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 RDS_{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 μA (Max) at T_A = 25°C
- Standard CMOS Logic Levels
- High Bandwidth, Improved Linearity
- Low RDS_{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.
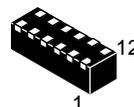- Can Switch Balanced Signal Pairs, e.g. LVDS > 200 Mb/s

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°C (See Appendix A)

ON Semiconductor®

WDFN12
MN SUFFIX
CASE 485AG

MARKING DIAGRAM

ASM̄∎

AS = Specific Device Code
M̄ = Date Code
∎ = Pb–Free Package
(Note: Microdot may be in either location)

FUNCTION TABLE

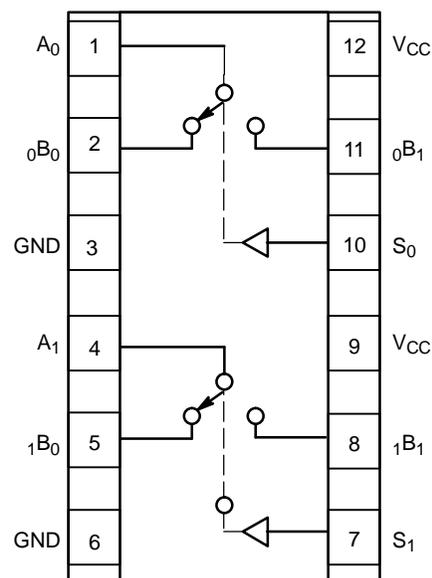| Select Input	Function
L	B0 Connected to A
H	B1 Connected to A

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.

DC ELECTRICAL CHARACTERISTICS (T_A = −40°C to +85°C)

Symbol	Parameter	Test Conditions	V_{CC} (V)	T_A = +25°C			T_A = −40°C to +85°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	$0 \leq V_{IN} \leq 5.5$ V	0–5.5		± 0.05	± 0.1		± 1	µA
I_{OFF}	OFF State Leakage Current	$0 \leq$ A, B $\leq V_{CC}$	1.65–5.5		± 0.05	± 0.1		± 1	µA
R_{ON}	Switch On Resistance (Note 3)	V_{IN} = 0 V, I_O = 30 mA V_{IN} = 2.4 V, I_O = −30 mA V_{IN} = 4.5 V, I_O = −30 mA	4.5		3.0 5.0 7.0	6.0 8.0 13		6.0 8.0 13	Ω
		V_{IN} = 0 V, I_O = 24 mA V_{IN} = 3 V, I_O = −24 mA	3.0		4.0 10	8.0 19		8.0 19	Ω
		V_{IN} = 0 V, I_O = 8 mA V_{IN} = 2.3 V, I_O = −8 mA	2.3		5.0 13	9.0 24		9.0 24	Ω
		V_{IN} = 0 V, I_O = 4 mA V_{IN} = 1.65 V, I_O = −4 mA	1.65		6.5 17	12 39		12 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 mA, $0 \leq V_{Bn} \leq V_{CC}$ I_A = −24 mA, $0 \leq V_{Bn} \leq V_{CC}$ I_A = −8 mA, $0 \leq V_{Bn} \leq V_{CC}$ I_A = −4 mA, $0 \leq V_{Bn} \leq V_{CC}$	4.5 3.0 2.3 1.65					25 50 100 300	Ω
ΔR_{ON}	On Resistance Match Between Channels (Note 3) (Note 4) (Note 5)	I_A = −30 mA, V_{Bn} = 3.15 I_A = −24 mA, V_{Bn} = 2.1 I_A = −8 mA, V_{Bn} = 1.6 I_A = −4 mA, V_{Bn} = 1.15	4.5 3.0 2.3 1.65		0.15 0.2 0.5 0.5				Ω
R_{flat}	On Resistance Flatness (Note 3) (Note 4) (Note 6)	I_A = −30 mA, $0 \leq V_{Bn} \leq V_{CC}$ I_A = −24 mA, $0 \leq V_{Bn} \leq V_{CC}$ I_A = −8 mA, $0 \leq V_{Bn} \leq V_{CC}$ I_A = −4 mA, $0 \leq V_{Bn} \leq V_{CC}$	5.0 3.3 2.5 1.8		5.0 10 24 110				Ω

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.

