

TOSHIBA CMOS Digital Integrated Circuit Silicon Monolithic

## TC74LCX541F, TC74LCX541FT, TC74LCX541FK

### Low-Voltage Octal Bus Buffer with 5-V Tolerant Inputs and Outputs

The TC74LCX541 is a high-performance CMOS octal bus buffer. Designed for use in 3.3-V systems, it achieves high-speed operation while maintaining the CMOS low power dissipation.

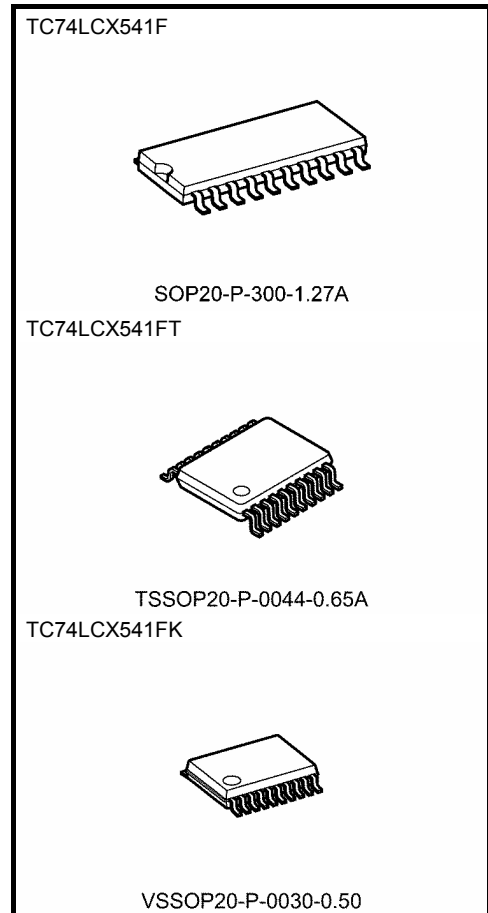
The device is designed for low-voltage (3.3 V) VCC applications, but it could be used to interface to 5 V supply environment for both inputs and outputs.

The TC74LCX541 is a non-inverting 3-state buffer having two active-low output enables. When either  $\overline{OE1}$  or  $\overline{OE2}$  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.

#### Features

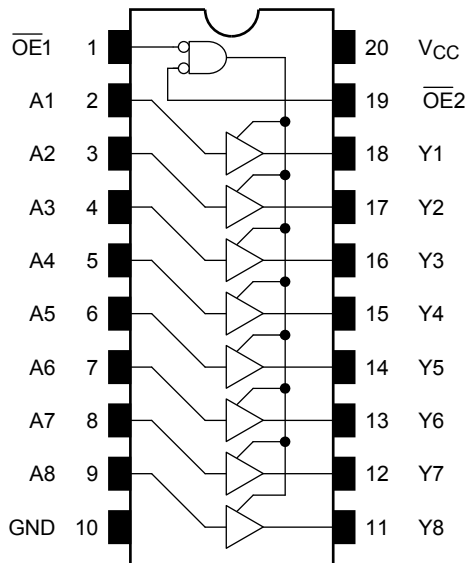
- Low-voltage operation:  $V_{CC} = 2.0$  to  $3.6$  V
- High-speed operation:  $t_{pd} = 6.5$  ns (max) ( $V_{CC} = 3.0$  to  $3.6$  V)
- Output current:  $|I_{OH}|/I_{OL} = 24$  mA (min) ( $V_{CC} = 3.0$  V)
- Latch-up performance:  $-500$  mA
- Available in JEITA SOP, TSSOP and VSSOP (US)
- Power-down protection provided on all inputs and outputs
- Pin and function compatible with the 74 series (74AC/VHC/HC/F/ALS/LS etc.) 541 type



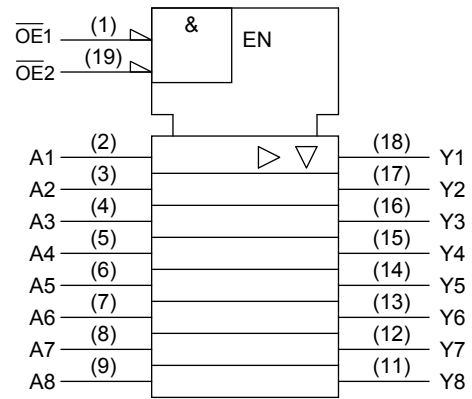
Weight:

SOP20-P-300-1.27A	: 0.22 g (typ.)
TSSOP20-P-0044-0.65A	: 0.08 g (typ.)
VSSOP20-P-0030-0.50	: 0.03 g (typ.)

