

# NLAST44599

## Low Voltage Single Supply Dual DPDT Analog Switch

The NLAST44599 is an advanced CMOS dual-independent DPDT (double pole-double throw) analog switch, fabricated with silicon gate CMOS technology. It achieves high-speed propagation delays and low ON resistances while maintaining CMOS low-power dissipation. This DPDT controls analog and digital voltages that may vary across the full power-supply range (from  $V_{CC}$  to GND).

The device has been designed so the ON resistance ( $R_{ON}$ ) is much lower and more linear over input voltage than  $R_{ON}$  of typical CMOS analog switches.

The channel-select input structure provides protection when voltages between 0 V and 5.5 V are applied, regardless of the supply voltage. This input structure helps prevent device destruction caused by supply voltage – input/output voltage mismatch, battery backup, hot insertion, etc.

The NLAST44599 can also be used as a quad 2-to-1 multiplexer-demultiplexer analog switch with two Select pins that each controls two multiplexer-demultiplexers.

- Select Pins Compatible with TTL Levels
- Channel Select Input Overvoltage Tolerant to 5.5 V
- Fast Switching and Propagation Speeds
- Break-Before-Make Circuitry
- Low Power Dissipation:  $I_{CC} = 2 \mu\text{A}$  (Max) at  $T_A = 25^\circ\text{C}$
- Diode Protection Provided on Channel Select Input
- Improved Linearity and Lower ON Resistance over Input Voltage
- Latch-up Performance Exceeds 300 mA
- ESD Performance: Human Body Model > 2000 V;  
Machine Model > 100 V
- Chip Complexity: 158 FETs
- Pb-Free Packages are Available



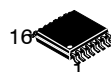
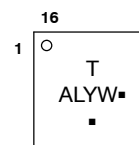
ON Semiconductor®

<http://onsemi.com>

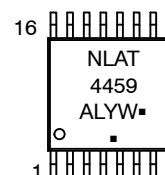
### MARKING DIAGRAMS



QFN-16  
MN SUFFIX  
CASE 485G



TSSOP-16  
DT SUFFIX  
CASE 948F



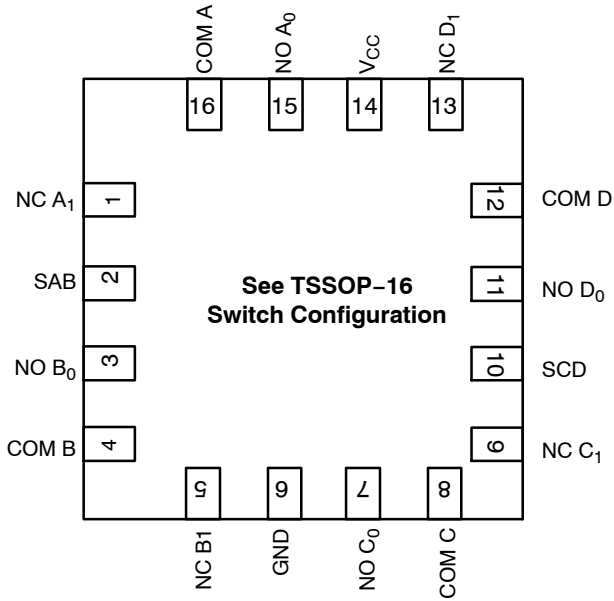
A = Assembly Location  
L = Wafer Lot  
Y = Year  
W = Work Week  
▪ = Pb-Free Package

(Note: Microdot may be in either location)

### ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 10 of this data sheet.

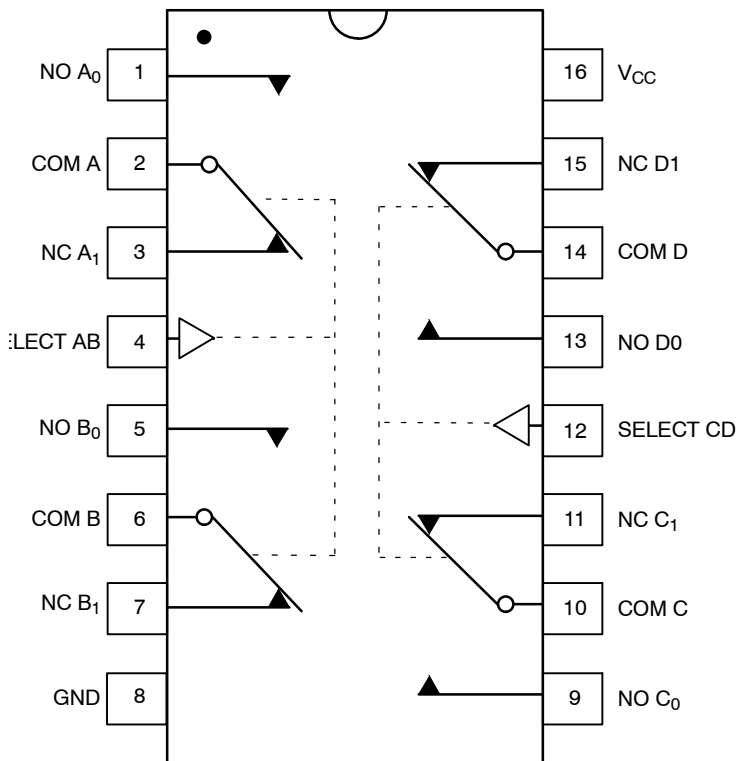
**QFN-16 PACKAGE**



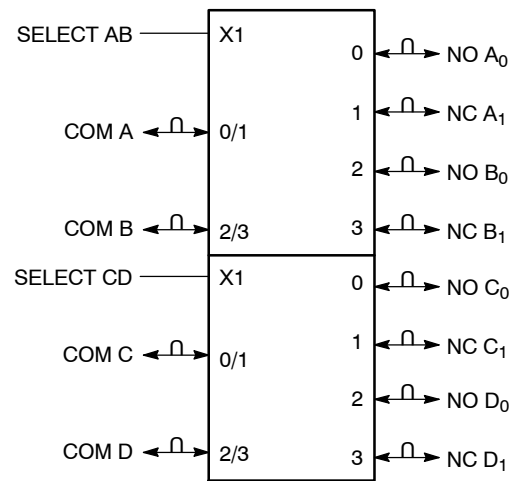
**FUNCTION TABLE**

Select AB or CD	ON Channel
L	NC to COM
H	NO to COM

**TSSOP-16 PACKAGE**



**Figure 1. Logic Diagram**



**Figure 2. IEC Logic Symbol**

**MAXIMUM RATINGS**

Symbol	Parameter	Value	Unit	
V <sub>CC</sub>	Positive DC Supply Voltage	- 0.5 to + 7.0	V	
V <sub>IS</sub>	Analog Input Voltage (V <sub>NO</sub> or V <sub>COM</sub> )	- 0.5 ≤ V <sub>IS</sub> ≤ V <sub>CC</sub> + 0.5	V	
V <sub>IN</sub>	Digital Select Input Voltage	- 0.5 ≤ V <sub>I</sub> ≤ + 7.0	V	
I <sub>IK</sub>	DC Current, Into or Out of Any Pin	± 50	mA	
P <sub>D</sub>	Power Dissipation in Still Air	QFN-16 TSSOP-16	800 450	mW
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	
MSL	Moisture Sensitivity	Level 1		
F <sub>R</sub>	Flammability Rating	Oxygen Index: 30% - 35%	UL-94-VO (0.125 in)	
V <sub>ESD</sub>	ESD Withstand Voltage	Human Body Model (Note 1) Machine Model (Note 2) Charged Device Model (Note 3)	2000 100 1000	V
I <sub>LATCH-UP</sub>	Latch-Up Performance	Above V <sub>CC</sub> and Below GND at 125°C (Note 4)	± 300	mA
θ <sub>JA</sub>	Thermal Resistance	QFN-16 TSSOP-16	80 164	°C/W

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. Tested to EIA/JESD22-A114-A.
2. Tested to EIA/JESD22-A115-A.
3. Tested to JESD22-C101-A.
4. Tested to EIA/JESD78.

**RECOMMENDED OPERATING CONDITIONS**

Symbol	Parameter	Min	Max	Unit
V <sub>CC</sub>	DC Supply Voltage	2.0	5.5	V
V <sub>IN</sub>	Digital Select Input Voltage	GND	5.5	V
V <sub>IS</sub>	Analog Input Voltage (NC, NO, COM)	GND	V <sub>CC</sub>	V
T <sub>A</sub>	Operating Temperature Range	- 55	+ 125	°C
t <sub>r</sub> , t <sub>f</sub>	Input Rise or Fall Time, SELECT	V <sub>CC</sub> = 3.3 V ± 0.3 V V <sub>CC</sub> = 5.0 V ± 0.5 V	0 100	ns/V
			20	

**DEVICE JUNCTION TEMPERATURE VERSUS TIME TO 0.1% BOND FAILURES**

Junction Temperature °C	Time, Hours	Time, Years
80	1,032,200	117.8
90	419,300	47.9
100	178,700	20.4
110	79,600	9.4
120	37,000	4.2
130	17,800	2.0
140	8,900	1.0

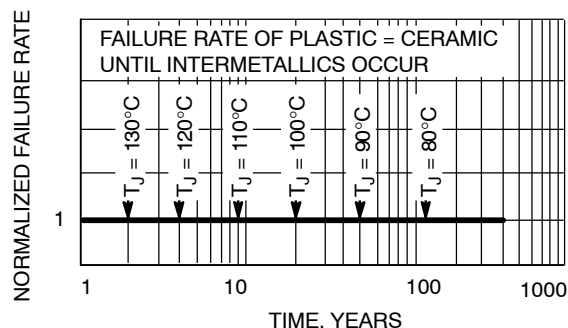


Figure 3. Failure Rate vs. Time Junction Temperature

# NLAST44599

## DC CHARACTERISTICS – Digital Section (Voltages Referenced to GND)

Symbol	Parameter	Condition	V <sub>CC</sub>	Guaranteed Limit			Unit
				–55°C to 25°C	< 85°C	< 125°C	
V <sub>IH</sub>	Minimum High-Level Input Voltage, Select Inputs		3.0	2.0	2.0	2.0	V
			4.5	2.0	2.0	2.0	
			5.5	2.0	2.0	2.0	
V <sub>IL</sub>	Maximum Low-Level Input Voltage, Select Inputs		3.0	0.5	0.5	0.5	V
			4.5	0.8	0.8	0.8	
			5.5	0.8	0.8	0.8	
I <sub>IN</sub>	Maximum Input Leakage Current	V <sub>IN</sub> = 5.5 V or GND	5.5	± 0.2	± 2.0	± 2.0	μA
I <sub>OFF</sub>	Power Off Leakage Current, Select Inputs	V <sub>IN</sub> = 5.5 V or GND	0	± 10	± 10	± 10	μA
I <sub>CC</sub>	Maximum Quiescent Supply Current	Select and V <sub>IS</sub> = V <sub>CC</sub> or GND	5.5	4.0	4.0	8.0	μA

