



**THE DATASHEET OF  
NC7SZ86P5**



# NC7SZ86

## TinyLogic UHS Two-Input Exclusive-OR Gate

### Description

The NC7SZ86 is a single two-input exclusive-OR gate from ON Semiconductor's Ultra-High Speed (UHS) series of TinyLogic. 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<sub>CC</sub> operating range. The device is specified to operate over the 1.65 V to 5.5 V V<sub>CC</sub> operating range. The inputs and output are high impedance when V<sub>CC</sub> is 0 V. Inputs tolerate voltages up to 5.5 V, independent of V<sub>CC</sub> operating voltage.

### Features

- Ultra-High Speed: t<sub>PD</sub> 2.9 ns (Typical) into 50 pF at 5 V V<sub>CC</sub>
- High Output Drive: ±24 mA at 3 V V<sub>CC</sub>
- Broad V<sub>CC</sub> Operating Range: 1.65 V to 5.5 V
- Matches Performance of LCX Operated at 3.3 V V<sub>CC</sub>
- Power Down High-Impedance Inputs / Outputs
- Over-Voltage Tolerance Inputs Facilitate 5 V to 3 V Translation
- Proprietary Noise / EMI Reduction Circuitry
- Ultra-Small MicroPak™ Packages
- Space-Saving SC-74A and SC-88A Packages
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

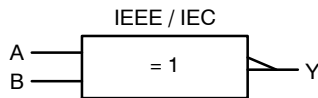


Figure 1. Logic Symbol



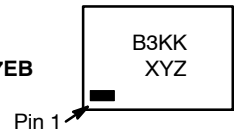
ON Semiconductor®

[www.onsemi.com](http://www.onsemi.com)

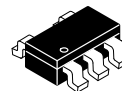
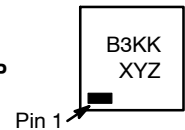
### MARKING DIAGRAMS



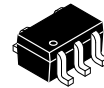
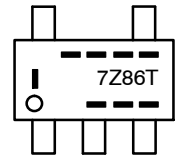
SIP6  
CASE 127EB



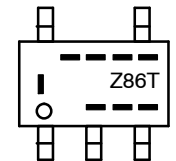
UDFN6  
CASE 517DP



SC-74A  
CASE 318BQ



SC-88A  
CASE 419A-02



B3, 7Z86, Z86 = Specific Device Code  
 KK = 2-Digit Lot Run Traceability Code  
 XY = 2-Digit Date Code Format  
 Z = Assembly Plant Code  
 M = Data Code  
 T = Die Run Code  
 --- = Year Coding Scheme  
 |--- = Plant Code Identifier  
 --- = Eight-Week Datacoding Scheme

### 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

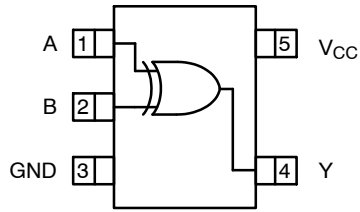


Figure 2. SC-88A and SC-74A (Top View)

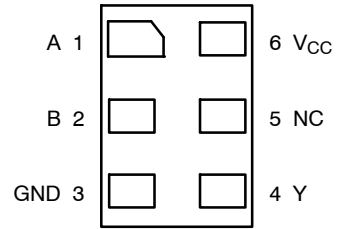


Figure 3. MicroPak (Top Through View)

### PIN DEFINITIONS

Pin # SC-88A / SC74A	Pin # MicroPak	Name	Description
1	1	A	Input
2	2	B	Input
3	3	GND	Ground
4	4	Y	Output
5	6	V <sub>CC</sub>	Supply Voltage
	5	NC	No Connect

