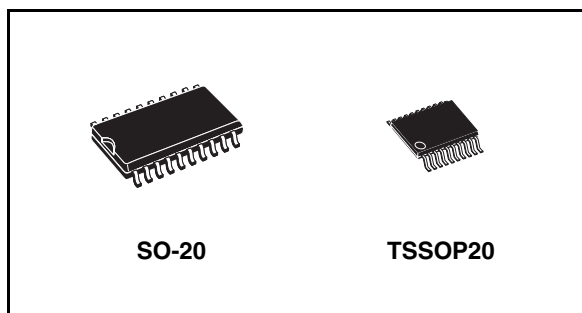# 74LCX541

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

Features

- 5V tolerant inputs and outputs
- High speed:
  - t_{PD} = 8.0ns (Max) at V_{CC} = 3V
- Power down protection on inputs and outputs
- Symmetrical output impedance:
  - $|I_{OH}|$ = 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_{CC} (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

SO-20   **TSSOP20**

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^{2}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

Contents

1   Logic symbols and I/O equivalent circuit
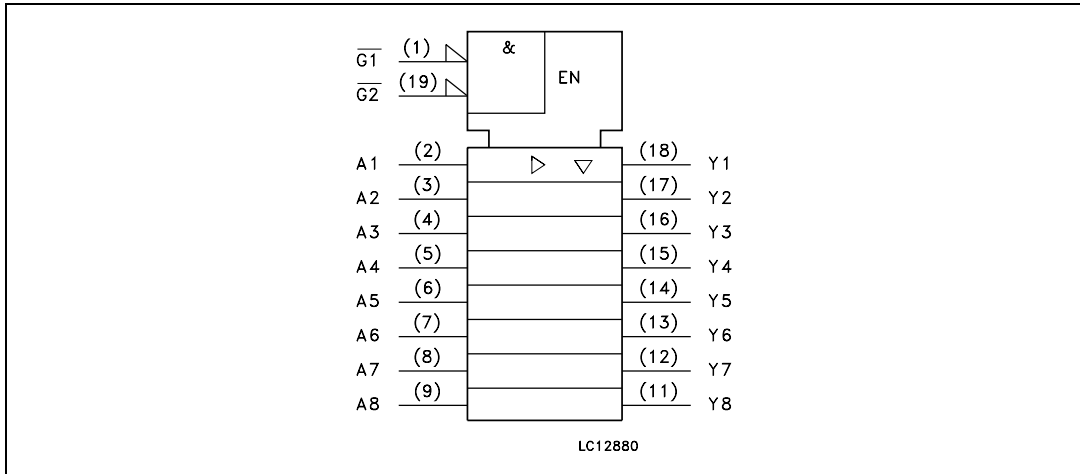
Figure 1.   IEC logic symbols

Figure 2.   Input and output equivalent circuit
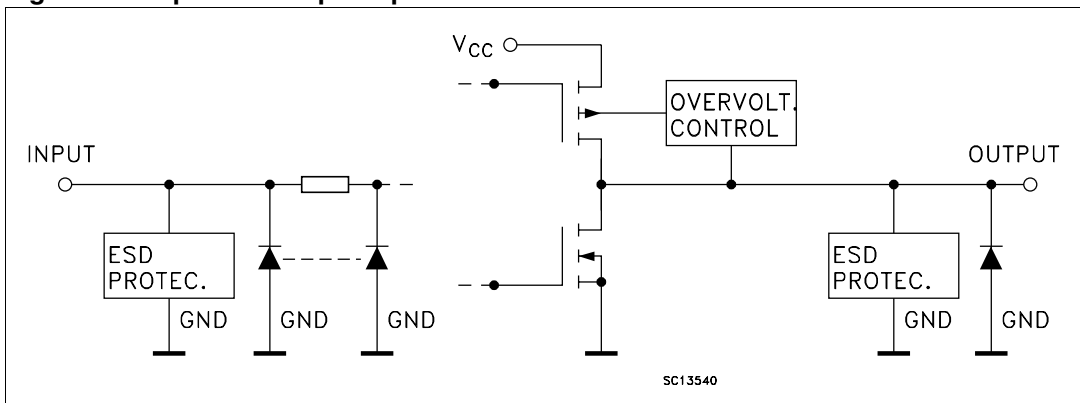
2 Pin settings