3. 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).
4. Parameter is characterized but not tested in production.
5. ΔR_{ON} = R_{ON} max − R_{ON} min measured at identical V_{CC}, temperature and voltage levels.
6. Flatness is defined as the difference between the maximum and minimum value of On Resistance over the specified range of conditions.
7. Guaranteed by Design.

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AC ELECTRICAL CHARACTERISTICS (T$_A$ = −40°C to +85°C)

Symbol	Parameter	Test Conditions	V$_{CC}$ (V)	T$_A$ = +25°C			T$_A$ = −40°C to +85°C		Unit	Figure Number
				Min	Typ	Max	Min	Max		
t$_{PHL}$ t$_{PLH}$	Propagation Delay Bus to Bus (Note 9)	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 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 × 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 5.3 3.8	ns	Figures 2, 3
t$_{BBM}$	Break Before Make Time (Note 8)	R$_L$ = 50 Ω C$_L$ = 35 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 nF, V$_{GEN}$ = 0 V R$_{GEN}$ = 0 Ω	5.0 3.3		7.0 3.0				pC	Figure 5
OIRR	Off Isolation (Note 10) NO	R$_L$ = 50 Ω f = 10 MHz	1.65–5.5		−55				dB	Figures 6, 16
OIRR	Off Isolation (Note 10) NC	R$_L$ = 50 Ω f = 10 MHz	1.65–5.5		−48				dB	Figures 6, 16
Xtalk	Crosstalk	R$_L$ = 50 Ω f = 10 MHz	1.65–5.5		−54				dB	Figure 7
BW	−3 dB Bandwidth	R$_L$ = 50 Ω	2.5–5.5		250				MHz	Figures 10, 15
THD	Total Harmonic Distortion (Note 8)	R$_L$ = 600 Ω 0.5 V$_{P–P}$ f = 600 Hz to 20 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 V	2.3		pF	
C$_{IO–B}$	B Port Off Capacitance	V$_{CC}$ = 5.0 V	6.5		pF	Figure 8
C$_{IOA–ON}$	A Port Capacitance when Switch is Enabled	V$_{CC}$ = 5.0 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°C, f = 1 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	$0 \leq V_{IN} \leq 5.5$ V	0–5.5		±0.05	±0.1		±1	μA
I_{OFF}	OFF State Leakage Current	$0 \leq A, B \leq V_{CC}$	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; V_{IN} = 2.4 V, I_O = −30 mA; V_{IN} = 4.5 V, I_O = −30 mA	4.5		3.0 5.0 7.0			8.5 13.0 15.0	Ω
		V_{IN} = 0 V, I_O = 24 mA; V_{IN} = 3 V, I_O = −24 mA	3.0		4.0 10			11 20	
		V_{IN} = 0 V, I_O = 8 mA; V_{IN} = 2.3 V, I_O = −8 mA	2.3		5.0 13			12 30	
		V_{IN} = 0 V, I_O = 4 mA; V_{IN} = 1.65 V, I_O = −4 mA	1.65		6.5 17			20 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, $0 \leq V_{Bn} \leq V_{CC}$	4.5					25	Ω
		I_A = −24 mA, $0 \leq V_{Bn} \leq V_{CC}$	3.0					50	
		I_A = −8 mA, $0 \leq V_{Bn} \leq V_{CC}$	2.3					100	
		I_A = −4 mA, $0 \leq V_{Bn} \leq V_{CC}$	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.

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APPENDIX A
AC ELECTRICAL EXTENDED AUTOMOTIVE TEMPERATURE RANGE CHARACTERISTICS

Symbol	Parameter	Test Conditions	V_{CC} (V)	T_A = +25°C Min	Typ	Max	T_A = −55°C to +125°C Min	Max	Unit	Figure Number
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)	$V_I = 2 \times V_{CC}$ 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)	$V_I = 2 \times V_{CC}$ 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).

