

# MC74LCX14

## Low Voltage CMOS Hex Schmitt Inverter With 5 V-Tolerant Inputs

The MC74LCX14 is a high performance hex inverter with Schmitt-Trigger inputs 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 MC74LCX14 inputs to be safely driven from 5 V devices.

Pin configuration and function are the same as the MC74LCX04, but the inputs have hysteresis and, with its Schmitt trigger function, the LCX14 can be used as a line receiver which will receive slow input signals.

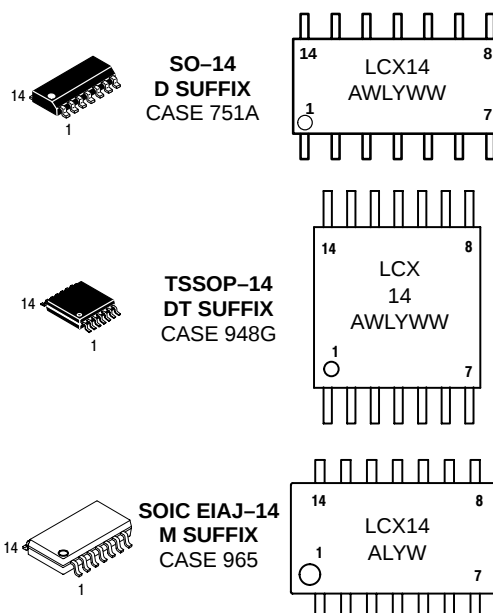
- Designed for 2.3 V to 3.6 V  $V_{CC}$  Operation
- 5 V Tolerant Inputs – Interface Capability With 5 V TTL Logic
- LVTTL Compatible
- LVCMOS Compatible
- 24 mA Balanced Output Sink and Source Capability
- Near Zero Static Supply Current (10  $\mu$ A) Substantially Reduces System Power Requirements
- Latchup Performance Exceeds 500 mA
- Current Drive Capability is 24 mA at Source/Sink
- Pin and Function Compatible with Other Standard Logic Families
- ESD Performance: HBM > 2000 V; Machine Model > 100 V
- Chip Complexity: 41 Equivalent Gates



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### MARKING DIAGRAMS



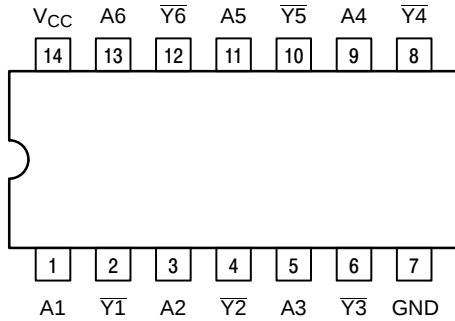
A = Assembly Location  
WL or L = Wafer Lot  
Y = Year  
WW or W = Work Week

### ORDERING INFORMATION

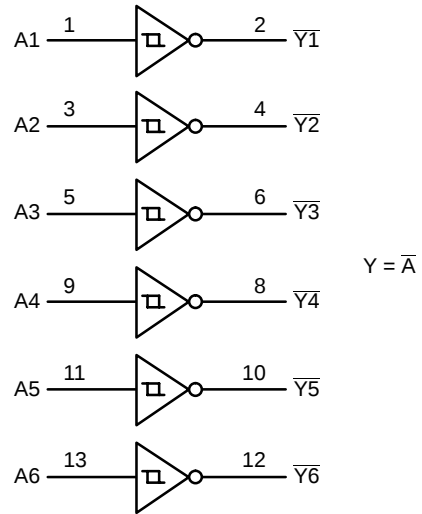
| Device        | Package         | Shipping        |
|---------------|-----------------|-----------------|
| MC74LCX14D    | SO-14           | 55 Units/Rail   |
| MC74LCX14DR2  | SO-14           | 2500 Units/Reel |
| MC74LCX14DT   | TSSOP-14        | 96 Untis/Rail   |
| MC74LCX14DTR2 | TSSOP-14        | 2500 Units/Reel |
| MC74LCX14M    | SOIC<br>EIAJ-14 | 50 Units/Rail   |
| MC74LCX14MEL  | SOIC<br>EIAJ-14 | 2000 Units/Reel |

# MC74LCX14

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



**Figure 2. Logic Diagram**



## PIN NAMES

| Pins             | Function    |
|------------------|-------------|
| $A_n$            | Data Inputs |
| $\overline{Y}_n$ | Outputs     |

