



## 74VHC16245

### 16-BIT BUS TRANSCEIVER WITH 3-STATE OUTPUTS (NON INVERTED)

- HIGH SPEED:  $t_{PD} = 4.0 \text{ ns}$  (TYP.) at  $V_{CC} = 5V$
- LOW POWER DISSIPATION:  
 $I_{CC} = 4 \mu A$  (MAX.) at  $T_A = 25^\circ C$
- HIGH NOISE IMMUNITY  
 $V_{NIH} = V_{NIL} = 28\% V_{CC}$  (MIN.)
- POWER DOWN PROTECTION ON INPUTS  
& OUTPUTS
- SYMMETRICAL OUTPUT IMPEDANCE:  
 $|I_{OH}| = I_{OL} = 8 \text{ mA}$  (MIN)
- BALANCED PROPAGATION DELAYS:  
 $t_{PLH} \approx t_{PHL}$
- OPERATING VOLTAGE RANGE:  
 $V_{CC(OPR)} = 2V \text{ to } 5.5V$
- IMPROVED LATCH-UP IMMUNITY
- LOW NOISE:  $V_{OLP} = 0.9V$  (MAX.)

#### DESCRIPTION

The 74VHC16245 is an advanced high-speed CMOS 16-BIT BUS TRANSCEIVER (3-STATE) fabricated with sub-micron silicon gate and double-layer metal wiring C<sup>2</sup>MOS technology.

This IC is intended for two-way asynchronous communication between data busses; the direction of data transmission is determined by DIR input. The enable input G can be used to disable the device so that the busses are effectively isolated.

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

All floating bus terminals during High Z State must be held HIGH or LOW.

