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TinyLogic ULP-A Inverter

NC7SV04

The NC7SV04 is a single Inverter in tiny footprint packages. The device is designed to operate for $V_{CC} = 0.9\text{ V}$ to 3.6 V .

Features

- Designed for 0.9 V to 3.6 V V_{CC} Operation
- 1.5 ns t_{PD} at 3.3 V (Typ)
- Inputs/Outputs Over-Voltage Tolerant up to 3.6 V
- I_{OFF} Supports Partial Power Down Protection
- Source/Sink 24 mA at 3.3 V
- Available in SC-88A and MicroPak™ Packages
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

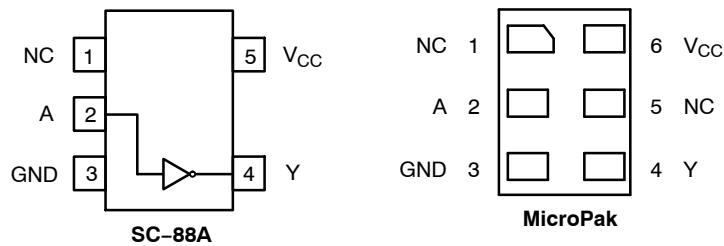


Figure 1. Pinout Diagrams (Top Views)

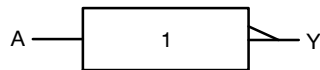


Figure 2. Logic Symbol

PIN ASSIGNMENT

| Pin | SC-88A | MicroPak |
|-----|----------|----------|
| 1 | N.C. | N.C. |
| 2 | A | A |
| 3 | GND | GND |
| 4 | Y | Y |
| 5 | V_{CC} | N.C. |
| 6 | - | V_{CC} |

N.C. = No Connect

FUNCTION TABLE

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



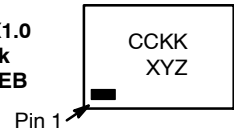
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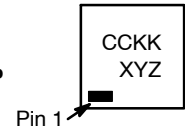
MARKING DIAGRAMS



SIP6 1.45X1.0
MicroPak
CASE 127EB



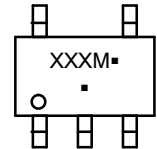
UDFN6
MicroPak2
CASE 517DP



CC = Specific Device Code
KK = 2-Digit Lot Run Traceability Code
XY = 2-Digit Date Code
Z = Assembly Plant Code



SC-88A
CASE 419A-02



XXX = Specific Device Code
M = Date Code
▪ = Pb-Free Package

ORDERING INFORMATION

See detailed ordering, marking and shipping information on page 6 of this data sheet.

NC7SV04

MAXIMUM RATINGS

| Symbol | Characteristics | Value | Unit |
|-------------------------------------|--|---|------|
| V _{CC} | DC Supply Voltage | -0.5 to +4.3 | V |
| V _{IN} | DC Input Voltage | -0.5 to +4.3 | V |
| V _{OUT} | DC Output Voltage Active-Mode (High or Low State) Tri-State Mode (Note 1) Power-Down Mode (V _{CC} = 0 V) | -0.5 to V _{CC} + 0.5 -0.5 to +4.3 -0.5 to +4.3 | V |
| I _{IK} | DC Input Diode Current V _{IN} < GND | -50 | mA |
| I _{OK} | DC Output Diode Current V _{OUT} < GND | -50 | mA |
| I _{OUT} | DC Output Source/Sink Current | ±50 | 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 |
| T _L | Lead Temperature, 1 mm from Case for 10 Seconds | 260 | °C |
| T _J | Junction Temperature Under Bias | +150 | °C |
| θ _{JA} | Thermal Resistance (Note 2) SC-88A MicroPak | 377 154 | °C/W |
| P _D | Power Dissipation in Still Air SC-88A MicroPak | 332 812 | 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 | 4000 2000 | 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.
2. Measured with minimum pad spacing on an FR4 board, using 10 mm-by-1 inch, 2 ounce copper trace no air flow per JESD51-7.
3. HBM tested to EIA / JESD22-A114-A. CDM tested to JESD22-C101-A. JEDEC recommends that ESD qualification to EIA/JESD22-A115A (Machine Model) be discontinued.
4. Tested to EIA/JESD78 Class II.

