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
- TDFN 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)

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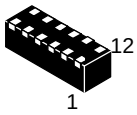


DFN12
MN SUFFIX
CASE 485AG

MARKING DIAGRAM

AS = Specific Device Code
$\overline{M}$ = 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

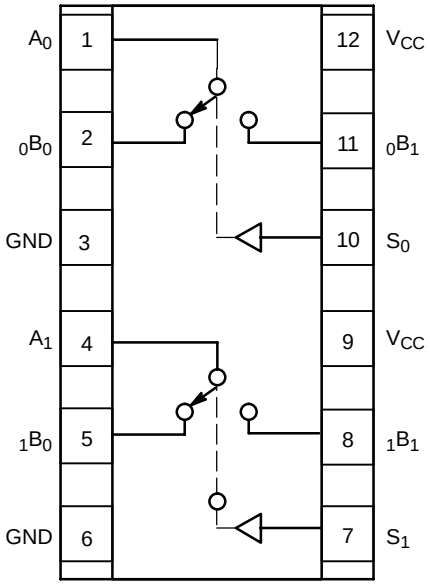


Figure 1. Pinout (Top View)

ORDERING INFORMATION

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

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

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, 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

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 ≤ 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 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 ≤ V_{Bn} ≤ V_{CC} I_A = −24 mA, 0 ≤ V_{Bn} ≤ V_{CC} I_A = −8 mA, 0 ≤ V_{Bn} ≤ V_{CC} I_A = −4 mA, 0 ≤ V_{Bn} ≤ 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 ≤ V_{Bn} ≤ V_{CC} I_A = −24 mA, 0 ≤ V_{Bn} ≤ V_{CC} I_A = −8 mA, 0 ≤ V_{Bn} ≤ V_{CC} I_A = −4 mA, 0 ≤ V_{Bn} ≤ V_{CC}	5.0 3.3 2.5 1.8		5.0 10 24 110				Ω

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.

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 ≤ 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 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 ≤ V_{Bn} ≤ V_{CC} I_A = −24 mA, 0 ≤ V_{Bn} ≤ V_{CC} I_A = −8 mA, 0 ≤ V_{Bn} ≤ V_{CC} I_A = −4 mA, 0 ≤ V_{Bn} ≤ V_{CC}	4.5 3.0 2.3 1.65					25 50 100 300	Ω

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).