2.1 Pin connection

Figure 3.   Pin connection (top through view)
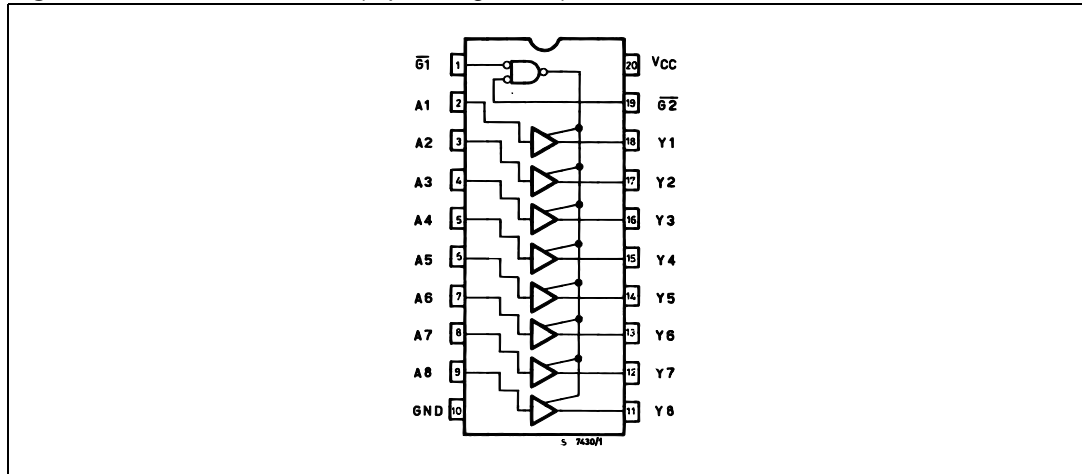
2.2 Pin description

Table 1. Pin description

Pin N°	Symbol	Name and function
1, 19	$\overline{G1}$, $\overline{G2}$	Output enable inputs
2, 3, 4, 5, 6, 7, 8, 9	A1 to A8	Data inputs
18, 17, 16, 15, 14, 13, 12, 11	$\overline{Y1}$ to $\overline{Y8}$	Data outputs
10	GND	Ground (0V)
20	V_{CC}	Positive supply voltage

3 Logic states

3.1 Truth table

Table 2. Truth table

Input			Output
$\overline{G1}$	$\overline{G2}$	An	$\overline{Yn}$
H	X	X	Z
X	H	X	Z
L	L	H	L
L	L	L	H

Note: *X : Do not care*

            Z : High impedance

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_{CC}	Supply voltage	-0.5 to +7.0	V
V_I	DC input voltage	-0.5 to +7.0	V
V_O	DC output voltage (OFF state)	-0.5 to +7.0	V
V_O	DC output voltage (high or low state) [1]	-0.5 to V_{CC} + 0.5	V
I_{IK}	DC input diode current	-50	mA
I_{OK}	DC output diode current [2]	-50	mA
I_O	DC output current	±50	mA
I_{CC}	DC supply current per supply pin	± 100	mA
I_{GND}	DC ground current per supply pin	± 100	mA
T_{stg}	Storage temperature	-65 to +150	°C
T_L	Lead temperature (10 sec)	300	°C

