



74VCXH16245

LOW VOLTAGE CMOS 16-BIT BUS TRANSCEIVER (3-STATE) WITH 3.6V TOLERANT INPUTS AND OUTPUTS

- 3.6V TOLERANT INPUTS AND OUTPUTS
- HIGH SPEED:
 - $t_{PD} = 2.5 \text{ ns (MAX.)}$ at $V_{CC} = 3.0 \text{ to } 3.6V$
 - $t_{PD} = 3.2 \text{ ns (MAX.)}$ at $V_{CC} = 2.3 \text{ to } 2.7V$
- POWER DOWN PROTECTION ON INPUTS AND OUTPUTS
- SYMMETRICAL OUTPUT IMPEDANCE:
 - $|I_{OH}| = I_{OL} = 24\text{mA (MIN)}$ at $V_{CC} = 3.0V$
 - $|I_{OH}| = I_{OL} = 18\text{mA (MIN)}$ at $V_{CC} = 2.3V$
- OPERATING VOLTAGE RANGE:
 - $V_{CC(OPR)} = 1.8V \text{ to } 3.6V$
- PIN AND FUNCTION COMPATIBLE WITH 74 SERIES H16245
- BUS HOLD PROVIDED ON BOTH SIDES
- LATCH-UP PERFORMANCE EXCEEDS 300mA (JESD 17)
- ESD PERFORMANCE:
 - HBM > 2000V (MIL STD 883 method 3015);
 - MM > 200V

DESCRIPTION

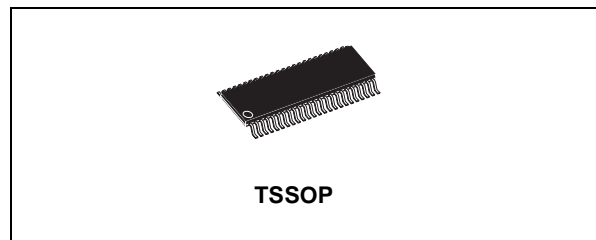
The 74VCXH16245 is a low voltage CMOS 16 BIT BUS TRANSCEIVER (3-STATE) fabricated with sub-micron silicon gate and five-layer metal wiring C²MOS technology. It is ideal for low power and very high speed 2.3 to 3.6V applications; it can be interfaced to 3.6V signal environment for both inputs and outputs.

This IC is intended for two-way asynchronous communication between data buses; the direction of data transmission is determined by DIR input. The two enable inputs \overline{nG} can be used to disable the device so that the buses are effectively isolated.

Bus hold on data inputs is provided in order to eliminate the need for external pull-up or pull-down resistor.

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

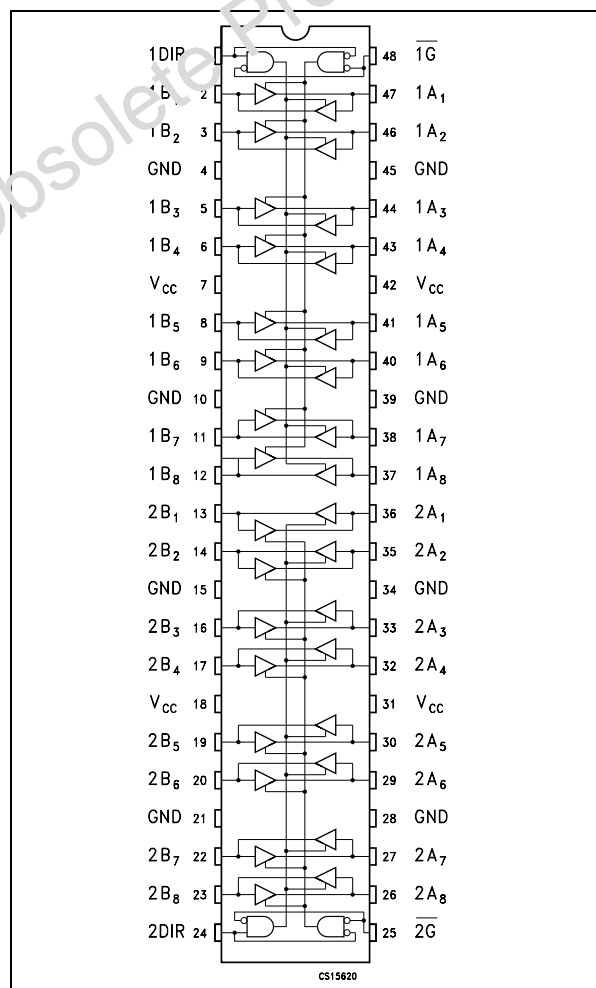
All floating bus terminals during High Z State must be held HIGH or LOW.