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

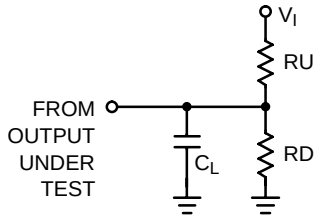


Figure 2. AC Test Circuit

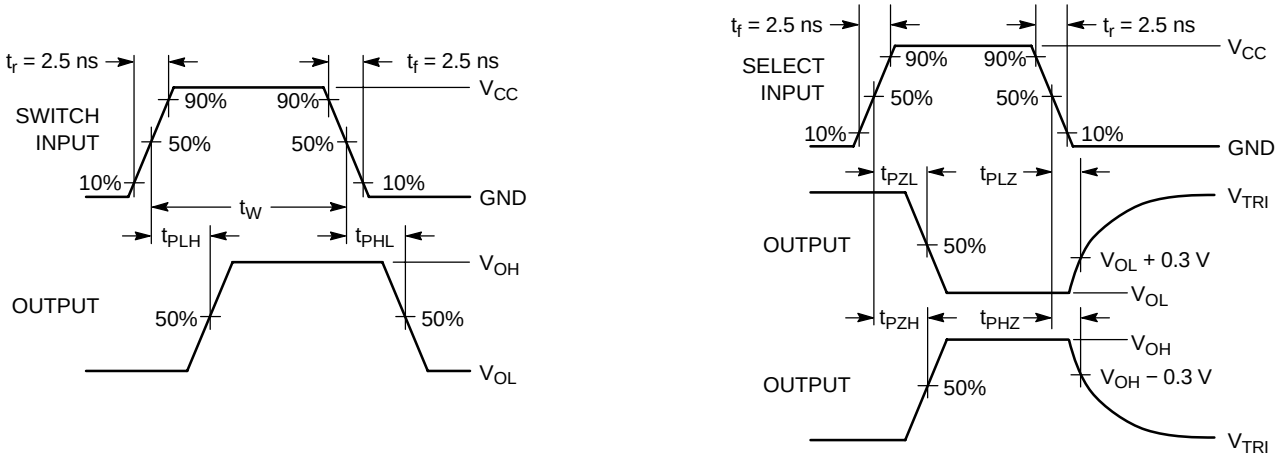


Figure 3. AC Waveforms

Figure 4. Break Before Make Interval Timing

AC LOADING AND WAVEFORMS

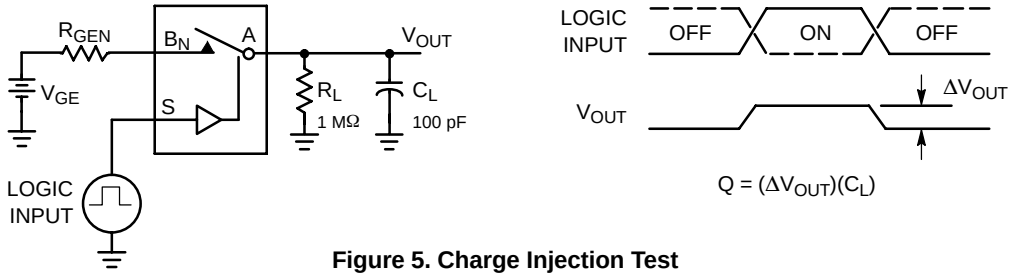


Figure 5. Charge Injection Test

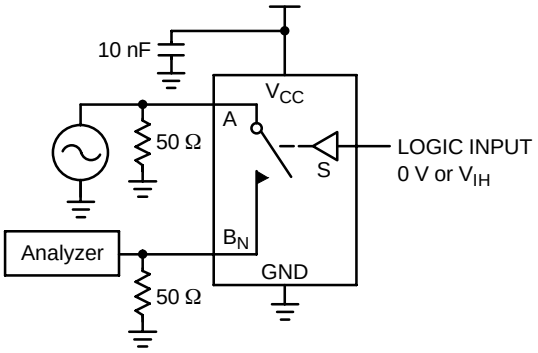


Figure 6. Off Isolation

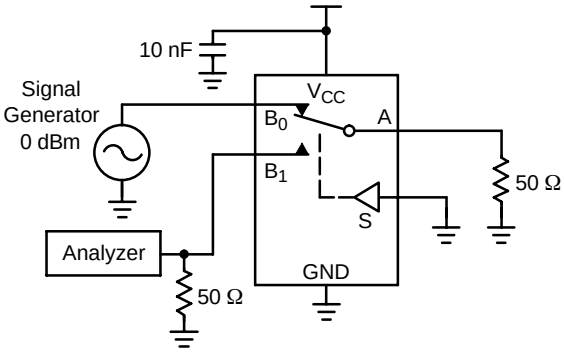


Figure 7. Crosstalk

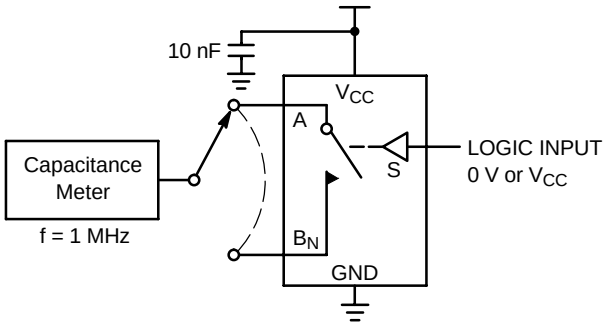


Figure 8. Channel Off Capacitance

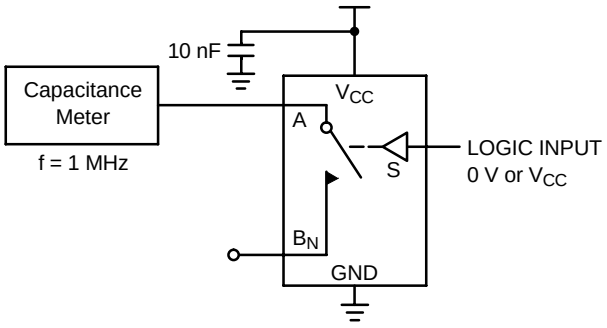


Figure 9. Channel On Capacitance

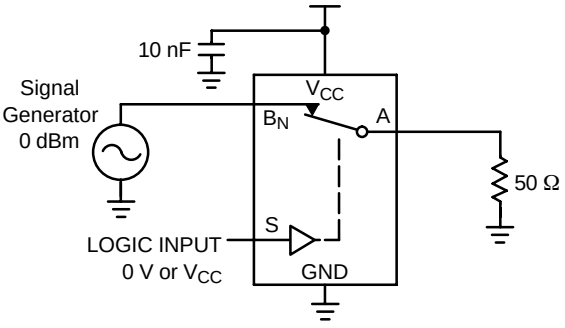


