

# MC74VHCU04

## Hex Inverter (Unbuffered)

The MC74VHCU04 is an advanced high speed CMOS unbuffered inverter fabricated with silicon gate CMOS technology. It achieves high speed operation similar to equivalent Bipolar Schottky TTL while maintaining CMOS low power dissipation.

The inputs tolerate voltages up to 7.0 V, allowing the interface of 5.0 V systems to 3.0 V systems.

### Features

- High Speed:  $t_{PD} = 3.5$  ns (Typ) at  $V_{CC} = 5.0$  V
- Low Power Dissipation:  $I_{CC} = 2$   $\mu$ A (Max) at  $T_A = 25^\circ\text{C}$
- High Noise Immunity:  $V_{NIH} = V_{NIL} = 10\%$   $V_{CC}$  (Min.)
- Power Down Protection Provided on Inputs
- Balanced Propagation Delays
- Designed for 2.0 V to 5.5 V Operating Range
- Low Noise:  $V_{OLP} = 0.8$  V (Max)
- Pin and Function Compatible with Other Standard Logic Families
- Latchup Performance Exceeds 300 mA
- ESD Performance:
  - Human Body Model > 2000 V;
  - Machine Model > 200 V
- Chip Complexity: 12 FETs or 3 Equivalent Gates
- These Devices are Pb-Free and are RoHS Compliant

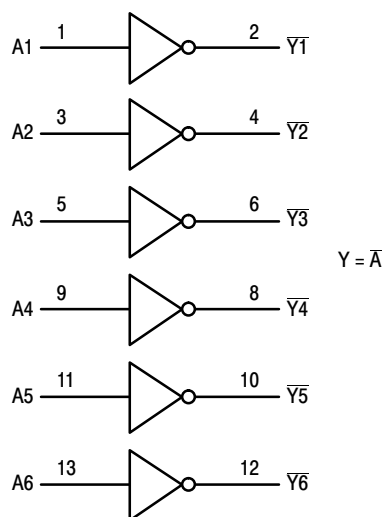


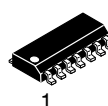
Figure 1. Logic Diagram



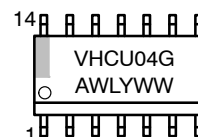
ON Semiconductor®

<http://onsemi.com>

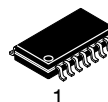
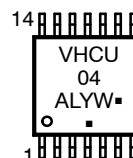
### MARKING DIAGRAMS



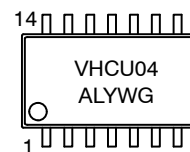
SOIC-14  
D SUFFIX  
CASE 751A



TSSOP-14  
DT SUFFIX  
CASE 948G



SOEIAJ-14  
M SUFFIX  
CASE 965



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

(Note: Microdot may be in either location)

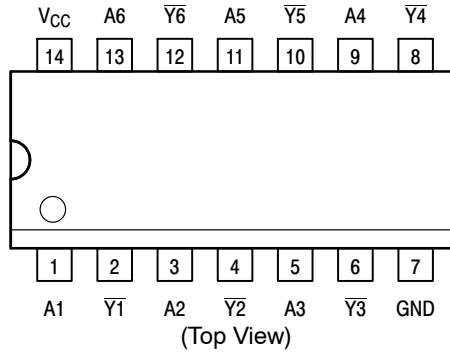
### FUNCTION TABLE

| Inputs | Outputs |
|--------|---------|
| A      | Y       |
| L      | H       |
| H      | L       |

### ORDERING INFORMATION

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

# MC74VHCU04



**Figure 2. Pinout: 14-Lead Packages**

## 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    |
| $I_{IK}$  | Input Diode Current                                              | -20                    | mA   |
| $I_{OK}$  | Output Diode Current                                             | $\pm 20$               | mA   |
| $I_{out}$ | DC Output Current, per Pin                                       | $\pm 25$               | mA   |
| $I_{CC}$  | DC Supply Current, $V_{CC}$ and GND Pins                         | $\pm 50$               | mA   |
| $P_D$     | Power Dissipation in Still Air, SOIC Packages†<br>TSSOP Package† | 500<br>450             | mW   |
| $T_{stg}$ | Storage Temperature                                              | - 65 to + 150          | °C   |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

†Derating — SOIC Packages: - 7 mW/°C from 65° to 125°C  
TSSOP Package: - 6.1 mW/°C from 65° to 125°C

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation,  $V_{in}$  and  $V_{out}$  should be constrained to the range  $GND \leq (V_{in} \text{ or } V_{out}) \leq V_{CC}$ .

Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or  $V_{CC}$ ). Unused outputs must be left open.

## RECOMMENDED OPERATING CONDITIONS

| Symbol    | Parameter             | Min | Max      | Unit |
|-----------|-----------------------|-----|----------|------|
| $V_{CC}$  | DC Supply Voltage     | 2.0 | 5.5      | V    |
| $V_{in}$  | DC Input Voltage      | 0   | 5.5      | V    |
| $V_{out}$ | DC Output Voltage     | 0   | $V_{CC}$ | V    |
| $T_A$     | Operating Temperature | -40 | + 85     | °C   |

# MC74VHCU04

## 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> | Minimum High-Level Input Voltage  |                                                                                     | 2.0<br>3.0 to 5.5    | 1.70<br>V <sub>CC</sub> × 0.8 |                   |                               | 1.70<br>V <sub>CC</sub> × 0.8 |                               | V    |
| V <sub>IL</sub> | Maximum Low-Level Input Voltage   |                                                                                     | 2.0<br>3.0 to 5.5    |                               |                   | 0.30<br>V <sub>CC</sub> × 0.2 |                               | 0.30<br>V <sub>CC</sub> × 0.2 | V    |
| V <sub>OH</sub> | Minimum High-Level Output Voltage | V <sub>in</sub> = V <sub>IL</sub><br>I <sub>OH</sub> = -50μA                        | 2.0<br>3.0<br>4.5    | 1.8<br>2.7<br>4.0             | 2.0<br>3.0<br>4.5 |                               | 1.8<br>2.7<br>4.0             |                               | V    |
|                 |                                   | V <sub>in</sub> = GND<br>I <sub>OH</sub> = -4mA<br>I <sub>OH</sub> = -8mA           | 3.0<br>4.5           | 2.58<br>3.94                  |                   |                               | 2.48<br>3.80                  |                               |      |
| V <sub>OL</sub> | Maximum Low-Level Output Voltage  | V <sub>in</sub> = V <sub>IH</sub><br>I <sub>OL</sub> = 50μA                         | 2.0<br>3.0<br>4.5    |                               | 0.0<br>0.0<br>0.0 | 0.2<br>0.3<br>0.5             |                               | 0.2<br>0.3<br>0.5             | V    |
|                 |                                   | V <sub>in</sub> = V <sub>CC</sub><br>I <sub>OL</sub> = 4mA<br>I <sub>OL</sub> = 8mA | 3.0<br>4.5           |                               |                   | 0.36<br>0.36                  |                               | 0.44<br>0.44                  |      |
| I <sub>in</sub> | Maximum Input Leakage Current     | V <sub>in</sub> = 5.5 or GND                                                        | 0 to 5.5             |                               |                   | ± 0.1                         |                               | ± 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                           |                               | 20.0                          | 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> | Maximum Propagation Delay,<br>A or B to Y | V <sub>CC</sub> = 3.3 ± 0.3V C <sub>L</sub> = 15pF<br>C <sub>L</sub> = 50pF |                       | 5.0<br>7.5 | 8.9<br>11.4 | 1.0<br>1.0                   | 10.5<br>13.0 | ns   |
|                                        |                                           | V <sub>CC</sub> = 5.0 ± 0.5V C <sub>L</sub> = 15pF<br>C <sub>L</sub> = 50pF |                       | 3.5<br>5.0 | 5.5<br>7.0  | 1.0<br>1.0                   | 6.5<br>8.0   |      |
| C <sub>in</sub>                        | Maximum Input Capacitance                 |                                                                             |                       | 5          | 10          |                              | 10           | pF   |

|                 |                                                       |                                        |    |
|-----------------|-------------------------------------------------------|----------------------------------------|----|
| C <sub>PD</sub> | Power Dissipation Capacitance (Per Inverter) (Note 1) | Typical @ 25°C, V <sub>CC</sub> = 5.0V | pF |
|                 |                                                       | 9                                      |    |