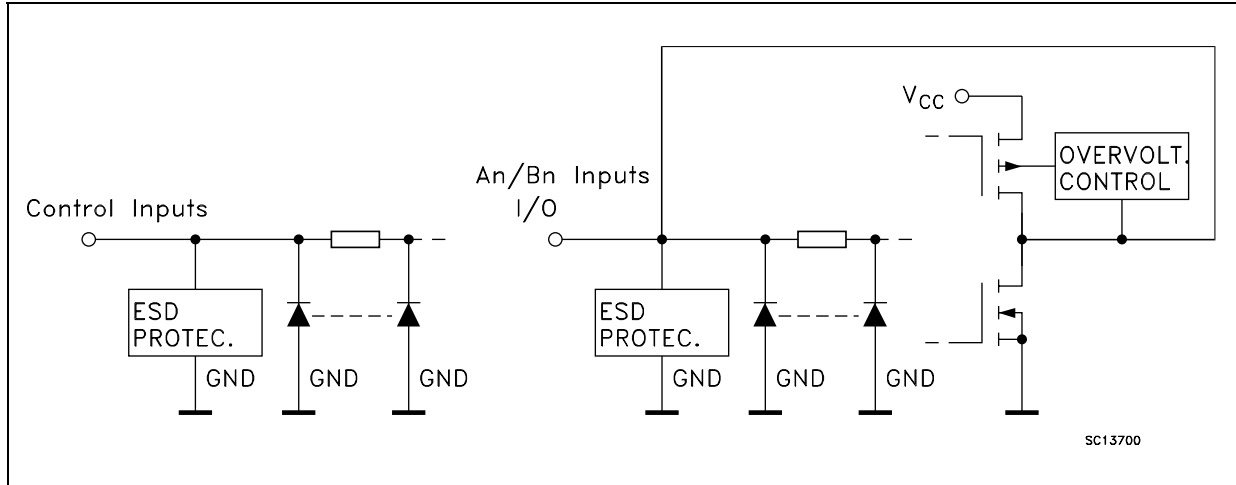
ORDER CODES

| PACKAGE | TUBE | T & P |
|---------|------|----------------|
| TSSOP | | 74VCXH16245TTR |

PIN CONNECTION



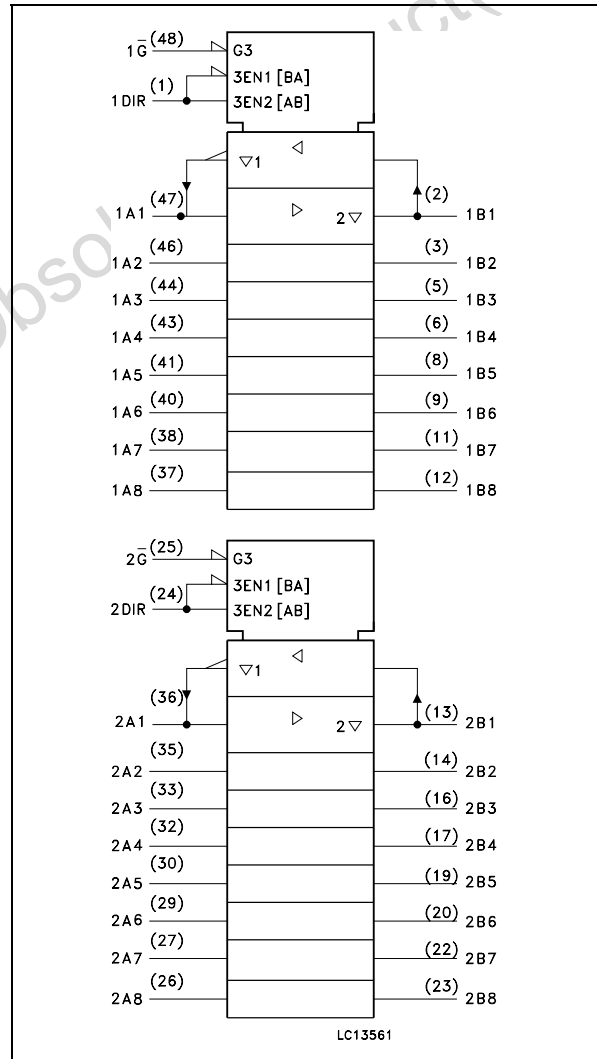
INPUT AND OUTPUT EQUIVALENT CIRCUIT



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 _{CC} | Positive Supply Voltage |