## TRUTH TABLE

| Inputs | Outputs        |
|--------|----------------|
| A      | $\overline{Y}$ |
| L      | H              |
| H      | L              |

## ABSOLUTE MAXIMUM RATINGS\*

| Symbol    | Parameter                        | Value                             | Condition                              | Unit |
|-----------|----------------------------------|-----------------------------------|----------------------------------------|------|
| $V_{CC}$  | DC Supply Voltage                | -0.5 to +7.0                      |                                        | V    |
| $V_I$     | DC Input Voltage                 | $-0.5 \leq V_I \leq +7.0$         |                                        | V    |
| $V_O$     | DC Output Voltage                | $-0.5 \leq V_O \leq V_{CC} + 0.5$ | 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   |

\* Absolute maximum continuous ratings are those values beyond which damage to the device may occur. Exposure to these conditions or conditions beyond those indicated may adversely affect device reliability. Functional operation under absolute-maximum-rated conditions is not implied.

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

# MC74LCX14

## RECOMMENDED OPERATING CONDITIONS

| Symbol          | Parameter                                                                                                              | Min        | Typ        | Max              | Unit |
|-----------------|------------------------------------------------------------------------------------------------------------------------|------------|------------|------------------|------|
| V <sub>CC</sub> | Supply Voltage<br>Operating<br>Data Retention Only                                                                     | 2.0<br>1.5 | 2.5 to 3.3 | 3.6<br>3.6       | V    |
| V <sub>I</sub>  | Input Voltage                                                                                                          | 0          |            | 5.5              | V    |
| V <sub>O</sub>  | Output Voltage<br>(HIGH or LOW State)                                                                                  | 0          |            | V <sub>CC</sub>  | V    |
| I <sub>OH</sub> | HIGH Level Output Current<br>V <sub>CC</sub> = 3.0V–3.6V<br>V <sub>CC</sub> = 2.7V–3.0V<br>V <sub>CC</sub> = 2.3V–2.7V |            |            | –24<br>–12<br>–8 | mA   |
| I <sub>OL</sub> | LOW Level Output Current<br>V <sub>CC</sub> = 3.0V–3.6V<br>V <sub>CC</sub> = 2.7V–3.0V<br>V <sub>CC</sub> = 2.3V–2.7V  |            |            | +24<br>+12<br>+8 | mA   |
| T <sub>A</sub>  | Operating Free–Air Temperature                                                                                         | –40        |            | +85              | °C   |

## DC ELECTRICAL CHARACTERISTICS

| Symbol           | Characteristic                                 | Condition                                                                     | T <sub>A</sub> = – 40 to 85°C |            | Unit |
|------------------|------------------------------------------------|-------------------------------------------------------------------------------|-------------------------------|------------|------|
|                  |                                                |                                                                               | Min                           | Max        |      |
| V <sub>T+</sub>  | Positive Input Threshold Voltage<br>(Figure 3) | V <sub>CC</sub> = 2.5V<br>V <sub>CC</sub> = 3.0V                              | 0.9<br>1.2                    | 1.7<br>2.2 | V    |
| V <sub>T–</sub>  | Negative Input Threshold Voltage<br>(Figure 3) | V <sub>CC</sub> = 2.5V<br>V <sub>CC</sub> = 3.0V                              | 0.4<br>0.6                    | 1.1<br>1.5 | V    |
| V <sub>H</sub>   | Input Hysteresis Voltage<br>(Figure 3)         | V <sub>CC</sub> = 2.5V<br>V <sub>CC</sub> = 3.0V                              | 0.3<br>0.4                    | 1.0<br>1.2 | V    |
| 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 μ                      |                               | 0.2        | V    |
|                  |                                                | V <sub>CC</sub> = 2.3 V; I <sub>OL</sub> = 8 mA                               |                               | 0.3        |      |
|                  |                                                | 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>I</sub>   | Input Leakage Current                          | 2.3 V ≤ V <sub>CC</sub> ≤ 3.6 V; 0 V ≤ V <sub>I</sub> ≤ 5.5 V                 |                               | ±5.0       | μA   |
| I <sub>CC</sub>  | Quiescent Supply Current                       | 2.3 ≤ V <sub>CC</sub> ≤ 3.6 V; V <sub>I</sub> = GND or V <sub>CC</sub>        |                               | 10         | μA   |
|                  |                                                | 2.3 ≤ V <sub>CC</sub> ≤ 3.6 V; 3.6 ≤ V <sub>I</sub> or V <sub>O</sub> ≤ 5.5 V |                               | ±10        |      |
| 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   |