AC LOADING AND WAVEFORMS

NOTE: Input driven by 50 Ω source terminated in 50 Ω
NOTE: C_L includes load and stray capacitance
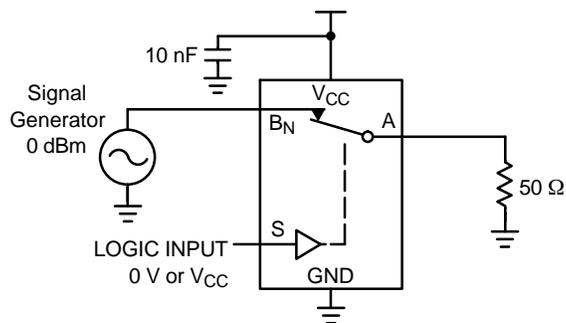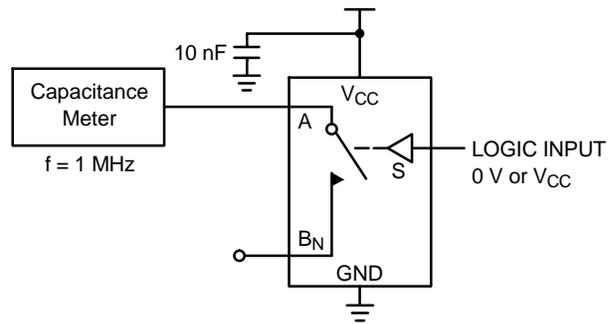NOTE: Input PRR = 1.0 MHz; t_W = 500 ns
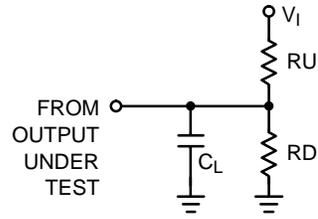
Figure 2. AC Test Circuit
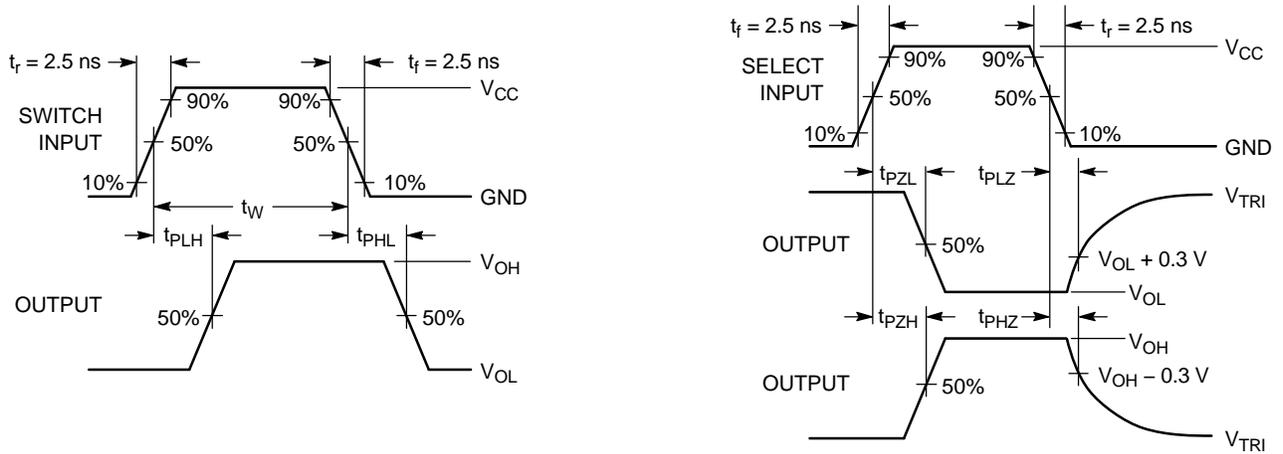
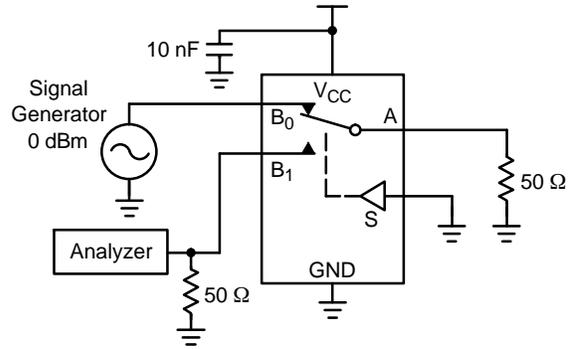**Figure 3. AC Waveforms**

