

NLAS3158

Low Voltage Dual SPDT Analog Switch Dual 2:1 Multiplexer

The NLAS3158 is an advanced CMOS analog switch fabricated with silicon gate CMOS technology. It achieves very low propagation delay and $R_{DS(ON)}$ resistances while maintaining CMOS low power dissipation. Analog and digital voltages that may vary across the full power-supply range (from V_{CC} to GND). This device is a drop in replacement for the PI5A3158.

The select pin has overvoltage protection that allows voltages above V_{CC} , up to 7.0 V to be present on the pin without damage or disruption of operation of the part, regardless of the operating voltage.

Features

- High Speed: $t_{PD} = 1.0$ ns (Typ) at $V_{CC} = 5.0$ V
- Low Power Dissipation: $I_{CC} = 1.0$ μ A (Max) at $T_A = 25^\circ$ C
- Standard CMOS Logic Levels
- High Bandwidth, Improved Linearity
- Low $R_{DS(ON)}$: 8 Ω Max at 3 V
- Break Before Make Circuitry, Prevents Inadvertent Shorts
- This is a Pb-Free Device

Typical Applications

- Switches Standard NTSC/PAL Video, Audio, SPDIF and HDTV
- May be used for Clock Switching, Data MUX'ing, etc.
- Can Switch Balanced Signal Pairs, e.g. LVDS > 200 Mb/s

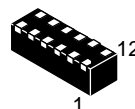
Important Information

- Latchup Performance Exceeds 300 mA
- Pin for Pin Drop in for PI5A3158
- WDFN Package, 3x1 mm
- ESD Performance: Human Body Model; > 2000 V;
Machine Model; > 200 V
- Extended Automotive Temperature Range -55° C to $+125^\circ$ C (See Appendix A)



ON Semiconductor®

www.onsemi.com



WDFN12
MN SUFFIX
CASE 485AG

MARKING DIAGRAM



1

AS = Specific Device Code
 \bar{M} = Date Code
 ■ = Pb-Free Package
 (Note: Microdot may be in either location)

FUNCTION TABLE

Select Input	Function
L	B0 Connected to A
H	B1 Connected to A

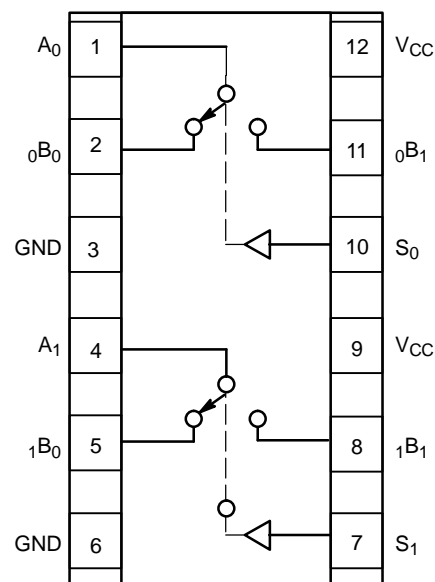


Figure 1. Pinout (Top View)

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 11 of this data sheet.

NLAS3158

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Supply Voltage	V_{CC}	-0.5 to +7.0	V
DC Switch Input Voltage (Note 1)	V_{IS}	-0.5 to $V_{CC} + 0.5$	V
DC Input Voltage (Note 1)	V_{IN}	-0.5 to +7.0	V
DC Input Diode Current @ $V_{IN} < 0$ V	I_{IK}	-50	mA
DC Output Current	I_{OUT}	128	mA
DC V_{CC} or Ground Current	I_{CC}/I_{GND}	+100	mA
Storage Temperature Range	T_{stg}	-65 to +150	°C
Junction Temperature Under Bias	T_J	150	°C
Junction Lead Temperature (Soldering, 10 Seconds)	T_L	260	°C
Power Dissipation @ +85°C	P_D	180	mW

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. The input and output negative voltage ratings may be exceeded if the input and output diode current ratings are observed.

RECOMMENDED OPERATING CONDITIONS (Note 2)

Characteristic	Symbol	Min	Max	Unit
Supply Voltage Operating	V_{CC}	1.65	5.5	V
Select Input Voltage	V_{IN}	0	V_{CC}	V
Switch Input Voltage	V_{IS}	0	V_{CC}	V
Output Voltage	V_{OUT}	0	V_{CC}	V
Operating Temperature	T_A	-55	+125	°C
Input Rise and Fall Time Control Input $V_{CC} = 2.3$ V–3.6 V Control Input $V_{CC} = 4.5$ V–5.5 V	t_r, t_f	0 0	10 5.0	ns/V
Thermal Resistance	θ_{JA}	–	350	°C/W

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.

