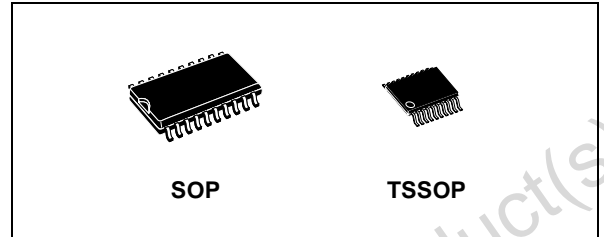


## LOW VOLTAGE CMOS OCTAL BUS BUFFER (3-STATE) WITH 5V TOLERANT INPUTS AND OUTPUTS

- 5V TOLERANT INPUTS AND OUTPUTS
- HIGH SPEED:  
 $t_{PD} = 6.5 \text{ ns (MAX.) at } V_{CC} = 3V$
- POWER DOWN PROTECTION ON INPUTS AND OUTPUTS
- SYMMETRICAL OUTPUT IMPEDANCE:  
 $|I_{OH}| = I_{OL} = 24\text{mA (MIN) at } V_{CC} = 3V$
- PCI BUS LEVELS GUARANTEED AT 24 mA
- BALANCED PROPAGATION DELAYS:  
 $t_{PLH} \cong t_{PHL}$
- OPERATING VOLTAGE RANGE:  
 $V_{CC(OPR)} = 2.0V \text{ to } 3.6V \text{ (1.5V Data Retention)}$
- PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 244
- LATCH-UP PERFORMANCE EXCEEDS 500mA (JESD 17)
- ESD PERFORMANCE:  
HBM > 2000V (MIL STD 883 method 3015);  
MM > 200V

### DESCRIPTION

The 74LCX244 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



**Table 1: Order Codes**

PACKAGE	T & R
SOP	74LCX244MTR
TSSOP	74LCX244TTR

and high speed 3.3V applications; it can be interfaced to 5V signal environment for both inputs and outputs.

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

This device is designed to be used with 3 state memory address drivers, etc.

