



# 74LCX162541

## LOW VOLTAGE CMOS 16-BIT BUS BUFFER (3-STATE) WITH 5V TOLERANT INPUTS AND OUTPUTS

- 5V TOLERANT INPUTS AND OUTPUTS
- HIGH SPEED :  
 $t_{PD} = 4.4 \text{ ns (MAX.) at } V_{CC} = 3V$
- POWER DOWN PROTECTION ON INPUTS AND OUTPUTS
- SYMMETRICAL OUTPUT IMPEDANCE:  
 $|I_{OH}| = I_{OL} = 12\text{mA (MIN) at } V_{CC} = 3V$
- PCI BUS LEVELS GUARANTEED AT 12 mA
- BALANCED PROPAGATION DELAYS:  
 $t_{PLH} \approx t_{PHL}$
- $26\Omega$  SERIE RESISTORS IN OUTPUTS
- OPERATING VOLTAGE RANGE:  
 $V_{CC(OPR)} = 2.0V \text{ to } 3.6V \text{ (1.5V Data Retention)}$
- PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 162541
- LATCH-UP PERFORMANCE EXCEEDS 500mA (JESD 17)
- ESD PERFORMANCE:  
HBM > 2000V (MIL STD 883 method 3015);  
MM > 200V

### DESCRIPTION

The 74LCX162541 is a low voltage CMOS 16 BIT 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.

This is composed of two 8-bit sections with separate output-enable signals. For either 8-bit buffers section, the 3 STATE control gate operates as a two input AND such that if either  $\overline{nG1}$  and  $\overline{nG2}$  are high, all outputs are in the high impedance state. This device is designed to be used with 3 state memory address drivers, etc.

The device circuits is including  $26\Omega$  series resistance in the outputs. These resistors permit to reduce line noise in high speed applications.

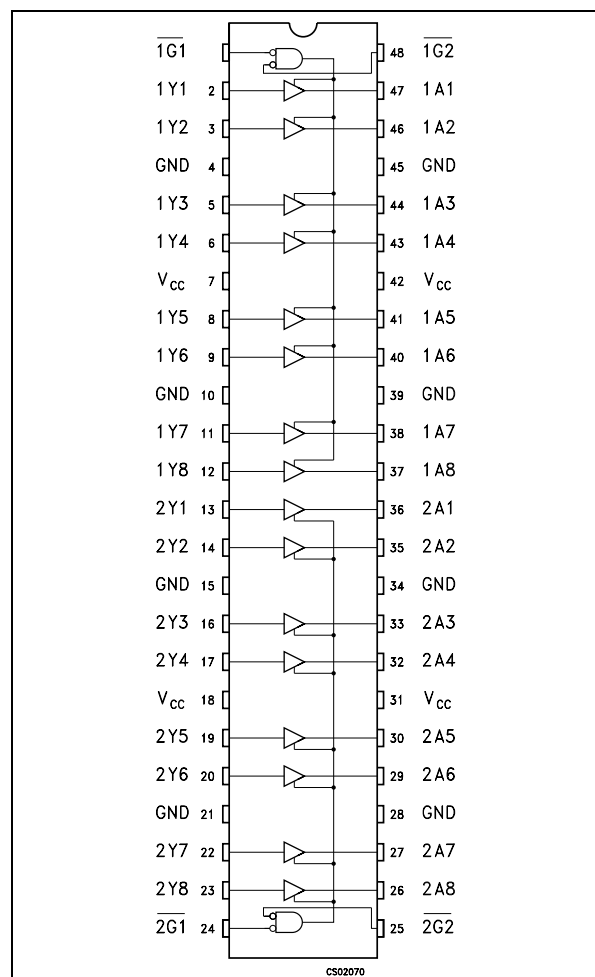
All inputs and outputs are equipped with protection circuits against static discharge, giving them 2KV ESD immunity and transient excess voltage.