2. Select input must be held HIGH or LOW, it must not float.

NLAS3158

DC ELECTRICAL CHARACTERISTICS ($T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$)

Symbol	Parameter	Test Conditions	V_{CC} (V)	$T_A = +25^{\circ}\text{C}$			$T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$		Unit
				Min	Typ	Max	Min	Max	
V_{IH}	HIGH Level Input Voltage		1.65–1.95 2.3–5.5				$0.75 V_{CC}$ $0.7 V_{CC}$		V
V_{IL}	LOW Level Input Voltage		1.65–1.95 2.3–5.5					$0.25 V_{CC}$ $0.3 V_{CC}$	V
I_{IN}	Input Leakage Current	$0 \leq V_{IN} \leq 5.5 \text{ V}$	0–5.5		± 0.0 5	± 0.1		± 1	μA
I_{OFF}	OFF State Leakage Current	$0 \leq A, B \leq V_{CC}$	1.65–5.5		± 0.0 5	± 0.1		± 1	μA
R_{ON}	Switch On Resistance (Note 3)	$V_{IN} = 0 \text{ V}, I_O = 30 \text{ mA}$	4.5		3.0	6.0		6.0	Ω
		$V_{IN} = 2.4 \text{ V}, I_O = -30 \text{ mA}$			5.0	8.0		8.0	
		$V_{IN} = 4.5 \text{ V}, I_O = -30 \text{ mA}$			7.0	13		13	
		$V_{IN} = 0 \text{ V}, I_O = 24 \text{ mA}$	3.0		4.0	8.0		8.0	Ω
		$V_{IN} = 3 \text{ V}, I_O = -24 \text{ mA}$			10	19		19	Ω
		$V_{IN} = 0 \text{ V}, I_O = 8 \text{ mA}$	2.3		5.0	9.0		9.0	Ω
		$V_{IN} = 2.3 \text{ V}, I_O = -8 \text{ mA}$			13	24		24	Ω
		$V_{IN} = 0 \text{ V}, I_O = 4 \text{ mA}$	1.65		6.5	12		12	Ω
		$V_{IN} = 1.65 \text{ V}, I_O = -4 \text{ mA}$			17	39		39	Ω
I_{CC}	Quiescent Supply Current All Channels ON or OFF	$V_{IN} = V_{CC}$ or GND $I_{OUT} = 0$	5.5			1.0		10	μA
	Analog Signal Range		V_{CC}	0		V_{CC}	0	V_{CC}	V
R_{RANGE}	On Resistance Over Signal Range (Note 3) (Note 7)	$I_A = -30 \text{ mA}, 0 \leq V_{Bn} \leq V_{CC}$	4.5					25	Ω
		$I_A = -24 \text{ mA}, 0 \leq V_{Bn} \leq V_{CC}$	3.0					50	
		$I_A = -8 \text{ mA}, 0 \leq V_{Bn} \leq V_{CC}$	2.3					100	
		$I_A = -4 \text{ mA}, 0 \leq V_{Bn} \leq V_{CC}$	1.65					300	
ΔR_{ON}	On Resistance Match Between Channels (Note 3) (Note 4) (Note 5)	$I_A = -30 \text{ mA}, V_{Bn} = 3.15$	4.5		0.15				Ω
		$I_A = -24 \text{ mA}, V_{Bn} = 2.1$	3.0		0.2				
		$I_A = -8 \text{ mA}, V_{Bn} = 1.6$	2.3		0.5				
		$I_A = -4 \text{ mA}, V_{Bn} = 1.15$	1.65		0.5				
R_{flat}	On Resistance Flatness (Note 3) (Note 4) (Note 6)	$I_A = -30 \text{ mA}, 0 \leq V_{Bn} \leq V_{CC}$	5.0		5.0				Ω
		$I_A = -24 \text{ mA}, 0 \leq V_{Bn} \leq V_{CC}$	3.3		10				
		$I_A = -8 \text{ mA}, 0 \leq V_{Bn} \leq V_{CC}$	2.5		24				
		$I_A = -4 \text{ mA}, 0 \leq V_{Bn} \leq V_{CC}$	1.8		110				

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

- Measured by the voltage drop between A and B pins at the indicated current through the switch. On Resistance is determined by the lower of the voltages on the two (A or B Ports).
- Parameter is characterized but not tested in production.
- $\Delta R_{ON} = R_{ON} \text{ max} - R_{ON} \text{ min}$ measured at identical V_{CC} , temperature and voltage levels.
- Flatness is defined as the difference between the maximum and minimum value of On Resistance over the specified range of conditions.
- Guaranteed by Design.

