

MC74LCXU04

Low-Voltage CMOS Unbuffered Hex Inverter

With 5 V-Tolerant Inputs

The MC74LCXU04 is a high performance unbuffered hex inverter operating from a 2.3 to 3.6 V supply. (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 MC74LCXU04 inputs to be safely driven from 5 V devices.

Features

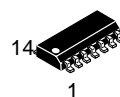
- Designed for 2.3 to 3.6 V V_{CC} Operation
- 5 V Tolerant Inputs – Interface Capability With 5 V TTL Logic
- LVTTTL Compatible
- LVCMOS Compatible
- Near Zero Static Supply Current (10 μ A) Substantially Reduces System Power Requirements
- Latchup Performance Exceeds 500 mA
- ESD Performance: Human Body Model >2000 V
Machine Model >200 V
- Pb-Free Packages are Available*



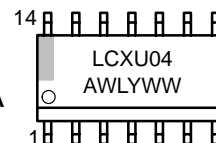
ON Semiconductor®

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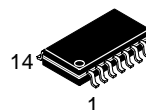
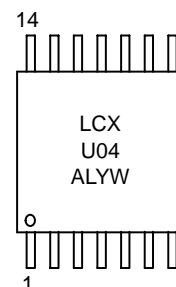
MARKING DIAGRAMS



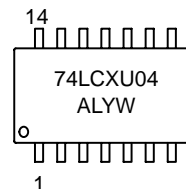
SOIC-14
D SUFFIX
CASE 751A



TSSOP-14
DT SUFFIX
CASE 948G



SOEIAJ-14
M SUFFIX
CASE 965



A = Assembly Location
WL, L = Wafer Lot
Y = Year
WW, W = Work Week

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 4 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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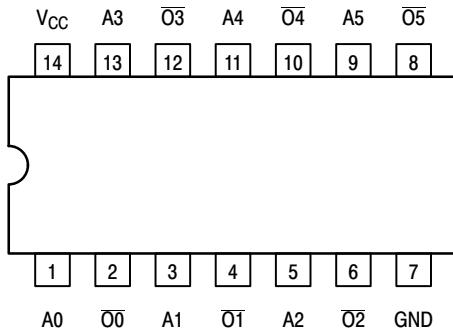


Figure 1. Pinout: 14-Lead (Top View)

PIN NAMES

| Pins | Function |
|----------------|-------------|
| A _n | Data Inputs |
| O _n | Outputs |

TRUTH TABLE

| A _n | O _n |
|----------------|----------------|
| L | H |
| H | L |

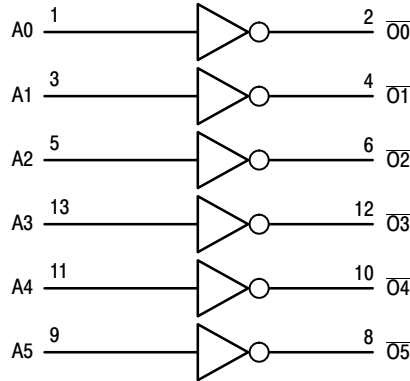


Figure 2. Logic Diagram

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 ≤ 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 |

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

1. I_O absolute maximum rating must be observed.

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RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Min | Typ | Max | Unit |
|-----------------|--|---------------------------------|----------|------------------|------|
| V _{CC} | Supply Voltage | Operating | 2.5, 3.3 | 3.6 | V |
| | | Data Retention Only | 2.0, 1.5 | 3.6 | |
| V _I | Input Voltage | 0 | | 5.5 | V |
| V _O | Output Voltage (HIGH or LOW State) | 0 | | V _{CC} | V |
| I _{OH} | HIGH Level Output Current | | | -18 -12 -8 | mA |
| I _{OL} | LOW Level Output Current | V _{CC} = 3.0 V – 3.6 V | | +16 | 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 | -40 | | +85 | °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 |