### ORDER CODES

PACKAGE	TUBE	T & R
TSSOP		74LCX162541TTR

### PIN CONNECTION



INPUT AND OUTPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

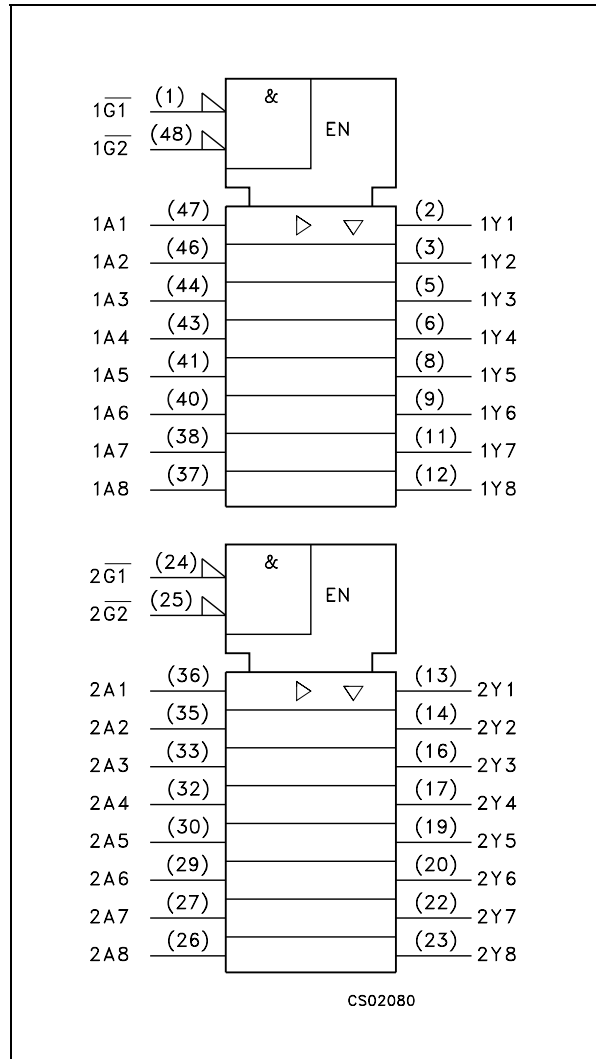
PIN No	SYMBOL	NAME AND FUNCTION
1, 48	1G1, 1G2	Output Enable Inputs
2, 3, 5, 6, 8, 9, 11, 12	1Y1 to 1Y8	Data Outputs
13, 14, 16, 17, 19, 20, 22, 23	2Y1 to 2Y8	Data Outputs
24, 25	2G1, 2G2	Output Enable Inputs
36, 35, 33, 32, 30, 29, 27, 26	2A1 to 2A8	Data Outputs
47, 46, 44, 43, 41, 40, 38, 37	1A1 to 1A8	Data Outputs
4, 10, 15, 21, 28, 34, 39, 45	GND	Ground (0V)
7, 18, 31, 42	V <sub>CC</sub>	Positive Supply Voltage

TRUTH TABLE

INPUTS			OUTPUT
$\overline{G1}$	$\overline{G2}$	A <sub>n</sub>	Y <sub>n</sub>
H	X	X	Z
X	H	X	Z
L	L	H	H
L	L	L	L

X : Don't Care  
Z : High Impedance

IEC LOGIC SYMBOLS



**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) (note 1)	-0.5 to $V_{CC} + 0.5$	V
$I_{IK}$	DC Input Diode Current	- 50	mA
$I_{OK}$	DC Output Diode Current (note 2)	- 50	mA
$I_O$	DC Output Current	$\pm 50$	mA
$I_{CC}$	DC Supply Current per Supply Pin	$\pm 100$	mA
$I_{GND}$	DC Ground Current per Supply Pin	$\pm 100$	mA
$T_{stg}$	Storage Temperature	-65 to +150	°C
$T_L$	Lead Temperature (10 sec)	300	°C

Absolute Maximum Ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied

1)  $I_O$  absolute maximum rating must be observed  
 2)  $V_O < GND$

**RECOMMENDED OPERATING CONDITIONS**

Symbol	Parameter	Value	Unit
$V_{CC}$	Supply Voltage (note 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 $3.6V$ )	$\pm 12$	mA
$I_{OH}, I_{OL}$	High or Low Level Output Current ( $V_{CC} = 2.7V$ )	$\pm 8$	mA
$T_{op}$	Operating Temperature	-55 to 125	°C
dt/dv	Input Rise and Fall Time (note 2)	0 to 10	ns/V

