NLAS3699

Dual DPDT Ultra-Low R_{ON} Switch

The NLAS3699 is a dual independent ultra−low R_{ON} DPDT analog switch. This device is designed for low operating voltage, high current switching of speaker output for cell phone applications. It can switch a balanced stereo output. The NLAS3699 can handle a balanced microphone/speaker/ring−tone generator in a monophone mode. The device contains a break−before−make feature.

Features

- Single Supply Operation
  1.65 to 3.6 V V_{CC}
- Maximum Breakdown Voltage: 4.6 V
- Tiny 3 x 3 mm QFN Pb−Free Package
  Meet JEDEC MO−220 Specifications
- Low Static Power
- This is a Pb−Free Device*

Typical Applications

- Cell Phone Speaker/Microphone Switching
- Ringtone−Chip/Amplifier Switching
- Four Unbalanced (Single−Ended) Switches
- Stereo Balanced (Push−Pull) Switching

Important Information

- ESD Protection:
  HBM (Human Body Model) > 8000 V
  MM (Machine Model) > 400 V
- Continuous Current Rating Through each Switch ±300 mA
- Conforms to: JEDEC MO−220, Issue H, Variation VEED−6
- Pin for Pin Compatible with STG3699

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

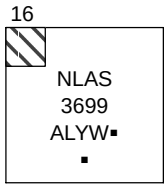
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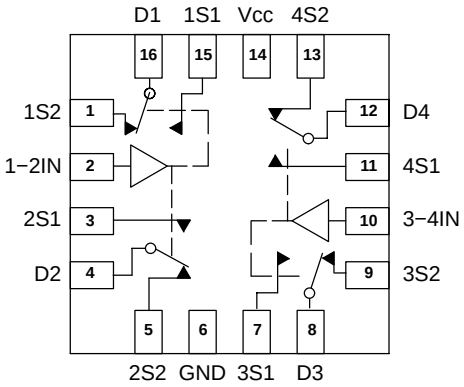
MARKING DIAGRAMS



QFN−16
CASE 485AE



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 9 of this data sheet.

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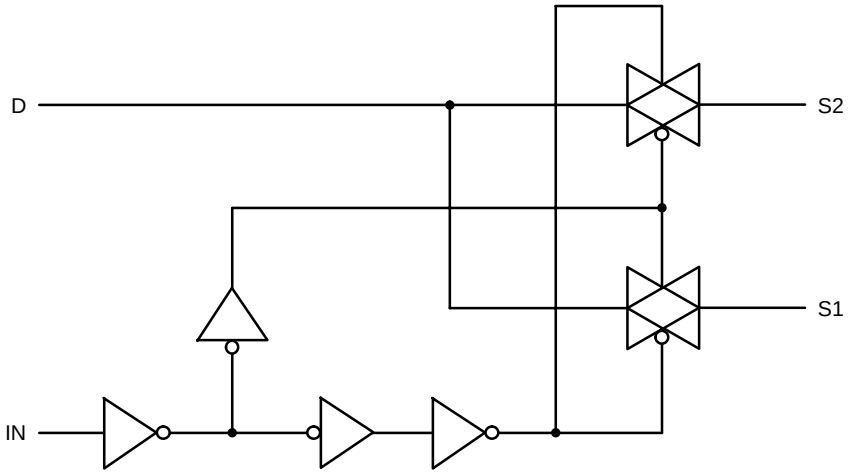


Figure 1. Input Equivalent Circuit

PIN DESCRIPTION

QFN PIN #	Symbol	Name and Function
1, 3, 5, 7, 9, 11, 13, 15	1S1 to 4S1, 1S2 to 4S2	Independent Channels
2, 10	1−2IN, 3−4IN	Controls
4, 8, 12, 16	D1 to D4	Common Channels
6	GND	Ground (V)
14	V_{CC}	Positive Supply Voltage

TRUTH TABLE

IN	S1	S2
H	ON	OFF(*)
L	OFF(*)	ON

*High impedance.