IEC LOGIC SYMBOLS



TRUTH TABLE

| INPUTS | | FUNCTION | | OUTPUT |
|----------------|-----|----------|--------|----------------|
| \overline{G} | DIR | A BUS | B BUS | Y _n |
| L | L | OUTPUT | INPUT | A = B |
| L | H | INPUT | OUTPUT | B = A |
| H | X | Z | Z | Z |

X : Don't Care
Z : High Impedance

ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|-----------------------|--|------------------------|-------------|
| V_{CC} | Supply Voltage | -0.5 to +4.6 | V |
| V_I | DC Input Voltage | -0.5 to +4.6 | V |
| V_O | DC Output Voltage (OFF State) | -0.5 to +4.6 | 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 | ± 50 | mA |
| I_{CC} or I_{GND} | DC V_{CC} or Ground Current per Supply Pin | ± 100 | mA |
| P_D | Power Dissipation | 400 | mW |
| T_{stg} | Storage Temperature | -65 to +150 | $^{\circ}C$ |
| T_L | Lead Temperature (10 sec) | 300 | $^{\circ}C$ |

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) $V_O < GND$, $V_O > V_{CC}$

RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Value | Unit |
|---------------------|---|---------------|-------------|
| V_{CC} | Supply Voltage | 2.3 to 3.6 | V |
| V_I | Input Voltage | -0.3 to 3.6 | V |
| V_O | Output Voltage (OFF State) | 0 to 3.6 | 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 $3.6V$) | ± 24 | mA |
| I_{OH} , I_{OL} | High or Low Level Output Current ($V_{CC} = 2.3$ to $2.7V$) | ± 18 | mA |
| T_{op} | Operating Temperature | -55 to 125 | $^{\circ}C$ |
| dt/dv | Input Rise and Fall Time (note 1) | 0 to 10 | ns/V |

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

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DC SPECIFICATIONS (2.7V < V_{CC} ≤ 3.6V unless otherwise specified)

| Symbol | Parameter | Test Condition | | Value | | | | Unit |
|----------------------|---------------------------------------|------------------------|---|----------------------|-------|----------------------|-------|------|
| | | V _{CC} (V) | | -40 to 85 °C | | -55 to 125 °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 μA | 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 μA | | 0.2 | | 0.2 | V |
| | | 2.7 | I _O =12 mA | | 0.4 | | 0.4 | |
| | | 3.0 | I _O =18 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 3.6V | | ± 5 | | ± 5 | μA |
| I _{I(HOLD)} | Input Hold Current | 3.0 | V _I = 0.8V | 75 | | 75 | | μA |
| | | | V _I = 2V | -75 | | -75 | | |
| | | 3.6 | V _I = 0 to 3.6V | | ± 500 | | ± 500 | |
| I _{off} | Power Off Leakage Current | 0 | V _I or V _O = 0 to 3.6V | | 10 | | 10 | μA |
| I _{oz} | High Impedance Output Leakage Current | 2.7 to 3.6 | V _I = V _{IH} or V _{IL} V _O = 0 to 3.6V | | ± 10 | | ± 10 | μA |
| I _{CC} | Quiescent Supply Current | 2.7 to 3.6 | V _I = V _{CC} or GND | | 20 | | 20 | μA |
| | | | V _I or V _O = V _{CC} to 3.6V | | ± 20 | | ± 20 | |
| ΔI _{CC} | I _{CC} incr. per Input | 2.7 to 3.6 | V _{IH} = V _{CC} - 0.6V | | 750 | | 750 | μA |

DC SPECIFICATIONS ($2.3V < V_{CC} \leq 2.7V$ unless otherwise specified)

