

Single Unbuffered Inverter MC74VHC1GU04

The MC74VHC1GU04 is an advanced high speed CMOS unbuffered inverter in tiny footprint packages.

This device consists of a single unbuffered inverter. In combination with others, or in the MC74VHCU04 Hex Unbuffered Inverter, these devices are well suited for use as oscillators, pulse shapers, and in many other applications requiring a high-input impedance amplifier. For digital applications, the MC74VHC1G04 or the MC74VHC04 are recommended.

The input structures provide protection when voltages up to 5.5 V are applied, regardless of the supply voltage. This allows the device to be used to interface 5 V circuits to 3 V circuits.

Features

- Designed for 2.0 V to 5.5 V V_{CC} Operation
- 2.5 ns t_{PD} at 5 V (typ)
- Inputs Over-Voltage Tolerant up to 5.5 V
- I_{OFF} Supports Partial Power Down Protection on Input
- Source/Sink 8 mA at 3.0 V
- Available in SC-88A, SC-74A, SOT-553, SOT-953 and UDFN6 Packages
- Chip Complexity < 100 FETs
- –Q Suffix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC–Q100 Qualified and PPAP Capable
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant



Figure 1. Logic Symbol

MARKING DIAGRAMS SC-88A XX M= **DF SUFFIX CASE 419A** SC-74A **DBV SUFFIX CASE 318BQ** SOT-553 **XV5 SUFFIX** CASE 463B SOT-953 P5 SUFFIX CASE 527AE UDFN6 1.45 x 1.0 CASE 517AQ UDFN6 XM1.2 x 1.0 CASE 517AA

XX = Specific Device Code
M = Date Code*
= Pb-Free Package

UDFN6

1.0 x 1.0

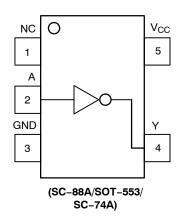
CASE 517BX

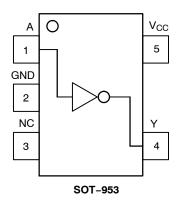
XM

(Note: Microdot may be in either location)

ORDERING INFORMATION

See detailed ordering, marking and shipping information in the package dimensions section on page 6 of this data sheet.





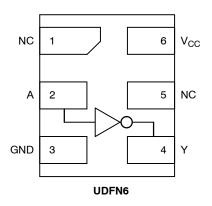


Figure 2. Pinout (Top View)

PIN ASSIGNMENT (SC-88A/SOT-553/ SC-74A)

| Pin | Function |
|-----|-----------------|
| 1 | NC |
| 2 | А |
| 3 | GND |
| 4 | Y |
| 5 | V _{CC} |

PIN ASSIGNMENT (SOT-953)

| Pin | Function |
|-----|-----------------|
| 1 | А |
| 2 | GND |
| 3 | NC |
| 4 | Y |
| 5 | V _{CC} |

PIN ASSIGNMENT (UDFN)

| Pin | Function |
|-----|-----------------|
| 1 | NC |
| 2 | A |
| 3 | GND |
| 4 | Y |
| 5 | NC |
| 6 | V _{CC} |

FUNCTION TABLE

| Input | Output |
|-------|--------|
| Α | Y |
| L | Н |
| Н | L |

MAXIMUM RATINGS

| Symbol | Characteristics | | 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 | V _{IN} < GND | -20 | mA |
| I _{OK} | DC Output Diode Current | | ±20 | mA |
| l _{out} | DC Output Source/Sink Current | | ±25 | mA |
| I _{CC} or I _{GND} | DC Supply Current per Supply Pin or Ground Pin | | ±50 | mA |
| T _{STG} | Storage Temperature Range | | -65 to +150 | °C |
| TL | Lead Temperature, 1 mm from Case for 10 secs | | 260 | °C |
| TJ | Junction Temperature Under Bias | | +150 | °C |
| θ_{JA} | Thermal Resistance (Note 2) | SC-88A SC-74A SOT-553 SOT-953 UDFN6 | 377 320 324 254 154 | °C/W |
| P _D | Power Dissipation in Still Air | SC-88A SC-74A SOT-553 SOT-953 UDFN6 | 332 390 386 491 812 | mW |
| MSL | Moisture Sensitivity | | Level 1 | - |
| F _R | Flammability Rating | Oxygen Index: 28 to 34 | UL 94 V-0 @ 0.125 in | - |
| V _{ESD} | ESD Withstand Voltage (Note 3) | Human Body Model Charged Device Model | 2000 1000 | V |
| I _{Latchup} | Latchup Performance (Note 4) | | ±100 | 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. Applicable to devices with outputs that may be tri–stated.

