

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.

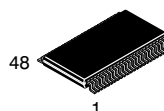
Features

- 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 μ A) Substantially Reduces System Power Requirements
- Latchup Performance Exceeds 500 mA
- ESD Performance: Human Body Model >2000 V;
Machine Model >200 V
- These are Pb-Free Devices*



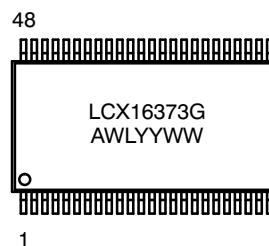
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TSSOP-48
DT SUFFIX
CASE 1201

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.

*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

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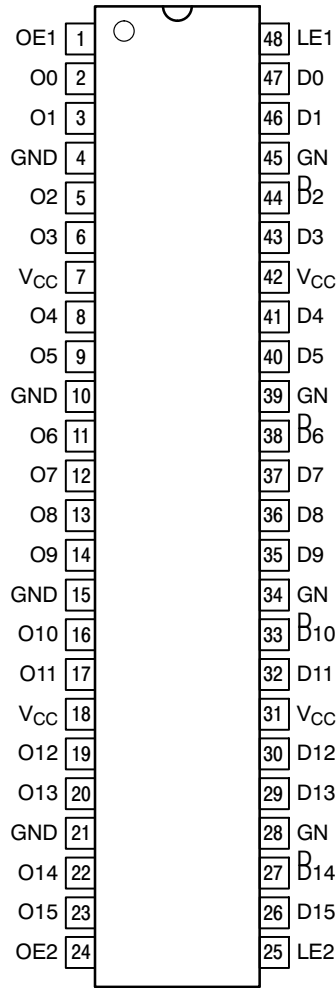


Figure 1. Pinout: 48-Lead
(Top View)

