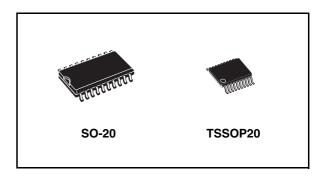


## 74LCX541

# Low voltage CMOS octal bus buffer (3-state) with 5V tolerant inputs and outputs

#### **Features**

- 5V tolerant inputs and outputs
- High speed:
  - t<sub>PD</sub> = 8.0ns (Max) at V<sub>CC</sub> = 3V
- Power down protection on inputs and outputs
- Symmetrical output impedance:
  - $II_{OH}I = I_{OL} = 24mA$  (Min) at  $V_{CC} = 3V$
- PCI bus levels guaranteed at 24mA
- Balanced propagation delays:
  - $t_{PLH} \cong t_{PHL}$
- Operating voltage range:
  - V<sub>CC</sub> (Opr) = 2.0V to 3.6V
- Pin and function compatible with 74 series 541
- Latch-up performance exceeds 500mA (JESD 17)
- ESD performance:
  - HBM > 2000V (MIL STD 883 method 3015); MM > 200V



#### **Description**

The 74LCX541 is a low voltage CMOS octal bus buffer (non-inverted) fabricated with sub-micron silicon gate and double-layer metal wiring C<sup>2</sup>MOS technology. It is ideal for low power and high speed 3.3V applications; it can be interfaced to 5V signal environment for both inputs and outputs.

The 3 STATE control gate operates as two input AND such that if either G1 and G2 are high, all eight outputs are in the high impedance state. In order to enhance PC board layout the 74LCX541 offers a pinout having inputs and outputs on opposite sides of the package.

It has same speed performance at 3.3V than 5V AC/ACT family, combined with a lower power consumption.

All inputs and outputs are equipped with protection circuits against static discharge, giving them 2KV ESD immunity and transient excess voltage.

#### Order codes

Part number	Package	Packaging
74LCX541MTR	SO-20	Tape and reel
74LCX541TTR	TSSOP20	Tape and reel

January 2007 Rev 5 1/17

Contents 74LCX541

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## 1 Logic symbols and I/O equivalent circuit

Figure 1. IEC logic symbols

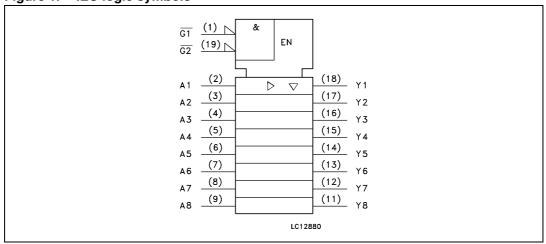
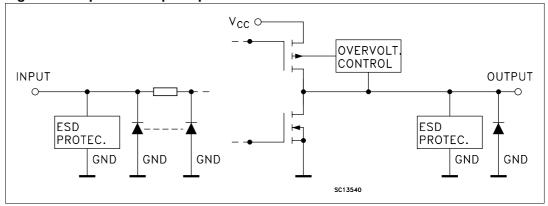


Figure 2. Input and output equivalent circuit

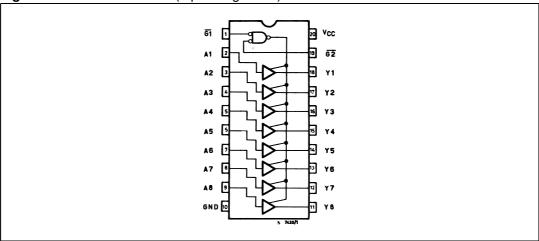


Pin settings 74LCX541

## 2 Pin settings

#### 2.1 Pin connection

Figure 3. Pin connection (top through view)



## 2.2 Pin description

Table 1. Pin description

Pin N°	Symbol	Name and function
1, 19	G1, G2	Output enable inputs
2, 3, 4, 5, 6, 7, 8, 9	A1 to A8	Data inputs
18, 17, 16, 15, 14, 13, 12, 11	₹1 to ₹8	Data outputs
10	GND	Ground (0V)
20	V <sub>CC</sub>	Positive supply voltage

