

# MC74LCX16373

## Low-Voltage CMOS 16-Bit Transparent Latch

### With 5 V-Tolerant Inputs and Outputs (3-State, Non-Inverting)

The MC74LCX16373 is a high performance, non-inverting 16-bit transparent latch operating from a 2.3 V to 3.6 V supply. The device is byte controlled. Each byte has separate Output Enable and Latch Enable inputs. These control pins can be tied together for full 16-bit operation. High impedance TTL compatible inputs significantly reduce current loading to input drivers while TTL compatible outputs offer improved switching noise performance. A  $V_I$  specification of 5.5 V allows MC74LCX16373 inputs to be safely driven from 5.0 V devices.

The MC74LCX16373 contains 16 D-type latches with 3-state 5.0 V-tolerant outputs. When the Latch Enable (LEn) inputs are HIGH, data on the Dn inputs enters the latches. In this condition, the latches are transparent, i.e., a latch output will change state each time its D input changes. When LE is LOW, the latches store the information that was present on the D inputs a setup time preceding the HIGH-to-LOW transition of LE. The 3-state outputs are controlled by the Output Enable ( $\overline{OE_n}$ ) inputs. When  $\overline{OE}$  is LOW, the outputs are enabled. When  $\overline{OE}$  is HIGH, the standard outputs are in the high impedance state, but this does not interfere with new data entering into the latches.

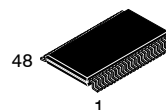
#### Features

- Designed for 2.3 to 3.6 V  $V_{CC}$  Operation
- 5.4 ns Maximum  $t_{pd}$
- 5.0 V Tolerant – Interface Capability With 5.0 V TTL Logic
- Supports Live Insertion and Withdrawal
- $I_{OFF}$  Specification Guarantees High Impedance When  $V_{CC} = 0$  V
- LVTTL Compatible
- LVCMOS Compatible
- 24 mA Balanced Output Sink and Source Capability
- Near Zero Static Supply Current in All Three Logic States (20  $\mu$ A) Substantially Reduces System Power Requirements
- Latchup Performance Exceeds 500 mA
- ESD Performance:
  - ◆ Human Body Model >2000 V
  - ◆ Machine Model >200 V
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant



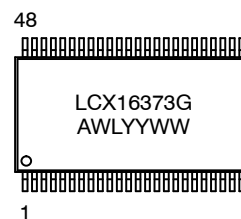
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TSSOP-48  
DT SUFFIX  
CASE 1201

#### MARKING DIAGRAM

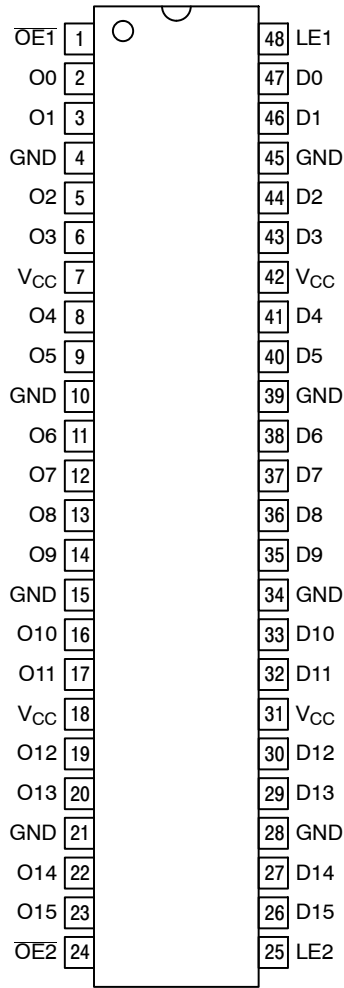


A = Assembly Location  
WL = Wafer Lot  
YY = Year  
WW = Work Week  
G = Pb-Free Package

