



# 74LCX240

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

- 5V TOLERANT INPUTS AND OUTPUTS
- HIGH SPEED:  
 $t_{PD} = 6.5 \text{ ns (MAX.) at } V_{CC} = 3\text{V}$
- POWER DOWN PROTECTION ON INPUTS AND OUTPUTS
- SYMMETRICAL OUTPUT IMPEDANCE:  
 $|I_{OH}| = I_{OL} = 24\text{mA (MIN) at } V_{CC} = 3\text{V}$
- PCI BUS LEVELS GUARANTEED AT 24 mA
- BALANCED PROPAGATION DELAYS:  
 $t_{PLH} \cong t_{PHL}$
- OPERATING VOLTAGE RANGE:  
 $V_{CC(OPR)} = 2.0\text{V to } 3.6\text{V (1.5V Data Retention)}$
- PIN AND FUNCTION COMPATIBLE WITH 74 SERIES 240
- LATCH-UP PERFORMANCE EXCEEDS 500mA (JESD 17)
- ESD PERFORMANCE:  
 $\text{HBM} > 2000\text{V (MIL STD 883 method 3015);}$   
 $\text{MM} > 200\text{V}$

### DESCRIPTION

The 74LCX240 is a low voltage CMOS OCTAL BUS BUFFER 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