| Symbol | Parameter | Test Condition | | Value | | | | Unit |
|----------------------|---------------------------------------|------------------------|---|----------------------|------|----------------------|------|------|
| | | V _{CC} (V) | | -40 to 85 °C | | -55 to 125 °C | | |
| | | | | Min. | Max. | Min. | Max. | |
| V _{IH} | High Level Input Voltage | 2.3 to 2.7 | | 1.6 | | 1.6 | | V |
| V _{IL} | Low Level Input Voltage | | | | 0.7 | | 0.7 | |
| V _{OH} | High Level Output Voltage | 2.3 to 2.7 | I _O =-100 μA | V _{CC} -0.2 | | V _{CC} -0.2 | | V |
| | | | I _O =-6 mA | 2.0 | | 2.0 | | |
| | | 2.3 | I _O =-12 mA | 1.8 | | 1.8 | | |
| | | | I _O =-18 mA | 1.7 | | 1.7 | | |
| V _{OL} | Low Level Output Voltage | 2.3 to 2.7 | I _O =100 μA | | 0.2 | | 0.2 | V |
| | | | I _O =12 mA | | 0.4 | | 0.4 | |
| | | 2.3 | I _O =18 mA | | 0.6 | | 0.6 | |
| I _I | Input Leakage Current | 2.3 to 2.7 | V _I = 0 to 3.6V | | ± 5 | | ± 5 | μA |
| I _{I(HOLD)} | Input Hold Current | 2.3 | V _I = 0.7V | 45 | | 45 | | μA |
| | | | V _I = 1.7V | -45 | | -45 | | |
| I _{off} | Power Off Leakage Current | 0 | V _I or V _O = 0 to 3.6V | | 10 | | 10 | μA |
| I _{OZ} | High Impedance Output Leakage Current | 2.3 to 2.7 | V _I = V _{IH} or V _{IL} V _O = 0 to 3.6V | | ± 10 | | ± 10 | μA |
| I _{CC} | Quiescent Supply Current | 2.3 to 2.7 | V _I = V _{CC} or GND | | 20 | | 20 | μA |
| | | | V _I or V _O = V _{CC} to 3.6V | | ± 20 | | ± 20 | |

DYNAMIC SWITCHING CHARACTERISTICS (T_a = 25°C, Input t_r = t_f = 2.0ns, C_L = 30pF, R_L = 500Ω)

| Symbol | Parameter | Test Condition | | Value | | | Unit |
|------------------|---|------------------------|-----------------------------------|------------------------|------|------|------|
| | | V _{CC} (V) | | T _A = 25 °C | | | |
| | | | | Min. | Typ. | Max. | |
| V _{OLP} | Dynamic Low Voltage Quiet Output (note 1, 3) | 2.5 | V _{IL} = 0V | | 0.6 | | V |
| | | 3.3 | V _{IH} = V _{CC} | | 0.8 | | |
| V _{OLV} | Dynamic Low Voltage Quiet Output (note 1, 3) | 2.5 | V _{IL} = 0V | | -0.6 | | V |
| | | 3.3 | V _{IH} = V _{CC} | | -0.8 | | |
| V _{OHV} | Dynamic High Voltage Quiet Output (note 2, 3) | 2.5 | V _{IL} = 0V | | 1.9 | | V |
| | | 3.3 | V _{IH} = V _{CC} | | 2.2 | | |

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.

2) 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 HIGH state.

3) Parameters guaranteed by design.

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AC ELECTRICAL CHARACTERISTICS ($C_L = 30\text{pF}$, $R_L = 500\Omega$, Input $t_r = t_f = 2.0\text{ns}$)

| Symbol | Parameter | Test Condition | | Value | | | | Unit |
|-----------------------|---------------------------------------|-----------------|--|--------------|------|---------------|------|------|
| | | V_{CC} (V) | | -40 to 85 °C | | -55 to 125 °C | | |
| | | | | Min. | Max. | Min. | Max. | |
| t_{PLH} t_{PHL} | Propagation Delay Time | 2.3 to 2.7 | | 1.0 | 3.2 | 1.0 | 3.8 | ns |
| | | 3.0 to 3.6 | | 0.8 | 2.5 | 0.8 | 3.1 | |
| t_{PZL} t_{PZH} | Output Enable Time | 2.3 to 2.7 | | 1.0 | 4.9 | 1.0 | 5.6 | ns |
| | | 3.0 to 3.6 | | 0.8 | 3.8 | 0.8 | 4.4 | |
| t_{PLZ} t_{PHZ} | Output Disable Time | 2.3 to 2.7 | | 1.0 | 4.2 | 1.0 | 4.8 | ns |
| | | 3.0 to 3.6 | | 0.8 | 3.7 | 0.8 | 4.3 | |
| t_{OSLH} t_{OSHL} | Output To Output Skew Time (note1, 2) | 2.3 to 2.7 | | | 0.5 | | 0.5 | ns |
| | | 3.0 to 3.6 | | | 0.5 | | 0.5 | |