1. I_O absolute maximum rating must be observed

2. V_O < GND

4.1   Recommended operating conditions

Table 4. Recommended operating conditions

Symsbol	Parameter	Value	Unit
V_{CC}	Supply voltage [1]	2.0 to 3.6	V
V_I	Input voltage	0 to 5.5	V
V_O	Output voltage (OFF state)	0 to 5.5	V
V_O	Output voltage (high or low state)	0 to V_{CC}	V
I_{OH}, I_{OL}	High or low level output current (V_{CC} = 3.0 to 3.6V)	± 24	mA
I_{OH}, I_{OL}	High or low level output current (V_{CC} = 2.7V)	± 12	mA
T_{op}	Operating temperature	-40 to 85	°C
dt/dv	Input rise and fall time [2]	0 to 10	ns/V

1. Truth table guaranteed: 1.5V to 3.6V

2. V_{IN} from 0.8V to 2V at V_{CC} = 3.0V

5 Electrical characteristics

Table 5. DC specifications

Symbol	Parameter	Test condition		Value		Unit
		V_{CC} (V)		-40 to 85°C		
				Min	Max	
V_{IH}	High level input voltage	2.7 to 3.6		2.0		V
V_{IL}	Low level input voltage				0.8	V
V_{OH}	High level output voltage	2.7 to 3.6	I_O = -100μA	V_{CC}-0.2		V
		2.7	I_O = -12mA	2.2		
		3.0	I_O = -18mA	2.4		
			I_O = -24mA	2.2		
V_{OL}	Low level output voltage	2.7 to 3.6	I_O = 100μA		0.2	V
		2.7	I_O = 12mA		0.4	
		3.0	I_O = 16mA		0.4	
			I_O = 24mA		0.55	
I_I	Input leakage current	2.7 to 3.6	V_I = 0 to 5.5V		± 5	μA
I_{off}	Power OFF leakage current	0	V_I or V_O = 5.5V		10	μA
I_{OZ}	High impedance output leakage current	2.7 to 3.6	V_I = V_{IH} or V_{IL} V_O = 0 to V_{CC}		± 5	μA
I_{CC}	Quiescent supply current	2.7 to 3.6	V_I = V_{CC} or GND		10	μA
			V_I or V_O = 3.6 to 5.5V		± 10	
ΔI_{CC}	I incr. per Input	2.7 to 3.6	V_{IH} = V_{CC} - 0.6V		500	μA

Table 6. Dynamic switching characteristics

Symbol	Parameter	Test condition		Value			Unit
		V_{CC} (V)		T_A = 25 °C			
				Min	Typ	Max	
V_{OLP}	Dynamic low level quiet output [1]	3.3	C_L = 50pF V_{IL} = 0V, V_{IH} = 3.3V		0.8		V
V_{OLV}					-0.8		

1. 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.

Table 7. AC electrical characteristics

Symbol	Parameter	Test condition				Value		Unit
		V_{CC} (V)	C_L (pF)	R_L (Ω)	$t_s = t_r$ (ns)	-40 to 85 °C		
						Min	Max	
t_{PLH} t_{PHL}	Propagation delay time	2.7	50	500	2.5	1.5	9.0	ns
		3.0 to 3.6				1.5	8.0	
t_{PZL} t_{PZH}	Output enable time	2.7	50	500	2.5	1.5	9.5	ns
		3.0 to 3.6				1.5	8.5	
t_{PLZ} t_{PHZ}	Output disable time	2.7	50	500	2.5	1.5	8.5	ns
		3.0 to 3.6				1.5	7.5	
t_{OSLH} t_{OSHL}	output to output skew time [1] [2]	3.0 to 3.6	50	500	2.5		1.0	ns

1. 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_{OSLH} = I t_{PLHm} - t_{PLHn}I, t_{OSHL} = I t_{PHLm} - t_{PHLn}I)

