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TinyLogic UHS Inverter

NC7SZ04

Description

The NC7SZ04 is a single inverter from onsemi'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_{CC} operating range. The device is specified to operate over the 1.65 V to 5.5 V V_{CC} operating range. The inputs and output are high-impedance when V_{CC} is 0 V. Inputs tolerate voltages up to 5.5 V, independent of V_{CC} operating voltage.

Features

- Ultra-High Speed: $t_{PD} = 2.4$ ns (Typical) into 50 pF at 5 V V_{CC}
- High Output Drive: ± 24 mA at 3 V V_{CC}
- Broad V_{CC} Operating Range: 1.65 V to 5.5 V
- Matches Performance of LCX when Operated at 3.3 V V_{CC}
- 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 SOT23-5, SC-74A and SC-88A Packages
- These Devices are Pb-Free, Halogen Free/BFR Free and are RoHS Compliant

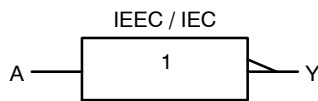
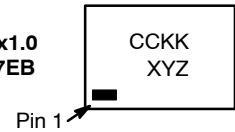


Figure 1. Logic Symbol

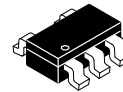
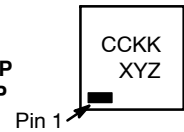
MARKING DIAGRAMS



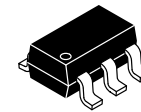
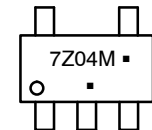
SIP6 1.45x1.0
CASE 127EB



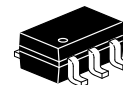
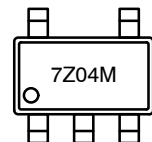
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1.0X1.0, 0.35P
CASE 517DP



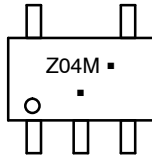
SC-74A
CASE 318BQ



SOT23-5
CASE 527AH



SC-88A
CASE 419A-02



CC, 7Z04, Z04 = 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.

NOTE: Some of the devices on this data sheet have been **DISCONTINUED**. Please refer to the table on page 6.

NC7SZ04

Pin Configurations

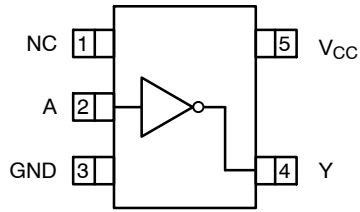


Figure 2. SOT23-5, SC-88A and SC-74A
(Top View)

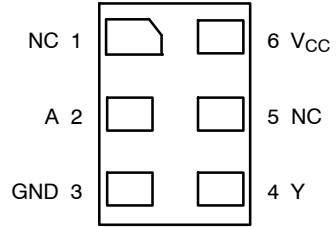


Figure 3. MicroPak (Top Through View)

PIN DEFINITIONS

Pin # SOT23-5, SC-88A / SC-74 A	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

Input	Output
A	Y
L	H
H	L

H = HIGH Logic Level
L = LOW Logic Level

NC7SZ04

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	6.5	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
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	SC-74A / SOT23-5	-	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		1.5	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
t _r , t _f	Input Rise and Fall Times	V _{CC} at 1.8 V, 2.5 V ±0.2 V	0	20	ns/V
		V _{CC} at 3.3 V ±0.3 V	0	10	
		V _{CC} at 5.0 V ±0.5 V	0	5	
θ _{JA}	Thermal Resistance	SC-74A / SOT23-5	-	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.

