

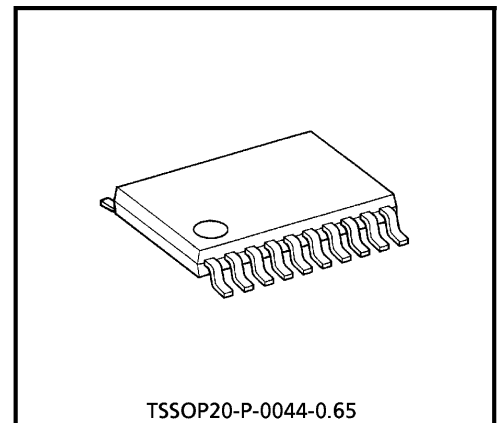
TC74VCX541FT

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

The TC74VCX541FT is a high performance CMOS OCTAL 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.

This device is a non-inverting 3-state buffer having two active-low output enables. When either $\overline{OE}1$ or $\overline{OE}2$ are high, the terminal outputs are in the 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.



TSSOP20-P-0044-0.65

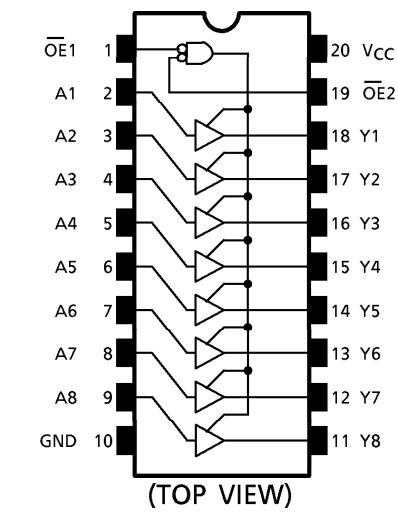
Weight : 0.08 g (Typ.)

FEATURES

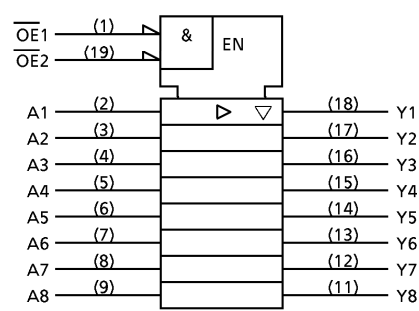
- Low Voltage Operation : $V_{CC} = 1.8 \sim 3.6 \text{ V}$
- High Speed Operation : $t_{pd} = 3.5 \text{ ns (max)}$ at $V_{CC} = 3.0 \sim 3.6 \text{ V}$
 $t_{pd} = 4.2 \text{ ns (max)}$ at $V_{CC} = 2.3 \sim 2.7 \text{ V}$
 $t_{pd} = 8.4 \text{ ns (max)}$ at $V_{CC} = 1.8 \text{ V}$
- 3.6 V Tolerant 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.

PIN ASSIGNMENT



IEC LOGIC SYMBOL



TRUTH TABLE

INPUTS			OUTPUTS
OE1	OE2	An	
H	X	X	Z
X	H	X	Z
L	L	H	H
L	L	L	L

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}	± 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): $V_{CC} = 3.0\sim 3.6\text{ V}$ (Note 8): $V_{CC} = 2.3\sim 2.7\text{ V}$ (Note 9): $V_{CC} = 1.8\text{ V}$ (Note 10): $V_{IN} = 0.8\sim 2.0\text{ V}$, $V_{CC} = 3.0\text{ V}$

ELECTRICAL CHARACTERISTICS

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

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 CHARACTERISTICSDC characteristics ($T_a = -40\sim 85^\circ\text{C}$, $2.3\text{ V} \leq V_{CC} \leq 2.7\text{ V}$)

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 CHARACTERISTICSDC characteristics (Ta = -40~85°C, 1.8 V ≤ 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 × 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 Ω)

PARAMETER		SYMBOL	TEST CONDITION		V _{CC} (V)	MIN	MAX	UNIT
Propagation Delay Time	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	3.5	
3-State Output Enable Time	t _{pZL} t _{pZH}	(Fig.1, 3)			1.8	1.5	9.8	ns
					2.5 ± 0.2	0.8	5.5	
					3.3 ± 0.3	0.6	4.5	
3-State Output Disable Time	t _{pLZ} t _{pHZ}	(Fig.1, 3)			1.8	1.5	6.5	ns
					2.5 ± 0.2	0.8	3.6	
					3.3 ± 0.3	0.6	3.3	
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 (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 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 V _{OL}	V _{OLV}	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 V _{OH}	V _{OHV}	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): Parameter guaranteed by design.