2. Parameter guaranteed by design

Table 8. Capacitive characteristics

Symbol	Parameter	Test condition		Value			Unit
		V_{CC} (V)		$T_A = 25$ °C			
				Min	Typ	Max	
C_{IN}	Input capacitance	3.3	V_{IN} = 0 to V_{CC}		6		pF
C_{OUT}	Output capacitance	3.3	V_{IN} = 0 to V_{CC}		12		pF
C_{PD}	Power dissipation capacitance [1]	3.3	f_{IN} = 10MHz V_{IN} = 0 or V_{CC}		25		pF

1. C_{PD} 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. $I_{CC(opr)} = C_{PD}$ x V_{CC} x f_{IN} + I_{CC}/8 (per buffer)
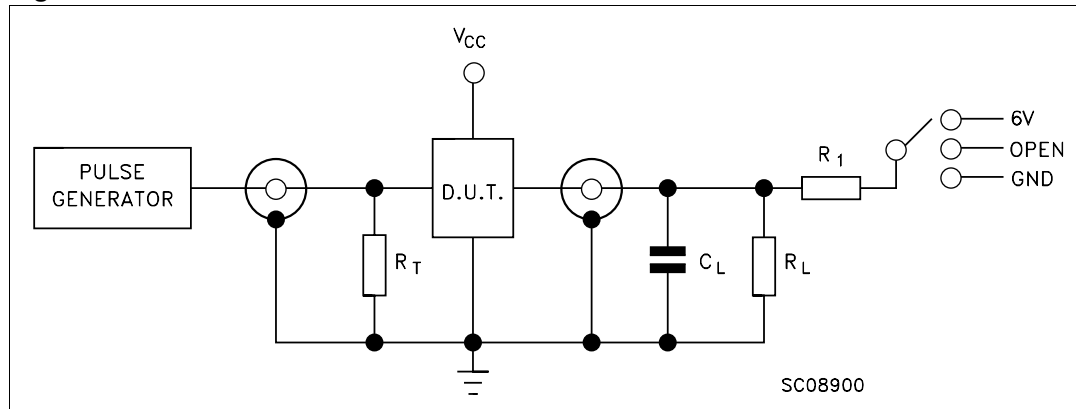
6   Test circuit

Figure 4.   Test circuit

Figure 5.   Test circuit

Test	Switch
t_{PLH}, t_{PHL}	Open
t_{PZL}, t_{PLZ}	6V
t_{PZH}, t_{PHZ}	GND

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

R_L = R_1 = 500Ω or equivalent

R_T = Z_{OUT} of pulse generator (typically 50Ω)

