# TinyLogic UHS Unbuffered Inverter

# NC7SZU04

## Description

The NC7SZU04 is a single unbuffered inverter from **onsemi**'s Ultra−High Speed series of TinyLogic. The special purpose unbuffered circuit design is primarily intended for crystal oscillator or analog applications. The device is fabricated with advanced CMOS technology to achieve ultra−high speed with high output drive while maintaining low static power dissipation over a broad $V_{CC}$ operating range. The device is specified to operate over the 1.65 V to 5.5 V $V_{CC}$ range.

## Features

- Unbuffered for Crystal Oscillator and Analog Applications
- Balanced Output Drive: ±32 mA at 4.5 V $V_{CC}$
- Broad $V_{CC}$ Operating Range: 1.65 V to 5.5 V
- Matches Performance of LCX Operated at 3.3 V $V_{CC}$
- Low Quiescent Power: $I_{CC}$ < 2 μA, $V_{CC}$ = 5.5 V, $T_A$ = 25°C
- Ultra−Small MicroPak™ Packages
- Space−Saving SOT−23−5 and SC−88A Packages
- These Devices are Pb−Free, Halogen Free/BFR Free and are RoHS Compliant

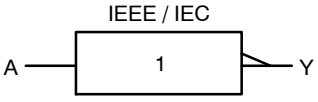
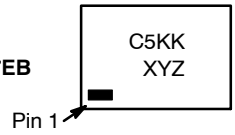



**Figure 1. Logic Symbol**

## MARKING DIAGRAMS

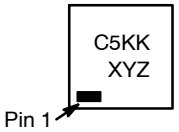


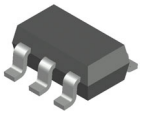
**SIP6**
**CASE 127EB**



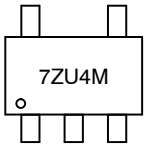


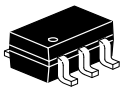

**UDFN6**
**CASE 517DP**



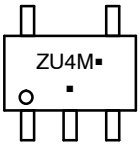



**SOT−23−5**
**CASE 527AH**



**SC−88A**
**CASE 419A−02**




C5, 7ZU4, ZU4 = Specific Device Code
KK = 2−Digit Lot Run Traceability Code
XY = 2−Digit Date Code Format
Z = Assembly Plant Code
M = Date Code*
▪ = Pb−Free Package

(Note: Microdot may be in either location)

*Date Code orientation and/or position may vary depending upon manufacturing location.

## ORDERING INFORMATION

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

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## Pin Configurations

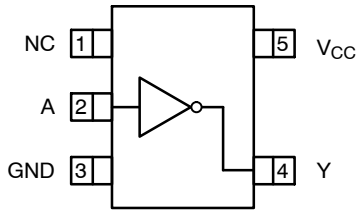



**Figure 2. SC88A and SOT−23−5 (Top View)**

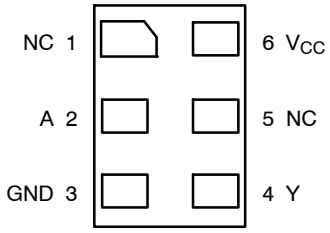



**Figure 3. MicroPak (Top Through View)**

### PIN DEFINITIONS

| Pin # SC−88A / SOT−23−5 | Pin # MicroPak | Name | Description |
|---|---|---|---|
| 1 | 1, 5 | NC | No Connect |
| 2 | 2 | A | Input |
| 3 | 3 | GND | Ground |
| 4 | 4 | Y | Output |
| 5 | 6 | $V_{CC}$ | Supply Voltage |