### FUNCTION TABLE (Y = A + B)

Inputs		Output
A	B	Y
L	L	L
L	H	H
H	L	H
H	H	L

H = HIGH Logic Level  
L = LOW Logic Level

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## ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Min	Max	Unit	
V <sub>CC</sub>	Supply Voltage	-0.5	6.0	V	
V <sub>IN</sub>	DC Input Voltage	-0.5	6.0	V	
V <sub>OUT</sub>	DC Output Voltage	-0.5	6.0	V	
I <sub>IK</sub>	DC Input Diode Current	V <sub>IN</sub> < -0.5 V	-	-50	mA
		V <sub>IN</sub> > 6.0 V	-	+20	
I <sub>OK</sub>	DC Output Diode Current	V <sub>OUT</sub> < -0.5 V	-	-50	mA
		V <sub>OUT</sub> > 6 V, V <sub>CC</sub> = GND	-	+20	
I <sub>OUT</sub>	DC Output Current	-	±50	mA	
I <sub>CC</sub> or I <sub>GND</sub>	DC V <sub>CC</sub> or Ground Current	-	±50	mA	
T <sub>STG</sub>	Storage Temperature Range	-65	+150	°C	
T <sub>J</sub>	Junction Temperature Under Bias	-	+150	°C	
T <sub>L</sub>	Junction Lead Temperature (Soldering, 10 Seconds)	-	+260	°C	
P <sub>D</sub>	Power Dissipation in Still Air	SC-74A	-	225	mW
		SC-88A	-	190	
		MicroPak-6	-	327	
		MicroPak2™-6	-	327	
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 <sub>CC</sub>	Supply Voltage Operating		1.65	5.50	V
	Supply Voltage Data Retention		1.50	5.50	
V <sub>IN</sub>	Input Voltage		0	5.5	V
V <sub>OUT</sub>	Output Voltage		0	V <sub>CC</sub>	V
T <sub>A</sub>	Operating Temperature		-40	+85	°C
t <sub>r</sub> , t <sub>f</sub>	Input Rise and Fall Times	V <sub>CC</sub> = 1.8 V, 2.5 V ±0.2 V	0	20	ns/V
		V <sub>CC</sub> = 3.3 V ±0.3 V	0	10	
		V <sub>CC</sub> = 5.0 V ±0.5 V	0	5	
θ <sub>JA</sub>	Thermal Resistance	SC-74A	-	555	°C/W
		SC-88A	-	659	
		MicroPak-6	-	382	
		MicroPak2-6	-	382	

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.

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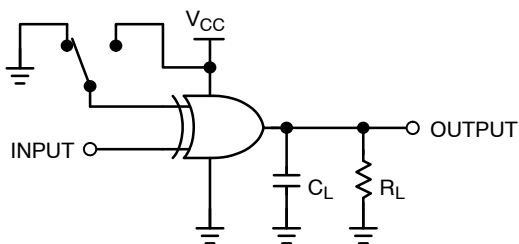
## DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	V <sub>CC</sub> (V)	Conditions	T <sub>A</sub> = +25°C			T <sub>A</sub> = -40 to +85°C		Unit
				Min	Typ	Max	Min	Max	
V <sub>IH</sub>	HIGH Level Input Voltage	1.65 to 1.95		0.65 V <sub>CC</sub>	-	-	0.65 V <sub>CC</sub>	-	V
		2.30 to 5.50		0.70 V <sub>CC</sub>	-	-	0.70 V <sub>CC</sub>	-	
V <sub>IL</sub>	LOW Level Input Voltage	1.65 to 1.95		-	-	0.35 V <sub>CC</sub>	-	0.35 V <sub>CC</sub>	V
		2.30 to 5.50		-	-	0.30 V <sub>CC</sub>	-	0.30 V <sub>CC</sub>	
V <sub>OH</sub>	HIGH Level Output Voltage	1.65	V <sub>IN</sub> = V <sub>IH</sub> , V <sub>IL</sub> I <sub>OH</sub> = -100 μA	1.55	1.65	-	1.55	-	V
		1.80		1.70	1.80	-	1.70	-	
		2.30		2.20	2.30	-	2.20	-	
		3.00		2.90	3.00	-	2.90	-	
		4.50		4.40	4.50	-	4.40	-	
		1.65	I <sub>OH</sub> = -4 mA	1.29	1.52	-	1.29	-	
		2.30	I <sub>OH</sub> = -8 mA	1.90	2.15	-	1.90	-	
		3.00	I <sub>OH</sub> = -16 mA	2.40	2.80	-	2.40	-	
		3.00	I <sub>OH</sub> = -24 mA	2.30	2.68	-	2.30	-	
		4.50	I <sub>OH</sub> = -32 mA	3.80	4.20	-	3.80	-	
V <sub>OL</sub>	LOW Level Output Voltage	1.65	V <sub>IN</sub> = V <sub>IH</sub> , or V <sub>IL</sub> I <sub>OL</sub> = 100 μA	-	0.00	0.10	-	0.10	V
		1.80		-	0.00	0.10	-	0.10	
		2.30		-	0.00	0.10	-	0.10	
		3.00		-	0.00	0.10	-	0.10	
		4.50		-	0.00	0.10	-	0.10	
		1.65	I <sub>OL</sub> = 4 mA	-	0.80	0.24	-	0.24	
		2.30	I <sub>OL</sub> = 8 mA	-	0.10	0.30	-	0.30	
		3.00	I <sub>OL</sub> = 16 mA	-	0.15	0.40	-	0.40	
		3.00	I <sub>OL</sub> = 24 mA	-	0.22	0.55	-	0.55	
		4.50	I <sub>OL</sub> = 32 mA	-	0.22	0.55	-	0.55	
I <sub>IN</sub>	Input Leakage Current	1.65 to 5.5	V <sub>IN</sub> = 5.5 V, GND	-	-	±1	-	±10	μA
I <sub>OFF</sub>	Power Off Leakage Current	0	V <sub>IN</sub> or V <sub>OUT</sub> = 5.5 V	-	-	1	-	10	μA
I <sub>CC</sub>	Quiescent Supply Current	1.65 to 5.50	V <sub>IN</sub> = 5.5 V, GND	-	-	2	-	20	μA

