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74LCX14 Low Voltage Hex Inverter with 5V Tolerant Schmitt Trigger Inputs

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General Description

The LCX14 contains six inverter gates each with a Schmitt trigger input. They are capable of transforming slowly changing input signals into sharply defined, jitter-free output signals. In addition, they have a greater noise margin than conventional inverters.

The LCX14 has hysteresis between the positive-going and negative-going input thresholds (typically 1.0V) which is determined internally by transistor ratios and is essentially insensitive to temperature and supply voltage variations.

The inputs tolerate voltages up to 7V allowing the interface of 5V, 3V and 2.5V systems.

The 74LCX14 is fabricated with advanced CMOS technology to achieve high speed operation while maintaining CMOS low power dissipation.

Features

- 5V tolerant inputs
- 2.3V–3.6V V_{CC} specifications provided
- 6.5 ns t_{PD} max ($V_{CC} = 3.3V$), 10 μA I_{CC} max
- Power down high impedance inputs and outputs
- ± 24 mA output drive ($V_{CC} = 3.0V$)
- Implements patented noise/EMI reduction circuitry
- Latch-up performance exceeds JEDEC 78 conditions
- ESD performance:
 - Machine model > 200V
 - Human model > 2000V
- Leadless Pb-Free DQFN package

Ordering Code:

| Order Number | Package Number | Package Description |
|----------------------------|----------------|---|
| 74LCX14M | M14A | 14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow |
| 74LCX14MX_NL (Note 2) | M14A | Pb-Free 14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow |
| 74LCX14SJ | M14D | Pb-Free 14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide |
| 74LCX14BQX (Note 1) | MLP014A | Pb-Free 14-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN), JEDEC MO-241, 2.5 x 3.0mm |
| 74LCX14MTC | MTC14 | 14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide |
| 74LCX14MTCX_NL (Note 2) | MTC14 | Pb-Free 14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide |

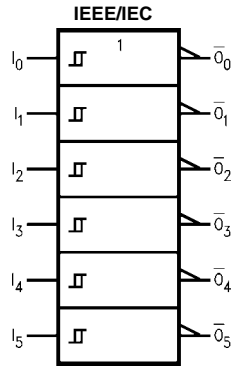
Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.
Pb-Free package per JEDEC J-STD-020B.

Note 1: DQFN package available in Tape and Reel only.

Note 2: "_NL" indicates Pb-Free package (per JEDEC J-STD-020B). Device available in Tape and Reel only.



Logic Symbol



Pin Descriptions

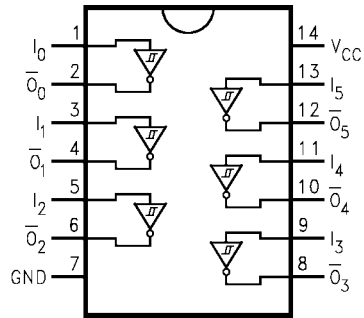
| Pin Names | Description |
|-------------|-------------|
| I_n | Inputs |
| \bar{O}_n | Outputs |

Truth Table

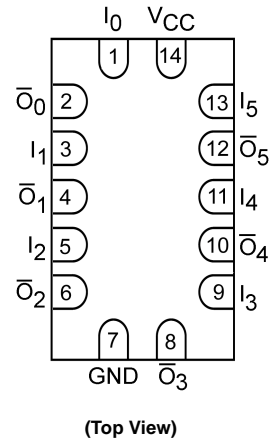
| Input | Output |
|-------|-----------|
| A | \bar{O} |
| L | H |
| H | L |

Connection Diagrams

Pin Assignments for SOIC, SOP, and TSSOP



Pad Assignments for DQFN



| Absolute Maximum Ratings ^(Note 3) | | | | | |
|--|----------------------------------|------------------------|--------------------------------------|-------|--|
| Symbol | Parameter | Value | Conditions | Units | |
| V_{CC} | Supply Voltage | -0.5 to +7.0 | | V | |
| V_I | DC Input Voltage | -0.5 to +7.0 | | V | |
| V_O | DC Output Voltage | -0.5 to $V_{CC} + 0.5$ | Output in HIGH or LOW State (Note 4) | V | |
| I_{IK} | DC Input Diode Current | -50 | $V_I < GND$ | mA | |
| I_{OK} | DC Output Diode Current | -50 | $V_O < GND$ | mA | |
| | | +50 | $V_O > V_{CC}$ | | |
| 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 | -65 to +150 | | °C | |