**Table 1: Order Codes**

| PACKAGE | T & R       |
|---------|-------------|
| SOP     | 74LCX240MTR |
| TSSOP   | 74LCX240TTR |

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**

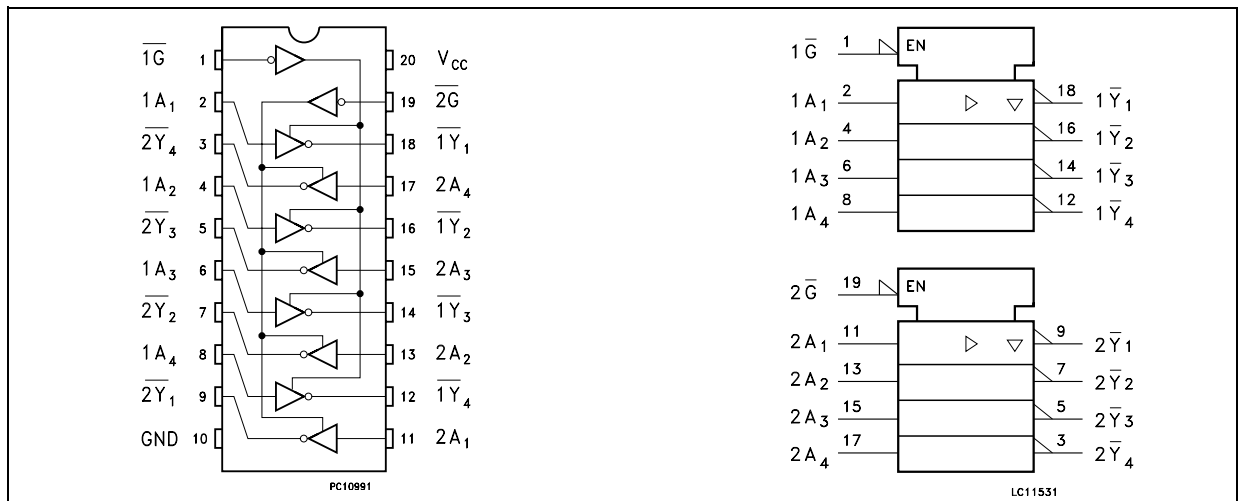


Figure 2: Input And Output Equivalent Circuit

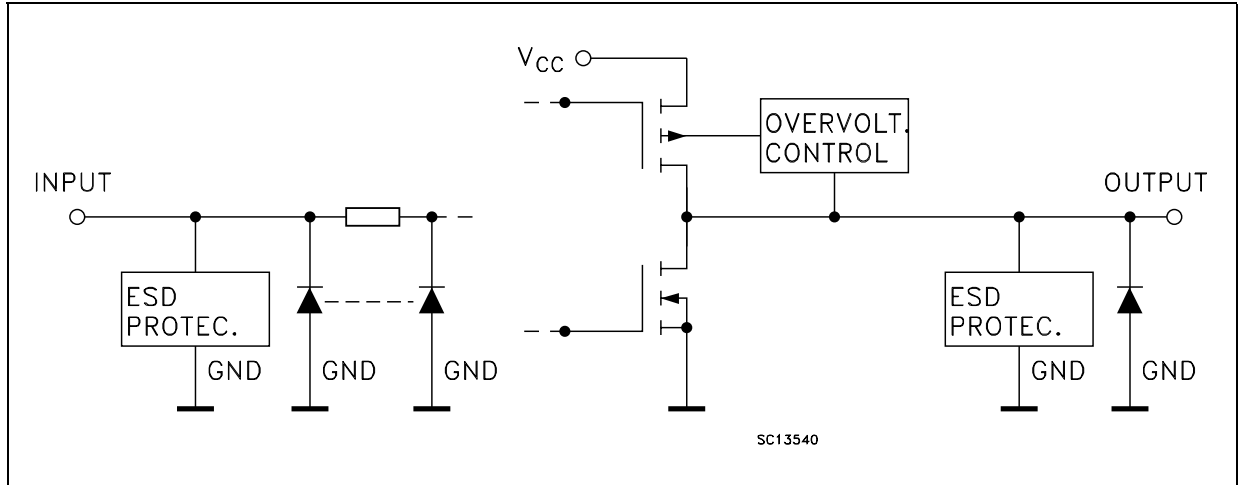


Table 2: Pin Description

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

Table 3: Truth Table

| INPUT          |       | OUTPUT           |
|----------------|-------|------------------|
| $\overline{G}$ | $A_n$ | $\overline{Y_n}$ |
| L              | L     | H                |
| L              | H     | L                |
| H              | X     | Z                |

X : Don't Care  
Z : High Impedance

Table 4: 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)  $V_O < GND$

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    |
|-----------------|---------------------------------------|-----------------|---|-----------------------|----------|------------------------|----------|---------|
|                 |                                       | $V_{CC}$<br>(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     |
| $V_{OH}$        | 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 $V_{IL}$<br>$V_O = 0$ 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><br>(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<br>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><br>(V) | C <sub>L</sub><br>(pF) | R <sub>L</sub><br>(Ω) | t <sub>s</sub> = t <sub>r</sub><br>(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           | 8.5  | ns   |
|  |                                       | 3.0 to 3.6             |                        |                       |   | 1.5          | 6.5  | 1.5           | 7.5  |      |
| 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           | 8.3  |      |
| t <sub>OSLH</sub><br>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>|)