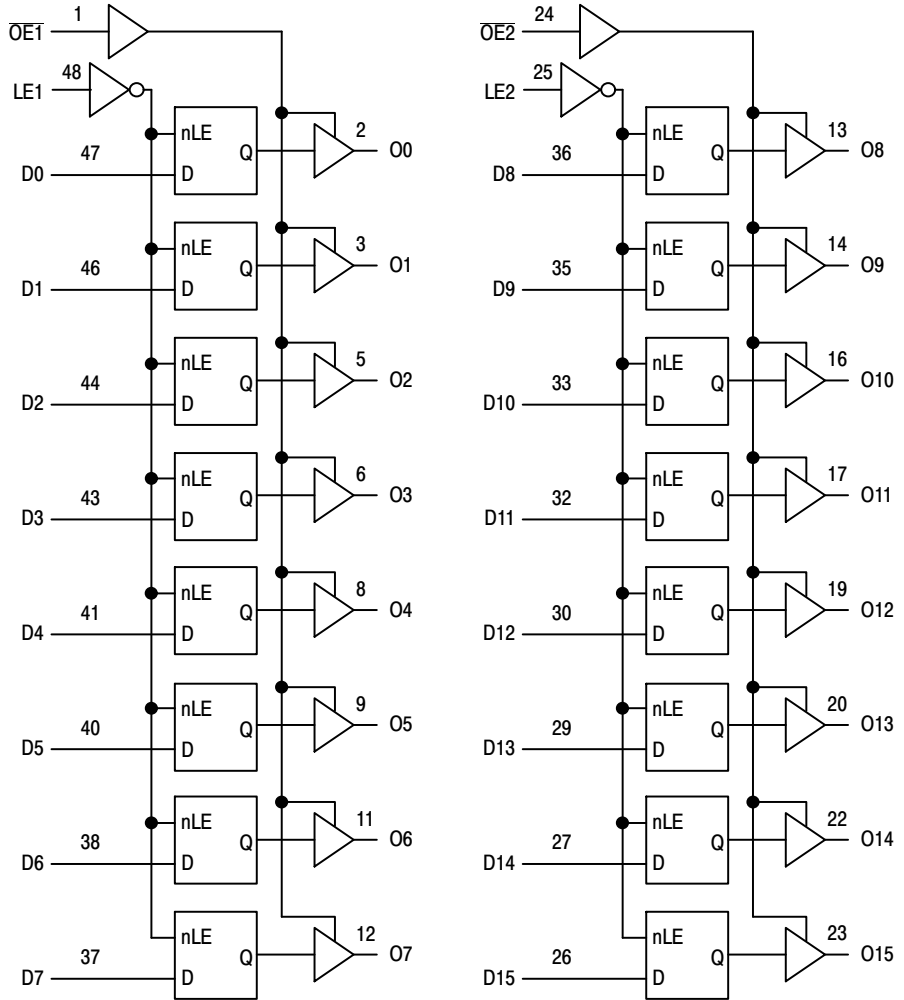
#### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 3 of this data sheet.

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**Figure 1. Pinout: 48-Lead (Top View)**



**Figure 2. Logic Diagram**

**Table 1. PIN NAMES**

| Pins             | Function             |
|------------------|----------------------|
| $\overline{OE}n$ | Output Enable Inputs |
| LEn              | Latch Enable Inputs  |
| D0-D15           | Inputs               |
| O0-O15           | Outputs              |

## TRUTH TABLE

| Inputs |                  |      | Outputs | Inputs |                  |       | Outputs |
|--------|------------------|------|---------|--------|------------------|-------|---------|
| LE1    | $\overline{OE}1$ | D0:7 | O0:7    | LE2    | $\overline{OE}2$ | D8:15 | O8:15   |
| X      | H                | X    | Z       | X      | H                | X     | Z       |
| H      | L                | L    | L       | H      | L                | L     | L       |
| H      | L                | H    | H       | H      | L                | H     | H       |
| L      | L                | X    | O0      | L      | L                | X     | O0      |