### FUNCTION TABLE

| Inputs | Output |
|---|---|
| **A** | **Y** |
| L | H |
| H | L |

H = HIGH Logic Level
L = LOW Logic Level

## ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_{CC}$ | Supply Voltage | | −0.5 | 6.5 | V |
| $V_{IN}$ | DC Input Voltage | | −0.5 | 6.5 | V |
| $V_{OUT}$ | DC Output Voltage | | −0.5 | $V_{CC}$ + 0.5 | V |
| $I_{IK}$ | DC Input Diode Current | $V_{IN}$ < 0 V | − | −50 | mA |
| $I_{OK}$ | DC Output Diode Current | $V_{OUT}$ < 0 V | − | −50 | mA |
| | | $V_{OUT}$ > $V_{CC}$ | − | +50 | |
| $I_{OUT}$ | DC Output Current | | − | ±50 | mA |
| $I_{CC}$ or $I_{GND}$ | DC $V_{CC}$ or Ground Current | | − | ±50 | mA |
| $T_{STG}$ | Storage Temperature Range | | −65 | +150 | °C |
| $T_J$ | Junction Temperature Under Bias | | − | +150 | °C |
| $T_L$ | Junction Lead Temperature (Soldering, 10 Seconds) | | − | +260 | °C |
| $P_D$ | Power Dissipation in Still Air | SOT−23−5 | − | 390 | mW |
| | | SC−88A | − | 332 | |
| | | MicroPak−6 | − | 812 | |
| | | MicroPak2™−6 | − | 812 | |
| ESD | Human Body Model, JEDEC: JESD22−A114 | | − | 4000 | V |
| | Charge Device Model, JEDEC: JESD22−C101 | | − | 2000 | |

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.

## RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Conditions | Min | Max | Unit |
|---|---|---|---|---|---|
| $V_{CC}$ | Supply Voltage Operating | | 1.65 | 5.5 | V |
| | Supply Voltage Data Retention | | 1.50 | 5.5 | |
| $V_{IN}$ | Input Voltage | | 0 | 5.5 | V |
| $V_{OUT}$ | Output Voltage | | 0 | $V_{CC}$ | V |
| $T_A$ | Operating Temperature | | −40 | +85 | °C |
| $\theta_{JA}$ | Thermal Resistance | SOT−23−5 | − | 320 | °C/W |
| | | SC−88A | − | 377 | |
| | | MicroPak−6 | − | 154 | |
| | | MicroPak2−6 | − | 154 | |

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.

1. Unused inputs must be held HIGH or LOW. They may not float.

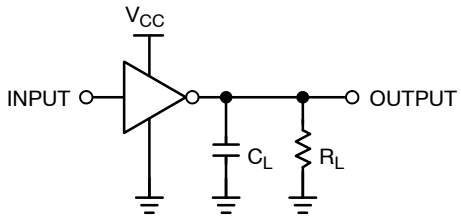
## DC ELECTRICAL CHARACTERISTICS

| Symbol | Parameter | Conditions | $V_{CC}$ (V) | $T_A$ = +25°C | | | $T_A$ = −40 to +85°C | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | Min | Max | |
| $V_{IH}$ | HIGH Level Input Voltage | | 1.8 to 2.7 | 0.85 $V_{CC}$ | – | – | 0.85 $V_{CC}$ | – | V |
| | | | 3.0 to 5.5 | 0.80 $V_{CC}$ | – | – | 0.80 $V_{CC}$ | – | |
| $V_{IL}$ | LOW Level Input Voltage | | 1.8 to 2.7 | – | – | 0.15 $V_{CC}$ | – | 0.15 $V_{CC}$ | V |
| | | | 3.0 to 5.5 | – | – | 0.20 $V_{CC}$ | – | 0.20 $V_{CC}$ | |
| $V_{OH}$ | High−Level Output Voltage | $V_{IN}$ = GND<br>$I_{OH}$ = −100 μA<br>$I_{OH}$ = −4 mA<br>$I_{OH}$ = −8 mA<br>$I_{OH}$ = −12 mA<br>$I_{OH}$ = −16 mA<br>$I_{OH}$ = −24 mA<br>$I_{OH}$ = −32 mA | <br>1.65 to 5.5<br>1.65<br>2.3<br>2.7<br>3.0<br>3.0<br>4.5 | <br>$V_{CC}$ − 0.1<br>1.29<br>1.9<br>2.2<br>2.4<br>2.3<br>3.8 | <br>$V_{CC}$<br>1.4<br>2.1<br>2.4<br>2.7<br>2.5<br>4.0 | <br>–<br>–<br>–<br>–<br>–<br>–<br>– | <br>$V_{CC}$ − 0.1<br>1.29<br>1.9<br>2.2<br>2.4<br>2.3<br>3.8 | <br>–<br>–<br>–<br>–<br>–<br>–<br>– | V |
| $V_{OL}$ | Low−Level Output Voltage | $V_{IN}$ = $V_{CC}$<br>$I_{OL}$ = 100 μA<br>$I_{OL}$ = 4 mA<br>$I_{OL}$ = 8 mA<br>$I_{OL}$ = 12 mA<br>$I_{OL}$ = 16 mA<br>$I_{OL}$ = 24 mA<br>$I_{OL}$ = 32 mA | <br>1.65 to 5.5<br>1.65<br>2.3<br>2.7<br>3.0<br>3.0<br>4.5 | <br>–<br>–<br>–<br>–<br>–<br>–<br>–<br>– | <br>–<br>0.08<br>0.2<br>0.22<br>0.28<br>0.38<br>0.42 | <br>0.1<br>0.24<br>0.3<br>0.4<br>0.4<br>0.55<br>0.55 | <br>–<br>–<br>–<br>–<br>–<br>–<br>– | <br>0.1<br>0.24<br>0.3<br>0.4<br>0.4<br>0.55<br>0.55 | V |
| $I_{IN}$ | Input Leakage Current | $V_{IN}$ = 5.5 V, GND | 1.65 to 5.5 | – | – | ±1 | – | ±10 | μA |
| $I_{CC}$ | Quiescent Supply Current | $V_{IN}$ = 5.5 V, GND | 1.65 to 5.5 | – | – | 2 | – | 20 | μA |