## DC ELECTRICAL CHARACTERISTICS – Analog Section

Symbol	Parameter	Condition	V <sub>CC</sub>	Guaranteed Limit			Unit
				–55°C to 25°C	< 85°C	< 125°C	
R <sub>ON</sub>	Maximum “ON” Resistance (Figures 17 – 23)	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> V <sub>IS</sub> = GND to V <sub>CC</sub>  I <sub>IN</sub>   ≤ 10.0 mA	2.5	85	95	105	Ω
			3.0	45	50	55	
			4.5	30	35	40	
			5.5	25	30	35	
R <sub>FLAT (ON)</sub>	ON Resistance Flatness (Figures 17 – 23)	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub>  I <sub>IN</sub>   ≤ 10.0 mA V <sub>IS</sub> = 1 V, 2 V, 3.5 V	4.5	4	4	5	Ω
I <sub>NC(OFF)</sub> I <sub>NO(OFF)</sub>	NO or NC Off Leakage Current (Figure 9)	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> V <sub>NO</sub> or V <sub>NC</sub> = 1.0 V <sub>COM</sub> 4.5 V	5.5	1	10	100	nA
I <sub>COM(ON)</sub>	COM ON Leakage Current (Figure 9)	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> V <sub>NO</sub> 1.0 V or 4.5 V with V <sub>NC</sub> floating or V <sub>NO</sub> 1.0 V or 4.5 V with V <sub>NO</sub> floating V <sub>COM</sub> = 1.0 V or 4.5 V	5.5	1	10	100	nA

# NLAST44599

## AC ELECTRICAL CHARACTERISTICS (Input $t_r = t_f = 3.0$ ns)

Symbol	Parameter	Test Conditions	V <sub>CC</sub> (V)	V <sub>IS</sub> (V)	Guaranteed Maximum Limit						Unit	
					-55°C to 25°C			< 85°C		< 125°C		
					Min	Typ*	Max	Min	Max	Min		Max
t <sub>ON</sub>	Turn-On Time (Figures 12 and 13)	R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF (Figures 5 and 6)	2.5	2.0	5	23	35	5	38	5	41	ns
			3.0	2.0	5	16	24	5	27	5	30	
			4.5	3.0	2	11	16	2	19	2	22	
			5.5	3.0	2	9	14	2	17	2	20	
t <sub>OFF</sub>	Turn-Off Time (Figures 12 and 13)	R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF (Figures 5 and 6)	2.5	2.0	1	7	12	1	15	1	18	ns
			3.0	2.0	1	5	10	1	13	1	16	
			4.5	3.0	1	4	6	1	9	1	12	
			5.5	3.0	1	3	5	1	8	1	11	
t <sub>BBM</sub>	Minimum Break-Before-Make Time	V <sub>IS</sub> = 3.0 V (Figure 4) R <sub>L</sub> = 300 Ω, C <sub>L</sub> = 35 pF	2.5	2.0	1	12		1		1		ns
			3.0	2.0	1	11		1		1		
			4.5	3.0	1	6		1		1		
			5.5	3.0	1	5		1		1		

\*Typical Characteristics are at 25°C.

Symbol	Parameter	Typical @ 25, V <sub>CC</sub> = 5.0 V		Unit
		Min	Max	
C <sub>IN</sub>	Maximum Input Capacitance, Select Input		8	pF
C <sub>NO</sub> or C <sub>NC</sub>	Analog I/O (Switch Off)		10	
C <sub>COM</sub>	Common I/O (Switch Off)		10	
C <sub>(ON)</sub>	Feedthrough (Switch On)		20	

## ADDITIONAL APPLICATION CHARACTERISTICS (Voltages Referenced to GND Unless Noted)

Symbol	Parameter	Condition	V <sub>CC</sub> V	Typical	Unit
				25°C	
BW	Maximum On-Channel -3 dB Bandwidth or Minimum Frequency Response (Figure 11)	V <sub>IN</sub> = 0 dBm V <sub>IN</sub> centered between V <sub>CC</sub> and GND (Figure 7)	3.0	145	MHz
			4.5	170	
			5.5	175	
V <sub>ONL</sub>	Maximum Feedthrough On Loss	V <sub>IN</sub> = 0 dBm @ 100 kHz to 50 MHz V <sub>IN</sub> centered between V <sub>CC</sub> and GND (Figure 7)	3.0	-3	dB
			4.5	-3	
			5.5	-3	
V <sub>ISO</sub>	Off-Channel Isolation (Figure 10)	f = 100 kHz; V <sub>IS</sub> = 1 V RMS V <sub>IN</sub> centered between V <sub>CC</sub> and GND (Figure 7)	3.0	-93	dB
			4.5	-93	
			5.5	-93	
Q	Charge Injection Select Input to Common I/O (Figure 15)	V <sub>IN</sub> = V <sub>CC</sub> to GND, F <sub>IS</sub> = 20 kHz t <sub>r</sub> = t <sub>f</sub> = 3 ns R <sub>IS</sub> = 0 Ω, C <sub>L</sub> = 1000 pF Q = C <sub>L</sub> * ΔV <sub>OUT</sub> (Figure 8)	3.0	1.5	pC
			5.5	3.0	
THD	Total Harmonic Distortion THD + Noise (Figure 14)	F <sub>IS</sub> = 20 Hz to 100 kHz, R <sub>L</sub> = R <sub>gen</sub> = 600 Ω, C <sub>L</sub> = 50 pF V <sub>IS</sub> = 5.0 V <sub>PP</sub> sine wave	5.5	0.1	%
VCT	Channel to Channel Crosstalk	f = 100 kHz; V <sub>IS</sub> = 1 V RMS V <sub>IN</sub> centered between V <sub>CC</sub> and GND (Figure 7)	5.5	-90	dB
			3.0	-90	

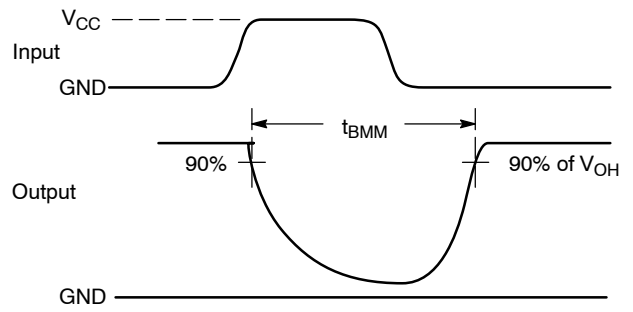
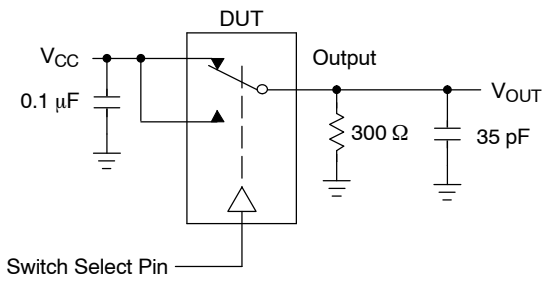