MAXIMUM RATINGS

Symbol	Parameter	Value		Unit
V_{CC}	Positive DC Supply Voltage	−0.5 to +4.6		V
V_{IS}	Analog Input Voltage (V_{NO}, V_{NC}, or V_{COM})	$-0.5 \le V_{IS} \le V_{CC}$		V
V_{IN}	Digital Select Input Voltage	$-0.5 \le V_I \le +4.6$		V
I_{anl1}	Continuous DC Current from COM to NC/NO	±300		mA
$I_{anl-pk\ 1}$	Peak Current from COM to NC/NO, 10 duty cycle (Note 1)	±500		mA
I_{clmp}	Continuous DC Current into COM/NO/NC with respect to V_{CC} or GND	±100		mA
t_r, t_f	Input Rise or Fall Time, SELECT V_{CC} = 1.6 V − 2.7 V V_{CC} = 3.0 V − 3.6 V	0 0	20 10	ns/V

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. Defined as 10% ON, 90% off duty cycle.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
V_{CC}	DC Supply Voltage	1.65	3.6	V
V_{IN}	Digital Select Input Voltage	GND	V_{CC}	V
V_{IS}	Analog Input Voltage (NC, NO, COM)	GND	V_{CC}	V
T_A	Operating Temperature Range	−40	+85	°C
t_r, t_f	Input Rise or Fall Time, SELECT V_{CC} = 1.6 V − 2.7 V V_{CC} = 3.0 V − 3.6 V	0 0	20 10	ns/V

DC CHARACTERISTICS − Digital Section (Voltages Referenced to GND)

Symbol	Parameter	Condition	V_{CC}	Guaranteed Limit		Unit
				−40°C to 25°C	<85°C	
V_{IH}	Minimum High−Level Input Voltage, Select Inputs		1.8 2.5 3.6	1.2 1.7 2.8	1.2 1.7 2.8	V
V_{IL}	Maximum Low−Level Input Voltage, Select Inputs		1.8 2.5 3.6	0.4 0.5 1.0	0.4 0.5 1.0	V
I_{IN}	Maximum Input Leakage Current, Select Inputs	V_{IN} = V_{CC} or GND	3.6	±0.1	±1.0	μA
I_{OFF}	Power Off Leakage Current	V_{IN} = V_{CC} or GND	0	±0.5	±2.0	μA
I_{CC}	Maximum Quiescent Supply Current (Note 2)	Select and V_{IS} = V_{CC} or GND	1.65 to 3.6	±1.0	±2.0	μA

DC ELECTRICAL CHARACTERISTICS − Analog Section

Symbol	Parameter	Condition	V_{CC}	Guaranteed Maximum Limit				Unit
				−40°C to 25°C		<85°C		
				Min	Max	Min	Max	
R_{ON}	NC/NO On−Resistance (Note 2)	$V_{IN} \le V_{IL}$ or $V_{IN} \ge V_{IH}$ V_{IS} = GND to V_{CC} $I_{IN}I \le 100$ mA	2.5 3.0 3.6		0.65 0.6 0.55		0.75 0.75 0.7	Ω
R_{FLAT}	NC/NO On−Resistance Flatness (Notes 2, 4)	I_{COM} = 100 mA V_{IS} = 0 to V_{CC}	2.5 3.0 3.6		0.15 0.15 0.15		0.15 0.15 0.15	Ω
ΔR_{ON}	On−Resistance Match Between Channels (Notes 2 and 3)	V_{IS} = 1.3 V; I_{COM} = 100 mA V_{IS} = 1.5 V; I_{COM} = 100 mA V_{IS} = 1.8 V; I_{COM} = 100 mA	2.5 3.0 3.6		0.06 0.05 0.05		0.06 0.05 0.05	Ω
$I_{NC(OFF)}$ $I_{NO(OFF)}$	NC or NO Off Leakage Current (Note 2)	V_{IN} = V_{IL} or V_{IH} V_{NO} or V_{NC} = 0.3 V V_{COM} = 3.3 V	3.6	−5.0	5.0	−10	10	nA
$I_{COM(ON)}$	COM ON Leakage Current (Note 2)	V_{IN} = V_{IL} or V_{IH} V_{NO} 0.3 V or 3.3 V with V_{NC} floating or V_{NC} 0.3 V or 3.3 V with V_{NO} floating V_{COM} = 0.3 V or 3.3 V	3.6	−10	10	−100	100	nA

2. Guaranteed by design. Resistance measurements do not include test circuit or package resistance.
3. $\Delta R_{ON} = R_{ON(MAX)} - R_{ON(MIN)}$ between nS1 or nS2.
4. Flatness is defined as the difference between the maximum and minimum value of on−resistance as measured over the specified analog signal ranges.