## AC ELECTRICAL CHARACTERISTICS

| Symbol | Parameter | $V_{CC}$ (V) | Conditions | $T_A$ = +25°C | | | $T_A$ = −40 to +85°C | | Unit |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | Min | Max | |
| $t_{PLH}$, $t_{PHL}$ | Propagation Delay (Figure 4, 5) | 1.65 | $C_L$ = 15 pF, $R_L$ = 1 MΩ | – | – | 11.7 | – | 12.1 | ns |
| | | 1.80 | | – | – | 8.5 | – | 9.0 | |
| | | 2.50 ±0.20 | | – | – | 6.2 | – | 6.5 | |
| | | 3.30 ±0.30 | | – | – | 4.5 | – | 4.8 | |
| | | 5.00 ±0.50 | | – | – | 3.9 | – | 4.1 | |
| | | 3.30 ±0.30 | $C_L$ = 50 pF, $R_L$ = 500 Ω | – | – | 6.0 | – | 6.5 | |
| | | 5.00 ±0.50 | | – | – | 5.0 | – | 5.5 | |
| $C_{IN}$ | Input Capacitance | 0.00 | | – | 4.5 | – | – | – | pF |
| $C_{PD}$ | Power Dissipation Capacitance (Note 2) (Figure 6) | 3.30 | | – | 6.3 | – | – | – | pF |
| | | 5.00 | | – | 9.5 | – | – | – | |

2. $C_{PD}$ is defined as the value of the internal equivalent capacitance which is derived from dynamic operating current consumption ($I_{CCD}$) at no output loading and operating at 50% duty cycle. $C_{PD}$ is related to $I_{CCD}$ dynamic operating current by the expression: $I_{CCD} = (C_{PD})\ (V_{CC})\ (f_{IN}) + (I_{CC}static)$.




NOTE:
3. $C_L$ includes load and stray capacitance.
4. Input PRR = 1.0 MHz; $t_W$ = 500 ns

**Figure 4. AC Test Circuit**

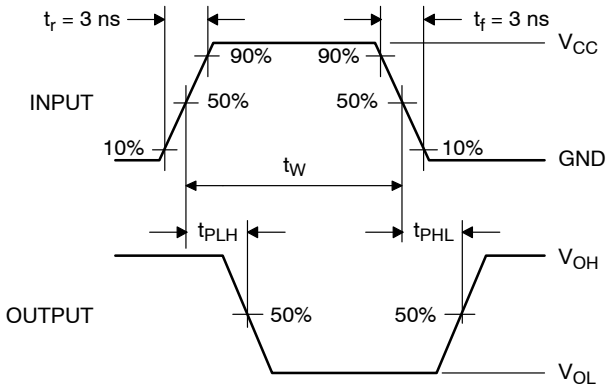
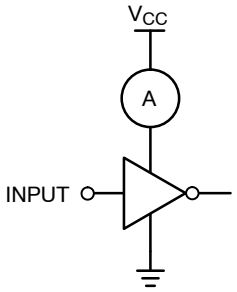



**Figure 5. AC Waveforms**




NOTE:
5. When operating the NC7SZU04's unbuffered output stage in its linear range, as in oscillator applications, care must be taken to observe maximum power rating for the device and package. The high drive nature of the design of the output stage results in substantial simultaneous conduction currents when the stage is in the linear region. *See the $I_{CCPEAK}$ specification in the DC Electrical Characteristics table.*
6. Input = AC Waveform; $t_r = t_f$ = 1.8 ns; PRR = Variable; Duty Cycle = 50%.