NLAS3158

AC ELECTRICAL CHARACTERISTICS ($T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$)

Symbol	Parameter	Test Conditions	V_{CC} (V)	$T_A = +25^{\circ}\text{C}$			$T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$		Unit	Figure Number
				Min	Typ	Max	Min	Max		
t_{PHL} t_{PLH}	Propagation Delay Bus to Bus (Note 9)	$V_I = \text{OPEN}$	1.65–1.95 2.3–2.7 3.0–3.6 4.5–5.5			1.2 0.8 0.3			ns	Figures 2, 3
t_{PZL} t_{PZH}	Output Enable Time Turn On Time (A to B_n)	$V_I = 2 \times V_{CC}$ for t_{PZL} $V_I = 0\text{ V}$ for t_{PZH}	1.65–1.95 2.3–2.7 3.0–3.6 4.5–5.5			23 13 6.9 5.2	7.0 3.5 2.5 1.7	24 14 7.6 5.7	ns	Figures 2, 3
t_{PLZ} t_{PHZ}	Output Disable Time Turn Off Time (A Port to B Port)	$V_I = 2 \times V_{CC}$ for t_{PLZ} $V_I = 0\text{ V}$ for t_{PHZ}	1.65–1.95 2.3–2.7 3.0–3.6 4.5–5.5			12.5 7.0 5.0 3.5	3.0 2.0 1.5 0.8	13 7.5 5.3 3.8	ns	Figures 2, 3
t_{BBM}	Break Before Make Time (Note 8)	$R_L = 50\ \Omega$ $C_L = 35\ \text{pF}$	1.65–1.95 2.3–2.7 3.0–3.6 4.5–5.5	0.5 0.5 0.5 0.5			0.5 0.5 0.5 0.5		ns	Figure 4
Q	Charge Injection (Note 8)	$C_L = 0.1\ \text{nF}$, $V_{GEN} = 0\text{ V}$ $R_{GEN} = 0\ \Omega$	5.0 3.3		7.0 3.0				pC	Figure 5
OIRR	Off Isolation (Note 10) NO	$R_L = 50\ \Omega$ $f = 10\ \text{MHz}$	1.65–5.5		-55				dB	Figures 6, 16
OIRR	Off Isolation (Note 10) NC	$R_L = 50\ \Omega$ $f = 10\ \text{MHz}$	1.65–5.5		-48				dB	Figures 6, 16
Xtalk	Crosstalk	$R_L = 50\ \Omega$ $f = 10\ \text{MHz}$	1.65–5.5		-54				dB	Figure 7
BW	-3 dB Bandwidth	$R_L = 50\ \Omega$	2.5–5.5		250				MHz	Figures 10, 15
THD	Total Harmonic Distortion (Note 8)	$R_L = 600\ \Omega$ $0.5\ V_{P-P}$ $f = 600\ \text{Hz}$ to $20\ \text{kHz}$	2.5 5.0		0.014 0.004				%	Figure 11

CAPACITANCE (Note 11)

Symbol	Parameter	Test Conditions	Typ	Max	Unit	Figure Number
C_{IN}	Select Pin Input Capacitance	$V_{CC} = 0\text{ V}$	2.3		pF	
C_{IO-B}	B Port Off Capacitance	$V_{CC} = 5.0\text{ V}$	6.5		pF	Figure 8
C_{IOA-ON}	A Port Capacitance when Switch is Enabled	$V_{CC} = 5.0\text{ V}$	18.5		pF	Figure 9

8. Guaranteed by Design.

9. This parameter is guaranteed by design but not tested. The bus switch contributes no propagation delay other than the RC delay of the On Resistance of the switch and the 35 pF load capacitance, when driven by an ideal voltage source (zero output impedance).

10. Off Isolation = $20 \log_{10} [V_A/V_{Bn}]$.

11. $T_A = +25^{\circ}\text{C}$, $f = 1\ \text{MHz}$, Capacitance is characterized but not tested in production.