Capacitive characteristics (Ta = 25°C)

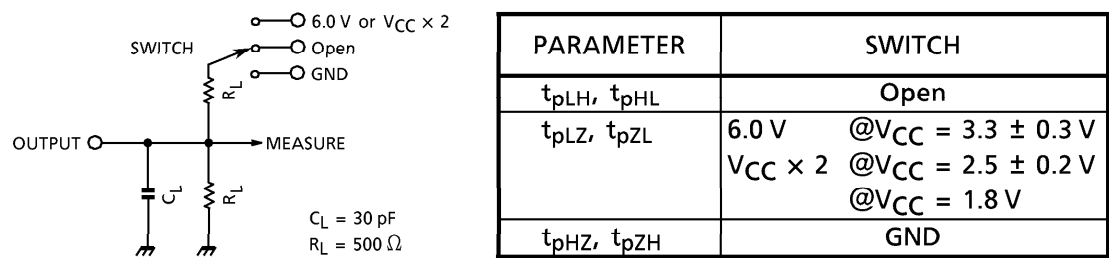
PARAMETER	SYMBOL	TEST CONDITION	V _{CC} (V)	TYP.	UNIT
Input Capacitance	C _{IN}		1.8, 2.5, 3.3	6	pF
Output Capacitance	C _{OUT}		1.8, 2.5, 3.3	7	pF
Power Dissipation Capacitance	C _{PD}	f _{IN} = 10 MHz (Note 13)	1.8, 2.5, 3.3	20	pF

(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 :

$$I_{CC(opr.)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/8 \text{ (per bit)}$$

TEST CIRCUIT
Fig.1



AC WAVEFORM

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

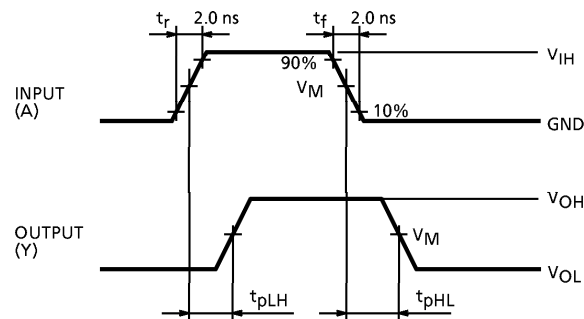
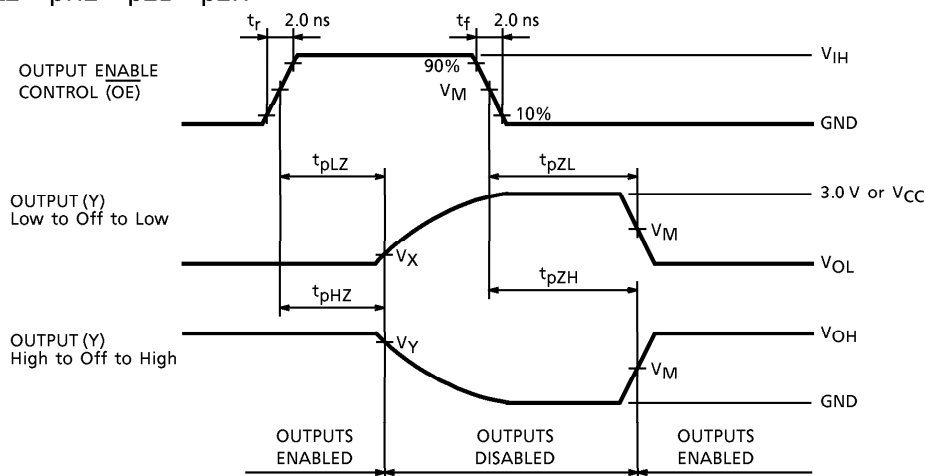


