

NLAST9431

Low Voltage Single Supply Dual DPDT Analog Switch

The NLAST9431 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 NLAST9431 can also be used as a quad 2-to-1 multiplexer-demultiplexer analog switch with two Select pins that each controls two multiplexer-demultiplexers.

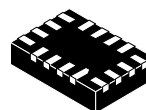
- Select Pins Compatible with TTL Levels
- Channel Select Input Overvoltage Tolerant to 5.5 V
- Fast Switching and Propagation Speeds
- Break-Before-Make Circuitry
- Low Power Dissipation: $I_{CC} = 2 \mu A$ (Max) at $T_A = 25^\circ C$
- Diode Protection Provided on Channel Select Input
- Improved Linearity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



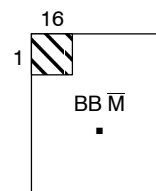
ON Semiconductor®

<http://onsemi.com>

MARKING DIAGRAMS



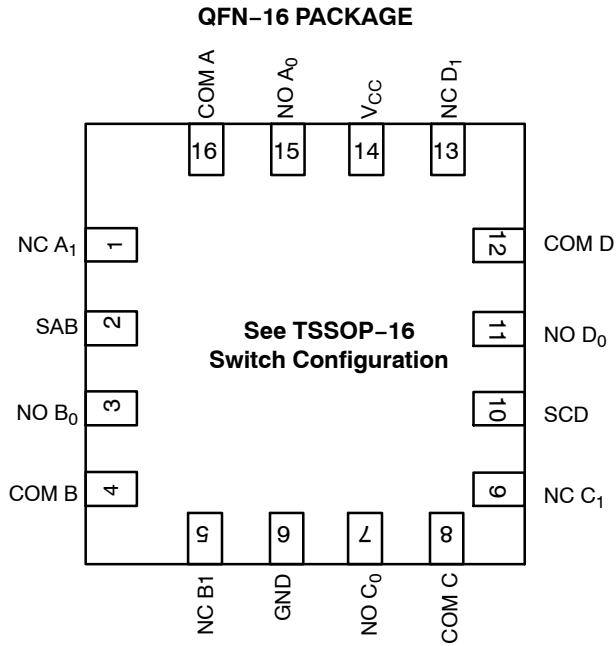
**WQFN16
CASE 488AP**



BB	= Specific Device Code
M	= Date Code & Assembly Location
■	= Pb-Free Device

ORDERING INFORMATION

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



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

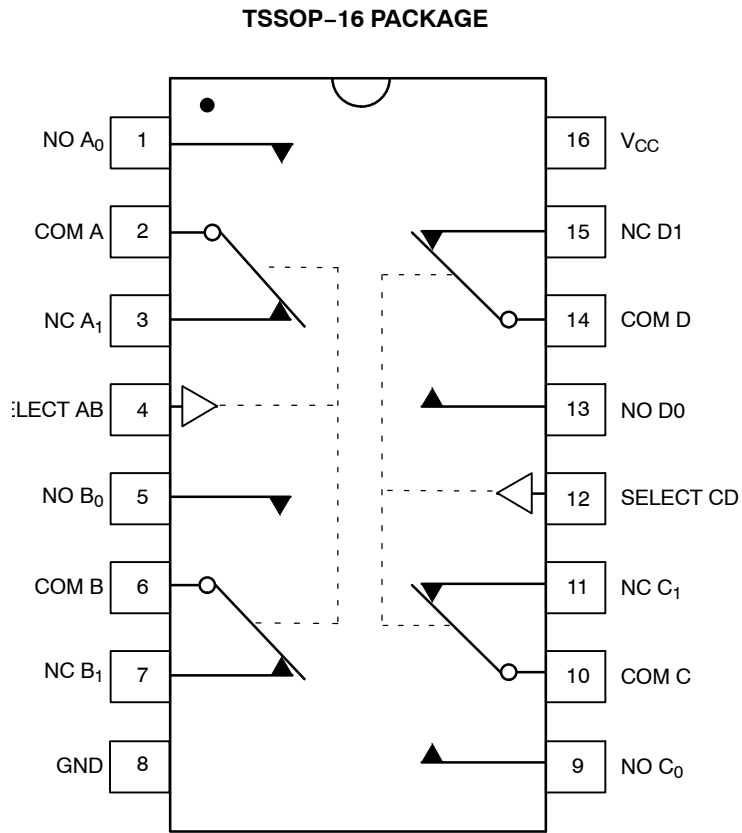


Figure 1. Logic Diagram

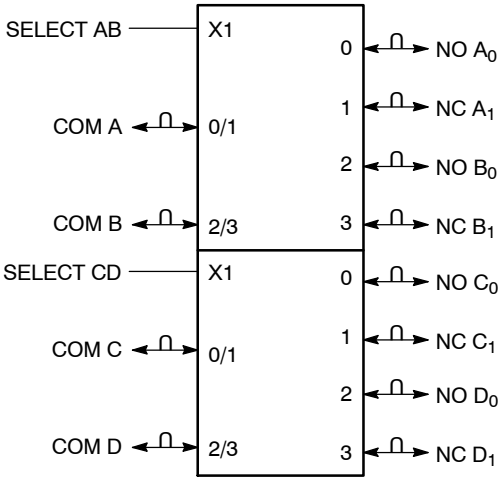


Figure 2. IEC Logic Symbol

MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V _{CC}	Positive DC Supply Voltage	− 0.5 to + 7.0	V
V _{IS}	Analog Input Voltage (V _{NO} or V _{COM})	− 0.5 ≤ V _{IS} ≤ V _{CC} + 0.5	V
V _{IN}	Digital Select Input Voltage	− 0.5 ≤ V _I ≤ + 7.0	V
I _{IK}	DC Current, Into or Out of Any Pin	± 50	mA
P _D	Power Dissipation in Still Air QFN–16 TSSOP–16	800 450	mW
