

# Hex Inverter (Unbuffered) MC74LVXU04

The MC74LVXU04 is an advanced high speed CMOS unbuffered hex inverter. The inputs tolerate voltages up to 6.5 V, allowing the interface of 5.0 V systems to 3.0 V systems.

## Features

- High Speed:  $t_{PD} = 4.1$  ns (Typ) at  $V_{CC} = 3.3$  V
- Low Power Dissipation:  $I_{CC} = 2$   $\mu$ A (Max) at  $T_A = 25^\circ\text{C}$
- Power Down Protection Provided on Inputs
- Balanced Propagation Delays
- Low Noise:  $V_{OLP} = 0.5$  V (Max)
- Pin and Function Compatible with Other Standard Logic Families
- These Devices are Pb-Free and are RoHS Compliant

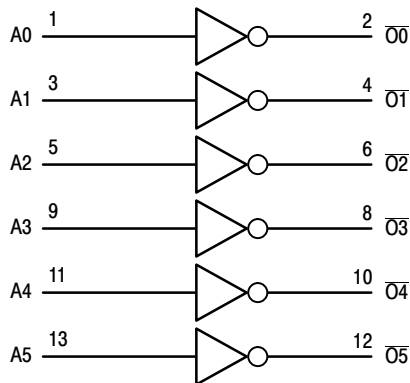


Figure 1. Logic Diagram

## PIN NAMES

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

## FUNCTION TABLE

| $A_n$ | $\overline{O_n}$ |
|-------|------------------|
| L     | H                |
| H     | L                |

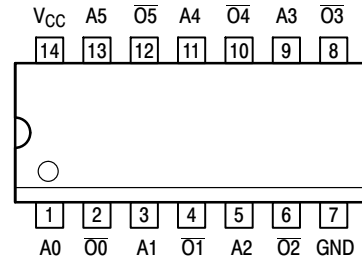


SOIC-14 NB  
D SUFFIX  
CASE 751A



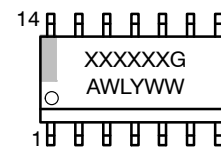
TSSOP-14  
DT SUFFIX  
CASE 948G

## PIN ASSIGNMENT

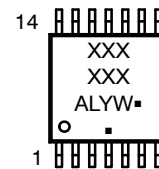


14-Lead (Top View)

## MARKING DIAGRAMS



SOIC-14 NB



TSSOP-14

XXXXXX = Specific Device Code

A = Assembly Location

WL, L = Wafer Lot

Y = Year

WW, W = Work Week

G or ■ = Pb-Free Package

(Note: Microdot may be in either location)

## ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 4 of this data sheet.

# MC74LVXU04

## MAXIMUM RATINGS

| Symbol        | Parameter                                                                           | Value                  | Unit |
|---------------|-------------------------------------------------------------------------------------|------------------------|------|
| $V_{CC}$      | DC Supply Voltage                                                                   | -0.5 to +6.5           | V    |
| $V_{IN}$      | DC Input Voltage                                                                    | -0.5 to +6.5           | V    |
| $V_{OUT}$     | DC Output Voltage                                                                   | -0.5 to $V_{CC} + 0.5$ | V    |
| $I_{IK}$      | DC Input Diode Current<br>$V_I < GND$                                               | -20                    | mA   |
| $I_{OK}$      | DC Output Diode Current<br>$V_O < GND$                                              | $\pm 20$               | mA   |
| $I_{OUT}$     | DC Output Sink Current                                                              | $\pm 25$               | mA   |
| $I_{CC}$      | DC Supply Current per Supply Pin                                                    | $\pm 50$               | mA   |
| $T_{STG}$     | Storage Temperature Range                                                           | -65 to +150            | °C   |
| $T_L$         | Lead Temperature, 1 mm from Case for 10 Seconds                                     | 260                    | °C   |
| $T_J$         | Junction Temperature under Bias                                                     | +150                   | °C   |
| $\theta_{JA}$ | Thermal Resistance<br>SOIC<br>TSSOP                                                 | 116<br>150             | °C/W |
| $P_D$         | Power Dissipation in Still Air at 25°C<br>SOIC<br>TSSOP                             | 1077<br>833            | mW   |
| MSL           | Moisture Sensitivity                                                                | Level 1                |      |
| $F_R$         | Flammability Rating<br>Oxygen Index: 30% – 35%                                      | UL 94-V0 @ 0.125 in    |      |
| $V_{ESD}$     | ESD Withstand Voltage<br>Human Body Model (Note 1)<br>Charged Device Model (Note 2) | > 2000<br>2000         | V    |
| $I_{Latchup}$ | Latchup Performance<br>Above $V_{CC}$ and Below GND at 85°C (Note 3)                | $\pm 300$              | mA   |

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Tested to EIA/JESD22-A114-A.
2. Tested to JESD22-C101-A.
3. Tested to EIA/JESD78.