Figure 4.  $t_{BMM}$  (Time Break-Before-Make)

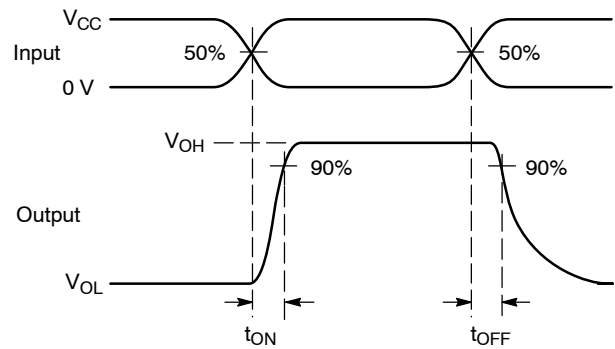
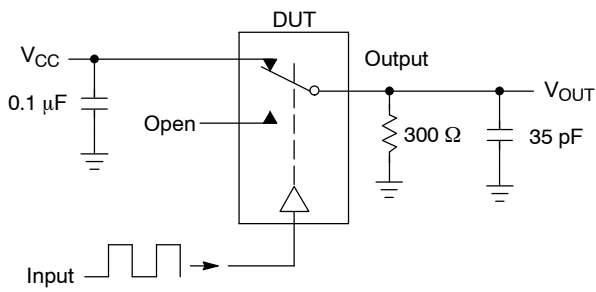


Figure 5.  $t_{ON}/t_{OFF}$

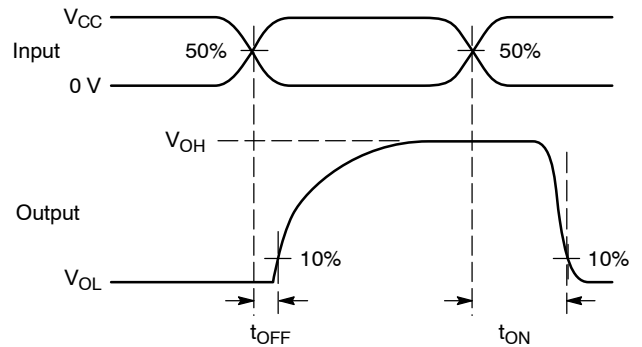
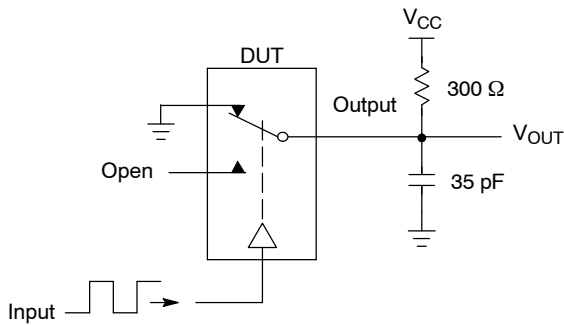
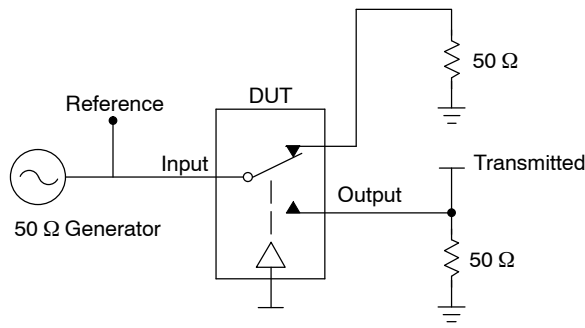


Figure 6.  $t_{ON}/t_{OFF}$

# NLAST44599



Channel switch control/s test socket is normalized. Off isolation is measured across an off channel. On loss is the bandwidth of an On switch.  $V_{ISO}$ , Bandwidth and  $V_{ONL}$  are independent of the input signal direction.

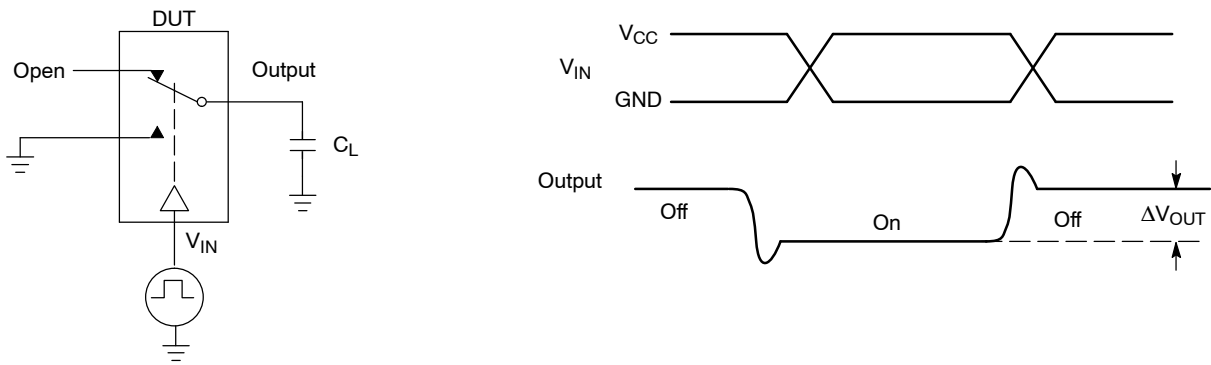
$$V_{ISO} = \text{Off Channel Isolation} = 20 \text{ Log} \left( \frac{V_{OUT}}{V_{IN}} \right) \text{ for } V_{IN} \text{ at } 100 \text{ kHz}$$

$$V_{ONL} = \text{On Channel Loss} = 20 \text{ Log} \left( \frac{V_{OUT}}{V_{IN}} \right) \text{ for } V_{IN} \text{ at } 100 \text{ kHz to } 50 \text{ MHz}$$