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
					−40°C to 25°C			<85°C		
					Min	Typ*	Max	Min	Max	
t_{ON}	Turn−On Time	R_L = 50 Ω, C_L = 35 pF (Figures 3 and 4)	2.3 − 3.6	1.5			50		60	ns
t_{OFF}	Turn−Off Time	R_L = 50 Ω, C_L = 35 pF (Figures 3 and 4)	2.3 − 3.6	1.5			30		40	ns
t_{BBM}	Minimum Break−Before−Make Time	V_{IS} = 3.0 R_L = 50 Ω, C_L = 35 pF (Figure 2)	3.0	1.5	2	15				ns

		Typical @ 25, V_{CC} = 3.6 V	
C_{IN}	Control Pin Input Capacitance	2.5	pF
C_{SN}	SN Port Capacitance	72	pF
C_D	D Port Capacitance When Switch is Enabled	230	pF

*Typical Characteristics are at 25°C.

ADDITIONAL APPLICATION CHARACTERISTICS (Voltages Referenced to GND Unless Noted)

Symbol	Parameter	Condition	V_{CC} (V)	25°C	Unit
				Typical	
BW	Maximum On−Channel −3dB Bandwidth or Minimum Frequency Response (Figure 12)	V_{IN} centered between V_{CC} and GND (Figure 5)	1.65 − 3.6	20	MHz
V_{ONL}	Maximum Feed−through On Loss	V_{IN} = 0 dBm @ 100 kHz to 50 MHz V_{IN} centered between V_{CC} and GND (Figure 5)	1.65 − 3.6	−0.06	dB
V_{ISO}	Off−Channel Isolation (Figure 13)	f = 100 kHz; V_{IS} = 1 V RMS; C_L = 5 pF V_{IN} centered between V_{CC} and GND(Figure 5)	1.65 − 3.6	−62	dB
Q	Charge Injection Select Input to Common I/O (Figure 8)	V_{IN} = $V_{CC\ to}$ GND, R_{IS} = 0 Ω, C_L = 1 nF Q = C_L x ΔV_{OUT} (Figure 6)	1.65 − 3.6	50	pC
THD	Total Harmonic Distortion THD + Noise (Figure 7)	F_{IS} = 20 Hz to 20 kHz, R_L = R_{gen} = 600 Ω, C_L = 50 pF V_{IS} = 2 V_{PP}	3.6	0.01	%
VCT	Channel−to−Channel Crosstalk	f = 100 kHz; V_{IS} = 1 V RMS, C_L = 5 pF, R_L = 50 Ω V_{IN} centered between V_{CC} and GND (Figure 5)	1.65 − 3.6	−62	dB

5. Off−Channel Isolation = 20log10 (Vcom/Vno), Vcom = output, Vno = input to off switch.

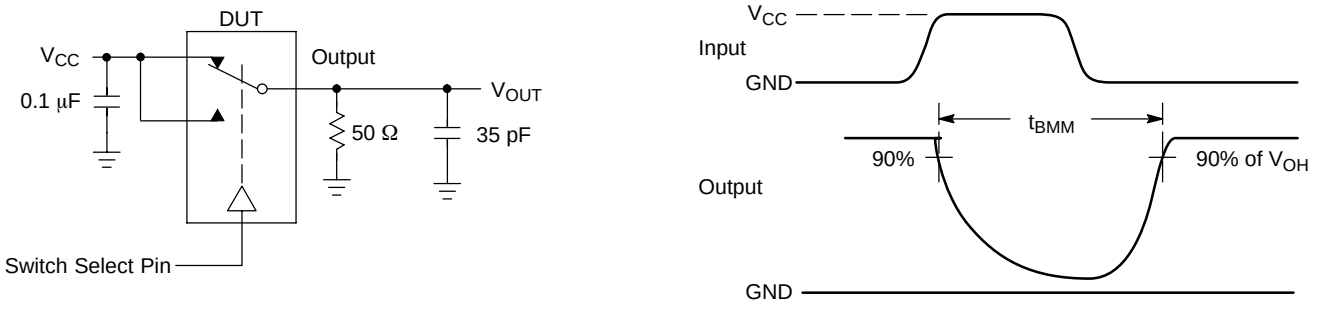


Figure 2. t_{BBM} (Time Break−Before−Make)

