

# MC74VHC1G125

## Noninverting 3-State Buffer

The MC74VHC1G125 is an advanced high speed CMOS noninverting 3-state buffer fabricated with silicon gate CMOS technology. It achieves high speed operation similar to equivalent Bipolar Schottky TTL while maintaining CMOS low power dissipation.

The internal circuit is composed of three stages, including a buffered 3-state output which provides high noise immunity and stable output.

The MC74VHC1G125 input structure provides protection when voltages up to 7.0 V are applied, regardless of the supply voltage. This allows the MC74VHC1G125 to be used to interface 5.0 V circuits to 3.0 V circuits.

### Features

- These are Pb-Free Devices
- High Speed:  $t_{PD} = 3.5$  ns (Typ) at  $V_{CC} = 5.0$  V
- Low Power Dissipation:  $I_{CC} = 1$   $\mu$ A (Max) at  $T_A = 25^\circ\text{C}$
- Power Down Protection Provided on Inputs
- Balanced Propagation Delays
- Pin and Function Compatible with Other Standard Logic Families
- Chip Complexity: FETs = 58; Equivalent Gates = 15

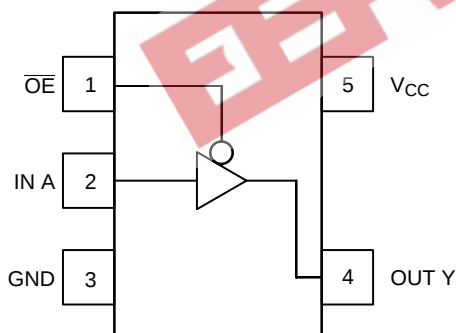


Figure 1. Pinout (Top View)

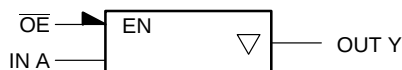


Figure 2. Logic Symbol



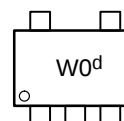
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### MARKING DIAGRAMS



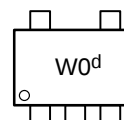
SC-88A/SOT-353/SC-70  
DF SUFFIX  
CASE 419A



Pin 1  
d = Date Code



TSOP-5/SOT-23/SC-59  
DT SUFFIX  
CASE 483



Pin 1  
d = Date Code

### PIN ASSIGNMENT

| Pin | Function        |
|-----|-----------------|
| 1   | $\overline{OE}$ |
| 2   | IN A            |
| 3   | GND             |
| 4   | OUT Y           |
| 5   | $V_{CC}$        |

### FUNCTION TABLE

| A Input | $\overline{OE}$ Input | Y Output |
|---------|-----------------------|----------|
| L       | L                     | L        |
| H       | L                     | H        |
| X       | H                     | Z        |

### ORDERING INFORMATION

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

# MC74VHC1G125

## MAXIMUM RATINGS

| Symbol        | Characteristics                                                                                               | 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<br>$V_{CC} = 0$<br>High or Low State                                                        | -0.5 to 7.0<br>-0.5 to $V_{CC} + 0.5$ | V    |
| $I_{IK}$      | Input Diode Current                                                                                           | -20                                   | mA   |
| $I_{OK}$      | Output Diode Current<br>$V_{OUT} < GND$ ; $V_{OUT} > V_{CC}$                                                  | +20                                   | mA   |
| $I_{OUT}$     | DC Output Current, per Pin                                                                                    | +25                                   | mA   |
| $I_{CC}$      | DC Supply Current, $V_{CC}$ and GND                                                                           | +50                                   | mA   |
| $P_D$         | Power Dissipation in Still Air<br>SC-88A, TSOP-5                                                              | 200                                   | mW   |
| $\theta_{JA}$ | Thermal Resistance<br>SC-88A, TSOP-5                                                                          | 333                                   | °C/W |
| $T_L$         | Lead Temperature, 1 mm from Case for 10 s                                                                     | 260                                   | °C   |
| $T_J$         | Junction Temperature Under Bias                                                                               | +150                                  | °C   |
| $T_{stg}$     | Storage Temperature                                                                                           | -65 to +150                           | °C   |
| $V_{ESD}$     | ESD Withstand Voltage<br>Human Body Model (Note 1)<br>Machine Model (Note 2)<br>Charged Device Model (Note 3) | > 2000<br>> 200<br>N/A                | V    |
| $I_{LatchUp}$ | LatchUp Performance<br>Above $V_{CC}$ and Below GND at 125°C (Note 4)                                         | ± 500                                 | mA   |