Figure 4. Break Before Make Interval Timing

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AC LOADING AND WAVEFORMS

Figure 5. Charge Injection Test

$$Q = (\Delta V_{OUT})(C_L)$$

Figure 6. Off Isolation

Figure 7. Crosstalk

Figure 8. Channel Off Capacitance

Figure 9. Channel On Capacitance
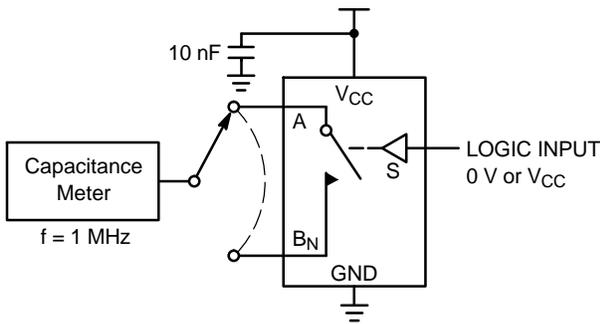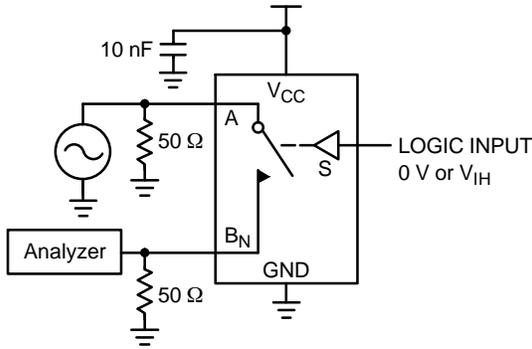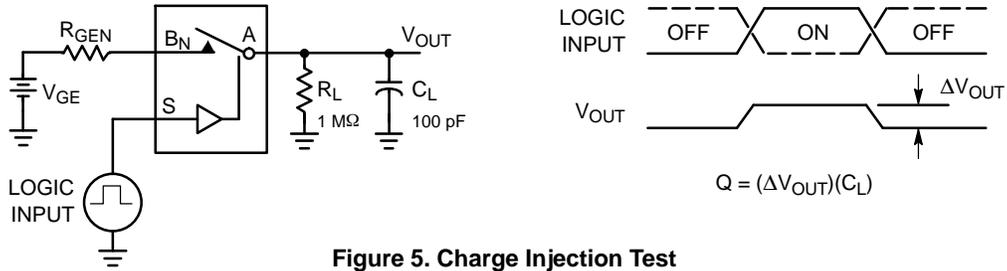
Figure 10. Bandwidth
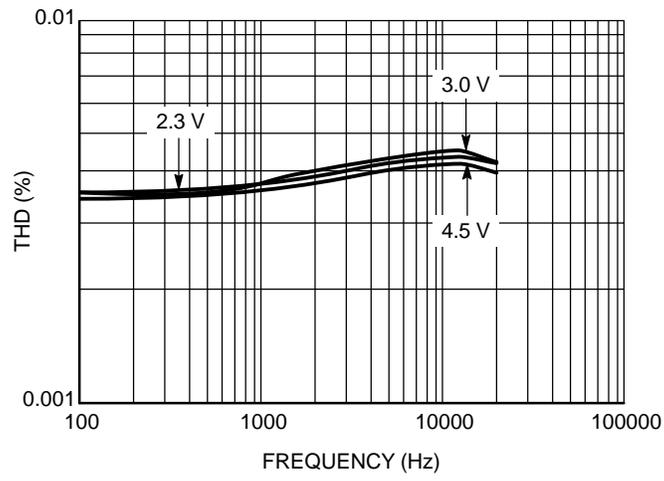
Figure 11. Total Harmonic Distortion vs. Frequency
