

# NLAS3799, NLAS3799L

## Dual DPDT Ultra-Low $R_{ON}$ Switch

The NLAS3799 is an ultra-low  $R_{ON}$  DPDT and a  $0.5 \Omega$   $R_{ON}$  DPDT analog switch. This device is designed for low operating voltage, high current switching of speaker output and earpiece for cellphone applications. It can switch a balanced stereo output. The NLAS3799 can handle a balanced microphone/speaker/ring-tone generator in a monophone mode. The device contains a break-before-make (BBM) feature.

### Features

- Single Supply Operation  
1.65 to 3.6 V  $V_{CC}$
- Maximum Breakdown Voltage: 4.6 V
- Low Static Power
- NLAS3799 Interfaces with 2.8 V Chipset  
NLAS3799L Interfaces with 1.8 V Chipset
- These are Pb-Free Devices\*

### 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:  
Human Body Model (HBM) > 8000 V  
Machine Model (MM) > 400 V
- Continuous Current Rating Through each Switch  $\pm 300$  mA
- Conforms to: JEDEC MO-220, Issue H, Variation VEED-6
- Package: 1.8 x 2.6 x 0.75 mm WQFN-16 Pb-Free

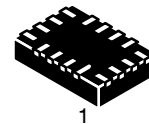
\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



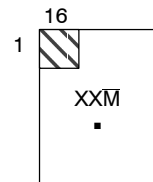
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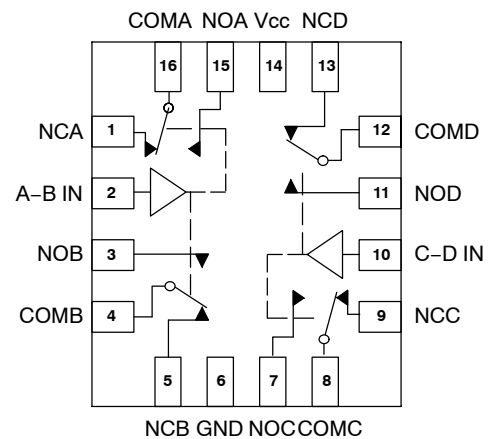
### MARKING DIAGRAMS



WQFN-16  
CASE 488AP



- XX = Specific Device Code  
AR = NLAS3799  
AT = NLAS3799L
- $\overline{M}$  = Date Code/Assembly Location
- = Pb-Free Package



### ORDERING INFORMATION

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

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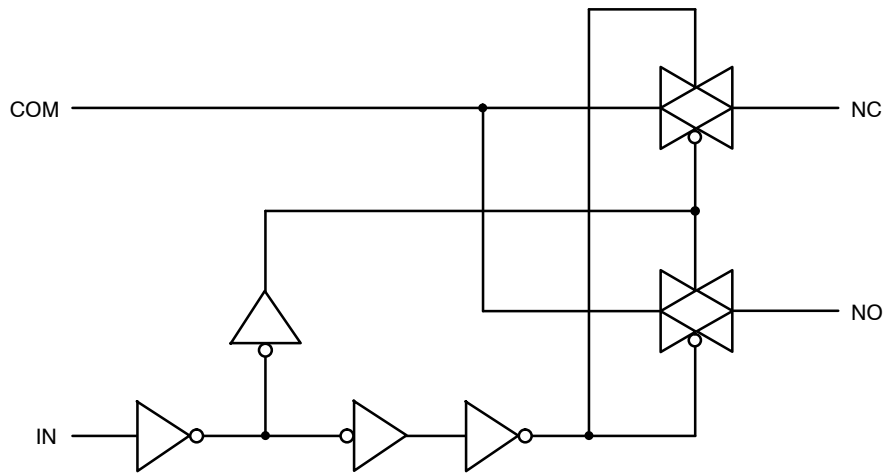


Figure 1. Input Equivalent Circuit

## PIN DESCRIPTION

QFN PIN #	Symbol	Name and Function
1, 3, 5, 7, 9, 11, 13, 15	NO A-D, NC A-D	Independent Channels
2, 10	A-B IN, C-D IN	Controls
4, 8, 12, 16	COM A-D	Common Channels
6	GND	Ground (V)
14	V <sub>CC</sub>	Positive Supply Voltage

## TRUTH TABLE

IN	NO	NC
H	ON	OFF*
L	OFF*	ON

\*High impedance.