NC7SV04

RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Min | Max | Unit |
|------------|-------------------------------------|---|------------------------|------|
| V_{CC} | Positive DC Supply Voltage | 0.9 | 3.6 | V |
| V_{IN} | DC Input Voltage | 0 | 3.6 | V |
| V_{OUT} | DC Output Voltage | Active-Mode (High or Low State) Tri-State Mode (Note 1) Power-Down Mode ($V_{CC} = 0$ V) | V_{CC} 3.6 3.6 | |
| T_A | Operating Temperature Range | -40 | +85 | °C |
| t_r, t_f | Input Transition Rise and Fall Time | $V_{CC} = 3.3$ V \pm 0.3 V | | 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

| Symbol | Parameter | Condition | V_{CC} (V) | $T_A = 25^\circ\text{C}$ | | | $T_A = -40^\circ\text{C to } +85^\circ\text{C}$ | | Unit | |
|-------------------|---------------------------|-------------------------------|--------------|--------------------------|----------------|----------------------|---|----------------------|------|---|
| | | | | Min | Typ | Max | Min | Max | | |
| V_{IH} | High-Level Input Voltage | | 0.9 | - | 0.5 | - | - | - | V | |
| | | | 1.1 to 1.3 | $0.65 \times V_{CC}$ | - | - | $0.65 \times V_{CC}$ | - | | |
| | | | 1.4 to 1.6 | $0.65 \times V_{CC}$ | - | - | $0.65 \times V_{CC}$ | - | | |
| | | | 1.65 to 1.95 | $0.65 \times V_{CC}$ | - | - | $0.65 \times V_{CC}$ | - | | |
| | | | 2.3 to <2.7 | 1.6 | - | - | 1.6 | - | | |
| | | | 2.7 to 3.6 | 2.0 | - | - | 2.0 | - | | |
| V_{IL} | Low-Level Input Voltage | | 0.9 | - | 0.5 | - | - | - | V | |
| | | | 1.1 to 1.3 | - | - | $0.35 \times V_{CC}$ | - | $0.35 \times V_{CC}$ | | |
| | | | 1.4 to 1.6 | - | - | $0.35 \times V_{CC}$ | - | $0.35 \times V_{CC}$ | | |
| | | | 1.65 to 1.95 | - | - | $0.35 \times V_{CC}$ | - | $0.35 \times V_{CC}$ | | |
| | | | 2.3 to <2.7 | - | - | 0.7 | - | 0.7 | | |
| | | | 2.7 to 3.6 | - | - | 0.8 | - | 0.8 | | |
| V_{OH} | High-Level Output Voltage | $V_{IN} = V_{IH}$ or V_{IL} | | | | | | | V | |
| | | $I_{OH} = -100 \mu\text{A}$ | 0.9 | - | $V_{CC} - 0.1$ | - | - | - | | - |
| | | | 1.1 to 1.3 | $V_{CC} - 0.1$ | - | - | $V_{CC} - 0.1$ | - | | - |
| | | | 1.4 to 1.6 | $V_{CC} - 0.1$ | - | - | $V_{CC} - 0.1$ | - | | - |
| | | | 1.65 to 1.95 | $V_{CC} - 0.2$ | - | - | $V_{CC} - 0.2$ | - | | - |
| | | | 2.3 to <2.7 | $V_{CC} - 0.2$ | - | - | $V_{CC} - 0.2$ | - | | - |
| | | | 2.7 to 3.6 | $V_{CC} - 0.2$ | - | - | $V_{CC} - 0.2$ | - | | - |
| | | $I_{OH} = -2$ mA | 1.1 to 1.3 | $0.75 \times V_{CC}$ | - | - | $0.75 \times V_{CC}$ | - | | - |
| | | | 1.4 to 1.6 | $0.75 \times V_{CC}$ | - | - | $0.75 \times V_{CC}$ | - | | - |
| | | $I_{OH} = -4$ mA | 1.65 to 1.95 | 1.25 | - | - | 1.25 | - | | - |
| | | | 2.3 to <2.7 | 2.0 | - | - | 2.0 | - | | - |
| | | $I_{OH} = -6$ mA | 2.3 to <2.7 | 1.8 | - | - | 1.8 | - | | - |
| | | | 2.7 to 3.6 | 2.2 | - | - | 2.2 | - | | - |
| | | $I_{OH} = -12$ mA | 2.3 to <2.7 | 1.7 | - | - | 1.7 | - | | - |
| | | | 2.7 to 3.6 | 2.4 | - | - | 2.4 | - | | - |
| $I_{OH} = -18$ mA | 2.7 to 3.6 | 2.2 | - | - | 2.2 | - | - | | | |
| | | | | | | | | | | |

