$ 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 ($T_a = -40\sim 85^\circ C$, 2.7 V < $V_{CC} \leq 3.6$ V)

PARAMETER		SYMBOL	TEST CONDITION		V_{CC} (V)	MIN	MAX	UNIT	
Input Voltage	"H" Level	V_{IH}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -100 \mu A$	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}	$I_{OH} = -6$ mA	2.7~3.6	—	—	V	
				$I_{OH} = -8$ mA	3.0	2.4	—		
				$I_{OH} = -12$ mA	3.0	2.2	—		
				$I_{OL} = 100 \mu A$	2.7~3.6	—	0.2		
	"L" Level	V_{OL}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OL} = 6$ mA	2.7	—	0.4	V	
				$I_{OL} = 8$ mA	3.0	—	0.55		
				$I_{OL} = 12$ mA	3.0	—	0.8		
Input Leakage Current	I_{IN}	$V_{IN} = 0\sim 3.6$ V			2.7~3.6	—	± 5.0	μA	
3-State Output Off-State Current	I_{OZ}	$V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = 0\sim 3.6$ V			2.7~3.6	—	± 10.0	μA	
Power Off Leakage Current	I_{OFF}	$V_{IN}, V_{OUT} = 0\sim 3.6$ V			0	—	10.0	μA	
Quiescent Supply Current	I_{CC}	$V_{IN} = V_{CC}$ or GND		$V_{CC} \leq (V_{IN}, V_{OUT}) \leq 3.6$ V	2.7~3.6	—	20.0	μA	
					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 CHARACTERISTICSDC characteristics ($T_a = -40\sim85^\circ C$, $2.3 V \leq V_{CC} \leq 2.7 V$)

PARAMETER		SYMBOL	TEST CONDITION		V_{CC} (V)	MIN	MAX	UNIT	
Input Voltage	"H" Level	V_{IH}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -100 \mu A$	2.3~2.7	1.6	—	V	
	"L" Level	V_{IL}		$I_{OH} = -4 mA$	2.3~2.7	—	0.7		
Output Voltage	"H" Level	V_{OH}		$I_{OH} = -6 mA$	2.3	2.0	—	V	
				$I_{OH} = -8 mA$	2.3	1.7	—		
				$I_{OL} = 100 \mu A$	2.3~2.7	—	0.2		
				$I_{OL} = 6 mA$	2.3	—	0.4		
	"L" Level	V_{OL}		$I_{OL} = 8 mA$	2.3	—	0.6		
Input Leakage Current				$V_{IN} = 0\sim3.6 V$	2.3~2.7	—	± 5.0	μA	
3-State Output Off-State Current				$V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = 0\sim3.6 V$	2.3~2.7	—	± 10.0	μA	
Power Off Leakage Current	I_{OFF}	$V_{IN}, V_{OUT} = 0\sim3.6 V$		0	—	10.0	μA		
Quiescent Supply Current		I_{CC}	$V_{IN} = V_{CC}$ or GND	2.3~2.7	—	20.0	μA		
			$V_{CC} \leq (V_{IN}, V_{OUT}) \leq 3.6 V$	2.3~2.7	—	± 20.0			

ELECTRICAL CHARACTERISTICSDC characteristics ($T_a = -40\sim85^\circ C$, $1.8 V \leq V_{CC} < 2.3 V$)

PARAMETER		SYMBOL	TEST CONDITION		V_{CC} (V)	MIN	MAX	UNIT	
Input Voltage	"H" Level	V_{IH}			1.8~2.3	$0.7 \times V_{CC}$	—	V	
	"L" Level	V_{IL}			1.8~2.3	—	$0.2 \times V_{CC}$		
Output Voltage	"H" Level	V_{OH}	$V_{IN} = V_{IH}$ or V_{IL}	$I_{OH} = -100 \mu A$	1.8	$V_{CC} - 0.2$	—	V	
				$I_{OH} = -4 mA$	1.8	1.4	—		
	"L" Level	V_{OL}	$V_N = V_{IH}$ or V_{IL}	$I_{OL} = 100 \mu A$	1.8	—	0.2		
				$I_{OL} = 4 mA$	1.8	—	0.3		
Input Leakage Current	I_{IN}	$V_{IN} = 0\sim3.6 V$		1.8		—	± 5.0	μA	
3-State Output Off-State Current	I_{OZ}	$V_{IN} = V_{IH}$ or V_{IL} $V_{OUT} = 0\sim3.6 V$		1.8		—	± 10.0	μA	
Power Off Leakage Current	I_{OFF}	$V_{IN}, V_{OUT} = 0\sim3.6 V$		0		—	10.0	μA	
Quiescent Supply Current	I_{CC}	$V_{IN} = V_{CC}$ or GND		1.8		—	20.0	μA	
		$V_{CC} \leq (V_{IN}, V_{OUT}) \leq 3.6 V$		1.8		—	± 20.0		