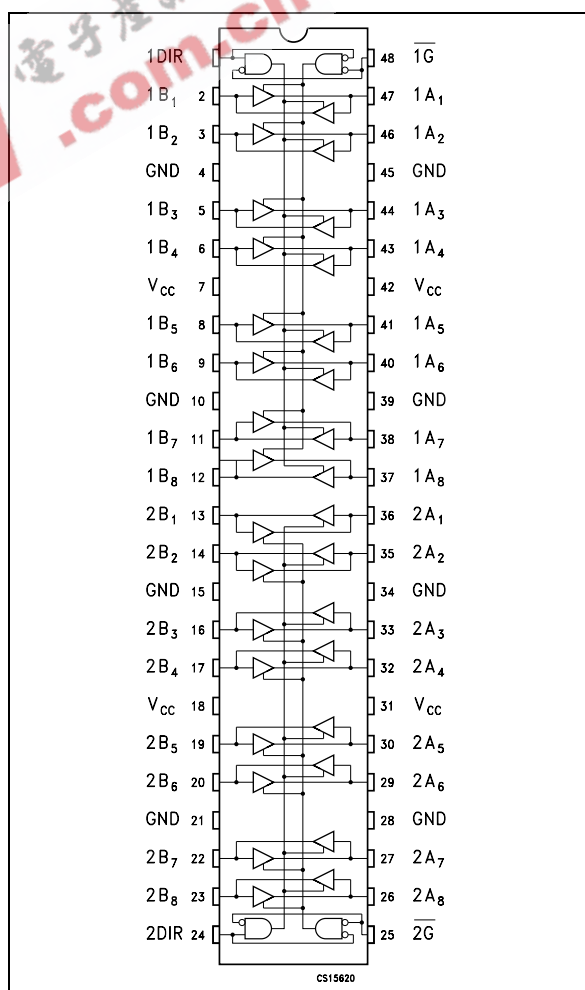


TSSOP

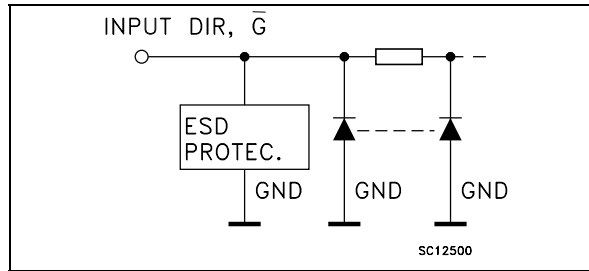
#### ORDER CODES

| PACKAGE | TUBE | T & R         |
|---------|------|---------------|
| TSSOP   |      | 74VHC16245TTR |

#### PIN CONNECTION



## INPUT EQUIVALENT CIRCUIT



## PIN DESCRIPTION

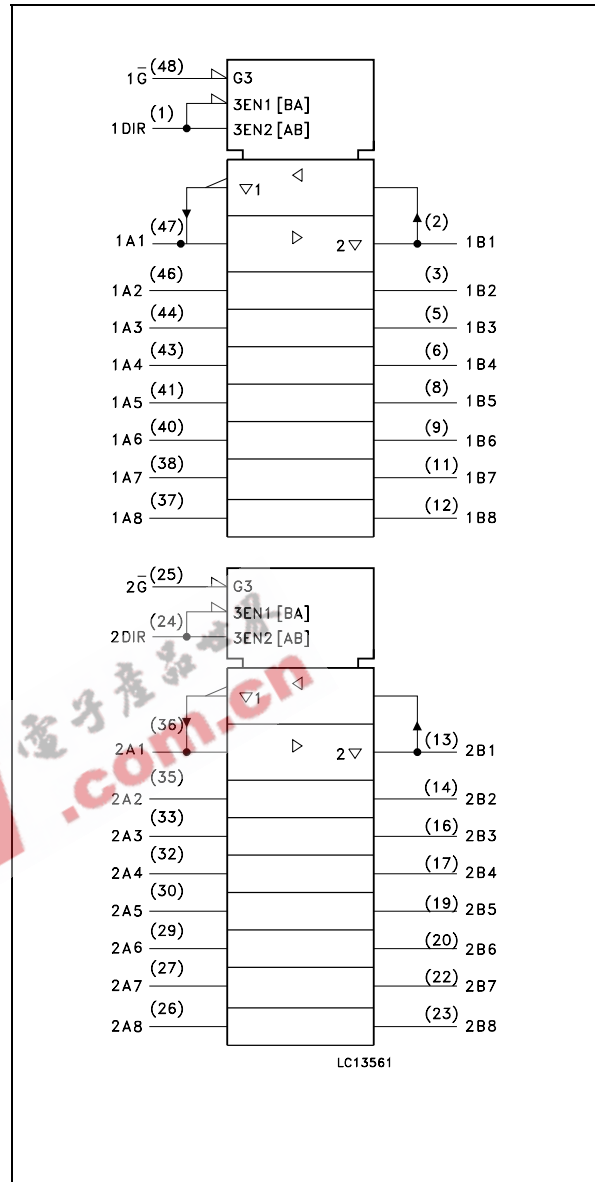
| PIN No                         | SYMBOL          | NAME AND FUNCTION       |
|--------------------------------|-----------------|-------------------------|
| 1                              | 1DIR            | Directional Control     |
| 2, 3, 5, 6, 8, 9, 11, 12       | 1B1 to 1B8      | Data Inputs/Outputs     |
| 13, 14, 16, 17, 19, 20, 22, 23 | 2B1 to 2B8      | Data Inputs/Outputs     |
| 24                             | 2DIR            | Directional Control     |
| 25                             | 2G              | Output Enable Input     |
| 36, 35, 33, 32, 30, 29, 27, 26 | 2A1 to 2A8      | Data Inputs/Outputs     |
| 47, 46, 44, 43, 41, 40, 38, 38 | 1A1 to 1A8      | Data Inputs/Outputs     |
| 48                             | 1G              | Output Enable Input     |
| 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 |     | FUNCTION |        | OUTPUT |
|--------|-----|----------|--------|--------|
| G-bar  | DIR | A BUS    | B BUS  | Yn     |
| L      | L   | OUTPUT   | INPUT  | A = B  |
| L      | H   | INPUT    | OUTPUT | B = A  |
| H      | X   | Z        | Z      | 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 (DIR, G)     | -0.5 to +7.0           | V    |
| $V_{I/O}$             | Bus I/O Voltage               | -0.5 to $V_{CC} + 0.5$ | V    |
| $V_O$                 | DC Output Voltage             | -0.5 to $V_{CC} + 0.5$ | V    |
| $I_{IK}$              | DC Input Diode Current        | - 20                   | mA   |
| $I_{OK}$              | DC Output Diode Current       | $\pm 20$               | mA   |
| $I_O$                 | DC Output Current             | $\pm 25$               | mA   |
| $I_{CC}$ or $I_{GND}$ | DC $V_{CC}$ or Ground Current | $\pm 75$               | 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.

