

# Hex Buffer

## MC74VHC50

The MC74VHC50 is an advanced high speed CMOS buffer fabricated with silicon gate CMOS technology.

The internal circuit is composed of three stages, including a buffered output which provides high noise immunity and stable output. The inputs tolerate voltages up to 7 V, allowing the interface of 5 V systems to 3 V systems.

### Features

- High Speed:  $t_{PD} = 3.8 \text{ ns}$  (Typ) at  $V_{CC} = 5 \text{ V}$
- Low Power Dissipation:  $I_{CC} = 2 \mu\text{A}$  (Max) at  $T_A = 25^\circ\text{C}$
- High Noise Immunity:  $V_{NIH} = V_{NIL} = 28\% V_{CC}$
- Power Down Protection Provided on Inputs
- Balanced Propagation Delays
- Designed for 2 V to 5.5 V Operating Range
- Low Noise:  $V_{OLP} = 0.8 \text{ V}$  (Max)
- NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable\*
- These Devices are Pb-Free and are RoHS Compliant

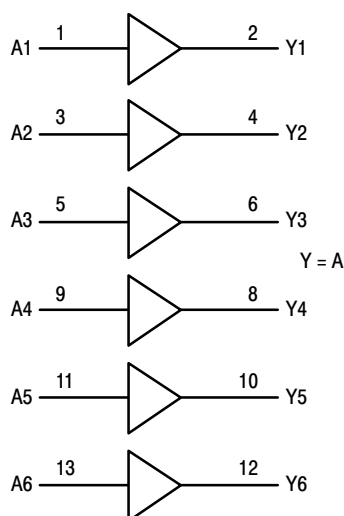


Figure 1. Logic Diagram

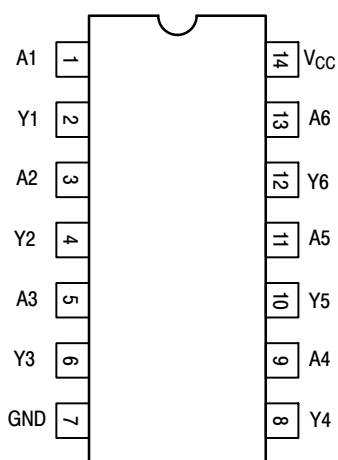
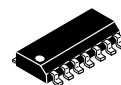
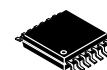


Figure 2. Pinout:  
14-Lead Packages  
(Top View)

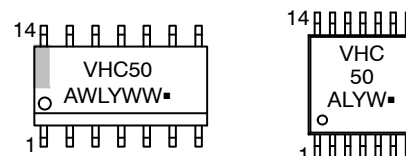


14-LEAD SOIC  
D SUFFIX  
CASE 751A



14-LEAD TSSOP  
DT SUFFIX  
CASE 948G

### MARKING DIAGRAM



A = Assembly Location  
 WL, L = Wafer Lot  
 Y = Year  
 WW, W = Work Week  
 ■ = Pb-Free Package

### FUNCTION TABLE

| A Input | Y Output |
|---------|----------|
| L       | L        |
| H       | H        |

### ORDERING INFORMATION

| Device           | Package            | Shipping <sup>†</sup> |
|------------------|--------------------|-----------------------|
| MC74VHC50DG      | SOIC-14 (Pb-Free)  | 55 Units / Tube       |
| MC74VHC50DR2G    | SOIC-14 (Pb-Free)  | 2500 / Tape & Reel    |
| MC74VHC50DTR2G   | TSSOP-14 (Pb-Free) | 2500 / Tape & Reel    |
| NLV74VHC50DTR2G* | TSSOP-14 (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](http://BRD8011/D).

