

# TinyLogic HS Inverter

## NC7S04

### Description

The NC7S04 is a single high performance CMOS Inverter. Advanced Silicon Gate CMOS fabrication assures high speed and low power circuit operation over a broad  $V_{CC}$  range. ESD protection diodes inherently guard both input and output with respect to the  $V_{CC}$  and GND rails. Three stages of gain between input and output assures high noise immunity and reduced sensitivity to input edge rate.

### Features

- Space-Saving SOT23-5, SC-74A and SC-88A 5-Lead Packages
- Ultra-Small MicroPak™ Leadless Package
- High Speed:  $t_{PD} = 3$  ns Typ
- Low Quiescent Power:  $I_{CC} < 1$   $\mu$ A
- Balanced Output Drive: 2 mA  $I_{OL}$ , -2 mA  $I_{OH}$
- Broad  $V_{CC}$  Operating Range: 2 V – 6 V
- Balanced Propagation Delays
- Specified for 3 V Operation
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

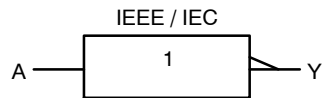
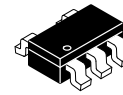
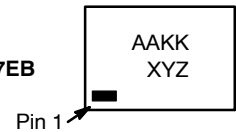


Figure 1. Logic Symbol

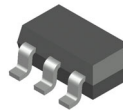
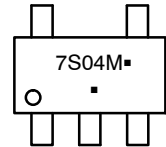
### MARKING DIAGRAMS



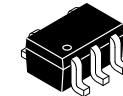
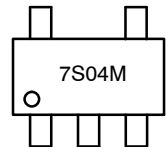
SIP6  
CASE 127EB



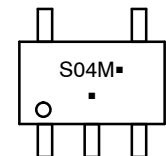
SC-74A  
CASE 318BQ



SOT23-5  
CASE 527AH



SC-88A  
CASE 419A-02



AA, 7S04, S04 = Specific Device Code  
 KK = 2-Digit Lot Run Traceability Code  
 XY = 2-Digit Date Code Format  
 Z = Assembly Plant Code  
 M = Date Code\*

\*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 5 of this data sheet.

# NC7S04

## Pin Configurations

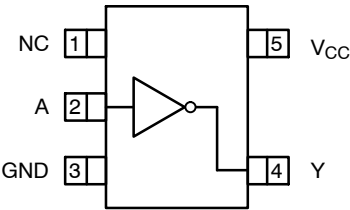


Figure 2. SOT23-5, SC-88A and SC-74A (Top View)

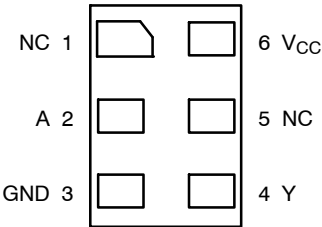


Figure 3. MicroPak (Top Through View)

## PIN DESCRIPTIONS

Name	Description
A	Input
Y	Output
NC	No Connect

## FUNCTION TABLE (Y = $\overline{A}$ )

Input	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
$I_{IK}$	DC Input Diode Current	$V_{IN} < 0\text{ V}$	-	-20	mA
		$V_{IN} > V_{CC}$	-	+20	
$V_{IN}$	DC Input Voltage		-0.5	$V_{CC} + 0.5$	V
$I_{OK}$	DC Output Diode Current	$V_{OUT} < 0\text{ V}$	-	-20	mA
		$V_{OUT} > V_{CC}$	-	+20	
$V_{OUT}$	DC Output Voltage		-0.5	$V_{CC} + 0.5$	V
$I_{OUT}$	DC Output Source or Sink Current		-	$\pm 12.5$	mA
$I_{CC}$ or $I_{GND}$	DC $V_{CC}$ or Ground Current per Output Pin		-	$\pm 25$	mA
$T_{STG}$	Storage Temperature		-65	+150	$^{\circ}\text{C}$
$T_J$	Junction Temperature		-	+150	$^{\circ}\text{C}$
$T_L$	Lead Temperature (Soldering, 10 Seconds)		-	+260	$^{\circ}\text{C}$
$P_D$	Power Dissipation in Still Air	SC-74A / SOT23-5	-	390	mW
		SC-88A	-	332	
		MicroPak-6	-	812	