NC7SZ04

DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	V _{CC} (V)	Conditions	T _A = 25°C			T _A = -40 to 85°C		Unit	
				Min	Typ	Max	Min	Max		
V _{IH}	HIGH Level Input Voltage	1.65 to 1.95		0.65 V _{CC}	-	-	0.65 V _{CC}	-	V	
		2.30 to 5.50		0.70 V _{CC}	-	-	0.70 V _{CC}	-		
V _{IL}	LOW Level Input Voltage	1.65 to 1.95		-	-	0.35 V _{CC}	-	0.35 V _{CC}	V	
		2.30 to 5.50		-	-	0.30 V _{CC}	-	0.30 V _{CC}		
V _{OH}	HIGH Level Output Voltage	1.65	V _{IN} = V _{IH} or V _{IL} , I _{OH} = -100 μA	1.55	1.65	-	-	-	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 _{OH} = -4 mA	1.29	1.52	-	1.29	-		
		2.30		I _{OH} = -8 mA	1.90	2.15	-	1.90		-
		3.00		I _{OH} = -16 mA	2.40	2.80	-	2.40		-
		3.00		I _{OH} = -24 mA	2.30	2.68	-	2.30		-
		4.50		I _{OH} = -32 mA	3.80	4.20	-	3.80		-
V _{OL}	LOW Level Output Voltage	1.65	V _{IN} = V _{IH} or V _{IL} , I _{OL} = 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 _{OL} = 4 mA	-	0.80	0.24	-	0.24		
		2.30		I _{OL} = 8 mA	-	0.10	0.30	-		0.30
		3.00		I _{OL} = 16 mA	-	0.15	0.40	-		0.40
		3.00		I _{OL} = 24 mA	-	0.22	0.55	-		0.55
		4.50		I _{OL} = 32 mA	-	0.22	0.55	-		0.55
I _{IN}	Input Leakage Current	1.65 to 5.5	0 ≤ V _{IN} ≤ 5.5 V	-	-	±1	-	±10	μA	
I _{OFF}	Power Off Leakage Current	0	V _{IN} or V _{OUT} = 5.5 V	-	-	1	-	10	μA	
I _{CC}	Quiescent Supply Current	1.65 to 5.50	V _{IN} = 5.5 V, GND	-	-	2.0	-	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	-	5.3	11.4	-	12.0	ns
		1.80		-	4.4	9.5	-	10.0	
		2.50 ±0.20		-	2.9	6.5	-	7.0	
		3.30 ±0.30		-	2.1	4.5	-	4.7	
		5.00 ±0.50		-	1.8	3.9	-	4.1	
		3.30 ±0.30		C _L = 50 pF, R _L = 500 Ω	-	2.9	5.0	-	
		5.00 ±0.50	-		2.4	4.3	-	4.5	
C _{IN}	Input Capacitance	0.00		-	4	-	-	-	pF
C _{PD}	Power Dissipation Capacitance (Note 2) (Figure 6)	3.30		-	20	-	-	-	pF
		5.00		-	26	-	-	-	

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

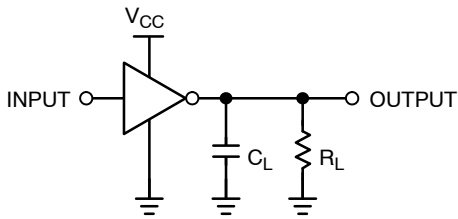


Figure 4. AC Test Circuit

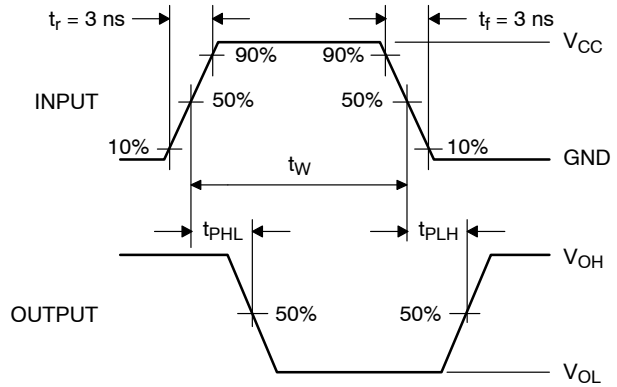
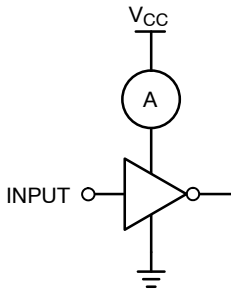


Figure 5. AC Waveforms



NOTE:

3. Input = AC Waveform; tr = tf = 1.8 ns;
 PRR = 10 MHz; Duty Cycle = 50%.

Figure 6. I_{CCD} Test Circuit

NC7SZ04

DEVICE ORDERING INFORMATION

Device	Top Mark	Packages	Shipping†
NC7SZ04M5X	7Z04	SC-74A	3000 / Tape & Reel
NC7SZ04P5X	Z04	SC-88A	3000 / Tape & Reel
NC7SZ04L6X	CC	SIP6, MicroPak	5000 / Tape & Reel
NC7SZ04FHX	CC	UDFN6, MicroPak2	5000 / Tape & Reel

DISCONTINUED (Note 4)

NC7SZ04M5X-L22090	7Z04	SOT23-5	3000 / Tape & Reel
NC7SZ04P5X-L22057	Z04	SC-88A	3000 / Tape & Reel
NC7SZ04L6X-L22175	CC	SIP6, MicroPak	5000 / Tape & Reel
NC7SZ04FHX-L22175	CC	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.