| Recommended Operating Conditions (Note 5) | | | | | |
|---|----------------|------------------------|----------|----------|----|
| Symbol | Parameter | Min | Max | Units | |
| V_{CC} | Supply Voltage | Operating | 2.0 | 3.6 | V |
| | | Data Retention | 1.5 | 3.6 | |
| V_I | Input Voltage | 0 | 5.5 | V | |
| V_O | Output Voltage | 0 | V_{CC} | V | |
| I_{OH}/I_{OL} | Output Current | $V_{CC} = 3.0V - 3.6V$ | | ± 24 | mA |
| | | $V_{CC} = 2.7V - 3.0V$ | | ± 12 | |
| | | $V_{CC} = 2.3V - 2.7V$ | | ± 8 | |

Note 3: The Absolute Maximum Ratings are those values beyond which the safety of the device cannot be guaranteed. The device should not be operated at these limits. The parametric values defined in the Electrical Characteristics tables are not guaranteed at the Absolute Maximum Ratings. The "Recommended Operating Conditions" table will define the conditions for actual device operation.

Note 4: I_O Absolute Maximum Rating must be observed.

Note 5: Unused inputs must be held HIGH or LOW. They may not float.

DC Electrical Characteristics

| Symbol | Parameter | Conditions | V_{CC} (V) | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ | | Units |
|-----------------|--------------------------------|----------------------------|-----------------|---|-----------|---------------|
| | | | | Min | Max | |
| V_{t+} | Positive Input Threshold | | 2.5 | 0.9 | 1.7 | V |
| | | | 3.0 | 1.2 | 2.2 | |
| V_{t-} | Negative Input Threshold | | 2.5 | 0.4 | 1.1 | V |
| | | | 3.0 | 0.6 | 1.5 | |
| V_H | Hysteresis | | 2.5 | 0.3 | 1.0 | V |
| | | | 3.0 | 0.4 | 1.2 | |
| V_{OH} | HIGH Level Output Voltage | $I_{OH} = -100\mu\text{A}$ | 2.3 - 3.6 | $V_{CC} - 0.2$ | | V |
| | | $I_{OH} = -8\text{ mA}$ | 2.3 | 1.8 | | |
| | | $I_{OH} = -12\text{ mA}$ | 2.7 | 2.2 | | |
| | | $I_{OH} = -18\text{ mA}$ | 3.0 | 2.4 | | |
| | | $I_{OH} = -24\text{ mA}$ | 3.0 | 2.2 | | |
| V_{OL} | LOW Level Output Voltage | $I_{OL} = 100\mu\text{A}$ | 2.3 - 3.6 | | 0.2 | V |
| | | $I_{OL} = 8\text{ mA}$ | 2.3 | | 0.6 | |
| | | $I_{OL} = 12\text{ mA}$ | 2.7 | | 0.4 | |
| | | $I_{OL} = 16\text{ mA}$ | 3.0 | | 0.4 | |
| | | $I_{OL} = 24\text{ mA}$ | 3.0 | | 0.55 | |
| I_I | Input Leakage Current | $0 \leq V_I \leq 5.5V$ | 2.3 - 3.6 | | ± 5.0 | μA |
| I_{OFF} | Power-Off Leakage Current | V_I or $V_O = 5.5V$ | 0 | | 10 | μA |
| I_{CC} | Quiescent Supply Current | $V_I = V_{CC}$ or GND | 2.3 - 3.6 | | 10 | μA |
| | | $3.6V \leq V_I \leq 5.5V$ | 2.3 - 3.6 | | ± 10 | |
| ΔI_{CC} | Increase in I_{CC} per Input | $V_{IH} = V_{CC} - 0.6V$ | 2.3 - 3.6 | | 500 | μA |

AC Electrical Characteristics

| Symbol | Parameter | $T_A = -40^\circ\text{C to } +85^\circ\text{C}, R_L = 500 \Omega$ | | | | | | Units |
|------------|-----------------------------------|---|-----|-----------------------|-----|--------------------------|-----|-------|
| | | $V_{CC} = 3.3V \pm 0.3V$ | | $V_{CC} = 2.7V$ | | $V_{CC} = 2.5V \pm 0.2V$ | | |
| | | $C_L = 50 \text{ pF}$ | | $C_L = 50 \text{ pF}$ | | $C_L = 30 \text{ pF}$ | | |
| | | Min | Max | Min | Max | Min | Max | |
| t_{PHL} | Propagation Delay Time | 1.5 | 6.5 | 1.5 | 7.5 | 1.5 | 7.8 | ns |
| t_{PLH} | | 1.5 | 6.5 | 1.5 | 7.5 | 1.5 | 7.8 | |
| t_{OSHL} | Output to Output Skew (Note 6) | | 1.0 | | | | | ns |
| t_{OSLH} | | | 1.0 | | | | | |

Note 6: 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}).