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

1. Tested to EIA/JESD22-A114-A.
2. Tested to EIA/JESD22-A115-A.
3. Tested to JESD22-C101-A.
4. Tested to EIA/JESD78.

## RECOMMENDED OPERATING CONDITIONS

| Symbol     | Characteristics                                                                                                      | Min    | Max       | Unit |
|------------|----------------------------------------------------------------------------------------------------------------------|--------|-----------|------|
| $V_{CC}$   | DC Supply Voltage                                                                                                    | 2.0    | 5.5       | V    |
| $V_{IN}$   | DC Input Voltage                                                                                                     | 0.0    | 5.5       | V    |
| $V_{OUT}$  | DC Output Voltage                                                                                                    | 0.0    | $V_{CC}$  | V    |
| $T_A$      | Operating Temperature Range                                                                                          | -55    | +125      | °C   |
| $t_r, t_f$ | Input Rise and Fall Time<br>$V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$<br>$V_{CC} = 5.0 \text{ V} \pm 0.5 \text{ V}$ | 0<br>0 | 100<br>20 | ns/V |

## Device Junction Temperature versus Time to 0.1% Bond Failures

| Junction Temperature °C | Time, Hours | Time, Years |
|-------------------------|-------------|-------------|
| 80                      | 1,032,200   | 117.8       |
| 90                      | 419,300     | 47.9        |
| 100                     | 178,700     | 20.4        |
| 110                     | 79,600      | 9.4         |
| 120                     | 37,000      | 4.2         |
| 130                     | 17,800      | 2.0         |
| 140                     | 8,900       | 1.0         |