Figure 10. Bandwidth

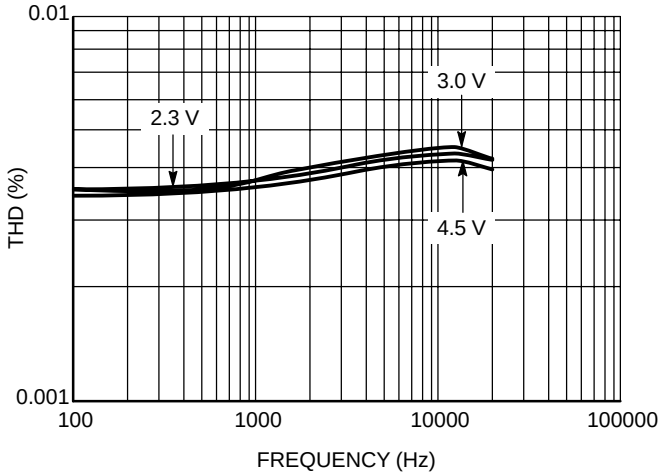


Figure 11. Total Harmonic Distortion vs. Frequency

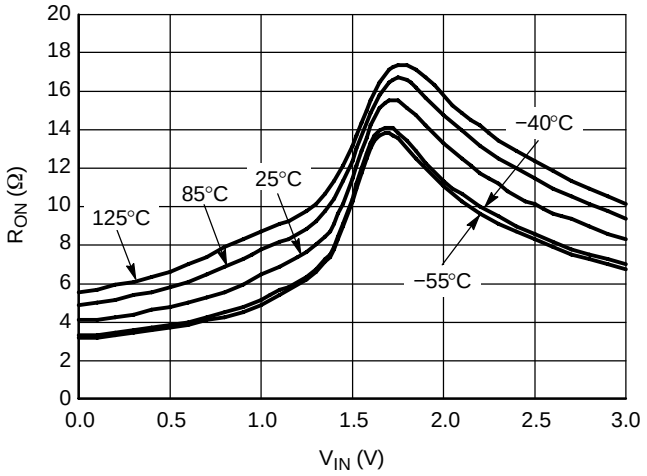


Figure 12. R_{ON} vs. V_{IN} vs. Temperature @ V_{CC} = 3.0 V

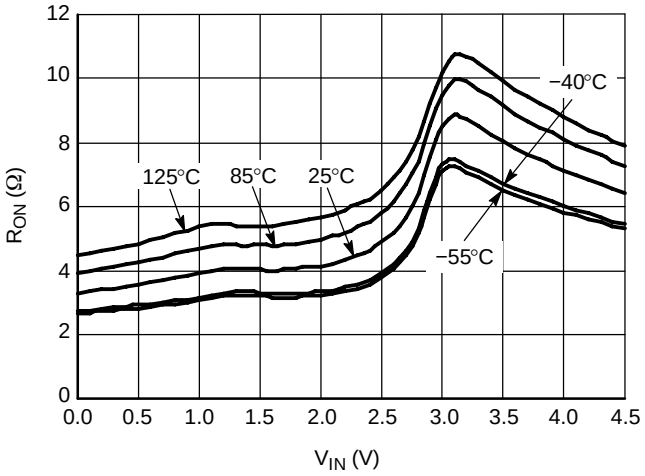


Figure 13. R_{ON} vs. V_{IN} vs. Temperature @ V_{CC} = 4.5 V

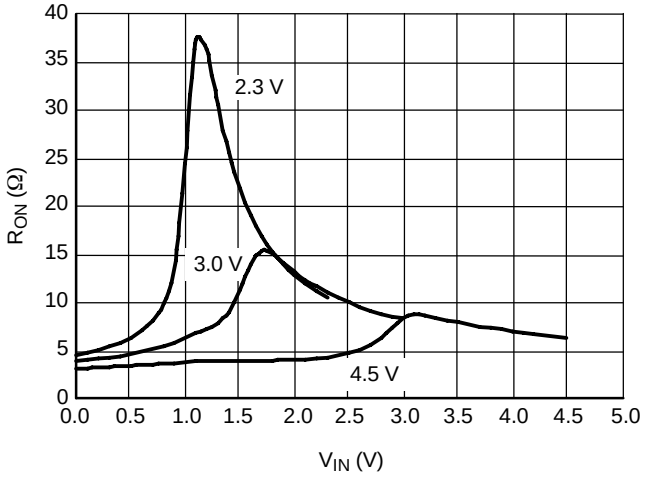


Figure 14. On−Resistance vs. Input Voltage

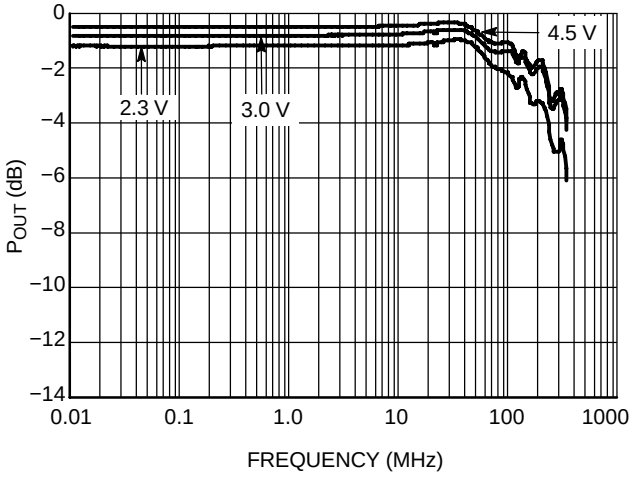


Figure 15. Bandwidth vs. Frequency

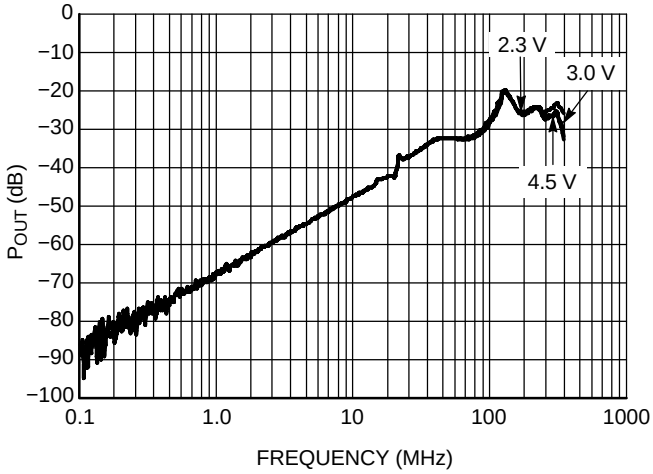


Figure 16. Off−Isolation vs. Frequency

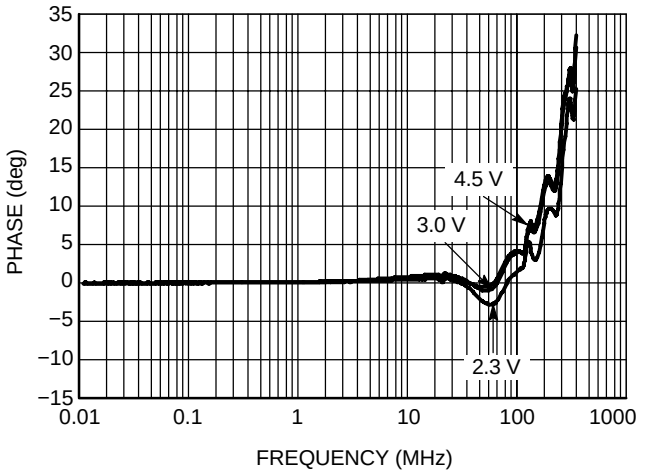


Figure 17. Phase Angle vs. Frequency