7   Waveforms

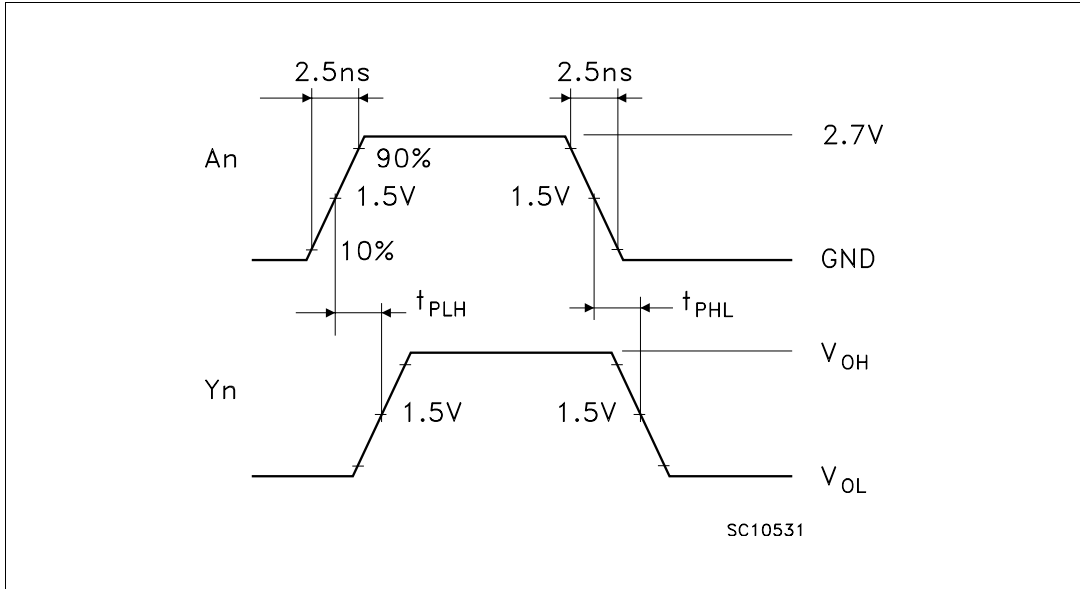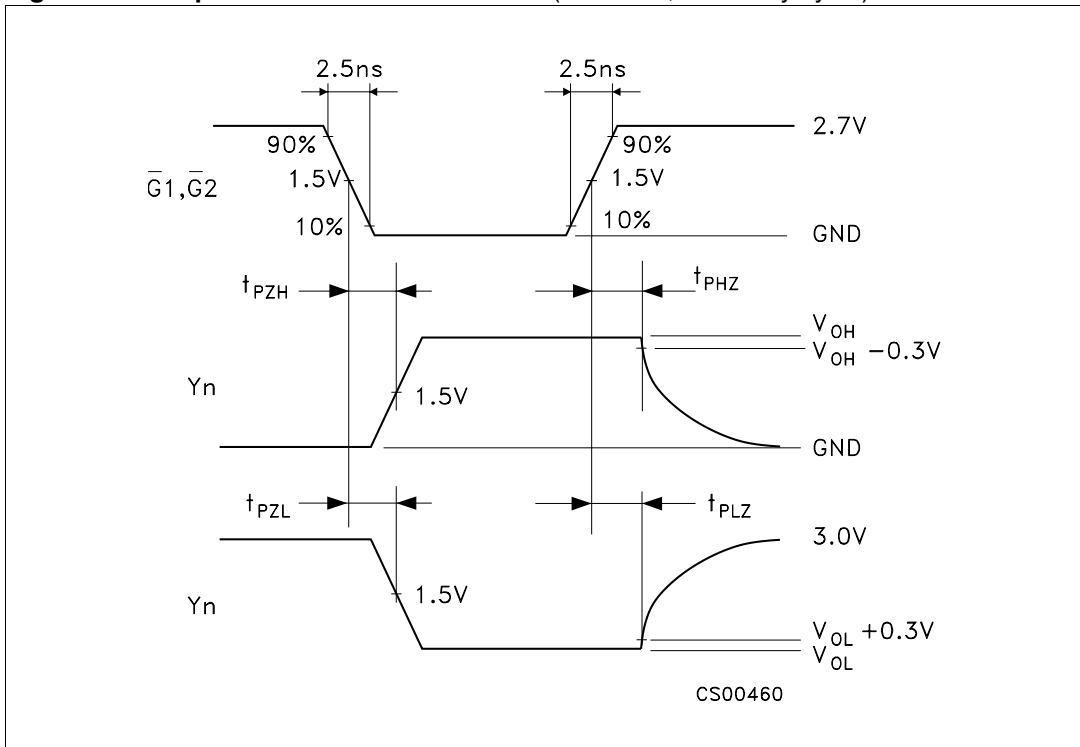**Figure 6.   Propagation delays** (f = 1MHz; 50% duty cycle)

**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 DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	2.35		2.65	0.093		0.104
A1	0.1		0.30	0.004		0.012
B	0.33		0.51	0.013		0.020
C	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
e		1.27			0.050	
H	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