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## 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 $V_{COM}$ )	$-0.5 \leq V_{IS} \leq V_{CC} + 0.5$	V
$V_{IN}$	Digital Select Input Voltage	$-0.5 \leq V_{IN} \leq +V_{CC}$	V
$I_{anI1}$	Continuous DC Current from COM to NC/NO	$\pm 300$	mA
$I_{anI-pk1}$	Peak Current from COM to NC/NO, 10 Duty Cycle (Note 1)	$\pm 500$	mA
$I_{clmp}$	Continuous DC Current into COM/NO/NC with Respect to $V_{CC}$ or GND	$\pm 100$	mA
$T_S$	Storage Temperature	-65 to +150	°C

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. 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, IN		20 10	ns/V
			$V_{CC} = 1.6\text{ V} - 2.7\text{ V}$ $V_{CC} = 3.0\text{ V} - 3.6\text{ V}$	

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## NLAS3799 DC CHARACTERISTICS – DIGITAL SECTION (Voltages Referenced to GND)

Symbol	Parameter	Condition	V <sub>CC</sub>	Guaranteed Limit		Unit
				25°C	-40°C to +85°C	
V <sub>IH</sub>	Minimum High-Level Input Voltage, Select Inputs		3.0	1.4	1.4	V
			3.6	1.7	1.7	
V <sub>IL</sub>	Maximum Low-Level Input Voltage, Select Inputs		3.0	0.5	0.5	V
			3.6	0.5	0.5	
I <sub>IN</sub>	Maximum Input Leakage Current, Select Inputs	V <sub>IN</sub> = V <sub>CC</sub> or GND	3.6	±0.1	±1.0	μA
I <sub>OFF</sub>	Power Off Leakage Current	V <sub>IN</sub> = 3.6 V or GND	0	±0.5	±2.0	μA
I <sub>CC</sub>	Maximum Quiescent Supply Current (Note 2)	Select and V <sub>IS</sub> = V <sub>CC</sub> or GND	1.65 to 3.6	±1.0	±2.0	μA

2. Guaranteed by design. Resistance measurements do not include test circuit or package resistance.

## NLAS3799 DC ELECTRICAL CHARACTERISTICS – ANALOG SECTION

Symbol	Parameter	Condition	V <sub>CC</sub>	Guaranteed Maximum Limit				Unit
				25°C		-40°C to +85°C		
				Min	Max	Min	Max	
R <sub>ON</sub>	NC/NO On-Resistance (Note 3)	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IN</sub> = V <sub>IH</sub> V <sub>IS</sub> = GND to V <sub>CC</sub>  I <sub>IN</sub>   = 100 mA	3.0		0.5		0.5	Ω
			3.6		0.4		0.4	
R <sub>FLAT</sub>	NC/NO On-Resistance Flatness (Notes 3 and 4)	I <sub>COM</sub> = 100 mA V <sub>IS</sub> = 0 to V <sub>CC</sub>	3.0		0.15		0.15	Ω
			3.6		0.15		0.15	
ΔR <sub>ON</sub>	On-Resistance Match Between Channels (Notes 3 and 5)	V <sub>IS</sub> = 1.5 V; I <sub>COM</sub> = 100 mA V <sub>IS</sub> = 1.8 V; I <sub>COM</sub> = 100 mA	3.0		0.05		0.05	Ω
			3.6		0.05		0.05	
I <sub>NC(OFF)</sub> I <sub>NO(OFF)</sub>	NC or NO Off Leakage Current (Note 3)	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> V <sub>NO</sub> or V <sub>NC</sub> = 0.3 V V <sub>COM</sub> = 3.3 V	3.6	-10	10	-100	100	nA
I <sub>COM(ON)</sub>	COM ON Leakage Current (Note 3)	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> V <sub>NO</sub> 0.3 V or 3.3 V with V <sub>NC</sub> floating or V <sub>NC</sub> 0.3 V or 3.3 V with V <sub>NO</sub> floating V <sub>COM</sub> = 0.3 V or 3.3 V	3.6	-10	10	-100	100	nA

3. Guaranteed by design. Resistance measurements do not include test circuit or package resistance.

4. Flatness is defined as the difference between the maximum and minimum value of On-resistance as measured over the specified analog signal ranges.