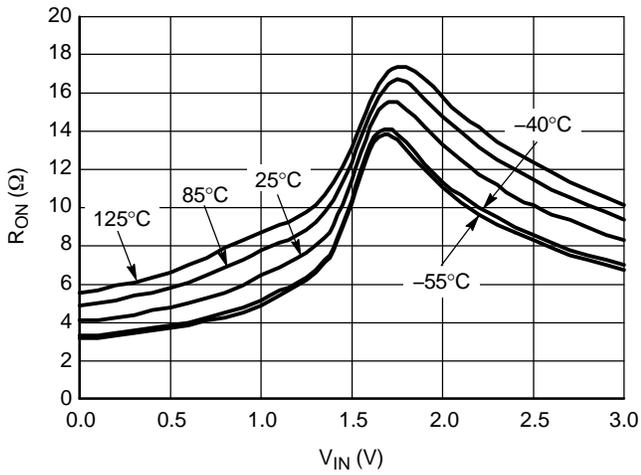
Figure 12. R$_{ON}$ vs. V$_{IN}$ vs. Temperature @ V$_{CC}$ = 3.0 V
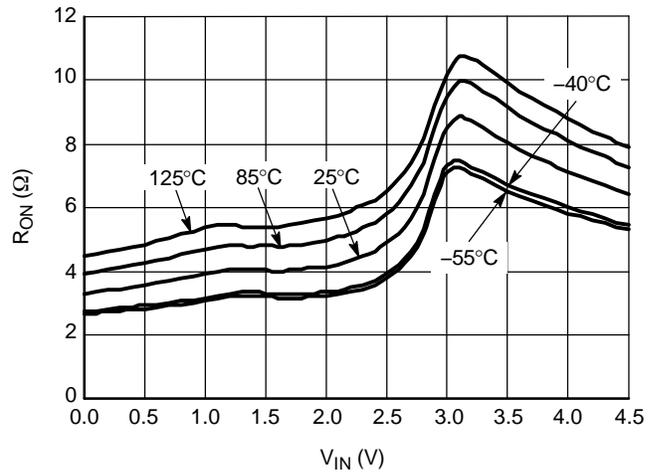
Figure 13. R$_{ON}$ vs. V$_{IN}$ vs. Temperature @ V$_{CC}$ = 4.5 V
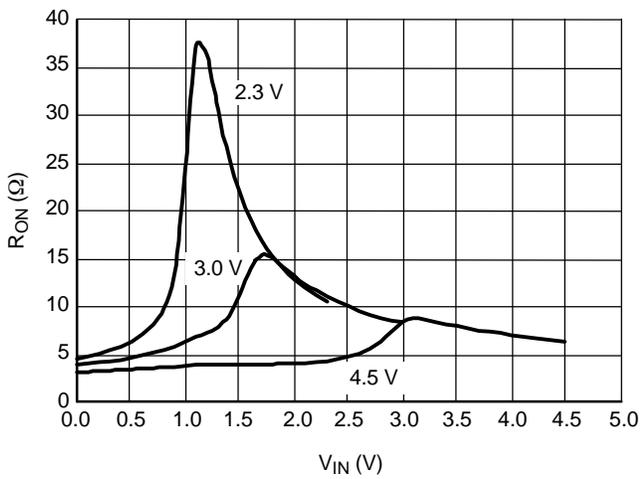
Figure 14. On–Resistance vs. Input Voltage
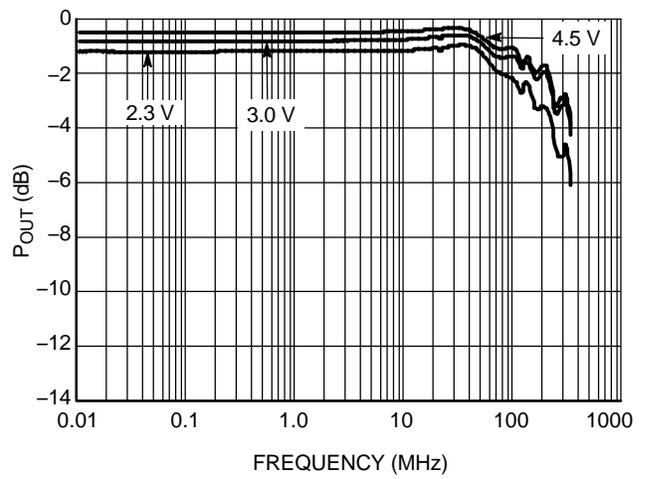
Figure 15. Bandwidth vs. Frequency
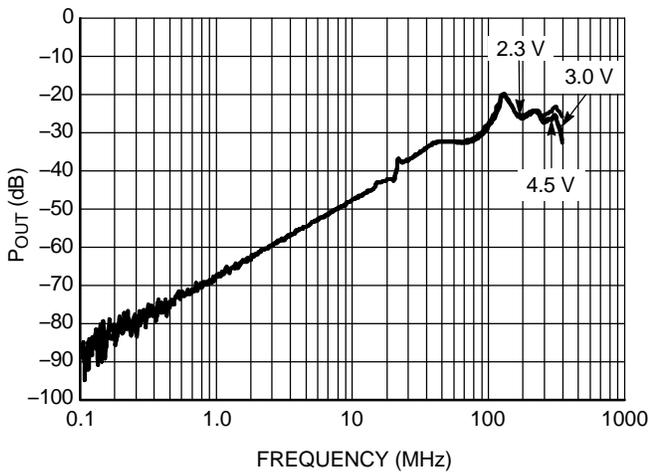
Figure 16. Off–Isolation vs. Frequency
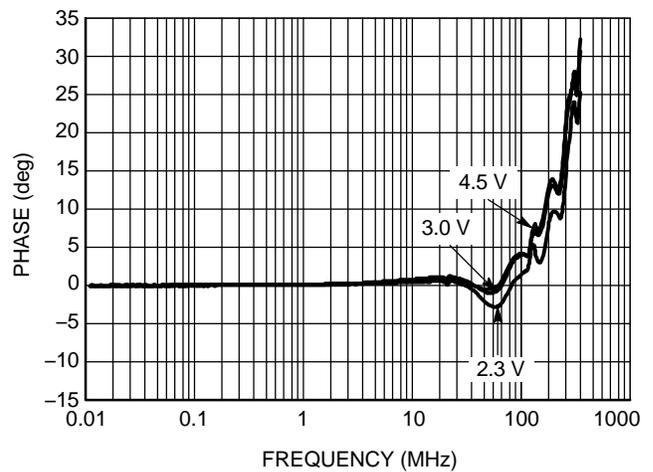
Figure 17. Phase Angle vs. Frequency

