

# TinyLogic ULP-A Unbuffered Inverter

## NC7SPU04

The NC7SPU04 is a single unbuffered inverter in tiny footprint packages. The device is designed to operate for  $V_{CC} = 0.9\text{ V}$  to  $3.6\text{ V}$ .

### Features

- Designed for 0.9 V to 3.6 V  $V_{CC}$  Operation
- 4.0 ns  $t_{PD}$  at 3.3 V (Typ)
- Input Over-Voltage Tolerant up to 3.6 V
- Source/Sink 2.6 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

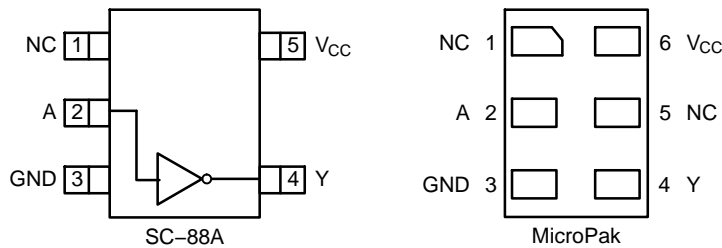


Figure 2. Pin Assignments for SC70

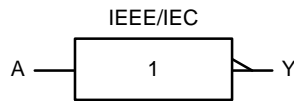


Figure 1. Logic Symbol

### 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

### FUNCTIONAL TABLE

Input	Output
A	Y
L	H
H	L

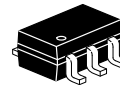
### MARKING DIAGRAM



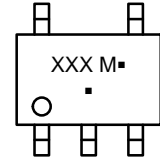
SIP6 1.45x1.0  
MicroPak  
CASE 127EB



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



SC-88A 1.25x2  
CASE 419AC-01



XXX = Specific Device 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 and shipping information on page 6 of this data sheet.

# NC7SPU04

## MAXIMUM RATINGS

Symbol	Parameter	Value	Rating
V <sub>CC</sub>	DC Supply Voltage	-0.5 to +4.3	V
V <sub>IN</sub>	DC Input Voltage	-0.5 to +4.3	V
V <sub>OUT</sub>	DC Output Voltage	-0.5 to V <sub>CC</sub> + 0.5	V
I <sub>IK</sub>	DC Input Diode Current V <sub>IN</sub> < GND	-50	mA
I <sub>OK</sub>	DC Output Diode Current	±50	mA
I <sub>OUT</sub>	DC Output Source/Sink Current	±50	mA
I <sub>CC</sub> or I <sub>GND</sub>	DC Supply Current Per Supply Pin or Ground Pin	±50	mA
T <sub>STG</sub>	Storage Temperature Range	-65 to +150	°C
T <sub>L</sub>	Lead Temperature, 1 mm from Case for 10 Seconds	260	°C
T <sub>J</sub>	Junction Temperature Under Bias	+150	°C
Θ <sub>JA</sub>	Thermal Resistance (Note 2)	SC-88A MicroPak 659 382	°C/W
P <sub>D</sub>	Power Dissipation in Still Air at 25°C	SC-88A MicroPak 190 327	mW
MSL	Moisture Sensitivity	Level 1	
F <sub>R</sub>	Flammability Rating Oxygen Index: 28 to 34	UL 94 V-0 @ 0.125 in	
V <sub>ESD</sub>	ESD Withstand Voltage (Note 3) Human Body Model Charged Device Model	4000 2000	V
I <sub>LATCHUP</sub>	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.
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.

## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
V <sub>CC</sub>	Positive DC Supply Voltage	0.9	3.6	V
V <sub>IN</sub>	Digital Input Voltage	0	3.6	V
V <sub>OUT</sub>	Output Voltage	0	V <sub>CC</sub>	V
T <sub>A</sub>	Operating Free-Air Temperature	-40	+85	°C
t <sub>r</sub> , t <sub>f</sub>	Input Transition Rise or Fall Rate V <sub>CC</sub> = 3.3 V ±0.3 V	0	10	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.