## RECOMMENDED OPERATING CONDITIONS

| Symbol              | Parameter                                                                      | Min | Max      | Unit |
|---------------------|--------------------------------------------------------------------------------|-----|----------|------|
| $V_{CC}$            | Supply Voltage                                                                 | 2.0 | 3.6      | V    |
| $V_I$               | Input Voltage (Note 4)                                                         | 0   | 5.5      | V    |
| $V_O$               | Output Voltage (HIGH or LOW State)                                             | 0   | $V_{CC}$ | V    |
| $T_A$               | Operating Free-Air Temperature                                                 | -40 | +85      | °C   |
| $\Delta t/\Delta V$ | Input Transition Rise or Fall Rate<br>$V_{CC} = 3.0\text{ V} \pm 0.3\text{ V}$ | 0   | 100      | ns/V |

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

4. Unused inputs may not be left open. All inputs must be tied to a high- or low-logic input voltage level.

# MC74LVXU04

## DC ELECTRICAL CHARACTERISTICS

| Symbol          | Parameter                                                                            | Test Conditions                                                                 | V <sub>CC</sub><br>V | T <sub>A</sub> = 25°C |            |                    | T <sub>A</sub> = -40 to 85°C |                    | Unit |
|-----------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|----------------------|-----------------------|------------|--------------------|------------------------------|--------------------|------|
|                 |                                                                                      |                                                                                 |                      | Min                   | Typ        | Max                | Min                          | Max                |      |
| V <sub>IH</sub> | High-Level Input Voltage                                                             |                                                                                 | 2.0<br>3.0<br>3.6    | 1.5<br>2.0<br>2.4     |            |                    | 1.5<br>2.0<br>2.4            |                    | V    |
| V <sub>IL</sub> | Low-Level Input Voltage                                                              |                                                                                 | 2.0<br>3.0<br>3.6    |                       |            | 0.5<br>0.8<br>0.8  |                              | 0.5<br>0.8<br>0.8  | V    |
| V <sub>OH</sub> | High-Level Output Voltage<br>(V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub> ) | I <sub>OH</sub> = -50 µA<br>I <sub>OH</sub> = -50 µA<br>I <sub>OH</sub> = -4 mA | 2.0<br>3.0<br>3.0    | 1.9<br>2.9<br>2.58    | 2.0<br>3.0 |                    | 1.9<br>2.9<br>2.48           |                    | V    |
| V <sub>OL</sub> | Low-Level Output Voltage<br>(V <sub>in</sub> = V <sub>IH</sub> or V <sub>IL</sub> )  | I <sub>OL</sub> = 50 µA<br>I <sub>OL</sub> = 50 µA<br>I <sub>OL</sub> = 4 mA    | 2.0<br>3.0<br>3.0    |                       | 0.0<br>0.0 | 0.1<br>0.1<br>0.36 |                              | 0.1<br>0.1<br>0.44 | V    |
| I <sub>in</sub> | Input Leakage Current                                                                | V <sub>in</sub> = 5.5 V or GND                                                  | 3.6                  |                       |            | ±0.1               |                              | ±1.0               | µA   |
| I <sub>CC</sub> | Quiescent Supply Current                                                             | V <sub>in</sub> = V <sub>CC</sub> or GND                                        | 3.6                  |                       |            | 2.0                |                              | 20.0               | µA   |