**RECOMMENDED OPERATING CONDITIONS**

| Symbol    | Parameter                                                                                    | Value               | Unit |
|-----------|----------------------------------------------------------------------------------------------|---------------------|------|
| $V_{CC}$  | Supply Voltage                                                                               | 2 to 5.5            | V    |
| $V_I$     | Input Voltage (DIR, G)                                                                       | 0 to 5.5            | V    |
| $V_{I/O}$ | Bus I/O Voltage                                                                              | 0 to $V_{CC}$       | V    |
| $V_O$     | Output Voltage                                                                               | 0 to $V_{CC}$       | V    |
| $T_{op}$  | Operating Temperature                                                                        | -55 to 125          | °C   |
| dt/dv     | Input Rise and Fall Time (note 1) ( $V_{CC} = 3.3 \pm 0.3V$ )<br>( $V_{CC} = 5.0 \pm 0.5V$ ) | 0 to 100<br>0 to 20 | ns/V |

1)  $V_{IN}$  from 30% to 70% of  $V_{CC}$

## DC SPECIFICATIONS

| Symbol          | Parameter                             | Test Condition         |                                                                                                | Value                 |      |                    |                    |                    |                    |                    | Unit |
|-----------------|---------------------------------------|------------------------|------------------------------------------------------------------------------------------------|-----------------------|------|--------------------|--------------------|--------------------|--------------------|--------------------|------|
|                 |                                       | V <sub>CC</sub><br>(V) |                                                                                                | T <sub>A</sub> = 25°C |      |                    | -40 to 85°C        |                    | -55 to 125°C       |                    |      |
|                 |                                       |                        |                                                                                                | Min.                  | Typ. | Max.               | Min.               | Max.               | Min.               | Max.               |      |
| V <sub>IH</sub> | High Level Input Voltage              | 2.0                    |                                                                                                | 1.5                   |      |                    | 1.5                |                    | 1.5                |                    | V    |
|                 |                                       | 3.0 to 5.5             |                                                                                                | 0.7V <sub>CC</sub>    |      |                    | 0.7V <sub>CC</sub> |                    | 0.7V <sub>CC</sub> |                    |      |
| V <sub>IL</sub> | Low Level Input Voltage               | 2.0                    |                                                                                                |                       |      | 0.5                |                    | 0.5                |                    | 0.5                | V    |
|                 |                                       | 3.0 to 5.5             |                                                                                                |                       |      | 0.3V <sub>CC</sub> |                    | 0.3V <sub>CC</sub> |                    | 0.3V <sub>CC</sub> |      |
| V <sub>OH</sub> | High Level Output Voltage             | 2.0                    | I <sub>O</sub> =-50 μA                                                                         | 1.9                   | 2.0  |                    | 1.9                |                    | 1.9                |                    | V    |
|                 |                                       | 3.0                    | I <sub>O</sub> =-50 μA                                                                         | 2.9                   | 3.0  |                    | 2.9                |                    | 2.9                |                    |      |
|                 |                                       | 4.5                    | I <sub>O</sub> =-50 μA                                                                         | 4.4                   | 4.5  |                    | 4.4                |                    | 4.4                |                    |      |
|                 |                                       | 3.0                    | I <sub>O</sub> =-4 mA                                                                          | 2.58                  |      |                    | 2.48               |                    | 2.4                |                    |      |
|                 |                                       | 4.5                    | I <sub>O</sub> =-8 mA                                                                          | 3.94                  |      |                    | 3.8                |                    | 3.7                |                    |      |
| V <sub>OL</sub> | Low Level Output Voltage              | 2.0                    | I <sub>O</sub> =50 μA                                                                          |                       | 0.0  | 0.1                |                    | 0.1                |                    | 0.1                | V    |
|                 |                                       | 3.0                    | I <sub>O</sub> =50 μA                                                                          |                       | 0.0  | 0.1                |                    | 0.1                |                    | 0.1                |      |
|                 |                                       | 4.5                    | I <sub>O</sub> =50 μA                                                                          |                       | 0.0  | 0.1                |                    | 0.1                |                    | 0.1                |      |
|                 |                                       | 3.0                    | I <sub>O</sub> =4 mA                                                                           |                       |      | 0.36               |                    | 0.44               |                    | 0.55               |      |
|                 |                                       | 4.5                    | I <sub>O</sub> =8 mA                                                                           |                       |      | 0.36               |                    | 0.44               |                    | 0.55               |      |
| I <sub>OZ</sub> | High Impedance Output Leakage Current | 5.5                    | V <sub>I</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>V <sub>O</sub> = V <sub>CC</sub> or GND |                       |      | ±0.25              |                    | ± 2.5              |                    | ± 2.5              | μA   |
| I <sub>I</sub>  | Input Leakage Current                 | 0 to 5.5               | V <sub>I</sub> = 5.5V or GND                                                                   |                       |      | ± 0.1              |                    | ± 1                |                    | ± 1                | μA   |
| I <sub>CC</sub> | Quiescent Supply Current              | 5.5                    | V <sub>I</sub> = V <sub>CC</sub> or GND                                                        |                       |      | 4                  |                    | 40                 |                    | 40                 | μA   |