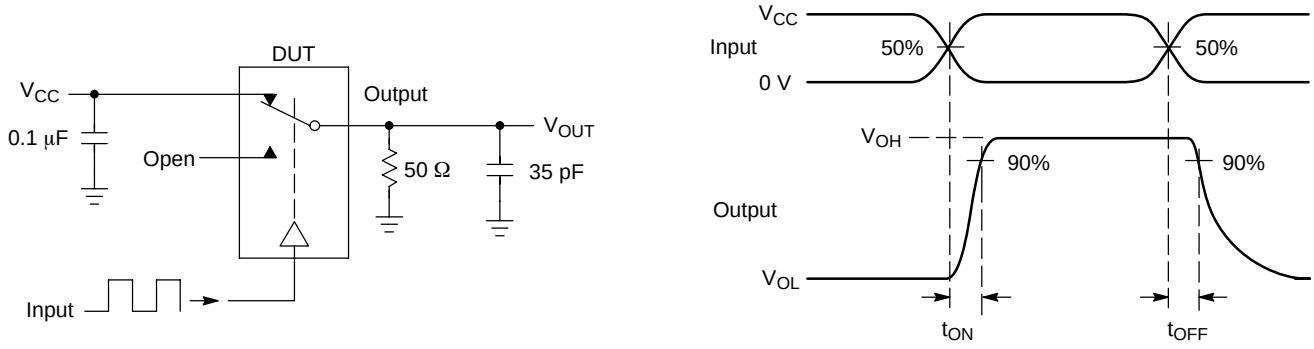


Figure 3. t_{ON}/t_{OFF}

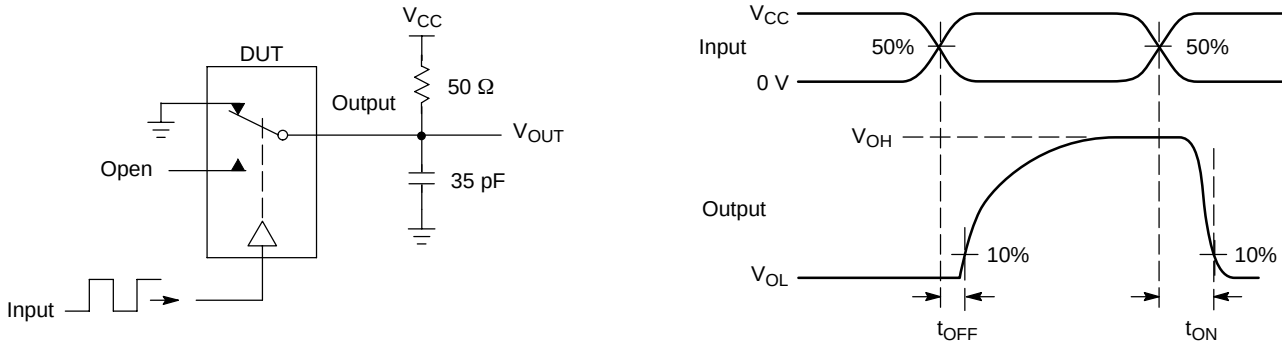
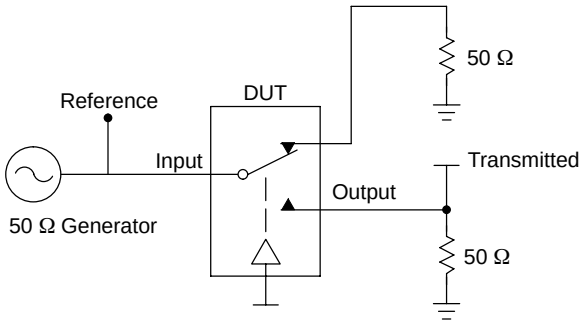


Figure 4. t_{ON}/t_{OFF}



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

V_{ONL} = On Channel Loss = 20 Log $\left(\frac{V_{OUT}}{V_{IN}}\right)$ for V_{IN} at 100 kHz to 50 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 5. Off Channel Isolation/On Channel Loss (BW)/Crosstalk (On Channel to Off Channel)/V_{ONL}