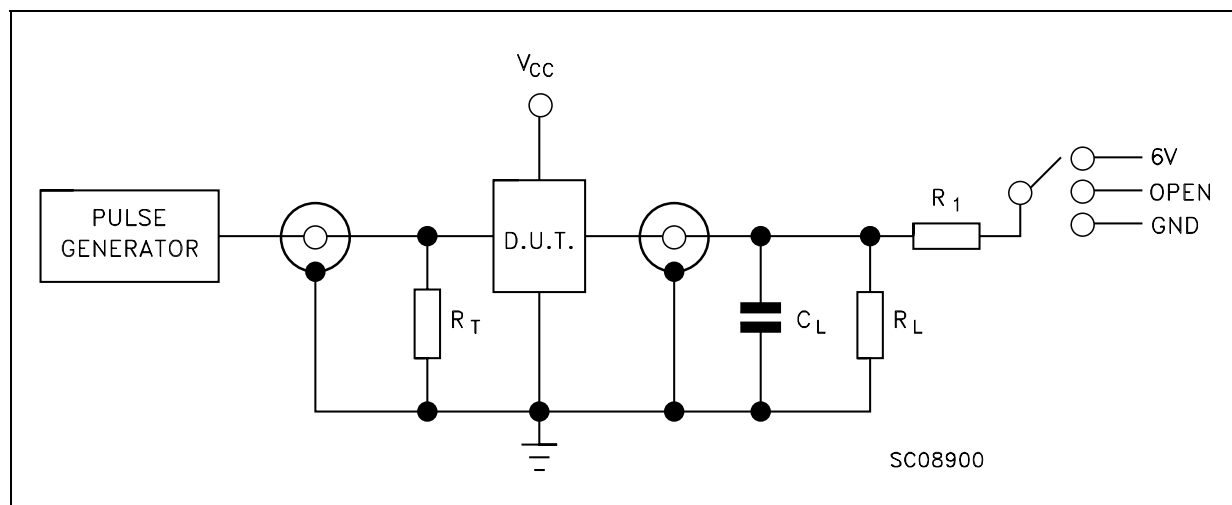
2) Parameter guaranteed by design

Table 9: Capacitive Characteristics

| Symbol           | Parameter                              | Test Condition         |   | Value                  |      |      | Unit |
|------------------|--|------------------------|---|------------------------|------|------|------|
|                  |  | V <sub>CC</sub><br>(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<br>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 $\Omega$ )