## AC ELECTRICAL CHARACTERISTICS (Input t<sub>r</sub> = t<sub>f</sub> = 3.0ns)

| Symbol                                   | Parameter                          | Test Conditions                                     | T <sub>A</sub> = 25°C |     |      | T <sub>A</sub> = -40 to 85°C |      | Unit |
|------------------------------------------|------------------------------------|-----------------------------------------------------|-----------------------|-----|------|------------------------------|------|------|
|                                          |                                    |                                                     | Min                   | Typ | Max  | Min                          | Max  |      |
| t <sub>PLH</sub> ,<br>t <sub>PHL</sub>   | Propagation Delay, Input to Output | V <sub>CC</sub> = 2.7V C <sub>L</sub> = 15 pF       |                       | 5.4 | 10.1 | 1.0                          | 12.5 | ns   |
|                                          |                                    | C <sub>L</sub> = 50 pF                              |                       | 7.9 | 13.6 | 1.0                          | 16.0 |      |
|                                          |                                    | V <sub>CC</sub> = 3.3 ± 0.3V C <sub>L</sub> = 15 pF |                       | 4.1 | 6.2  | 1.0                          | 7.5  |      |
|                                          |                                    | C <sub>L</sub> = 50 pF                              |                       | 6.6 | 9.7  | 1.0                          | 11.0 |      |
| t <sub>OSSL</sub> ,<br>t <sub>OSLH</sub> | Output-to-Output Skew<br>(Note 5)  | V <sub>CC</sub> = 2.7V C <sub>L</sub> = 50 pF       |                       |     | 1.5  |                              | 1.5  | ns   |
|                                          |                                    | V <sub>CC</sub> = 3.3 ± 0.3V C <sub>L</sub> = 50 pF |                       |     | 1.5  |                              | 1.5  |      |

5. 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>OSSL</sub>) or LOW-to-HIGH (t<sub>OSLH</sub>); parameter guaranteed by design.

## CAPACITIVE CHARACTERISTICS

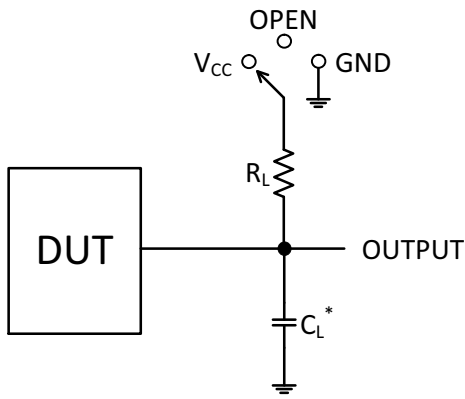
| Symbol          | Parameter                              | T <sub>A</sub> = 25°C |     |     | T <sub>A</sub> = -40 to 85°C |     | Unit |
|-----------------|----------------------------------------|-----------------------|-----|-----|------------------------------|-----|------|
|                 |                                        | Min                   | Typ | Max | Min                          | Max |      |
| C <sub>in</sub> | Input Capacitance                      |                       | 4   | 10  |                              | 10  | pF   |
| C <sub>PD</sub> | Power Dissipation Capacitance (Note 6) |                       | 18  |     |                              |     | pF   |

6. C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation: I<sub>CC(OPR)</sub> = C<sub>PD</sub> • V<sub>CC</sub> • f<sub>in</sub> + I<sub>CC</sub>/6 (per buffer). C<sub>PD</sub> is used to determine the no-load dynamic power consumption; P<sub>D</sub> = C<sub>PD</sub> • V<sub>CC</sub><sup>2</sup> • f<sub>in</sub> + I<sub>CC</sub> • V<sub>CC</sub>.

## NOISE CHARACTERISTICS (Input t<sub>r</sub> = t<sub>f</sub> = 3.0 ns, C<sub>L</sub> = 50 pF, V<sub>CC</sub> = 3.3 V, Measured in SOIC Package)

| Symbol           | Characteristic                               | T <sub>A</sub> = 25°C |      | Unit |
|------------------|----------------------------------------------|-----------------------|------|------|
|                  |                                              | Typ                   | Max  |      |
| V <sub>OLP</sub> | Quiet Output Maximum Dynamic V <sub>OL</sub> | 0.3                   | 0.5  | V    |
| V <sub>OLV</sub> | Quiet Output Minimum Dynamic V <sub>OL</sub> | -0.3                  | -0.5 | V    |
| V <sub>IHD</sub> | Minimum High Level Dynamic Input Voltage     |                       | 2.0  | V    |
| V <sub>ILD</sub> | Maximum Low Level Dynamic Input Voltage      |                       | 0.8  | V    |