**AC ELECTRICAL CHARACTERISTICS** (Input  $t_r = t_f = 3\text{ns}$ )

| Symbol                                 | Parameter                           | Test Condition         |                        |                      | Value                 |      |      |             |      |              | Unit |      |
|----------------------------------------|-------------------------------------|------------------------|------------------------|----------------------|-----------------------|------|------|-------------|------|--------------|------|------|
|                                        |                                     | V <sub>CC</sub><br>(V) | C <sub>L</sub><br>(pF) |                      | T <sub>A</sub> = 25°C |      |      | -40 to 85°C |      | -55 to 125°C |      |      |
|                                        |                                     |                        |                        |                      | Min.                  | Typ. | Max. | Min.        | Max. | Min.         |      | Max. |
| t <sub>PLH</sub><br>t <sub>PHL</sub>   | Propagation Delay Time              | 3.3 <sup>(*)</sup>     | 15                     |                      |                       | 5.8  | 8.4  | 1.0         | 10.0 | 1.0          | 10.0 | ns   |
|                                        |                                     | 3.3 <sup>(*)</sup>     | 50                     |                      |                       | 8.3  | 11.9 | 1.0         | 13.5 | 1.0          | 13.5 |      |
|                                        |                                     | 5.0 <sup>(**)</sup>    | 15                     |                      |                       | 4.0  | 5.5  | 1.0         | 6.5  | 1.0          | 6.5  |      |
|                                        |                                     | 5.0 <sup>(**)</sup>    | 50                     |                      |                       | 5.5  | 7.5  | 1.0         | 8.5  | 1.0          | 8.5  |      |
| t <sub>PZL</sub><br>t <sub>PZH</sub>   | Output Disable Time                 | 3.3 <sup>(*)</sup>     | 15                     | R <sub>L</sub> = 1KΩ |                       | 8.5  | 13.2 | 1.0         | 15.5 | 1.0          | 15.5 | ns   |
|                                        |                                     | 3.3 <sup>(*)</sup>     | 50                     | R <sub>L</sub> = 1KΩ |                       | 11.0 | 16.7 | 1.0         | 19.0 | 1.0          | 19.0 |      |
|                                        |                                     | 5.0 <sup>(**)</sup>    | 15                     | R <sub>L</sub> = 1KΩ |                       | 5.8  | 8.5  | 1.0         | 10.0 | 1.0          | 10.0 |      |
|                                        |                                     | 5.0 <sup>(**)</sup>    | 50                     | R <sub>L</sub> = 1KΩ |                       | 7.3  | 10.6 | 1.0         | 12.0 | 1.0          | 12.0 |      |
| t <sub>PLZ</sub><br>t <sub>PHZ</sub>   | Output Enable Time                  | 3.3 <sup>(*)</sup>     | 50                     | R <sub>L</sub> = 1KΩ |                       | 11.5 | 15.8 | 1.0         | 18.0 | 1.0          | 18.0 | ns   |
|                                        |                                     | 5.0 <sup>(**)</sup>    | 50                     | R <sub>L</sub> = 1KΩ |                       | 7.0  | 9.7  | 1.0         | 11.0 | 1.0          | 11.0 |      |
| t <sub>OSLH</sub><br>t <sub>OSHL</sub> | Output to Output Skew time (note 1) | 3.3 <sup>(*)</sup>     | 50                     |                      |                       |      | 1.5  |             | 1.5  |              | 1.5  | ns   |
|                                        |                                     | 5.0 <sup>(**)</sup>    | 50                     |                      |                       |      | 1.0  |             | 1.0  |              | 1.0  |      |

(\*) Voltage range is  $3.3\text{V} \pm 0.3\text{V}$ (\*\*) Voltage range is  $5.0\text{V} \pm 0.5\text{V}$ Note 1: Parameter guaranteed by design.  $t_{soLH} = |t_{pLHm} - t_{pLHn}|$ ,  $t_{soHL} = |t_{pHLm} - t_{pHLn}|$ **CAPACITIVE CHARACTERISTICS**

| Symbol           | Parameter                              | Test Condition | Value                 |      |      |             |      |              |      | Unit |    |
|------------------|----------------------------------------|----------------|-----------------------|------|------|-------------|------|--------------|------|------|----|
|                  |                                        |                | T <sub>A</sub> = 25°C |      |      | -40 to 85°C |      | -55 to 125°C |      |      |    |
|                  |                                        |                | Min.                  | Typ. | Max. | Min.        | Max. | Min.         | Max. |      |    |
| C <sub>IN</sub>  | Input Capacitance                      |                |                       | 4    | 10   |             |      | 10           |      | 10   | pF |
| C <sub>I/O</sub> | Output Capacitance                     |                |                       | 8    |      |             |      |              |      |      | pF |
| C <sub>PD</sub>  | Power Dissipation Capacitance (note 1) |                |                       | 21   |      |             |      |              |      |      | pF |