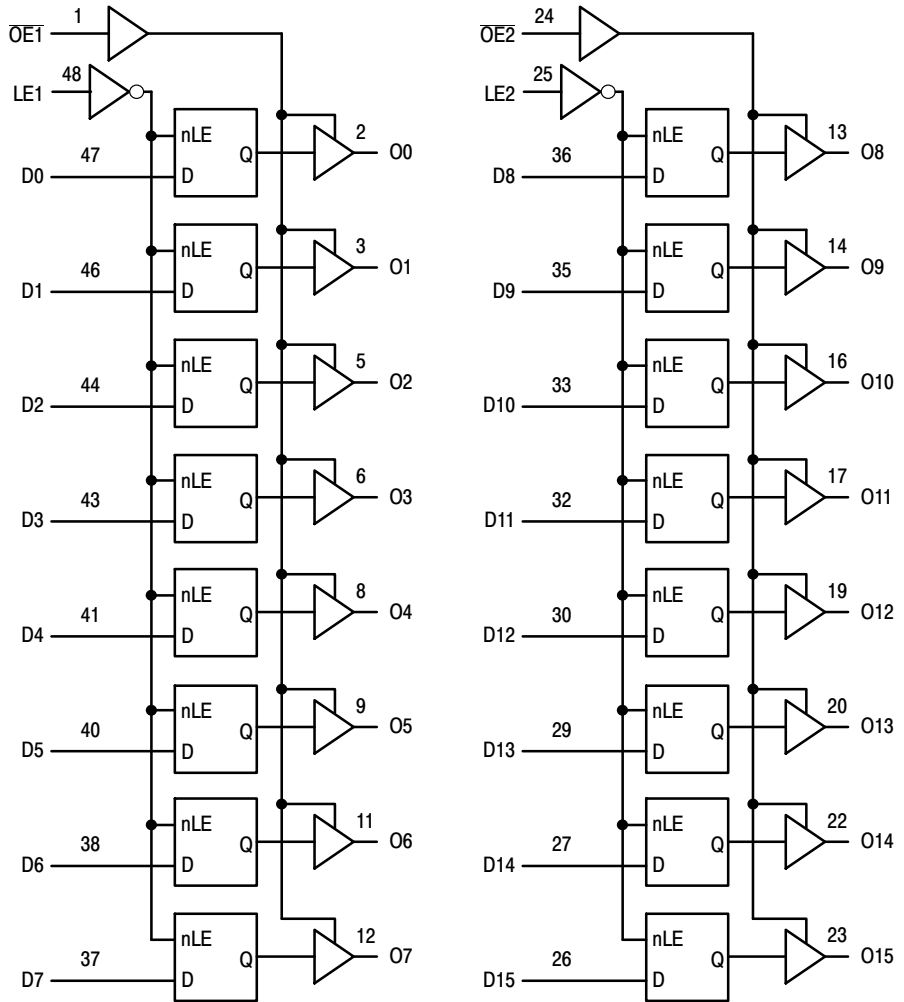


Figure 2. Logic Diagram

Table 1. PIN NAMES

| Pins | Function |
|--|--|
| OE \bar{n} LE \bar{n} D0-D15 O0-O15 | Output Enable Inputs Latch Enable Inputs Inputs Outputs |

TRUTH TABLE

| Inputs | | | Outputs | Inputs | | | Outputs |
|--------|-----|------|---------|--------|-----|-------|---------|
| LE1 | OE1 | D0:7 | O0:7 | LE2 | OE2 | 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

MC74LCX16373

ORDERING INFORMATION

| Device | Package | Shipping [†] |
|------------------|-----------|-----------------------|
| MC74LCX16373DT | TSSOP-48* | 39 Units / Rail |
| MC74LCX16373DTG | TSSOP-48* | 39 Units / Rail |
| MC74LCX16373DTR2 | TSSOP-48* | 2500 / Tape & Reel |
| M74LCX16373DTR2G | TSSOP-48* | 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.

*This package is inherently Pb-Free.

MAXIMUM RATINGS

| Symbol | Parameter | Value | Condition | Unit |
|------------------|----------------------------------|---|---------------------------------------|------|
| V _{CC} | DC Supply Voltage | -0.5 to +7.0 | | V |
| V _I | DC Input Voltage | -0.5 ≤ V _I ≤ +7.0 | | V |
| V _O | DC Output Voltage | -0.5 ≤ V _O ≤ +7.0 | Output in 3-State | V |
| | | -0.5 ≤ V _O ≤ 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 | ±50 | | mA |
| I _{CC} | DC Supply Current Per Supply Pin | ±100 | | mA |
| I _{GND} | DC Ground Current Per Ground Pin | ±100 | | mA |
| T _{STG} | Storage Temperature Range | -65 to +150 | | °C |

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 | Unit | |
|-----------------|--|---------------------------------|-----|----------|-----------------|----|
| V _{CC} | Supply Voltage | Operating | 2.0 | 2.5, 3.3 | 3.6 | V |
| | | Data Retention Only | 1.5 | 2.5, 3.3 | 3.6 | |
| V _I | Input Voltage | 0 | | 5.5 | V | |
| V _O | Output Voltage | (HIGH or LOW State) | 0 | | V _{CC} | V |
| | | (3-State) | 0 | | 5.5 | |
| I _{OH} | HIGH Level Output Current | V _{CC} = 3.0 V - 3.6 V | | | - 24 | mA |
| | | V _{CC} = 2.7 V - 3.0 V | | | - 12 | |
| | | V _{CC} = 2.3 V - 2.7 V | | | - 8 | |
| I _{OL} | LOW Level Output Current | V _{CC} = 3.0 V - 3.6 V | | | + 24 | mA |
| | | V _{CC} = 2.7 V - 3.0 V | | | + 12 | |
| | | V _{CC} = 2.3 V - 2.7 V | | | + 8 | |
| T _A | Operating Free-Air Temperature | -55 | | +125 | °C | |
| Δt/ΔV | Input Transition Rise or Fall Rate, V _{IN} from 0.8 V to 2.0 V, V _{CC} = 3.0 V | 0 | | 10 | ns/V | |

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DC ELECTRICAL CHARACTERISTICS