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 ($t_{OSLH} = |t_{PLHm} - t_{PLHn}|$, $t_{OSHL} = |t_{PHLm} - t_{PHLn}|$)

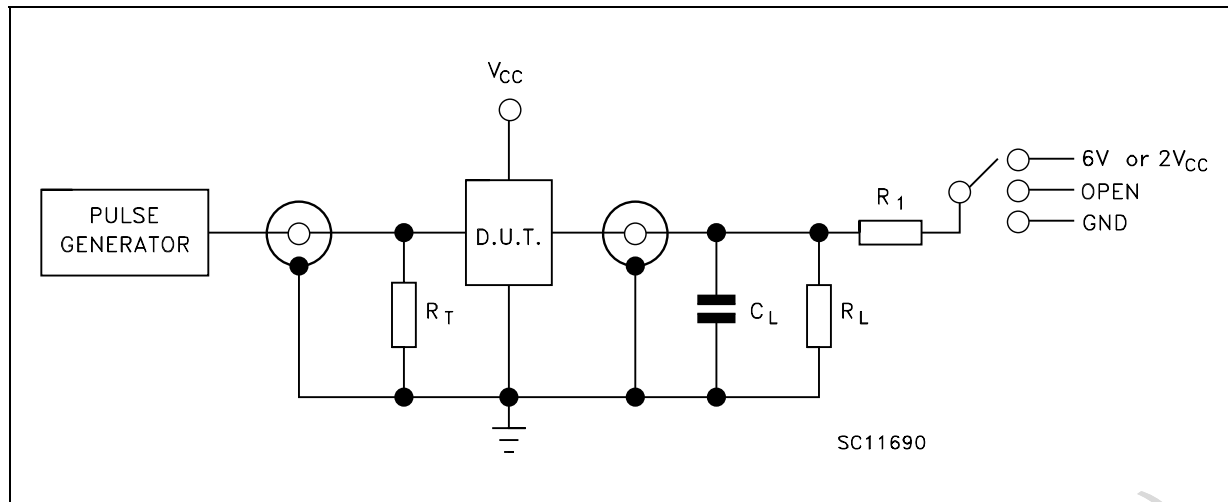
2) Parameter guaranteed by design

CAPACITIVE CHARACTERISTICS

| Symbol | Parameter | Test Condition | | Value | | | Unit |
|-----------|--|-----------------|---|----------------------|------|------|------|
| | | V_{CC} (V) | | $T_A = 25\text{ °C}$ | | | |
| | | | | Min. | Typ. | Max. | |
| C_{IN} | Input Capacitance | 2.5 or 3.3 | $V_{IN} = 0$ or V_{CC} | | 4 | | pF |
| C_{OUT} | Output Capacitance | 2.5 or 3.3 | $V_{IN} = 0$ or V_{CC} | | 8 | | pF |
| C_{PD} | Power Dissipation Capacitance (note 1) | 2.5 or 3.3 | $f_{IN} = 10\text{MHz}$ $V_{IN} = 0$ or V_{CC} | | 28 | | 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. $I_{CC(opr)} = C_{PD} \times V_{CC} \times f_{IN} + I_{CC}/16$ (per circuit)

TEST CIRCUIT



| TEST | SWITCH |
|--|-----------|
| t_{PLH} , t_{PHL} | Open |
| t_{PZL} , t_{PLZ} ($V_{CC} = 3.0$ to $3.6V$) | 6V |
| t_{PZL} , t_{PLZ} ($V_{CC} = 2.3$ to $2.7V$) | $2V_{CC}$ |
| t_{PZH} , t_{PHZ} | GND |

$C_L = 30$ pF or equivalent (includes jig and probe capacitance)