5. ΔR<sub>ON</sub> = R<sub>ON(MAX)</sub> – R<sub>ON(MIN)</sub> between nS2 or nS1.

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## NLAS3799L DC CHARACTERISTICS – DIGITAL SECTION (Voltages Referenced to GND)

Symbol	Parameter	Condition	V <sub>CC</sub>	Guaranteed Limit		Unit
				25°C	-40 to +85°C	
V <sub>IH</sub>	Minimum High-Level Input Voltage, Select Inputs		3.0	1.2	1.2	V
			3.6	1.3	1.3	
V <sub>IL</sub>	Maximum Low-Level Input Voltage, Select Inputs		3.0	0.5	0.5	V
			3.6	0.5	0.5	
I <sub>IN</sub>	Maximum Input Leakage Current, Select Inputs	V <sub>IN</sub> = V <sub>CC</sub> or GND	3.6	±0.1	±1.0	µA
I <sub>OFF</sub>	Power Off Leakage Current	V <sub>IN</sub> = 3.6 V or GND	0	±0.5	±2.0	µA
I <sub>CC</sub>	Maximum Quiescent Supply Current (Note 6)	Select and V <sub>IS</sub> = V <sub>CC</sub> or GND	1.65 to 3.6	±10	±20	µA

6. Guaranteed by design. Resistance measurements do not include test circuit or package resistance.

## NLAS3799L DC ELECTRICAL CHARACTERISTICS – ANALOG SECTION

Symbol	Parameter	Condition	V <sub>CC</sub>	Guaranteed Maximum Limit				Unit
				25°C		-40°C to +85°C		
				Min	Max	Min	Max	
R <sub>ON</sub>	NC/NO On-Resistance (Note 7)	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IN</sub> = V <sub>IH</sub> V <sub>IS</sub> = GND to V <sub>CC</sub> I <sub>IN</sub> = 100 mA	3.0		0.5		0.5	Ω
			3.6		0.5		0.5	
R <sub>FLAT</sub>	NC/NO On-Resistance Flatness (Notes 7 and 8)	I <sub>COM</sub> = 100 mA V <sub>IS</sub> = 0 to V <sub>CC</sub>	3.0 3.6		0.15 0.15		0.15 0.15	Ω
ΔR <sub>ON</sub>	On-Resistance Match Between Channels (Notes 7 and 9)	V <sub>IS</sub> = 1.5 V; I <sub>COM</sub> = 100 mA V <sub>IS</sub> = 1.8 V; I <sub>COM</sub> = 100 mA	3.0		0.05		0.05	Ω
			3.6		0.05		0.05	
I <sub>NC(OFF)</sub> I <sub>NO(OFF)</sub>	NC or NO Off Leakage Current (Note 7)	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> V <sub>NO</sub> or V <sub>NC</sub> = 0.3 V V <sub>COM</sub> = 3.3 V	3.6	-10	10	-100	100	nA
I <sub>COM(ON)</sub>	COM ON Leakage Current (Note 7)	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> V <sub>NO</sub> 0.3 V or 3.3 V with V <sub>NC</sub> floating or V <sub>NC</sub> 0.3 V or 3.3 V with V <sub>NO</sub> floating V <sub>COM</sub> = 0.3 V or 3.3 V	3.6	-10	10	-100	100	nA

7. Guaranteed by design. Resistance measurements do not include test circuit or package resistance.

8. Flatness is defined as the difference between the maximum and minimum value of On-resistance as measured over the specified analog signal ranges.

9. ΔR<sub>ON</sub> = R<sub>ON(MAX)</sub> - R<sub>ON(MIN)</sub> between NC1 and NC2 or between NO1 and NO2.