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

**Figure 1: Pin Connection And IEC Logic Symbols**

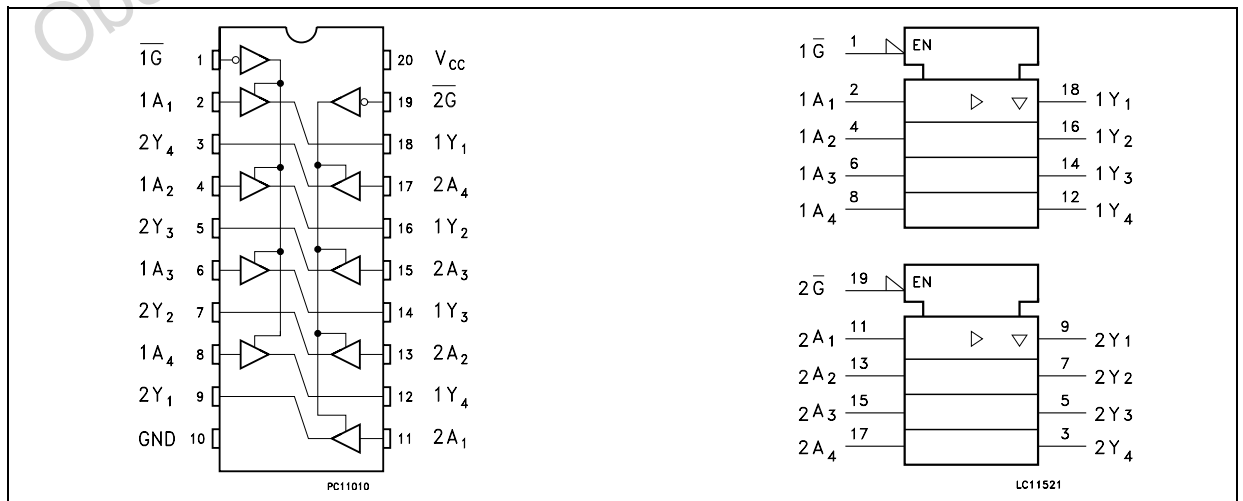


Figure 2: Input And Output Equivalent Circuit

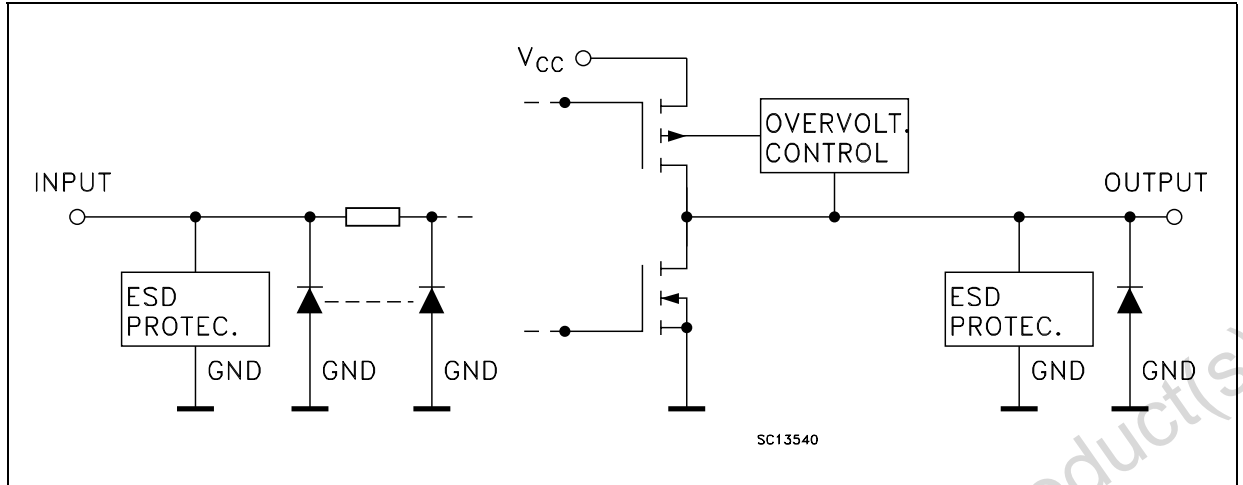


Table 2: Pin Description

PIN N°	SYMBOL	NAME AND FUNCTION
1	$\overline{1G}$	Output Enable Input
2, 4, 6, 8	1A1 to 1A4	Data Inputs
9, 7, 5, 3	2Y1 to 2Y4	Data Outputs
11, 13, 15, 17	2A1 to 2A4	Data Inputs
18, 16, 14, 12	1Y1 to 1Y4	Data Outputs
19	2G	Output Enable Input
10	GND	Ground (0V)
20	V <sub>CC</sub>	Positive Supply Voltage

Table 3: Truth Table

INPUT		OUTPUT
$\overline{G}$	A <sub>n</sub>	Y <sub>n</sub>
L	L	L
L	H	H
H	X	Z

X : Don't Care  
Z : High Impedance

Table 4: Absolute Maximum Ratings

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	Supply Voltage	-0.5 to +7.0	V
V <sub>I</sub>	DC Input Voltage	-0.5 to +7.0	V
V <sub>O</sub>	DC Output Voltage (OFF State)	-0.5 to +7.0	V
V <sub>O</sub>	DC Output Voltage (High or Low State) (note 1)	-0.5 to V <sub>CC</sub> + 0.5	V
I <sub>IK</sub>	DC Input Diode Current	- 50	mA
I <sub>OK</sub>	DC Output Diode Current (note 2)	- 50	mA
I <sub>O</sub>	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

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

1) I<sub>O</sub> absolute maximum rating must be observed

2) V<sub>O</sub> < GND

Table 5: 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 $3.6V$ )	$\pm 24$	mA
$I_{OH}, I_{OL}$	High or Low Level Output Current ( $V_{CC} = 2.7V$ )	$\pm 12$	mA
$T_{op}$	Operating Temperature	-55 to 125	$^{\circ}C$
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  $V_{CC} = 3.0V$ 