1) Truth Table guaranteed: 1.5V to 3.6V

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

## DC SPECIFICATIONS

Symbol	Parameter	Test Condition		Value				Unit
		V <sub>CC</sub> (V)		-40 to 85 °C		-55 to 125 °C		
				Min.	Max.	Min.	Max.	
V <sub>IH</sub>	High Level Input Voltage	2.7 to 3.6		2.0		2.0		V
V <sub>IL</sub>	Low Level Input Voltage					0.8		0.8
V <sub>OH</sub>	High Level Output Voltage	2.7 to 3.6	I <sub>O</sub> =-100 μA	V <sub>CC</sub> -0.2		V <sub>CC</sub> -0.2		V
		2.7	I <sub>O</sub> =-8 mA	2.0		2.0		
		3.0	I <sub>O</sub> =-6 mA	2.4		2.4		
			I <sub>O</sub> =-12 mA	2.0		2.0		
V <sub>OL</sub>	Low Level Output Voltage	2.7 to 3.6	I <sub>O</sub> =100 μA		0.2		0.2	V
		2.7	I <sub>O</sub> =8 mA		0.6		0.6	
		3.0	I <sub>O</sub> =6 mA		0.55		0.55	
			I <sub>O</sub> =12 mA		0.8		0.8	
I <sub>I</sub>	Input Leakage Current	2.7 to 3.6	V <sub>I</sub> = 0 to 5.5V		± 5		± 5	μA
I <sub>off</sub>	Power Off Leakage Current	0	V <sub>I</sub> or V <sub>O</sub> = 5.5V		10		10	μA
I <sub>oz</sub>	High Impedance Output Leakage Current	2.7 to 3.6	V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub> V <sub>O</sub> = 0 to V <sub>CC</sub>		± 5		± 5	μA
I <sub>CC</sub>	Quiescent Supply Current	2.7 to 3.6	V <sub>I</sub> = V <sub>CC</sub> or GND		20		20	μA
			V <sub>I</sub> or V <sub>O</sub> = 3.6 to 5.5V		± 20		± 20	
ΔI <sub>CC</sub>	I <sub>CC</sub> incr. per Input	2.7 to 3.6	V <sub>IH</sub> = V <sub>CC</sub> - 0.6V		500		500	μA

## DYNAMIC SWITCHING CHARACTERISTICS

Symbol	Parameter	Test Condition		Value			Unit
		V <sub>CC</sub> (V)		T <sub>A</sub> = 25 °C			
				Min.	Typ.	Max.	
V <sub>OLP</sub>	Dynamic Low Level Quiet Output (note 1)	3.3	C <sub>L</sub> = 50pF V <sub>IL</sub> = 0V, V <sub>IH</sub> = 3.3V		0.8		V
V <sub>OLV</sub>					-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.

## AC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Test Condition				Value				Unit
		V <sub>CC</sub> (V)	C <sub>L</sub> (pF)	R <sub>L</sub> (Ω)	t <sub>s</sub> = t <sub>r</sub> (ns)	-40 to 85 °C		-55 to 125 °C		
						Min.	Max.	Min.	Max.	
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay Time	2.7	50	500	2.5	1.5	5.6	1.5	6.5	ns
		3.0 to 3.6				1.5	4.4	1.5	5.1	
t <sub>PZL</sub> t <sub>PZH</sub>	Output Enable Time	2.7	50	500	2.5	1.5	6.3	1.5	7.2	ns
		3.0 to 3.6				1.5	5.9	1.5	6.8	
t <sub>PLZ</sub> t <sub>PHZ</sub>	Output Disable Time	2.7	50	500	2.5	1.5	6.3	1.5	7.2	ns
		3.0 to 3.6				1.5	5.9	1.5	6.8	
t <sub>OSLH</sub> t <sub>OSHL</sub>	Output To Output Skew Time (note1, 2)	3.0 to 3.6	50	500	2.5		1.0		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<sub>OSLH</sub> = |t<sub>PLHm</sub> - t<sub>PLHn</sub>|, t<sub>OSHL</sub> = |t<sub>PHLm</sub> - t<sub>PHLn</sub>|)