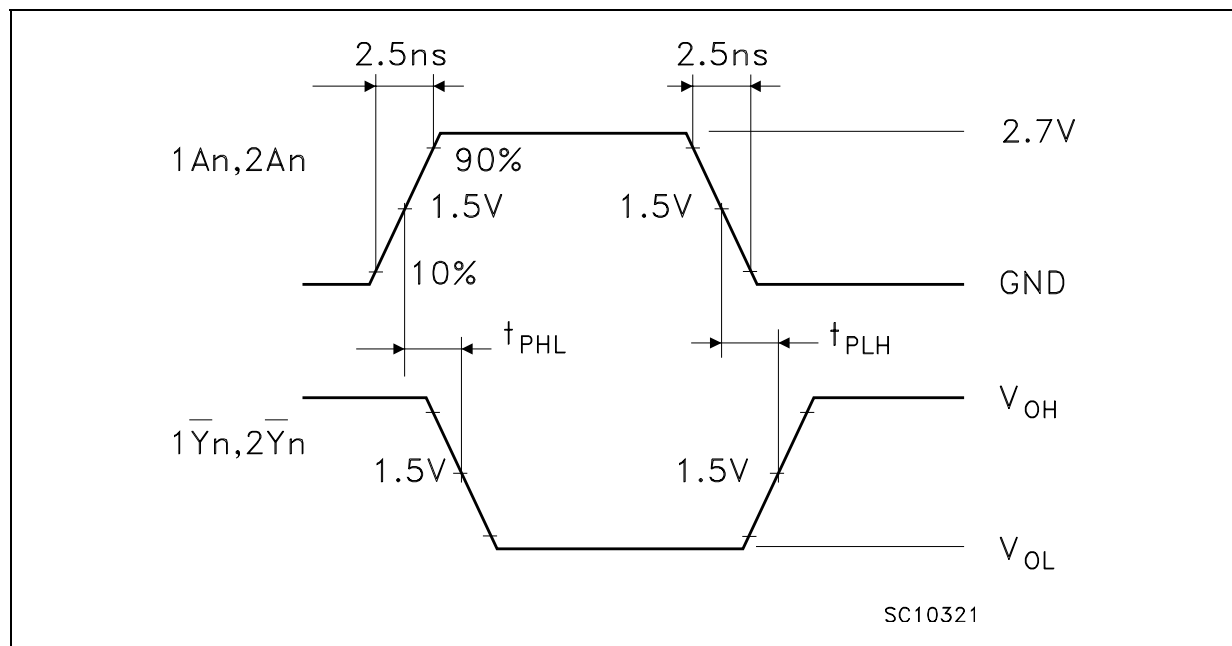
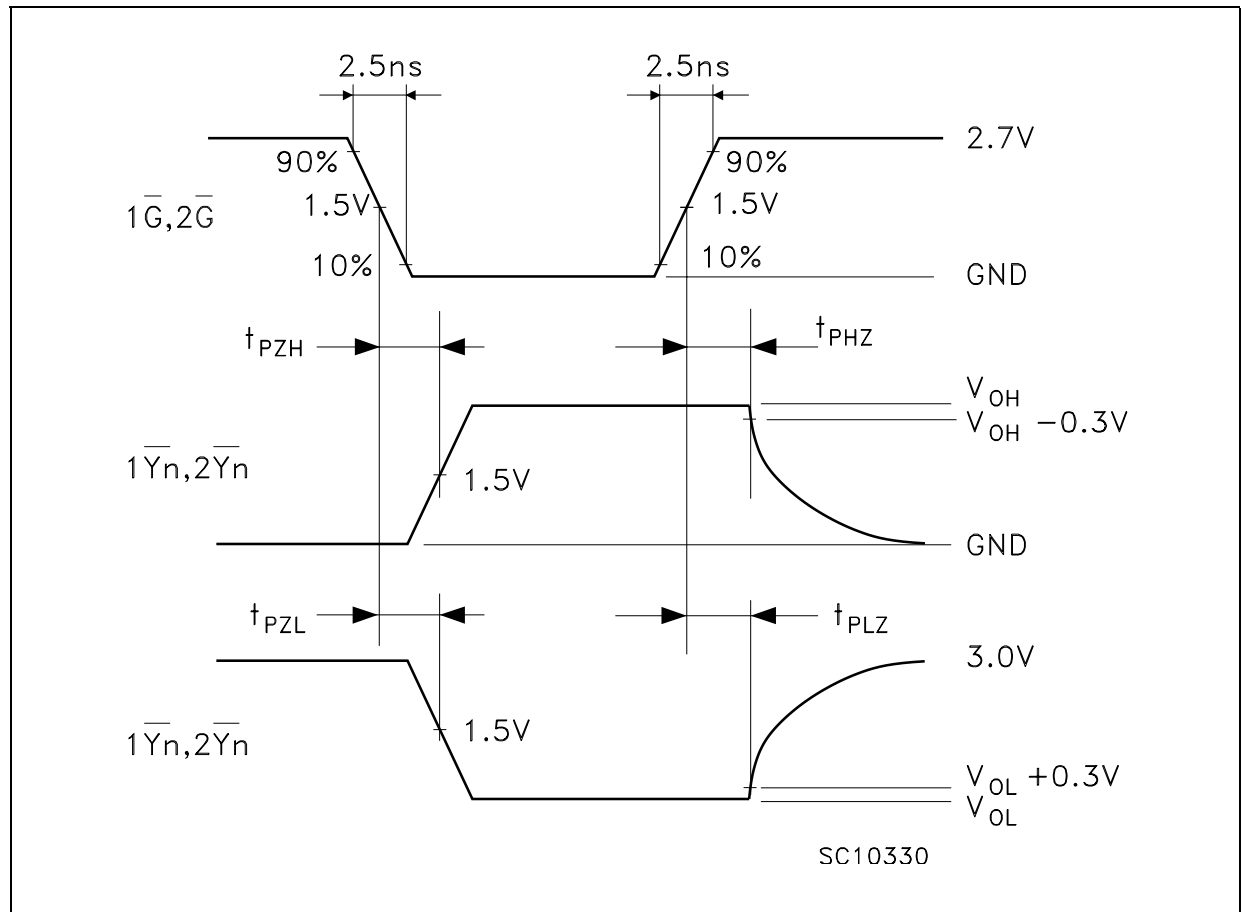
Figure 4: Waveform - Propagation Delays ( $f=1\text{MHz}$ ; 50% duty cycle)

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



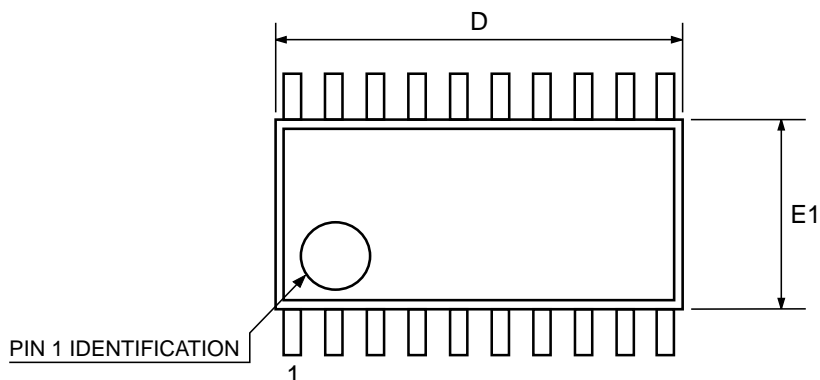
## SO-20 MECHANICAL DATA

| 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  |



0087225C



## 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 | 6        | Ordering Codes Revision - pag. 1. |

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