Table 6: DC Specifications

Symbol	Parameter	Test Condition		Value				Unit
		$V_{CC}$ (V)		-40 to 85 $^{\circ}C$		-55 to 125 $^{\circ}C$		
				Min.	Max.	Min.	Max.	
$V_{IH}$	High Level Input Voltage	2.7 to 3.6		2.0		2.0		V
$V_{IL}$	Low Level Input Voltage				0.8		0.8	V
$V_{OH}$	High Level Output Voltage	2.7 to 3.6	$I_O = -100 \mu A$	$V_{CC} - 0.2$		$V_{CC} - 0.2$		V
		2.7	$I_O = -12 mA$	2.2		2.2		
		3.0	$I_O = -18 mA$	2.4		2.4		
			$I_O = -24 mA$	2.2		2.2		
$V_{OL}$	Low Level Output Voltage	2.7 to 3.6	$I_O = 100 \mu A$		0.2		0.2	V
		2.7	$I_O = 12 mA$		0.4		0.4	
		3.0	$I_O = 16 mA$		0.4		0.4	
			$I_O = 24 mA$		0.55		0.55	
$I_I$	Input Leakage Current	2.7 to 3.6	$V_I = 0$ to $5.5V$		$\pm 5$		$\pm 5$	$\mu A$
$I_{off}$	Power Off Leakage Current	0	$V_I$ or $V_O = 5.5V$		10		10	$\mu A$
$I_{OZ}$	High Impedance Output Leakage Current	2.7 to 3.6	$V_I = V_{IH}$ or $V_{IL}$ $V_O = 0$ to $V_{CC}$		$\pm 5$		$\pm 5$	$\mu A$
$I_{CC}$	Quiescent Supply Current	2.7 to 3.6	$V_I = V_{CC}$ or GND		10		10	$\mu A$
			$V_I$ or $V_O = 3.6$ to $5.5V$		$\pm 10$		$\pm 10$	
$\Delta I_{CC}$	$I_{CC}$ incr. per Input	2.7 to 3.6	$V_{IH} = V_{CC} - 0.6V$		500		500	$\mu A$

Table 7: 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.

Table 8: 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	7.5	1.5	8.2	ns
		3.0 to 3.6				1.5	6.5	1.5	7.1	
t <sub>PZL</sub> t <sub>PZH</sub>	Output Enable Time	2.7	50	500	2.5	1.5	9.0	1.5	10.5	ns
		3.0 to 3.6				1.5	8.0	1.5	9.2	
t <sub>PLZ</sub> t <sub>PHZ</sub>	Output Disable Time	2.7	50	500	2.5	1.5	8.0	1.5	9.2	ns
		3.0 to 3.6				1.5	7.0	1.5	7.7	
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>|)

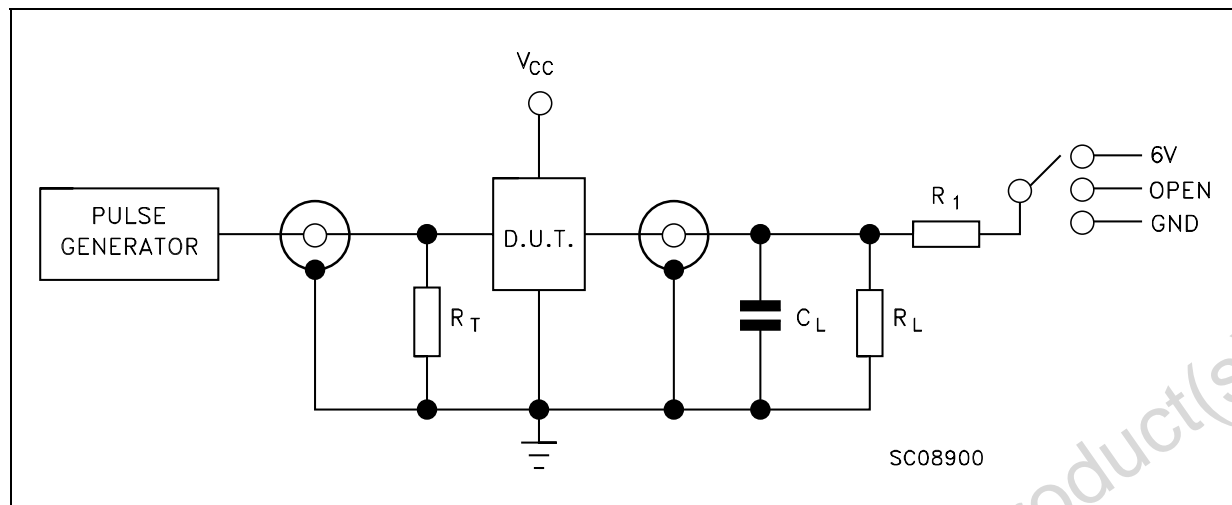
2) Parameter guaranteed by design

Table 9: 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	3.3	V <sub>IN</sub> = 0 to V <sub>CC</sub>		6		pF
C <sub>OUT</sub>	Output Capacitance	3.3	V <sub>IN</sub> = 0 to V <sub>CC</sub>		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>		40		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(opr)</sub> = C<sub>PD</sub> × V<sub>CC</sub> × f<sub>IN</sub> + I<sub>CC</sub>/8 (per circuit)