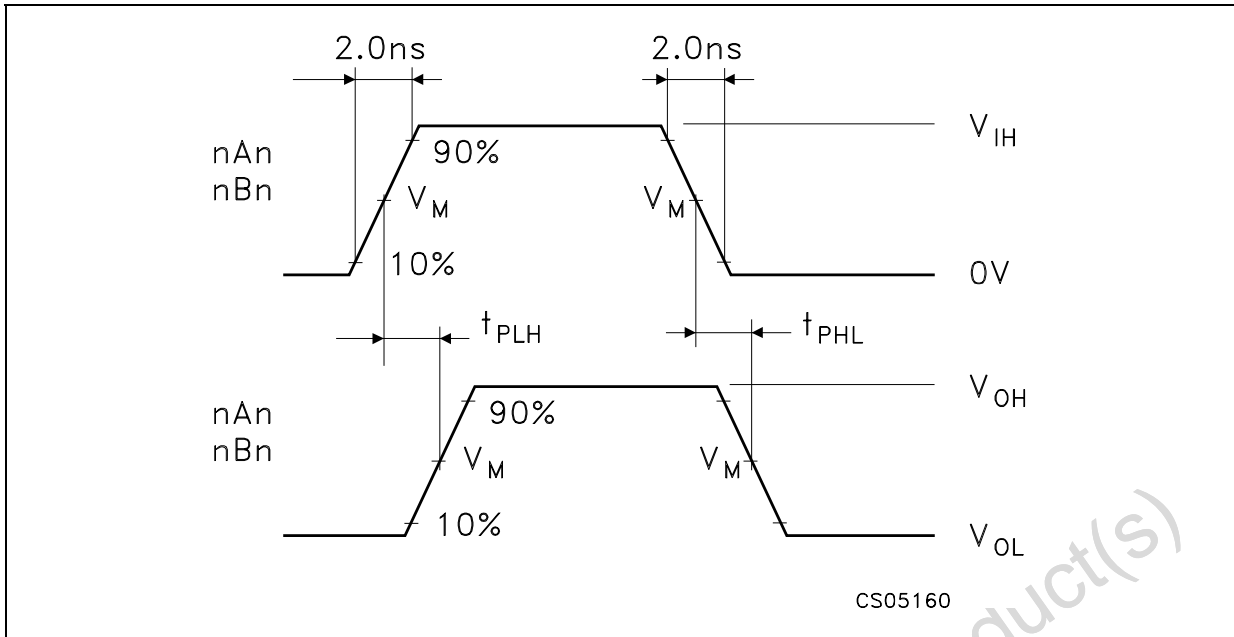
$R_L = R_1 = 500\Omega$ or equivalent

$R_T = Z_{OUT}$ of pulse generator (typically 50Ω)