AC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	V <sub>CC</sub> (V)	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> , t <sub>PHL</sub>	Propagation Delay (Figure 4, 5)	1.65	C <sub>L</sub> = 15 pF, R <sub>L</sub> = 1 MΩ	-	6.9	13.8	-	14.5	ns
		1.80		-	5.7	11.5	-	12.0	
		2.50 ±0.20		-	3.8	8.0	-	8.5	
		3.30 ±0.30	C <sub>L</sub> = 50 pF, R <sub>L</sub> = 500 Ω	-	3.0	5.7	-	6.0	
		5.00 ±0.50		-	2.4	5.0	-	5.4	
		3.30 ±0.30		-	3.5	6.2	-	6.5	
		5.00 ±0.50		-	2.9	5.4	-	5.8	
C <sub>IN</sub>	Input Capacitance	0.00		-	4	-	-	-	pF
C <sub>PD</sub>	Power Dissipation Capacitance (Note 2) (Figure 6)	3.30		-	25	-	-	-	pF
		5.00		-	31	-	-	-	

2. C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is derived from dynamic operating current consumption (I<sub>CCD</sub>) at no output loading and operating at 50% duty cycle. C<sub>PD</sub> is related to I<sub>CCD</sub> dynamic operating current by the expression:  
I<sub>CCD</sub> = (C<sub>PD</sub>) (V<sub>CC</sub>) (f<sub>IN</sub>) + (I<sub>CCstatic</sub>).



NOTE:  
3. C<sub>L</sub> includes load and stray capacitance;  
Input PRR = 10 MHz; t<sub>W</sub> = 500 ns

Figure 4. AC Test Circuit

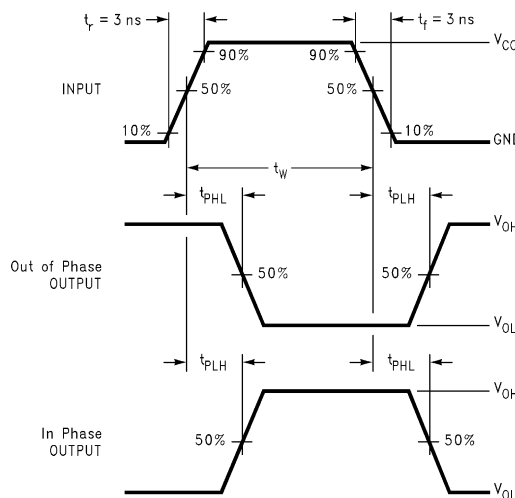
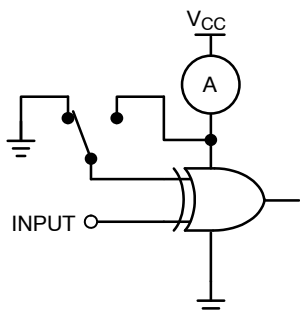


Figure 5. AC Waveforms



NOTE:  
4. Input = AC Waveform; t<sub>r</sub> = t<sub>f</sub> = 1.8 ns;  
PRR = 10 MHz; Duty Cycle = 50%.

