



# 74LCXH162244

## 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
- BUS HOLD PROVIDED ON DATA INPUT
- OPERATING VOLTAGE RANGE:  
 $V_{CC(OPR)} = 2.0V$  to  $3.6V$  (1.5V Data Retention)
- PIN AND FUNCTION COMPATIBLE WITH 74 SERIES H162244
- LATCH-UP PERFORMANCE EXCEEDS 500mA (JESD 17)
- ESD PERFORMANCE:  
HBM > 2000V (MIL STD 883 method 3015);  
MM > 200V

### DESCRIPTION

The 74LCXH162244 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.

Any  $\overline{nG}$  output control governs four BUS BUFFERS. Output Enable input ( $\overline{nG}$ ) tied together gives full 16-bit operation.

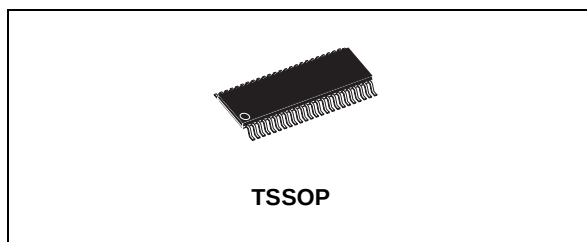
When  $\overline{nG}$  is LOW, the outputs are on. When  $\overline{nG}$  is HIGH, the output are in high impedance state.

Active bus-hold circuitry is provided to hold unused or floating data inputs at a valid logic level.

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.

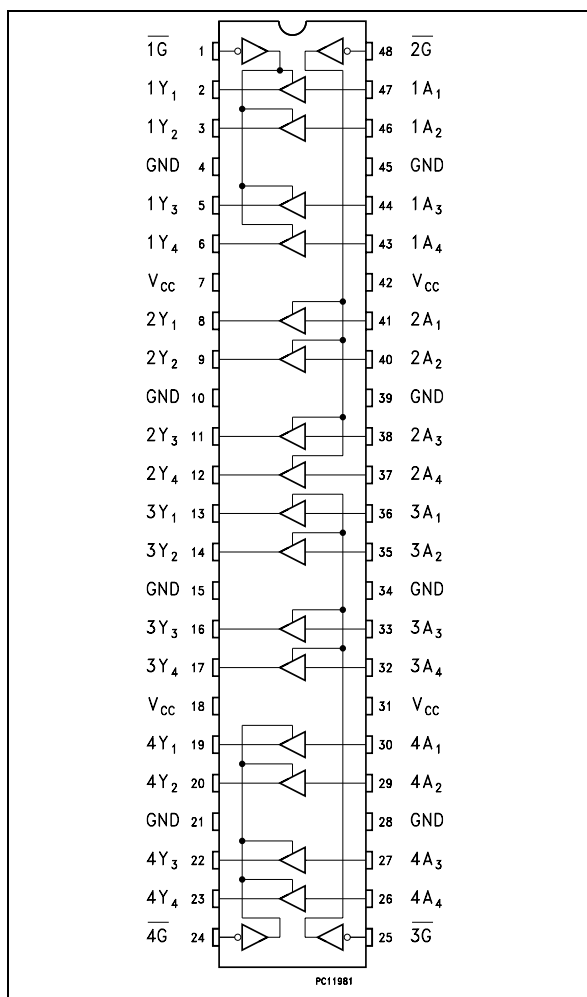
All inputs and outputs are equipped with protection circuits against static discharge, giving them 2KV ESD immunity and transient excess voltage.