H = High Voltage Level

L = Low Voltage Level

Z = High Impedance State

X = High or Low Voltage Level and Transitions Are Acceptable; for  $I_{CC}$  reasons, DO NOT FLOAT Inputs

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## ORDERING INFORMATION

| Device           | Package               | Shipping†          |
|------------------|-----------------------|--------------------|
| MC74LCX16373DTRG | TSSOP-48<br>(Pb-Free) | 39 Units / Rail    |
| M74LCX16373DTR2G | TSSOP-48<br>(Pb-Free) | 2500 / Tape & Reel |

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

## MAXIMUM RATINGS

| Symbol    | Parameter                        | Value                             | Condition                             | Units |
|-----------|----------------------------------|-----------------------------------|---------------------------------------|-------|
| $V_{CC}$  | DC Supply Voltage                | -0.5 to +7.0                      |                                       | V     |
| $V_I$     | DC Input Voltage                 | $-0.5 \leq V_I \leq +7.0$         |                                       | V     |
| $V_O$     | DC Output Voltage                | $-0.5 \leq V_O \leq +7.0$         | Output in 3-State                     | V     |
|           |                                  | $-0.5 \leq V_O \leq V_{CC} + 0.5$ | Output in HIGH or LOW State. (Note 1) | V     |
| $I_{IK}$  | DC Input Diode Current           | -50                               | $V_I < GND$                           | mA    |
| $I_{OK}$  | DC Output Diode Current          | -50                               | $V_O < GND$                           | mA    |
|           |                                  | +50                               | $V_O > V_{CC}$                        | mA    |
| $I_O$     | DC Output Source/Sink Current    | $\pm 50$                          |                                       | mA    |
| $I_{CC}$  | DC Supply Current Per Supply Pin | $\pm 100$                         |                                       | mA    |
| $I_{GND}$ | DC Ground Current Per Ground Pin | $\pm 100$                         |                                       | mA    |
| $T_{STG}$ | Storage Temperature Range        | -65 to +150                       |                                       | °C    |
| MSL       | Moisture Sensitivity             |                                   | Level 1                               |       |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1.  $I_O$  absolute maximum rating must be observed.

## RECOMMENDED OPERATING CONDITIONS

| Symbol              | Parameter   | Min | Typ      | Max      | Units |
|---------------------|---|-----|----------|----------|-------|
| $V_{CC}$            | Supply Voltage<br>Operating<br>Data Retention Only  | 2.0 | 2.5, 3.3 | 3.6      | V     |
|                     |   | 1.5 | 2.5, 3.3 | 3.6      |       |
| $V_I$               | Input Voltage   | 0   |          | 5.5      | V     |
| $V_O$               | Output Voltage<br>(HIGH or LOW State)<br>(3-State)  | 0   |          | $V_{CC}$ | V     |
|                     |   | 0   |          | 5.5      |       |
| $I_{OH}$            | HIGH Level Output Current<br>$V_{CC} = 3.0\text{ V} - 3.6\text{ V}$<br>$V_{CC} = 2.7\text{ V} - 3.0\text{ V}$<br>$V_{CC} = 2.3\text{ V} - 2.7\text{ V}$ |     |          | -24      | mA    |
|                     |   |     |          | -12      |       |
|                     |   |     |          | -8       |       |
| $I_{OL}$            | LOW Level Output Current<br>$V_{CC} = 3.0\text{ V} - 3.6\text{ V}$<br>$V_{CC} = 2.7\text{ V} - 3.0\text{ V}$<br>$V_{CC} = 2.3\text{ V} - 2.7\text{ V}$  |     |          | +24      | mA    |
|                     |   |     |          | +12      |       |
|                     |   |     |          | +8       |       |
| $T_A$               | Operating Free-Air Temperature  | -55 |          | +125     | °C    |
| $\Delta t/\Delta V$ | Input Transition Rise or Fall Rate, $V_{IN}$ from 0.8 V to 2.0 V, $V_{CC} = 3.0\text{ V}$   | 0   |          | 10       | ns/V  |