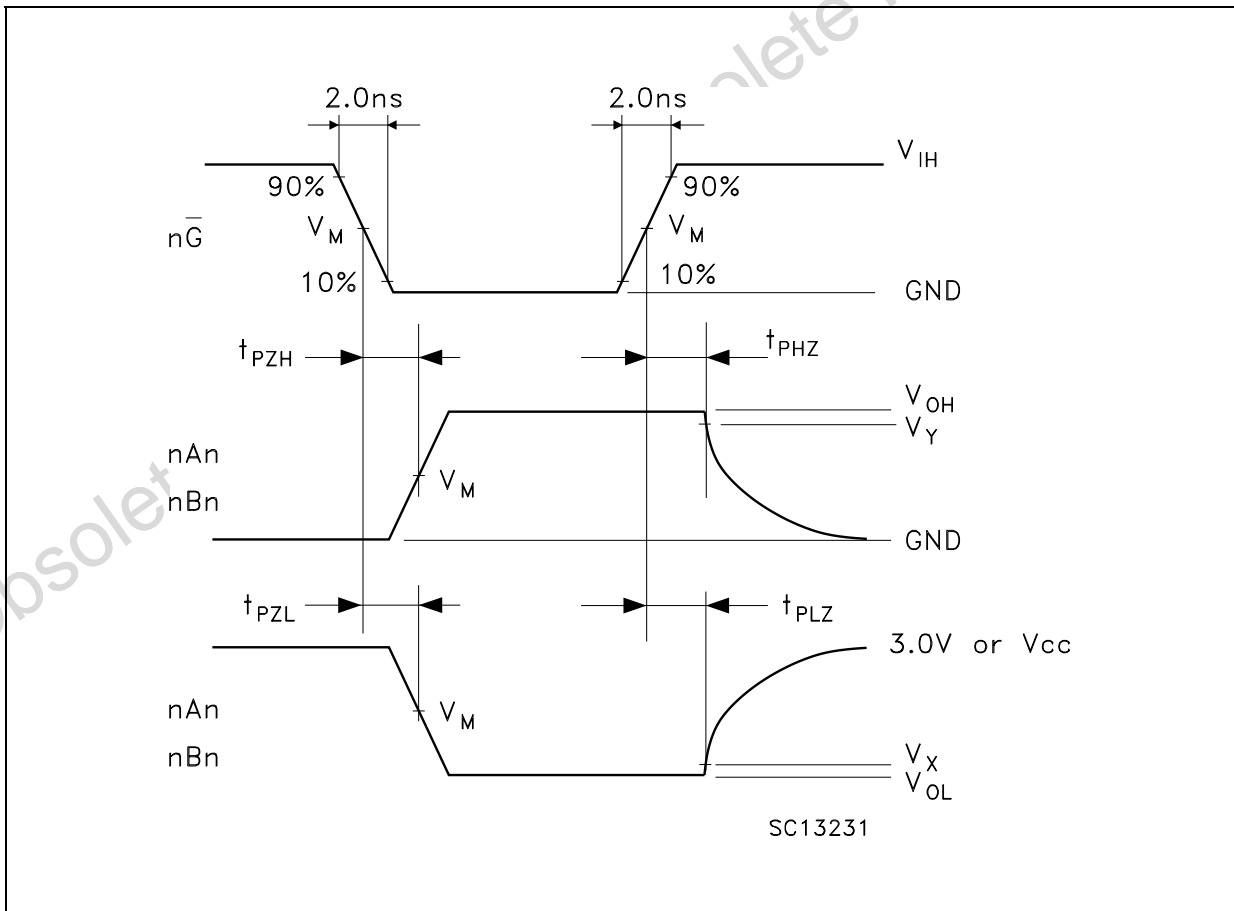
WAVEFORM SYMBOL VALUES

| Symbol | V_{CC} | |
|----------|-----------------|------------------|
| | 3.0 to 3.6V | 2.3 to 2.7V |
| V_{IH} | 2.7V | V_{CC} |
| V_M | 1.5V | $V_{CC}/2$ |
| V_X | $V_{OL} + 0.3V$ | $V_{OL} + 0.15V$ |
| V_Y | $V_{OH} - 0.3V$ | $V_{OH} - 0.15V$ |

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

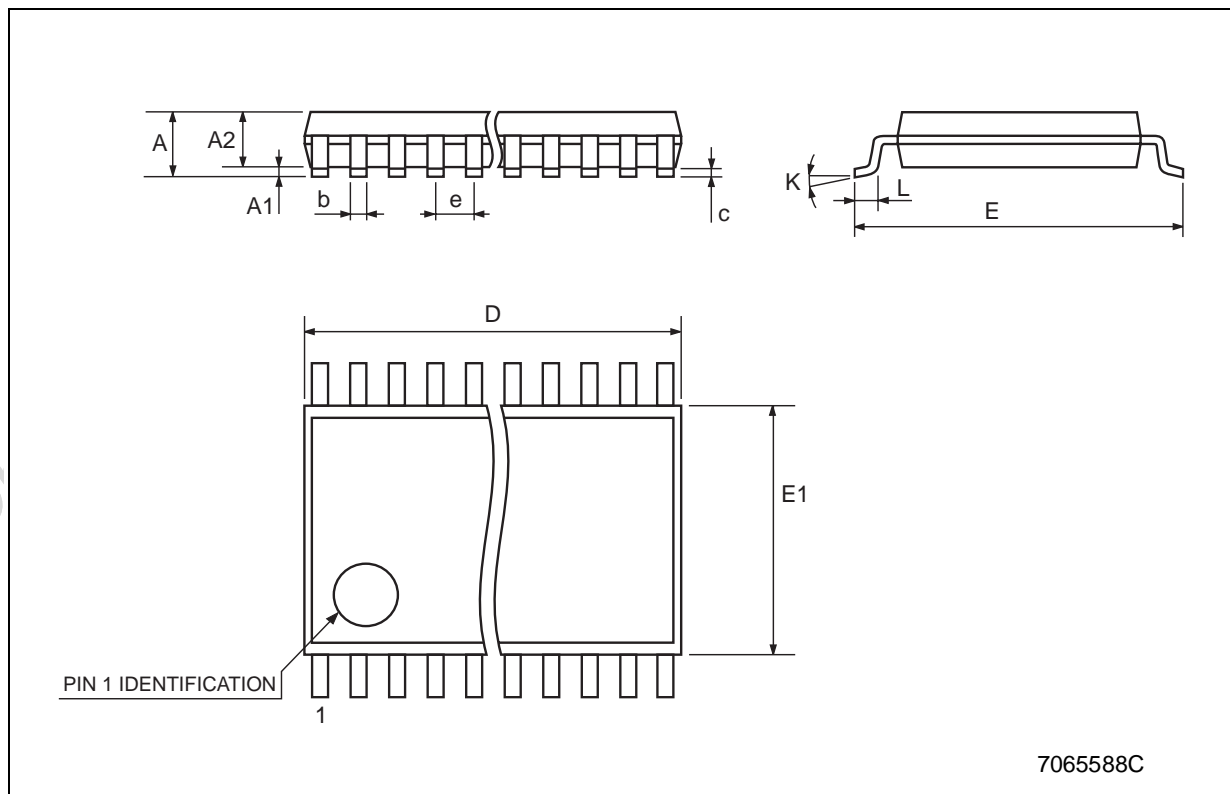


WAVEFORM 2: OUTPUT ENABLE AND DISABLE TIME (f=1MHz; 50% duty cycle)