# MC74LCX14

## AC ELECTRICAL CHARACTERISTICS (Input $t_r = t_f = 2.5$ ns)

| Symbol                                 | Parameter                            | Waveform | Limits                          |            |                         |            |                                 |            | Unit |
|----------------------------------------|--------------------------------------|----------|---------------------------------|------------|-------------------------|------------|---------------------------------|------------|------|
|                                        |                                      |          | T <sub>A</sub> = −40°C to +85°C |            |                         |            |                                 |            |      |
|                                        |                                      |          | V <sub>CC</sub> = 3.3 V ± 0.3 V |            | V <sub>CC</sub> = 2.7 V |            | V <sub>CC</sub> = 2.5 V ± 0.2 V |            |      |
|                                        |                                      |          | C <sub>L</sub> = 50 pF          |            | C <sub>L</sub> = 50 pF  |            | C <sub>L</sub> = 30 pF          |            |      |
|                                        |                                      |          | Min                             | Max        | Min                     | Max        | Min                             | Max        |      |
| t <sub>PLH</sub><br>t <sub>PHL</sub>   | Propagation Delay<br>Input to Output | 1        | 1.5<br>1.5                      | 6.5<br>6.5 | 1.5<br>1.5              | 7.5<br>7.5 | 1.5<br>1.5                      | 7.8<br>7.8 | ns   |
| t <sub>OSHL</sub><br>t <sub>OSLH</sub> | Output-to-Output Skew<br>(Note 2.)   |          |                                 | 1.0<br>1.0 |                         |            |                                 |            | ns   |

2. 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<br>(Note 3.)   | $V_{CC} = 3.3 \text{ V}, C_L = 50 \text{ pF}, V_{IH} = 3.3 \text{ V}, V_{IL} = 0 \text{ V}$<br>$V_{CC} = 2.5 \text{ V}, C_L = 30 \text{ pF}, V_{IH} = 2.5 \text{ V}, V_{IL} = 0 \text{ V}$ |                             | 0.8<br>0.6   |     | V    |
| $V_{OLV}$ | Dynamic LOW Valley Voltage<br>(Note 3.) | $V_{CC} = 3.3 \text{ V}, C_L = 50 \text{ pF}, V_{IH} = 3.3 \text{ V}, V_{IL} = 0 \text{ V}$<br>$V_{CC} = 2.5 \text{ V}, C_L = 30 \text{ pF}, V_{IH} = 2.5 \text{ V}, V_{IL} = 0 \text{ V}$ |                             | -0.8<br>-0.6 |     | V    |

3. 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   |

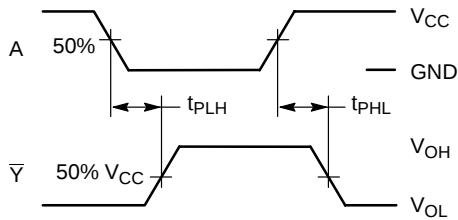
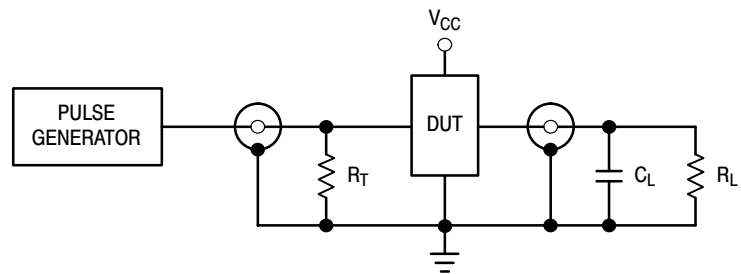