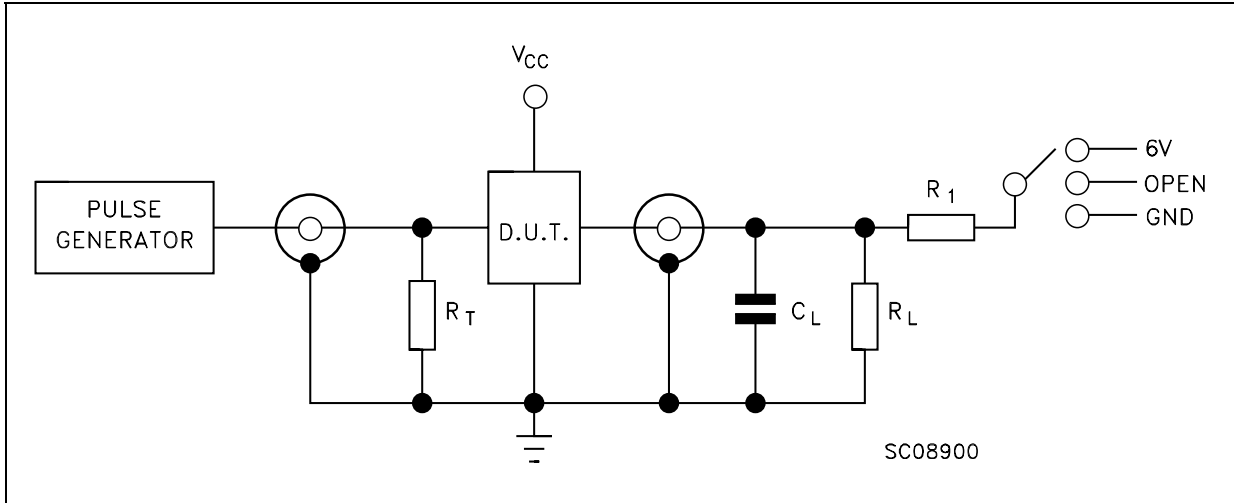
2) Parameter guaranteed by design

## CAPACITIVE CHARACTERISTICS

Symbol	Parameter	Test Condition		Value			Unit
		V <sub>CC</sub> (V)		T <sub>A</sub> = 25 °C			
				Min.	Typ.	Max.	
C <sub>IN</sub>	Input Capacitance				4		pF
C <sub>OUT</sub>	Output Capacitance				10		pF
C <sub>PD</sub>	Power Dissipation Capacitance (note 1)	3.3	f <sub>IN</sub> = 10MHz V <sub>IN</sub> = 0 or V <sub>CC</sub>		50		pF

1) 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(oper)</sub> = C<sub>PD</sub> × V<sub>CC</sub> × f<sub>IN</sub> + I<sub>CC</sub>/16 (per circuit)