- Measured with minimum pad spacing on an FR4 board, using 10mm-by-1inch, 2 ounce copper trace no air flow per JESD51-7.
 HBM tested to ANSI/ESDA/JEDEC JS-001-2017. CDM tested to EIA/JESD22-C101-F. JEDEC recommends that ESD qualification to EIA/JESD22-A115-A (Machine Model) be discontinued per JEDEC/JEP172A.
- 4. Tested to EIA/JESD78 Class II.

RECOMMENDED OPERATING CONDITIONS

| Symbol | Characteristics | Min | Max | Unit |
|---------------------------------|---|------------|---------------------|------|
| V _{CC} | Positive 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 Range | -55 | +125 | °C |
| t _r , t _f | Input Rise and Fall Time V _{CC} = 2.0 V V _{CC} = 2.3 V to 2.7 V V _{CC} = 3.0 V to 3.6 V V _{CC} = 4.5 V to 5.5 V | / 0 / 0 | 20 20 10 5 | 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.

DC ELECTRICAL CHARACTERISTICS

| | | Test | V _{CC} | 7 | Γ _A = 25° | C | -40°C ≤ 7 | Γ _A ≤ 85°C | -55°C ≤ T | _A ≤ 125°C | |
|------------------|------------------------------|---|--|-------------------|----------------------|-------------------|-------------------|-----------------------|-------------------|----------------------|--------|
| Symbol | | | (V) | Min | Тур | Max | Min | Max | Min | Max | Unit |
| V _{IH} | High-Level Input | | 2.0 | 1.7 | _ | - | 1.7 | - | 1.7 | - | ٧ |
| | Voltage | | 3.0 | 2.4 | _ | - | 2.4 | - | 2.4 | - | |
| | | | 4.5 | 3.6 | _ | - | 3.6 | - | 3.6 | - | |
| | | | 5.5 | 4.4 | - | - | 4.4 | - | 4.4 | - | |
| V_{IL} | Low-Level Input | | 2.0 | - | - | 0.3 | - | 0.3 | - | 0.3 | ٧ |
| | Voltage | | 3.0 | - | - | 0.6 | - | 0.6 | - | 0.6 | |
| | | | 4.5 | - | _ | 0.9 | - | 0.9 | - | 0.9 | |
| | | | 5.5 | - | _ | 1.1 | - | 1.1 | - | 1.1 | |
| V _{OH} | High-Level Output Voltage | $V_{IN} = V_{IH} \text{ or } V_{IL}$ $I_{OH} = -50 \mu A$ | 2.0 3.0 4.5 | 1.9 2.9 4.4 | 2.0 3.0 4.5 | - - - | 1.9 2.9 4.4 | - - - | 1.9 2.9 4.4 | - - - | V |
| | | | $V_{IN} = GND$ $I_{OH} = -4 \text{ mA}$ $I_{OH} = -8 \text{ mA}$ | 3.0 4.5 | 2.58 3.94 | - - | - - | 2.48 3.80 | - - | 2.34 3.66 | - - |
| V _{OL} | Low-Level Output Voltage | $V_{IN} = V_{IH} \text{ or } V_{IL}$ $I_{OL} = 50 \mu\text{A}$ | 2.0 3.0 4.5 | - - - | 0.0 0.0 0.0 | 0.1 0.1 0.1 | - - - | 0.1 0.1 0.1 | - - - | 0.1 0.1 0.1 | V |
| | | $V_{IN} = V_{CC}$ $I_{OL} = 4 \text{ mA}$ $I_{OL} = 8 \text{ mA}$ | 3.0 4.5 | - - | - - | 0.36 0.36 | - - | 0.44 0.44 | - - | 0.52 0.52 | |
| I _{IN} | Input Leakage Current | V _{IN} = 5.5 V or GND | 2.0 to 5.5 | - | _ | ±0.1 | - | ±1.0 | _ | ±1.0 | μΑ |
| I _{OFF} | Power Off Leakage Current | V _{IN} = 5.5 V | 0 | _ | _ | 1.0 | - | 10 | _ | 10 | μΑ |
| I _{CC} | Quiescent Supply Current | V _{IN} = V _{CC} or GND | 5.5 | _ | _ | 1.0 | - | 20 | - | 40 | μΑ |