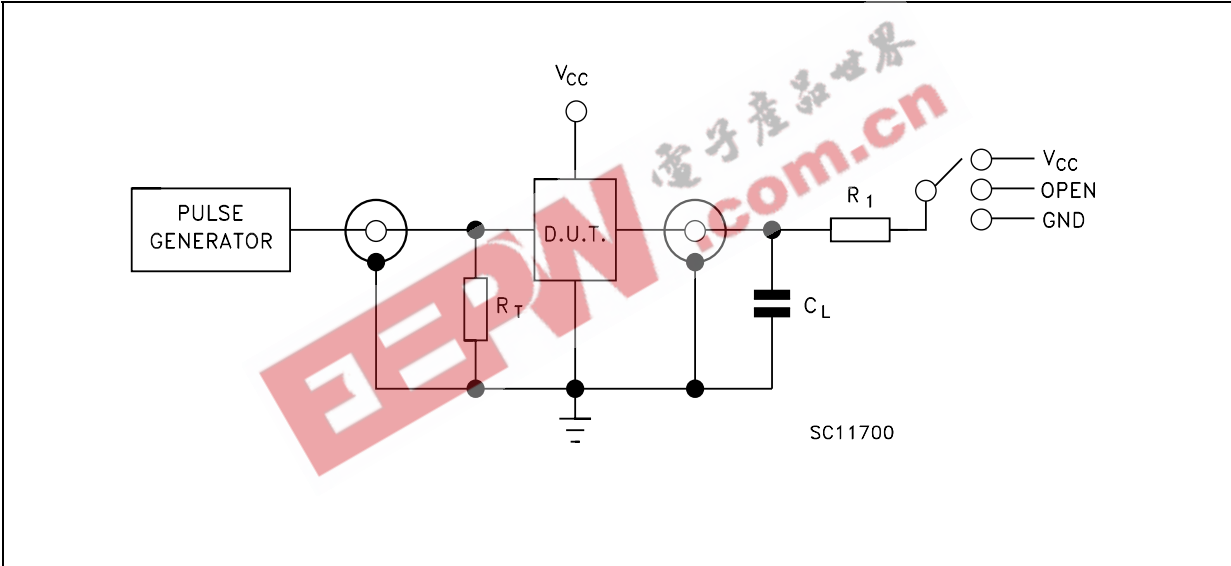
1)  $C_{PD}$  is defined as the value of the IC's internal equivalent capacitance which is calculated from the operating current consumption without load. (Refer to Test Circuit). Average operating current can be obtained by the following equation.  $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/8$  (per circuit)

DYNAMIC SWITCHING CHARACTERISTICS

| Symbol           | Parameter                                    | Test Condition         |                        | Value                 |      |      |             |      |              | Unit |      |
|------------------|----------------------------------------------|------------------------|------------------------|-----------------------|------|------|-------------|------|--------------|------|------|
|                  |                                              | V <sub>CC</sub><br>(V) |                        | T <sub>A</sub> = 25°C |      |      | -40 to 85°C |      | -55 to 125°C |      |      |
|                  |                                              |                        |                        | Min.                  | Typ. | Max. | Min.        | Max. | Min.         |      | Max. |
| V <sub>OLP</sub> | Dynamic Low Voltage Quiet Output (note 1, 2) | 5.0                    | C <sub>L</sub> = 50 pF |                       | 0.6  | 0.9  |             |      |              |      | V    |
| V <sub>OLV</sub> |                                              |                        |                        | -0.9                  | -0.6 |      |             |      |              |      |      |
| V <sub>IHD</sub> | Dynamic High Voltage Input (note 1, 3)       | 5.0                    |                        | 3.5                   |      |      |             |      |              |      | V    |
| V <sub>ILD</sub> | Dynamic Low Voltage Input (note 1, 3)        | 5.0                    |                        |                       |      |      | 1.5         |      |              |      |      |