DC ELECTRICAL CHARACTERISTICS

| Symbol | Characteristic | Condition | T _A = -40°C to +85°C | | Unit |
|------------------|---------------------------------------|---|---------------------------------|------|------|
| | | | Min | Max | |
| V _{IH} | HIGH Level Input Voltage (Note 2) | V _{CC} = 2.3 V | 1.7 | | V |
| | | V _{CC} = 2.7 V | 2.1 | | |
| | | V _{CC} = 3.0 V | 2.2 | | |
| | | V _{CC} = 3.6 V | 2.7 | | |
| V _{IL} | LOW Level Input Voltage (Note 2) | V _{CC} = 2.3 V | | 0.55 | V |
| | | V _{CC} = 2.7 V | | 0.55 | |
| | | V _{CC} = 3.0 V | | 0.55 | |
| | | V _{CC} = 3.6 V | | 0.55 | |
| 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 _{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 | | 0.5 | |
| 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} | | 10 | μA |
| | | 2.3 ≤ V _{CC} ≤ 3.6 V; 3.6 ≤ V _I or V _O ≤ 5.5 V | | ±10 | |
| 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.

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AC CHARACTERISTICS $t_R = t_F = 2.5\text{ns}$; $R_L = 500\ \Omega$ (Note 3)

| Symbol | Parameter | Waveform | Limits | | | | | | Unit |
|--------------------------|--------------------------------------|----------|---|------------|-------------------------|------------|--|------------|------|
| | | | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ | | | | | | |
| | | | $V_{CC} = 3.3\text{ V} \pm 0.3\text{ V}$ | | $V_{CC} = 2.7\text{ V}$ | | $V_{CC} = 2.5\text{ V} \pm 0.2\text{ V}$ | | |
| | | | $C_L = 50\text{ pF}$ | | $C_L = 50\text{ pF}$ | | $C_L = 30\text{ pF}$ | | |
| | | | Min | Max | Min | Max | Min | Max | |
| t_{PLH} t_{PHL} | Propagation Delay Input to Output | 1 | 1.0 1.0 | 3.6 3.6 | 1.0 1.0 | 4.5 4.5 | 1.0 1.0 | 4.3 4.3 | ns |
| t_{OSHL} t_{OSLH} | Output-to-Output Skew (Note 4) | | | 1.0 1.0 | | | | | ns |

3. These AC parameters are preliminary and may be modified.

4. 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.

DYNAMIC SWITCHING CHARACTERISTICS

| Symbol | Characteristic | Condition | $T_A = +25^\circ\text{C}$ | | | Unit |
|-----------|--|--|---------------------------|--------------|-----|--------|
| | | | Min | Typ | Max | |
| V_{OLP} | Dynamic LOW Peak Voltage (Note 5) | $V_{CC} = 3.3\text{ V}, C_L = 50\text{ pF}, V_{IH} = 3.3\text{ V}, V_{IL} = 0\text{ V}$ $V_{CC} = 2.5\text{ V}, C_L = 30\text{ pF}, V_{IH} = 2.5\text{ V}, V_{IL} = 0\text{ V}$ | | 0.8 0.6 | | V V |
| V_{OLV} | Dynamic LOW Valley Voltage (Note 5) | $V_{CC} = 3.3\text{ V}, C_L = 50\text{ pF}, V_{IH} = 3.3\text{ V}, V_{IL} = 0\text{ V}$ $V_{CC} = 2.5\text{ V}, C_L = 30\text{ pF}, V_{IH} = 2.5\text{ V}, V_{IL} = 0\text{ V}$ | | -0.8 -0.6 | | V V |

5. 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 | $V_{CC} = 3.3\text{ V}, V_I = 0\text{ V or } V_{CC}$ | 7 | pF |
| C_{OUT} | Output Capacitance | $V_{CC} = 3.3\text{ V}, V_I = 0\text{ V or } V_{CC}$ | 8 | pF |
| C_{PD} | Power Dissipation Capacitance | 10 MHz, $V_{CC} = 3.3\text{ V}, V_I = 0\text{ V or } V_{CC}$ | 25 | pF |