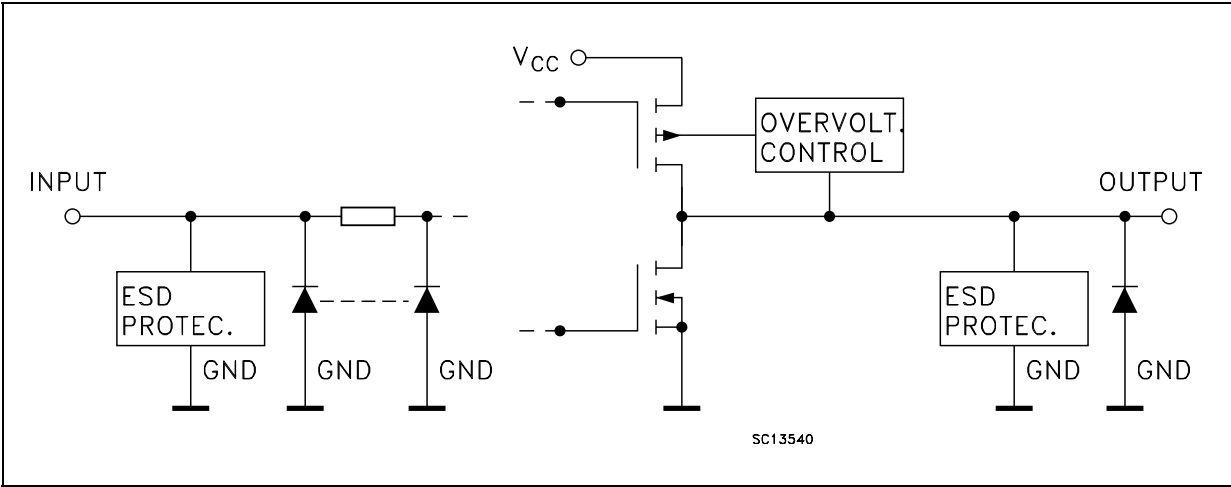
### ORDER CODES

| PACKAGE | TUBE | T & R           |
|---------|------|-----------------|
| TSSOP   |      | 74LCXH162244TTR |

### PIN CONNECTION



INPUT AND OUTPUT EQUIVALENT CIRCUIT



PIN DESCRIPTION

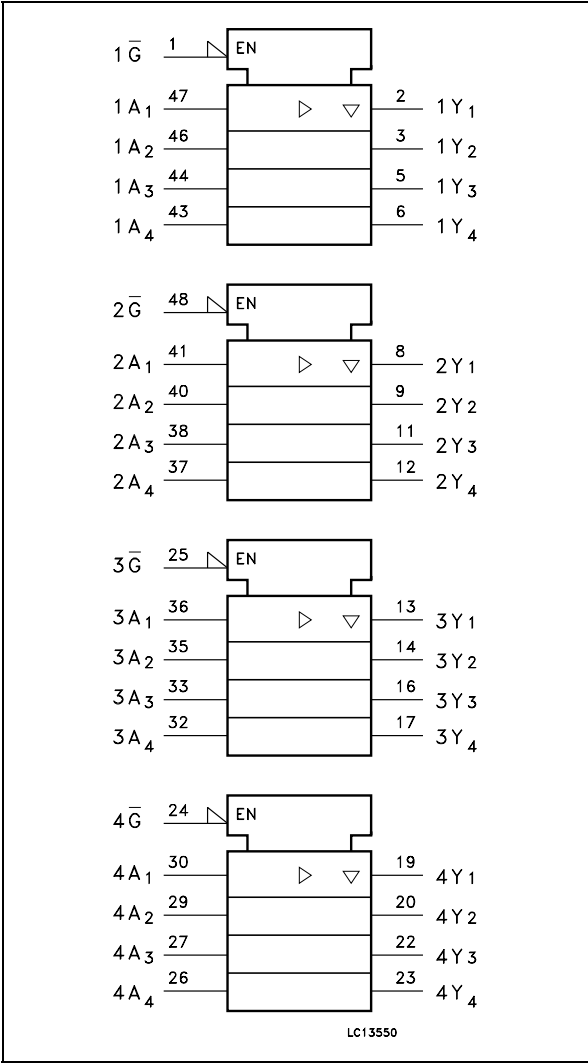
| PIN No                        | SYMBOL     | NAME AND FUNCTION       |
|-------------------------------|------------|-------------------------|
| 1                             | 1G         | Output Enable Input     |
| 2, 3, 5, 6                    | 1Y1 to 1Y4 | Data Outputs            |
| 8, 9, 11, 12                  | 2Y1 to 2Y4 | Data Outputs            |
| 13, 14, 16, 17                | 3Y1 to 3Y4 | Data Outputs            |
| 19, 20, 22, 23                | 4Y1 to 4Y4 | Data Outputs            |
| 24                            | 4G         | Output Enable Input     |
| 25                            | 3G         | Output Enable Input     |
| 30, 29, 27, 26                | 4A1 to 4A4 | Data Outputs            |
| 36, 35, 33, 32                | 3A1 to 3A4 | Data Outputs            |
| 41, 40, 38, 37                | 2A1 to 2A4 | Data Outputs            |
| 47, 46, 44, 43                | 1A1 to 1A4 | Data Outputs            |
| 48                            | 2G         | Output Enable Input     |
| 4, 10, 15, 21, 28, 34, 39, 45 | GND        | Ground (0V)             |
| 7, 18, 31, 42                 | VCC        | Positive Supply Voltage |