1. 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> = 3.0ns, C<sub>L</sub> = 50pF, V<sub>CC</sub> = 5.0V)

| Symbol           | Characteristic                               | T <sub>A</sub> = 25°C |      | Unit |
|------------------|----------------------------------------------|-----------------------|------|------|
|                  |                                              | Typ                   | Max  |      |
| V <sub>OLP</sub> | Quiet Output Maximum Dynamic V <sub>OL</sub> | 0.5                   | 0.8  | V    |
| V <sub>OLV</sub> | Quiet Output Minimum Dynamic V <sub>OL</sub> | -0.5                  | -0.8 | V    |
| V <sub>IHD</sub> | Minimum High Level Dynamic Input Voltage     |                       | 4.0  | V    |
| V <sub>ILD</sub> | Maximum Low Level Dynamic Input Voltage      |                       | 1.0  | V    |

# MC74VHCU04

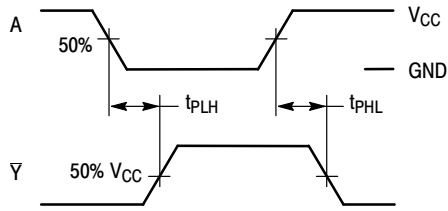
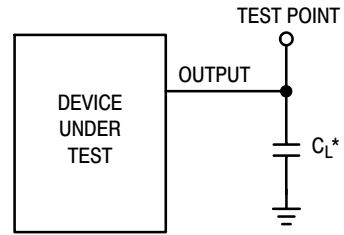


Figure 3. Switching Waveforms



\*Includes all probe and jig capacitance

Figure 4. Test Circuit

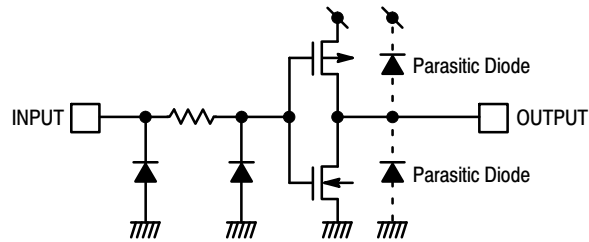


Figure 5. Input Equivalent Circuit

## ORDERING INFORMATION

| Device          | Package                | Shipping†        |
|-----------------|------------------------|------------------|
| MC74VHCU04DR2G  | SOIC-14<br>(Pb-Free)   | 2500 Tape & Reel |
| MC74VHCU04DTR2G | TSSOP-14*              | 2500 Tape & Reel |
| MC74VHCU04MELG  | SOEIAJ-14<br>(Pb-Free) | 2000 Tape & Reel |

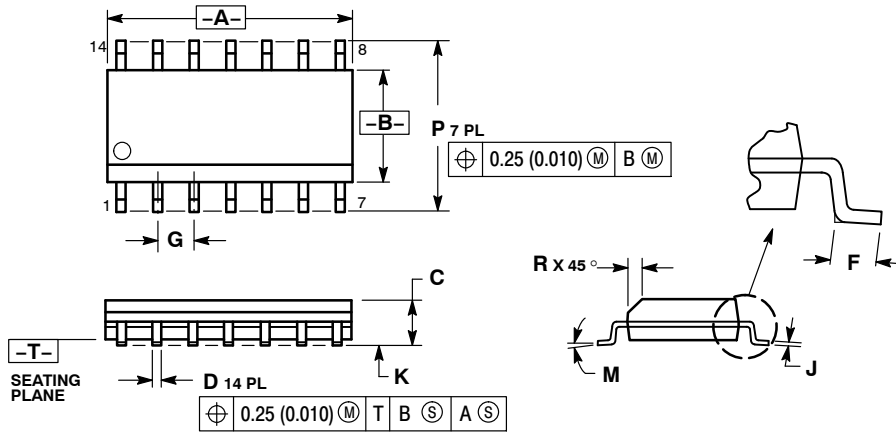
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

\*This package is inherently Pb-Free.