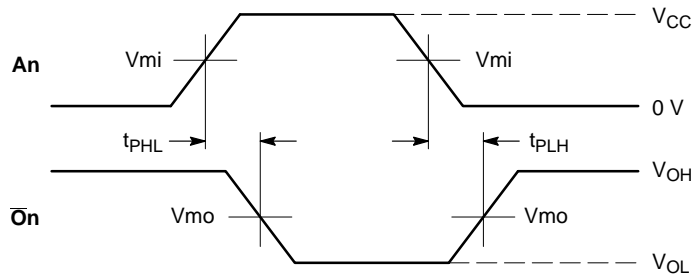
ORDERING INFORMATION

| Device | Package | Shipping† |
|----------------|----------------------|------------------|
| MC74LCXU04D | SOIC-14 | 55 Units / Rail |
| MC74LCXU04DG | SOIC-14 (Pb-Free) | 55 Units / Rail |
| MC74LCXU04DR2 | SOIC-14 | 2500 Tape & Reel |
| MC74LCXU04DR2G | SOIC-14 (Pb-Free) | 2500 Tape & Reel |
| MC74LCXU04DT | TSSOP-14* | 96 Units / Rail |
| MC74LCXU04DTR2 | TSSOP-14* | 2500 Tape & Reel |
| MC74LCXU04M | SOEIAJ-14 | 50 Units / Rail |
| MC74LCXU04MEL | SOEIAJ-14 | 2000 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.

MC74LCXU04

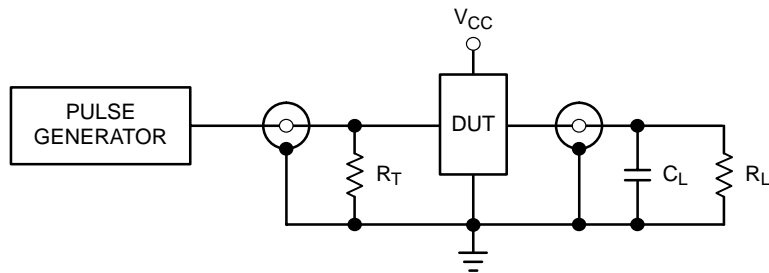


PROPAGATION DELAYS

$t_R = t_F = 2.5 \text{ ns}$, 10% to 90%; $f = 1 \text{ MHz}$; $t_W = 500 \text{ ns}$

| Symbol | V_{CC} | | |
|--------|-----------------------------------|-----------------|-----------------------------------|
| | $3.3 \text{ V} \pm 0.3 \text{ V}$ | 2.7 V | $2.5 \text{ V} \pm 0.2 \text{ V}$ |
| Vmi | 1.5 V | 1.5 V | $V_{CC}/2$ |
| Vmo | 1.5 V | 1.5 V | $V_{CC}/2$ |

Figure 3. AC Waveforms



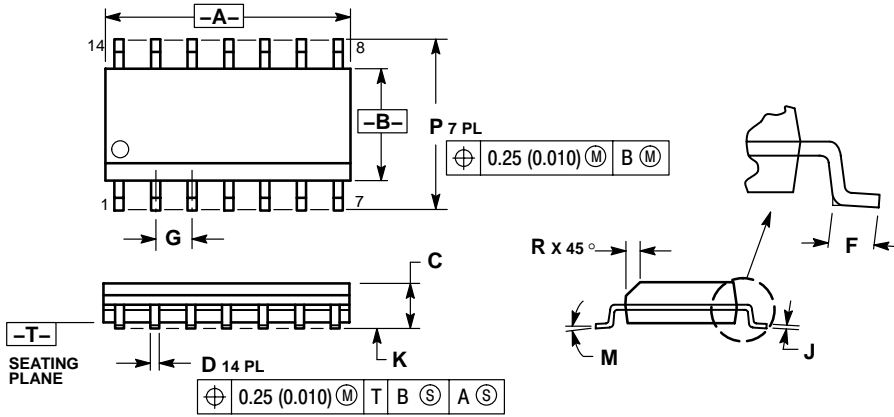
- $C_L = 50 \text{ pF}$ at $V_{CC} = 3.3 \pm 0.3 \text{ V}$ or equivalent (includes jig and probe capacitance)
- $C_L = 30 \text{ pF}$ at $V_{CC} = 2.5 \pm 0.2 \text{ V}$ or equivalent (includes jig and probe capacitance)
- $R_L = R_1 = 500 \Omega$ or equivalent
- $R_T = Z_{OUT}$ of pulse generator (typically 50Ω)