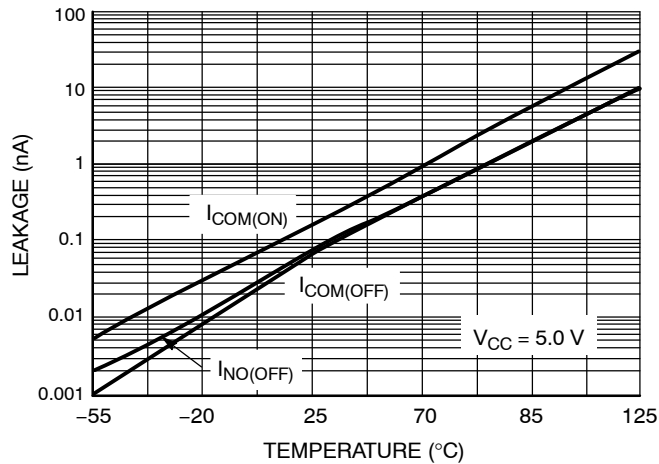
Bandwidth (BW) = the frequency 3 dB below  $V_{ONL}$

$V_{CT}$  = Use  $V_{ISO}$  setup and test to all other switch analog input/outputs terminated with 50  $\Omega$

**Figure 7. Off Channel Isolation/On Channel Loss (BW)/Crosstalk (On Channel to Off Channel)/ $V_{ONL}$**



**Figure 8. Charge Injection: (Q)**



**Figure 9. Switch Leakage vs. Temperature**

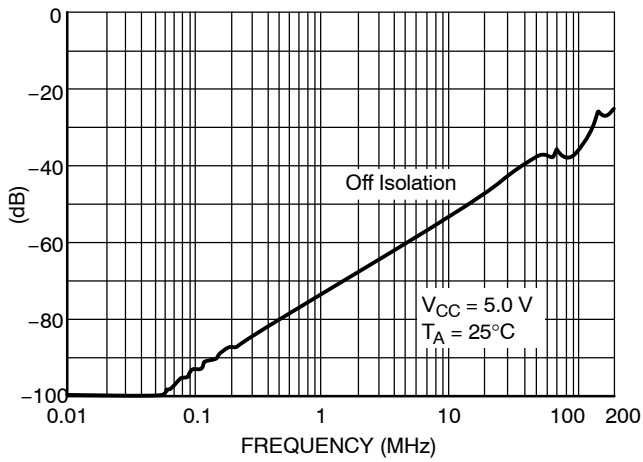


Figure 10. Off-Channel Isolation

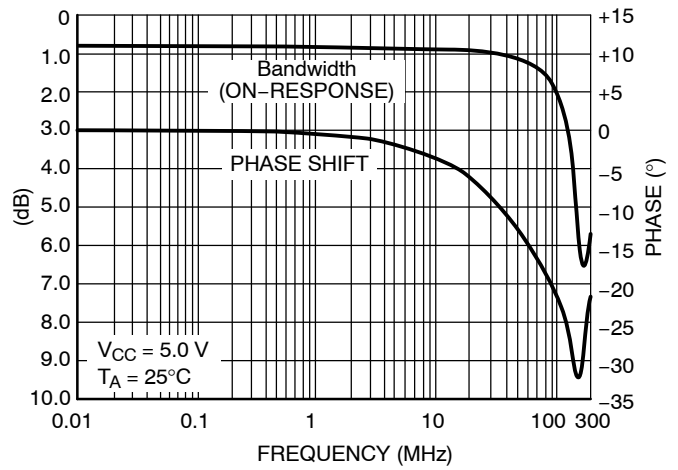


Figure 11. Typical Bandwidth and Phase Shift



Figure 12.  $t_{ON}$  and  $t_{OFF}$  vs.  $V_{CC}$  at  $25^\circ\text{C}$

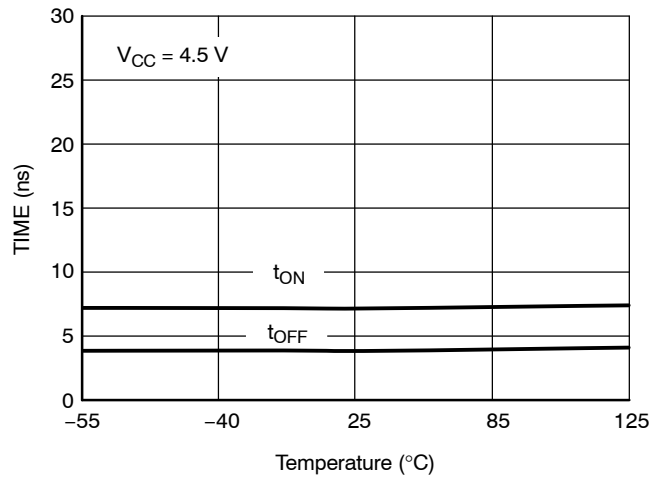


Figure 13.  $t_{ON}$  and  $t_{OFF}$  vs. Temp

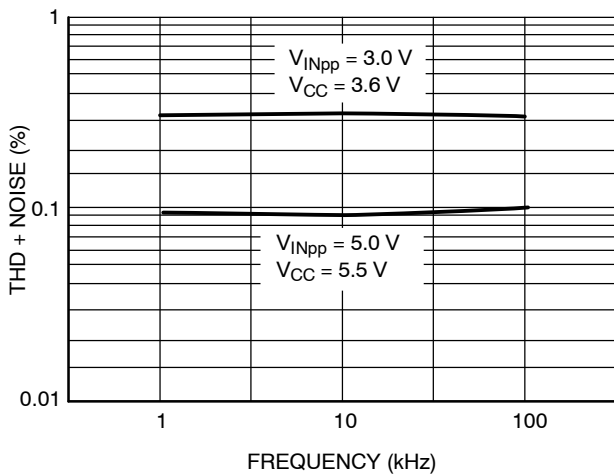