# NC7SPU04

## DC ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Conditions	V <sub>CC</sub> (V)	T <sub>A</sub> = 25°C			T <sub>A</sub> = -40°C to +85°C		Unit
				Min	Typ	Max	Min	Max	
V <sub>IH</sub>	High-Level Input Voltage		0.9	-	0.8 x V <sub>CC</sub>	-	-	-	V
			1.1 to 1.3	0.8 x V <sub>CC</sub>	-	-	0.8 x V <sub>CC</sub>	-	
			1.4 to 1.6	0.8 x V <sub>CC</sub>	-	-	0.8 x V <sub>CC</sub>	-	
			1.65 to 1.95	0.8 x V <sub>CC</sub>	-	-	0.8 x V <sub>CC</sub>	-	
			2.3 to 2.7	0.8 x V <sub>CC</sub>	-	-	0.8 x V <sub>CC</sub>	-	
			3.0 to 3.6	0.8 x V <sub>CC</sub>	-	-	0.8 x V <sub>CC</sub>	-	
V <sub>IL</sub>	Low-Level Input Voltage		0.9	-	0.2 x V <sub>CC</sub>	-	-	-	V
			1.1 to 1.3	-	-	0.2 x V <sub>CC</sub>	-	0.2 x V <sub>CC</sub>	
			1.4 to 1.6	-	-	0.2 x V <sub>CC</sub>	-	0.2 x V <sub>CC</sub>	
			1.65 to 1.95	-	-	0.2 x V <sub>CC</sub>	-	0.2 x V <sub>CC</sub>	
			2.3 to 2.7	-	-	0.2 x V <sub>CC</sub>	-	0.2 x V <sub>CC</sub>	
			3.0 to 3.6	-	-	0.2 x V <sub>CC</sub>	-	0.2 x V <sub>CC</sub>	
V <sub>OH</sub>	High-Level Output Voltage	V <sub>IN</sub> = V <sub>CC</sub> or GND	-	-	-	-	-	-	V
		I <sub>OH</sub> = -5 μA	0.9	-	V <sub>CC</sub> - 0.2	-	-	-	
		I <sub>OH</sub> = -20 μA	1.1 to 1.3	V <sub>CC</sub> - 0.2	-	-	V <sub>CC</sub> - 0.2	-	
			1.4 to 1.6	V <sub>CC</sub> - 0.2	-	-	V <sub>CC</sub> - 0.2	-	
			1.65 to 1.95	V <sub>CC</sub> - 0.2	-	-	V <sub>CC</sub> - 0.2	-	
			2.3 to 2.7	V <sub>CC</sub> - 0.2	-	-	V <sub>CC</sub> - 0.2	-	
			3.0 to 3.6	V <sub>CC</sub> - 0.2	-	-	V <sub>CC</sub> - 0.2	-	
		I <sub>OH</sub> = -0.5 mA	1.1 to 1.3	0.75 x V <sub>CC</sub>	-	-	0.70 x V <sub>CC</sub>	-	
		I <sub>OH</sub> = -1 mA	1.4 to 1.6	1.07	-	-	0.99	-	
		I <sub>OH</sub> = -1.5 mA	1.65 to 1.95	1.24	-	-	1.22	-	
		I <sub>OH</sub> = -2.1 mA	2.3 to 2.7	1.95	-	-	1.87	-	
I <sub>OH</sub> = -2.6 mA	3.0 to 3.6	2.61	-	-	2.55	-			
V <sub>OL</sub>	Low-Level Output Voltage	V <sub>IN</sub> = V <sub>CC</sub> or GND	-	-	-	-	-	-	V
		I <sub>OL</sub> = 5 μA	0.9	-	0.2	-	-	-	
		I <sub>OL</sub> = 20 μA	1.1 to 1.3	-	-	0.2	-	0.2	
			1.4 to 1.6	-	-	0.2	-	0.2	
			1.65 to 1.95	-	-	0.2	-	0.2	
			2.3 to 2.7	-	-	0.2	-	0.2	
			3.0 to 3.6	-	-	0.2	-	0.2	
		I <sub>OL</sub> = 0.5 mA	1.1 to 1.3	-	-	0.3 x V <sub>CC</sub>	-	0.3 x V <sub>CC</sub>	
		I <sub>OL</sub> = 1 mA	1.4 to 1.6	-	-	0.31	-	0.37	
		I <sub>OL</sub> = 1.5 mA	1.65 to 1.95	-	-	0.31	-	0.35	
		I <sub>OL</sub> = 2.1 mA	2.3 to 2.7	-	-	0.31	-	0.33	
I <sub>OL</sub> = 2.6 mA	3.0 to 3.6	-	-	0.31	-	0.33			
I <sub>IN</sub>	Input Leakage Current	V <sub>IN</sub> = 0 V to 3.6 V	0.9 to 3.6	-	-	±0.1	-	±0.5	μA
I <sub>CC</sub>	Quiescent Supply Current	V <sub>IN</sub> = V <sub>CC</sub> or GND	0.9 to 3.6	-	-	0.9	-	0.9	μA