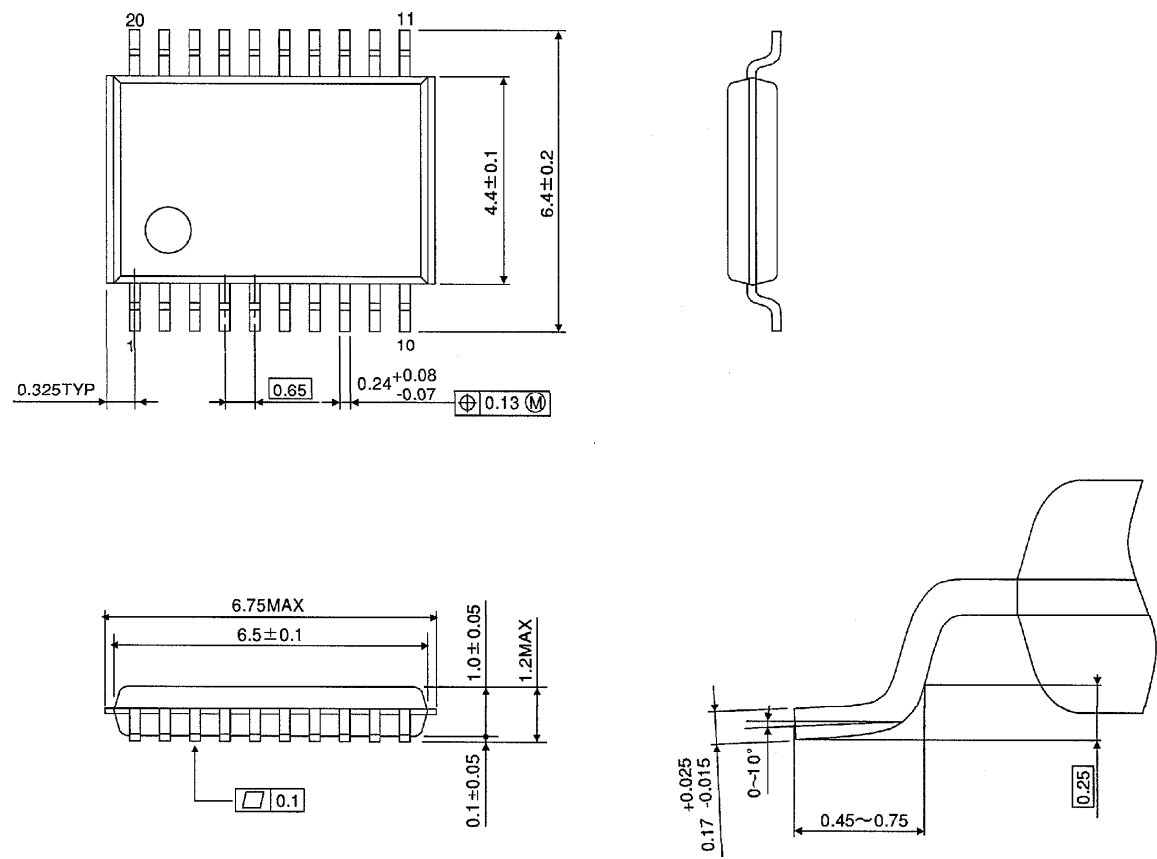
Fig.3 $t_{pLZ}, t_{pHZ}, t_{pZL}, t_{pZH}$



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

PACKAGE DIMENSIONS
TSSOP20-P-0044-0.65

Unit : mm



Weight : 0.08 g (Typ.)

RESTRICTIONS ON PRODUCT USE

000707EBA

- TOSHIBA is continually working to improve the quality and reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products could cause loss of human life, bodily injury or damage to property. In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the "Handling Guide for Semiconductor Devices," or "TOSHIBA Semiconductor Reliability Handbook" etc..
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury ("Unintended Usage"). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in this document shall be made at the customer's own risk.
- The products described in this document are subject to the foreign exchange and foreign trade laws.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA CORPORATION for any infringements of intellectual property or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any intellectual property or other rights of TOSHIBA CORPORATION or others.
- The information contained herein is subject to change without notice.