Figure 14. Total Harmonic Distortion Plus Noise vs. Frequency

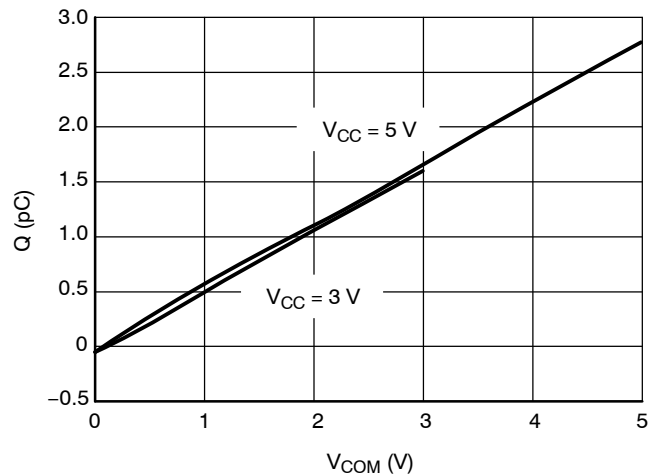


Figure 15. Charge Injection vs. COM Voltage



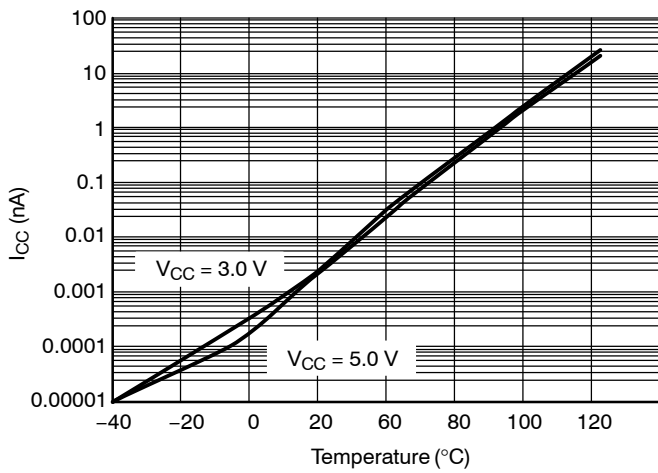


Figure 16.  $I_{CC}$  vs. Temp,  $V_{CC} = 3\text{ V}$  and  $5\text{ V}$

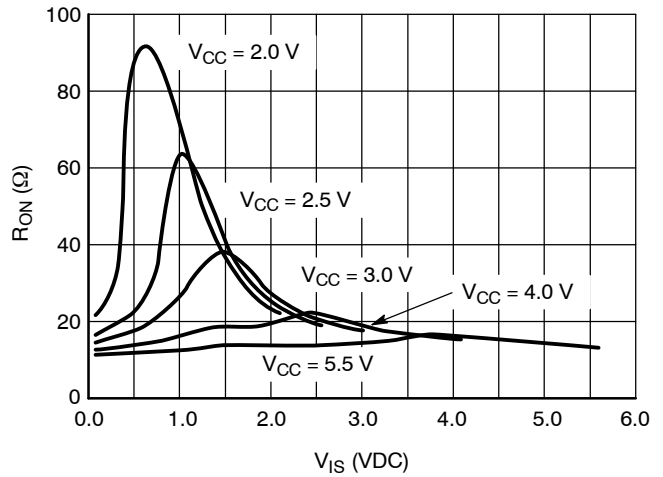


Figure 17.  $R_{ON}$  vs.  $V_{CC}$ , Temp =  $25^\circ\text{C}$

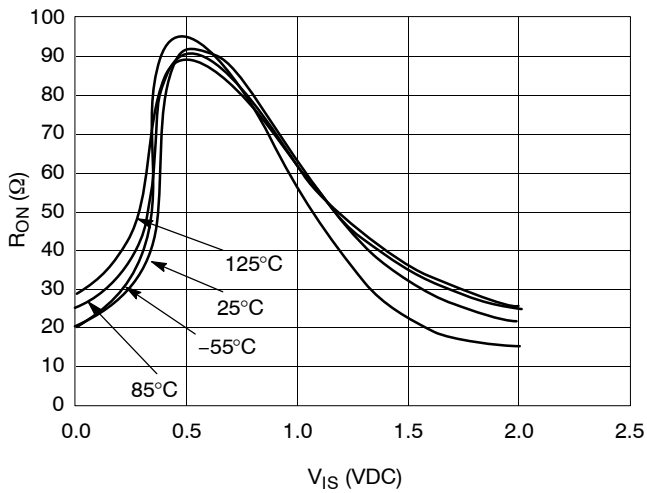


Figure 18.  $R_{ON}$  vs Temp,  $V_{CC} = 2.0\text{ V}$

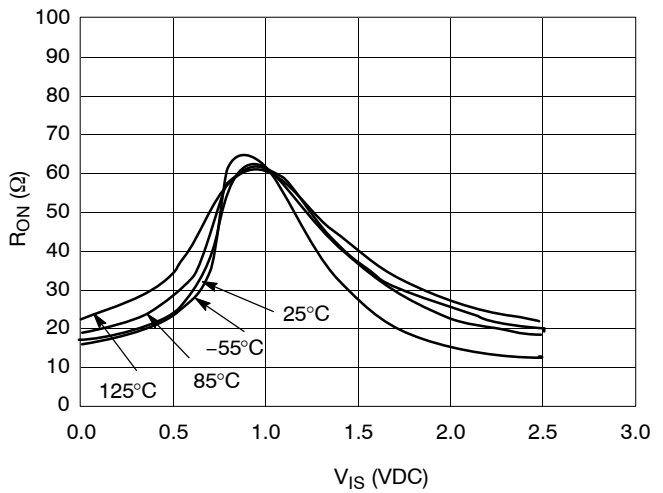


Figure 19.  $R_{ON}$  vs. Temp,  $V_{CC} = 2.5\text{ V}$

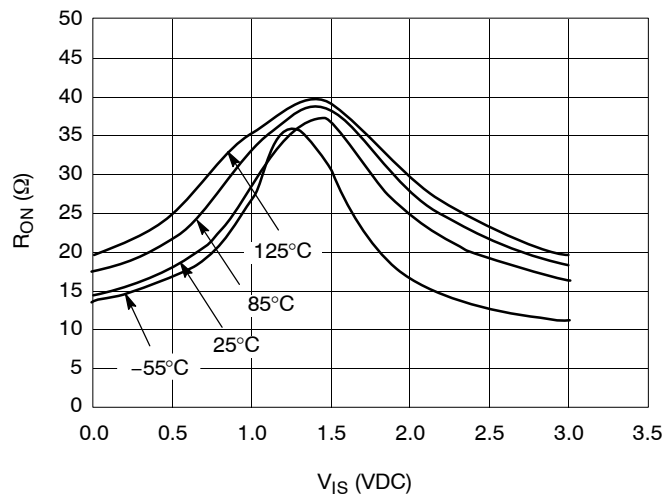


Figure 20.  $R_{ON}$  vs. Temp,  $V_{CC} = 3.0\text{ V}$

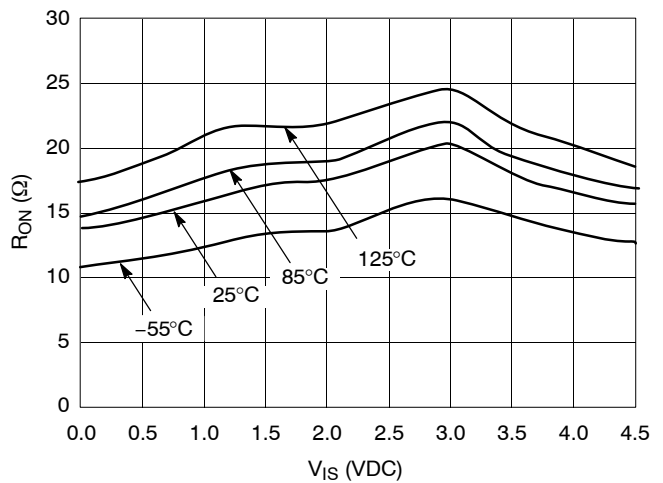


Figure 21.  $R_{ON}$  vs. Temp,  $V_{CC} = 4.5\text{ V}$