Figure 3: 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 $\Omega$ )

Figure 4: Waveform - Propagation Delays (f=1MHz; 50% duty cycle)

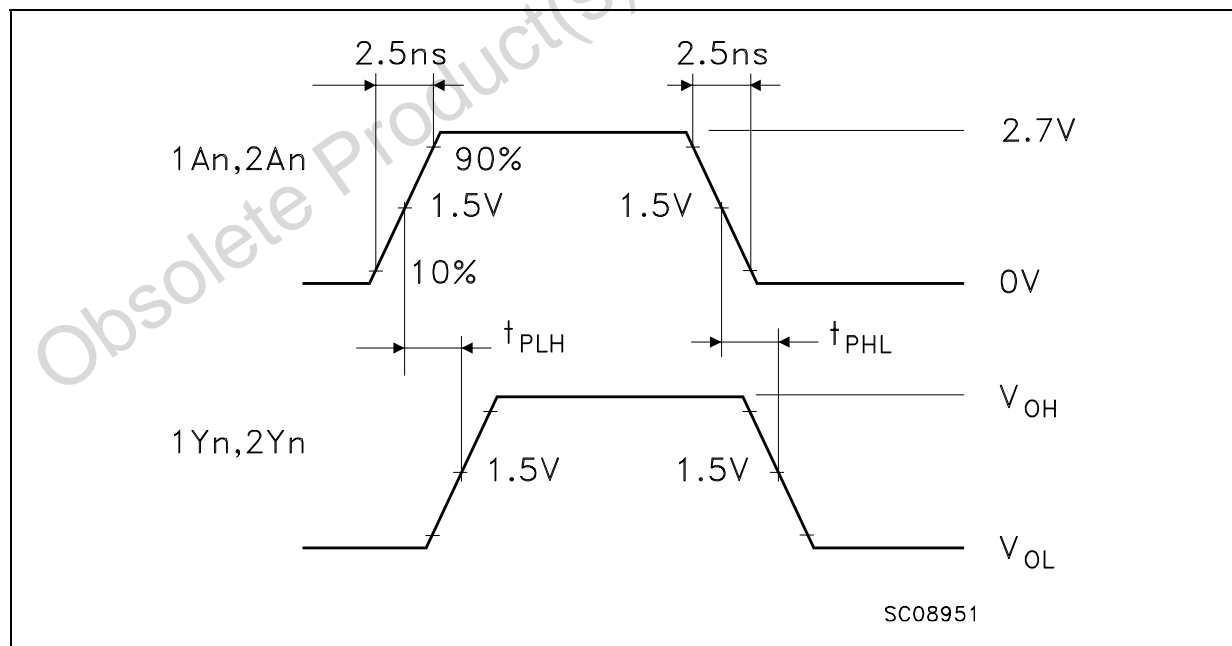
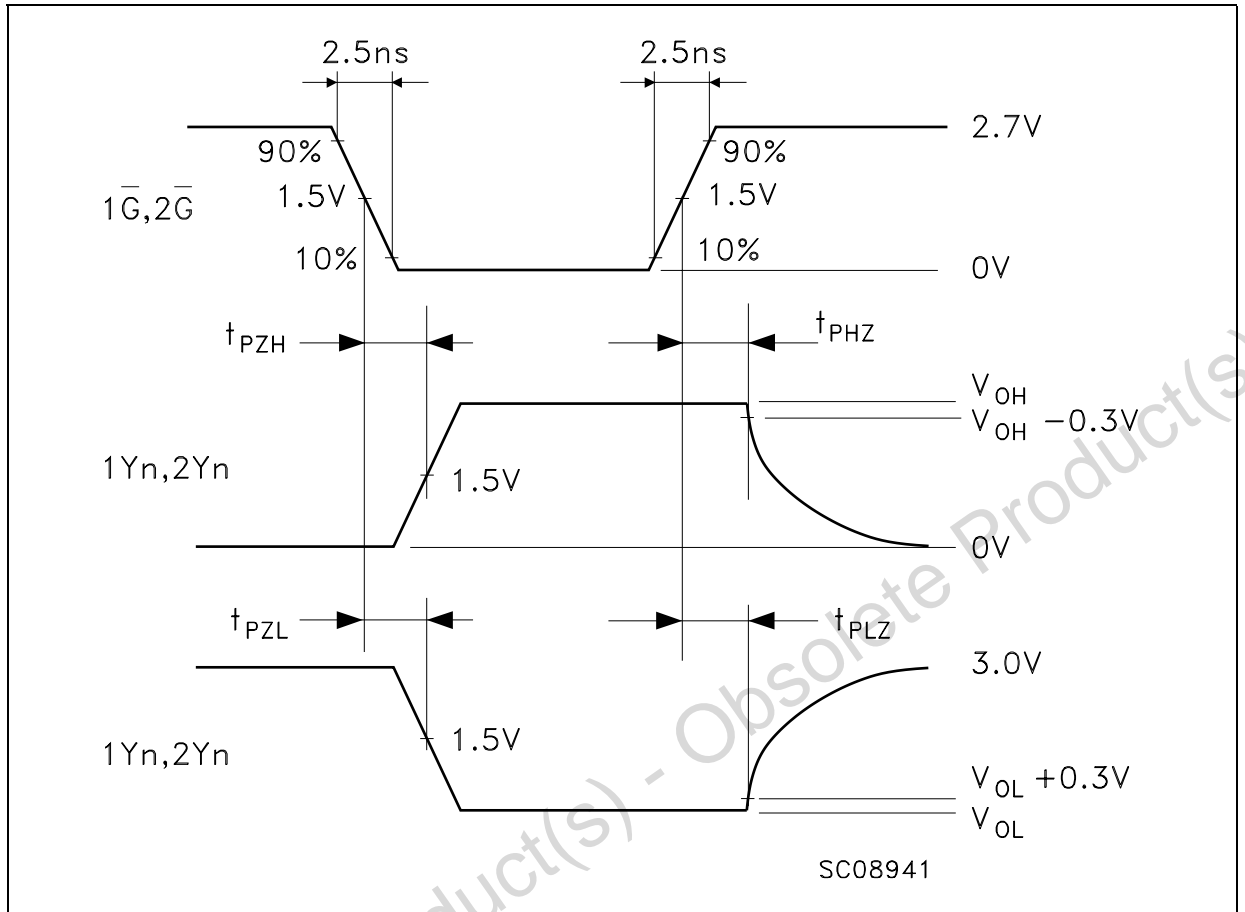
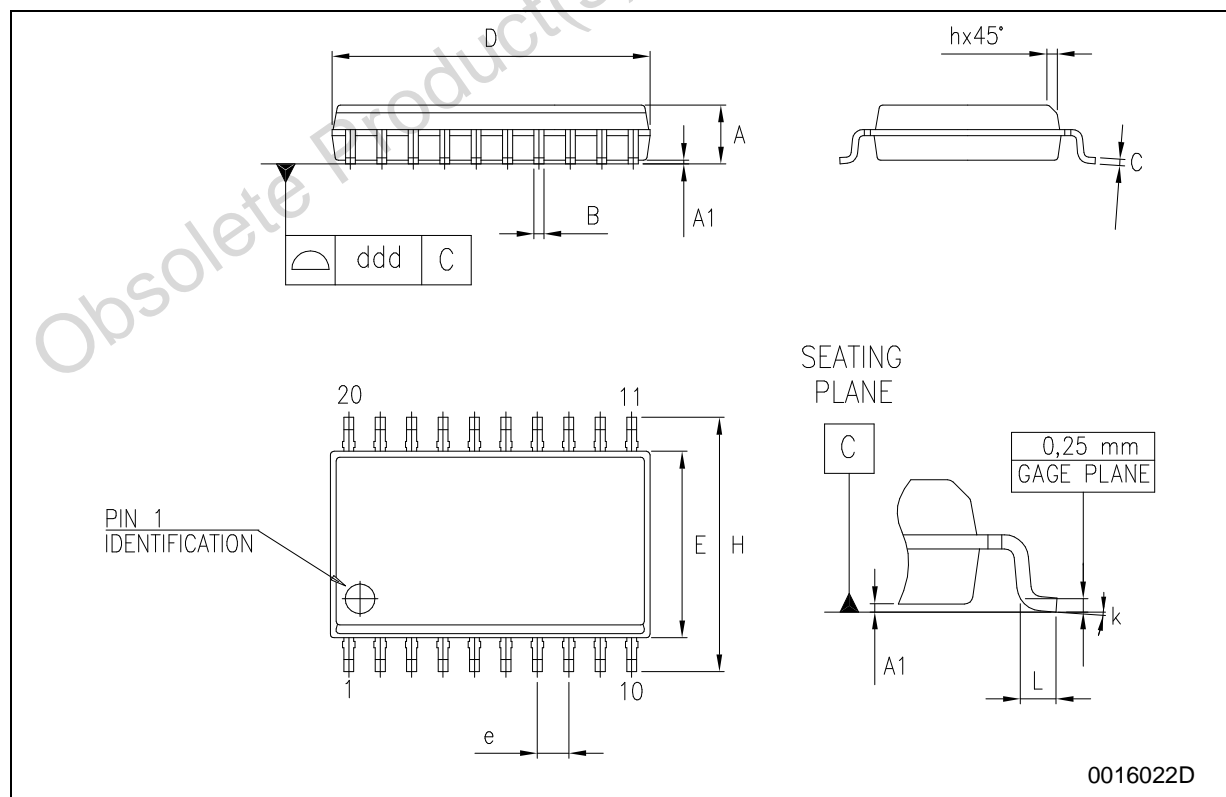