**Figure 6. $I_{CCD}$ Test Circuit**

## ORDERING INFORMATION

| Part Number | Top Mark | Packages | Shipping† |
|---|---|---|---|
| NC7SZU04M5X | 7ZU4 | SOT−23−5 | 3000 / Tape & Reel |
| NC7SZU04P5X | ZU4 | SC−88A | 3000 / Tape & Reel |
| NC7SZU04L6X | C5 | SIP6, MicroPak | 5000 / Tape & Reel |
| NC7SZU04FHX | C5 | UDFN6, MicroPak2 | 5000 / Tape & Reel |

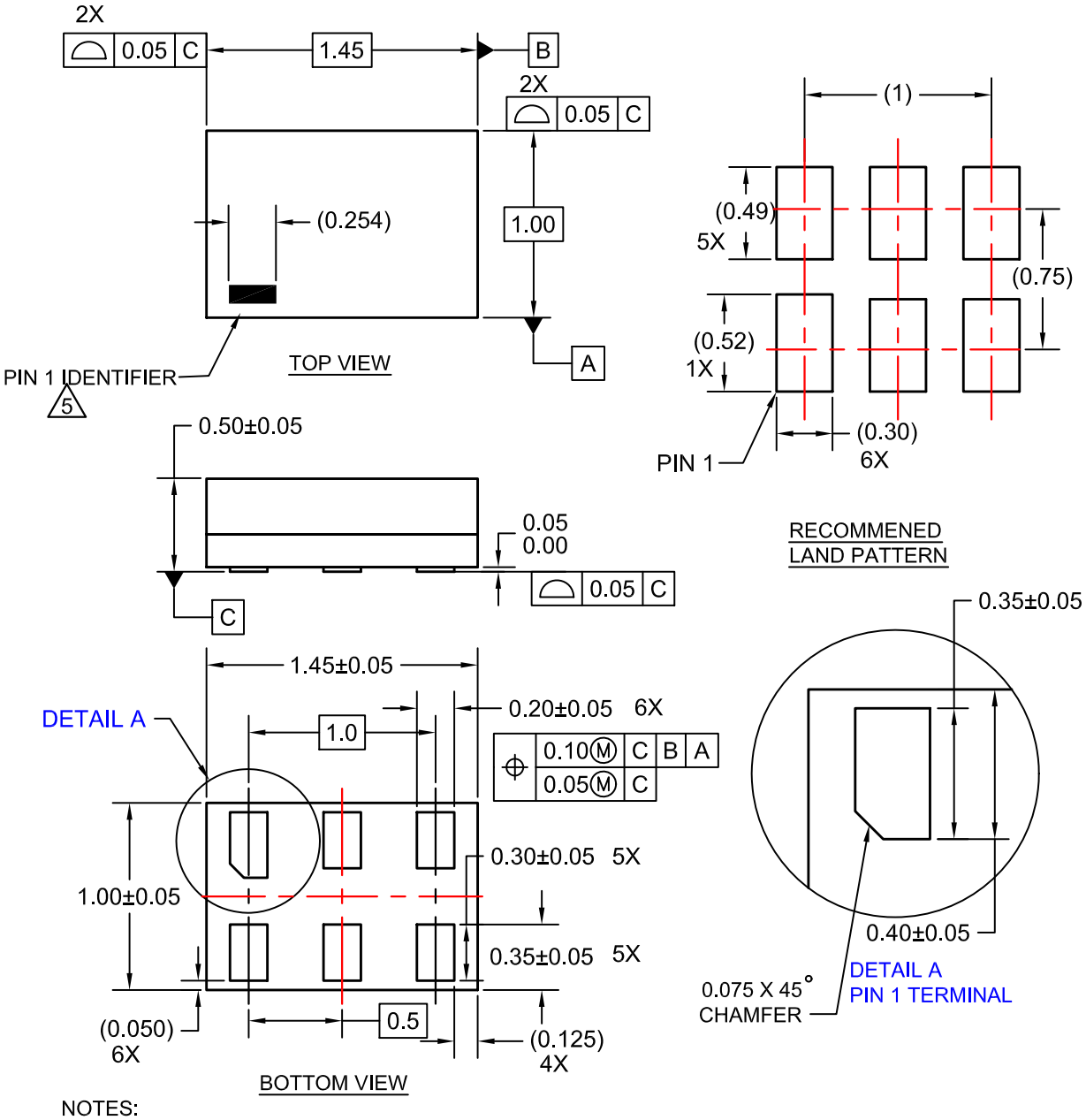
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