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## DC ELECTRICAL CHARACTERISTICS

| Symbol           | Characteristic                        | Condition  | T <sub>A</sub> = -55°C to +125°C |      | Units |
|------------------|---------------------------------------|--|----------------------------------|------|-------|
|                  |                                       |  | Min                              | Max  |       |
| V <sub>IH</sub>  | HIGH Level Input Voltage (Note 2)     | 2.3 V ≤ V <sub>CC</sub> ≤ 2.7 V  | 1.7                              |      | V     |
|                  |                                       | 2.7 V ≤ V <sub>CC</sub> ≤ 3.6 V  | 2.0                              |      |       |
| V <sub>IL</sub>  | LOW Level Input Voltage (Note 2)      | 2.3 V ≤ V <sub>CC</sub> ≤ 2.7 V  |                                  | 0.7  | V     |
|                  |                                       | 2.7 V ≤ V <sub>CC</sub> ≤ 3.6 V  |                                  | 0.8  |       |
| V <sub>OH</sub>  | HIGH Level Output Voltage             | 2.3 V ≤ V <sub>CC</sub> ≤ 3.6 V; I <sub>OL</sub> = 100 μA  | V <sub>CC</sub> - 0.2            |      | V     |
|                  |                                       | V <sub>CC</sub> = 2.3 V; I <sub>OH</sub> = -8 mA   | 1.8                              |      |       |
|                  |                                       | V <sub>CC</sub> = 2.7 V; I <sub>OH</sub> = -12 mA  | 2.2                              |      |       |
|                  |                                       | V <sub>CC</sub> = 3.0 V; I <sub>OH</sub> = -18 mA  | 2.4                              |      |       |
|                  |                                       | V <sub>CC</sub> = 3.0 V; I <sub>OH</sub> = -24 mA  | 2.2                              |      |       |
| V <sub>OL</sub>  | LOW Level Output Voltage              | 2.3 V ≤ V <sub>CC</sub> ≤ 3.6 V; I <sub>OL</sub> = 100 μA  |                                  | 0.2  | V     |
|                  |                                       | V <sub>CC</sub> = 2.3 V; I <sub>OL</sub> = 8 mA  |                                  | 0.6  |       |
|                  |                                       | V <sub>CC</sub> = 2.7 V; I <sub>OL</sub> = 12 mA   |                                  | 0.4  |       |
|                  |                                       | V <sub>CC</sub> = 3.0 V; I <sub>OL</sub> = 16 mA   |                                  | 0.4  |       |
|                  |                                       | V <sub>CC</sub> = 3.0 V; I <sub>OL</sub> = 24 mA   |                                  | 0.55 |       |
| I <sub>OZ</sub>  | 3-State Output Current                | V <sub>CC</sub> = 3.6 V, V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> ,<br>V <sub>OUT</sub> = 0 to 5.5 V |                                  | ±5   | μA    |
| I <sub>OFF</sub> | Power Off Leakage Current             | V <sub>CC</sub> = 0, V <sub>IN</sub> = 5.5 V or V <sub>OUT</sub> = 5.5 V   |                                  | 10   | μA    |
| I <sub>IN</sub>  | Input Leakage Current                 | V <sub>CC</sub> = 3.6 V, V <sub>IN</sub> = 5.5 V or GND  |                                  | ±5   | μA    |
| I <sub>CC</sub>  | Quiescent Supply Current              | V <sub>CC</sub> = 3.6 V, V <sub>IN</sub> = 5.5 V or GND  |                                  | 20   | μA    |
| ΔI <sub>CC</sub> | Increase in I <sub>CC</sub> per Input | 2.3 ≤ V <sub>CC</sub> ≤ 3.6 V; V <sub>IH</sub> = V <sub>CC</sub> - 0.6 V   |                                  | 500  | μA    |