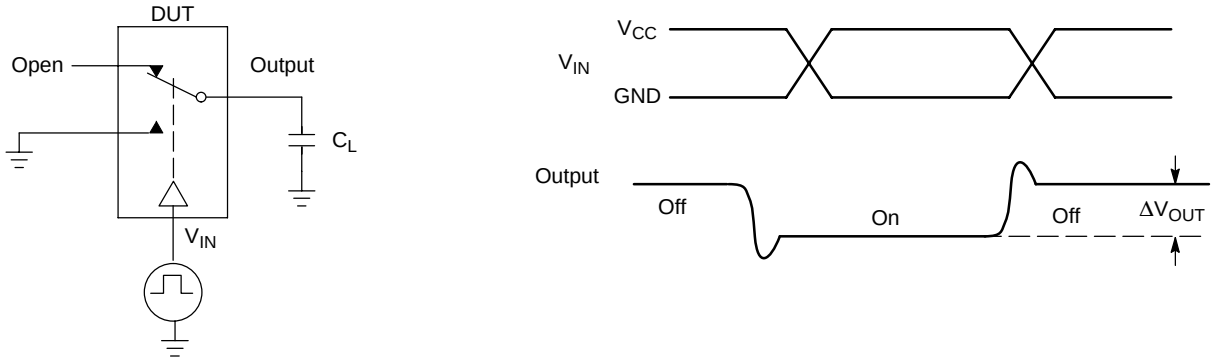


Figure 6. Charge Injection: (Q)