APPENDIX A

DC ELECTRICAL EXTENDED AUTOMOTIVE TEMPERATURE RANGE CHARACTERISTICS (Note 14)

Symbol	Parameter	Test Conditions	V _{CC} (V)	T _A = +25°C			T _A = -55°C to +125°C		Unit
				Min	Typ	Max	Min	Max	
V _{IH}	HIGH Level Input Voltage		1.65–1.95 2.3–5.5				0.75 V _{CC} 0.7 V _{CC}		V
V _{IL}	LOW Level Input Voltage		1.65–1.95 2.3–5.5					0.25 V _{CC} 0.3 V _{CC}	V
I _{IN}	Input Leakage Current	0 ≤ V _{IN} ≤ 5.5 V	0–5.5		±0.05	±0.1		±1	μA
I _{OFF}	OFF State Leakage Current	0 ≤ A, B ≤ V _{CC}	1.65–5.5		±0.05	±0.1		±1	μA
R _{ON}	Switch On Resistance (Note 12)	V _{IN} = 0 V, I _O = 30 mA	4.5		3.0			8.5	Ω
		V _{IN} = 2.4 V, I _O = -30 mA			5.0		13.0		
		V _{IN} = 4.5 V, I _O = -30 mA			7.0		15.0		
		V _{IN} = 0 V, I _O = 24 mA	3.0		4.0		11		
		V _{IN} = 3 V, I _O = -24 mA			10		20		
		V _{IN} = 0 V, I _O = 8 mA	2.3		5.0		12		
		V _{IN} = 2.3 V, I _O = -8 mA			13		30		
		V _{IN} = 0 V, I _O = 4 mA	1.65		6.5		20		
		V _{IN} = 1.65 V, I _O = -4 mA			17		50		
I _{CC}	Quiescent Supply Current All Channels ON or OFF	V _{IN} = V _{CC} or GND I _{OUT} = 0	5.5			1.0		10	μA
	Analog Signal Range		V _{CC}	0		V _{CC}	0	V _{CC}	V
R _{RANGE}	On Resistance Over Signal Range (Note 12) (Note 13)	I _A = -30 mA, 0 ≤ V _{Bn} ≤ V _{CC}	4.5					25	Ω
		I _A = -24 mA, 0 ≤ V _{Bn} ≤ V _{CC}	3.0				50		
		I _A = -8 mA, 0 ≤ V _{Bn} ≤ V _{CC}	2.3				100		
		I _A = -4 mA, 0 ≤ V _{Bn} ≤ V _{CC}	1.65				300		

12. Measured by the voltage drop between A and B pins at the indicated current through the switch. On Resistance is determined by the lower of the voltages on the two (A or B Ports).

13. Guaranteed by Design.

14. For ΔR_{ON}, R_{FLAT} see -40°C to +85°C section.

APPENDIX A

AC ELECTRICAL EXTENDED AUTOMOTIVE TEMPERATURE RANGE CHARACTERISTICS

Symbol	Parameter	Test Conditions	V _{CC} (V)	T _A = +25°C			T _A = -55°C to +125°C		Unit	Figure Number
				Min	Typ	Max	Min	Max		
t _{PHL} t _{PLH}	Propagation Delay Bus to Bus (Note 16)	V _I = OPEN	1.65–1.95 2.3–2.7 3.0–3.6 4.5–5.5					1.2 0.8 0.3	ns	Figures 2, 3
t _{PZL} t _{PZH}	Output Enable Time Turn On Time (A to B _n)	V _I = 2 × V _{CC} for t _{PZL} V _I = 0 V for t _{PZH}	1.65–1.95 2.3–2.7 3.0–3.6 4.5–5.5			23 13 6.9 5.2	7.0 3.5 2.5 1.7	24 14 9.0 7.0	ns	Figures 2, 3
t _{PLZ} t _{PHZ}	Output Disable Time Turn Off Time (A Port to B Port)	V _I = 2 × V _{CC} for t _{PLZ} V _I = 0 V for t _{PHZ}	1.65–1.95 2.3–2.7 3.0–3.6 4.5–5.5			12.5 7.0 5.0 3.5	3.0 2.0 1.5 0.8	13 7.5 6.5 5.0	ns	Figures 2, 3
t _{B-M}	Break Before Make Time (Note 15)		1.65–1.95 2.3–2.7 3.0–3.6 4.5–5.5				0.5 0.5 0.5 0.5		ns	Figure 4

15. Guaranteed by Design.

16. This parameter is guaranteed by design but not tested. The bus switch contributes no propagation delay other than the RC delay of the On Resistance of the switch and the 50 pF load capacitance, when driven by an ideal voltage source (zero output impedance).