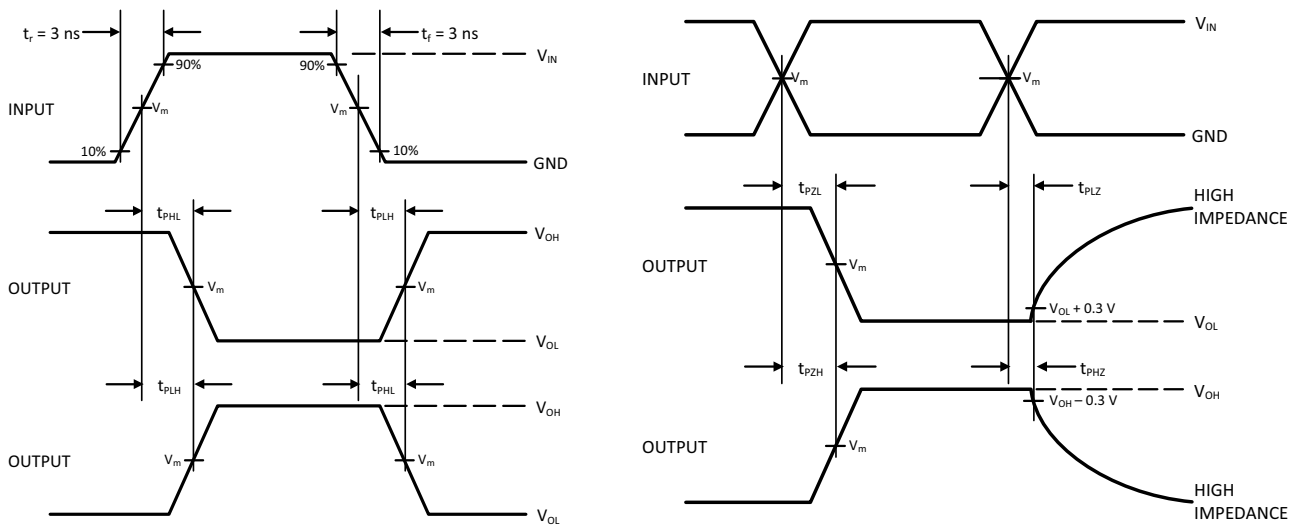
## MC74LVXU04



\*C<sub>L</sub> Includes probe and jig capacitance

| Test                                | Switch Position | C <sub>L</sub>               | R <sub>L</sub> |
|-------------------------------------|-----------------|------------------------------|----------------|
| t <sub>PLH</sub> / t <sub>PHL</sub> | Open            | See AC Characteristics Table | 1 kΩ           |
| t <sub>PLZ</sub> / t <sub>PZL</sub> | V <sub>CC</sub> |                              |                |
| t <sub>PHZ</sub> / t <sub>PZH</sub> | GND             |                              |                |

Figure 2. Test Circuit



| Device     | V <sub>IN</sub> , V | V <sub>m</sub> , V    |
|------------|---------------------|-----------------------|
| MC74LVXU04 | V <sub>CC</sub>     | 50% x V <sub>CC</sub> |

Figure 3. Switching Waveforms

### ORDERING INFORMATION

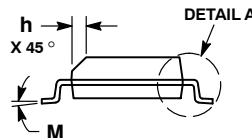
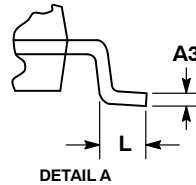
| Device          | Marking    | Package                 | Shipping <sup>†</sup> |
|-----------------|------------|-------------------------|-----------------------|
| MC74LVXU04DR2G  | LVXU04     | SOIC-14 NB<br>(Pb-Free) | 2500 Tape & Reel      |
| MC74LVXU04DTR2G | LVX<br>U04 | TSSOP-14<br>(Pb-Free)   | 2500 Tape & Reel      |

<sup>†</sup>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.