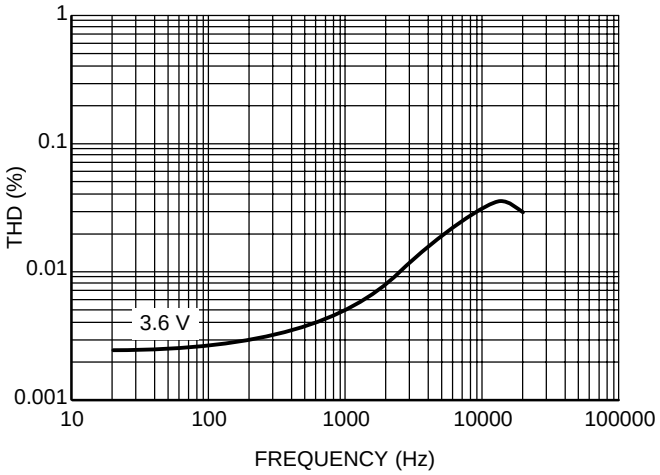


Figure 7. Total Harmonic Distortion Plus Noise Versus Frequency

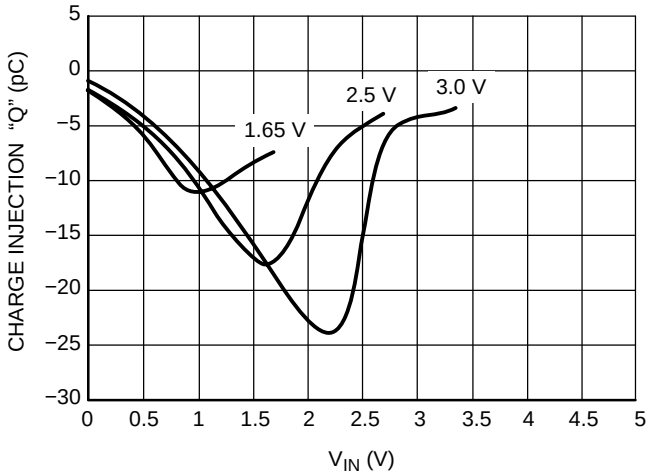


Figure 8. Charge Injection versus V_{is}

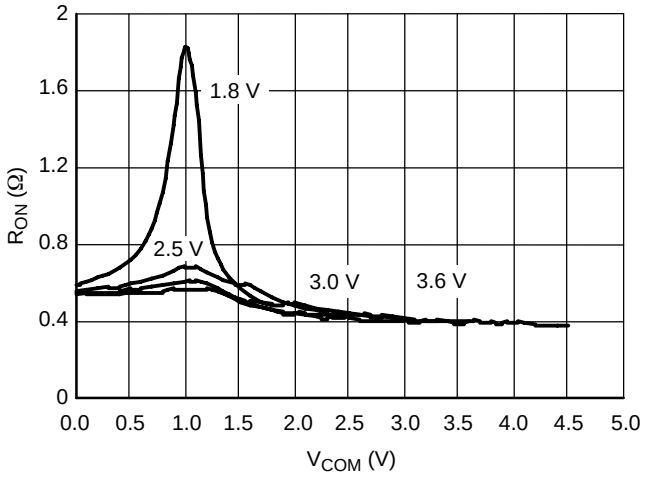


Figure 9. On−Resistance vs. COM Voltage

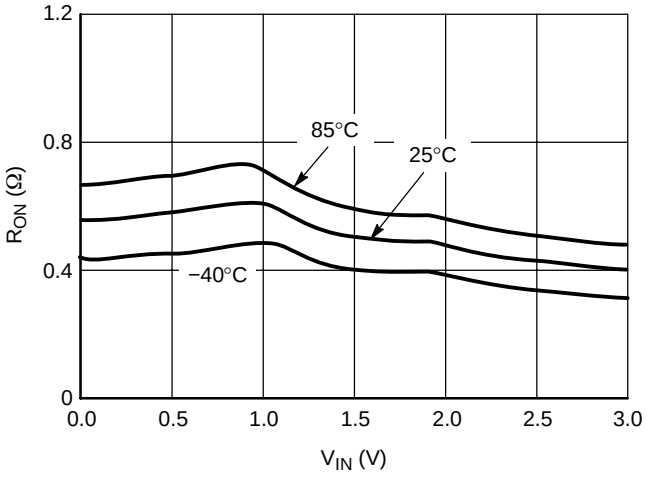


Figure 10. R_{ON} vs. V_{IN} vs. Temperature @ V_{CC} = 3.0 V

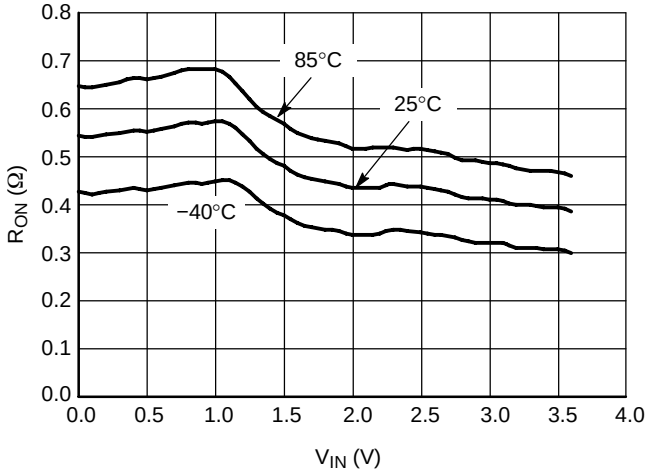


Figure 11. R_{ON} vs. V_{IN} vs. Temperature @ V_{CC} = 3.6 V

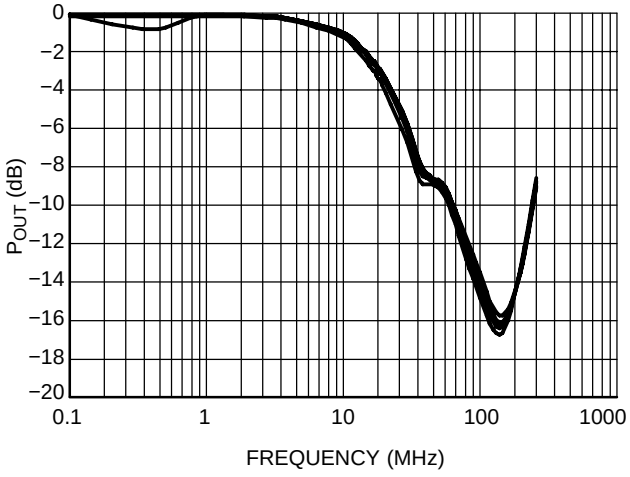


Figure 12. Bandwidth vs. Frequency @ V_{CC} = 1.65 V to 3.6 V

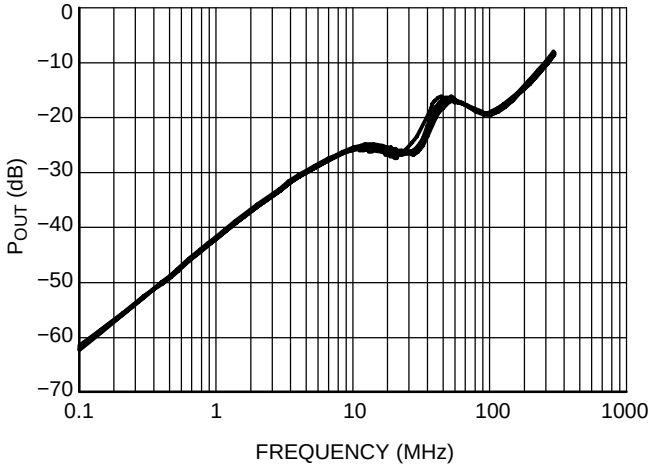


Figure 13. Off−Isolation vs. Frequency @ V_{CC} = 1.65 V to 3.6 V

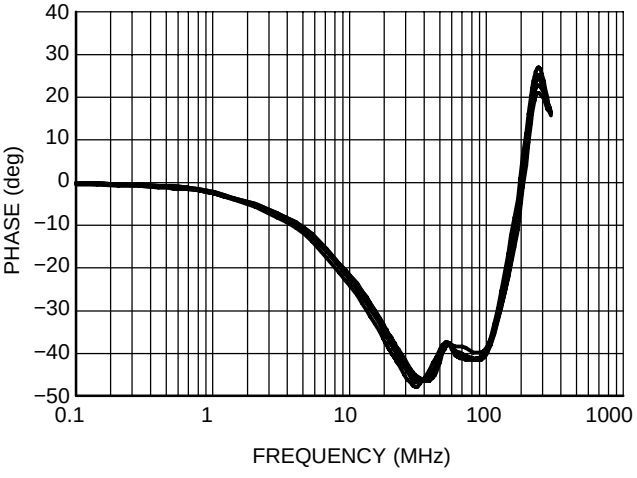


Figure 14. Phase Angle vs. Frequency @ V_{CC} = 1.65 V to 3.6 V