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## NLAS3799/NLAS3799L AC ELECTRICAL CHARACTERISTICS (Input $t_r = t_f = 3.0$ ns)

Symbol	Parameter	Test Conditions	V <sub>CC</sub> (V)	V <sub>IS</sub> (V)	Guaranteed Maximum Limit					Unit
					25°C			-40°C to +85°C		
					Min	Typ*	Max	Min	Max	
t <sub>ON</sub>	Turn-On Time	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 35 pF (Figures 3 and 4)	2.3 – 3.6	1.5			50		60	ns
t <sub>OFF</sub>	Turn-Off Time	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 35 pF (Figures 3 and 4)	2.3 – 3.6	1.5			30		40	ns
t <sub>BBM</sub>	Minimum Break-Before-Make Time	V <sub>IS</sub> = 3.0 R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 35 pF (Figure 2)	3.0	1.5	2	15				ns

		Typical @ 25, V <sub>CC</sub> = 3.6 V	
C <sub>IN</sub>	Control Pin Input Capacitance	3.0	pF
C <sub>SN</sub>	SN Port Capacitance	72	pF
C <sub>D</sub>	D Port Capacitance When Switch is Enabled	220	pF

\*Typical Characteristics are at 25°C.

## ADDITIONAL APPLICATION CHARACTERISTICS (Voltages Referenced to GND Unless Noted)

Symbol	Parameter	Condition	V <sub>CC</sub> (V)	25°C	Unit
				Typical	
BW	Maximum On-Channel -3 dB Bandwidth or Minimum Frequency Response (Figure 9)	V <sub>IN</sub> centered between V <sub>CC</sub> and GND (Figure 5)	1.65 – 3.6	19	MHz
V <sub>ONL</sub>	Maximum Feed-through On Loss	V <sub>IN</sub> = 0 dBm @ 100 kHz to 50 MHz V <sub>IN</sub> centered between V <sub>CC</sub> and GND (Figure 5)	1.65 – 3.6	-0.06	dB
V <sub>ISO</sub>	Off-Channel Isolation	f = 100 kHz; V <sub>IS</sub> = 1 V RMS; C <sub>L</sub> = 5.0 pF V <sub>IN</sub> centered between V <sub>CC</sub> and GND (Figure 5)	1.65 – 3.6	-69	dB
Q	Charge Injection Select Input to Common I/O (Figure 8)	V <sub>IN</sub> = V <sub>CC</sub> to GND, R <sub>IS</sub> = 0 Ω, C <sub>L</sub> = 1.0 nF Q = C <sub>L</sub> × ΔV <sub>OUT</sub> (Figure 6)	1.65 – 3.6	42	pC
THD	Total Harmonic Distortion THD + Noise (Figure 7)	F <sub>IS</sub> = 20 Hz to 20 kHz, R <sub>L</sub> = R <sub>gen</sub> = 600 Ω, C <sub>L</sub> = 50 pF V <sub>IS</sub> = 2 V <sub>PP</sub>	3.0	0.11	%
VCT	Channel-to-Channel Crosstalk (Figure 10)	f = 100 kHz; V <sub>IS</sub> = 1.0 V RMS, C <sub>L</sub> = 5.0 pF, R <sub>L</sub> = 50 Ω V <sub>IN</sub> centered between V <sub>CC</sub> and GND (Figure 5)	1.65 – 3.6	-90	dB

10. Off-Channel Isolation = 20log<sub>10</sub> (V<sub>COM</sub>/V<sub>NO</sub>), V<sub>COM</sub> = output, V<sub>NO</sub> = input to off switch.

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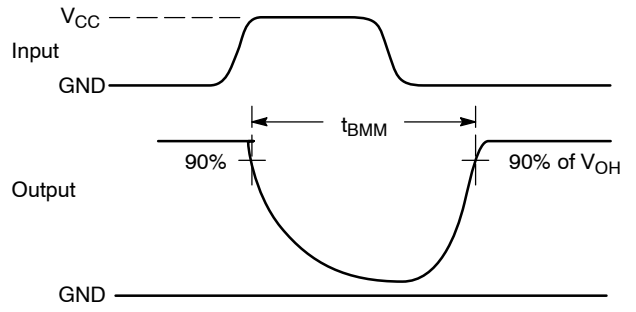
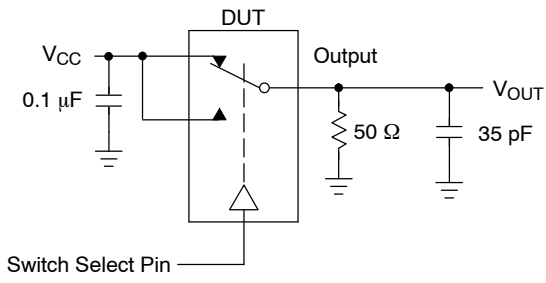