| Symbol | Characteristic | Condition | T _A = -55°C to +125°C | | Unit |
|------------------|---------------------------------------|--|----------------------------------|------|------|
| | | | Min | Max | |
| V _{IH} | HIGH Level Input Voltage (Note 2) | 2.3 V ≤ V _{CC} ≤ 2.7 V | 1.7 | | V |
| | | 2.7 V ≤ V _{CC} ≤ 3.6 V | 2.0 | | |
| V _{IL} | LOW Level Input Voltage (Note 2) | 2.3 V ≤ V _{CC} ≤ 2.7 V | | 0.7 | V |
| | | 2.7 V ≤ V _{CC} ≤ 3.6 V | | 0.8 | |
| V _{OH} | HIGH Level Output Voltage | 2.3 V ≤ V _{CC} ≤ 3.6 V; I _{OL} = 100 μA | V _{CC} - 0.2 | | V |
| | | V _{CC} = 2.3 V; I _{OH} = -8 mA | 1.8 | | |
| | | V _{CC} = 2.7 V; I _{OH} = -12 mA | 2.2 | | |
| | | V _{CC} = 3.0 V; I _{OH} = -18 mA | 2.4 | | |
| | | V _{CC} = 3.0 V; I _{OH} = -24 mA | 2.2 | | |
| V _{OL} | LOW Level Output Voltage | 2.3 V ≤ V _{CC} ≤ 3.6 V; I _{OL} = 100 μA | | 0.2 | V |
| | | V _{CC} = 2.3 V; I _{OL} = 8 mA | | 0.6 | |
| | | V _{CC} = 2.7 V; I _{OL} = 12 mA | | 0.4 | |
| | | V _{CC} = 3.0 V; I _{OL} = 16 mA | | 0.4 | |
| | | V _{CC} = 3.0 V; I _{OL} = 24 mA | | 0.55 | |
| I _I | Input Leakage Current | 2.3 V ≤ V _{CC} ≤ 3.6 V; 0 V ≤ V _I ≤ 5.5 V | | ±5.0 | μA |
| I _{OZ} | 3-State Output Current | 2.3 ≤ V _{CC} ≤ 3.6 V; 0V ≤ V _O ≤ 5.5 V; V _I = V _{IH} or V _{IL} | | ±5.0 | μA |
| I _{OFF} | Power-Off Leakage Current | V _{CC} = 0 V; V _I or V _O = 5.5 V | | 10 | μA |
| I _{CC} | Quiescent Supply Current | 2.3 ≤ V _{CC} ≤ 3.6 V; V _I = GND or V _{CC} | | 20 | μA |
| | | 2.3 ≤ V _{CC} ≤ 3.6 V; 3.6 ≤ V _I or V _O ≤ 5.5 V | | ±20 | μA |
| ΔI _{CC} | Increase in I _{CC} per Input | 2.3 ≤ V _{CC} ≤ 3.6 V; V _{IH} = V _{CC} - 0.6 V | | 500 | μA |

2. These values of V_I are used to test DC electrical characteristics only.

AC CHARACTERISTICS t_R = t_F = 2.5 ns; C_L = 50 pF; R_L = 500 Ω

| Symbol | Parameter | Waveform | T _A = -55°C to +125°C | | | | | | Unit |
|--|---|----------|---|------------|---|------------|---|------------|------|
| | | | V _{CC} = 3.3 V ± 0.3 V C _L = 50 pF | | V _{CC} = 2.7 V C _L = 50 pF | | V _{CC} = 2.5 V ± 0.2 V C _L = 30 pF | | |
| | | | Min | Max | Min | Max | Min | Max | |
| t _{PLH} t _{PHL} | Propagation Delay D _n to O _n | 1 | 1.5 1.5 | 5.4 5.4 | 1.5 1.5 | 5.9 5.9 | 1.5 1.5 | 6.5 6.5 | ns |
| t _{PLH} t _{PHL} | Propagation Delay LE to O _n | 3 | 1.5 1.5 | 5.5 5.5 | 1.5 1.5 | 6.4 6.4 | 1.5 1.5 | 6.6 6.6 | ns |
| t _{PZH} t _{PZL} | Output Enable Time to High and Low Level | 2 | 1.5 1.5 | 6.1 6.1 | 1.5 1.5 | 6.5 6.5 | 1.5 1.5 | 7.9 7.9 | ns |
| t _{PHZ} t _{PLZ} | Output Disable Time From High and Low Level | 2 | 1.5 1.5 | 6.0 6.0 | 1.5 1.5 | 6.3 6.3 | 1.5 1.5 | 7.2 7.2 | ns |
| t _s | Setup Time, HIGH or LOW D ⁿ to LE | 3 | 2.5 | | 2.5 | | 3.0 | | ns |
| t _h | Hold Time, HIGH or LOW D ⁿ to LE | 3 | 1.5 | | 1.5 | | 2.0 | | ns |
| t _w | LE Pulse Width, HIGH | 3 | 3.0 | | 3.0 | | 3.5 | | ns |
| t _{OSHL} t _{OSLH} | Output-to-Output Skew (Note 3) | | | 1.0 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_{OSHL}) or LOW-to-HIGH (t_{OSLH}); parameter guaranteed by design.