TRUTH TABLE

| INPUTS         |                | 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

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><br>(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    |
| 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>I(HOLD)</sub> | Input Hold Current                    | 3.0                    | V <sub>I</sub> = 0.8V                                                                        | 75                   |       | 75                   |       | µA   |
|                      |                                       |                        | V <sub>I</sub> = 2.0V                                                                        | -75                  |       | -75                  |       |      |
|                      |                                       | 3.6                    | V <sub>I</sub> = 0 to 3.6V                                                                   |                      | ± 500 |                      | ± 500 |      |
| 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><br>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><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.

## 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          | 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><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>|)

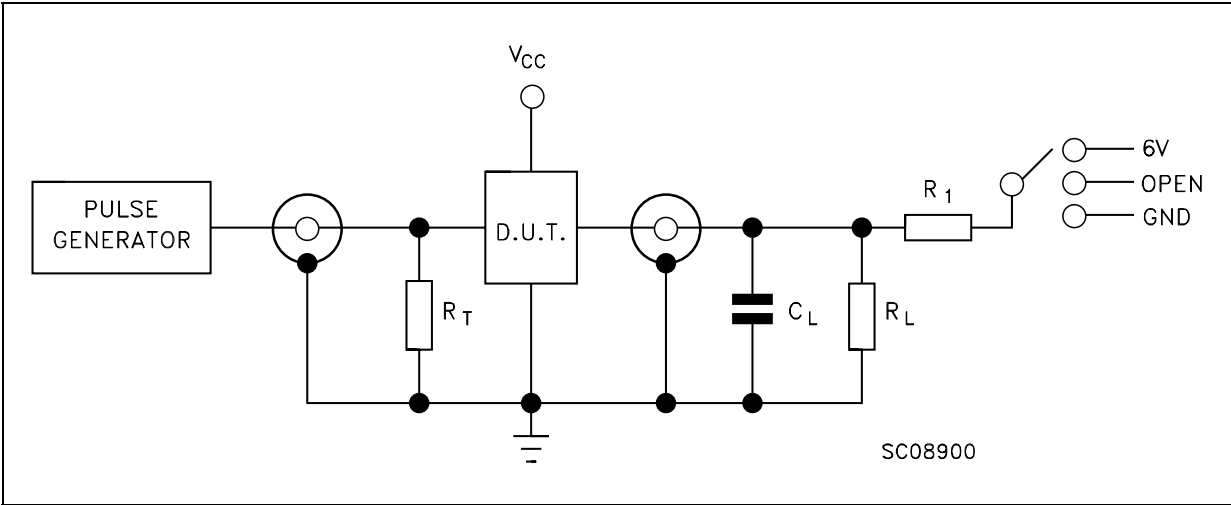
2) Parameter guaranteed by design

## 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                      |                        |                                                                   |                        | 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<br>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(opr)</sub> = C<sub>PD</sub> × V<sub>CC</sub> × f<sub>IN</sub> + I<sub>CC</sub>/16 (per circuit)