0016022D
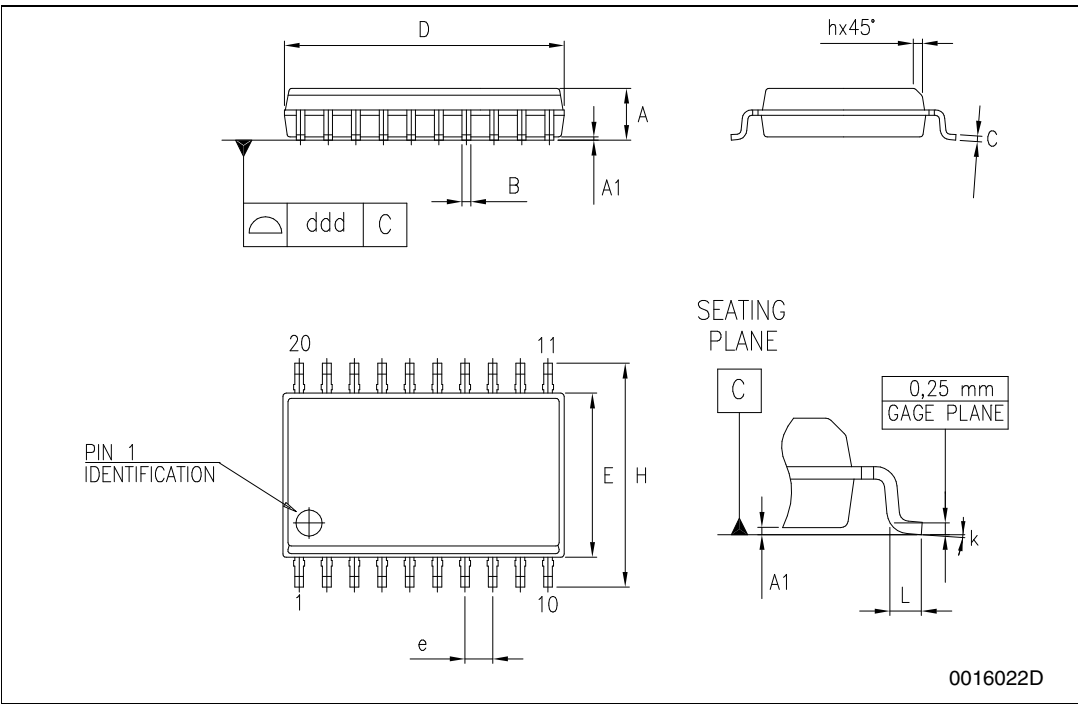
TSSOP20 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			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
c	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
e		0.65 BSC			0.0256 BSC	
K	0˚		8˚	0˚		8˚
L	0.45	0.60	0.75	0.018	0.024	0.030