# NLAST44599



Figure 22.  $R_{ON}$  vs. Temp,  $V_{CC} = 5.0$  V

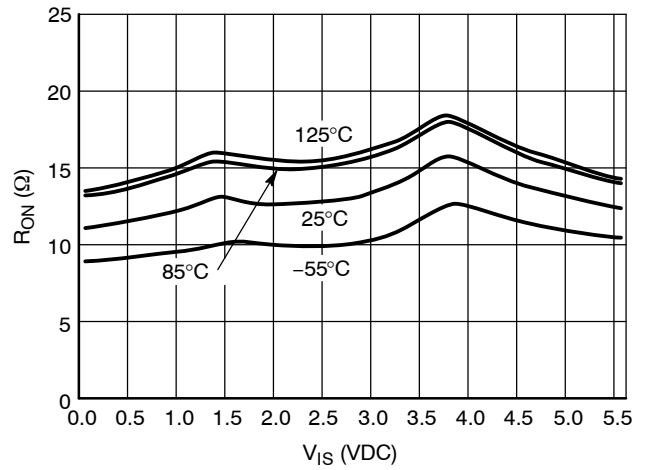


Figure 23.  $R_{ON}$  vs. Temp,  $V_{CC} = 5.5$  V

## DEVICE ORDERING INFORMATION

Device Order Number	Device Nomenclature					Package Type	Shipping <sup>†</sup>
	Circuit Indicator	Technology	Device Function	Package Suffix	Tape and Reel Suffix		
NLAST44599DT	NL	AS	44599	DT		TSSOP-16*	96 Unit / Rail
NLAST44599DTR2	NL	AS	44599	DT	R2	TSSOP-16*	2500 / Tape & Reel
NLAST44599MN	NL	AS	44599	MN		QFN-16	124 Unit Rail
NLAST44599MNG	NL	AS	44599	MN		QFN-16 (Pb-Free)	124 Unit Rail
NLAST44599MNR2	NL	AS	44599	MN	R2	QFN-16	2500 / Tape & Reel
NLAST44599MNR2G	NL	AS	44599	MN	R2	QFN-16 (Pb-Free)	2500 / 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.

\*This package is inherently Pb-Free.