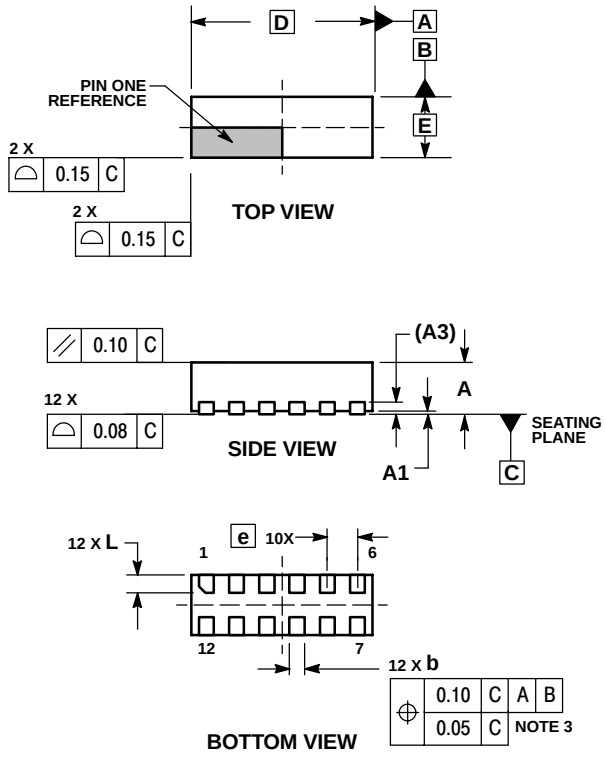
DEVICE ORDERING INFORMATION

Device Order Number	Device Nomenclature					Package Type	Tape & Reel Size†
	Circuit Indicator	Technology	Device Function	Package Suffix	Tape & Reel Suffix		
NLAS3158MNR2G	NL	AS	3158	MN	R2	QFN (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.

PACKAGE DIMENSIONS

DFN12 3.0*1.0*0.8 MM
CASE 485AG−01
ISSUE O



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	0.90
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

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
P.O. Box 61312, Phoenix, Arizona 85082−1312 USA
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