2. These values of V<sub>I</sub> are used to test DC electrical characteristics only.

## AC CHARACTERISTICS (t<sub>R</sub> = t<sub>F</sub> = 2.5 ns; C<sub>L</sub> = 50 pF; R<sub>L</sub> = 500 Ω)

| Symbol                                 | Parameter   | Waveform | T <sub>A</sub> = -55°C to +125°C                          |            |   |     |   |     | Units |
|--|---|----------|---|------------|---|-----|---|-----|-------|
|  |   |          | V <sub>CC</sub> = 3.3 V ± 0.3 V<br>C <sub>L</sub> = 50 pF |            | V <sub>CC</sub> = 2.7 V<br>C <sub>L</sub> = 50 pF |     | V <sub>CC</sub> = 2.5 V ± 0.2 V<br>C <sub>L</sub> = 30 pF |     |       |
|  |   |          | Min   | Max        | Min   | Max | Min   | Max |       |
| t <sub>PLH</sub><br>t <sub>PHL</sub>   | Propagation Delay<br>D <sub>n</sub> to O <sub>n</sub> | 1        | 1.5   | 5.4        | 1.5   | 5.9 | 1.5   | 6.5 | ns    |
|  |   |          | 1.5   | 5.4        | 1.5   | 5.9 | 1.5   | 6.5 |       |
| t <sub>PLH</sub><br>t <sub>PHL</sub>   | Propagation Delay<br>LE to O <sub>n</sub>             | 3        | 1.5   | 5.5        | 1.5   | 6.4 | 1.5   | 6.6 | ns    |
|  |   |          | 1.5   | 5.5        | 1.5   | 6.4 | 1.5   | 6.6 |       |
| t <sub>PZH</sub><br>t <sub>PZL</sub>   | Output Enable Time to<br>High and Low Level           | 2        | 1.5   | 6.1        | 1.5   | 6.5 | 1.5   | 7.9 | ns    |
|  |   |          | 1.5   | 6.1        | 1.5   | 6.5 | 1.5   | 7.9 |       |
| t <sub>PHZ</sub><br>t <sub>PLZ</sub>   | Output Disable Time From<br>High and Low Level        | 2        | 1.5   | 6.0        | 1.5   | 6.3 | 1.5   | 7.2 | ns    |
|  |   |          | 1.5   | 6.0        | 1.5   | 6.3 | 1.5   | 7.2 |       |
| t <sub>s</sub>                         | Setup Time, HIGH or LOW D <sup>n</sup> to<br>LE       | 3        | 2.5   |            | 2.5   |     | 3.0   | ns  |       |
| t <sub>h</sub>                         | Hold Time, HIGH or LOW D <sup>n</sup> to LE           | 3        | 1.5   |            | 1.5   |     | 2.0   | ns  |       |
| t <sub>w</sub>                         | LE Pulse Width, HIGH                                  | 3        | 3.0   |            | 3.0   |     | 3.5   | ns  |       |
| t <sub>OSHL</sub><br>t <sub>OSLH</sub> | Output-to-Output Skew<br>(Note 3)                     |          |   | 1.0<br>1.0 |   |     |   | ns  |       |

3. Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH-to-LOW (t<sub>OSHL</sub>) or LOW-to-HIGH (t<sub>OSLH</sub>); parameter guaranteed by design.

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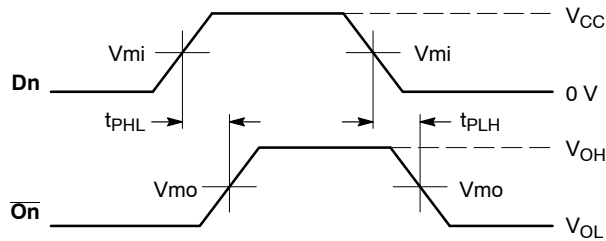
## DYNAMIC SWITCHING CHARACTERISTICS