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DC ELECTRICAL CHARACTERISTICS (continued)

| Symbol | Parameter | Condition | V _{CC} (V) | T _A = 25°C | | | T _A = -40°C to +85°C | | Unit | |
|-------------------------|---------------------------|---|---------------------|-----------------------|-----|------------------------|---------------------------------|------------------------|------|---|
| | | | | Min | Typ | Max | Min | Max | | |
| V _{OL} | Low-Level Output Voltage | V _{IN} = V _{IH} or V _{IL} | | | | | | | V | |
| | | I _{OL} = 100 μA | 0.9 | - | 0.1 | - | - | - | | - |
| | | | 1.1 to 1.3 | - | - | 0.1 | - | 0.1 | | - |
| | | | 1.4 to 1.6 | - | - | 0.1 | - | 0.1 | | - |
| | | | 1.65 to 1.95 | - | - | 0.2 | - | 0.2 | | - |
| | | | 2.3 to <2.7 | - | - | 0.2 | - | 0.2 | | - |
| | | | 2.7 to 3.6 | - | - | 0.2 | - | 0.2 | | - |
| | | I _{OL} = 2 mA | 1.1 to 1.3 | - | - | 0.25 x V _{CC} | - | 0.25 x V _{CC} | | - |
| | | | 1.4 to 1.6 | - | - | 0.25 x V _{CC} | - | 0.25 x V _{CC} | | - |
| | | I _{OL} = 4 mA | 1.65 to 1.95 | - | - | 0.3 | - | 0.3 | | - |
| | | | 2.3 to <2.7 | - | - | 0.4 | - | 0.4 | | - |
| | | I _{OL} = 6 mA | 2.7 to 3.6 | - | - | 0.4 | - | 0.4 | | - |
| | | | 2.3 to <2.7 | - | - | 0.6 | - | 0.6 | | - |
| I _{OL} = 12 mA | 2.7 to 3.6 | - | - | 0.4 | - | 0.4 | - | | | |
| | 2.3 to <2.7 | - | - | 0.6 | - | 0.6 | - | | | |
| I _{OL} = 18 mA | 2.7 to 3.6 | - | - | 0.4 | - | 0.4 | - | | | |
| | 2.3 to <2.7 | - | - | 0.6 | - | 0.6 | - | | | |
| I _{OL} = 24 mA | 2.7 to 3.6 | - | - | 0.55 | - | 0.55 | - | | | |
| | 2.3 to <2.7 | - | - | 0.6 | - | 0.6 | - | | | |
| I _{IN} | Input Leakage Current | V _{IN} = 0 V to 3.6 V | 0.9 to 3.6 | - | - | ±0.1 | - | ±0.5 | μA | |
| I _{OFF} | Power Off Leakage Current | V _{IN} = 0 V to 3.6 V or V _{OUT} = 0 V to 3.6 V | 0 | - | - | 0.5 | - | 0.5 | μA | |
| I _{CC} | Quiescent Supply Current | V _{IN} = V _{CC} or GND | 0.9 to 3.6 | - | - | 0.9 | - | 0.9 | μA | |

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

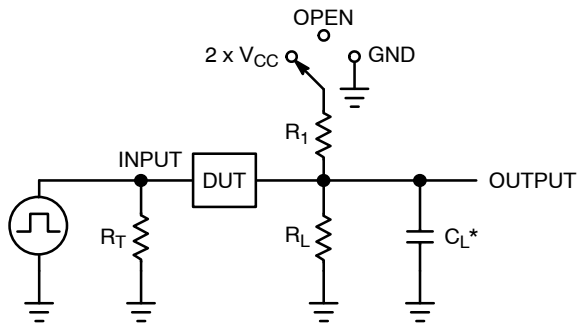
| Symbol | Parameter | Condition | V _{CC} (V) | T _A = 25°C | | | T _A = -40°C to +85°C | | Unit |
|--|---|--|---------------------|-----------------------|------|-----|---------------------------------|------|------|
| | | | | Min | Typ | Max | Min | Max | |
| t _{PLH} , t _{PHL} | Propagation Delay, A to Y (Figures 3 and 4) | R _L = 1 MΩ, C _L = 15 pF | 0.9 | - | 11.7 | - | - | - | ns |
| | | R _L = 2 kΩ, C _L = 15 pF | 1.1 to 1.3 | - | 5.5 | 9.0 | - | 13.9 | |
| | | | 1.4 to 1.6 | - | 3.1 | 5.1 | - | 6.0 | |
| | | | 1.65 to 1.95 | - | 2.4 | 4.2 | - | 5.2 | |
| | | R _L = 500 Ω, C _L = 30 pF | 2.3 to 2.7 | - | 1.8 | 2.7 | - | 3.4 | |
| | | | 2.7 to 3.6 | - | 1.5 | 2.3 | - | 2.8 | |