# MC74VHC50

## MAXIMUM RATINGS

| Symbol         | Parameter                                                                                                  | Value                   | Unit |
|----------------|------------------------------------------------------------------------------------------------------------|-------------------------|------|
| $V_{CC}$       | DC Supply Voltage                                                                                          | − 0.5 to + 7.0          | V    |
| $V_{IN}$       | DC Input Voltage                                                                                           | − 0.5 to + 7.0          | V    |
| $V_{OUT}$      | DC Output Voltage                                                                                          | − 0.5 to $V_{CC} + 0.5$ | V    |
| $I_{IK}$       | DC Input Diode Current $V_I < GND$                                                                         | − 20                    | mA   |
| $I_{OK}$       | DC Output Diode Current $V_O < GND$                                                                        | ± 20                    | mA   |
| $I_{OUT}$      | DC Output Sink Current                                                                                     | ± 25                    | mA   |
| $I_{CC}$       | DC Supply Current per Supply Pin                                                                           | ± 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 (Note 1)<br>SOIC<br>TSSOP                                                               | 125<br>170              | °C/W |
| MSL            | Moisture Sensitivity                                                                                       | Level 1                 |      |
| $F_R$          | Flammability Rating Oxygen Index: 30 to 35                                                                 | UL 94 V-0 @ 0.125 in    |      |
| $V_{ESD}$      | ESD Withstand Voltage Human Body Model (Note 2)<br>Machine Model (Note 3)<br>Charged Device Model (Note 4) | > 2000<br>> 200<br>2000 | V    |
| $I_{Latch-Up}$ | Latch-Up Performance Above $V_{CC}$ and Below GND at 85°C (Note 5)                                         | ± 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. Measured with minimum pad spacing on an FR4 board, using 10 mm-by-1 inch, 2-ounce copper trace with no air flow.
2. Tested to EIA/JESD22-A114-A.
3. Tested to EIA/JESD22-A115-A.
4. Tested to JESD22-C101-A.
5. Tested to EIA/JESD78.

## RECOMMENDED OPERATING CONDITIONS

| Symbol              | Parameter                                                                                                               | Min    | Max       | Unit |
|---------------------|-------------------------------------------------------------------------------------------------------------------------|--------|-----------|------|
| $V_{CC}$            | Supply Voltage                                                                                                          | 2.0    | 5.5       | V    |
| $V_I$               | Input Voltage (Note 6)                                                                                                  | 0      | 5.5       | V    |
| $V_O$               | Output Voltage (HIGH or LOW State)                                                                                      | 0      | $V_{CC}$  | V    |
| $T_A$               | Operating Free-Air Temperature                                                                                          | − 55   | + 125     | °C   |
| $\Delta t/\Delta V$ | Input Transition Rise or Fall Rate $V_{CC} = 3.0\text{ V} \pm 0.3\text{ V}$<br>$V_{CC} = 5.0\text{ V} \pm 0.5\text{ V}$ | 0<br>0 | 100<br>20 | ns/V |

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

NOTE: The  $\theta_{JA}$  of the package is equal to 1/Derating. Higher junction temperatures may affect the expected lifetime of the device per the table and figure below.