| Symbol           | Characteristic                      | Condition  | T <sub>A</sub> = +25°C |              |     | Units |
|------------------|-------------------------------------|--|------------------------|--------------|-----|-------|
|                  |                                     |  | Min                    | Typ          | Max |       |
| V <sub>OLP</sub> | Dynamic LOW Peak Voltage (Note 4)   | V <sub>CC</sub> = 3.3 V, C <sub>L</sub> = 50 pF, V <sub>IH</sub> = 3.3 V, V <sub>IL</sub> = 0 V<br>V <sub>CC</sub> = 2.5 V, C <sub>L</sub> = 30 pF, V <sub>IH</sub> = 2.5 V, V <sub>IL</sub> = 0 V |                        | 0.8<br>0.6   |     | V     |
| V <sub>OLV</sub> | Dynamic LOW Valley Voltage (Note 4) | V <sub>CC</sub> = 3.3 V, C <sub>L</sub> = 50 pF, V <sub>IH</sub> = 3.3 V, V <sub>IL</sub> = 0 V<br>V <sub>CC</sub> = 2.5 V, C <sub>L</sub> = 30 pF, V <sub>IH</sub> = 2.5 V, V <sub>IL</sub> = 0 V |                        | -0.8<br>-0.6 |     | V     |

4. 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.

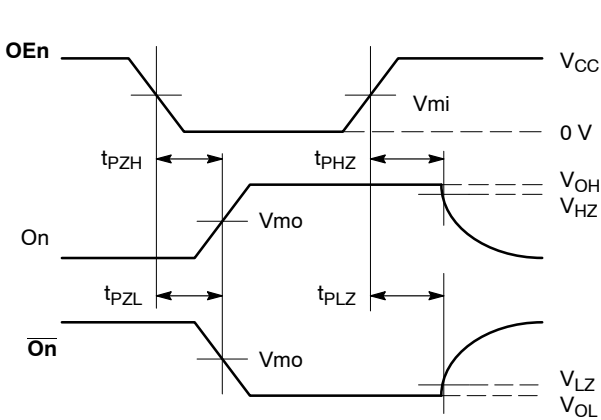
## CAPACITIVE CHARACTERISTICS

| Symbol           | Parameter                     | Condition  | Typical | Units |
|------------------|-------------------------------|--|---------|-------|
| C <sub>IN</sub>  | Input Capacitance             | V <sub>CC</sub> = 3.3 V, V <sub>I</sub> = 0 V or V <sub>CC</sub>         | 7       | pF    |
| C <sub>OUT</sub> | Output Capacitance            | V <sub>CC</sub> = 3.3 V, V <sub>I</sub> = 0 V or V <sub>CC</sub>         | 8       | pF    |
| C <sub>PD</sub>  | Power Dissipation Capacitance | 10 MHz, V <sub>CC</sub> = 3.3 V, V <sub>I</sub> = 0 V or V <sub>CC</sub> | 20      | pF    |



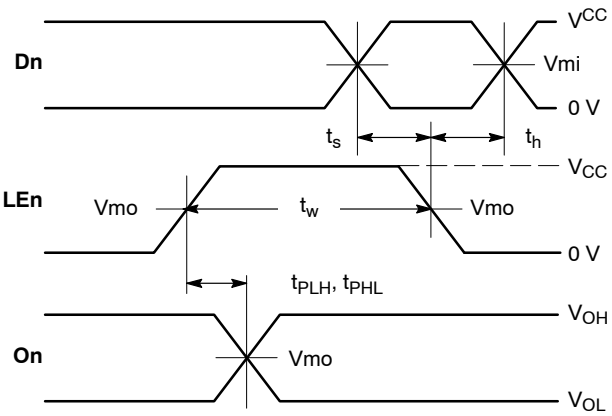
**WAVEFORM 1 - PROPAGATION DELAYS**

t<sub>R</sub> = t<sub>F</sub> = 2.5 ns, 10% to 90%; f = 1 MHz; t<sub>W</sub> = 500 ns



**WAVEFORM 2 - OUTPUT ENABLE AND DISABLE TIMES**

t<sub>R</sub> = t<sub>F</sub> = 2.5 ns, 10% to 90%; f = 1 MHz; t<sub>W</sub> = 500 ns