CAPACITIVE CHARACTERISTICS

| Symbol | Parameter | Test Condition | Typical (T _A = 25°C) | Unit |
|-----------------|--|--|---------------------------------|------|
| C _{IN} | Input Capacitance | V _{CC} = 0 V | 2.0 | pF |
| C _{PD} | Power Dissipation Capacitance (Note 5) | f = 10 MHz, V _{CC} = 0.9 to 3.6 V, V _{IN} = 0 V or V _{CC} | 10.0 | 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} • V_{CC} • f_{in} + I_{CC}. C_{PD} is used to determine the no-load dynamic power consumption: P_D = C_{PD} • V_{CC}² • f_{in} + I_{CC} • V_{CC}.

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

| Test | Switch Position |
|---------------------|-------------------|
| t_{PLH} / t_{PHL} | Open |
| t_{PLZ} / t_{PZL} | $2 \times V_{CC}$ |
| t_{PHZ} / t_{PZH} | GND |

Figure 3. Test Circuit



| V_{CC}, V | V_{mi}, V | V_{mo}, V | V_Y, V |
|--------------|--------------|--------------|----------|
| 0.9 | $V_{CC} / 2$ | $V_{CC} / 2$ | 0.1 |
| 1.1 to 1.3 | $V_{CC} / 2$ | $V_{CC} / 2$ | 0.1 |
| 1.4 to 1.6 | $V_{CC} / 2$ | $V_{CC} / 2$ | 0.1 |
| 1.65 to 1.95 | $V_{CC} / 2$ | $V_{CC} / 2$ | 0.15 |
| 2.3 to 2.7 | $V_{CC} / 2$ | $V_{CC} / 2$ | 0.15 |
| 3.0 to 3.6 | 1.5 | 1.5 | 0.3 |

Figure 4. Switching Waveforms

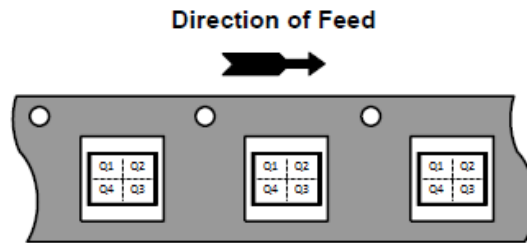
NC7SV04

ORDERING INFORMATION

| Device | Package | Marking | Pin 1 Orientation (See below) | Shipping† |
|------------|-----------|---------|----------------------------------|--------------------|
| NC7SV04P5X | SC-88A | V04 | Q4 | 3000 / Tape & Reel |
| NC7SV04L6X | MicroPak | F7 | Q4 | 5000 / Tape & Reel |
| NC7SV04FHX | MicroPak2 | F7 | Q4 | 5000 / 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.