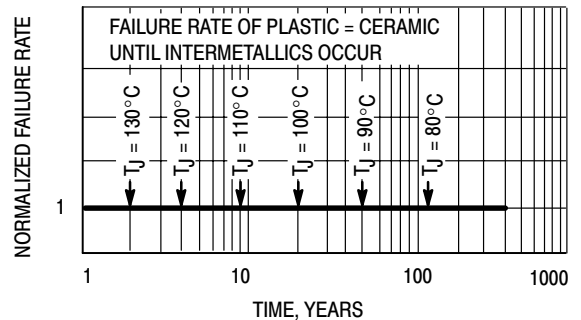


Figure 3. Failure Rate vs. Time Junction Temperature

# MC74VHC1G125

## 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      |                            | -55 ≤ 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>2.1<br>3.15<br>3.85 |                   |                            | 1.5<br>2.1<br>3.15<br>3.85 |                            | 1.5<br>2.1<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<br>V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> | 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<br>V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>  | 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>OZ</sub> | Maximum 3-State Leakage Current                                                           | V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub><br>V <sub>OUT</sub> = V <sub>CC</sub> or GND          | 5.5                      |                            |                   | ±0.25                      |                            | ±2.5                       |                              | ±2.5                       | μA   |
| 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                      |                            |                   | 1.0                        |                            | 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 |              | -55 ≤ 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,<br>Input A to Y<br>(Figures 3 and 4)     | V <sub>CC</sub> = 3.3 ± 0.3 V C <sub>L</sub> = 15 pF<br>C <sub>L</sub> = 50 pF                         |                       | 4.5<br>6.4 | 8.0<br>11.5 |                       | 9.5<br>13.0  |                              | 12.0<br>16.0 | ns   |
|                                        |                                                                     | V <sub>CC</sub> = 5.0 ± 0.5 V C <sub>L</sub> = 15 pF<br>C <sub>L</sub> = 50 pF                         |                       | 3.5<br>4.5 | 5.5<br>7.5  |                       | 6.5<br>8.5   |                              | 8.5<br>10.5  |      |
| t <sub>PZL</sub> ,<br>t <sub>PZH</sub> | Maximum Output Enable Time,<br>Input OE to Y<br>(Figures 4 and 5)   | V <sub>CC</sub> = 3.3 ± 0.3 V C <sub>L</sub> = 15 pF<br>R <sub>L</sub> = 1000 Ω C <sub>L</sub> = 50 pF |                       | 4.5<br>6.4 | 8.0<br>11.5 |                       | 9.5<br>13.0  |                              | 11.5<br>15.0 | ns   |
|                                        |                                                                     | V <sub>CC</sub> = 5.0 ± 0.5 V C <sub>L</sub> = 15 pF<br>R <sub>L</sub> = 1000 Ω C <sub>L</sub> = 50 pF |                       | 3.5<br>4.5 | 5.1<br>7.1  |                       | 6.0<br>8.0   |                              | 8.5<br>10.5  |      |
| t <sub>PLZ</sub> ,<br>t <sub>PHZ</sub> | Maximum Output Disable Time,<br>Input OE to Y<br>(Figures 4 and 5)  | V <sub>CC</sub> = 3.3 ± 0.3 V C <sub>L</sub> = 15 pF<br>R <sub>L</sub> 1000 Ω C <sub>L</sub> = 50 pF   |                       | 6.5<br>8.0 | 9.7<br>13.2 |                       | 11.5<br>15.0 |                              | 14.5<br>18.0 | ns   |
|                                        |                                                                     | V <sub>CC</sub> = 5.0 ± 0.5 V C <sub>L</sub> = 15 pF<br>R <sub>L</sub> = 1000 Ω C <sub>L</sub> = 50 pF |                       | 4.8<br>7.0 | 6.8<br>8.8  |                       | 8.0<br>10.0  |                              | 10.0<br>12.0 |      |
| C <sub>IN</sub>                        | Maximum Input Capacitance                                           |                                                                                                        |                       | 4.0        | 10          |                       | 10           |                              | 10           | pF   |
| C <sub>OUT</sub>                       | Maximum 3-State Output Capacitance (Output in High Impedance State) |                                                                                                        |                       | 6.0        |             |                       |              |                              |              | pF   |

|                 |                                        |                                         |    |
|-----------------|----------------------------------------|-----------------------------------------|----|
| C <sub>PD</sub> | Power Dissipation Capacitance (Note 5) | Typical @ 25°C, V <sub>CC</sub> = 5.0 V | pF |
|                 |                                        | 8.0                                     |    |

5. 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>.

# MC74VHC1G125

## SWITCHING WAVEFORMS

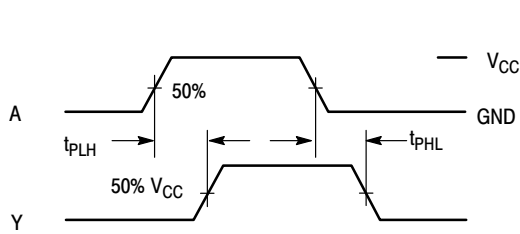


Figure 4. Switching Wave Forms

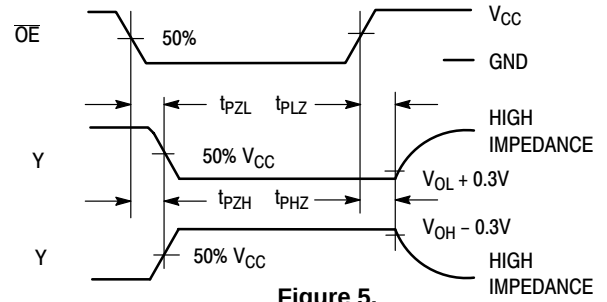
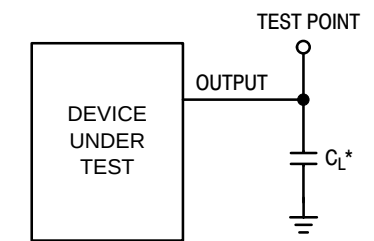
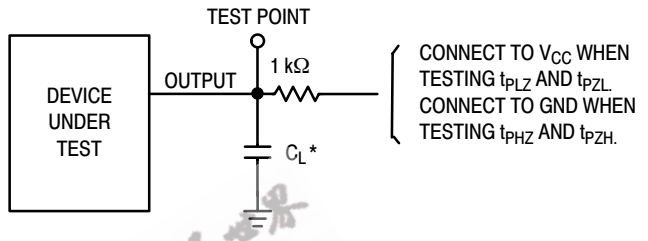


Figure 5.