74LCX541 Logic states

# 3 Logic states

#### 3.1 Truth table

Table 2. Truth table

Input			Output
G1	G2	An	Ϋ́n
Н	X	Х	Z
Х	Н	Х	Z
L	L	Н	L
L	L	L	Н

Note: X : Do not care

Z: High impedance

Maximum rating 74LCX541

## 4 Maximum rating

Stressing the device above the rating listed in the "absolute maximum ratings" table may cause permanent damage to the device. these are stress ratings only and operation of the device at these or any other conditions above those indicated in the operating sections of this specification is not implied. exposure to absolute maximum rating conditions for extended periods may affect device reliability. refer also to the STMicroelectronics sure program and other relevant quality documents.

Table 3. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	Supply voltage	-0.5 to +7.0	V
VI	DC input voltage	-0.5 to +7.0	٧
Vo	DC output voltage (OFF state)	-0.5 to +7.0	٧
Vo	DC output voltage (high or low state) (1)	-0.5 to V <sub>CC</sub> + 0.5	٧
I <sub>IK</sub>	DC input diode current	-50	mA
I <sub>OK</sub>	DC output diode current (2)	-50	mA
Io	DC output current	±50	mA
I <sub>CC</sub>	DC supply current per supply pin	± 100	mA
I <sub>GND</sub>	DC ground current per supply pin	± 100	mA
T <sub>stg</sub>	Storage temperature	-65 to +150	°C
T <sub>L</sub>	Lead temperature (10 sec)	300	°C

<sup>1.</sup>  $I_O$  absolute maximum rating must be observed

### 4.1 Recommended operating conditions

Table 4. Recommended operating conditions

Symsbol	Parameter	Value	Unit
V <sub>CC</sub>	Supply voltage <sup>(1)</sup>	2.0 to 3.6	V
V <sub>I</sub>	Input voltage	0 to 5.5	٧
V <sub>O</sub>	Output voltage (OFF state)	0 to 5.5	٧
V <sub>O</sub>	Output voltage (high or low state)	0 to V <sub>CC</sub>	٧
I <sub>OH</sub> , I <sub>OL</sub>	High or low level output current (V <sub>CC</sub> = 3.0 to 3.6V)	± 24	mA
I <sub>OH</sub> , I <sub>OL</sub>	High or low level output current (V <sub>CC</sub> = 2.7V)	± 12	mA
T <sub>op</sub>	Operating temperature	-40 to 85	°C
dt/dv	Input rise and fall time (2)	0 to 10	ns/V

<sup>1.</sup> Truth table guaranteed: 1.5V to 3.6V

<sup>2.</sup>  $V_O < GND$ 

<sup>2.</sup>  $V_{IN}$  from 0.8V to 2V at  $V_{CC} = 3.0V$ 

## 5 Electrical characteristics

**Table 5. DC specifications** 

		Te	est condition	Val		
Symbol	Parameter	V <sub>CC</sub>		-40 to	85°C	Unit
		(V)		Min	Max	
V <sub>IH</sub>	High level input voltage	2.7 to 3.6		2.0		٧
$V_{IL}$	Low level input voltage	2.7 10 0.0			0.8	٧
		2.7 to 3.6	I <sub>O</sub> = -100μA	V <sub>CC</sub> -0.2		
V <sub>OH</sub>	High level output voltage	2.7	I <sub>O</sub> = -12mA	2.2		V
VOH	High level output voltage	3.0	I <sub>O</sub> = -18mA	2.4		\ \
		I <sub>O</sub> = -24mA	I <sub>O</sub> = -24mA	2.2		
		2.7 to 3.6	I <sub>O</sub> = 100μA		0.2	
V.		2.7	I <sub>O</sub> = 12mA		0.4	.,
V <sub>OL</sub>	Low level output voltage	2.0	I <sub>O</sub> = 16mA		0.4	V
		3.0	I <sub>O</sub> = 24mA		0.55	
l <sub>l</sub>	Input leakage current	2.7 to 3.6	V <sub>I</sub> = 0 to 5.5V		± 5	μА
I <sub>off</sub>	Power OFF leakage current	0	$V_I$ or $V_O = 5.5V$		10	μΑ
l <sub>OZ</sub>	High impedance output leakage current	2.7 to 3.6	$V_I = V_{IH} \text{ or } V_{IL}$ $V_O = 0 \text{ to } V_{CC}$		± 5	μΑ
	Outro and a second	0.74- 0.0	$V_I = V_{CC}$ or GND		10	
I <sub>CC</sub>	Quiescent supply current	2.7 to 3.6	$V_1$ or $V_0 = 3.6$ to 5.5V		± 10	μA
$\Delta I_{CC}$	I incr. per Input	2.7 to 3.6	V <sub>IH</sub> = V <sub>CC</sub> - 0.6V		500	μА