Figure 3. Switching Waveforms



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

Figure 4. Test Circuit

# MC74LCX14

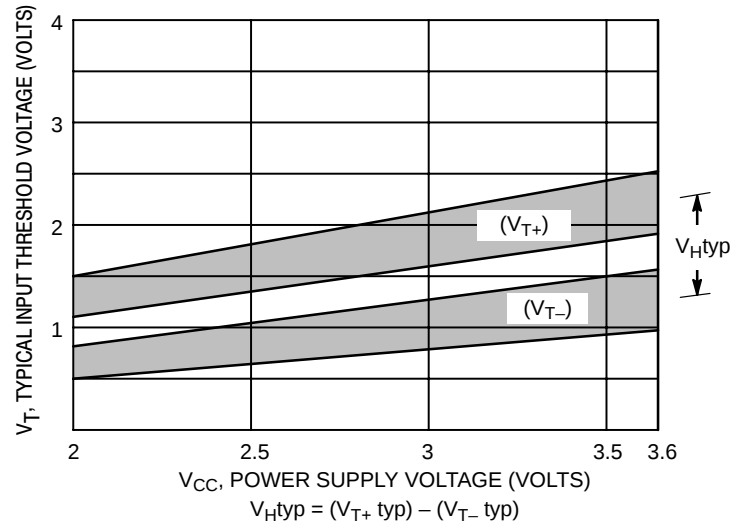
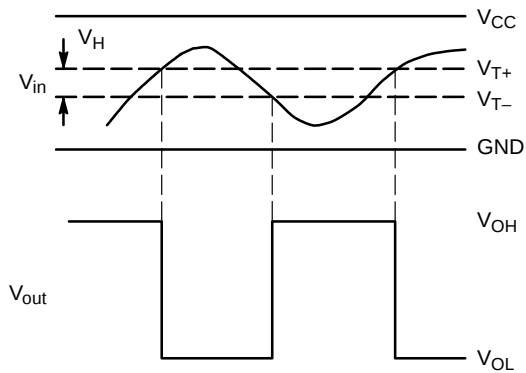


Figure 5. Typical Input Threshold,  $V_{T+}$ ,  $V_{T-}$  versus Power Supply Voltage

(a) A Schmitt-Trigger Squares Up Inputs With Slow Rise and Fall Times



(b) A Schmitt-Trigger Offers Maximum Noise Immunity

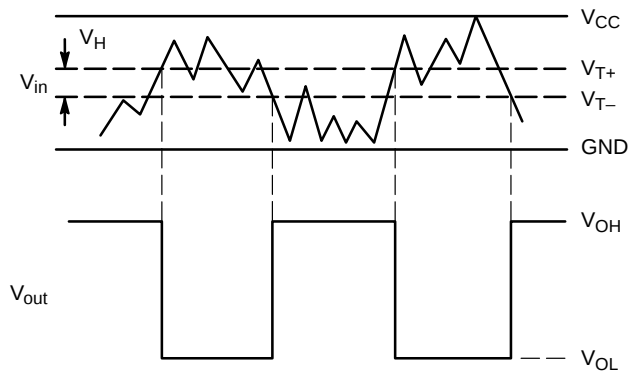


Figure 6. Typical Schmitt-Trigger Applications

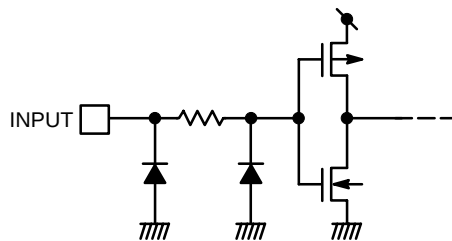
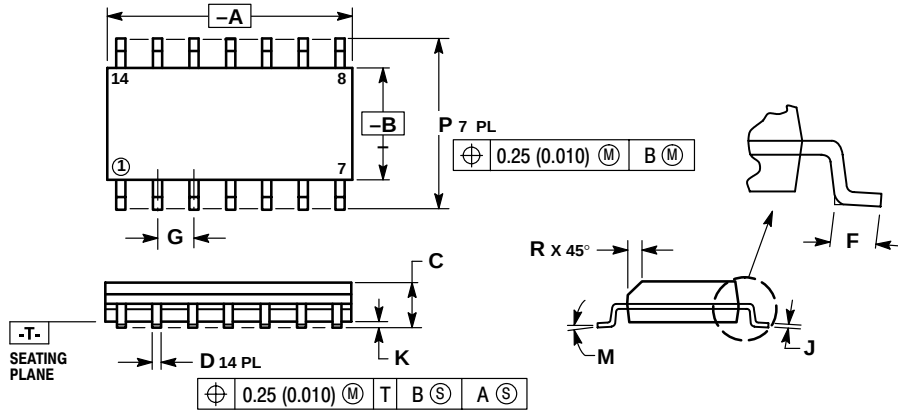