**Pin Assignment (top view)**



**IEC Logic Symbol**



**Truth Table**

Inputs			Outputs
$\overline{OE1}$	$\overline{OE2}$	$A_n$	
H	X	X	Z
X	H	X	Z
L	L	H	H
L	L	L	L

X: Don't care

Z: High impedance

## Absolute Maximum Ratings (Note 1)

Characteristics	Symbol	Rating	Unit
Power supply voltage	$V_{CC}$	-0.5 to 7.0	V
DC input voltage	$V_{IN}$	-0.5 to 7.0	V
DC output voltage	$V_{OUT}$	-0.5 to 7.0 (Note 2)	V
		-0.5 to $V_{CC} + 0.5$ (Note 3)	
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	$P_D$	180	mW
DC $V_{CC}$ /ground current	$I_{CC}/I_{GND}$	±100	mA
Storage temperature	$T_{stg}$	-65 to 150	°C

Note 1: Exceeding any of the absolute maximum ratings, even briefly, lead to deterioration in IC performance or even destruction.

Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings and the operating ranges.

Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook ("Handling Precautions"/"Derating Concept and Methods") and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

Note 2: Output in OFF state

Note 3: High or low state.  $I_{OUT}$  absolute maximum rating must be observed.

Note 4:  $V_{OUT} < GND$ ,  $V_{OUT} > V_{CC}$

## Operating Ranges (Note 1)

Characteristics	Symbol	Rating	Unit
Power supply voltage	$V_{CC}$	2.0 to 3.6	V
		1.5 to 3.6 (Note 2)	
Input voltage	$V_{IN}$	0 to 5.5	V
Output voltage	$V_{OUT}$	0 to 5.5 (Note 3)	V
		0 to $V_{CC}$ (Note 4)	
Output current	$I_{OH}/I_{OL}$	±24 (Note 5)	mA
		±12 (Note 6)	
Operating temperature	$T_{opr}$	-40 to 85	°C
Input rise and fall time	$dt/dv$	0 to 10 (Note 7)	ns/V

Note 1: The operating ranges must be maintained to ensure the normal operation of the device. Unused inputs must be tied to either  $V_{CC}$  or GND.