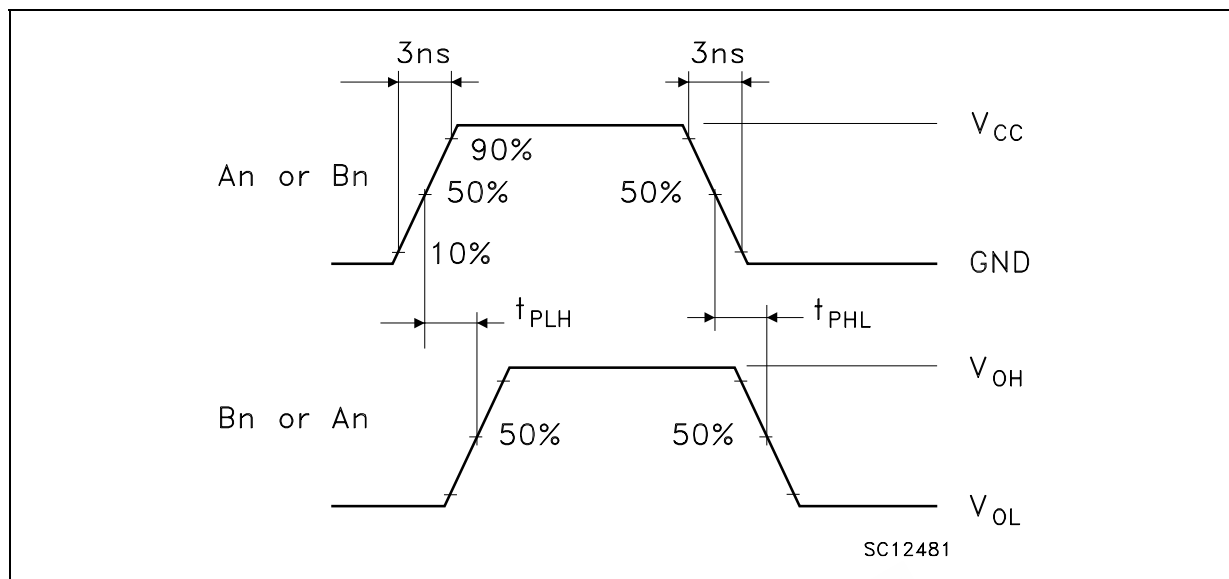
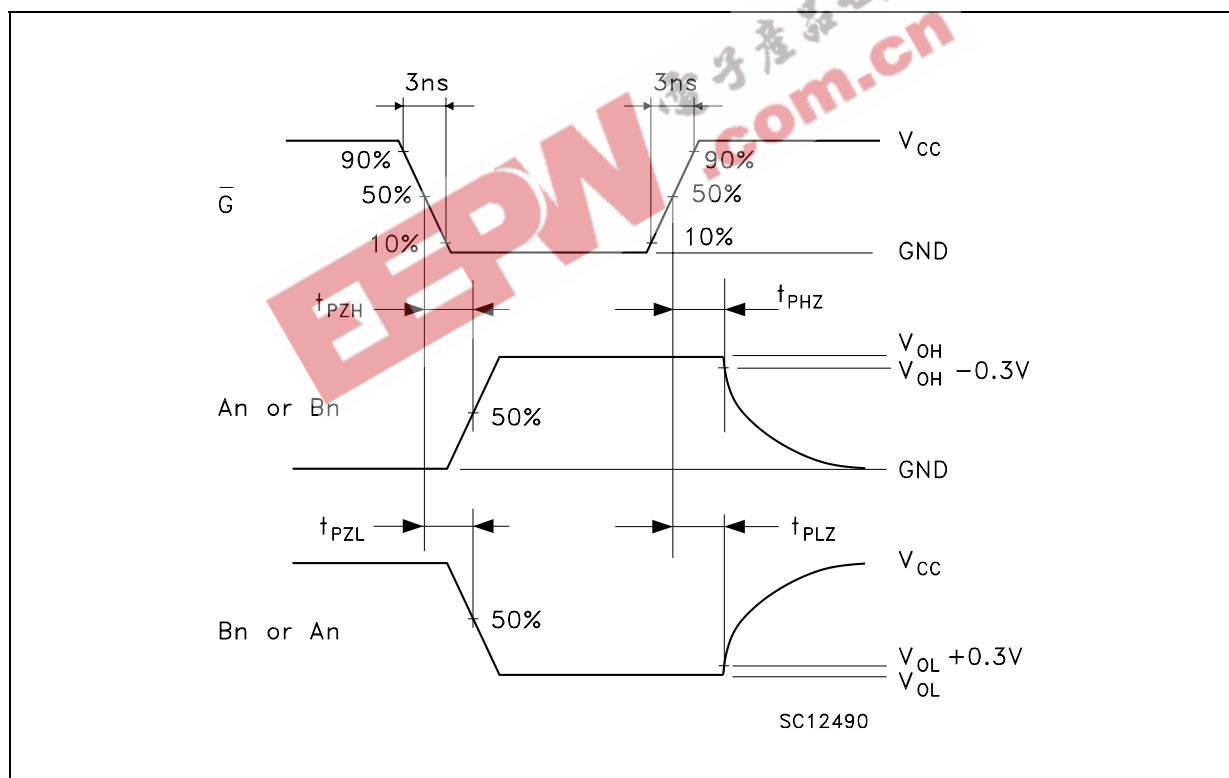
1) Worst case package.  
2) Max number of outputs defined as (n). Data inputs are driven 0V to 5.0V, (n-1) outputs switching and one output at GND.  
3) Max number of data inputs (n) switching. (n-1) switching 0V to 5.0V. Inputs under test switching: 5.0V to threshold (V<sub>ILD</sub>), 0V to threshold (V<sub>IHD</sub>), f=1MHz.