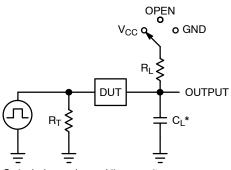
Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

AC ELECTRICAL CHARACTERISTICS

| | | | T _A = 25°C | | -40°C ≤ T _A ≤ 85°C | | -55°C ≤ T _A ≤ 125°C | | | | |
|--|--------------------|------------------------|-----------------------|-----|-------------------------------|------|--------------------------------|------|-----|------|------|
| Symbol | Parameter | Conditions | V _{CC} (V) | Min | Тур | Max | Min | Max | Min | Max | Unit |
| t _{PLH} , | Propagation Delay, | C _L = 15 pF | 3.0 to 3.6 | - | 3.5 | 8.9 | - | 10.5 | - | 12.0 | ns |
| t _{PHL} A to Y (Figures 3 and 4) | | C _L = 50 pF | | _ | 4.8 | 11.4 | - | 13.0 | - | 15.5 | |
| | | C _L = 15 pF | 4.5 to 5.5 | - | 2.5 | 5.5 | - | 6.5 | - | 8.0 | 1 |
| | | C _L = 50 pF | | - | 3.8 | 7.0 | - | 8.0 | - | 9.5 | 1 |
| C _{IN} | Input Capacitance | | | _ | 4.0 | 10 | _ | 10 | _ | 10 | pF |

| | | Typical @ 25°C, V _{CC} = 5.0 V | |
|----------|--|---|----|
| C_{PD} | Power Dissipation Capacitance (Note 5) | 22.0 | pF |

^{5.} C_{PD} 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: $I_{CC(OPR)} = C_{PD} \bullet V_{CC} \bullet f_{in} + I_{CC}$. C_{PD} is used to determine the no–load dynamic power consumption; $P_D = C_{PD} \bullet V_{CC}^2 \bullet f_{in} + I_{CC} \bullet V_{CC}$.



| Test | Switch Position | C _L , pF | R_L , Ω |
|-------------------------------------|--------------------|------------------------------|------------------|
| t _{PLH} / t _{PHL} | Open | See AC Characteristics Table | Х |
| t _{PLZ} / t _{PZL} | V _{CC} | | 1 k |
| t _{PHZ} / t _{PZH} | GND | | 1 k |

X = Don't Care

 C_L includes probe and jig capacitance R_T is Z_{OUT} of pulse generator (typically 50 $\Omega)$ f = 1 MHz

Figure 3. Test Circuit

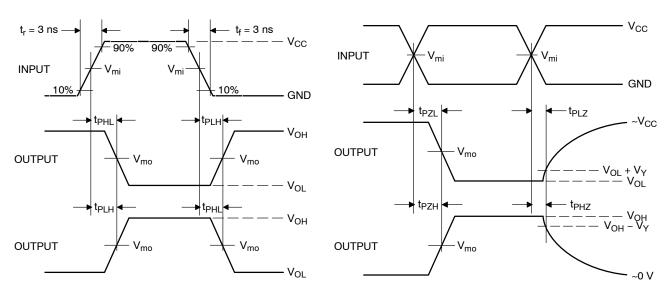


Figure 4. Switching Waveforms

| | | V _m | | |
|---------------------|---------------------|-------------------------------------|---|--------------------|
| V _{CC} , V | V _{mi} , V | t _{PLH} , t _{PHL} | t_{PZL} , t_{PLZ} , t_{PZH} , t_{PHZ} | V _Y , V |
| 3.0 to 3.6 | V _{CC} /2 | V _{CC} /2 | V _{CC} /2 | 0.3 |
| 4.5 to 5.5 | V _{CC} /2 | V _{CC} /2 | V _{CC} /2 | 0.3 |