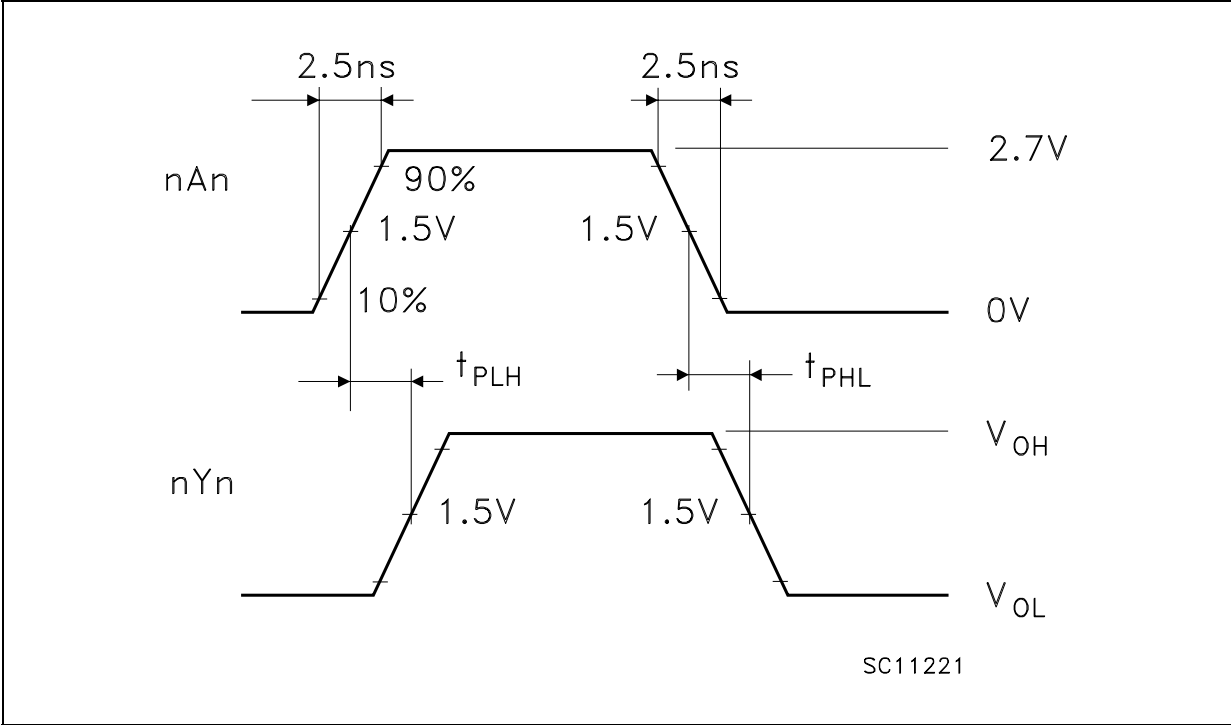
TEST CIRCUIT

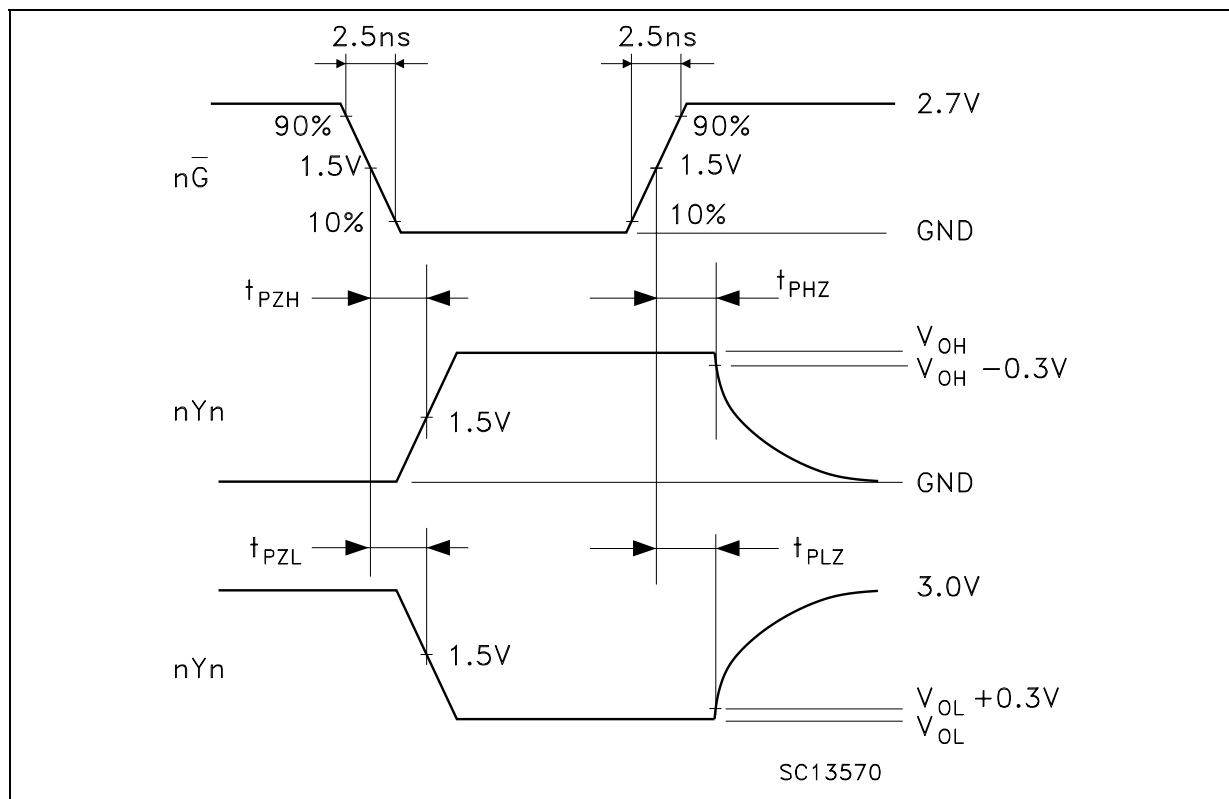


| TEST               | SWITCH |
|--------------------|--------|
| $t_{PLH}, t_{PHL}$ | Open   |
| $t_{PZL}, t_{PLZ}$ | 6V     |
| $t_{PZH}, t_{PHZ}$ | GND    |