T _{STG}	Storage Temperature Range	− 65 to + 150	°C
T _L	Lead Temperature, 1 mm from Case for 10 Seconds	260	°C
T _J	Junction Temperature Under Bias	+150	°C
MSL	Moisture Sensitivity	Level 1	
F _R	Flammability Rating Oxygen Index: 30% – 35%	UL–94–VO (0.125 in)	
I _{LATCH–UP}	Latch–Up Performance Above V _{CC} and Below GND at 125°C (Note 1)	± 300	mA
θ _{JA}	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/JESD78.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
V _{CC}	DC Supply Voltage	2.0	5.5	V
V _{IN}	Digital Select Input Voltage	GND	5.5	V
V _{IS}	Analog Input Voltage (NC, NO, COM)	GND	V _{CC}	V
T _A	Operating Temperature Range	− 55	+ 125	°C
t _r , t _f	Input Rise or Fall Time, SELECT	V _{CC} = 3.3 V ± 0.3 V V _{CC} = 5.0 V ± 0.5 V	0 100 20	ns/V

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

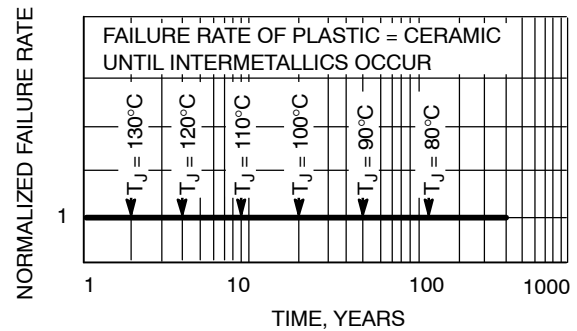


Figure 3. Failure Rate vs. Time Junction Temperature

NLAST9431

DC CHARACTERISTICS – Digital Section (Voltages Referenced to GND)

Symbol	Parameter	Condition	V _{CC}	Guaranteed Limit			Unit
				– 55°C to 25°C	< 85°C	< 125°C	
V _{IH}	Minimum High-Level Input Voltage, Select Inputs		3.0	1.4	1.4	1.4	V
			4.5	2.0	2.0	2.0	
			5.5	2.0	2.0	2.0	
V _{IL}	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 _{IN}	Maximum Input Leakage Current	V _{IN} = 5.5 V or GND	5.5	± 0.2	± 2.0	± 2.0	μA
I _{OFF}	Power Off Leakage Current, Select Inputs	V _{IN} = 5.5 V or GND	0	± 10	± 10	± 10	μA
I _{CC}	Maximum Quiescent Supply Current	Select and V _{IS} = V _{CC} or GND	5.5	4.0	4.0	8.0	μA