Note 2: Data retention only

Note 3: Output in OFF state

Note 4: High or low state

Note 5:  $V_{CC} = 3.0$  to 3.6 V

Note 6:  $V_{CC} = 2.7$  to 3.0 V

Note 7:  $V_{IN} = 0.8$  to 2.0 V,  $V_{CC} = 3.0$  V

## Electrical Characteristics

### DC Characteristics (Ta = -40 to 85°C)

Characteristics		Symbol	Test Condition	V <sub>CC</sub> (V)	Min	Max	Unit
Input voltage	H-level	V <sub>IH</sub>	—	2.7 to 3.6	2.0	—	V
	L-level	V <sub>IL</sub>	—	2.7 to 3.6	—	0.8	
Output voltage	H-level	V <sub>OH</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = -100 μA	2.7 to 3.6	V <sub>CC</sub> - 0.2	V
				I <sub>OH</sub> = -12 mA	2.7	2.2	
				I <sub>OH</sub> = -18 mA	3.0	2.4	
				I <sub>OH</sub> = -24 mA	3.0	2.2	
	L-level	V <sub>OL</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OL</sub> = 100 μA	2.7 to 3.6	—	0.2
				I <sub>OL</sub> = 12 mA	2.7	—	0.4
				I <sub>OL</sub> = 16 mA	3.0	—	0.4
				I <sub>OL</sub> = 24 mA	3.0	—	0.55
Input leakage current		I <sub>IN</sub>	V <sub>IN</sub> = 0 to 5.5 V	2.7 to 3.6	—	±5.0	μA
3-state output off-state current		I <sub>OZ</sub>	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> V <sub>OUT</sub> = 0 to 5.5 V	2.7 to 3.6	—	±5.0	μA
Power off leakage current		I <sub>OFF</sub>	V <sub>IN</sub> /V <sub>OUT</sub> = 5.5 V	0	—	10.0	μA
Quiescent supply current		I <sub>CC</sub>	V <sub>IN</sub> = V <sub>CC</sub> or GND	2.7 to 3.6	—	10.0	μA
			V <sub>IN</sub> /V <sub>OUT</sub> = 3.6 to 5.5 V	2.7 to 3.6	—	±10.0	
Increase in I <sub>CC</sub> per input		ΔI <sub>CC</sub>	V <sub>IH</sub> = V <sub>CC</sub> - 0.6 V	2.7 to 3.6	—	500	

### AC Characteristics (Ta = -40 to 85°C)

Characteristics		Symbol	Test Condition	V <sub>CC</sub> (V)	Min	Max	Unit
Propagation delay time	t <sub>pLH</sub>	t <sub>pHL</sub>	Figure 1, Figure 2	2.7	—	7.5	ns
	3.3 ± 0.3			1.5	6.5		
Output enable time	t <sub>pZL</sub>	t <sub>pZH</sub>	Figure 1, Figure 3	2.7	—	9.5	ns
	3.3 ± 0.3			1.5	8.5		
Output disable time	t <sub>pLZ</sub>	t <sub>pHZ</sub>	Figure 1, Figure 3	2.7	—	8.5	ns
	3.3 ± 0.3			1.5	7.5		
Output to output skew	t <sub>osLH</sub>	t <sub>osHL</sub>	(Note)	2.7	—	—	ns
	3.3 ± 0.3			—	1.0		

Note: Parameter guaranteed by design.  
 (t<sub>osLH</sub> = |t<sub>pLHm</sub> - t<sub>pLHn</sub>|, t<sub>osHL</sub> = |t<sub>pHLm</sub> - t<sub>pHLn</sub>|)

### Dynamic Switching Characteristics (Ta = 25°C, input: t<sub>r</sub> = t<sub>f</sub> = 2.5 ns, C<sub>L</sub> = 50 pF, R<sub>L</sub> = 500 Ω)

Characteristics		Symbol	Test Condition	V <sub>CC</sub> (V)	Typ.	Unit
Quiet output maximum dynamic	V <sub>OL</sub>	V <sub>OLP</sub>	V <sub>IH</sub> = 3.3 V, V <sub>IL</sub> = 0 V	3.3	0.8	V
Quiet output minimum dynamic	V <sub>OL</sub>	V <sub>OLV</sub>	V <sub>IH</sub> = 3.3 V, V <sub>IL</sub> = 0 V	3.3	0.8	V

## Capacitive Characteristics (Ta = 25°C)

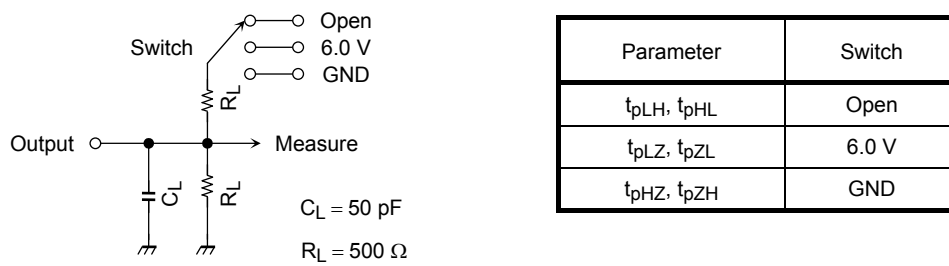
Characteristics	Symbol	Test Condition	V <sub>CC</sub> (V)	Typ.	Unit
Input capacitance	C <sub>IN</sub>	—	3.3	7	pF
Output capacitance	C <sub>OUT</sub>	—	3.3	8	pF
Power dissipation capacitance	C <sub>PD</sub>	f <sub>IN</sub> = 10 MHz (Note)	3.3	40	pF

Note: C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption.