$C_L = 50 \text{ pF}$  or equivalent (includes jig and probe capacitance)  
 $R_L = R_1 = 500\Omega$  or equivalent  
 $R_T = Z_{OUT}$  of pulse generator (typically  $50\Omega$ )

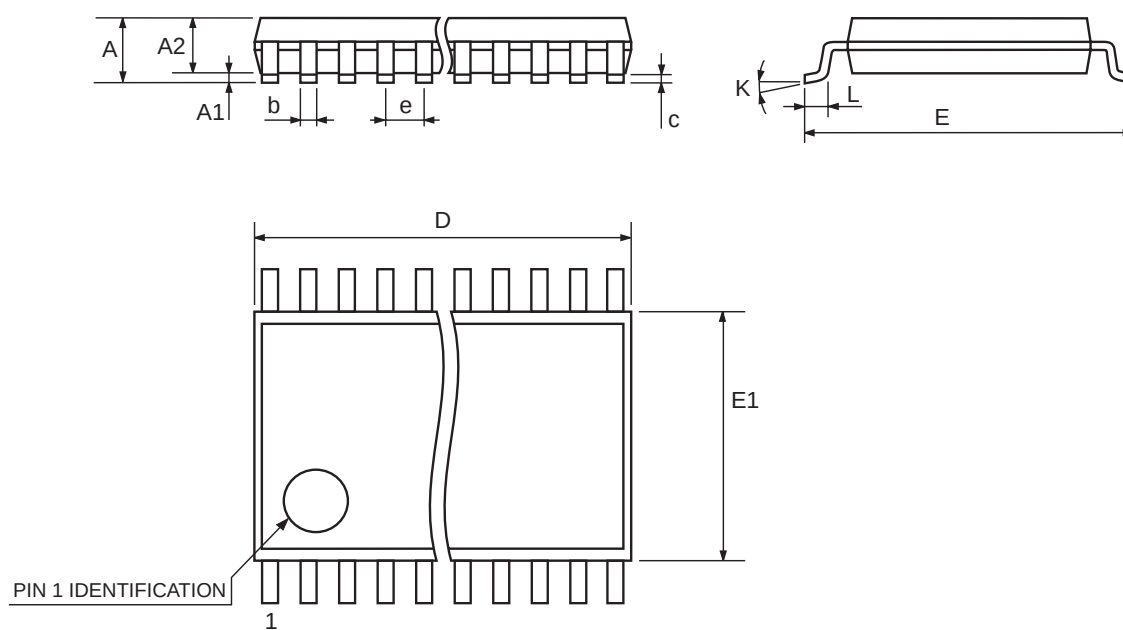
WAVEFORM 1 : PROPAGATION DELAYS (f=1MHz; 50% duty cycle)