# MECHANICAL CASE OUTLINE
## PACKAGE DIMENSIONS

ON Semiconductor®

**SIP6 1.45X1.0**
CASE 127EB
ISSUE O

DATE 31 AUG 2016




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.

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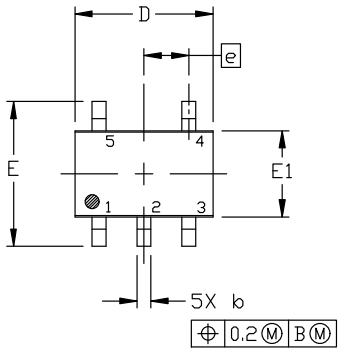

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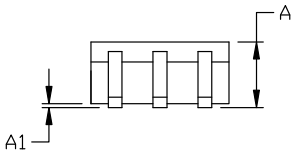
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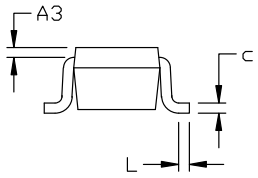
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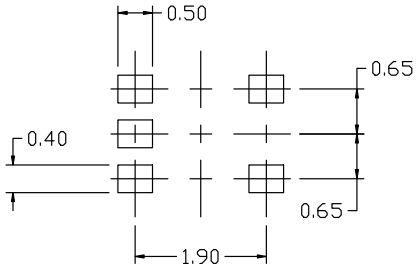
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CASE 419A−02
ISSUE M

DATE 11 APR 2023




RECOMMENDED
MOUNTING FOOTPRINT

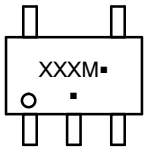
* For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETERS
3. 419A−01 OBSOLETE. 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 | | |
|---|---|---|---|
| | MIN. | NOM. | MAX. |
| A | 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 |
| E | 2.00 | 2.10 | 2.20 |
| E1 | 1.15 | 1.25 | 1.35 |
| e | 0.65 BSC | | |
| L | 0.10 | 0.15 | 0.30 |

### GENERIC MARKING DIAGRAM*




*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.

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

(Note: Microdot may be in either location)

STYLE 1:
PIN 1. BASE
2. EMITTER
3. BASE
4. COLLECTOR
5. COLLECTOR

STYLE 2:
PIN 1. ANODE
2. EMITTER
3. BASE
4. COLLECTOR
5. CATHODE

STYLE 3:
PIN 1. ANODE 1
2. N/C
3. ANODE 2
4. CATHODE 2
5. CATHODE 1

STYLE 4:
PIN 1. SOURCE 1
2. DRAIN 1/2
3. SOURCE 1
4. GATE 1
5. GATE 2

STYLE 5:
PIN 1. CATHODE
2. COMMON ANODE
3. CATHODE 2
4. CATHODE 3
5. CATHODE 4

STYLE 6:
PIN 1. EMITTER 2
2. BASE 2
3. EMITTER 1
4. COLLECTOR
5. COLLECTOR 2/BASE 1

STYLE 7:
PIN 1. BASE
2. EMITTER
3. BASE
4. COLLECTOR
5. COLLECTOR

STYLE 8:
PIN 1. CATHODE
2. COLLECTOR
3. N/C
4. BASE
5. EMITTER

STYLE 9:
PIN 1. ANODE
2. CATHODE
3. ANODE
4. ANODE
5. ANODE

Note: Please refer to datasheet for style callout. If style type is not called out in the datasheet refer to the device datasheet pinout or pin assignment.