Figure 6. I<sub>CCD</sub> Test Circuit

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## ORDERING INFORMATION

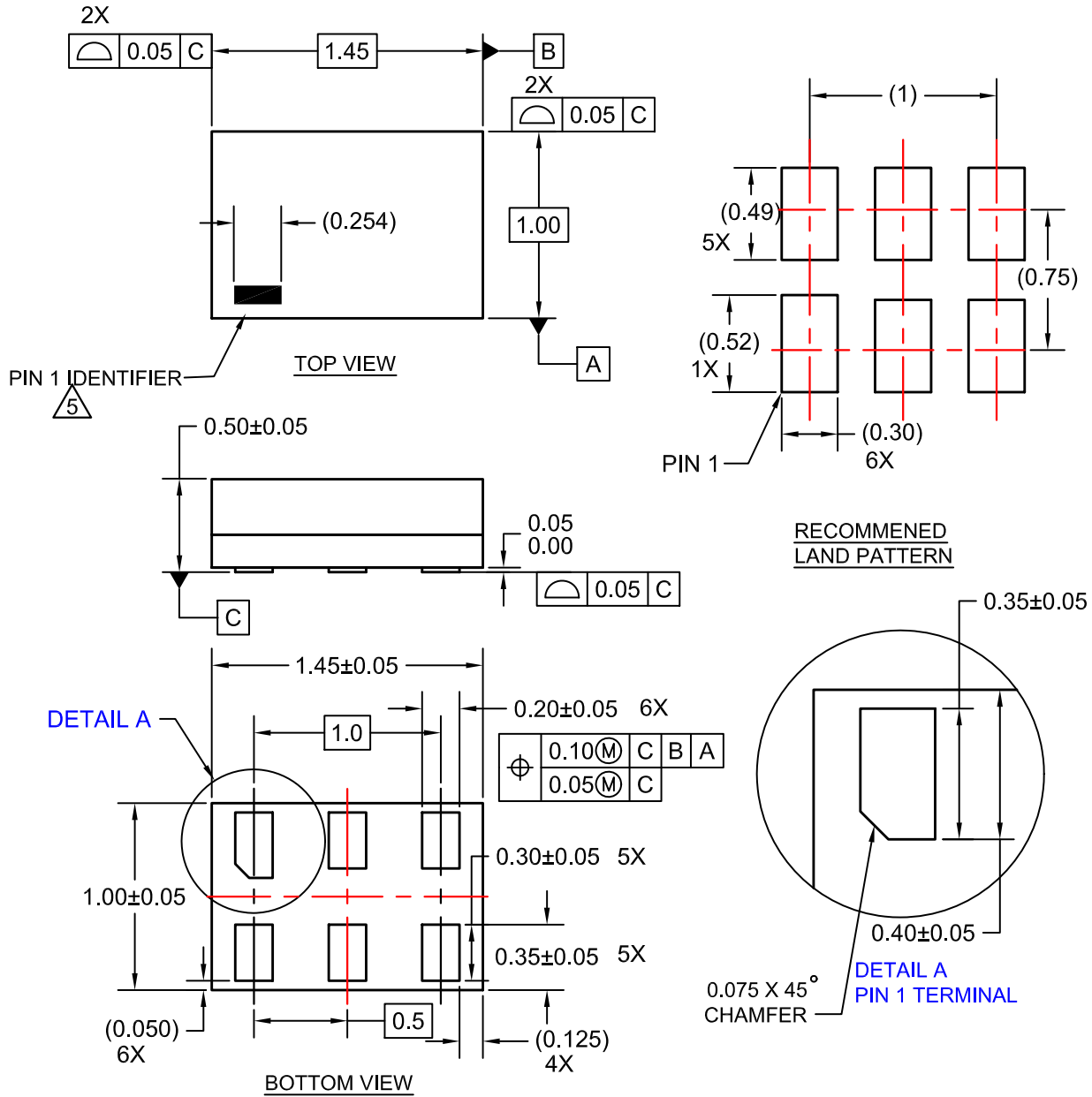
Part Number	Top Mark	Package	Shipping <sup>†</sup>
NC7SZ86M5X	7Z86	SC-74A	3000 / Tape & Reel
NC7SZ86P5X	Z86	SC-88A	3000 / Tape & Reel
NC7SZ86L6X	B3	SIP6, MicroPak	5000 / Tape & Reel
NC7SZ86FHX	B3	UDFN6, MicroPak2	5000 / Tape & Reel

<sup>†</sup>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.