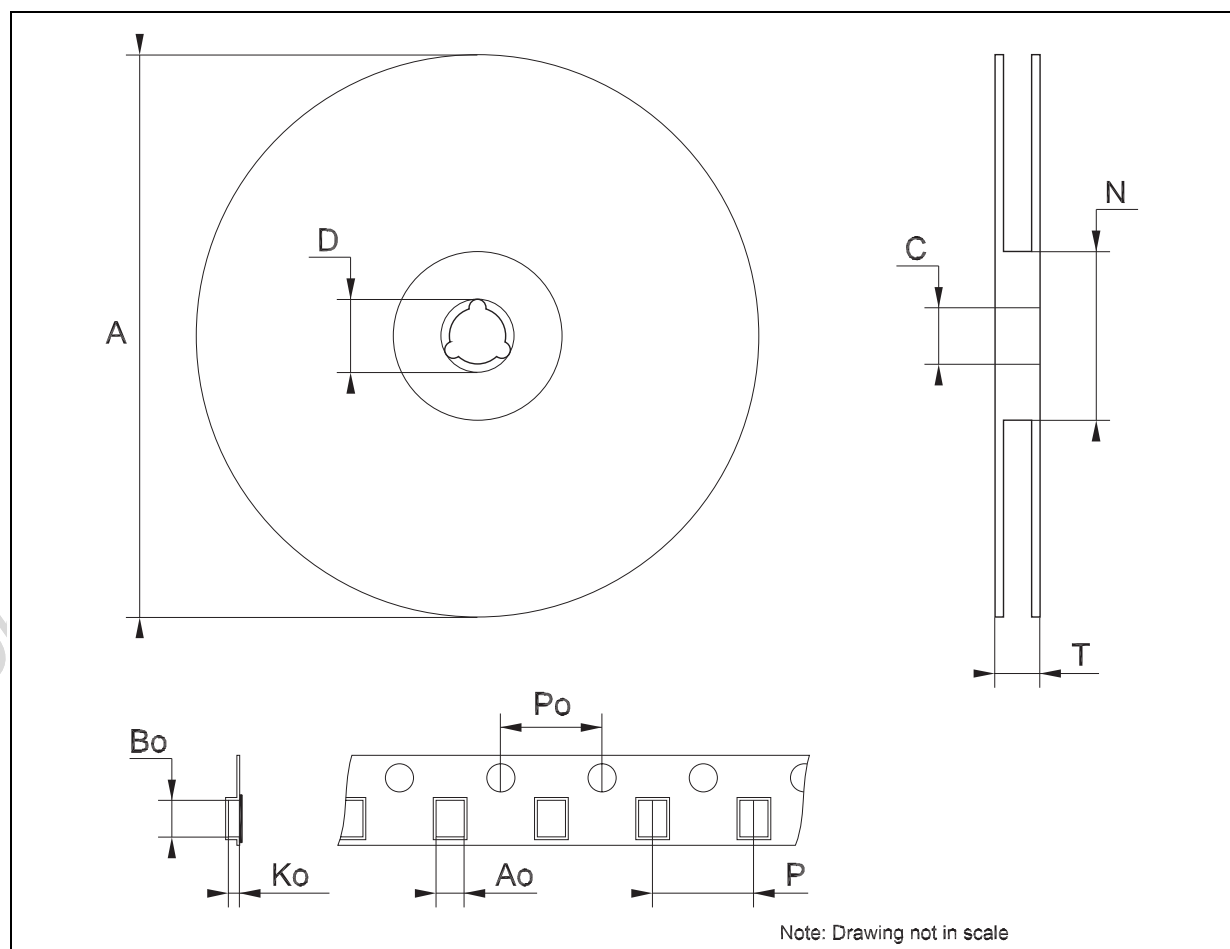
TSSOP48 MECHANICAL DATA

| 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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