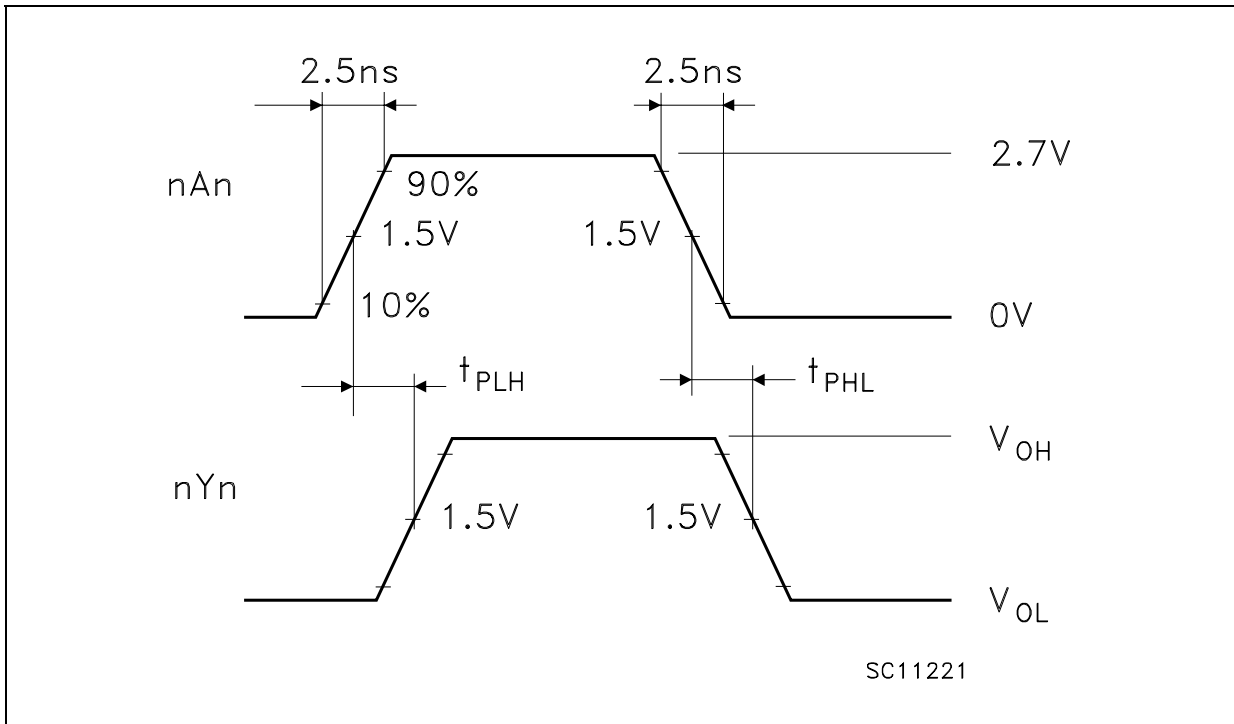
TEST CIRCUIT

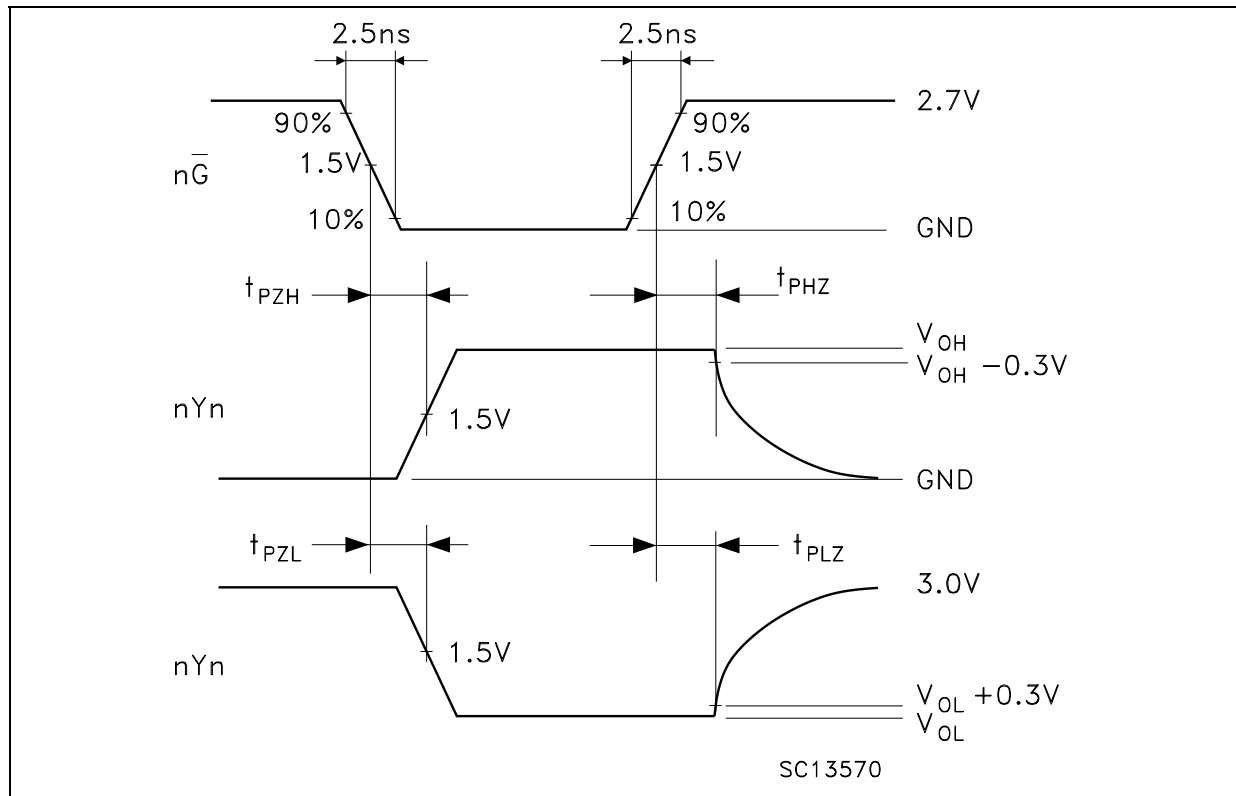


TEST	SWITCH
$t_{PLH}$ , $t_{PHL}$	Open
$t_{PZL}$ , $t_{PLZ}$	6V
$t_{PZH}$ , $t_{PHZ}$	GND

$C_L$  = 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 $\Omega$ )

WAVEFORM 1 : PROPAGATION DELAYS (f=1MHz; 50% duty cycle)