Average operating current can be obtained by the equation:

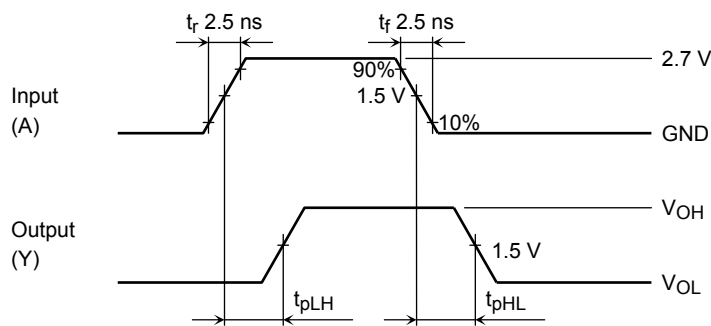
$$I_{CC(opr)} = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}/8 \text{ (per bit)}$$

## AC Test Circuit

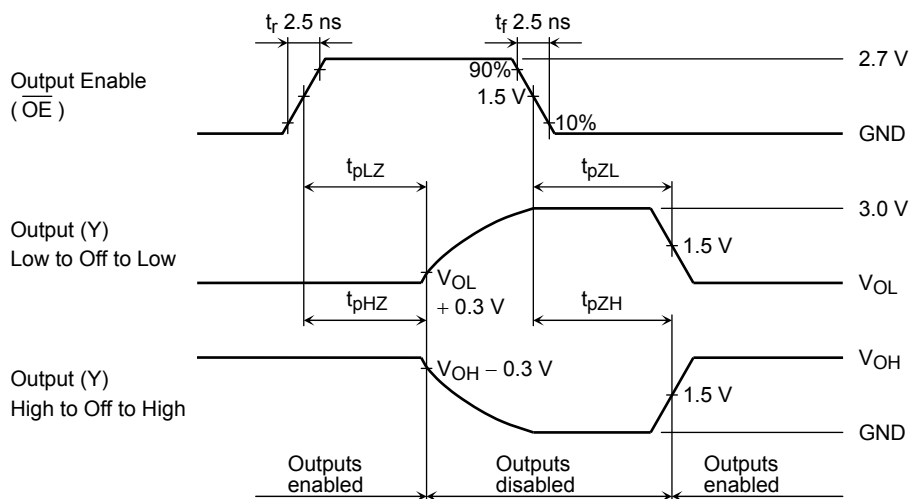


**Figure 1**

## AC Waveform



**Figure 2**  $t_{pLH}$ ,  $t_{pHL}$



**Figure 3**  $t_{pLZ}$ ,  $t_{pHZ}$ ,  $t_{pZL}$ ,  $t_{pZH}$

## Package Dimensions

SOP20-P-300-1.27A