# NC7SPU04

## AC ELECTRICAL CHARACTERISTICS

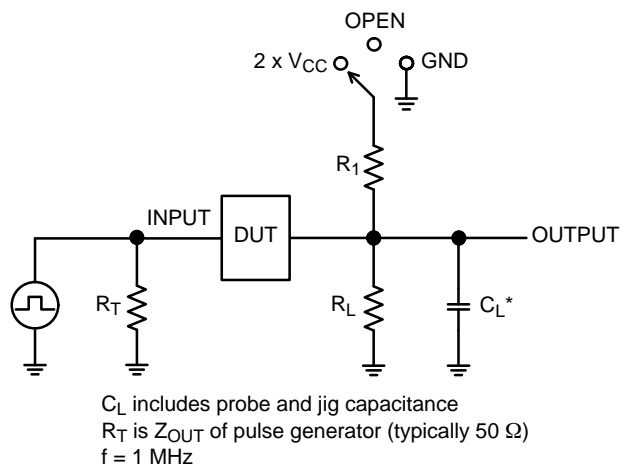
Symbol	Parameter	Test Condition	V <sub>CC</sub> (V)	T <sub>A</sub> = 25°C			T <sub>A</sub> = -40°C to +85°C		Unit
				Min	Typ	Max	Min	Max	
t <sub>PLH</sub> , t <sub>PHL</sub>	Propagation Delay, A to Y (Figures 3 and 4)	R <sub>L</sub> = 1 MΩ, C <sub>L</sub> = 10 pF	0.9	-	15.6	-	-	-	ns
			1.1 to 1.3	-	8.0	21.8	-	34.3	
			1.4 to 1.6	-	7.0	14.8	-	15.0	
			1.65 to 1.95	-	6.0	12.0	-	12.2	
			2.3 to 2.7	-	5.0	9.4	-	9.9	
			3.0 to 3.6	-	4.0	8.3	-	9.0	
		R <sub>L</sub> = 1 MΩ, C <sub>L</sub> = 15 pF	0.9	-	16.3	-	-	-	ns
			1.1 to 1.3	-	9.0	22.8	-	37.3	
			1.4 to 1.6	-	8.0	15.5	-	16.5	
			1.65 to 1.95	-	6.0	12.6	-	13.6	
			2.3 to 2.7	-	5.0	9.9	-	10.8	
			3.0 to 3.6	-	4.0	8.7	-	9.5	
		R <sub>L</sub> = 1 MΩ, C <sub>L</sub> = 30 pF	0.9	-	18.3	-	-	-	ns
			1.1 to 1.3	-	10.0	25.9	-	46.3	
			1.4 to 1.6	-	9.0	17.8	-	18.2	
			1.65 to 1.95	-	7.0	14.4	-	15.9	
			2.3 to 2.7	-	6.0	11.3	-	12.8	
			3.0 to 3.6	-	5.0	9.2	-	10.7	