Pin 1 Orientation in Tape and Reel

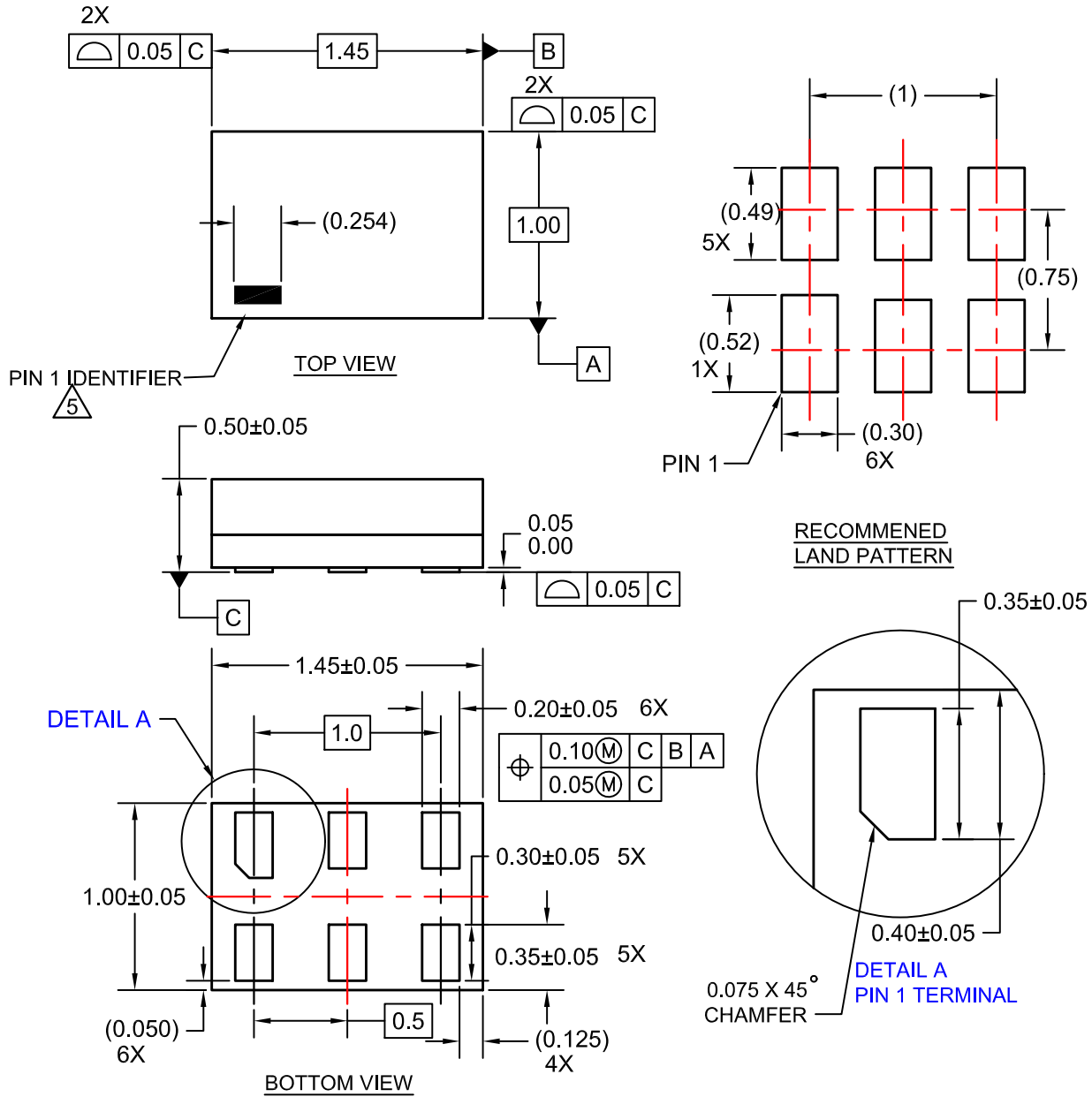


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NC7SV04

PACKAGE DIMENSIONS

SIP6 1.45X1.0
CASE 127EB
ISSUE O



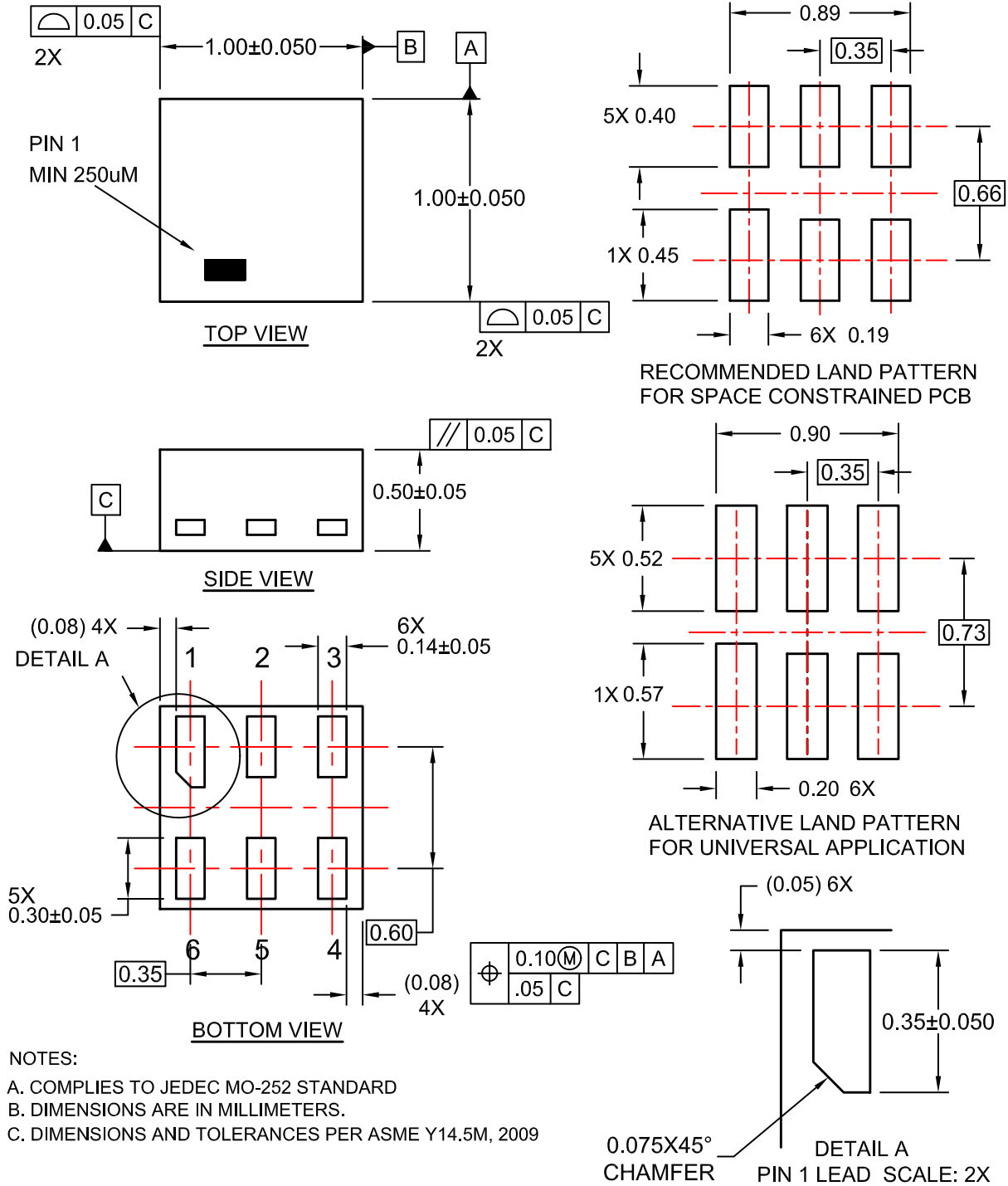
NOTES:

1. CONFORMS TO JEDEC STANDARD MO-252 VARIATION UAAD
2. DIMENSIONS ARE IN MILLIMETERS
3. DRAWING CONFORMS TO ASME Y14.5M-2009
4. PIN ONE IDENTIFIER IS 2X LENGTH OF ANY OTHER LINE IN THE MARK CODE LAYOUT.