Figure 2.  $t_{BMM}$  (Time Break-Before-Make)

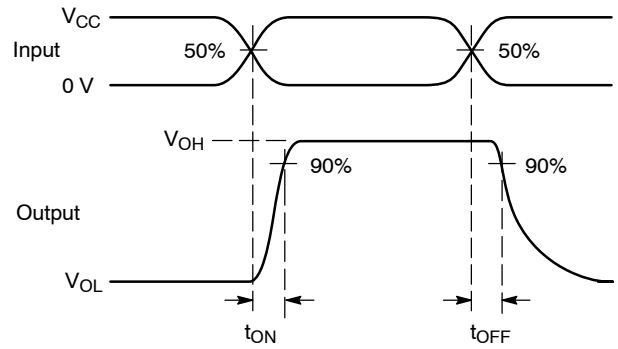
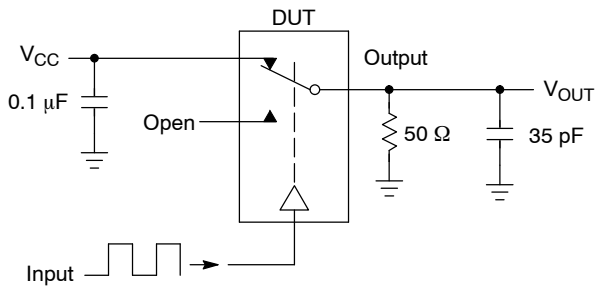


Figure 3.  $t_{ON}/t_{OFF}$

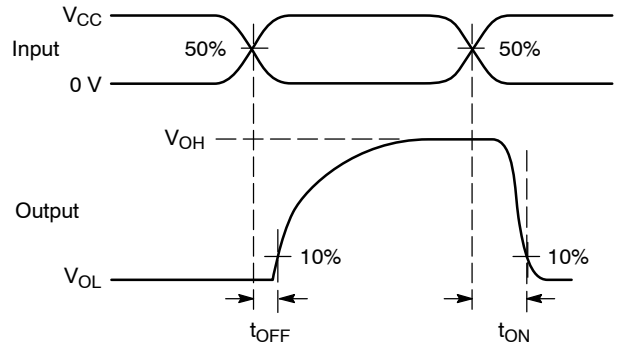
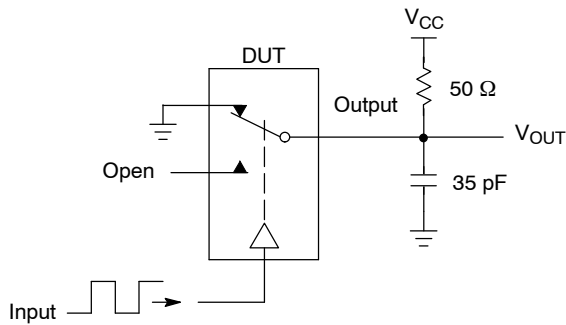
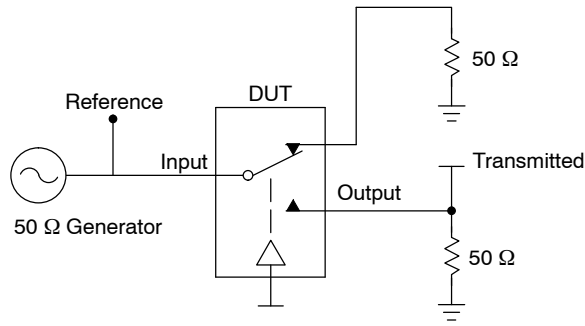


Figure 4.  $t_{ON}/t_{OFF}$

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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.