**Table 6. Dynamic switching characteristics** 

. ubio 0. b	ymannio omnoming omai	40101101100					
			st condition	ondition Value			
Symbol	Parameter	V <sub>CC</sub>		Т,	<sub>A</sub> = 25 °	,C	Unit
		(V)		Min	Тур	Max	
V <sub>OLP</sub>	Dynamic low level quiet	3.3	$C_L = 50pF$ $V_{IL} = 0V, V_{IH} = 3.3V$		0.8		V
V <sub>OLV</sub>	output <sup>(1)</sup>	3.3	$V_{IL} = 0V, V_{IH} = 3.3V$		-0.8		\ \

Number of outputs defined as "n". Measured with "n-1" outputs switching from HIGH to LOW or LOW to HIGH. The remaining output is measured in the LOW state.

Electrical characteristics 74LCX541

Table 7. AC electrical characteristics

			Test cor	ndition		Va	lue	
Symbol	Parameter	V <sub>CC</sub>	CL	C <sub>L</sub> R <sub>L</sub>		-40 to	85 °C	Unit
		(V)	(pF)	<b>(</b> Ω <b>)</b>	(ns)	Min	Max	
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation delay	2.7	50	500	2.5	1.5	9.0	ns
	time	3.0 to 3.6				1.5	8.0	
t <sub>PZL</sub> t <sub>PZH</sub>	Output enable	2.7	50	500	2.5	1.5	9.5	ns
	time	3.0 to 3.6				1.5	8.5	
t <sub>PLZ</sub> t <sub>PHZ</sub>	Output disable	2.7	50	500	2.5	1.5	8.5	ns
	time	3.0 to 3.6				1.5	7.5	
t <sub>OSLH</sub> t <sub>OSHL</sub>	output to output skew time (1) (2)	3.0 to 3.6	50	500	2.5		1.0	ns

Skew is defined as the absolute value of the difference between the actual propagation delay for any two
outputs of the same device switching in the same direction, either HIGH or LOW (t<sub>OSLH</sub> = I t<sub>PLHm</sub> - t<sub>PLHn</sub>I,
t<sub>OSHL</sub> = I t<sub>PHLm</sub> - t<sub>PHLn</sub>I)

**Table 8. Capacitive characteristics** 

		Test condition			Value		
Symbol	Parameter	V <sub>CC</sub>		T <sub>A</sub> = 25 °C		Unit	
		(V)		Min	Тур	Max	
C <sub>IN</sub>	Input capacitance	3.3	$V_{IN} = 0$ to $V_{CC}$		6		pF
C <sub>OUT</sub>	Output capacitance	3.3	$V_{IN} = 0$ to $V_{CC}$		12		pF
C <sub>PD</sub>	Power dissipation capacitance (1)	3.3	$f_{IN} = 10MHz$ $V_{IN} = 0 \text{ or } V_{CC}$		25		pF

C<sub>PD</sub> is defined as the value of the IC's internal equivalent capacitance which is calculated from the
operating current consumption without load. (Refer to Test Circuit). Average operating current can be
obtained by the following equation. I<sub>CC(opr)</sub> = C<sub>PD</sub> x V<sub>CC</sub> x f<sub>IN</sub> + I<sub>CC</sub>/8 (per buffer)