AC characteristics ($T_a = -40\sim85^\circ C$, 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
Propagation Delay Time	t_{pLH} t_{pHL}	(Fig.1, 2)			1.8	1.0	9.6	ns
					2.5 ± 0.2	0.8	4.8	
					3.3 ± 0.3	0.6	3.7	
3-State Output Enable Time	t_{pZL} t_{pZH}	(Fig.1, 3)			1.8	1.0	9.8	ns
					2.5 ± 0.2	0.8	5.1	
					3.3 ± 0.3	0.6	4.1	
3-State Output Disable Time	t_{pLZ} t_{pHZ}	(Fig.1, 3)			1.8	1.0	8.1	ns
					2.5 ± 0.2	0.8	4.5	
					3.3 ± 0.3	0.6	4.1	
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 ($T_a = 25^\circ\text{C}$, Input $t_r = t_f = 2.0 \text{ ns}$, $C_L = 30 \text{ pF}$)

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

(Note 12) : Parameter guaranteed by design.

Capacitive characteristics ($T_a = 25^\circ\text{C}$)

PARAMETER	SYMBOL	TEST CONDITION	$V_{CC} (\text{V})$	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}	$f_{IN} = 10 \text{ MHz}$ (Note 13)	1.8, 2.5, 3.3	20	pF

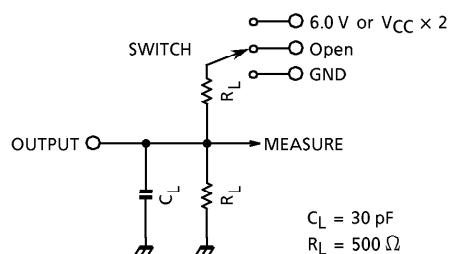
(Note 13) : C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load.

Average operating current can be obtained by the equation :

$$I_{CC}(\text{opr.}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/4 \text{ (per bit)}$$

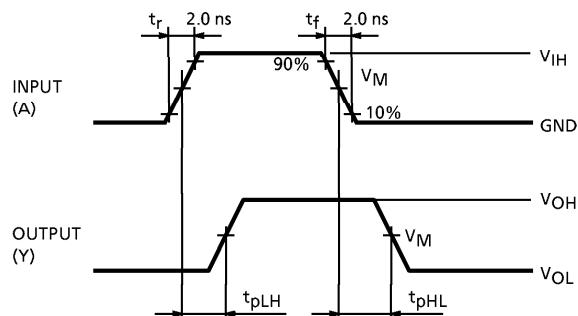
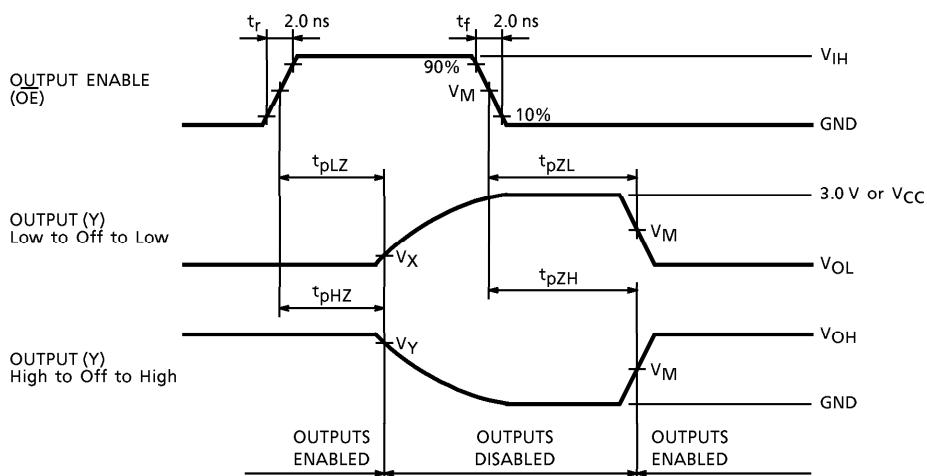
TEST CIRCUIT