DC ELECTRICAL CHARACTERISTICS – Analog Section

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

NLAST9431

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

Symbol	Parameter	Test Conditions	V _{CC} (V)	V _{IS} (V)	Guaranteed Maximum Limit							Unit
					– 55°C to 25°C			< 85°C		< 125°C		
					Min	Typ*	Max	Min	Max	Min	Max	
t _{ON}	Turn-On Time (Figures 12 and 13)	R _L = 300 Ω, C _L = 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 _{OFF}	Turn-Off Time (Figures 12 and 13)	R _L = 300 Ω, C _L = 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 _{BBM}	Minimum Break-Before-Make Time	V _{IS} = 3.0 V (Figure 4) R _L = 300 Ω, C _L = 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.

		Typical @ 25, VCC = 5.0 V	pF
C _{IN}	Maximum Input Capacitance, Select Input	8	
C _{NO} or C _{NC}	Analog I/O (Switch Off)	10	
C _{COM}	Common I/O (Switch Off)	10	
C _(ON)	Feedthrough (Switch On)	20	

ADDITIONAL APPLICATION CHARACTERISTICS (Voltages Referenced to GND Unless Noted)

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

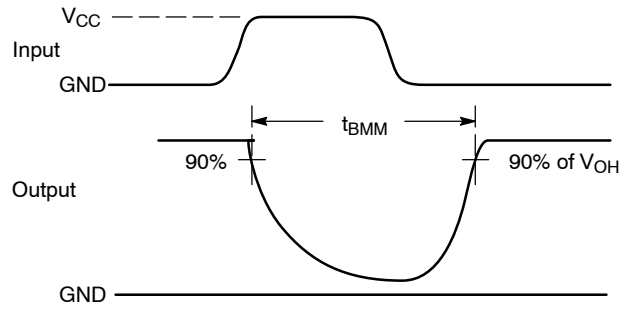
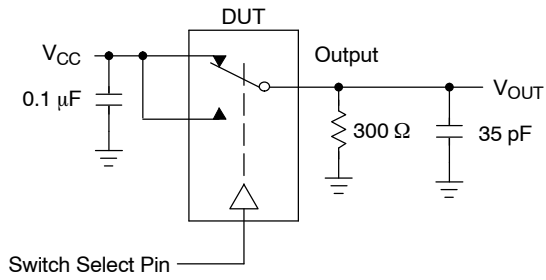


Figure 4. t_{BMM} (Time Break-Before-Make)

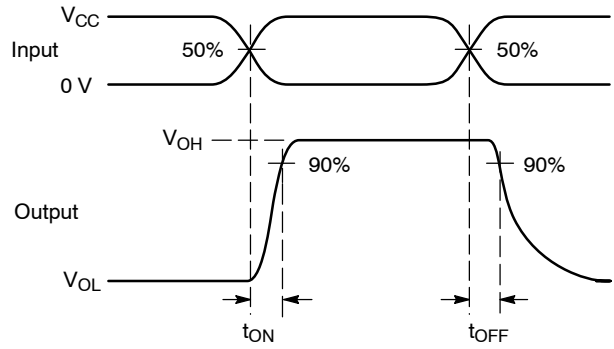
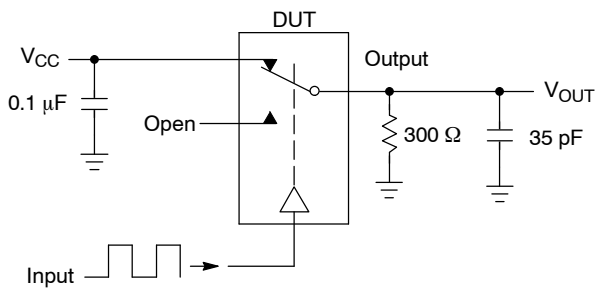