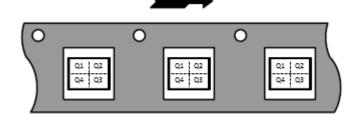
ORDERING INFORMATION

| Device | Package | Specific Device Code | Pin 1 Orientation (See below) | Shipping [†] |
|---|-------------------------|----------------------|----------------------------------|-----------------------|
| MC74VHC1GU04DF1G | SC-88A | V6 | Q2 | 3000 / Tape & Reel |
| MC74VHC1GU04DFT1G (Please contact onsemi) | SC-88A | V6 | Q2 | 3000 / Tape & Reel |
| MC74VHC1GU04DFT2G (Please contact onsemi) | SC-88A | V6 | Q4 | 3000 / Tape & Reel |
| MC74VHC1GU04DFT2G-Q* (Please contact onsemi) | SC-88A | V6 | Q4 | 3000 / Tape & Reel |
| MC74VHC1GU04DBVT1G | SC-74A | V6 | Q4 | 3000 / Tape & Reel |
| MC74VHC1GU04MU1TCG | UDFN6, 1.45 x 1.0, 0.5P | Т | Q4 | 3000 / Tape & Reel |
| MC74VHC1GU04MU2TCG (Please contact onsemi) | UDFN6, 1.2 x 1.0, 0.4P | К | Q4 | 3000 / Tape & Reel |
| MC74VHC1GU04MU3TCG (Please contact onsemi) | UDFN6, 1.0 x 1.0, 0.35P | Y | Q4 | 3000 / Tape & Reel |
| MC74VHC1GU04XV5T2G (Please contact onsemi) | SOT-553 | TBD | Q4 | 4000 / Tape & Reel |
| MC74VHC1GU04P5T5G (Please contact onsemi) | SOT-953 | TBD | Q2 | 8000 / 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.

*-Q Suffix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP

Pin 1 Orientation in Tape and Reel Direction of Feed



Capable.

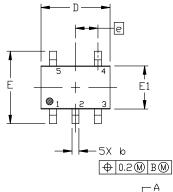
PACKAGE DIMENSIONS

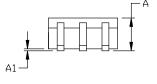
SC-88A (SC-70-5/SOT-353) CASE 419A-02 ISSUE M

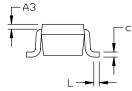
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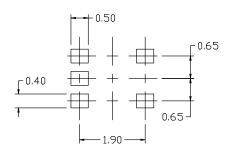
- 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- 2. CONTROLLING DIMENSION: MILLIMETERS
- 3. 419A-01 DBSOLETE, NEW STANDARD 419A-02
- 4. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH,
 PROTRUSIONS, OR GATE BURRS.MOLD FLASH, PROTRUSIONS,
 OR GATE BURRS SHALL NOT EXCEED 0.1016MM PER SIDE.

| DIM | MILLIMETERS | | | |
|-------|-------------|------|------|--|
| ויונע | MIN. | N□M. | MAX. | |
| Α | 0.80 | 0.95 | 1.10 | |
| A1 | | | 0.10 | |
| A3 | 0.20 REF | | | |
| b | 0.10 | 0.20 | 0.30 | |
| C | 0.10 | | 0,25 | |
| D | 1.80 | 2.00 | 2,20 | |
| Е | 2.00 | 2.10 | 2.20 | |
| E1 | 1.15 | 1.25 | 1.35 | |
| е | 0.65 BSC | | | |
| L | 0.10 | 0.15 | 0.30 | |







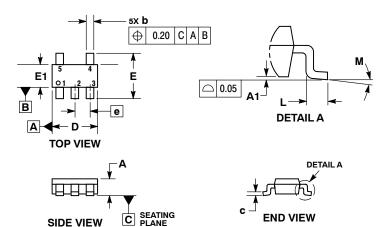


RECOMMENDED MOUNTING FOOTPRINT

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

PACKAGE DIMENSIONS

SC-74A CASE 318BQ **ISSUE B**



- NOTES:

 1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.