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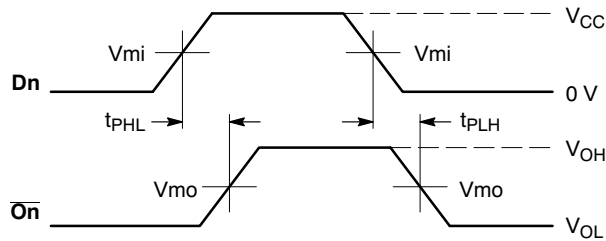
DYNAMIC SWITCHING CHARACTERISTICS

| Symbol | Characteristic | Condition | T _A = +25°C | | | Unit |
|------------------|--|--|------------------------|--------------|-----|--------|
| | | | Min | Typ | Max | |
| V _{OLP} | Dynamic LOW Peak Voltage (Note 4) | V _{CC} = 3.3 V, C _L = 50 pF, V _{IH} = 3.3 V, V _{IL} = 0 V V _{CC} = 2.5 V, C _L = 30 pF, V _{IH} = 2.5 V, V _{IL} = 0 V | | 0.8 0.6 | | V V |
| V _{OLV} | Dynamic LOW Valley Voltage (Note 4) | V _{CC} = 3.3 V, C _L = 50 pF, V _{IH} = 3.3 V, V _{IL} = 0 V V _{CC} = 2.5 V, C _L = 30 pF, V _{IH} = 2.5 V, V _{IL} = 0 V | | -0.8 -0.6 | | V 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.

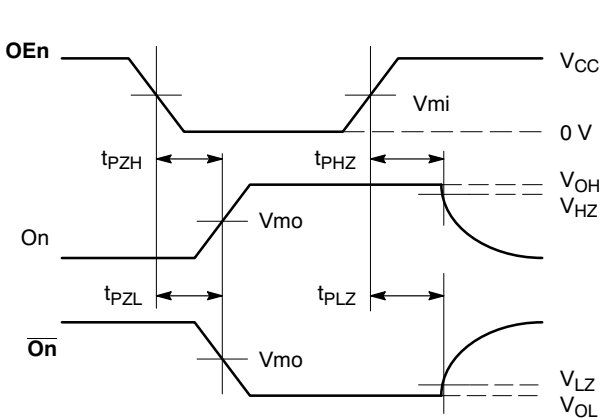
CAPACITIVE CHARACTERISTICS

| Symbol | Parameter | Condition | Typical | Unit |
|------------------|-------------------------------|--|---------|------|
| C _{IN} | Input Capacitance | V _{CC} = 3.3 V, V _I = 0 V or V _{CC} | 7 | pF |
| C _{OUT} | Output Capacitance | V _{CC} = 3.3 V, V _I = 0 V or V _{CC} | 8 | pF |
| C _{PD} | Power Dissipation Capacitance | 10 MHz, V _{CC} = 3.3 V, V _I = 0 V or V _{CC} | 20 | pF |