4. **DISCONTINUED:** These devices are not recommended for new design. Please contact your **onsemi** representative for information. The most current information on these devices may be available on www.onsemi.com.

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MECHANICAL CASE OUTLINE

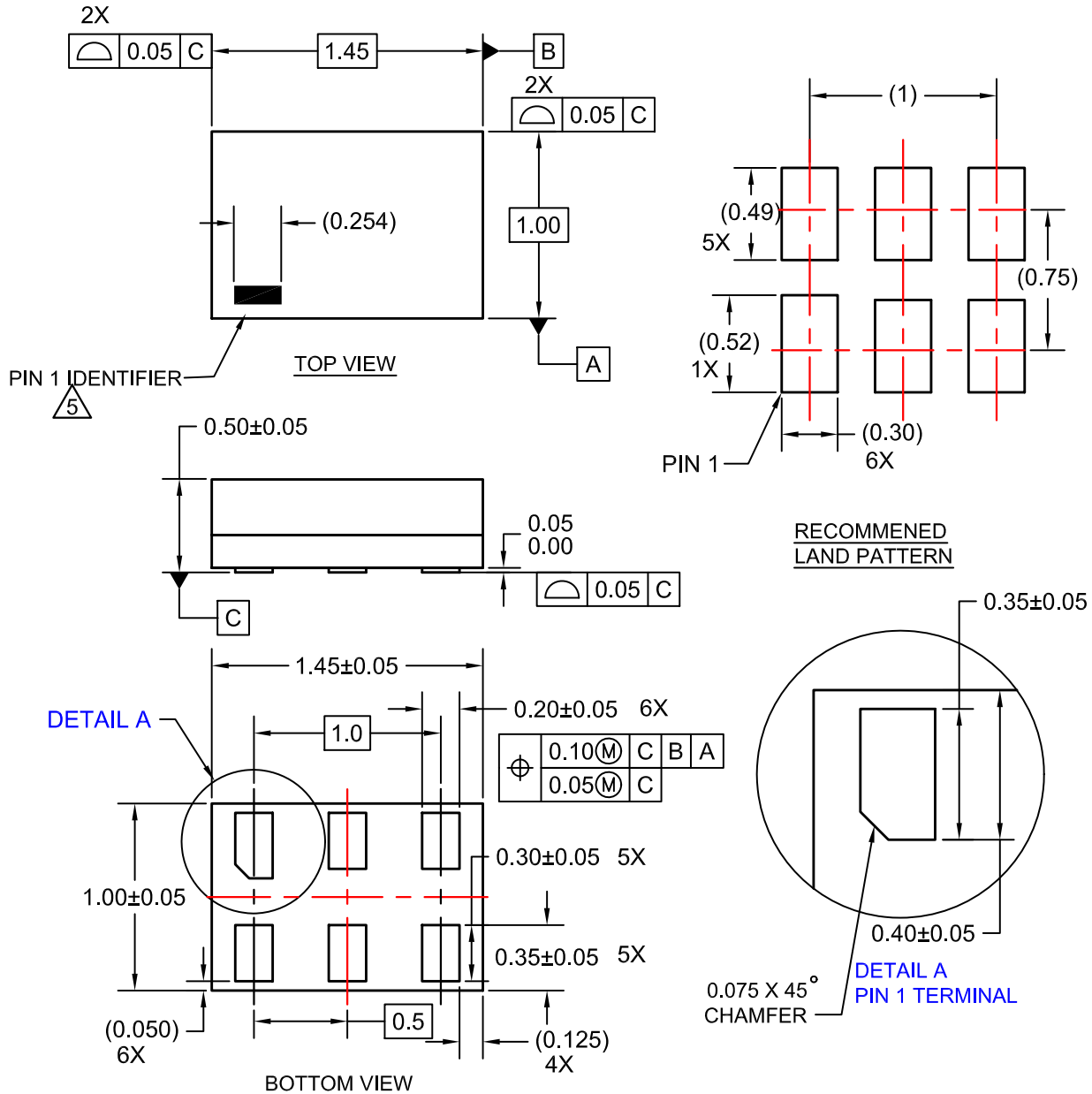
PACKAGE DIMENSIONS

ON Semiconductor®



SIP6 1.45X1.0
CASE 127EB
ISSUE O

DATE 31 AUG 2016



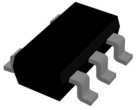
NOTES:

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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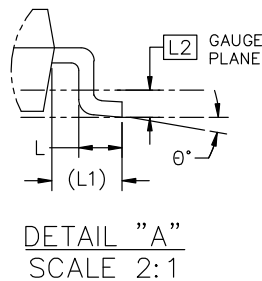
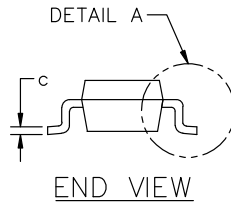
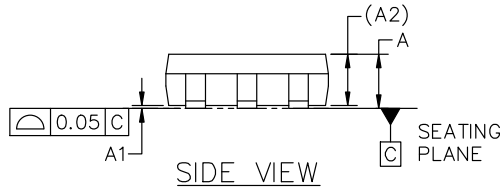
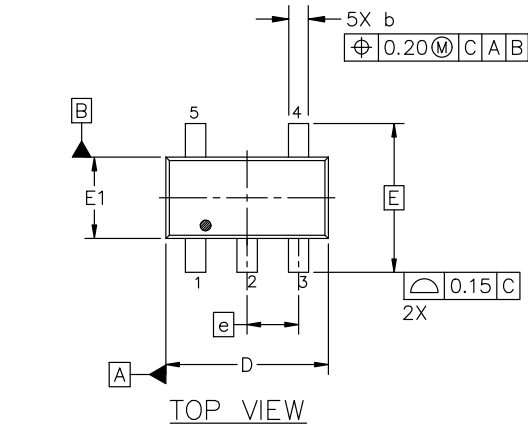
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MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

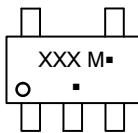


SC-74A-5 3.00x1.50x0.95, 0.95P
CASE 318BQ
ISSUE C

DATE 26 FEB 2024



GENERIC MARKING DIAGRAM*



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

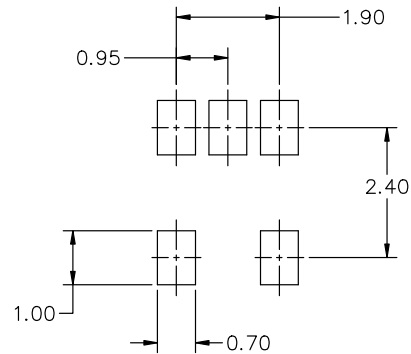
(Note: Microdot may be in either location)

*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.

NOTES:

1. DIMENSIONING AND TOLERANCING CONFORM TO ASME Y14.5-2018.
2. ALL DIMENSION ARE IN MILLIMETERS (ANGLES IN DEGREES).
3. MAXIMUM LEAD THICKNESS INCLUDES LEAD FINISH THICKNESS. MINIMUM LEAD THICKNESS IS THE MINIMUM THICKNESS OF BASE MATERIAL.
4. DIMENSIONS D AND E1 DO NOT INCLUDE MOLD FLASH, PROTRUSIONS OF GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.15 PER SIDE.

DIM	MILLIMETERS		
	MIN.	NOM.	MAX.
A	0.90	1.00	1.10
A1	0.01	0.18	0.10
A2	0.95 REF.		
b	0.25	0.37	0.50
c	0.10	0.18	0.26
D	2.85	3.00	3.15
E	2.75 BSC		
E1	1.35	1.50	1.65
e	0.95 BSC		
L	0.20	0.40	0.60
L1	0.62 REF.		
L2	0.25 BSC		
θ	0°	5°	10°



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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DESCRIPTION:	SC-74A-5 3.00x1.50x0.95, 0.95P	PAGE 1 OF 1

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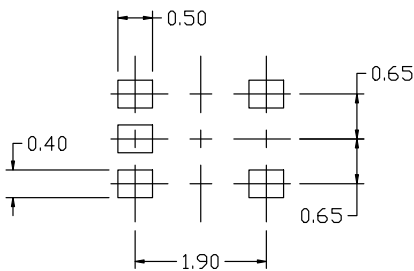
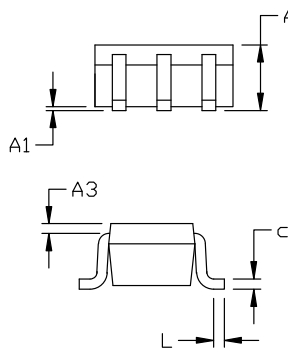
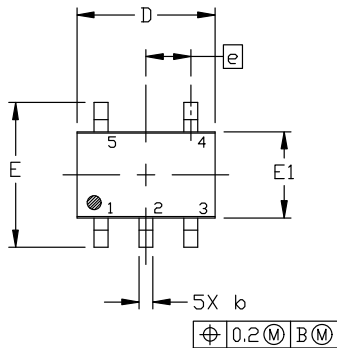
MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS



SCALE 2:1

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

DATE 11 APR 2023



RECOMMENDED
MOUNTING FOOTPRINT

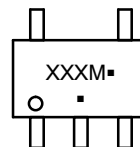
* For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERM/D.