Dynamic Switching Characteristics

| Symbol | Parameter | Conditions | V_{CC} (V) | $T_A = 25^\circ\text{C}$ | Units |
|-----------|--------------------------------------|---|-----------------|--------------------------|-------|
| | | | | Typical | |
| V_{OLP} | Quiet Output Dynamic Peak V_{OL} | $C_L = 50 \text{ pF}, V_{IH} = 3.3V, V_{IL} = 0V$ | 3.3 | 0.8 | V |
| | | $C_L = 30 \text{ pF}, V_{IH} = 2.5V, V_{IL} = 0V$ | 2.5 | 0.6 | |
| V_{OLV} | Quiet Output Dynamic Valley V_{OL} | $C_L = 50 \text{ pF}, V_{IH} = 3.3V, V_{IL} = 0V$ | 3.3 | -0.8 | V |
| | | $C_L = 30 \text{ pF}, V_{IH} = 2.5V, V_{IL} = 0V$ | 2.5 | -0.6 | |

Capacitance

| Symbol | Parameter | Conditions | Typical | Units |
|-----------|-------------------------------|--|---------|-------|
| C_{IN} | Input Capacitance | $V_{CC} = \text{Open}, V_I = 0V \text{ or } V_{CC}$ | 7 | pF |
| C_{OUT} | Output Capacitance | $V_{CC} = 3.3V, V_I = 0V \text{ or } V_{CC}$ | 8 | pF |
| C_{PD} | Power Dissipation Capacitance | $V_{CC} = 3.3V, V_I = 0V \text{ or } V_{CC}, f = 10 \text{ MHz}$ | 25 | pF |

AC Loading and Waveforms Generic for LCX Family

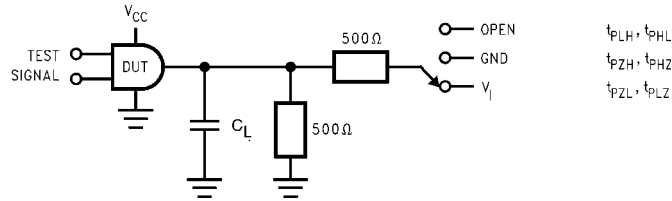
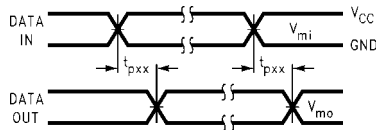
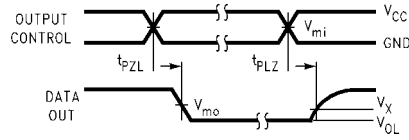


FIGURE 1. AC Test Circuit
(C_L includes probe and jig capacitance)

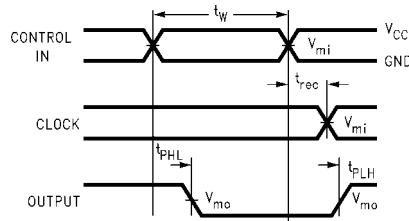
| Test | Switch |
|--------------------|---|
| t_{PLH}, t_{PHL} | Open |
| t_{PZL}, t_{PLZ} | 6V at $V_{CC} = 3.3 \pm 0.3V$ $V_{CC} \times 2$ at $V_{CC} = 2.5 \pm 0.2V$ |
| t_{PZH}, t_{PHZ} | GND |



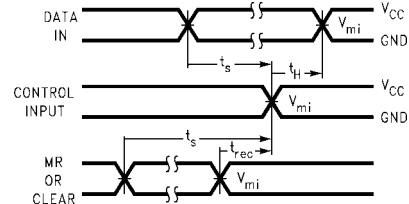
Waveform for Inverting and Non-Inverting Functions



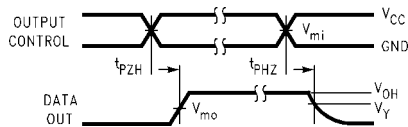
3-STATE Output Low Enable and Disable Times for Logic