# MC74VHC50

## DC ELECTRICAL CHARACTERISTICS

| Symbol          | Parameter                         | Test Conditions                                                                                            | V <sub>CC</sub><br>(V)   | T <sub>A</sub> = 25°C      |                   |                            | T <sub>A</sub> ≤ 85°C      |                            | T <sub>A</sub> ≤ 125°C     |                            | Unit |
|-----------------|-----------------------------------|------------------------------------------------------------------------------------------------------------|--------------------------|----------------------------|-------------------|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|------|
|                 |                                   |                                                                                                            |                          | Min                        | Typ               | Max                        | Min                        | Max                        | Min                        | Max                        |      |
| V <sub>IH</sub> | Minimum High-Level Input Voltage  |                                                                                                            | 2.0<br>3.0<br>4.5<br>5.5 | 1.5<br>2.0<br>3.15<br>3.85 |                   |                            | 1.5<br>2.0<br>3.15<br>3.85 |                            | 1.5<br>2.0<br>3.15<br>3.85 |                            | V    |
| V <sub>IL</sub> | Maximum Low-Level Input Voltage   |                                                                                                            | 2.0<br>3.0<br>4.5<br>5.5 |                            |                   | 0.5<br>0.9<br>1.35<br>1.65 |                            | 0.5<br>0.9<br>1.35<br>1.65 |                            | 0.5<br>0.9<br>1.35<br>1.65 | V    |
| V <sub>OH</sub> | Minimum High-Level Output Voltage | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>I <sub>OH</sub> = -50 µA                           | 2.0<br>3.0<br>4.5        | 1.9<br>2.9<br>4.4          | 2.0<br>3.0<br>4.5 |                            | 1.9<br>2.9<br>4.4          |                            | 1.9<br>2.9<br>4.4          |                            | V    |
|                 |                                   | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>I <sub>OH</sub> = -4 mA<br>I <sub>OH</sub> = -8 mA | 3.0<br>4.5               | 2.58<br>3.94               |                   |                            | 2.48<br>3.80               |                            | 2.34<br>3.66               |                            | V    |
| V <sub>OL</sub> | Maximum Low-Level Output Voltage  | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>I <sub>OL</sub> = 50 µA                            | 2.0<br>3.0<br>4.5        |                            | 0.0<br>0.0<br>0.0 | 0.1<br>0.1<br>0.1          |                            | 0.1<br>0.1<br>0.1          |                            | 0.1<br>0.1<br>0.1          | V    |
|                 |                                   | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>I <sub>OL</sub> = 4 mA<br>I <sub>OL</sub> = 8 mA   | 3.0<br>4.5               |                            |                   | 0.36<br>0.36               |                            | 0.44<br>0.44               |                            | 0.52<br>0.52               | V    |
| I <sub>IN</sub> | Maximum Input Leakage Current     | V <sub>IN</sub> = 5.5 V or GND                                                                             | 0 to 5.5                 |                            |                   | ±0.1                       |                            | ±1.0                       |                            | ±1.0                       | µA   |
| I <sub>CC</sub> | Maximum Quiescent Supply Current  | V <sub>IN</sub> = V <sub>CC</sub> or GND                                                                   | 5.5                      |                            |                   | 2.0                        |                            | 20                         |                            | 40                         | µA   |

## AC ELECTRICAL CHARACTERISTICS (C<sub>load</sub> = 50 pF, Input t<sub>r</sub> = t<sub>f</sub> = 3.0 ns)

| Symbol                                 | Parameter                               | Test Conditions                                                                   | T <sub>A</sub> = 25°C |            |             | T <sub>A</sub> ≤ 85°C |             | T <sub>A</sub> ≤ 125°C |              | Unit |
|----------------------------------------|-----------------------------------------|-----------------------------------------------------------------------------------|-----------------------|------------|-------------|-----------------------|-------------|------------------------|--------------|------|
|                                        |                                         |                                                                                   | Min                   | Typ        | Max         | Min                   | Max         | Min                    | Max          |      |
| t <sub>PLH</sub> ,<br>t <sub>PHL</sub> | Maximum Propagation Delay, Input A to Y | V <sub>CC</sub> = 3.0 ± 0.3 V    C <sub>L</sub> = 15 pF<br>C <sub>L</sub> = 50 pF |                       | 5.0<br>7.5 | 7.1<br>10.6 |                       | 8.5<br>12.0 |                        | 10.0<br>14.5 | ns   |
|                                        |                                         | V <sub>CC</sub> = 5.0 ± 0.5 V    C <sub>L</sub> = 15 pF<br>C <sub>L</sub> = 50 pF |                       | 3.8<br>5.3 | 5.5<br>7.5  |                       | 6.5<br>8.5  |                        | 8.0<br>10.0  |      |
| C <sub>IN</sub>                        | Maximum Input Capacitance               |                                                                                   |                       | 4          | 10          |                       | 10          |                        | 10           | pF   |

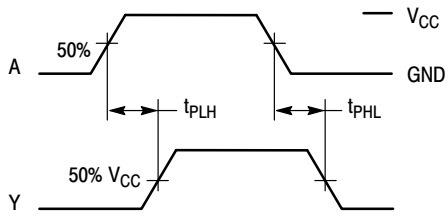
|                 |                                        |                                         |    |
|-----------------|----------------------------------------|-----------------------------------------|----|
| C <sub>PD</sub> | Power Dissipation Capacitance (Note 7) | Typical @ 25°C, V <sub>CC</sub> = 5.0 V | pF |
|                 |                                        | 18                                      |    |

7. 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>. 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>.