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

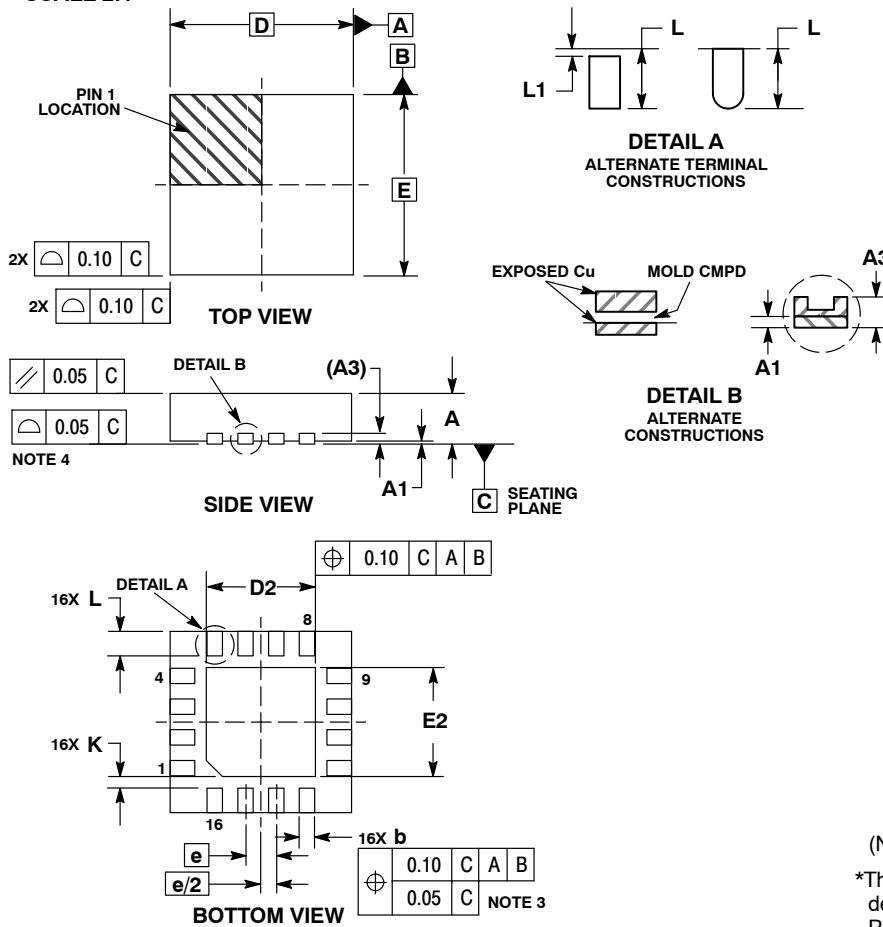
ON Semiconductor®



SCALE 2:1

**QFN16 3x3, 0.5P**  
CASE 485G-01  
ISSUE F

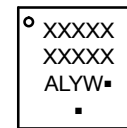
DATE 22 JUN 2011



- NOTES:
- DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
  - CONTROLLING DIMENSION: MILLIMETERS.
  - DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.25 AND 0.30 MM FROM TERMINAL.
  - COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

MILLIMETERS			
DIM	MIN	NOM	MAX
A	0.80	0.90	1.00
A1	0.00	0.03	0.05
A3	0.20 REF		
b	0.18	0.24	0.30
D	3.00 BSC		
D2	1.65	1.75	1.85
E	3.00 BSC		
E2	1.65	1.75	1.85
e	0.50 BSC		
K	0.18 TYP		
L	0.30	0.40	0.50
L1	0.00	0.08	0.15

### GENERIC MARKING DIAGRAM\*

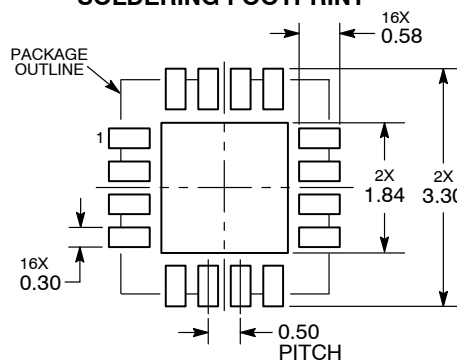


- XXXXX = Specific Device Code
- A = Assembly Location
- L = Wafer Lot
- Y = Year
- W = Work Week
- # = Pb-Free Package

(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.

### RECOMMENDED SOLDERING FOOTPRINT\*



DIMENSIONS: MILLIMETERS

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

<b>DOCUMENT NUMBER:</b>	<b>98AON04795D</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>QFN16, 3X3 MM, 0.5 PITCH</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.

# MECHANICAL CASE OUTLINE

## PACKAGE DIMENSIONS

ON Semiconductor®



TSSOP-16  
CASE 948F-01  
ISSUE B

DATE 19 OCT 2006

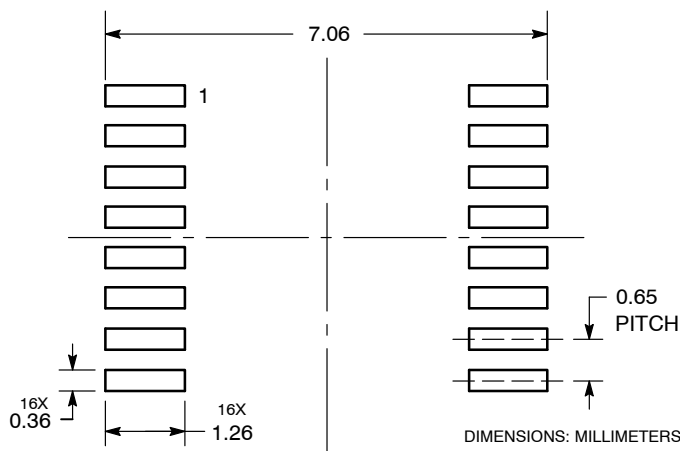


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH. PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.90	5.10	0.193	0.200
B	4.30	4.50	0.169	0.177
C	---	1.20	---	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.18	0.28	0.007	0.011
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0°	8°	0°	8°

SOLDERING FOOTPRINT



GENERIC MARKING DIAGRAM\*



- XXXX = Specific Device Code
- A = Assembly Location
- L = Wafer Lot
- Y = Year
- W = Work Week
- G or ■ = Pb-Free Package

\*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.

DOCUMENT NUMBER:	98ASH70247A	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	TSSOP-16	PAGE 1 OF 1

ON Semiconductor and ON 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.

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 owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor'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). 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. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor 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. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor 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 ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor 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 ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## PUBLICATION ORDERING INFORMATION

### LITERATURE FULFILLMENT:

Email Requests to: [orderlit@onsemi.com](mailto:orderlit@onsemi.com)

ON Semiconductor Website: [www.onsemi.com](http://www.onsemi.com)

### TECHNICAL SUPPORT

North American Technical Support:  
Voice Mail: 1 800-282-9855 Toll Free USA/Canada  
Phone: 011 421 33 790 2910

### Europe, Middle East and Africa Technical Support:

Phone: 00421 33 790 2910

For additional information, please contact your local Sales Representative