<sup>2.</sup> Parameter guaranteed by design

74LCX541 Test circuit

## 6 Test circuit

Figure 4. Test circuit

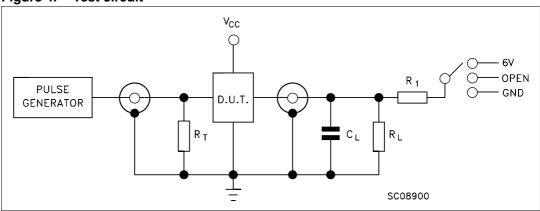


Figure 5. Test circuit

Test	Switch
t <sub>PLH</sub> , t <sub>PHL</sub>	Open
t <sub>PZL</sub> , t <sub>PLZ</sub>	6V
t <sub>PZH</sub> , t <sub>PHZ</sub>	GND

 $C_L = 50 pF$  or equivalent (includes jig and probe capacitance)

 $R_L = R_1 = 500\Omega$  or equivalent

 $R_T = Z_{OUT}$  of pulse generator (typically  $50\Omega$ )

Waveforms 74LCX541

## 7 Waveforms



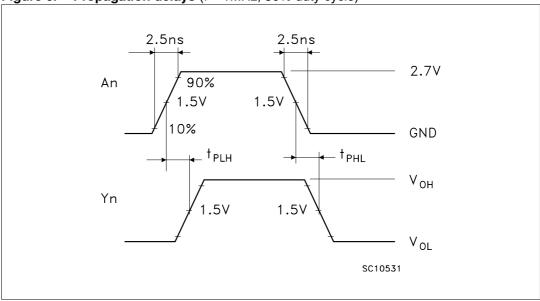
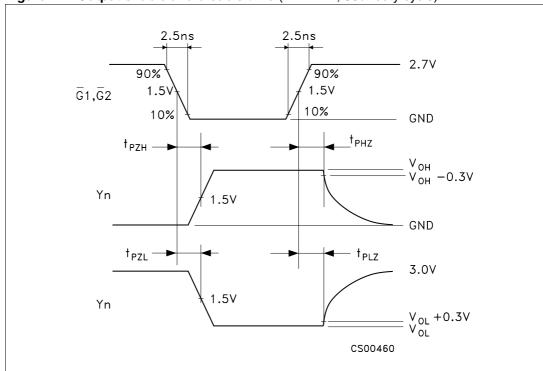


Figure 7. Output enable and disable time (f = 1MHz; 50% duty cycle)

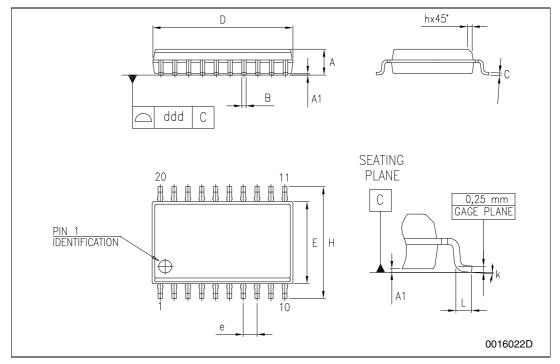


## 8 Package mechanical data

In order to meet environmental requirements, ST offers these devices in ECOPACK® packages. These packages have a Lead-free second level interconnect . The category of second level interconnect is marked on the package and on the inner box label, in compliance with JEDEC Standard JESD97. The maximum ratings related to soldering conditions are also marked on the inner box label. ECOPACK is an ST trademark. ECOPACK specifications are available at: www.st.com

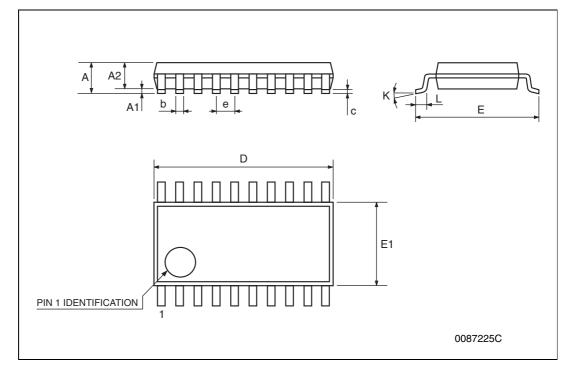
SO-20 MECHANICAL DA	ATA
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DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
Α	2.35		2.65	0.093		0.104
A1	0.1		0.30	0.004		0.012
В	0.33		0.51	0.013		0.020
С	0.23		0.32	0.009		0.013
D	12.60		13.00	0.496		0.512
E	7.4		7.6	0.291		0.299
е		1.27			0.050	
Н	10.00		10.65	0.394		0.419
h	0.25		0.75	0.010		0.030
L	0.4		1.27	0.016		0.050
k	0°		8°	0°		8°
ddd			0.100			0.004