Figure 5. t_{ON}/t_{OFF}

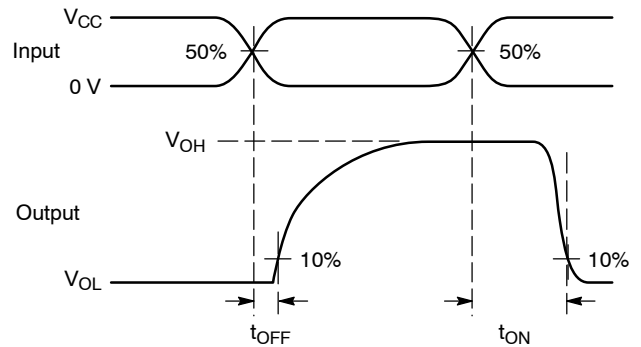
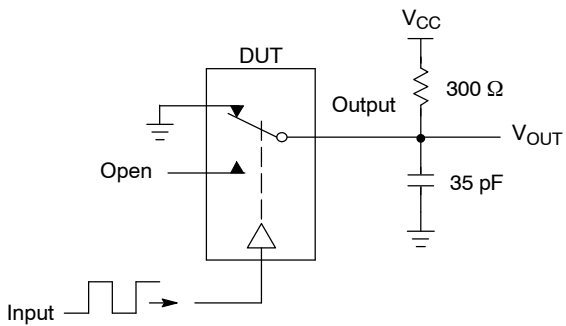
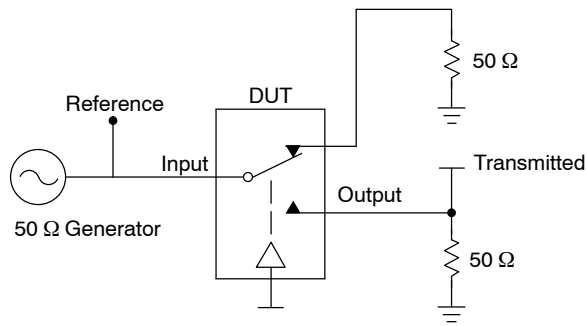


Figure 6. t_{ON}/t_{OFF}



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 Ω

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

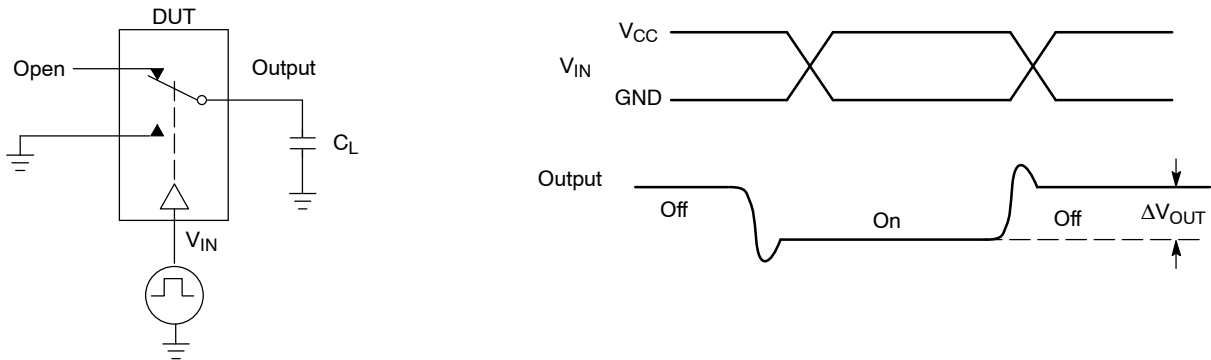


Figure 8. Charge Injection: (Q)