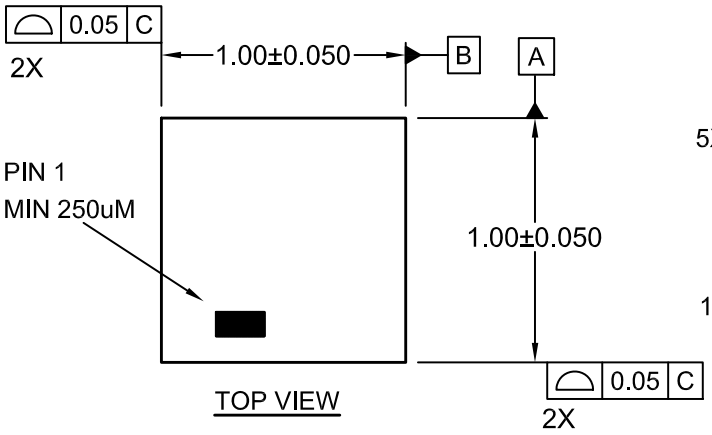
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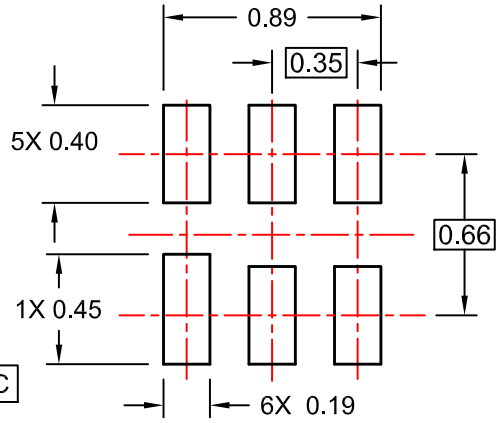
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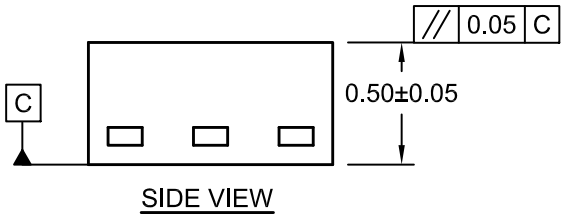
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CASE 517DP
ISSUE O

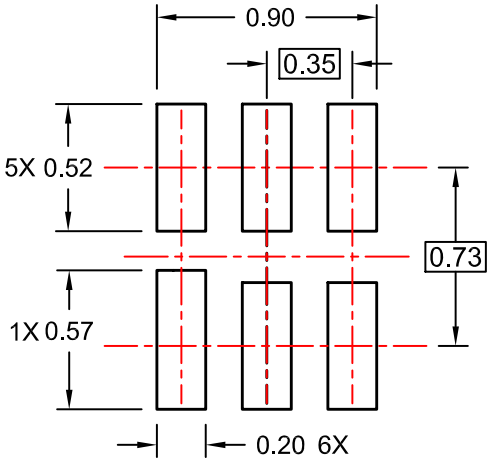
DATE 31 AUG 2016



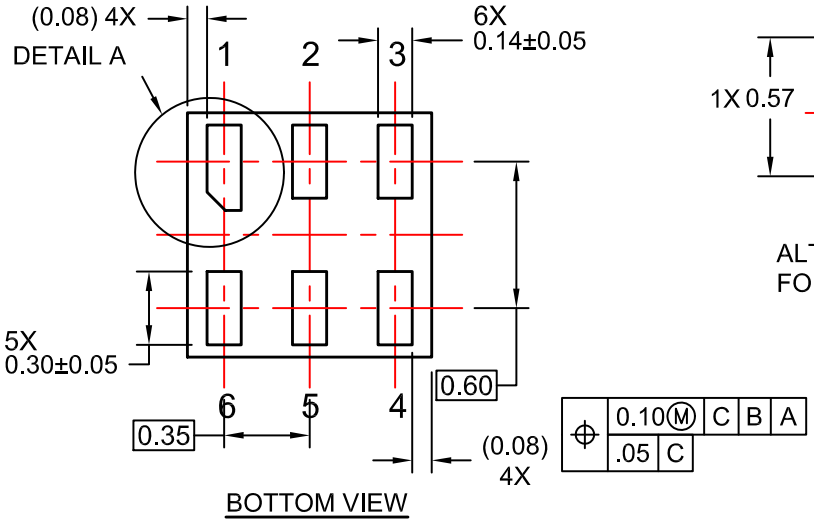



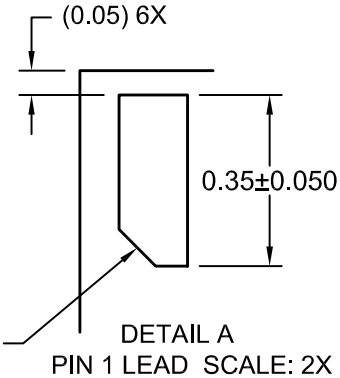

RECOMMENDED LAND PATTERN
FOR SPACE CONSTRAINED PCB




ALTERNATIVE LAND PATTERN
FOR UNIVERSAL APPLICATION




NOTES:

A. COMPLIES TO JEDEC MO-252 STANDARD
B. DIMENSIONS ARE IN MILLIMETERS.
C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 2009

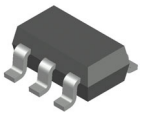
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| **DESCRIPTION:** | **UDFN6 1.0X1.0, 0.35P** | **PAGE 1 OF 1** |

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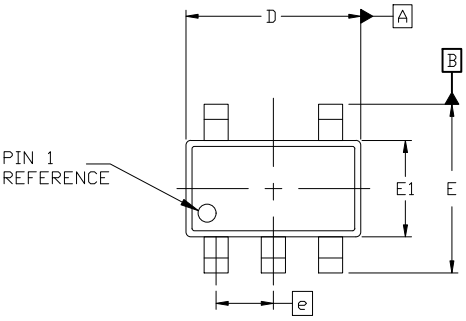
# MECHANICAL CASE OUTLINE
## PACKAGE DIMENSIONS

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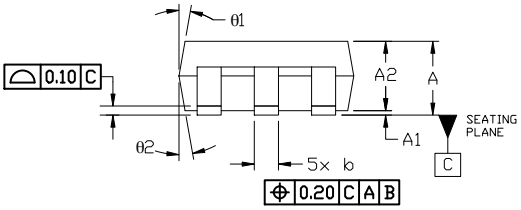


**SOT−23, 5 Lead**
CASE 527AH
ISSUE A

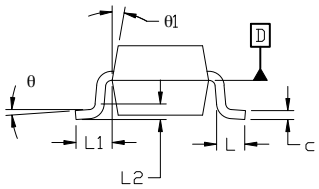
DATE 09 JUN 2021




TOP VIEW



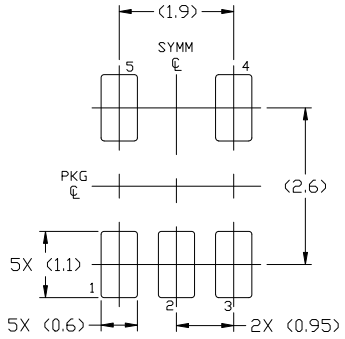

SIDE VIEW




END VIEW

NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 19894
2. CONTROLLING DIMENSION: MILLIMETERS
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF THE BASE MATERIAL.
4. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.25 PER SIDE. D AND E1 DIMENSIONS ARE DETERMINED AT DATUM D.
5. DIMENSION 'b' DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08mm TOTAL IN EXCESS OF THE 'b' DIMENSION AT MAXIMUM MATERIAL CONDITION. MINIMUM SPACE BETWEEN PROTRUSION AND AN ADJACENT LEAD SHALL NOT BE LESS THAN 0.07mm.

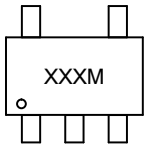
| | MILLIMETERS | | |
|---|---|---|---|
| DIM | MIN. | NOM. | MAX. |
| A | 0.90 | — | 1.45 |
| A1 | 0.00 | — | 0.15 |
| A2 | 0.90 | 1.15 | 1.30 |
| b | 0.30 | — | 0.50 |
| c | 0.08 | — | 0.22 |
| D | 2.90 BSC | | |
| E | 2.80 BSC | | |
| E1 | 1.60 BSC | | |
| e | 0.95 BSC | | |
| L | 0.30 | 0.45 | 0.60 |
| L1 | 0.60 REF | | |
| L2 | 0.25 REF | | |
| θ | 0° | 4° | 8° |
| θ1 | 0° | 10° | 15° |
| θ2 | 0° | 10° | 15° |




**RECOMMENDED MOUNTING 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.

**GENERIC MARKING DIAGRAM***




XXX = Specific Device Code
M = Date Code

*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.

| | | |
|---|---|---|
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| **DESCRIPTION:** | **SOT−23, 5 LEAD** | **PAGE 1 OF 1** |

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