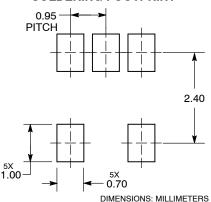
 2. CONTROLLING DIMENSION: MILLIMETERS.

 3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.

 4. DIMENSIONS A AND B DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.15 PER SIDE.

| | MILLIMETERS | | |
|-----|-------------|--------------|--|
| DIM | MIN | MAX | |
| Α | 0.90 | 1.10 | |
| A1 | 0.01 | 0.10 0.50 | |
| b | 0.25 | | |
| С | 0.10 | 0.26 | |
| D | 2.85 | 3.15 | |
| E | 2.50 | 3.00 | |
| E1 | 1.35 | 1.65 | |
| е | 0.95 BSC | | |
| L | 0.20 | 0.60 | |
| M | 0 ° | 10° | |

RECOMMENDED SOLDERING FOOTPRINT*

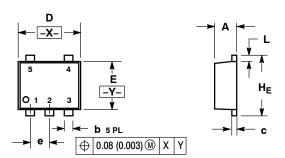


*For additional information on our Pb-Free strategy and soldering details, please download the onsemi Soldering and Mounting
Techniques Reference Manual, SOLDERRM/D.

PACKAGE DIMENSIONS

SOT-553, 5 LEAD

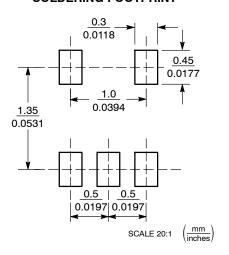
CASE 463B ISSUE C



- NOTES:
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: MILLIMETERS
 3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH
 THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM
 THICKNESS OF BASE MATERIAL.

| | MILLIMETERS | | | INCHES | | |
|-----|-------------|------|-----------|--------|-------|-------|
| DIM | MIN | NOM | MAX | MIN | NOM | MAX |
| Α | 0.50 | 0.55 | 0.60 | 0.020 | 0.022 | 0.024 |
| b | 0.17 | 0.22 | 0.27 | 0.007 | 0.009 | 0.011 |
| С | 0.08 | 0.13 | 0.18 | 0.003 | 0.005 | 0.007 |
| D | 1.55 | 1.60 | 1.65 | 0.061 | 0.063 | 0.065 |
| E | 1.15 | 1.20 | 1.25 | 0.045 | 0.047 | 0.049 |
| е | 0.50 BSC | | 0.020 BSC | | | |
| L | 0.10 | 0.20 | 0.30 | 0.004 | 0.008 | 0.012 |
| HE | 1.55 | 1.60 | 1.65 | 0.061 | 0.063 | 0.065 |

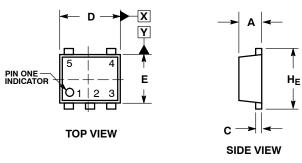
SOLDERING FOOTPRINT*

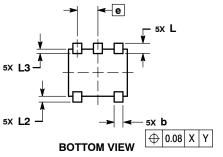


*For additional information on our Pb-Free strategy and soldering details, please download the onsemi Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

PACKAGE DIMENSIONS

SOT-953 CASE 527AE ISSUE E





- NOTES:

 1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.

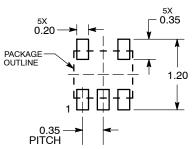
 2. CONTROLLING DIMENSION: MILLIMETERS

 3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF THE BASE MATERIAL.