**WAVEFORM 2 : OUTPUT ENABLE AND DISABLE TIME (f=1MHz; 50% duty cycle)**

## TSSOP48 MECHANICAL DATA

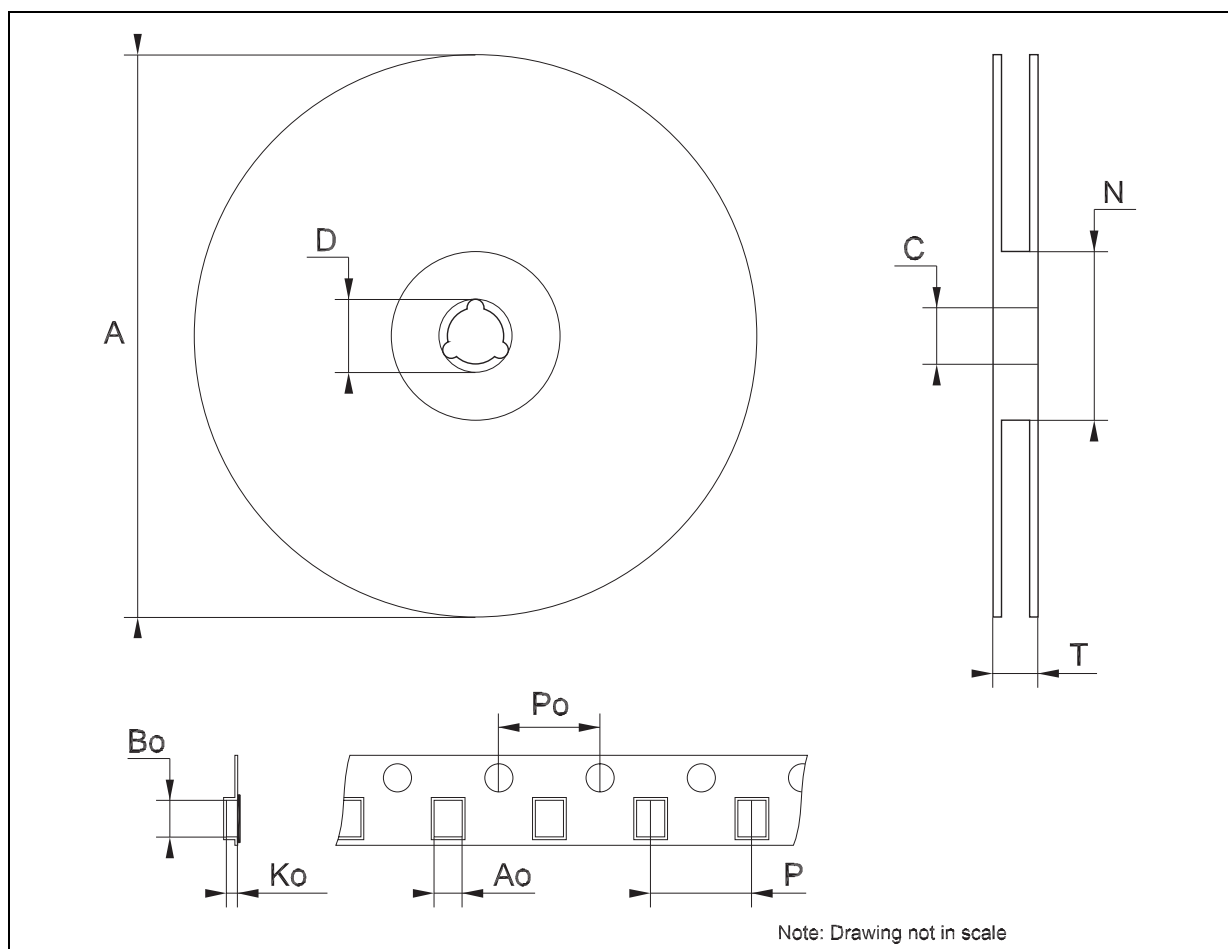
DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A			1.2			0.047
A1	0.05		0.15	0.002		0.006
A2		0.9			0.035	
b	0.17		0.27	0.0067		0.011
c	0.09		0.20	0.0035		0.0079
D	12.4		12.6	0.488		0.496
E		8.1 BSC			0.318 BSC	
E1	6.0		6.2	0.236		0.244
e		0.5 BSC			0.0197 BSC	
K	0°		8°	0°		8°
L	0.50		0.75	0.020		0.030





### Tape & Reel TSSOP48 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	8.7		8.9	0.343		0.350
Bo	13.1		13.3	0.516		0.524
Ko	1.5		1.7	0.059		0.067
Po	3.9		4.1	0.153		0.161
P	11.9		12.1	0.468		0.476



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