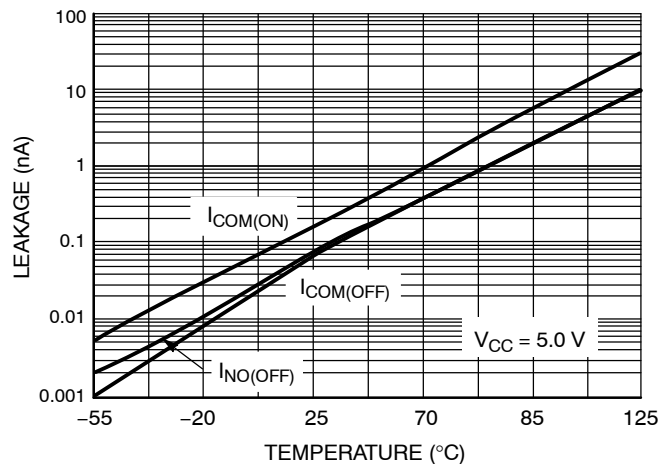


Figure 9. Switch Leakage vs. Temperature

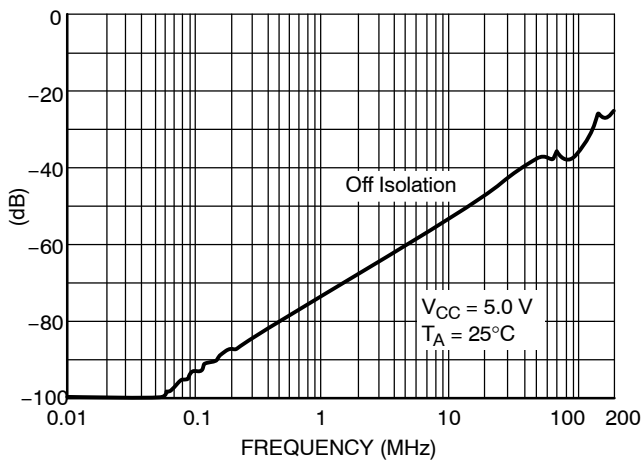


Figure 10. Off-Channel Isolation

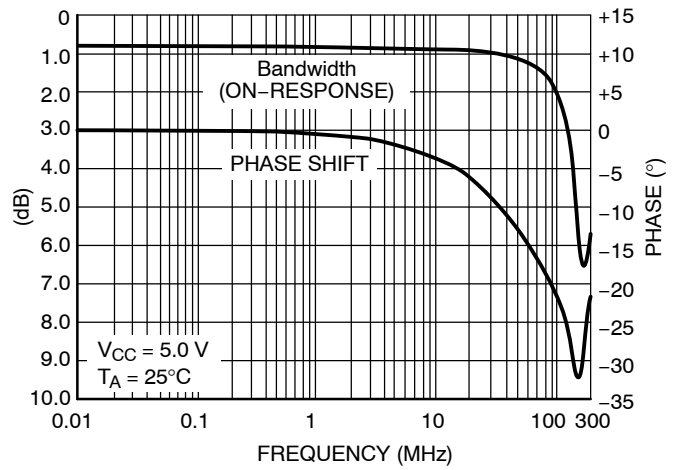


Figure 11. Typical Bandwidth and Phase Shift



Figure 12. t_{ON} and t_{OFF} vs. V_{CC} at 25°C



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

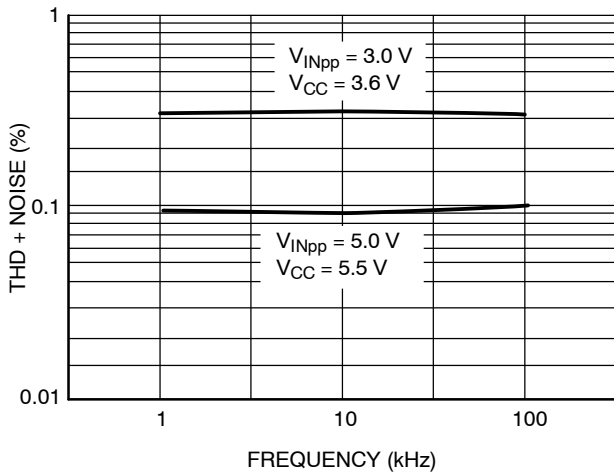


Figure 14. Total Harmonic Distortion Plus Noise vs. Frequency

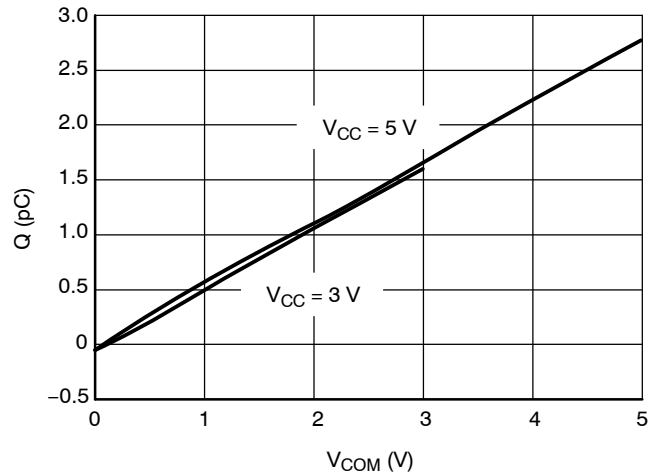