NC7SV04

PACKAGE DIMENSIONS

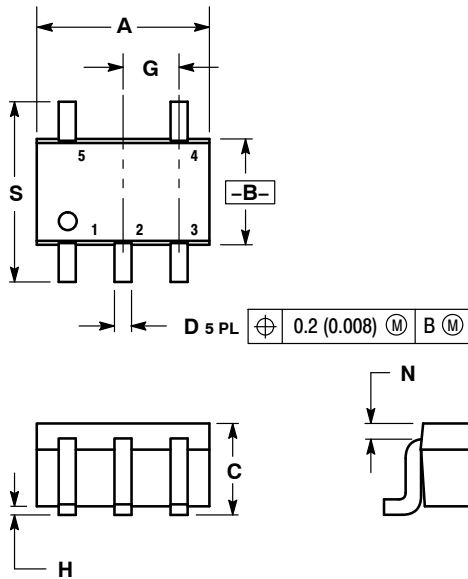
UDFN6 1.0X1.0, 0.35P
CASE 517DP
ISSUE O



NC7SV04

PACKAGE DIMENSIONS

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

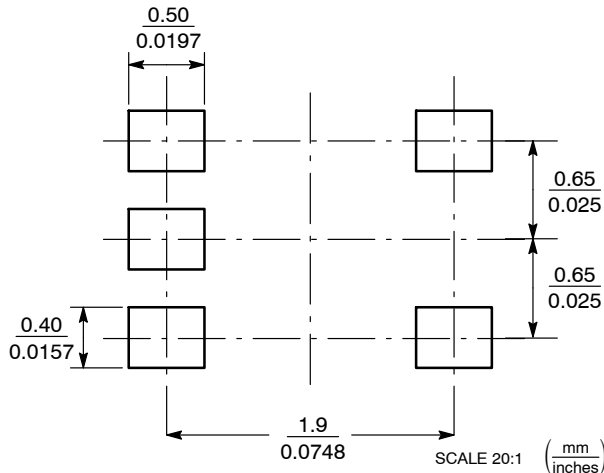


NOTES:

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 |

SOLDER FOOTPRINT



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