Fig.1



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

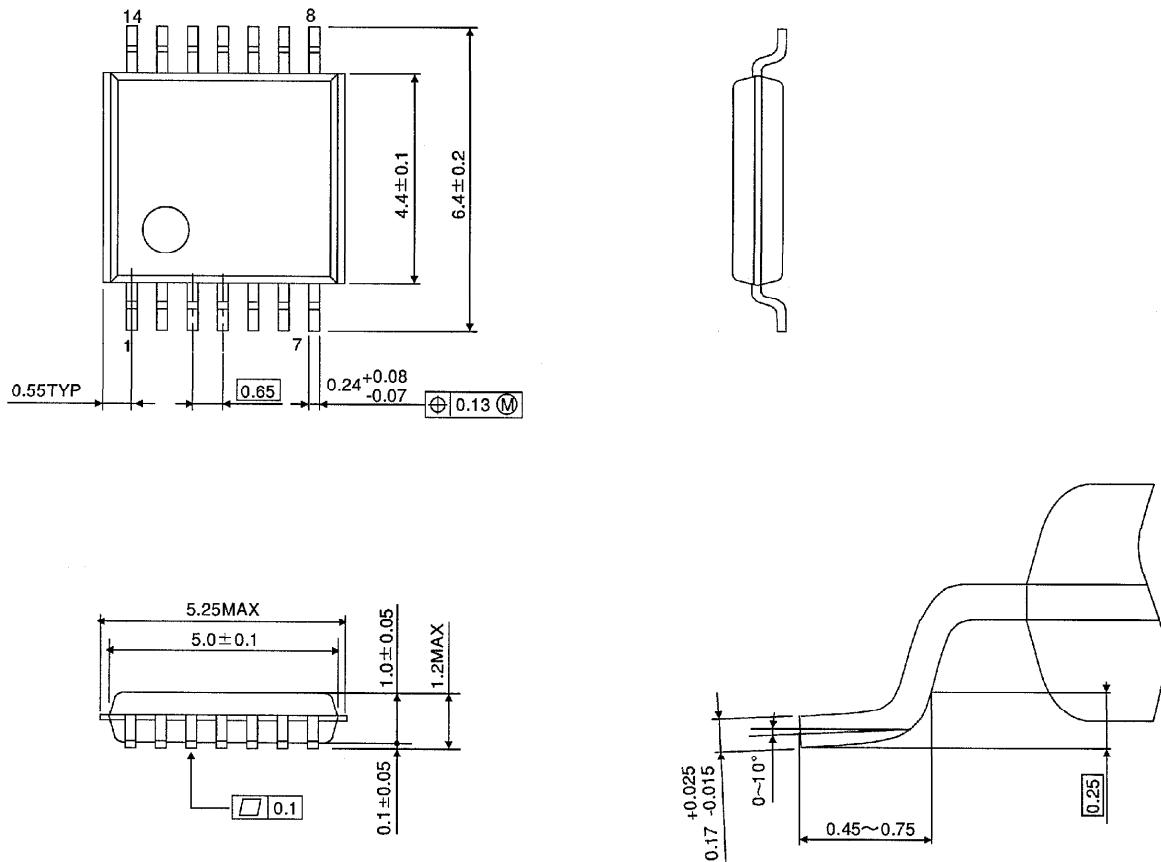
AC WAVEFORM

Fig.2 t_{pLH}, t_{pHL} Fig.3 $t_{pLZ}, t_{pHZ}, t_{pZL}, t_{pZH}$ 

SYMBOL	V_{CC}		
	$3.3 \pm 0.3 \text{ V}$	$2.5 \pm 0.2 \text{ V}$	1.8 V
V_{IH}	2.7V	V_{CC}	V_{CC}
V_M	1.5V	$V_{CC}/2$	$V_{CC}/2$
V_X	$V_{OL} + 0.3 \text{ V}$	$V_{OL} + 0.15 \text{ V}$	$V_{OL} + 0.15 \text{ V}$
V_Y	$V_{OH} - 0.3 \text{ V}$	$V_{OH} - 0.15 \text{ V}$	$V_{OH} - 0.15 \text{ V}$

PACKAGE DIMENSIONS
TSSOP14-P-0044-0.65

Unit : mm



Weight : 0.06 g (Typ.)