NLAS3158

AC LOADING AND WAVEFORMS

NOTE: Input driven by 50 Ω source terminated in 50 Ω
 NOTE: C_L includes load and stray capacitance
 NOTE: Input PRR = 1.0 MHz; $t_W = 500$ ns

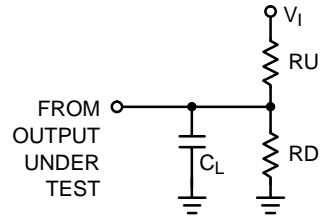


Figure 2. AC Test Circuit

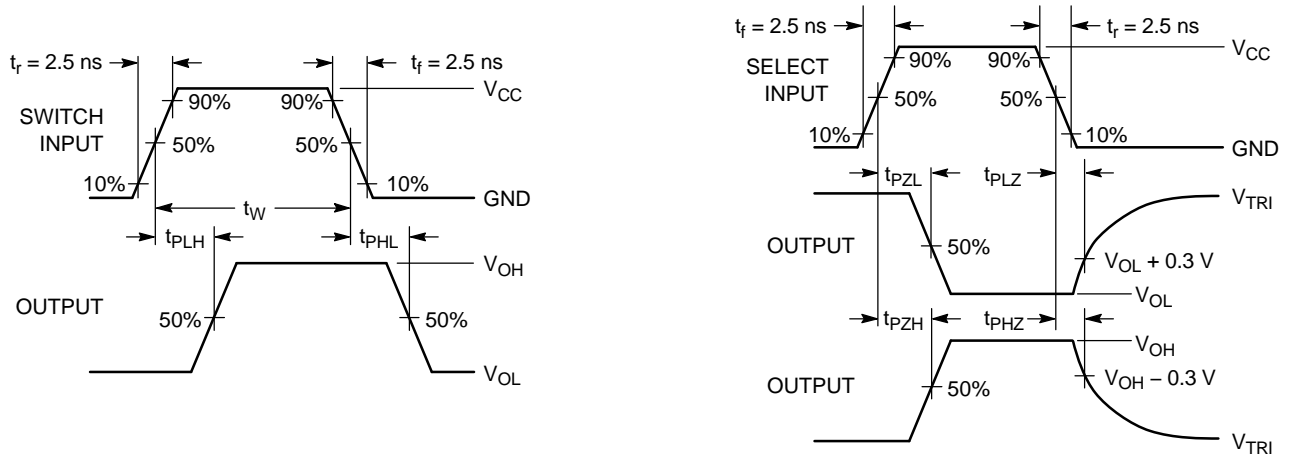
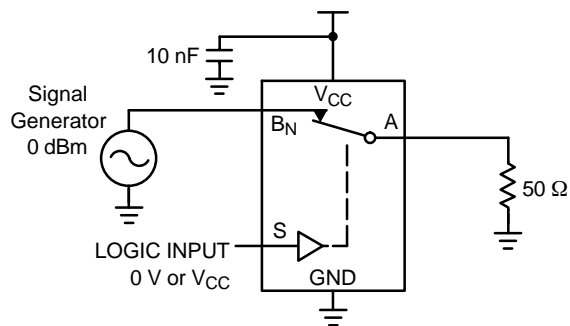
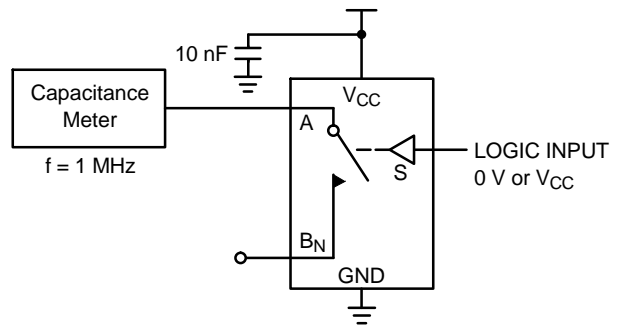
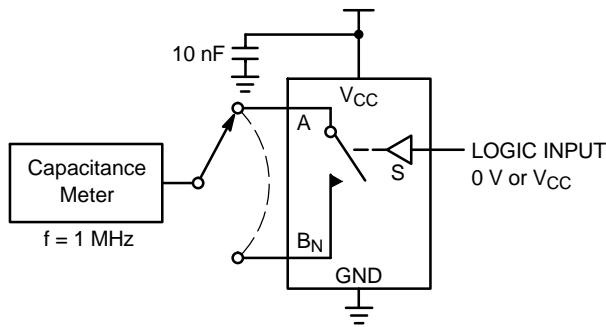
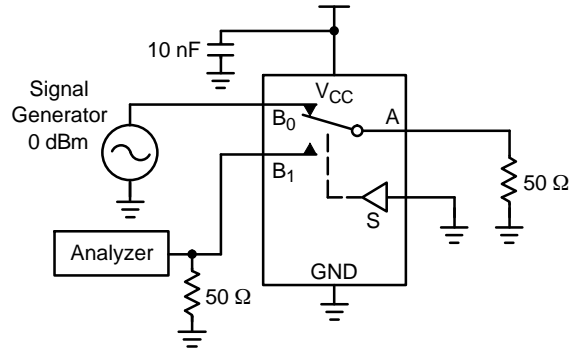
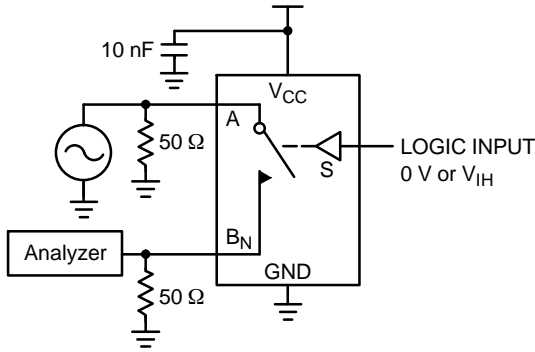
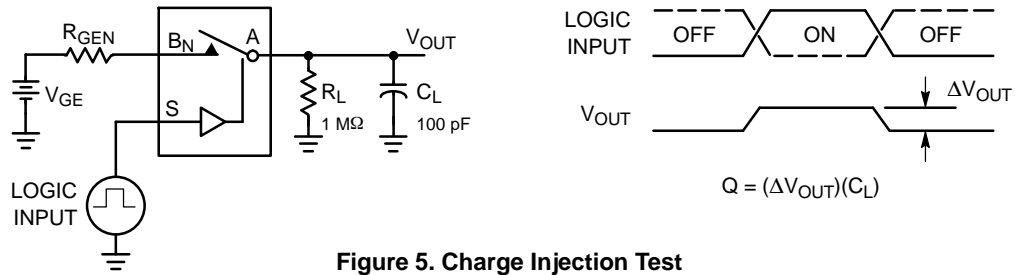