**WAVEFORM 3 - LE to On PROPAGATION DELAYS, LE MINIMUM PULSE WIDTH, Dn to LE SETUP AND HOLD TIMES**

t<sub>R</sub> = t<sub>F</sub> = 2.5 ns, 10% to 90%; f = 1 MHz; t<sub>W</sub> = 500 ns except when noted

**Figure 3. AC Waveforms**

**Table 2. AC WAVEFORMS**

| Symbol          | V <sub>CC</sub>         |                         |                          |
|-----------------|-------------------------|-------------------------|--------------------------|
|                 | 3.3 V ± 0.3 V           | 2.7 V                   | 2.5 V ± 0.2 V            |
| V <sub>mi</sub> | 1.5 V                   | 1.5 V                   | V <sub>CC</sub> / 2      |
| V <sub>mo</sub> | 1.5 V                   | 1.5 V                   | V <sub>CC</sub> / 2      |
| V <sub>Hz</sub> | V <sub>OL</sub> + 0.3 V | V <sub>OL</sub> + 0.3 V | V <sub>OL</sub> + 0.15 V |
| V <sub>Lz</sub> | V <sub>OH</sub> - 0.3 V | V <sub>OH</sub> - 0.3 V | V <sub>OH</sub> - 0.15 V |

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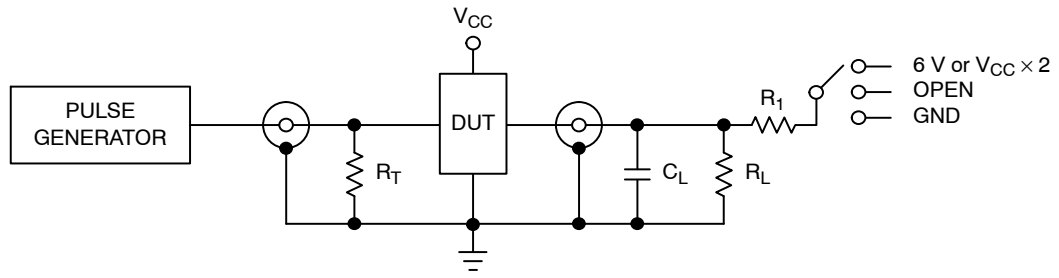


Figure 4. Test Circuit

Table 3. TEST CIRCUIT

| Test   | Switch   |
|--|--|
| $t_{PLH}$ , $t_{PHL}$                        | Open   |
| $t_{PZL}$ , $t_{PLZ}$                        | 6 V at $V_{CC} = 3.3 \pm 0.3$ V<br>6 V at $V_{CC} = 2.5 \pm 0.2$ V |
| Open Collector/Drain $t_{PLH}$ and $t_{PHL}$ | 6 V  |
| $t_{PZH}$ , $t_{PHZ}$                        | GND  |

$C_L = 50$  pF at  $V_{CC} = 3.3 \pm 0.3$  V or equivalent (includes jig and probe capacitance)

$C_L = 30$  pF at  $V_{CC} = 2.5 \pm 0.2$  V or equivalent (includes jig and probe capacitance)