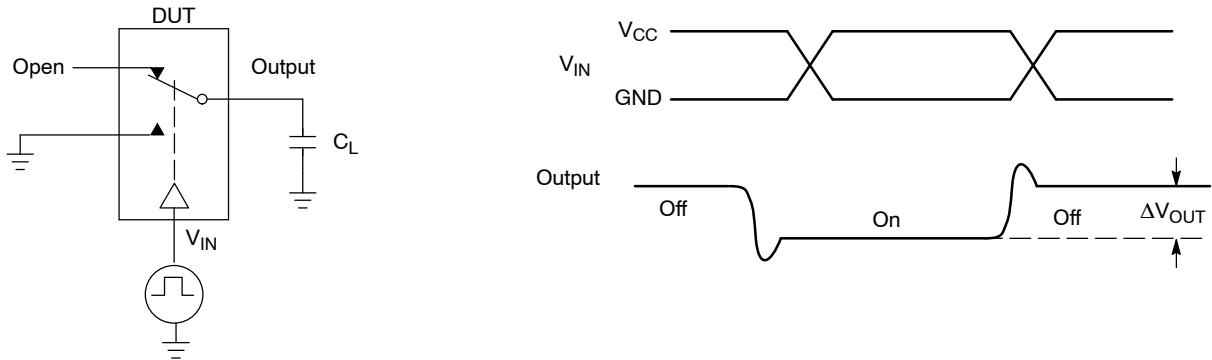
$$V_{ISO} = \text{Off Channel Isolation} = 20 \text{ Log} \left( \frac{V_{OUT}}{V_{IN}} \right) \text{ for } V_{IN} \text{ at } 100 \text{ kHz}$$

$$V_{ONL} = \text{On Channel Loss} = 20 \text{ Log} \left( \frac{V_{OUT}}{V_{IN}} \right) \text{ for } V_{IN} \text{ at } 100 \text{ kHz to } 50 \text{ MHz}$$

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  $\Omega$

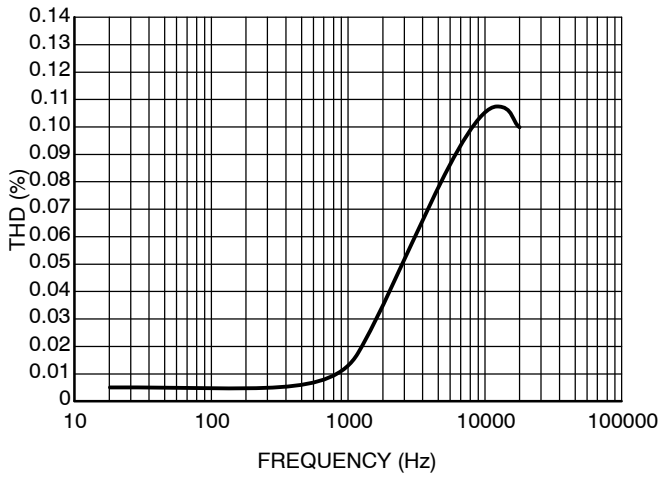
**Figure 5. Off Channel Isolation/On Channel Loss (BW)/Crosstalk (On Channel to Off Channel)/ $V_{ONL}$**