**WAVEFORM 2 : OUTPUT ENABLE AND DISABLE TIME** ( $f=1\text{MHz}$ ; 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  |

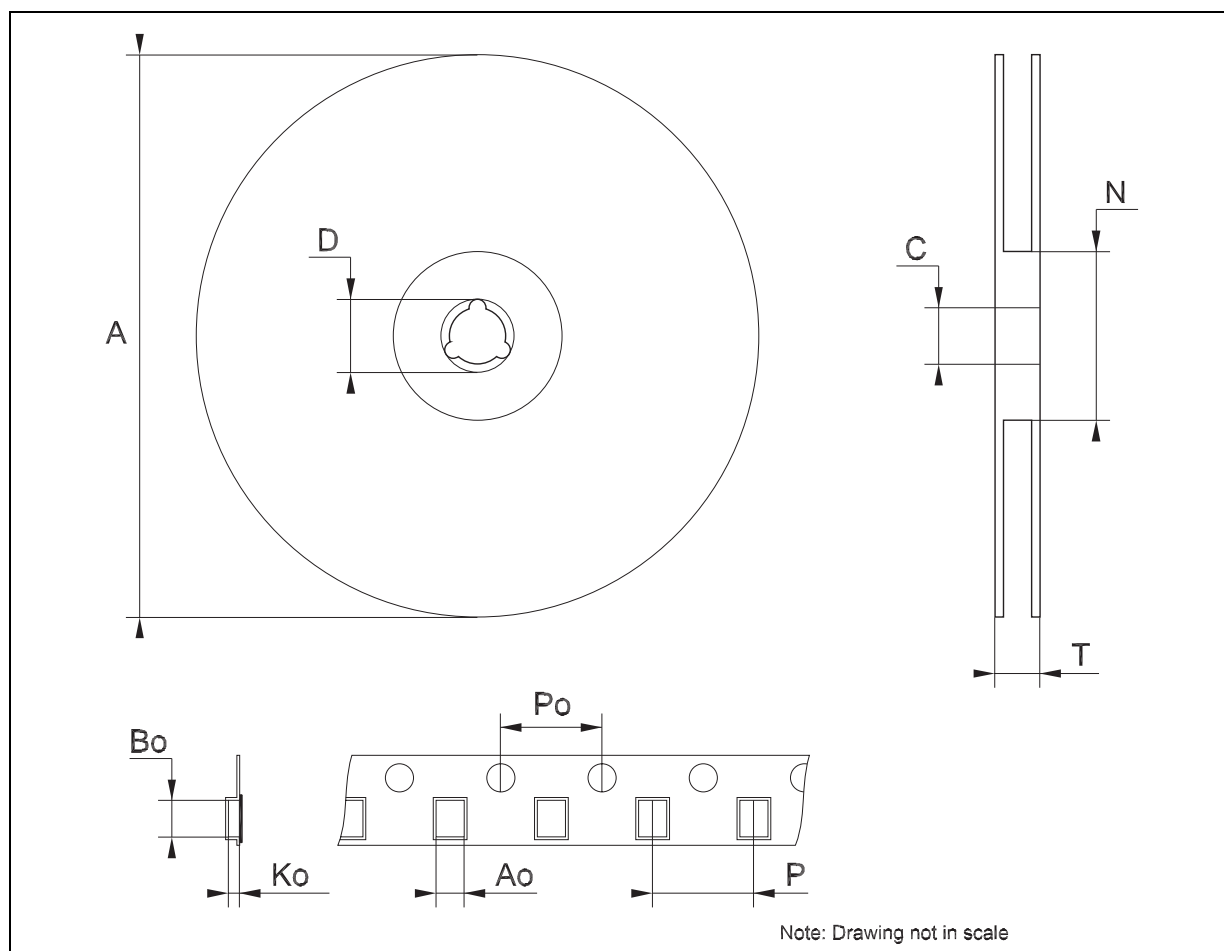


7065588C



### 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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