Propagation Delay, Pulse Width and t_{rec} Waveforms



Setup Time, Hold Time and Recovery Time for Logic



3-STATE Output High Enable and Disable Times for Logic

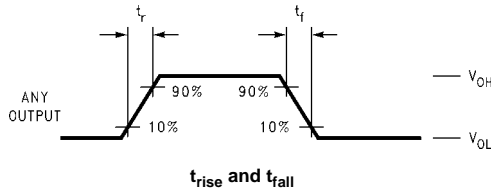
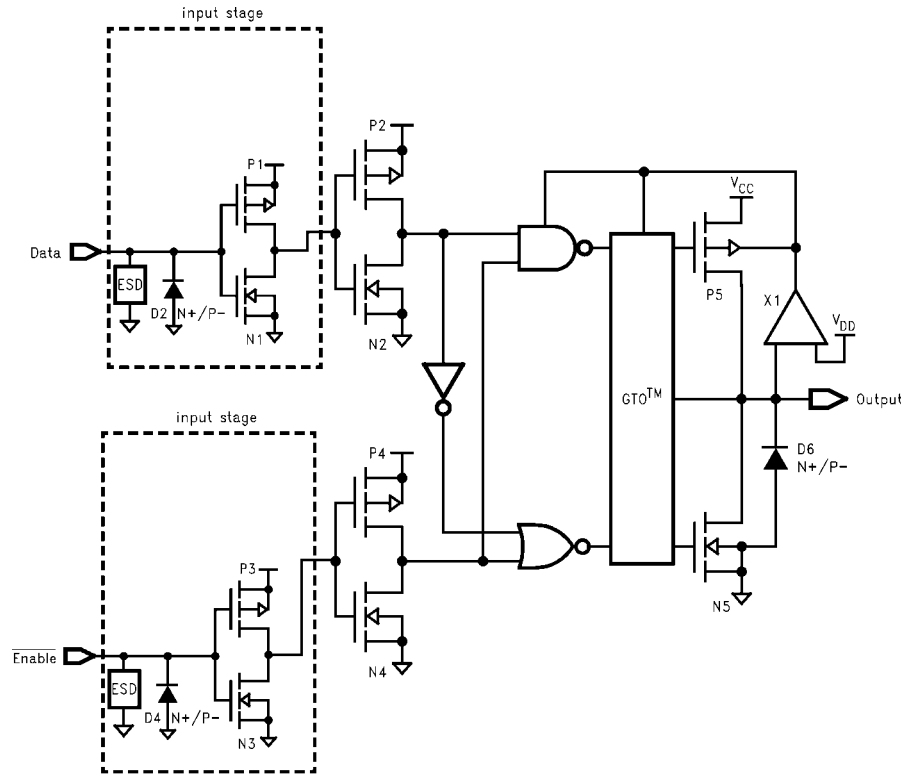


FIGURE 2. Waveforms
(Input Pulse Characteristics; $f = 1MHz$, $t_r = t_f = 3ns$)

| Symbol | V_{CC} | | |
|----------|-----------------|-----------------|------------------|
| | 3.3V \pm 0.3V | 2.7V | 2.5V \pm 0.2V |
| V_{mi} | 1.5V | 1.5V | $V_{CC}/2$ |
| V_{mo} | 1.5V | 1.5V | $V_{CC}/2$ |
| V_x | $V_{OL} + 0.3V$ | $V_{OL} + 0.3V$ | $V_{OL} + 0.15V$ |
| V_y | $V_{OH} - 0.3V$ | $V_{OH} - 0.3V$ | $V_{OH} - 0.15V$ |