Figure 15. Charge Injection vs. COM Voltage

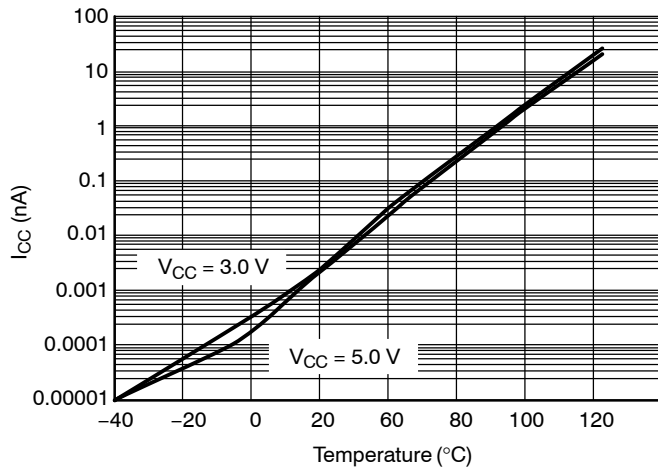


Figure 16. I_{CC} vs. Temp, $V_{CC} = 3\text{ V}$ and 5 V

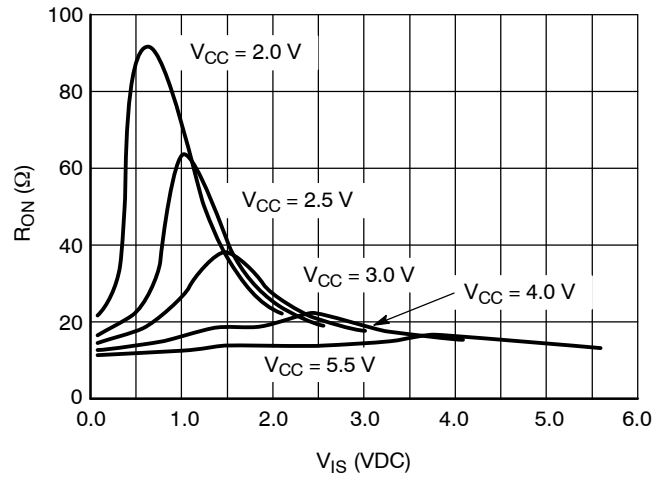


Figure 17. R_{ON} vs. V_{CC} , Temp = 25°C

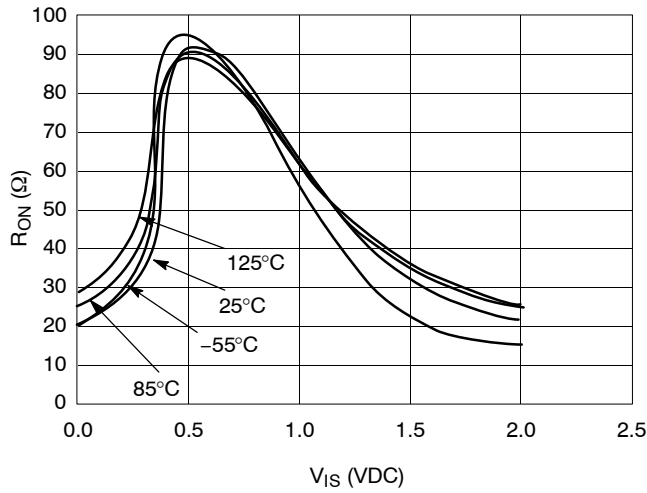


Figure 18. R_{ON} vs. Temp, $V_{CC} = 2.0\text{ V}$

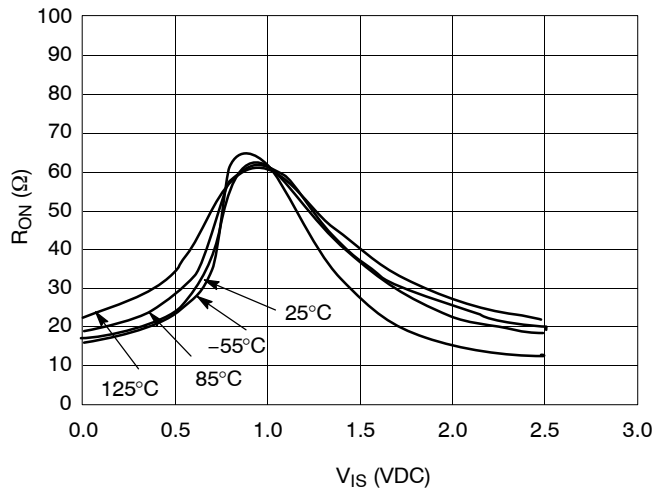


Figure 19. R_{ON} vs. Temp, $V_{CC} = 2.5\text{ V}$

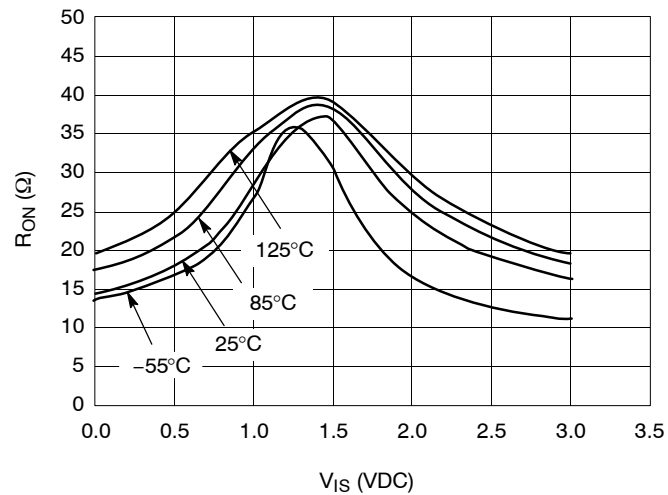


Figure 20. R_{ON} vs. Temp, $V_{CC} = 3.0\text{ V}$

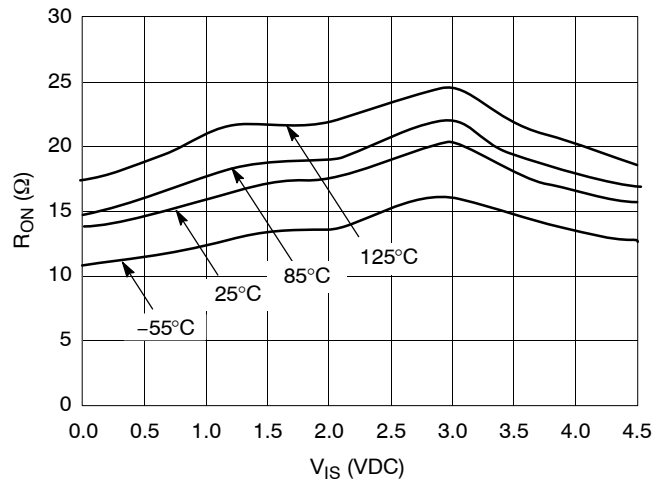