\*Includes all probe and jig capacitance

Figure 6. Test Circuit



\*Includes all probe and jig capacitance

Figure 7. Test Circuit

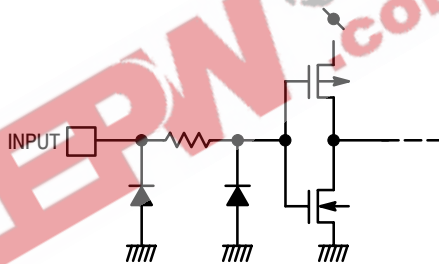


Figure 8. Input Equivalent Circuit

## DEVICE ORDERING INFORMATION

| Device Order Number | Device Nomenclature |                       |            |                 |                |                    | Package Type (Name/SOT#/Common Name) | Tape and Reel Size†   |
|---------------------|---------------------|-----------------------|------------|-----------------|----------------|--------------------|--------------------------------------|-----------------------|
|                     | Circuit Indicator   | Temp Range Identifier | Technology | Device Function | Package Suffix | Tape & Reel Suffix |                                      |                       |
| MC74VHC1G125DFT1    | MC                  | 74                    | VHC1G      | 125             | DF             | T1                 | SC-88A/SOT-353/SC-70                 | 178 mm (7") 3000 Unit |
| MC74VHC1G125DFT1G   | MC                  | 74                    | VHC1G      | 125             | DF             | T1                 | SC-88A/SOT-353/SC-70 (Pb-Free)       | 178 mm (7") 3000 Unit |
| MC74VHC1G125DFT2    | MC                  | 74                    | VHC1G      | 125             | DF             | T2                 | SC-88A/SOT-353/SC-70                 | 178 mm (7") 3000 Unit |
| MC74VHC1G125DFT2G   | MC                  | 74                    | VHC1G      | 125             | DF             | T2                 | TSC-88A/SOT-353/SC-70 (Pb-Free)      | 178 mm (7") 3000 Unit |
| MC74VHC1G125DTT1    | MC                  | 74                    | VHC1G      | 125             | DT             | T1                 | TSOP-5/SOT-23/SC-59                  | 178 mm (7") 3000 Unit |
| MC74VHC1G125DTT1G   | MC                  | 74                    | VHC1G      | 125             | DT             | T1                 | TSOP-5/SOT-23/SC-59 (Pb-Free)        | 178 mm (7") 3000 Unit |

†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.

# MC74VHC1G125

## PACKAGE DIMENSIONS

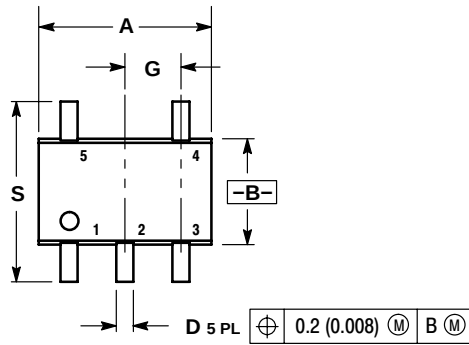
SC70-5/SC-88A/SOT-353

DF SUFFIX

5-LEAD PACKAGE

CASE 419A-02

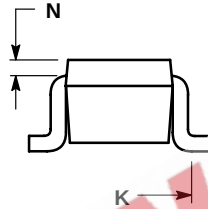
ISSUE G



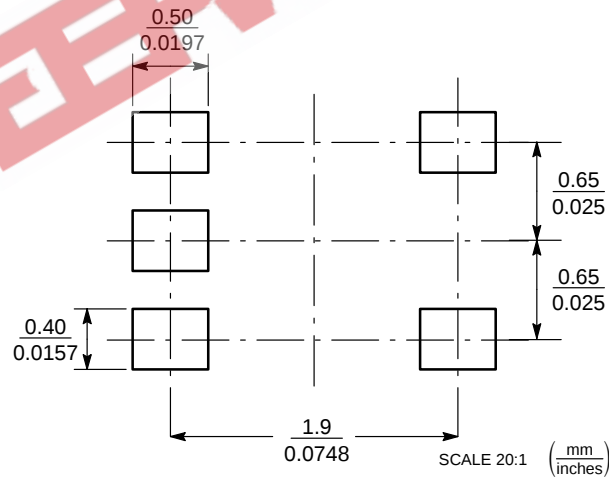
### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. 419A-01 OBSOLETE. NEW STANDARD 419A-02.
4. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