Figure 5: Waveform - Output Enable And Disable Time (f=1MHz; 50% duty cycle)



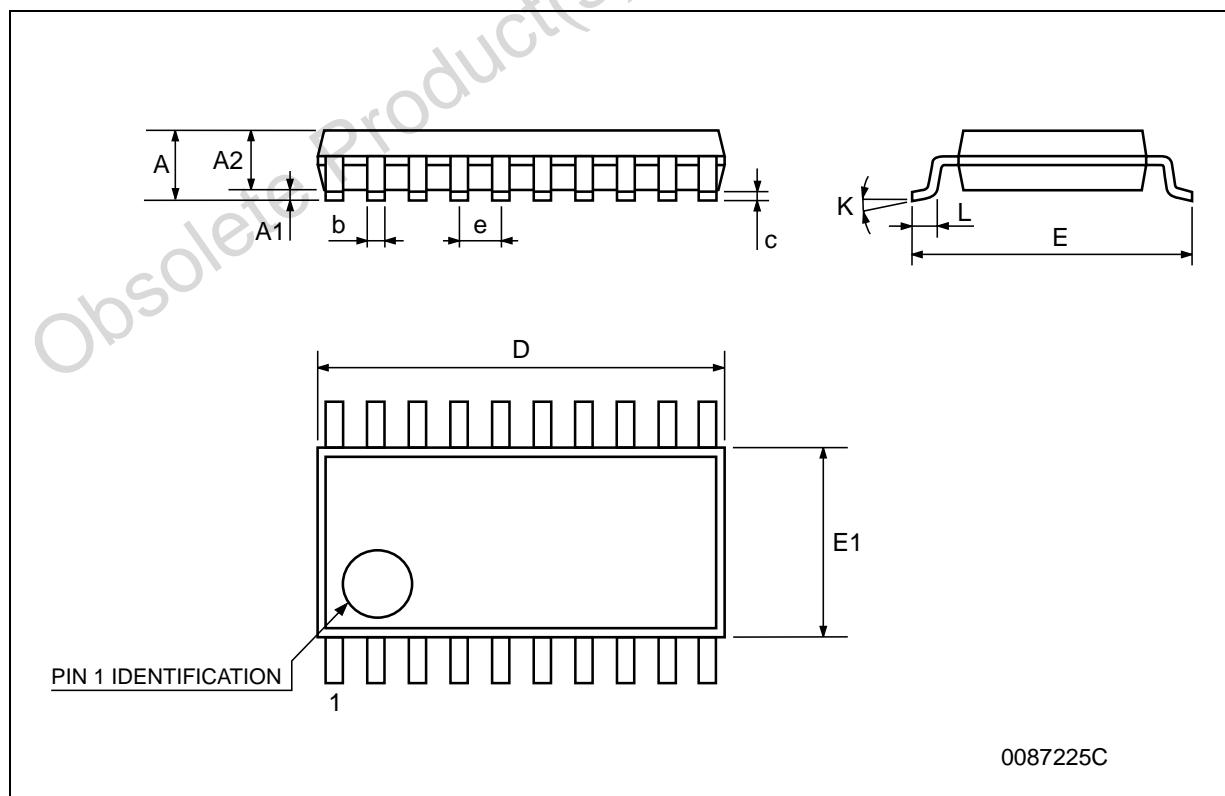
## SO-20 MECHANICAL DATA

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



## 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