SOIC-14 NB  
CASE 751A-03  
ISSUE L

DATE 03 FEB 2016

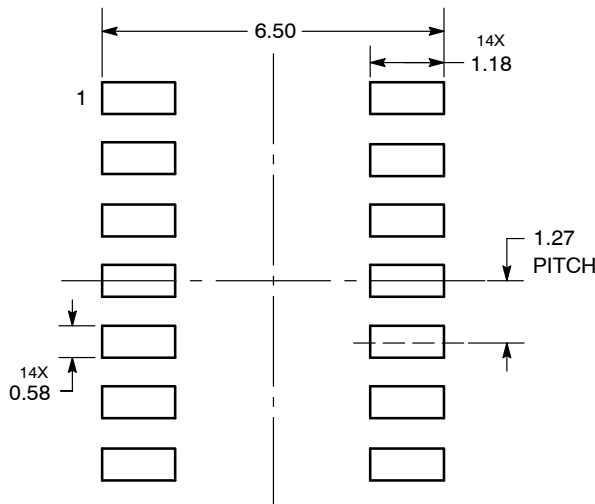


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF AT MAXIMUM MATERIAL CONDITION.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSIONS.
5. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.

| DIM | MILLIMETERS |      | INCHES    |       |
|-----|-------------|------|-----------|-------|
|     | MIN         | MAX  | MIN       | MAX   |
| A   | 1.35        | 1.75 | 0.054     | 0.068 |
| A1  | 0.10        | 0.25 | 0.004     | 0.010 |
| A3  | 0.19        | 0.25 | 0.008     | 0.010 |
| b   | 0.35        | 0.49 | 0.014     | 0.019 |
| D   | 8.55        | 8.75 | 0.337     | 0.344 |
| E   | 3.80        | 4.00 | 0.150     | 0.157 |
| e   | 1.27 BSC    |      | 0.050 BSC |       |
| H   | 5.80        | 6.20 | 0.228     | 0.244 |
| h   | 0.25        | 0.50 | 0.010     | 0.019 |
| L   | 0.40        | 1.25 | 0.016     | 0.049 |
| M   | 0°          | 7°   | 0°        | 7°    |

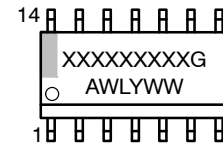
SOLDERING FOOTPRINT\*



DIMENSIONS: MILLIMETERS

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

GENERIC  
MARKING DIAGRAM\*



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

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

STYLES ON PAGE 2

|                  |             |                                                                                                                                                                                     |
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SOIC-14  
CASE 751A-03  
ISSUE L

DATE 03 FEB 2016

STYLE 1:  
PIN 1. COMMON CATHODE  
2. ANODE/CATHODE  
3. ANODE/CATHODE  
4. NO CONNECTION  
5. ANODE/CATHODE  
6. NO CONNECTION  
7. ANODE/CATHODE  
8. ANODE/CATHODE  
9. ANODE/CATHODE  
10. NO CONNECTION  
11. ANODE/CATHODE  
12. ANODE/CATHODE  
13. NO CONNECTION  
14. COMMON ANODE

STYLE 2:  
CANCELLED

STYLE 3:  
PIN 1. NO CONNECTION  
2. ANODE  
3. ANODE  
4. NO CONNECTION  
5. ANODE  
6. NO CONNECTION  
7. ANODE  
8. ANODE  
9. ANODE  
10. NO CONNECTION  
11. ANODE  
12. ANODE  
13. NO CONNECTION  
14. COMMON CATHODE

STYLE 4:  
PIN 1. NO CONNECTION  
2. CATHODE  
3. CATHODE  
4. NO CONNECTION  
5. CATHODE  
6. NO CONNECTION  
7. CATHODE  
8. CATHODE  
9. CATHODE  
10. NO CONNECTION  
11. CATHODE  
12. CATHODE  
13. NO CONNECTION  
14. COMMON ANODE

STYLE 5:  
PIN 1. COMMON CATHODE  
2. ANODE/CATHODE  
3. ANODE/CATHODE  
4. ANODE/CATHODE  
5. ANODE/CATHODE  
6. NO CONNECTION  
7. COMMON ANODE  
8. COMMON CATHODE  
9. ANODE/CATHODE  
10. ANODE/CATHODE  
11. ANODE/CATHODE  
12. ANODE/CATHODE  
13. NO CONNECTION  
14. COMMON ANODE

STYLE 6:  
PIN 1. CATHODE  
2. CATHODE  
3. CATHODE  
4. CATHODE  
5. CATHODE  
6. CATHODE  
7. CATHODE  
8. ANODE  
9. ANODE  
10. ANODE  
11. ANODE  
12. ANODE  
13. ANODE  
14. ANODE