TEST CIRCUIT



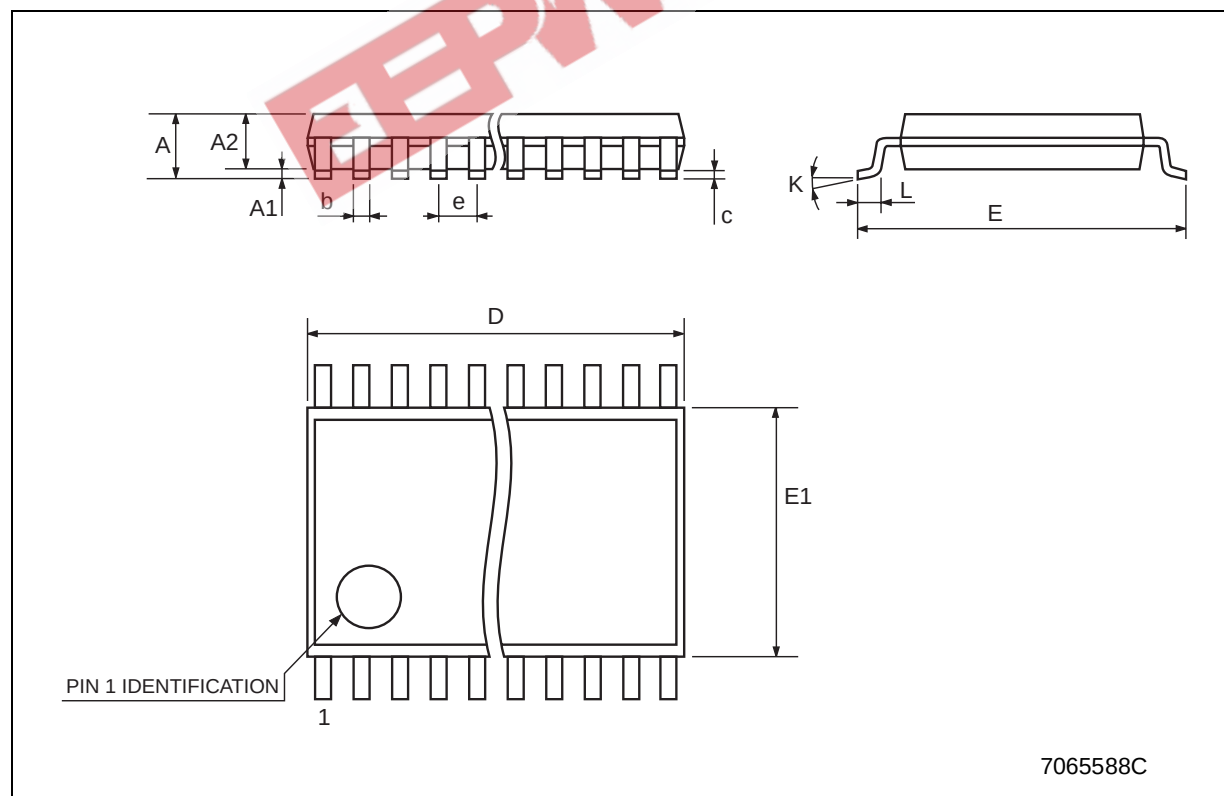
| TEST                                | SWITCH          |
|-------------------------------------|-----------------|
| t <sub>PLH</sub> , t <sub>PHL</sub> | Open            |
| t <sub>PZL</sub> , t <sub>PLZ</sub> | V <sub>CC</sub> |
| t <sub>PZH</sub> , t <sub>PHZ</sub> | GND             |

C<sub>L</sub> = 15/ 50pF or equivalent (includes jig and probe capacitance)  
R<sub>L</sub> = R<sub>1</sub> = 1KΩ or equivalent  
R<sub>T</sub> = Z<sub>OUT</sub> of pulse generator (typically 50Ω)