Figure 4. Test Circuit

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PACKAGE DIMENSIONS

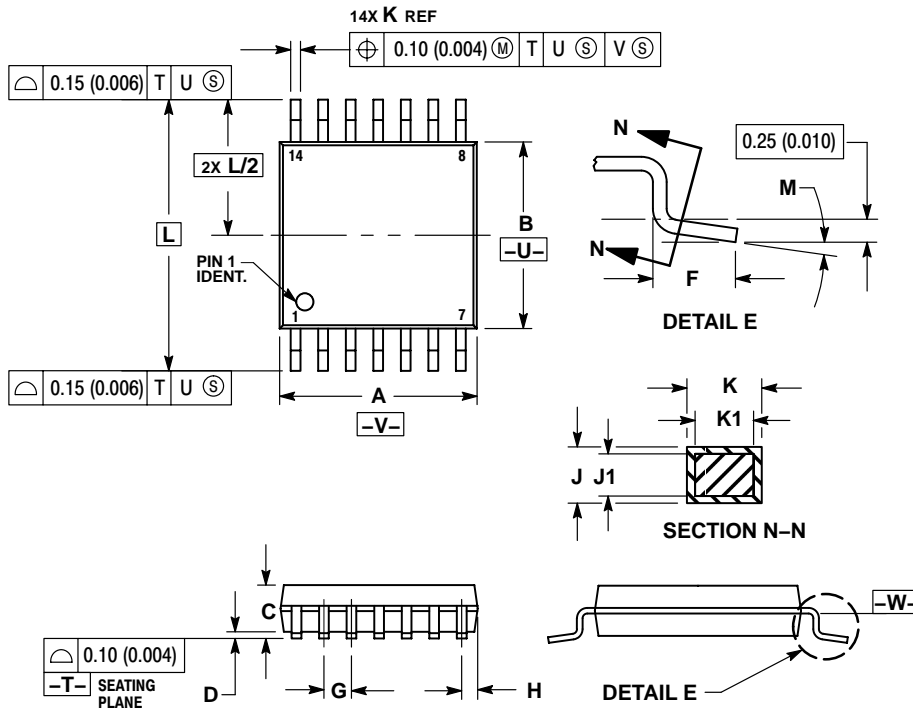
SOIC-14
D SUFFIX
CASE 751A-03
ISSUE G



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: MILLIMETER.
 3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
 4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
 5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|------|-----------|-------|
| | MIN | MAX | MIN | MAX |
| A | 8.55 | 8.75 | 0.337 | 0.344 |
| B | 3.80 | 4.00 | 0.150 | 0.157 |
| C | 1.35 | 1.75 | 0.054 | 0.068 |
| D | 0.35 | 0.49 | 0.014 | 0.019 |
| F | 0.40 | 1.25 | 0.016 | 0.049 |
| G | 1.27 BSC | | 0.050 BSC | |
| J | 0.19 | 0.25 | 0.008 | 0.009 |
| K | 0.10 | 0.25 | 0.004 | 0.009 |
| M | 0° | 7° | 0° | 7° |
| P | 5.80 | 6.20 | 0.228 | 0.244 |
| R | 0.25 | 0.50 | 0.010 | 0.019 |