## CAPACITIVE CHARACTERISTICS

Symbol	Parameter	Test Condition	Typical T <sub>A</sub> = 25°C	Unit
C <sub>IN</sub>	Input Capacitance	V <sub>CC</sub> = 0 V	2.0	pF
C <sub>OUT</sub>	Output Capacitance	V <sub>CC</sub> = 0 V	4.0	pF
C <sub>PD</sub>	Power Dissipation Capacitance (Note 5)	f = 10 MHz, V <sub>CC</sub> = 0.9 V to 3.6 V, V <sub>IN</sub> = 0 V or V <sub>CC</sub>	8.0	pF

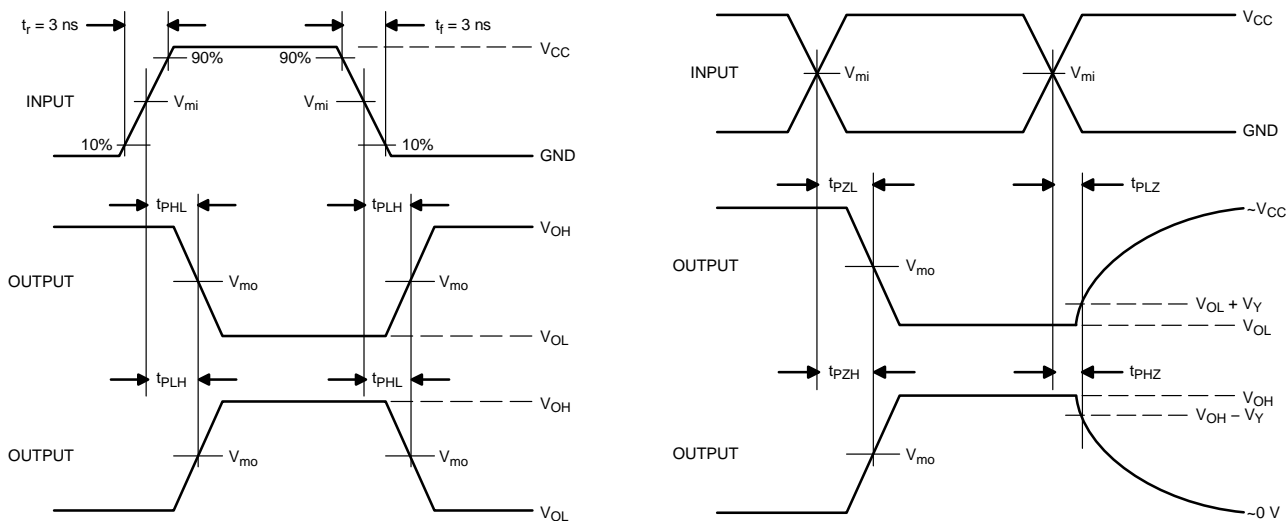
5. C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the dynamic operating current consumption without load. Average operating current can be obtained by the equation I<sub>CC(OPR)</sub> = C<sub>PD</sub> • V<sub>CC</sub> • f<sub>in</sub> + I<sub>CC</sub>. C<sub>PD</sub> is used to determine the no-load dynamic power consumption: P<sub>D</sub> = C<sub>PD</sub> • V<sub>CC</sub><sup>2</sup> • f<sub>in</sub> + I<sub>CC</sub> • V<sub>CC</sub>.

# NC7SPU04



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



$V_{CC}, \text{V}$	$V_{mi}, \text{V}$	$V_{mo}, \text{V}$	$V_Y, \text{V}$
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

# NC7SPU04

## ORDERING INFORMATION

Order Number	Marking	Package	Pin 1 Orientation (See Below)	Shipping†
NC7SPU04P5X	PU4	SC-88A (Pb-Free)	Q4	3000 / Tape & Reel
NC7SPU04L6X	N3	SIP6, MicroPak (Pb-Free)	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.