 4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS.

| | MILLIMETERS | | | |
|-----|-------------|------|------|--|
| DIM | MIN | NOM | MAX | |
| Α | 0.34 | 0.37 | 0.40 | |
| b | 0.10 | 0.15 | 0.20 | |
| С | 0.07 | 0.12 | 0.17 | |
| D | 0.95 | 1.00 | 1.05 | |
| Е | 0.75 | 0.80 | 0.85 | |
| е | 0.35 BSC | | | |
| HE | 0.95 | 1.00 | 1.05 | |
| L | 0.175 REF | | | |
| L2 | 0.05 | 0.10 | 0.15 | |
| L3 | | | 0.15 | |

SOLDERING FOOTPRINT*

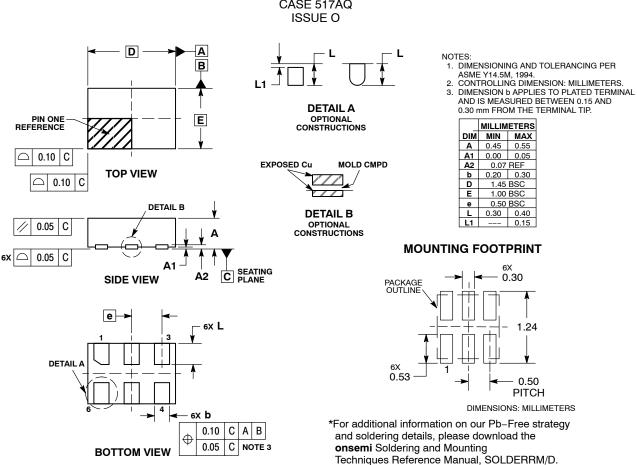


DIMENSIONS: MILLIMETERS

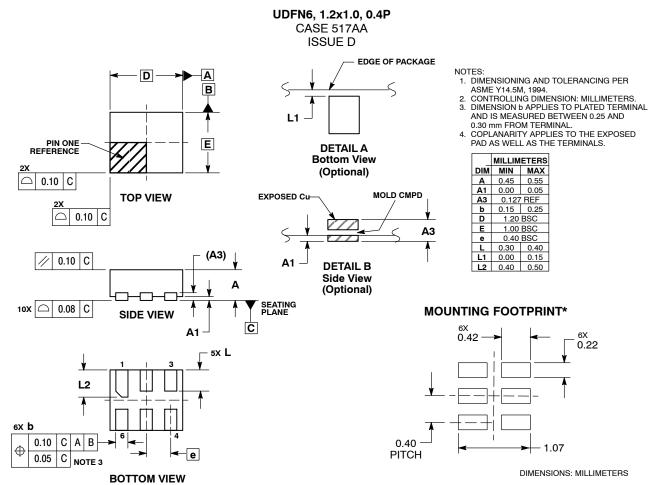
^{*}For additional information on our Pb-Free strategy and soldering details, please download the **onsemi** Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

PACKAGE DIMENSIONS

UDFN6, 1.45x1.0, 0.5P CASE 517AQ

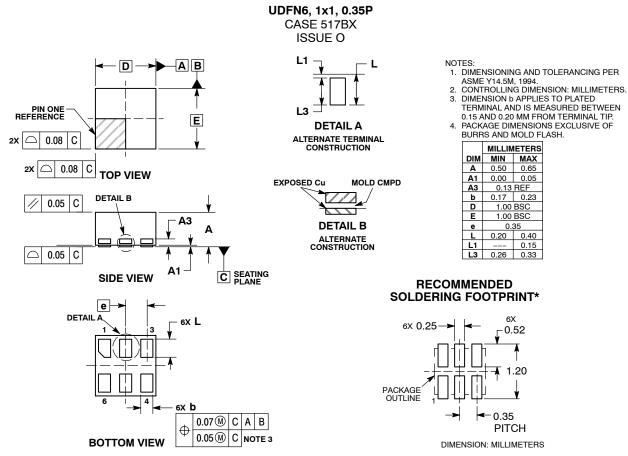


PACKAGE DIMENSIONS



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PACKAGE DIMENSIONS



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MC74VHC1GU04DBVT1G MC74VHC1GU04MU1TCG M74VHC1GU04DFT1G-L22038 MC74VHC1GU04DFT2G-Q MC74VHC1GU04DFT1G MC74VHC1GU04DFT2G