STYLE 7:  
PIN 1. ANODE/CATHODE  
2. COMMON ANODE  
3. COMMON CATHODE  
4. ANODE/CATHODE  
5. ANODE/CATHODE  
6. ANODE/CATHODE  
7. ANODE/CATHODE  
8. ANODE/CATHODE  
9. ANODE/CATHODE  
10. ANODE/CATHODE  
11. COMMON CATHODE  
12. COMMON ANODE  
13. ANODE/CATHODE  
14. ANODE/CATHODE

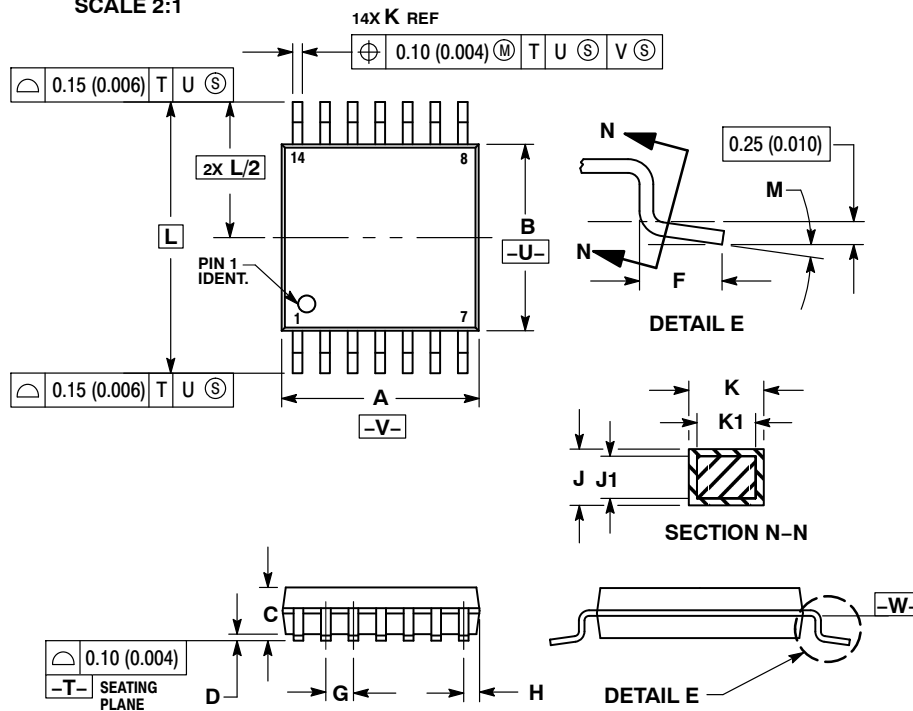
STYLE 8:  
PIN 1. COMMON CATHODE  
2. ANODE/CATHODE  
3. ANODE/CATHODE  
4. NO CONNECTION  
5. ANODE/CATHODE  
6. ANODE/CATHODE  
7. COMMON ANODE  
8. COMMON ANODE  
9. ANODE/CATHODE  
10. ANODE/CATHODE  
11. NO CONNECTION  
12. ANODE/CATHODE  
13. ANODE/CATHODE  
14. COMMON CATHODE

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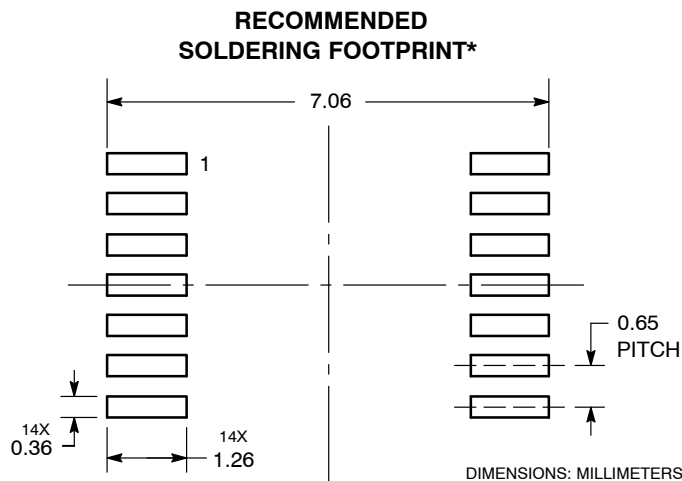

**TSSOP-14 WB**  
**CASE 948G**  
**ISSUE C**

DATE 17 FEB 2016


**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°    |



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

A = Assembly Location  
L = Wafer Lot  
Y = Year  
W = Work Week  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

\*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

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