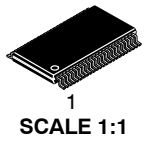
$R_L = R_1 = 500 \Omega$  or equivalent

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

# MECHANICAL CASE OUTLINE

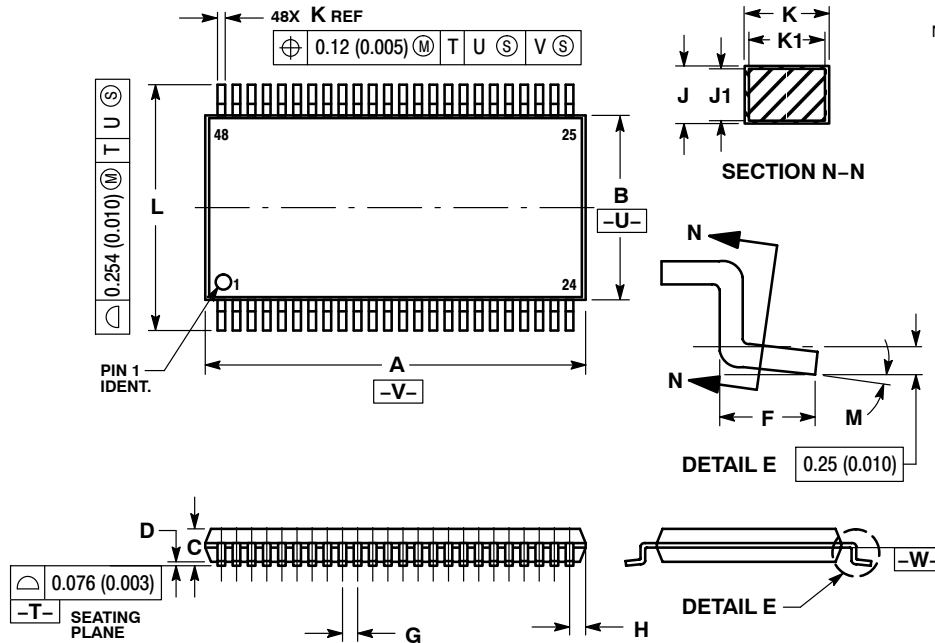
## PACKAGE DIMENSIONS

ON Semiconductor®



TSSOP-48  
CASE 1201-01  
ISSUE B

DATE 06 JUL 2010

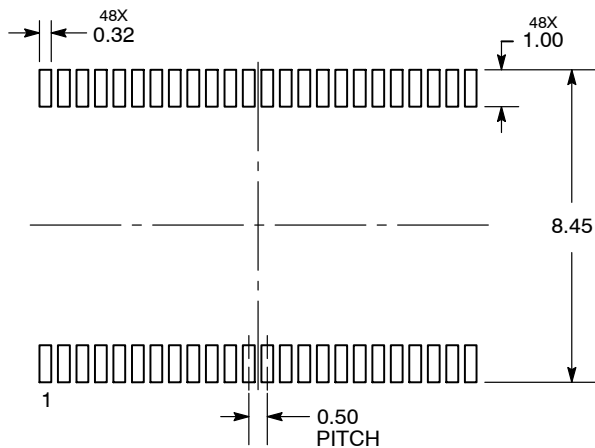


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
5. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
6. DIMENSIONS A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.

| DIM | MILLIMETERS |       | INCHES     |       |
|-----|-------------|-------|------------|-------|
|     | MIN         | MAX   | MIN        | MAX   |
| A   | 12.40       | 12.60 | 0.488      | 0.496 |
| B   | 6.00        | 6.20  | 0.236      | 0.244 |
| C   | ---         | 1.10  | ---        | 0.043 |
| D   | 0.05        | 0.15  | 0.002      | 0.006 |
| F   | 0.50        | 0.75  | 0.020      | 0.030 |
| G   | 0.50 BSC    |       | 0.0197 BSC |       |
| H   | 0.37        | ---   | 0.015      | ---   |
| J   | 0.09        | 0.20  | 0.004      | 0.008 |
| J1  | 0.09        | 0.16  | 0.004      | 0.006 |
| K   | 0.17        | 0.27  | 0.007      | 0.011 |
| K1  | 0.17        | 0.23  | 0.007      | 0.009 |
| L   | 7.95        | 8.25  | 0.313      | 0.325 |
| M   | 0°          | 8°    | 0°         | 8°    |

### RECOMMENDED SOLDERING FOOTPRINT



DIMENSIONS: MILLIMETERS

### GENERIC MARKING DIAGRAM\*



- XXXXX = Specific Device Code
- A = Assembly Location
- WL = Wafer Lot
- YY = Year
- WW = Work Week
- G = Pb-Free Package

\*This information is generic. Please refer to device data sheet for actual part marking.

|                  |             |  |
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