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		2.0	6.0	V
$V_{IN}$	Input Voltage		0	$V_{CC}$	V
$V_{OUT}$	Output Voltage		0	$V_{CC}$	V
$T_A$	Operating Temperature		-40	+85	$^{\circ}\text{C}$
$t_r, t_f$	Input Rise and Fall Times	$V_{CC}$ at 2.0 V	0	20	ns
		$V_{CC}$ at 3.0 V	0	20	
		$V_{CC}$ at 4.5 V	0	10	
		$V_{CC}$ at 6.0 V	0	5	
$\theta_{JA}$	Thermal Resistance	SC-74A / SOT23-5	-	320	$^{\circ}\text{C/W}$
		SC-88A	-	377	
		MicroPak-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.

# NC7S04

## 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	2.0 3.0 – 6.0		1.50 0.7 V <sub>CC</sub>	– –	– –	1.50 0.7 V <sub>CC</sub>	– –	V
V <sub>IL</sub>	LOW Level Input Voltage	2.0 3.0 – 6.0		– –	– –	0.50 0.3 V <sub>CC</sub>	– –	0.50 0.3 V <sub>CC</sub>	V
V <sub>OH</sub>	HIGH Level Output Voltage	2.0 3.0 4.5 6.0	I <sub>OH</sub> = –20 µA V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	1.90 2.90 4.40 5.90	2.0 3.0 4.5 6.0	– – – –	1.90 2.90 4.40 5.90	– – – –	V
		3.0 4.5 6.0	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>OH</sub> = –1.3 mA I <sub>OH</sub> = –2.0 mA I <sub>OH</sub> = –2.6 mA	2.68 4.18 5.68	2.85 4.35 5.85	– – –	2.63 4.13 5.63	– – –	V
V <sub>OL</sub>	LOW Level Output Voltage	2.0 3.0 4.5 6.0	I <sub>OL</sub> = 20 µA V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	– – – –	0.0 0.0 0.0 0.0	0.10 0.10 0.10 0.10	– – – –	0.10 0.10 0.10 0.10	V
		3.0 4.5 6.0	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> I <sub>OL</sub> = 1.3 mA I <sub>OL</sub> = 2.0 mA I <sub>OL</sub> = 2.6 mA	– – –	0.1 0.1 0.1	0.26 0.26 0.26	– – –	0.33 0.33 0.33	V
I <sub>IN</sub>	Input Leakage Current	6.0	V <sub>IN</sub> = V <sub>CC</sub> , GND	–	–	±0.1	–	±1.0	µA
I <sub>CC</sub>	Quiescent Supply Current	6.0	V <sub>IN</sub> = V <sub>CC</sub> , GND	–	–	1.0	–	10.0	µA

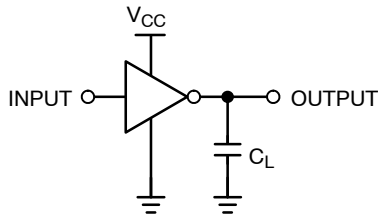
## AC ELECTRICAL CHARACTERISTICS

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, 6)	5.0	C <sub>L</sub> = 15 pF	–	3.0	15.0	–	–	ns
		2.0	C <sub>L</sub> = 50 pF	–	18.0	100.0	–	125.0	ns
		3.0		–	10.0	27.0	–	35.0	
		4.5		–	7.0	20.0	–	25.0	
t <sub>TLH</sub> , t <sub>THL</sub>	Output Transition Time (Figure 4, 6)	5.0	C <sub>L</sub> = 15 pF	–	3.0	10.0	–	–	ns
		2.0	C <sub>L</sub> = 50 pF	–	25.0	125.0	–	155.0	ns
		3.0		–	16.0	35.0	–	45.0	
		4.5		–	11.0	25.0	–	31.0	
C <sub>IN</sub>	Input Capacitance (Figure 4, 6)	Open		–	2.0	10.0	–	10.0	pF
C <sub>PD</sub>	Power Dissipation Capacitance (Figure 5)	5.0	(Note 2)	–	6.0	–	–	–	pF

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:  