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:

1. BASE
2. EMITTER
3. BASE
4. COLLECTOR
5. COLLECTOR

STYLE 2:

1. ANODE
2. EMITTER
3. BASE
4. COLLECTOR
5. CATHODE

STYLE 3:

1. ANODE 1
2. N/C
3. ANODE 2
4. CATHODE 2
5. CATHODE 1

STYLE 4:

1. SOURCE 1
2. DRAIN 1/2
3. SOURCE 1
4. GATE 1
5. GATE 2

STYLE 5:

1. CATHODE
2. COMMON ANODE
3. CATHODE 2
4. CATHODE 3
5. CATHODE 4

STYLE 6:

1. EMITTER 2
2. BASE 2
3. EMITTER 1
4. COLLECTOR
5. COLLECTOR 2/BASE 1

STYLE 7:

1. BASE
2. EMITTER
3. BASE
4. COLLECTOR
5. COLLECTOR

STYLE 8:

1. CATHODE
2. COLLECTOR
3. N/C
4. BASE
5. EMITTER

STYLE 9:

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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DESCRIPTION:	SC-88A (SC-70-5/SOT-353)	PAGE 1 OF 1

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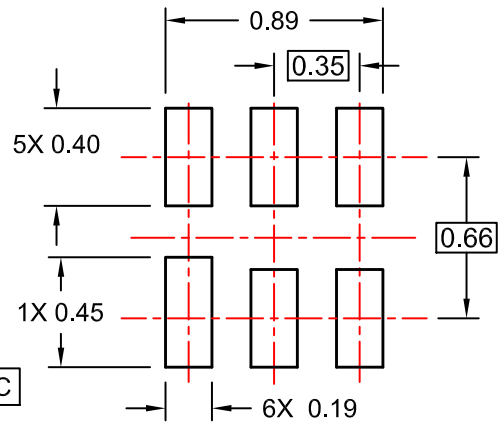
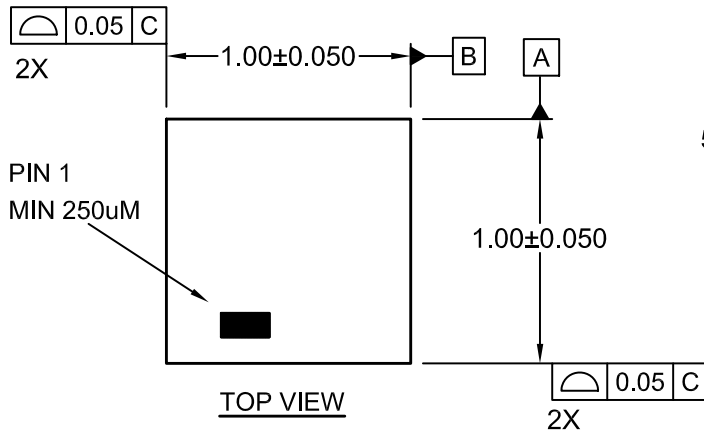
MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

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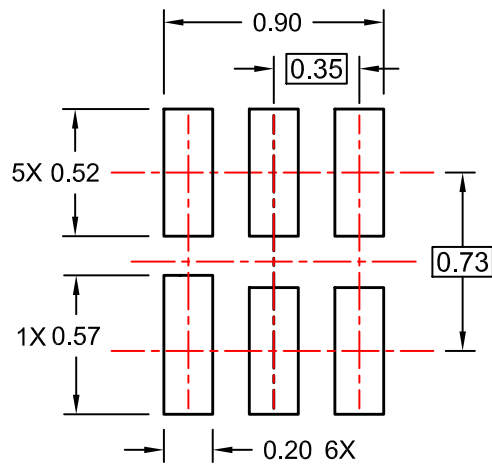
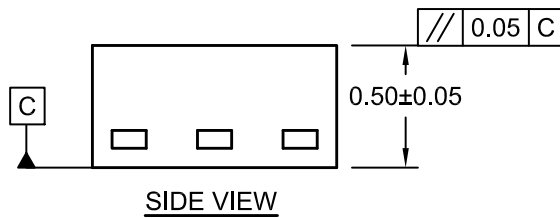