# MC74VHCU04

## PACKAGE DIMENSIONS

SOIC-14  
CASE 751A-03  
ISSUE J

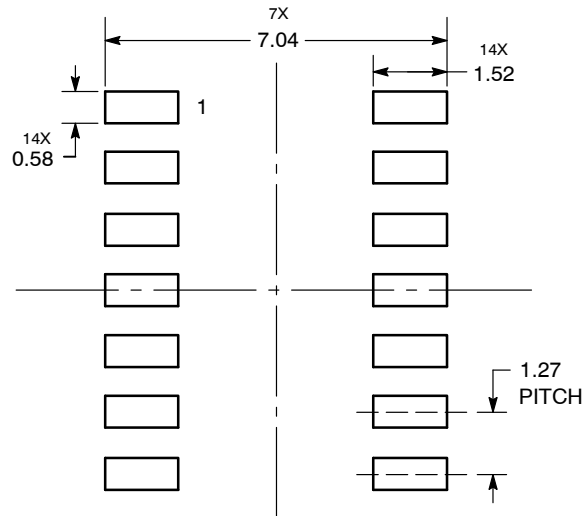


### NOTES:

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 |

### SOLDERING FOOTPRINT\*



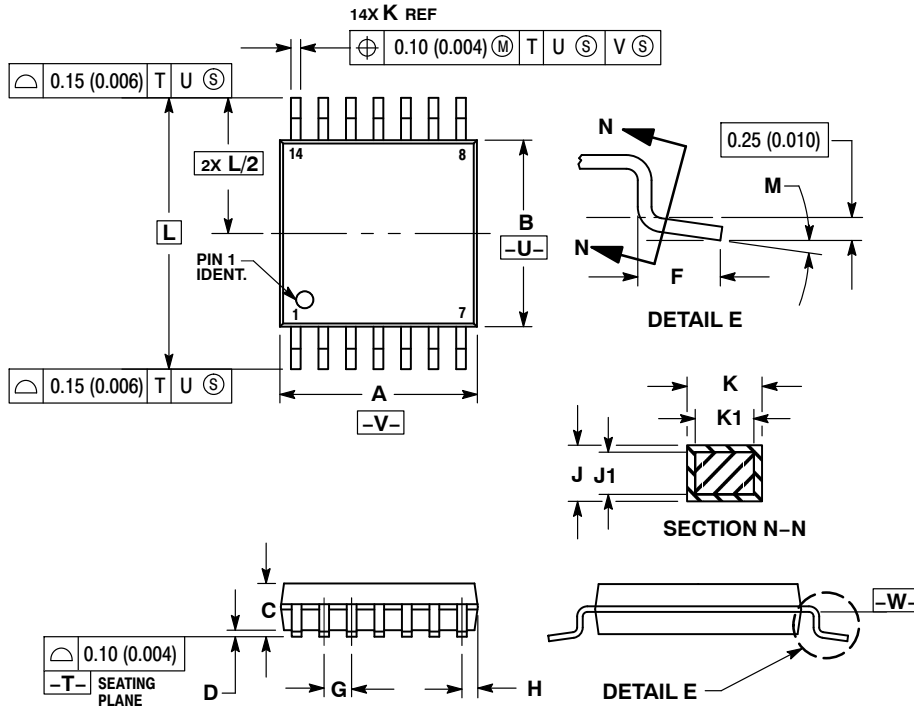
DIMENSIONS: MILLIMETERS

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

# MC74VHCU04

## PACKAGE DIMENSIONS

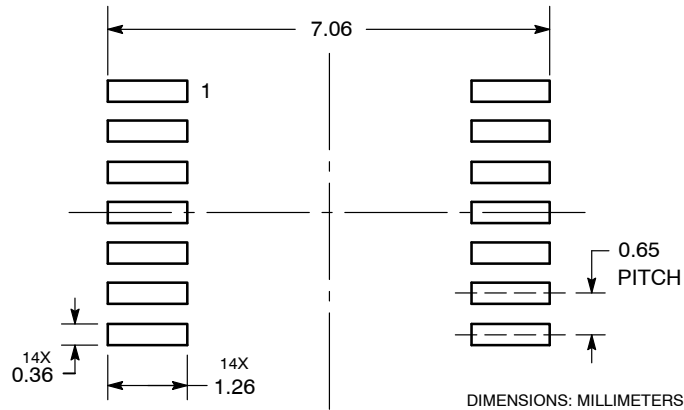
**TSSOP-14**  
**DT SUFFIX**  
CASE 948G-01  
ISSUE B