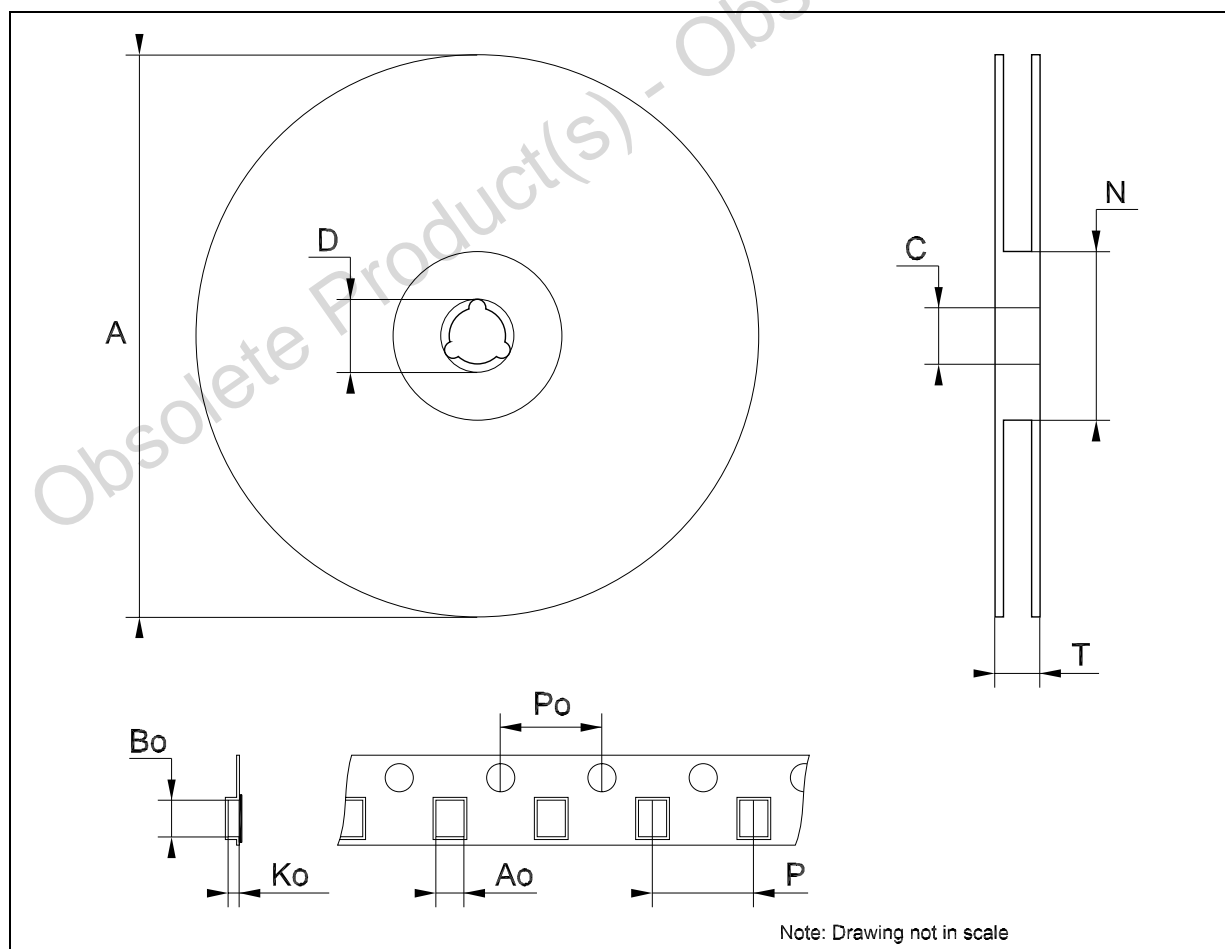


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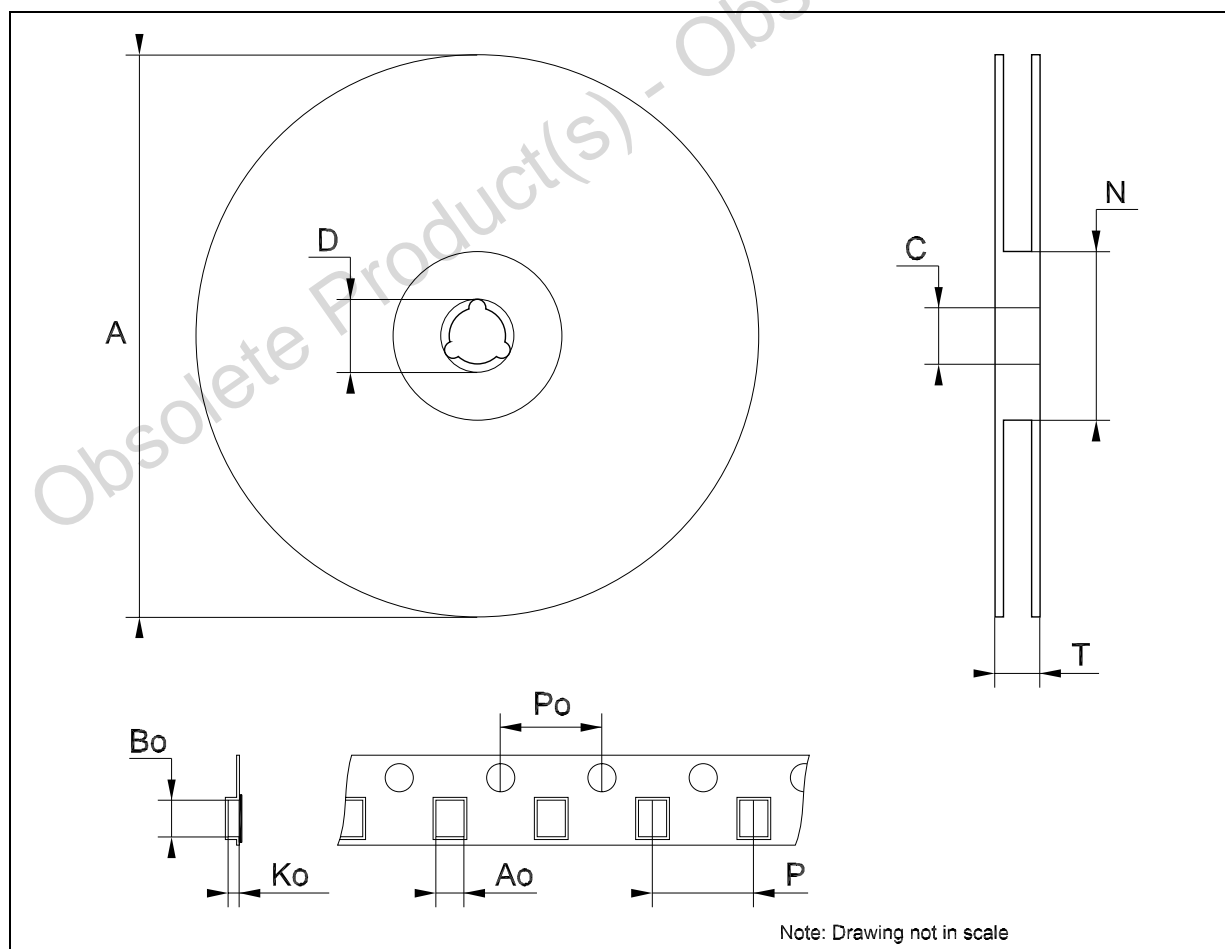
## Tape &amp; Reel SO-20 MECHANICAL DATA

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



## Tape &amp; 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



**Table 10: Revision History**

Date	Revision	Description of Changes
15-Sep-2004	8	Ordering Codes Revision - pag. 1.

Obsolete Product(s) - Obsolete Product(s)

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