# NC7SZ86

## PACKAGE DIMENSIONS

SIP6 1.45X1.0  
CASE 127EB  
ISSUE O



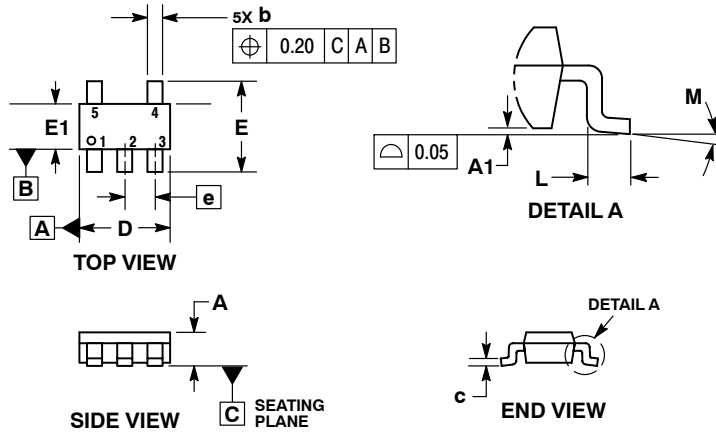
**NOTES:**

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.

# NC7SZ86

## PACKAGE DIMENSIONS

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

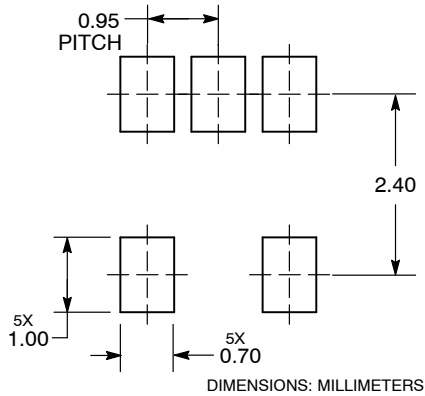


**NOTES:**

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.

DIM	MILLIMETERS	
	MIN	MAX
A	0.90	1.10
A1	0.01	0.10
b	0.25	0.50
c	0.10	0.26
D	2.85	3.15
E	2.50	3.00
E1	1.35	1.65
e	0.95 BSC	
L	0.20	0.60
M	0°	10°