UDFN6 1.0X1.0, 0.35P
CASE 517DP
ISSUE O

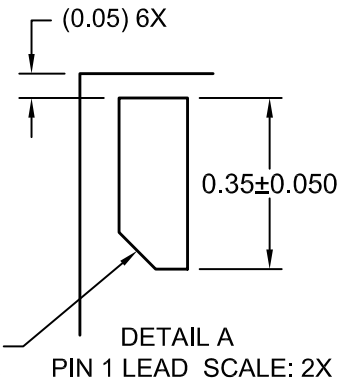
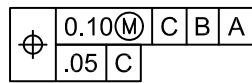
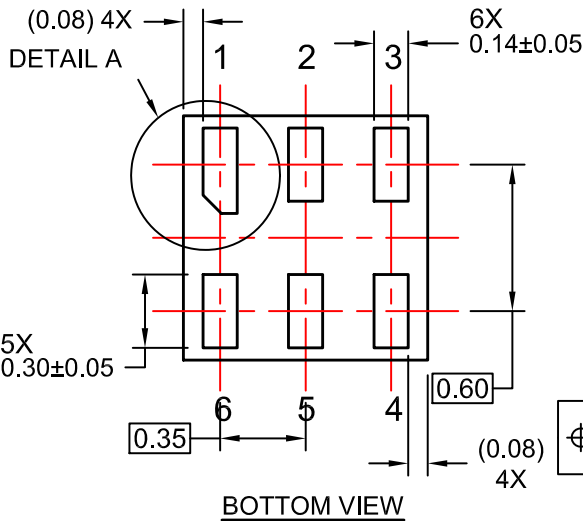
DATE 31 AUG 2016



RECOMMENDED LAND PATTERN FOR SPACE CONSTRAINED PCB



ALTERNATIVE LAND PATTERN FOR UNIVERSAL APPLICATION



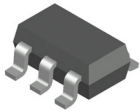
- NOTES:**
- A. COMPLIES TO JEDEC MO-252 STANDARD
 - B. DIMENSIONS ARE IN MILLIMETERS.
 - C. DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 2009

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

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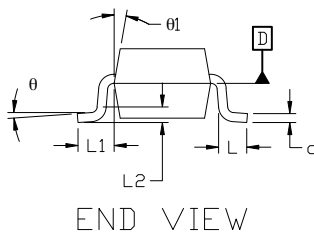
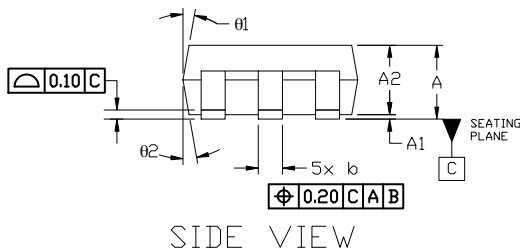
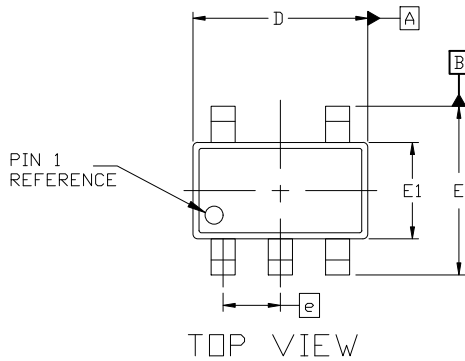
MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

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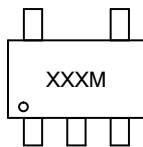


SOT-23, 5 Lead CASE 527AH ISSUE A

DATE 09 JUN 2021



GENERIC MARKING DIAGRAM*



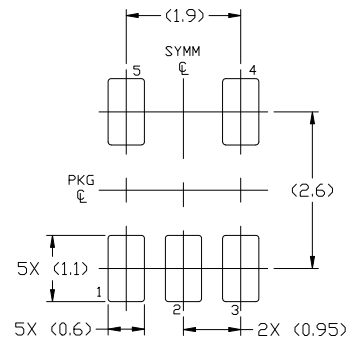
XXX = Specific Device Code
M = Date Code

*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.

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°



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:	SOT-23, 5 LEAD	PAGE 1 OF 1

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