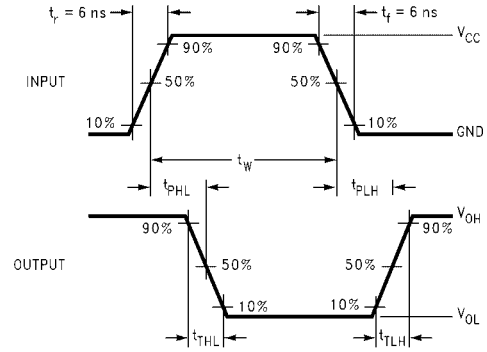
$$I_{CCD} = (C_{PD}) (V_{CC}) (f_{IN}) + (I_{CCstatic})$$

## AC Loading and Waveforms

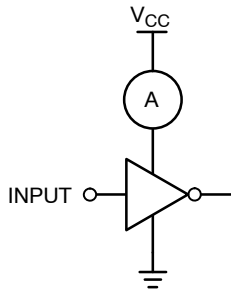


$C_L$  includes load and stray capacitance  
Input PRR = 1.0 MHz,  $t_w = 500$  ns

**Figure 4. AC Test Circuit**



**Figure 6. AC Waveforms**



Input = AC Waveforms;  
PRR = Variable; Duty Cycle = 50%.