Figure 3. AC Waveforms



Figure 4. Break Before Make Interval Timing

AC LOADING AND WAVEFORMS



NLAS3158

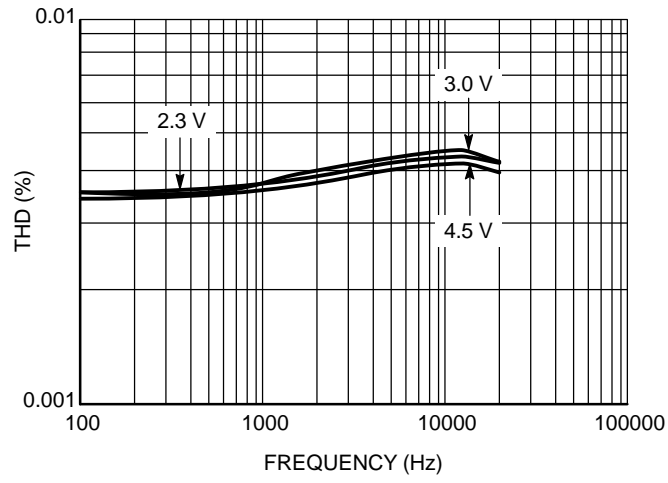


Figure 11. Total Harmonic Distortion vs. Frequency

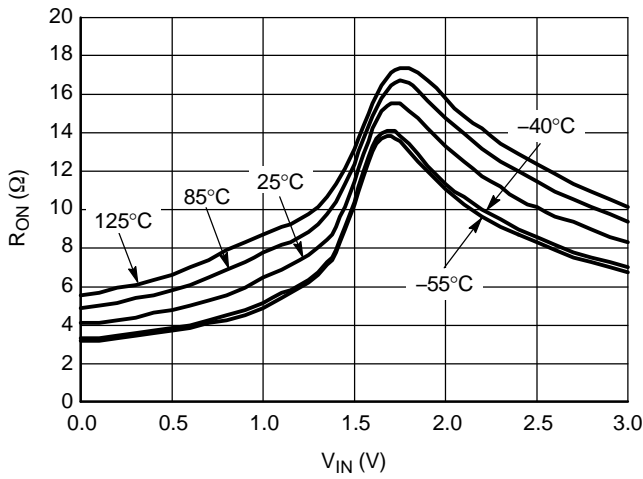


Figure 12. R_{ON} vs. V_{IN} vs. Temperature @ $V_{CC} = 3.0\text{ V}$

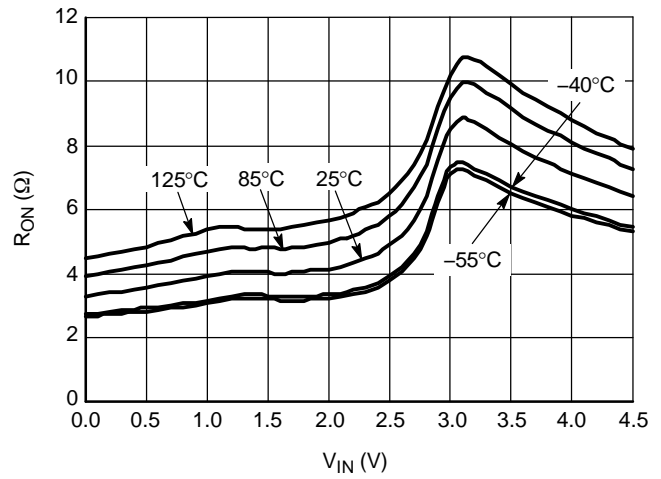


Figure 13. R_{ON} vs. V_{IN} vs. Temperature @ $V_{CC} = 4.5\text{ V}$

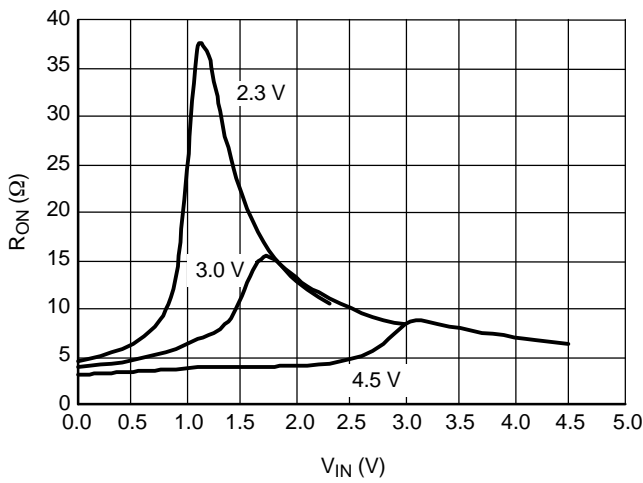


Figure 14. On-Resistance vs. Input Voltage

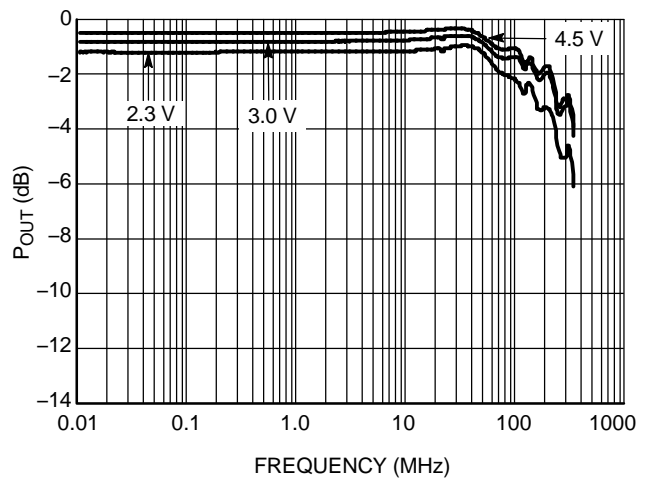


Figure 15. Bandwidth vs. Frequency

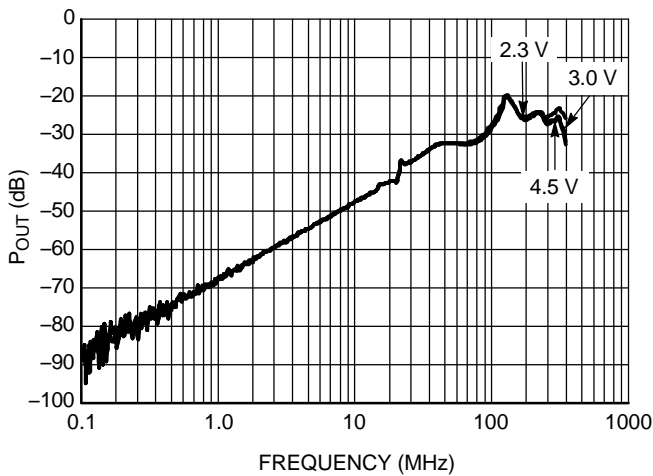


Figure 16. Off-Isolation vs. Frequency

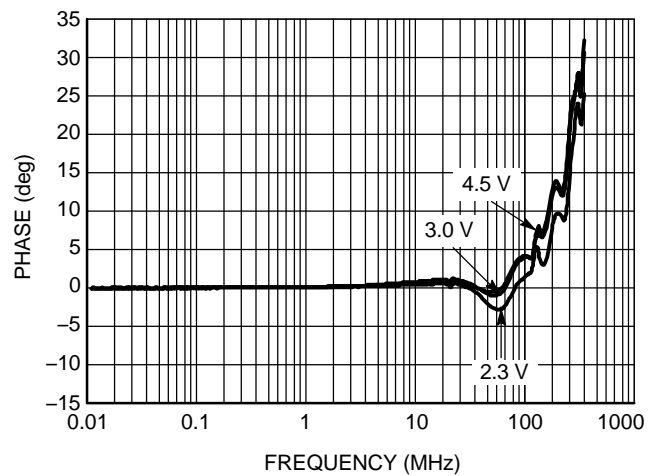


Figure 17. Phase Angle vs. Frequency

NLAS3158

DEVICE ORDERING INFORMATION

Device Order Number	Package Type	Tape & Reel Size†