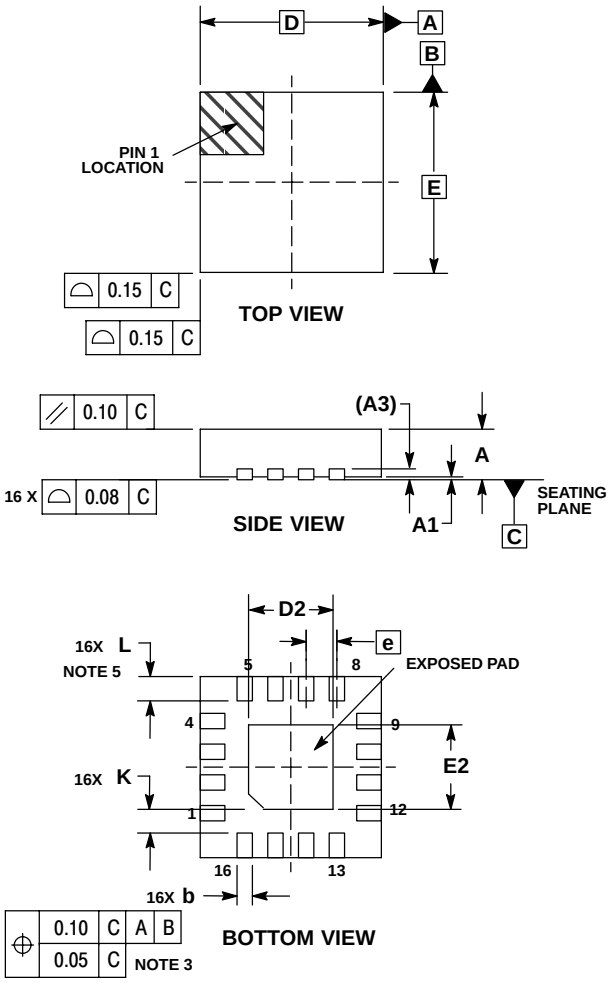
DEVICE ORDERING INFORMATION

Device Order Number	Device Nomenclature					Package Type	Tape & Reel Size†
	Circuit Indicator	Technology	Device Function	Package Suffix	Tape & Reel Suffix		
NLAS3699MN1R2G	NL	AS	3699	MN1	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

QFN−16 (3 x 3 x 0.85 mm)
CASE 485AE−01
ISSUE O



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. OUTLINE MEETS JEDEC DIMENSIONS PER MO−220, VARIATION VEED−6.

	MILLIMETERS		
DIM	MIN	NOM	MAX
A	0.800	0.900	1.000
A1	0.000	0.025	0.050
A3		0.200 REF	
b	0.180	0.250	0.300
D		3.00 BSC	
D2	1.250	1.40	1.550
E		3.00 BSC	
E2	1.250	1.40	1.550
e		0.500 BSC	
K	0.200	−−−	−−−
L	0.300	0.400	0.500

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