**RECOMMENDED  
SOLDERING FOOTPRINT\***

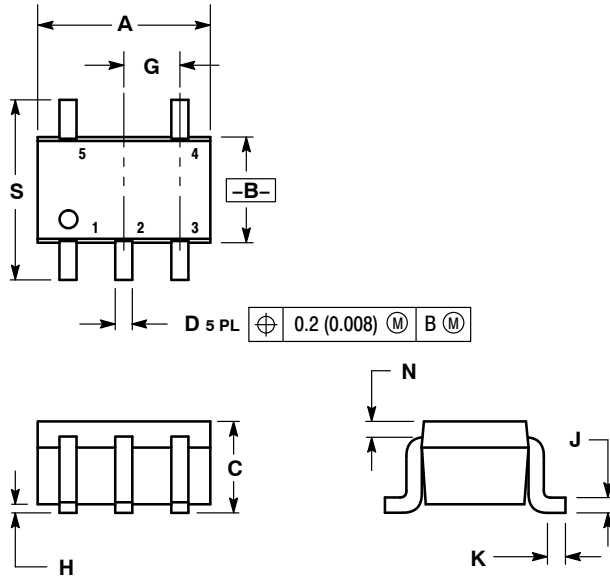


\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

# NC7SZ86

## PACKAGE DIMENSIONS

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

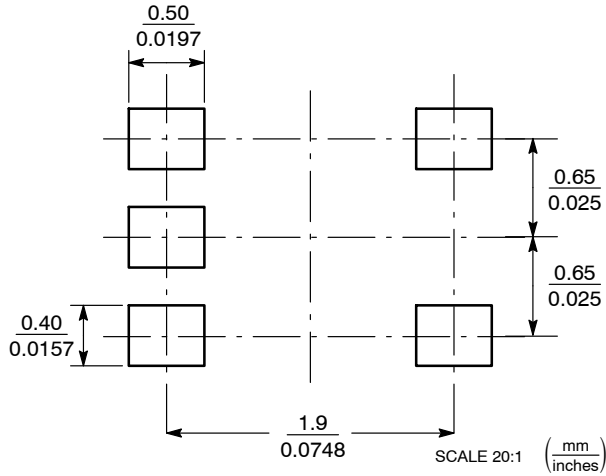


**NOTES:**

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



**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

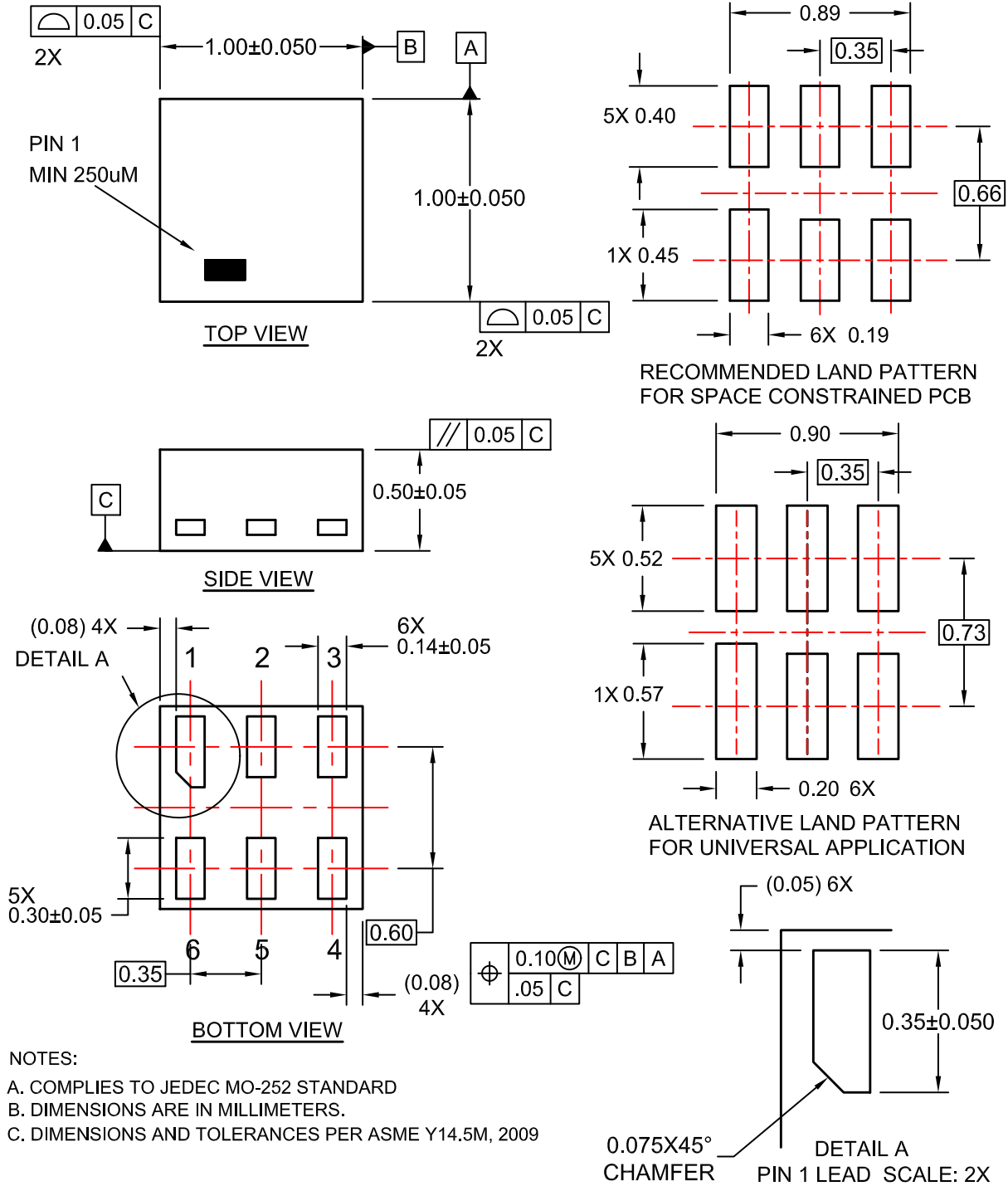
**STYLE 9:**

- PIN 1. ANODE
- 2. CATHODE
- 3. ANODE
- 4. ANODE
- 5. ANODE

# NC7SZ86

## PACKAGE DIMENSIONS

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



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- ✓ Shortage Management
- ✓ Alternative Solution
- ✓ Excess Inventory Management