Figure 7. Input Equivalent Circuit

# MC74LCX14

## PACKAGE DIMENSIONS

SO-14  
D SUFFIX  
CASE 751A-03  
ISSUE F

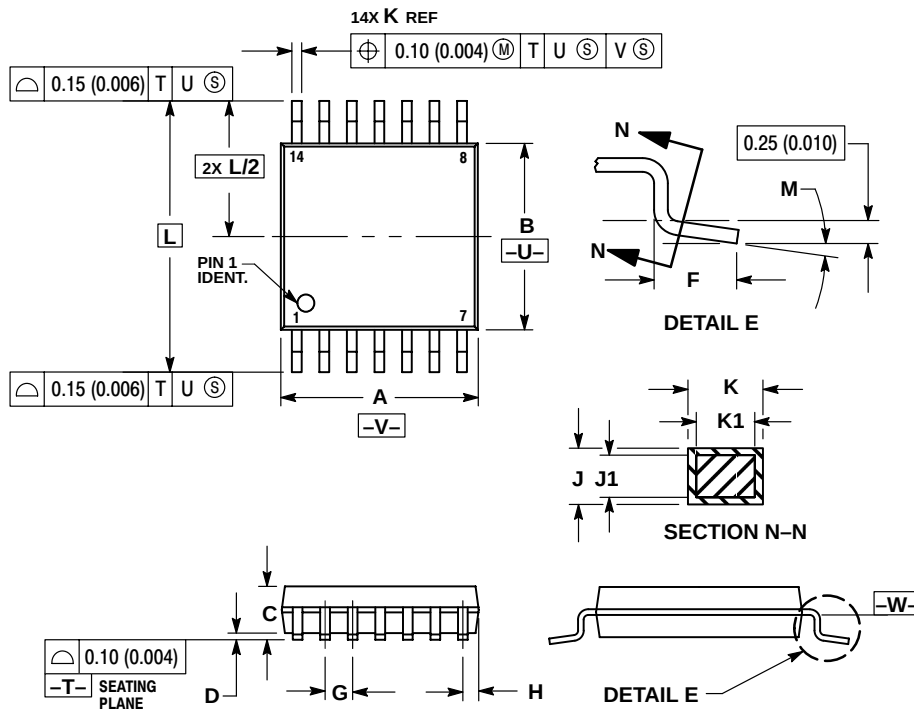


### NOTES:

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°    |

# MC74LCX14

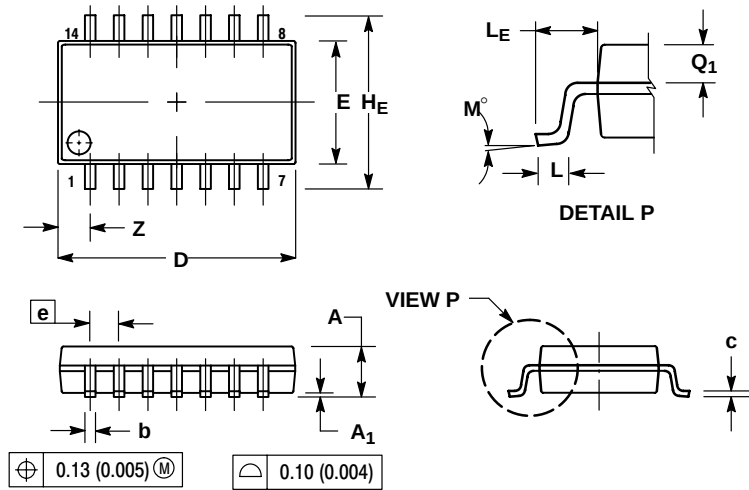
## PACKAGE DIMENSIONS

SOIC EIAJ-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 <sub>1</sub> | 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 |       |
| H <sub>E</sub> | 7.40        | 8.20  | 0.291     | 0.323 |
| L              | 0.50        | 0.85  | 0.020     | 0.033 |
| L <sub>E</sub> | 1.10        | 1.50  | 0.043     | 0.059 |
| M              | 0 °         | 10 °  | 0 °       | 10 °  |
| Q <sub>1</sub> | 0.70        | 0.90  | 0.028     | 0.035 |
| Z              | ---         | 1.42  | ---       | 0.056 |

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