Schematic Diagram Generic for LCX Family

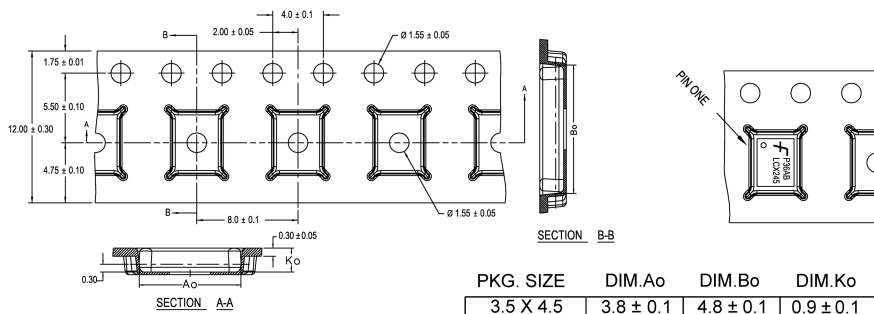


Tape and Reel Specification

Tape Format for DQFN

| Package Designator | Tape Section | Number Cavities | Cavity Status | Cover Tape Status |
|--------------------|--------------------|-----------------|---------------|-------------------|
| BQX | Leader (Start End) | 125 (typ) | Empty | Sealed |
| | Carrier | 2500/3000 | Filled | Sealed |
| | Trailer (Hub End) | 75 (typ) | Empty | Sealed |

TAPE DIMENSIONS inches (millimeters)



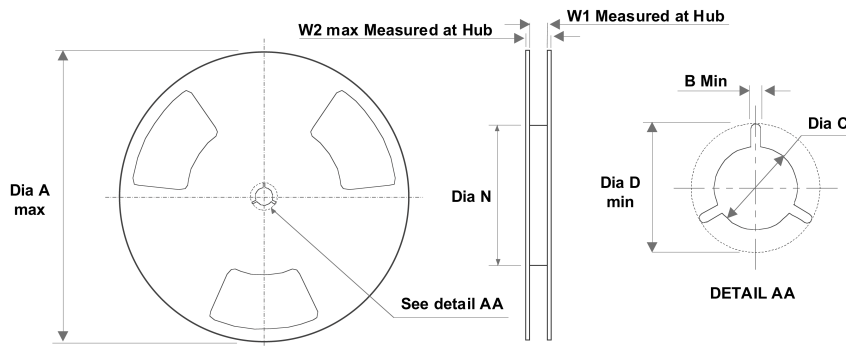
| PKG. SIZE | DIM.Ao | DIM.Bo | DIM.Ko |
|-----------|-----------|-----------|-----------|
| 3.5 X 4.5 | 3.8 ± 0.1 | 4.8 ± 0.1 | 0.9 ± 0.1 |
| 3.0 X 3.0 | 3.3 ± 0.1 | 3.3 ± 0.1 | 0.9 ± 0.1 |
| 2.5 X 4.5 | 2.8 ± 0.1 | 4.8 ± 0.1 | 0.9 ± 0.1 |
| 2.5 X 3.5 | 2.8 ± 0.1 | 3.8 ± 0.1 | 0.9 ± 0.1 |
| 2.5 X 3.0 | 2.8 ± 0.1 | 3.3 ± 0.1 | 0.9 ± 0.1 |
| 2.5 X 2.5 | 2.8 ± 0.1 | 2.8 ± 0.1 | 0.9 ± 0.1 |

DIMENSIONS ARE IN MILLIMETERS

NOTES: unless otherwise specified

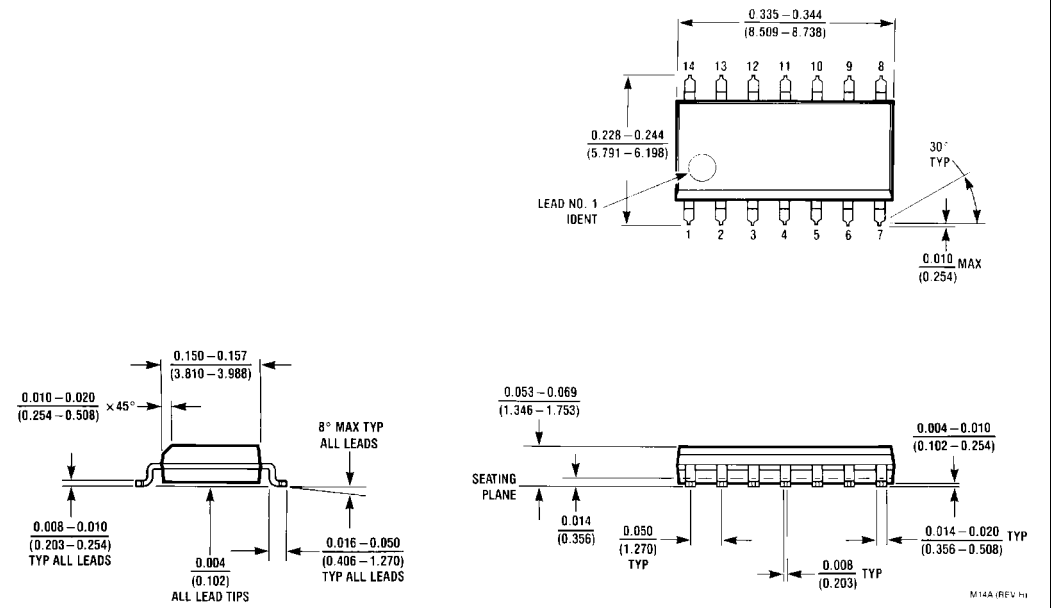
1. Cumulative pitch for feeding holes and cavities (chip pockets) not to exceed 0.008[0.20] over 10 pitch span.
2. Smallest allowable bending radius.
3. Thru hole inside cavity is centered within cavity.
4. Tolerance is $\pm 0.002[0.05]$ for these dimensions on all 12mm tapes.
5. Ao and Bo measured on a plane 0.120[0.30] above the bottom of the pocket.
6. Ko measured from a plane on the inside bottom of the pocket to the top surface of the carrier.
7. Pocket position relative to sprocket hole measured as true position of pocket. Not pocket hole.
8. Controlling dimension is millimeter. Dimension in inches rounded.