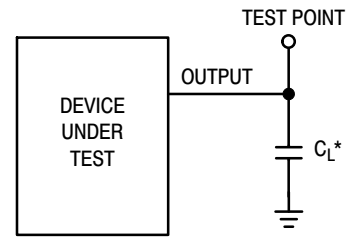
## NOISE CHARACTERISTICS (Input t<sub>r</sub> = t<sub>f</sub> = 3.0 ns, C<sub>L</sub> = 50 pF, V<sub>CC</sub> = 5.0 V)

| Symbol           | Characteristic                               | T <sub>A</sub> = 25°C |      | Unit |
|------------------|----------------------------------------------|-----------------------|------|------|
|                  |                                              | Typ                   | Max  |      |
| V <sub>OLP</sub> | Quiet Output Maximum Dynamic V <sub>OL</sub> | 0.8                   | 1.0  | V    |
| V <sub>OLV</sub> | Quiet Output Minimum Dynamic V <sub>OL</sub> | -0.8                  | -1.0 | V    |
| V <sub>IHD</sub> | Minimum High Level Dynamic Input Voltage     |                       | 3.5  | V    |
| V <sub>ILD</sub> | Maximum Low Level Dynamic Input Voltage      |                       | 1.5  | V    |

# MC74VHC50

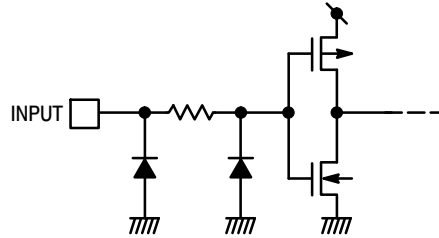


**Figure 3. Switching Waveforms**



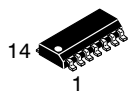
\*Includes all probe and jig capacitance

**Figure 4. Test Circuit**



**Figure 5. Input Equivalent Circuit**

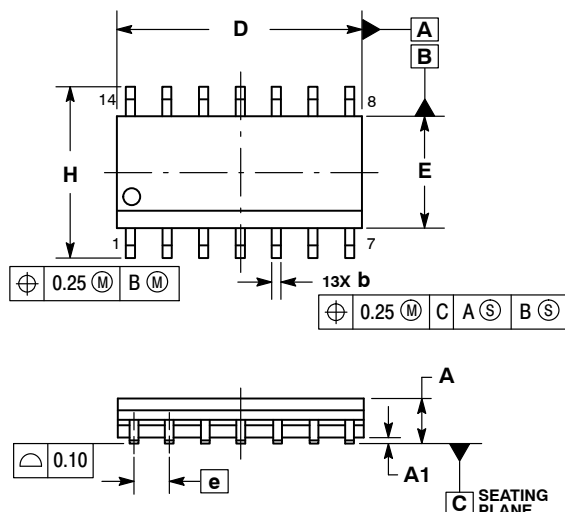
# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



SCALE 1:1

SOIC-14 NB  
CASE 751A-03  
ISSUE L

DATE 03 FEB 2016

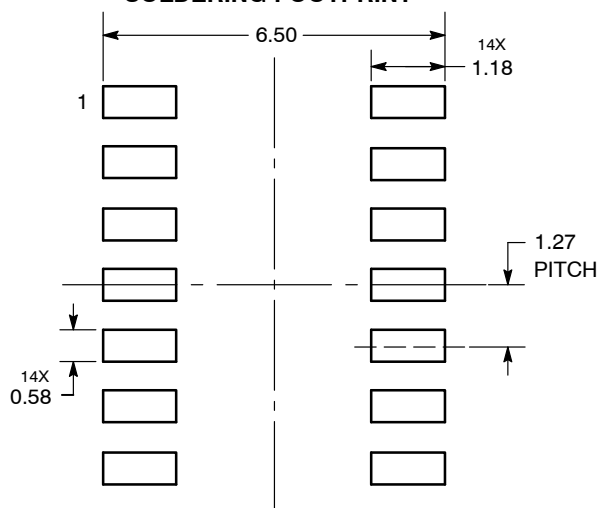


## NOTES:

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°    |

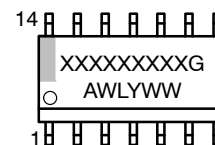
## SOLDERING FOOTPRINT\*



DIMENSIONS: MILLIMETERS

\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor 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