**Figure 5.  $I_{CCD}$  Test Circuit**

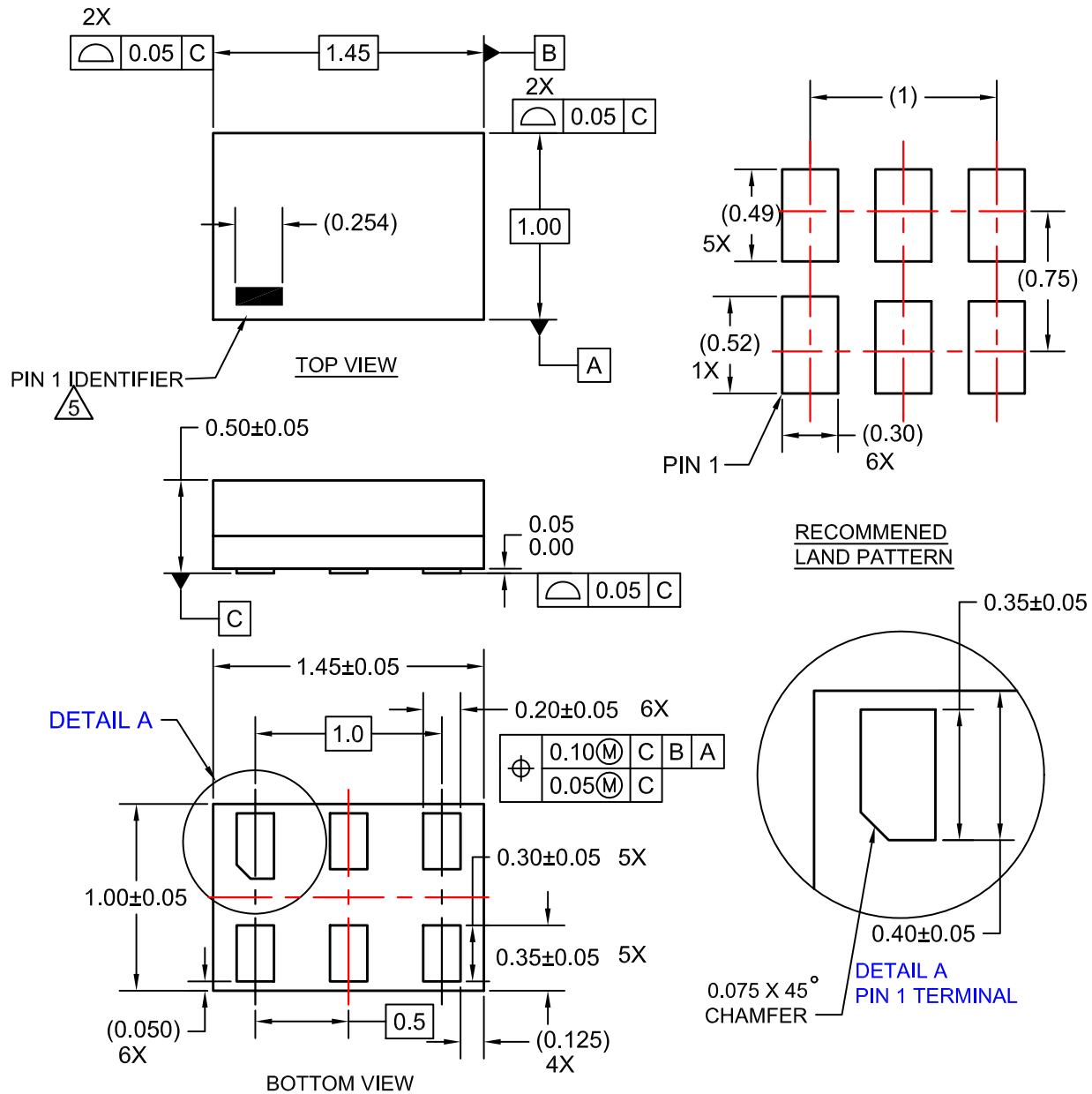
## DEVICE ORDERING INFORMATION

Device	Top Mark	Packages	Shipping <sup>†</sup>
NC7S04M5X	7S04	SC-74A	3000 / Tape & Reel
NC7S04M5X-L22090	7S04	SOT23-5	3000 / Tape & Reel
NC7S04P5X	S04	SC-88A	3000 / Tape & Reel
NC7S04P5X-L22057	S04	SC-88A	3000 / Tape & Reel
NC7S04L6X	AA	SIP6, MicroPak	5000 / Tape & Reel
NC7S04L6X-L22175	AA	SIP6, MicroPak	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.

## ON


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.

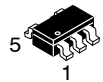
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<b>DESCRIPTION:</b>	<b>SIP6 1.45X1.0</b>	<b>PAGE 1 OF 1</b>

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# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

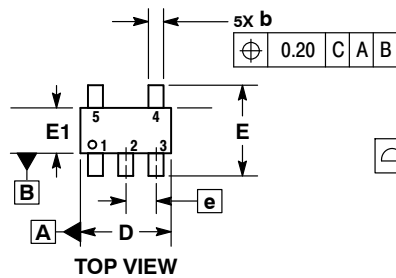
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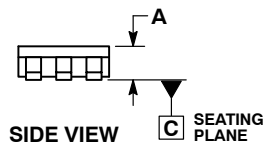
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### SC-74A CASE 318BQ ISSUE B

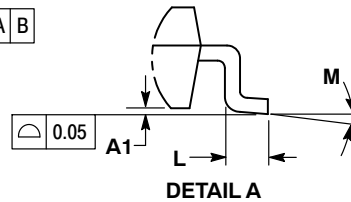
DATE 18 JAN 2018



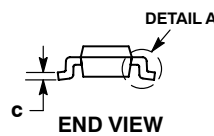
TOP VIEW



SIDE VIEW



DETAIL A



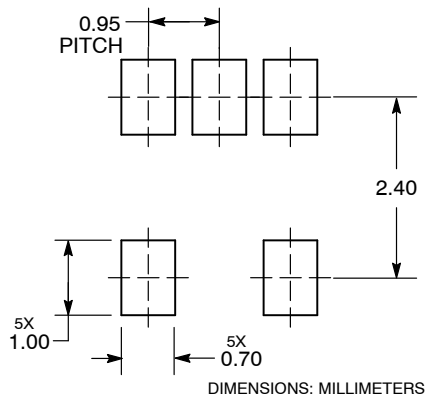
END VIEW

#### 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.

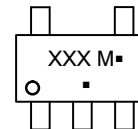
DIM	MILLIMETERS	
	MIN	MAX
A	0.90	1.10
A1	0.01	0.10
b	0.25	0.50
c	0.10	0.26
D	2.85	3.15
E	2.50	3.00
E1	1.35	1.65
e	0.95 BSC	
L	0.20	0.60
M	0°	10°

#### RECOMMENDED SOLDERING FOOTPRINT\*



DIMENSIONS: MILLIMETERS

#### GENERIC MARKING DIAGRAM\*



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

(Note: Microdot may be in either location)

\*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.