PIN 1 IDENTIFICATION

0087225C
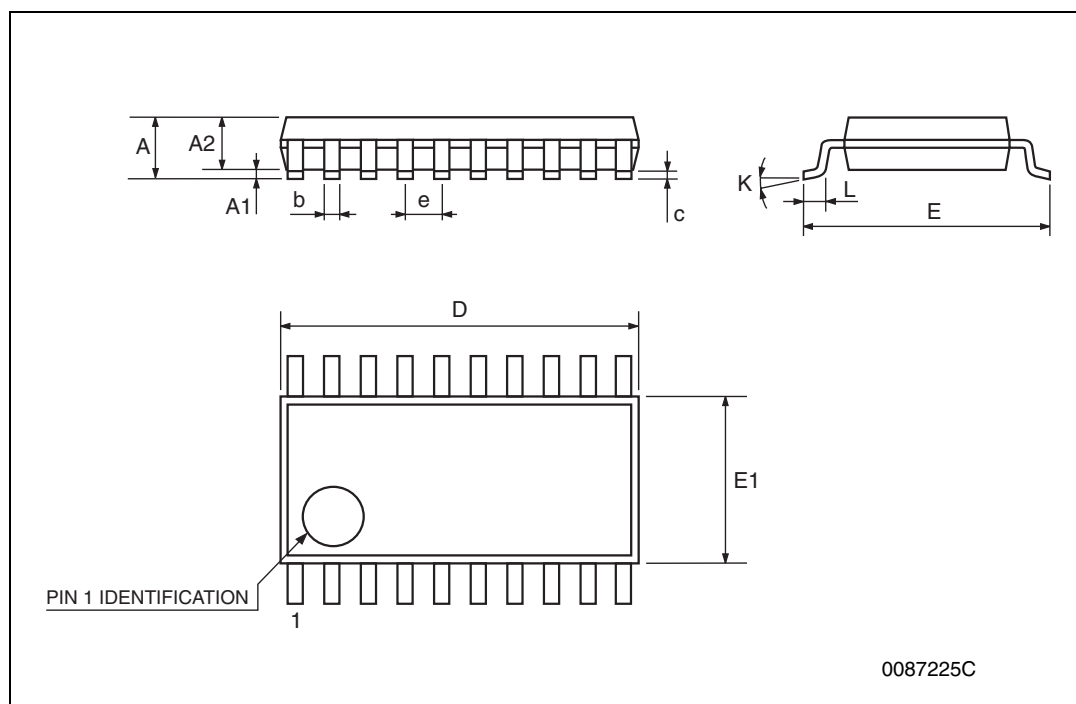
Tape & Reel SO-20 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			330			12.992
C	12.8		13.2	0.504		0.519
D	20.2			0.795		
N	60			2.362		
T			30.4			1.197
Ao	10.8		11	0.425		0.433
Bo	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
P	11.9		12.1	0.468		0.476

Note: Drawing not in scale
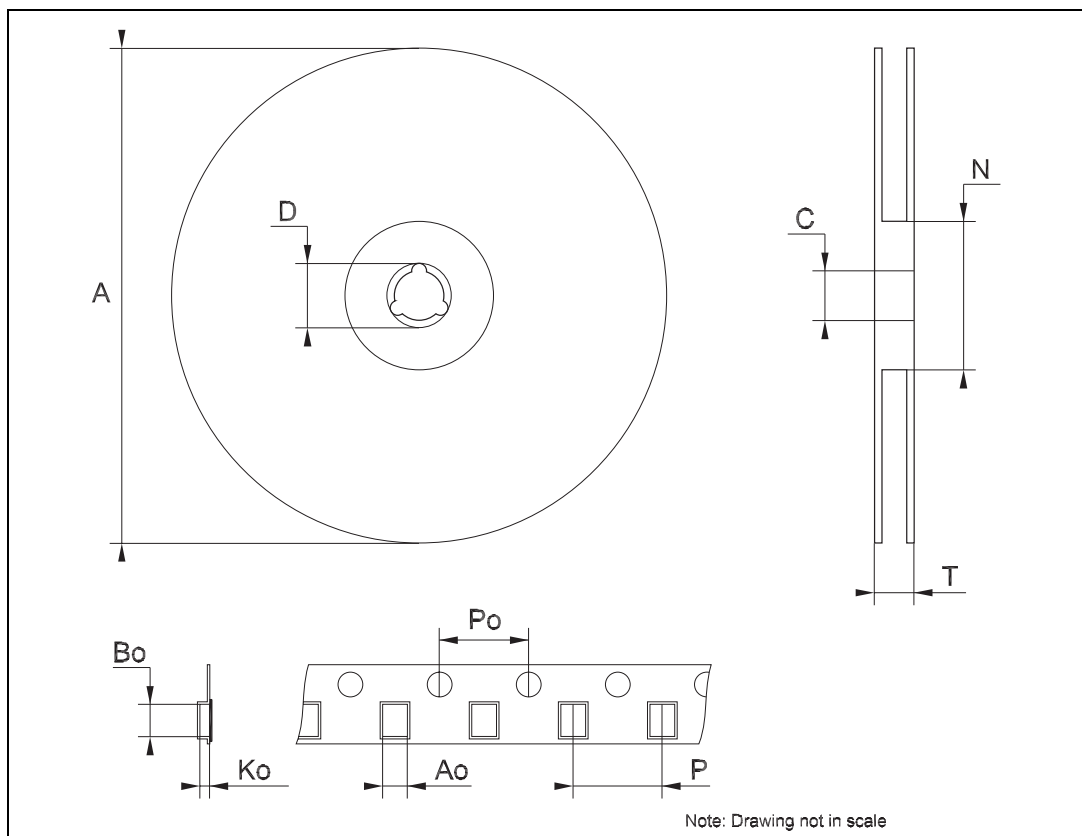
Tape & Reel TSSOP20 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			330			12.992
C	12.8		13.2	0.504		0.519
D	20.2			0.795		
N	60			2.362		
T			22.4			0.882
Ao	6.8		7	0.268		0.276
Bo	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
P	11.9		12.1	0.468		0.476