REEL DIMENSIONS inches (millimeters)



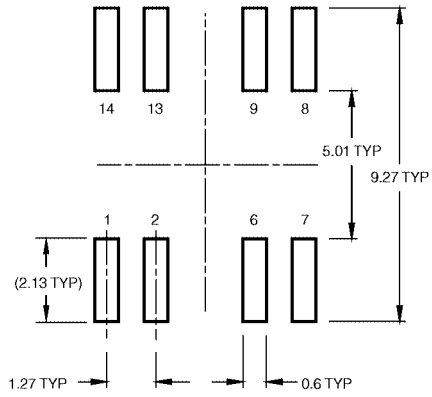
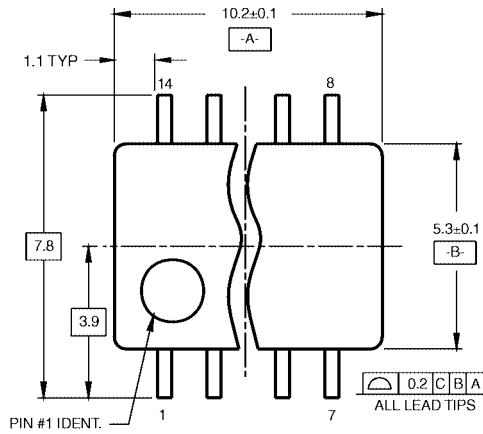
| Tape Size | A | B | C | D | N | W1 | W2 |
|-----------|---------------|-----------------|------------------|------------------|----------------|-----------------|-----------------|
| 12 mm | 13.0 (330) | 0.059 (1.50) | 0.512 (13.00) | 0.795 (20.20) | 7.008 (178) | 0.488 (12.4) | 0.724 (18.4) |

Physical Dimensions inches (millimeters) unless otherwise noted

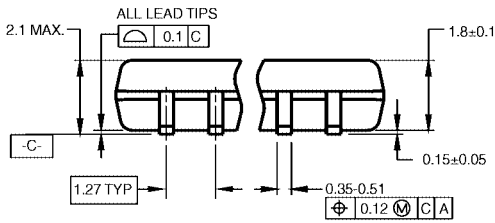


14-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow Package Number M14A

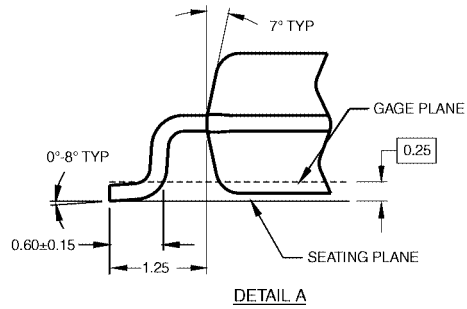
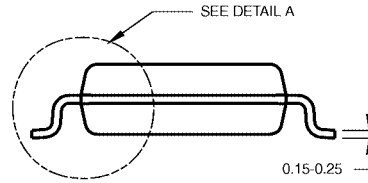
Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