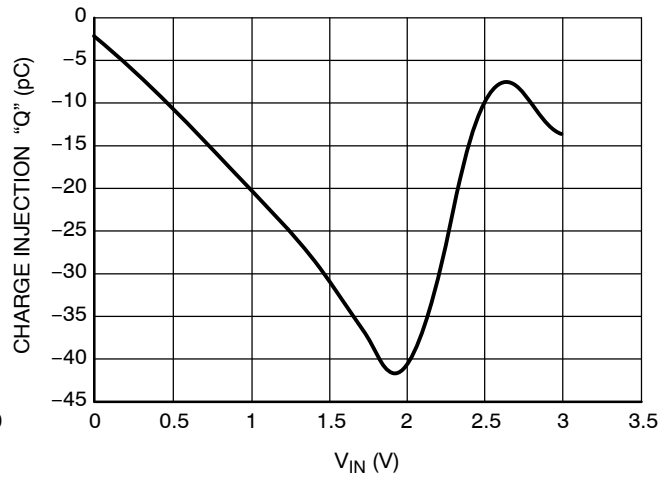
**Figure 6. Charge Injection: (Q)**



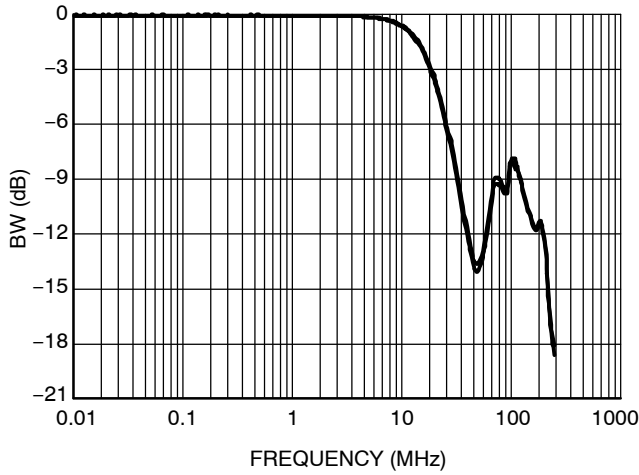
# NLAS3799, NLAS3799L



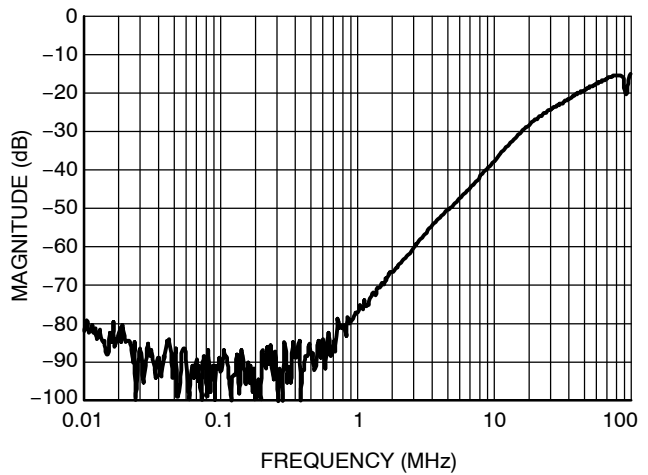
**Figure 7. Total Harmonic Distortion vs. Frequency**



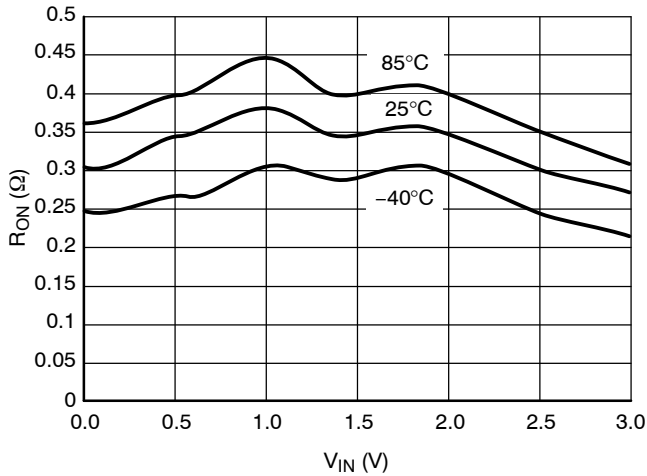
**Figure 8. Charge Injection @  $V_{CC} = 3.0\text{ V}$**