| DIM | INCHES    |       | MILLIMETERS |      |
|-----|-----------|-------|-------------|------|
|     | MIN       | MAX   | MIN         | MAX  |
| A   | 0.071     | 0.087 | 1.80        | 2.20 |
| B   | 0.045     | 0.053 | 1.15        | 1.35 |
| C   | 0.031     | 0.043 | 0.80        | 1.10 |
| D   | 0.004     | 0.012 | 0.10        | 0.30 |
| G   | 0.026 BSC |       | 0.65 BSC    |      |
| H   | ---       | 0.004 | ---         | 0.10 |
| J   | 0.004     | 0.010 | 0.10        | 0.25 |
| K   | 0.004     | 0.012 | 0.10        | 0.30 |
| N   | 0.008 REF |       | 0.20 REF    |      |
| S   | 0.079     | 0.087 | 2.00        | 2.20 |



### SOLDERING FOOTPRINT\*



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

# MC74VHC1G125

## PACKAGE DIMENSIONS

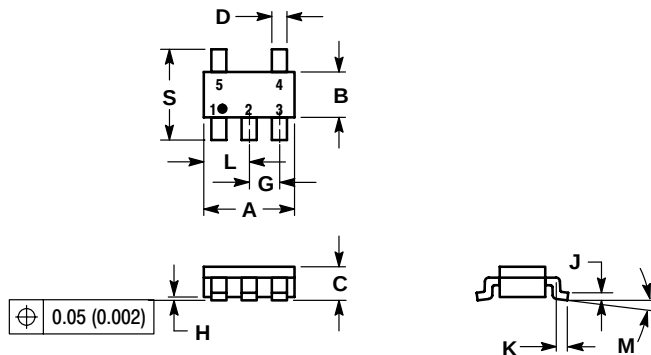
SOT23-5/TSOP-5/SC59-5

DT SUFFIX

5-LEAD PACKAGE

CASE 483-02

ISSUE C

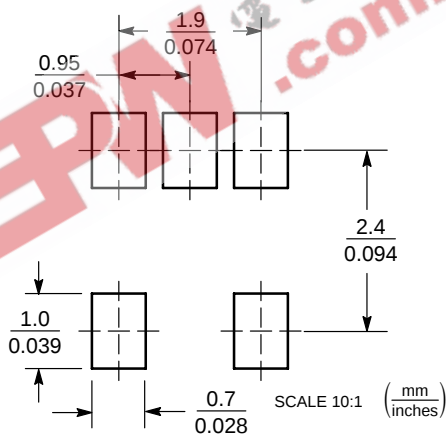


### NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. A AND B DIMENSIONS DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

| DIM | MILLIMETERS |       | INCHES |        |
|-----|-------------|-------|--------|--------|
|     | MIN         | MAX   | MIN    | MAX    |
| A   | 2.90        | 3.10  | 0.1142 | 0.1220 |
| B   | 1.30        | 1.70  | 0.0512 | 0.0669 |
| C   | 0.90        | 1.10  | 0.0354 | 0.0433 |
| D   | 0.25        | 0.50  | 0.0098 | 0.0197 |
| G   | 0.85        | 1.05  | 0.0335 | 0.0413 |
| H   | 0.013       | 0.100 | 0.0005 | 0.0040 |
| J   | 0.10        | 0.26  | 0.0040 | 0.0102 |
| K   | 0.20        | 0.60  | 0.0079 | 0.0236 |
| L   | 1.25        | 1.55  | 0.0493 | 0.0610 |
| M   | 0           | 10    | 0      | 10     |
| S   | 2.50        | 3.00  | 0.0985 | 0.1181 |

## 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.

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MC74VHC1G125/D