LAND PATTERN RECOMMENDATION



DIMENSIONS ARE IN MILLIMETERS

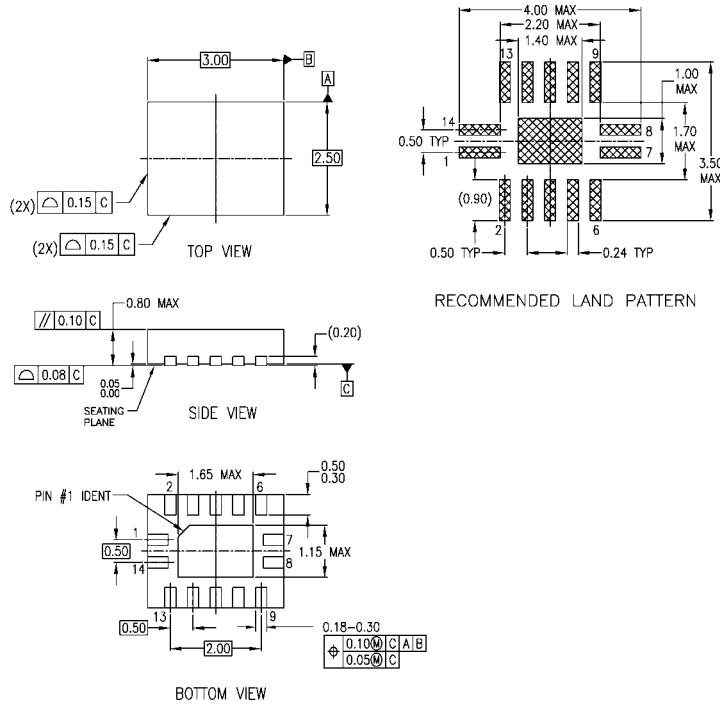


- NOTES:
A. CONFORMS TO EIAJ EDR-7320 REGISTRATION, ESTABLISHED IN DECEMBER, 1998.
B. DIMENSIONS ARE IN MILLIMETERS.
C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

M14DRevB1

Pb-Free 14-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide Package Number M14D

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



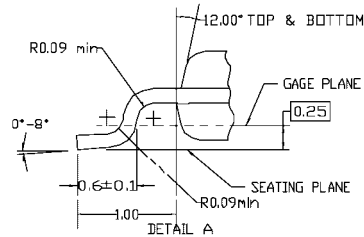
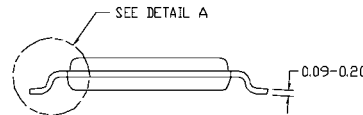
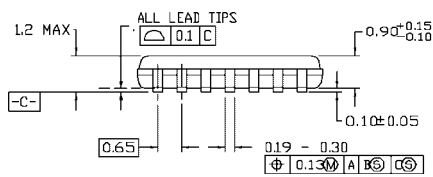
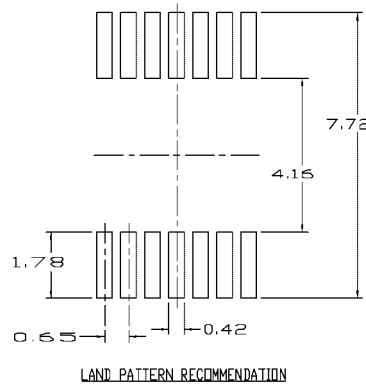
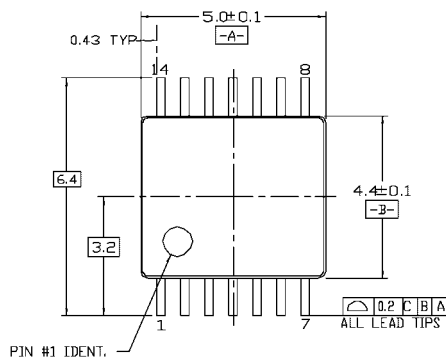
NOTES:

- A. CONFORMS TO JEDEC REGISTRATION MO-241, VARIATION AA
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994

MLP014ArevA

Pb-Free 14-Terminal Depopulated Quad Very-Thin Flat Pack No Leads (DQFN), JEDEC MO-241, 2.5 x 3.0mm Package Number MLP014A

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



NOTES:

- A. CONFORMS TO JEDEC REGISTRATION MO-153 VARIATION AB, REF NOTE 6, DATED 7/93
- B. DIMENSIONS ARE IN MILLIMETERS
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS
- D. DIMENSIONING AND TOLERANCES PER ANSI Y14.5M, 1982

MTC14revD

14-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide Package Number MTC14

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2. A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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