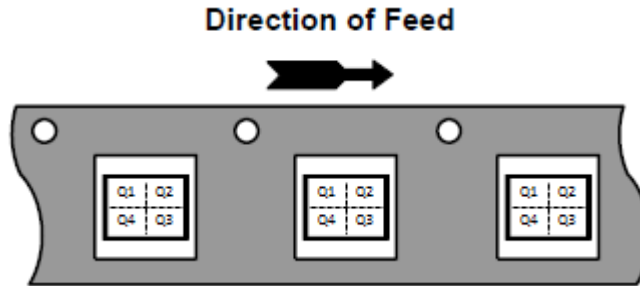


Figure 5. Pin 1 Orientation in Tape and Reel

MicroPak is trademark of Semiconductor Components Industries, LLC dba "onsemi" or its affiliates and/or subsidiaries in the United States and/or other countries.



**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.

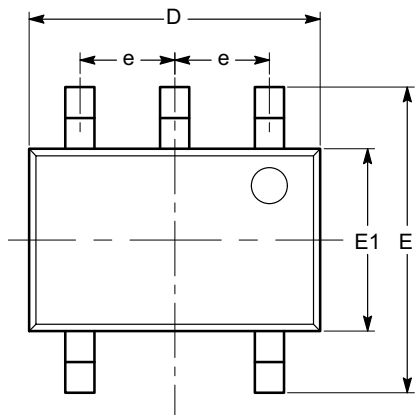
<b>DOCUMENT NUMBER:</b>	<b>98AON13590G</b>	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
<b>DESCRIPTION:</b>	<b>SIP6 1.45X1.0</b>	<b>PAGE 1 OF 1</b>

ON Semiconductor and are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. ON Semiconductor does not convey any license under its patent rights nor the rights of others.



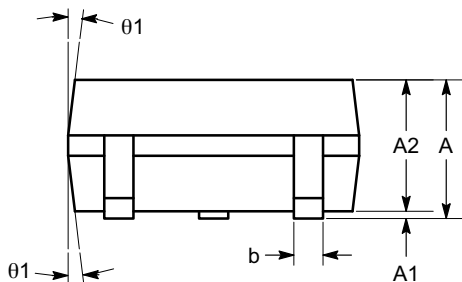
**SC-88A (SC-70 5 Lead), 1.25x2**  
CASE 419AC-01  
ISSUE A

DATE 29 JUN 2010

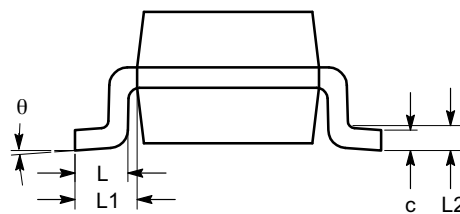


**TOP VIEW**

SYMBOL	MIN	NOM	MAX
A	0.80		1.10
A1	0.00		0.10
A2	0.80		1.00
b	0.15		0.30
c	0.10		0.18
D	1.80	2.00	2.20
E	1.80	2.10	2.40
E1	1.15	1.25	1.35
e	0.65 BSC		
L	0.26	0.36	0.46
L1	0.42 REF		
L2	0.15 BSC		
θ	0°		8°
θ1	4°		10°



**SIDE VIEW**



**END VIEW**

**Notes:**

- (1) All dimensions are in millimeters. Angles in degrees.
- (2) Complies with JEDEC MO-203.

<b>DOCUMENT NUMBER:</b>	<b>98AON34260E</b>	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
<b>DESCRIPTION:</b>	<b>SC-88A (SC-70 5 LEAD), 1.25X2</b>	<b>PAGE 1 OF 1</b>

ON Semiconductor and are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. ON Semiconductor does not convey any license under its patent rights nor the rights of others.



**onsemi**, **Onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## ADDITIONAL INFORMATION

### TECHNICAL PUBLICATIONS:

Technical Library: [www.onsemi.com/design/resources/technical-documentation](http://www.onsemi.com/design/resources/technical-documentation)  
onsemi Website: [www.onsemi.com](http://www.onsemi.com)

### ONLINE SUPPORT: [www.onsemi.com/support](http://www.onsemi.com/support)

For additional information, please contact your local Sales Representative at [www.onsemi.com/support/sales](http://www.onsemi.com/support/sales)