### 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-.

### SOLDERING FOOTPRINT\*

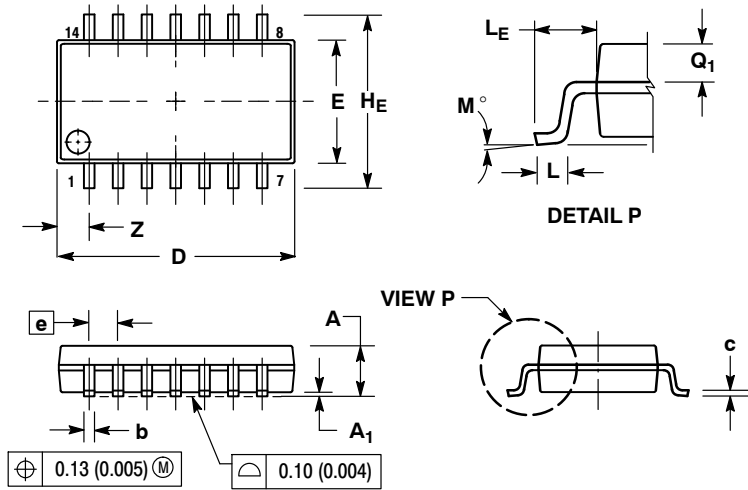


\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

# MC74VHCU04

## PACKAGE DIMENSIONS

SOEIAJ-14  
CASE 965-01  
ISSUE B



### 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              | 0.10        | 0.20  | 0.004     | 0.008 |
| 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 |

ON Semiconductor and  are registered trademarks of Semiconductor Components Industries, LLC (SCILLC). SCILLC reserves the right to make changes without further notice to any products herein. SCILLC makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does SCILLC assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. "Typical" parameters which may be provided in SCILLC data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. SCILLC does not convey any license under its patent rights nor the rights of others. SCILLC products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the SCILLC product could create a situation where personal injury or death may occur. Should Buyer purchase or use SCILLC products for any such unintended or unauthorized application, Buyer shall indemnify and hold SCILLC and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that SCILLC was negligent regarding the design or manufacture of the part. SCILLC is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

### PUBLICATION ORDERING INFORMATION

#### LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor  
P.O. Box 5163, Denver, Colorado 80217 USA  
Phone: 303-675-2175 or 800-344-3860 Toll Free USA/Canada  
Fax: 303-675-2176 or 800-344-3867 Toll Free USA/Canada  
Email: [orderlit@onsemi.com](mailto:orderlit@onsemi.com)

N. American Technical Support: 800-282-9855 Toll Free  
USA/Canada  
Europe, Middle East and Africa Technical Support:  
Phone: 421 33 790 2910  
Japan Customer Focus Center  
Phone: 81-3-5773-3850

ON Semiconductor Website: [www.onsemi.com](http://www.onsemi.com)

Order Literature: <http://www.onsemi.com/orderlit>

For additional information, please contact your local Sales Representative

## Данный компонент на территории Российской Федерации

**Вы можете приобрести в компании MosChip.**

Для оперативного оформления запроса Вам необходимо перейти по данной ссылке:

<http://moschip.ru/get-element>

Вы можете разместить у нас заказ для любого Вашего проекта, будь то серийное производство или разработка единичного прибора.

В нашем ассортименте представлены ведущие мировые производители активных и пассивных электронных компонентов.

Нашей специализацией является поставка электронной компонентной базы двойного назначения, продукции таких производителей как XILINX, Intel (ex.ALTERA), Vicor, Microchip, Texas Instruments, Analog Devices, Mini-Circuits, Amphenol, Glenair.

Сотрудничество с глобальными дистрибьюторами электронных компонентов, предоставляет возможность заказывать и получать с международных складов практически любой перечень компонентов в оптимальные для Вас сроки.

На всех этапах разработки и производства наши партнеры могут получить квалифицированную поддержку опытных инженеров.

Система менеджмента качества компании отвечает требованиям в соответствии с ГОСТ Р ИСО 9001, ГОСТ РВ 0015-002 и ЭС РД 009

### Офис по работе с юридическими лицами:

105318, г.Москва, ул.Щербаковская д.3, офис 1107, 1118, ДЦ «Щербаковский»

Телефон: +7 495 668-12-70 (многоканальный)

Факс: +7 495 668-12-70 (доб.304)

E-mail: [info@moschip.ru](mailto:info@moschip.ru)

Skype отдела продаж:

moschip.ru

moschip.ru\_4

moschip.ru\_6

moschip.ru\_9