NLAS3158MNR2G	WDFN12 (Pb-Free)	3000 Unit / 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.

MECHANICAL CASE OUTLINE

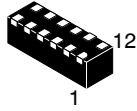
PACKAGE DIMENSIONS

ON Semiconductor®

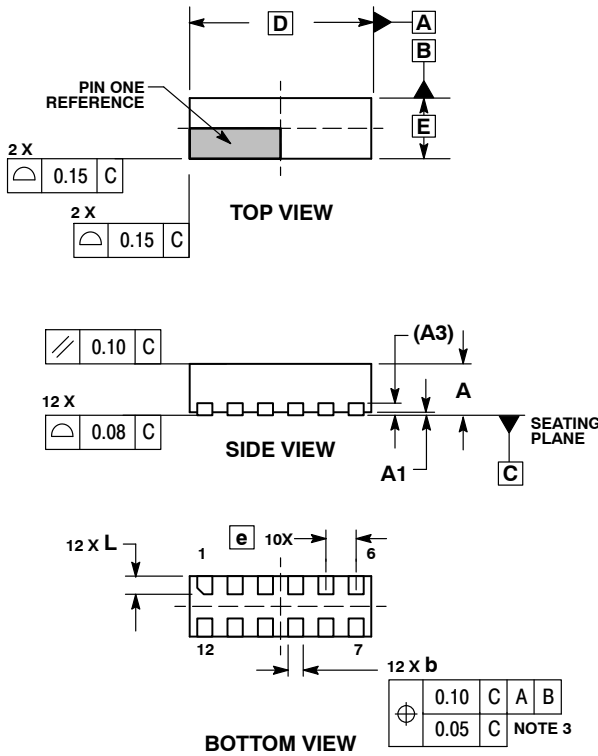


12 PIN WDFN 3.0x1.0, 0.5P CASE 485AG-01 ISSUE A

DATE 31 MAR 2006



SCALE 4:1

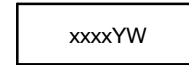


NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION b APPLIES TO 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.

MILLIMETERS		
DIM	MIN	MAX
A	0.70	0.80
A1	0.00	0.05
A3	0.20	REF
b	0.18	0.30
D	3.00	BSC
E	1.00	BSC
e	0.50	BSC
L	0.20	0.40

GENERIC MARKING DIAGRAM*



1

- xxxx = Specific Device Code
- 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:	98AON19981D	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	12 PIN WDFN 3.0X1.0, 0.5 MM PITCH	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