Note: Drawing not in scale
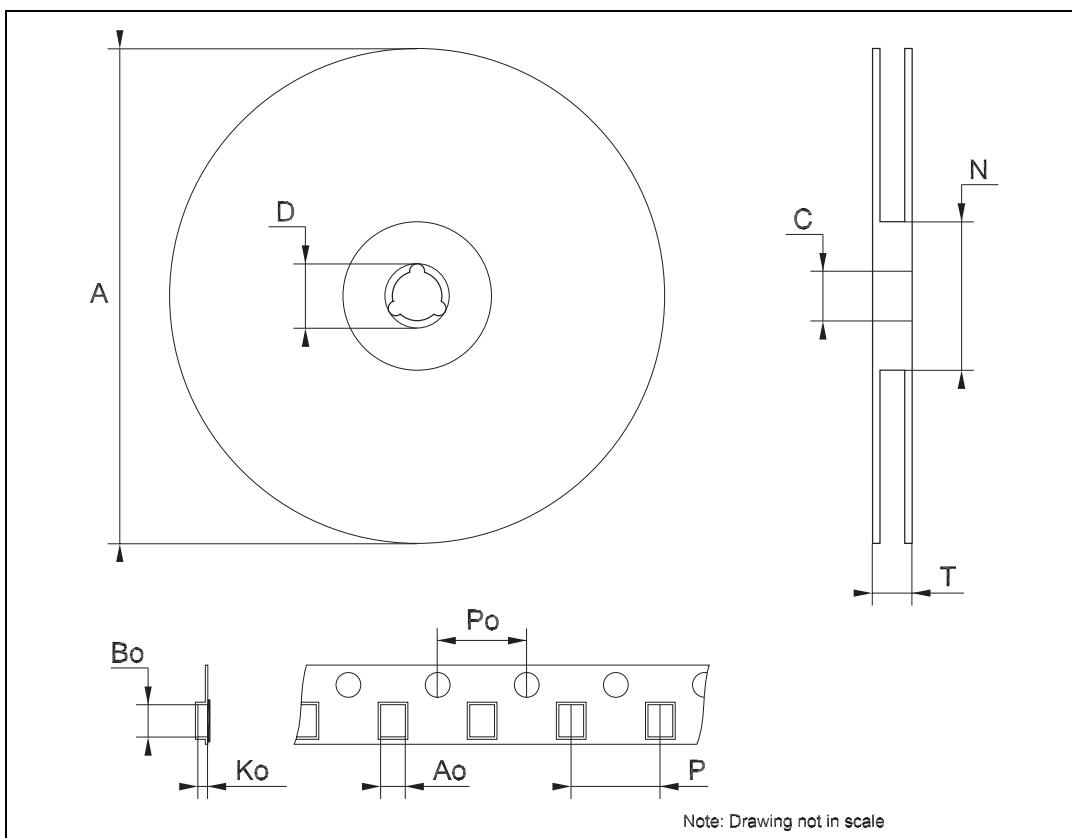
9   Revision history

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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