TSSOP-14
DT SUFFIX
CASE 948G-01
ISSUE O



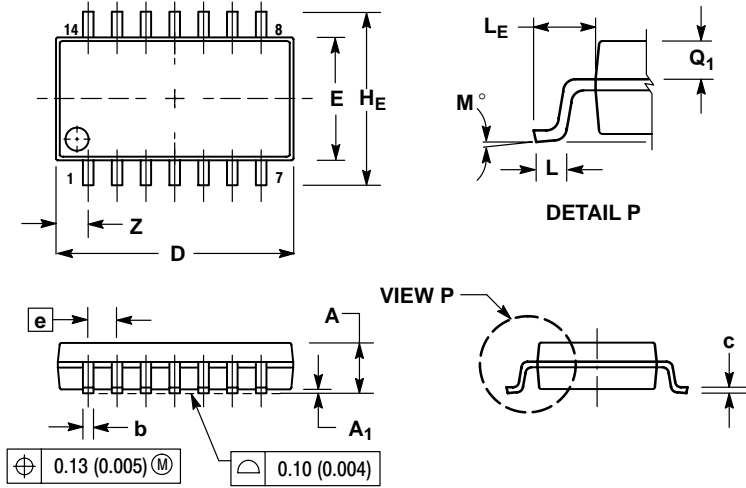
- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: MILLIMETER.
 3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
 4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
 5. 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.
 6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
 7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.

| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|------|-----------|-------|
| | MIN | MAX | MIN | MAX |
| A | 4.90 | 5.10 | 0.193 | 0.200 |
| B | 4.30 | 4.50 | 0.169 | 0.177 |
| C | --- | 1.20 | --- | 0.047 |
| D | 0.05 | 0.15 | 0.002 | 0.006 |
| F | 0.50 | 0.75 | 0.020 | 0.030 |
| G | 0.65 BSC | | 0.026 BSC | |
| H | 0.50 | 0.60 | 0.020 | 0.024 |
| J | 0.09 | 0.20 | 0.004 | 0.008 |
| J1 | 0.09 | 0.16 | 0.004 | 0.006 |
| K | 0.19 | 0.30 | 0.007 | 0.012 |
| K1 | 0.19 | 0.25 | 0.007 | 0.010 |
| L | 6.40 BSC | | 0.252 BSC | |
| M | 0° | 8° | 0° | 8° |

MC74LCXU04

PACKAGE DIMENSIONS

SOEIAJ-14
M SUFFIX
CASE 965-01
ISSUE O




NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS AND ARE MEASURED AT THE PARTING LINE. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
5. THE LEAD WIDTH DIMENSION (b) DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE LEAD WIDTH DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT. MINIMUM SPACE BETWEEN PROTRUSIONS AND ADJACENT LEAD TO BE 0.46 (0.018).

| DIM | MILLIMETERS | | INCHES | |
|----------------|-------------|-------|-----------|-------|
| | MIN | MAX | MIN | MAX |
| A | --- | 2.05 | --- | 0.081 |
| A ₁ | 0.05 | 0.20 | 0.002 | 0.008 |
| b | 0.35 | 0.50 | 0.014 | 0.020 |
| c | 0.18 | 0.27 | 0.007 | 0.011 |
| D | 9.90 | 10.50 | 0.390 | 0.413 |
| E | 5.10 | 5.45 | 0.201 | 0.215 |
| e | 1.27 BSC | | 0.050 BSC | |
| HE | 7.40 | 8.20 | 0.291 | 0.323 |
| L | 0.50 | 0.85 | 0.020 | 0.033 |
| LE | 1.10 | 1.50 | 0.043 | 0.059 |
| M | 0° | 10° | 0° | 10° |
| Q ₁ | 0.70 | 0.90 | 0.028 | 0.035 |
| Z | --- | 1.42 | --- | 0.056 |

MC74LCXU04

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