Figure 21. R_{ON} vs. Temp, $V_{CC} = 4.5\text{ V}$

NLAST9431



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

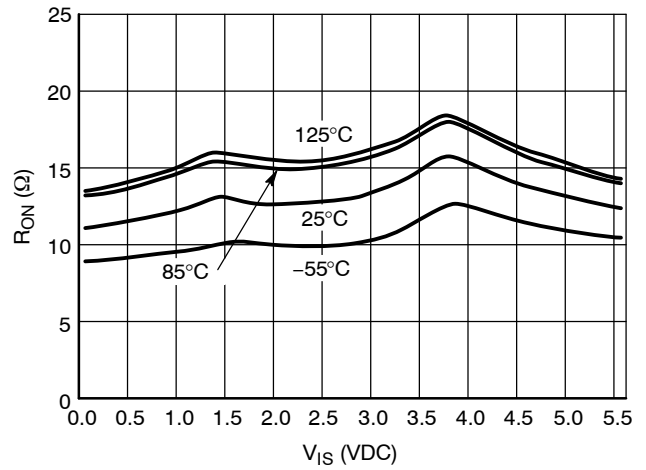


Figure 23. R_{ON} vs. Temp, $V_{CC} = 5.5$ V

DEVICE ORDERING INFORMATION

Device Order Number	Device Nomenclature					Package Type	Shipping [†]
	Circuit Indicator	Technology	Device Function	Package Suffix	Tape and Reel Suffix		
NLAST9431MTR2G	NL	AST	9431	MT	R2G	WQFN-16 (Pb-Free)	3000 / 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.