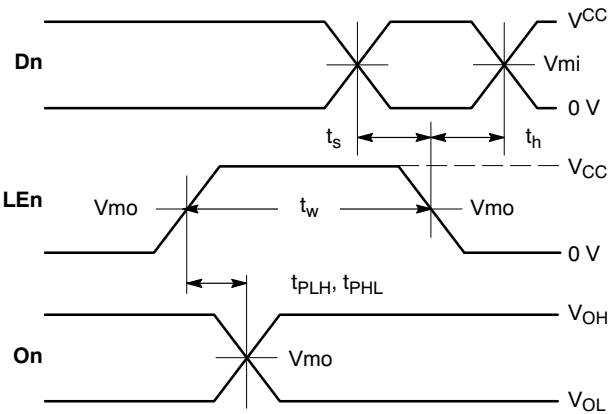
WAVEFORM 1 - PROPAGATION DELAYS

t_R = t_F = 2.5 ns, 10% to 90%; f = 1 MHz; t_W = 500 ns



WAVEFORM 2 - OUTPUT ENABLE AND DISABLE TIMES

t_R = t_F = 2.5 ns, 10% to 90%; f = 1 MHz; t_W = 500 ns



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

t_R = t_F = 2.5 ns, 10% to 90%; f = 1 MHz; t_W = 500 ns except when noted

Figure 3. AC Waveforms

Table 2. AC WAVEFORMS

| Symbol | V _{CC} | | |
|-----------------|-------------------------|-------------------------|--------------------------|
| | 3.3 V ± 0.3 V | 2.7 V | 2.5 V ± 0.2 V |
| V _{mi} | 1.5 V | 1.5 V | V _{CC} / 2 |
| V _{mo} | 1.5 V | 1.5 V | V _{CC} / 2 |
| V _{HZ} | V _{OL} + 0.3 V | V _{OL} + 0.3 V | V _{OL} + 0.15 V |
| V _{LZ} | V _{OH} - 0.3 V | V _{OH} - 0.3 V | V _{OH} - 0.15 V |

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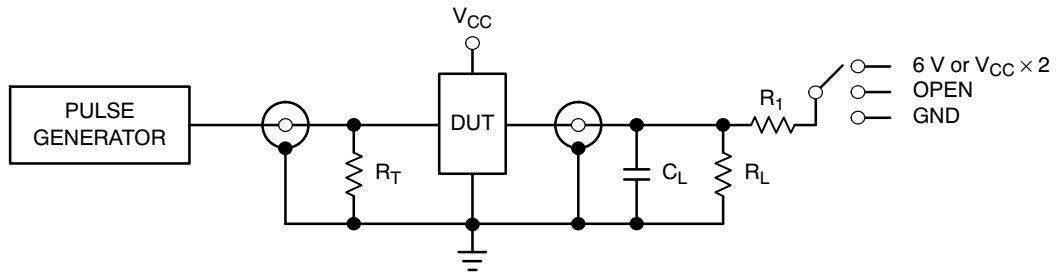


Figure 4. Test Circuit

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 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)

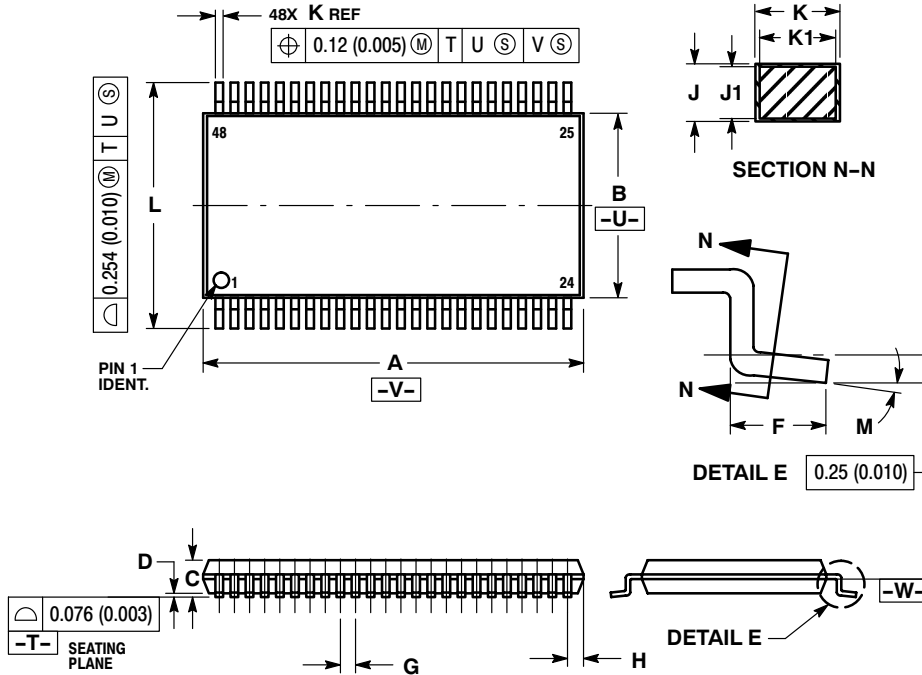
$R_L = R_1 = 500 \Omega$ or equivalent

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

MC74LCX16373

PACKAGE DIMENSIONS

TSSOP-48
DT SUFFIX
CASE 1201-01
ISSUE A



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 ° |

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