**WAVEFORM 1: PROPAGATION DELAYS** ( $f=1\text{MHz}$ ; 50% duty cycle)**WAVEFORM 2: OUTPUT ENABLE AND DISABLE TIME** ( $f=1\text{MHz}$ ; 50% duty cycle)

## TSSOP48 MECHANICAL DATA

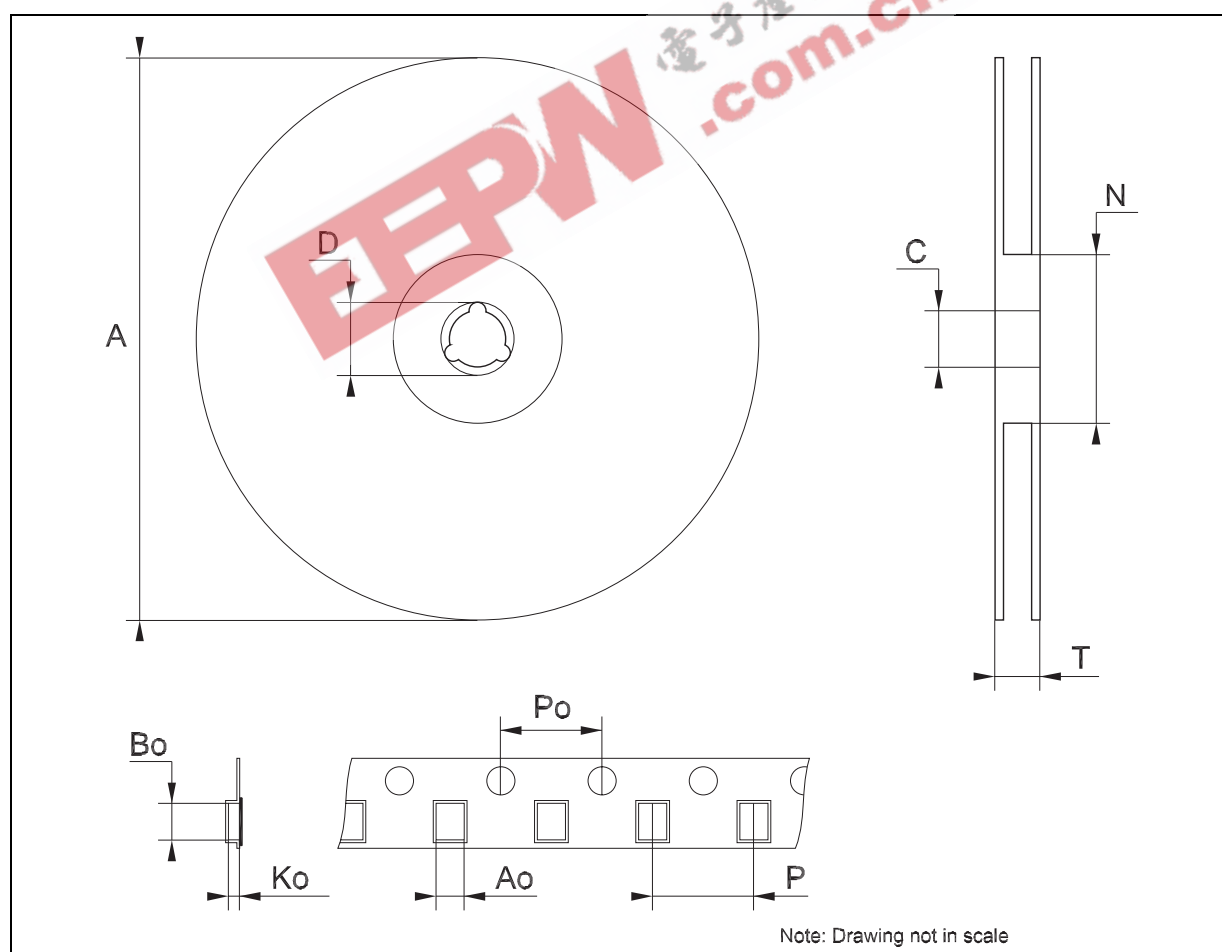
| DIM. | mm.  |         |      | inch   |            |        |
|------|------|---------|------|--------|------------|--------|
|      | MIN. | TYP     | MAX. | MIN.   | TYP.       | MAX.   |
| A    |      |         | 1.2  |        |            | 0.047  |
| A1   | 0.05 |         | 0.15 | 0.002  |            | 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  |





## Tape &amp; 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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