*This package is inherently Pb-Free.

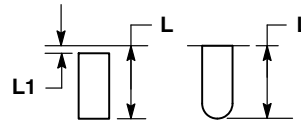
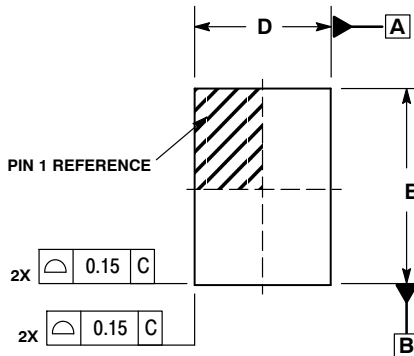
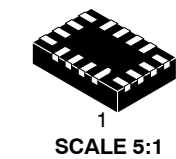
MECHANICAL CASE OUTLINE PACKAGE DIMENSIONS

ON Semiconductor®



WQFN16, 1.8x2.6, 0.4P
CASE 488AP-01
ISSUE B

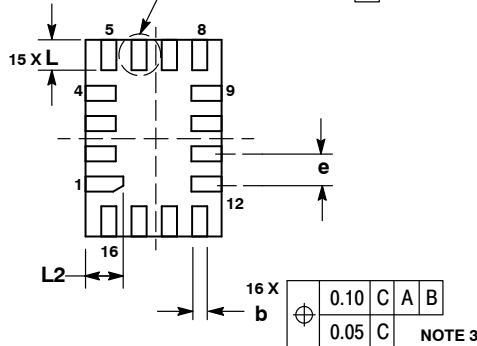
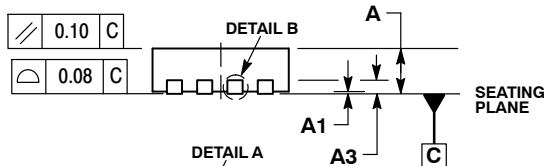
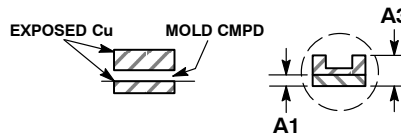
DATE 25 JUN 2008



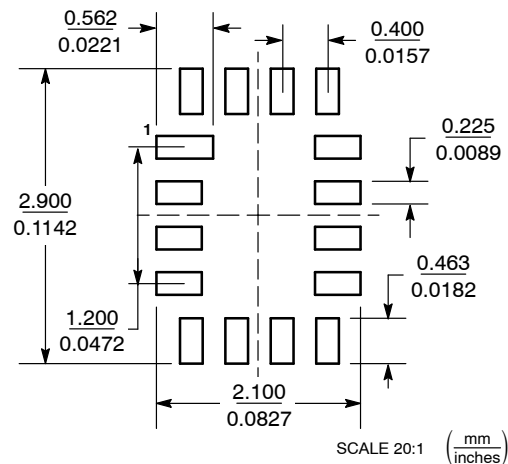
NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS
3. DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.25 AND 0.30 MM FROM TERMINAL.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.
5. EXPOSED PADS CONNECTED TO DIE FLAG. USED AS TEST CONTACTS.

DIM	MILLIMETERS	
	MIN	MAX
A	0.70	0.80
A1	0.00	0.050
A3	0.20 REF	
b	0.15	0.25
D	1.80 BSC	
E	2.60 BSC	
e	0.40 BSC	
L	0.30	0.50
L1	0.00	0.15
L2	0.40	0.60



MOUNTING FOOTPRINT



DOCUMENT NUMBER: 98AON20790D

Electronic versions are uncontrolled except when accessed directly from the Document Repository.
Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.

DESCRIPTION: WQFN16, 1.8 X 2.6, 0.4P

PAGE 1 OF 1

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. **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.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:

Email Requests to: orderlit@onsemi.com

onsemi Website: 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