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.

NLAS3158

PACKAGE DIMENSIONS

WDFN12 3.0x1.0, 0.5P
CASE 485AG
ISSUE A

TOP VIEW

SIDE VIEW

BOTTOM VIEW
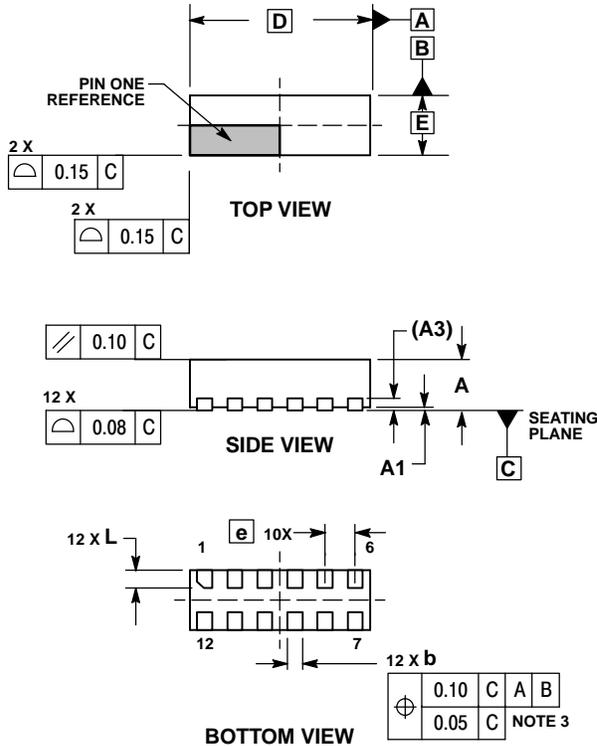
NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION b APPLIES TO TERMINAL AND IS MEASURED BETWEEN 0.25 AND 0.30 MM FROM TERMINAL.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

DIM	MILLIMETERS	
	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

PUBLICATION ORDERING INFORMATION