\*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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DESCRIPTION:	SC-74A	PAGE 1 OF 1

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# MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

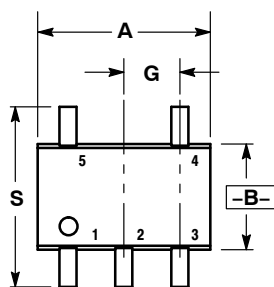
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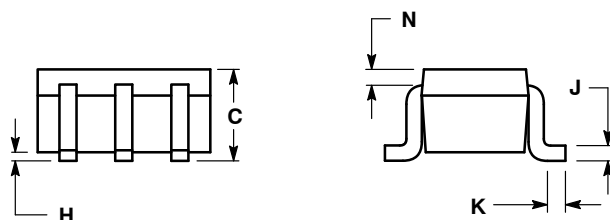
SCALE 2:1

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

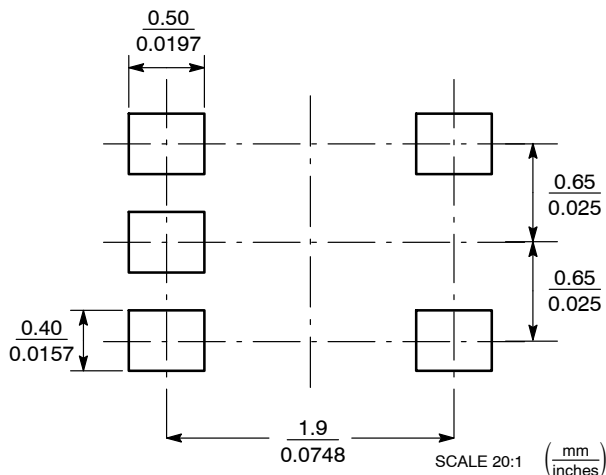
DATE 17 JAN 2013



D 5 PL  $\oplus$  0.2 (0.008) (M) B (M)



## 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

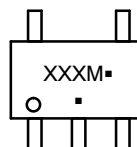
Note: Please refer to datasheet for style callout. If style type is not called out in the datasheet refer to the device datasheet pinout or pin assignment.

## NOTES:

- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- CONTROLLING DIMENSION: INCH.
- 419A-01 OBSOLETE. NEW STANDARD 419A-02.
- 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

## GENERIC MARKING DIAGRAM\*



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

(Note: Microdot may be in either location)

\*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.

DOCUMENT NUMBER: 98ASB42984B

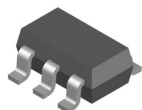
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DESCRIPTION: SC-88A (SC-70-5/SOT-353)

PAGE 1 OF 1

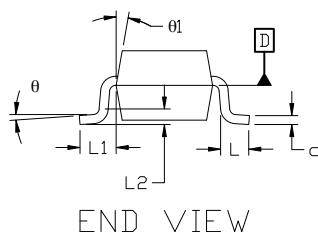
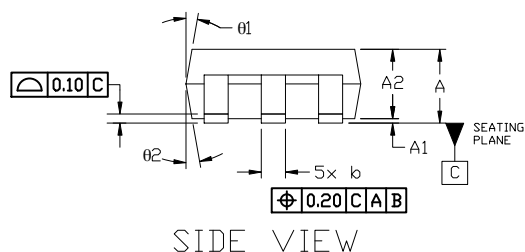
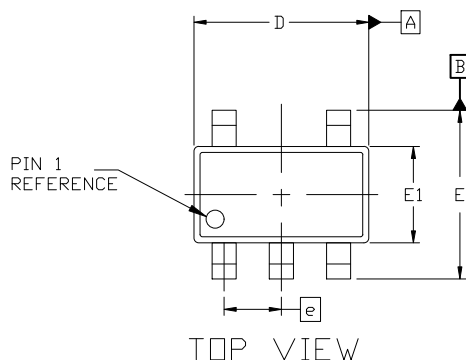
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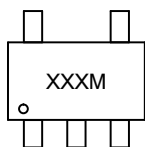


### SOT-23, 5 Lead CASE 527AH ISSUE A

DATE 09 JUN 2021



### GENERIC MARKING DIAGRAM\*



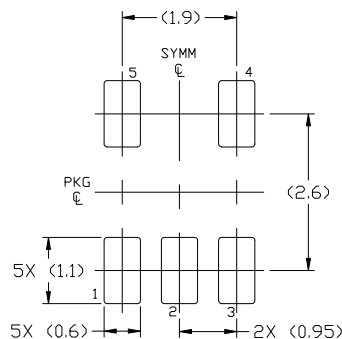
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M = Date Code

\*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.

#### NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1989A
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.

DIM	MILLIMETERS		
	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.

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