Unit: mm

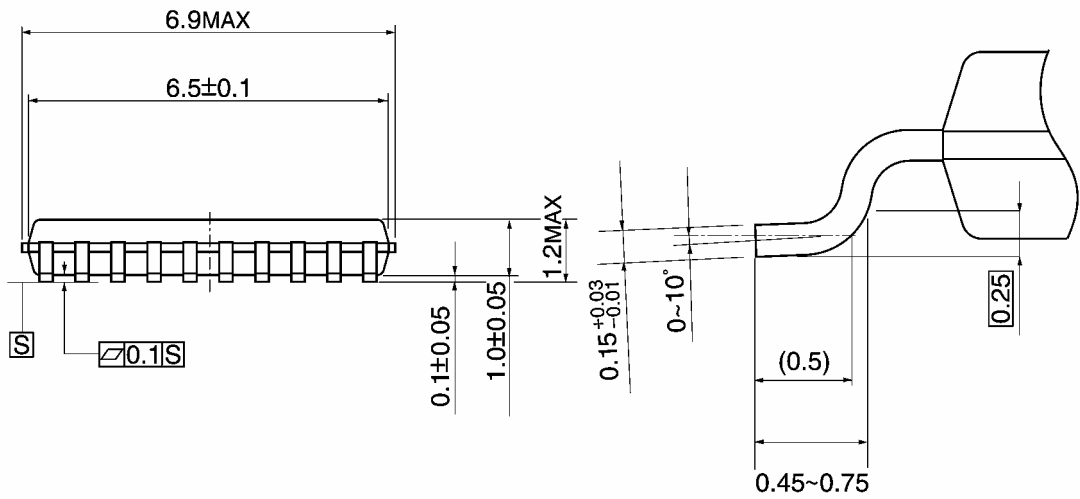


Weight: 0.22 g (typ.)

**Package Dimensions**

TSSOP20-P-0044-0.65A

Unit: mm



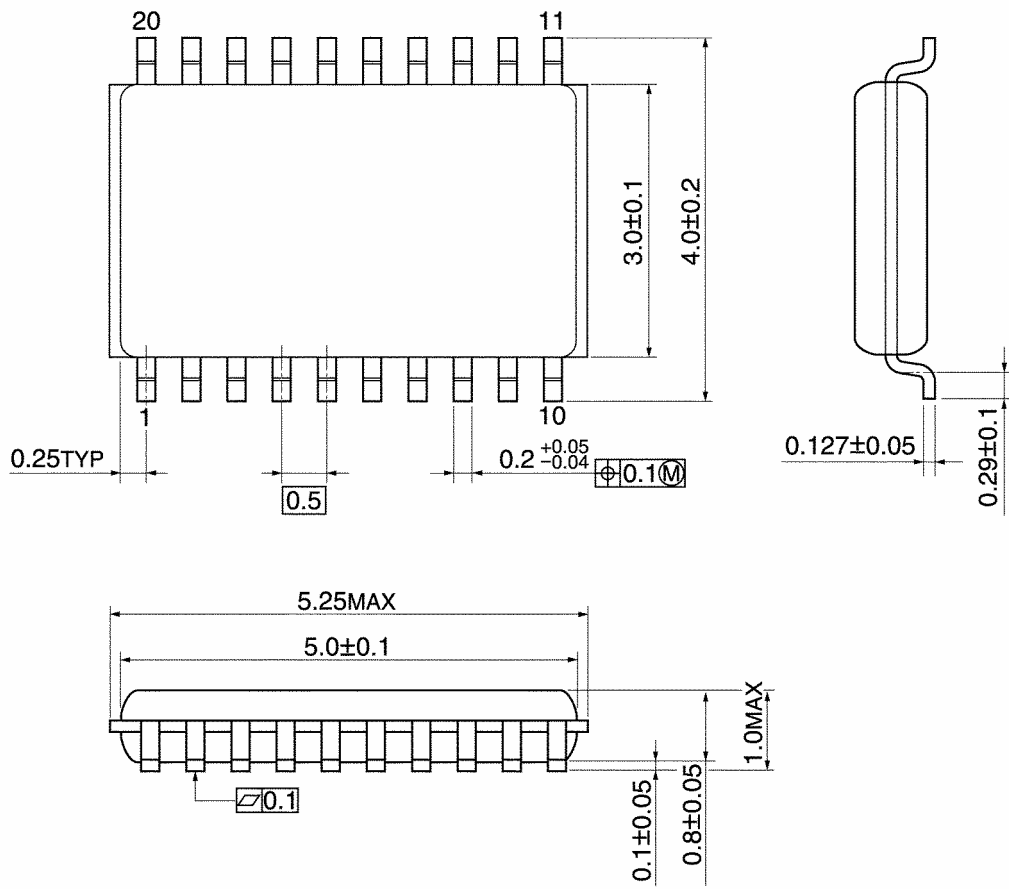
Weight: 0.08 g (typ.)



**Package Dimensions**

VSSOP20-P-0030-0.50

Unit: mm



Weight: 0.03 g (typ.)

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20070701-EN GENERAL

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