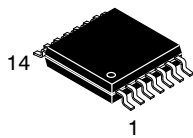
STYLE 7:  
PIN 1. ANODE/CATHODE  
2. COMMON ANODE  
3. COMMON CATHODE  
4. ANODE/CATHODE  
5. ANODE/CATHODE  
6. ANODE/CATHODE  
7. ANODE/CATHODE  
8. ANODE/CATHODE  
9. ANODE/CATHODE  
10. ANODE/CATHODE  
11. COMMON CATHODE  
12. COMMON ANODE  
13. ANODE/CATHODE  
14. ANODE/CATHODE

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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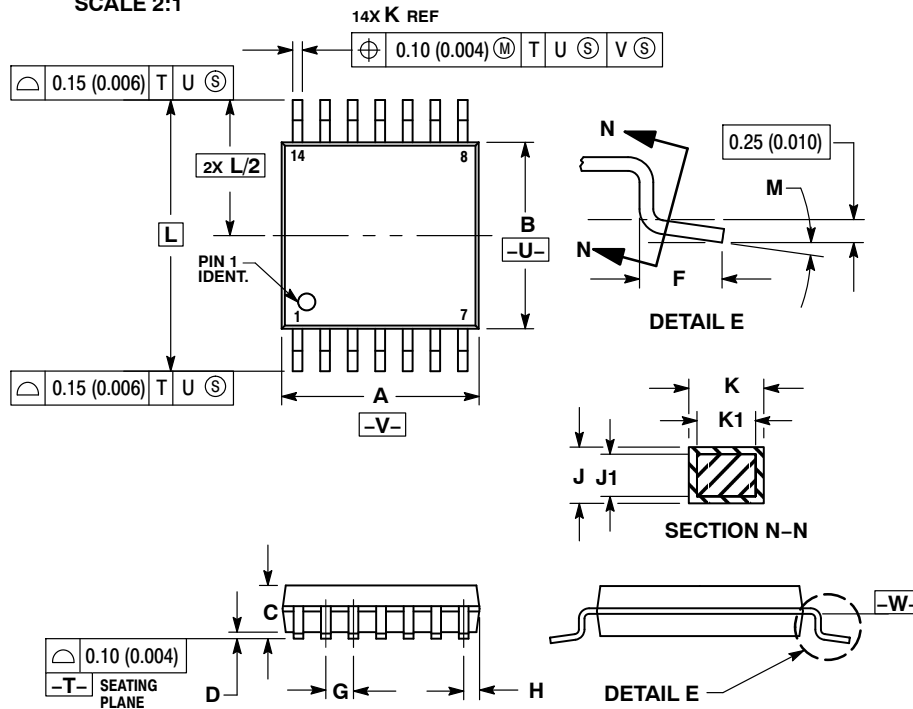
# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



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

DATE 17 FEB 2016

SCALE 2:1

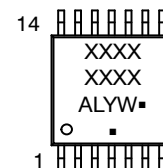


## NOTES:

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°    |

## GENERIC MARKING DIAGRAM\*

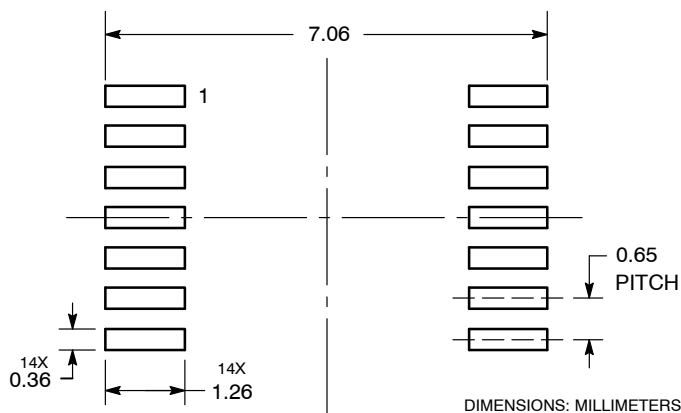


- A = Assembly Location  
L = Wafer Lot  
Y = Year  
W = Work Week  
▪ = Pb-Free Package

(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.

## SOLDERING FOOTPRINT



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DESCRIPTION: TSSOP-14 WB

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