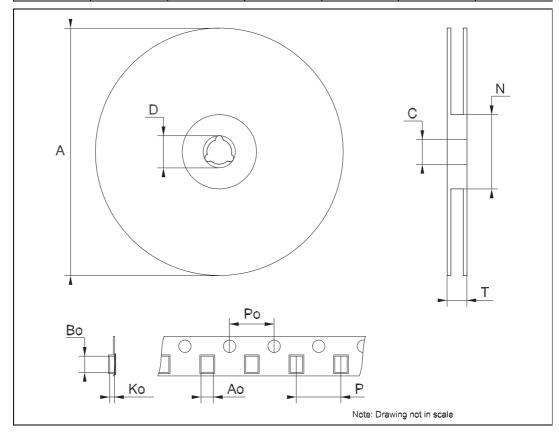
## TSSOP20 MECHANICAL DATA

DIM.	mm.			inch		
DIWI.	MIN.	ТҮР	MAX.	MIN.	TYP.	MAX.
А			1.2			0.047
A1	0.05		0.15	0.002	0.004	0.006
A2	0.8	1	1.05	0.031	0.039	0.041
b	0.19		0.30	0.007		0.012
С	0.09		0.20	0.004		0.0079
D	6.4	6.5	6.6	0.252	0.256	0.260
E	6.2	6.4	6.6	0.244	0.252	0.260
E1	4.3	4.4	4.48	0.169	0.173	0.176
е		0.65 BSC			0.0256 BSC	
К	0°		8°	0°		8°
L	0.45	0.60	0.75	0.018	0.024	0.030



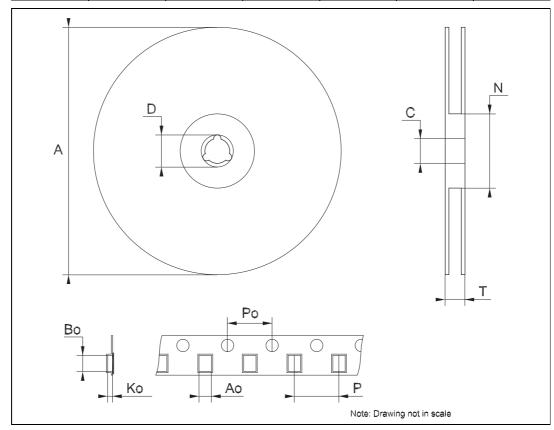
Tape & Re	el SO-20	<b>MECHANICAL</b>	DATA
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DIM.	mm.			inch		
DIW.	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
Α			330			12.992
С	12.8		13.2	0.504		0.519
D	20.2			0.795		
N	60			2.362		
Т			30.4			1.197
Ao	10.8		11	0.425		0.433
Во	13.2		13.4	0.520		0.528
Ko	3.1		3.3	0.122		0.130
Po	3.9		4.1	0.153		0.161
Р	11.9		12.1	0.468		0.476



Tape & Reel TSSOP20 MECHANICAL DATA

	mm.			inch		
DIM.	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
Α			330			12.992
С	12.8		13.2	0.504		0.519
D	20.2			0.795		
N	60			2.362		
Т			22.4			0.882
Ao	6.8		7	0.268		0.276
Во	6.9		7.1	0.272		0.280
Ko	1.7		1.9	0.067		0.075
Po	3.9		4.1	0.153		0.161
Р	11.9		12.1	0.468		0.476



Revision history 74LCX541

# 9 Revision history

Table 9. Revision history

Date	Revision	Changes
15-Sep-2004	4	Ordering Codes Revision - pag. 1.
24-Jan-2007	5	The document has been reformatted, temperature ranges updated

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