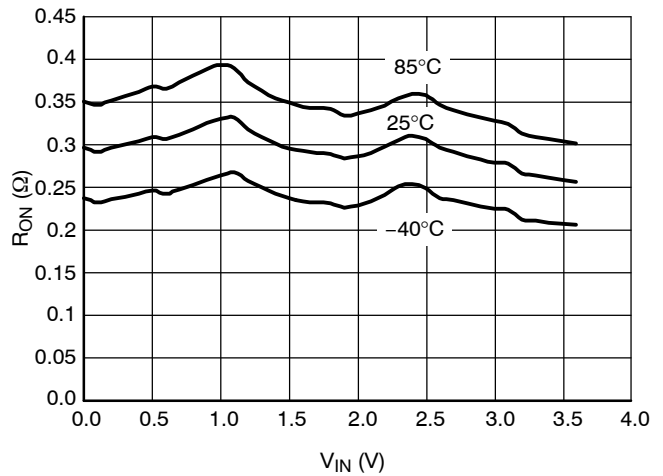
**Figure 9. Bandwidth vs. Frequency**



**Figure 10. Cross-Talk vs. Frequency**



**Figure 11.  $R_{ON}$  vs.  $V_{IN}$  vs. Temperature @  $V_{CC} = 3.0\text{ V}$**



**Figure 12.  $R_{ON}$  vs.  $V_{IN}$  vs. Temperature @  $V_{CC} = 3.6\text{ V}$**

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## DEVICE ORDERING INFORMATION

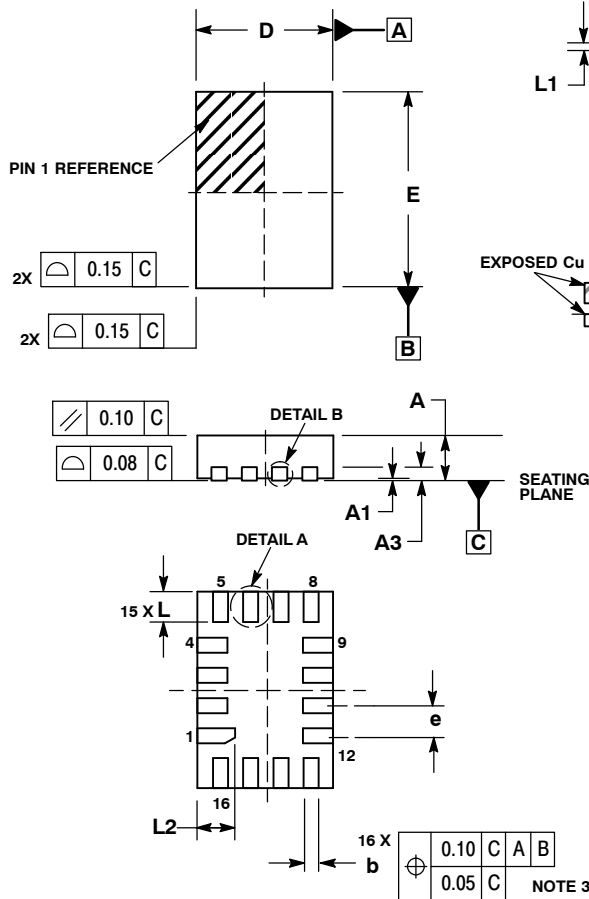
Device Order Number	Device Nomenclature					Package Type	Tape & Reel Size <sup>†</sup>
	Circuit Indicator	Technology	Device Function	Package Suffix	Tape & Reel Suffix		
NLAS3799MNR2G	NL	AS	3799	MN	R2	WQFN (Pb-Free)	3000 / Tape & Reel
NLAS3799LMNR2G	NL	AS	3799L	MN	R2	WQFN (Pb-Free)	3000 / Tape & Reel

<sup>†</sup>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.

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## PACKAGE DIMENSIONS

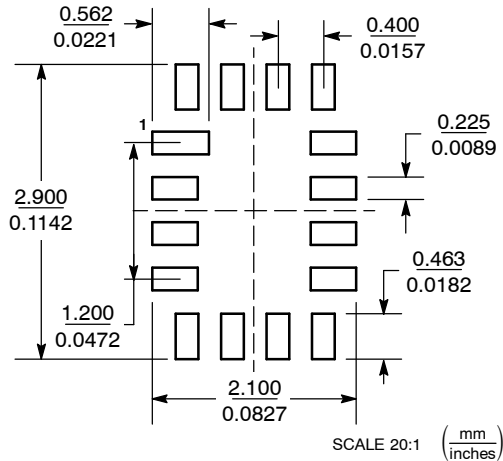
WQFN16, 1.8x2.6, 0.4P  
CASE 488AP-01  
ISSUE B



- 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\*



\*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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