

# NLAS4783

## Triple SPDT 1.0 $\Omega$ $R_{ON}$ Switch

The NLAS4783 is a triple independent ultra-low  $R_{ON}$  SPDT analog switch with ENABLE. 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 NLAS4783 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  $V_{CC}$
- Tiny 3 x 3 mm 16-Pin QFN Package  
Meets JEDEC MO-220 Specifications
- Low Static Power
- OVT on Logic Address and Enable Inputs
- This is a Pb-Free Device\*

### Typical Applications

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

### Important Information

- ESD Protection:  
Human Body Model (HBM) > 8000 V  
Machine Model (MM) > 400 V
- Ringtone-Chip/Amplifier Switching
- Continuous Current Rating Through each Switch  $\pm 300$  mA
- Conforms to: JEDEC MO-220, Issue H, Variation VEED-6
- Pin-for-Pin Compatible with MAX4783

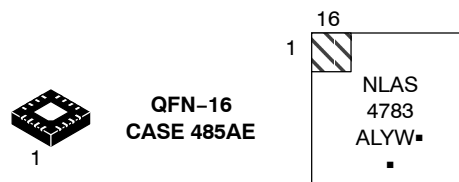
\*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.



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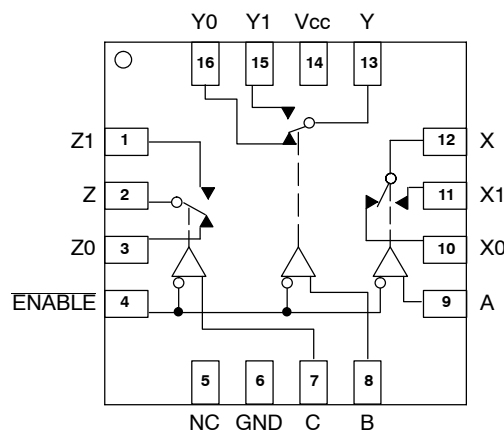
<http://onsemi.com>

### MARKING DIAGRAM



A = Assembly Location  
L = Wafer Lot  
Y = Year  
W = Work Week  
▪ = Pb-Free Package  
(Note: Microdot may be in either location)

### PIN CONNECTIONS



### ORDERING INFORMATION

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

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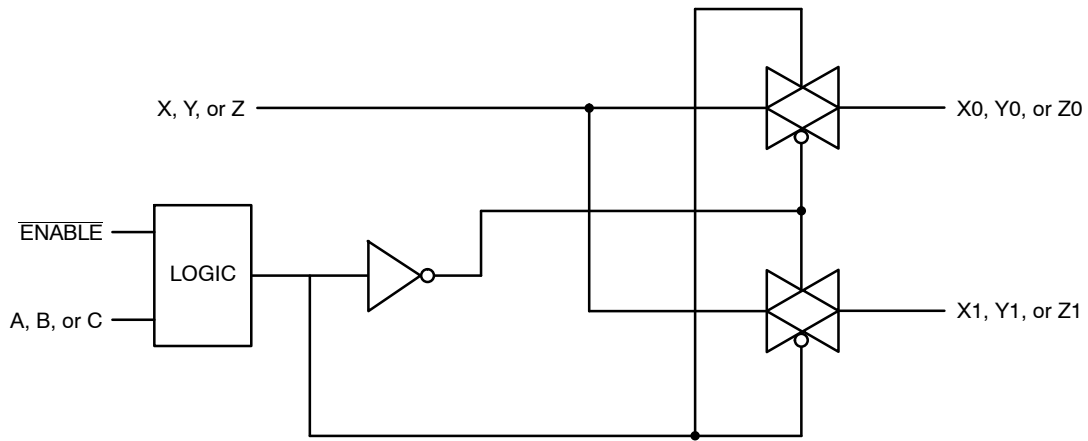


Figure 1. Input Equivalent Circuit

## PIN FUNCTION DESCRIPTION

QFN PIN #	Symbol	Description
15	Y1	Analog Switch Y Normally Open Input
16	Y0	Analog Switch Y Normally Closed Input
1	Z1	Analog Switch Z Normally Open Input
2	Z	Analog Switch Z Output
3	Z0	Analog Switch Z Normally Closed Input
4	ENABLE	Digital Enable Input. Normally connect to GND. Drive to logic high to set all switches off.
5	NC	No Connection. Not internally connected.
6	GND	Ground
7	C	Digital Address C Input
8	B	Digital Address B Input
9	A	Digital Address A Input
10	X0	Analog Switch X Normally Closed Input
11	X1	Analog Switch X Normally Open Input
12	X	Analog Switch X Output
13	Y	Analog Switch Y Output
14	V <sub>CC</sub>	Positive Analog and Digital Supply Voltage Input

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## TRUTH TABLE/SWITCH PROGRAMMING

Enable Input	Select Input			
	C	B	A	
H	X	X	X	All Switches Open
L	L	L	L	X-X0 Y-Y0 Z-Z0
L	L	L	H	X-X1 Y-Y0 Z-Z0
L	L	H	L	X-X0 Y-Y1 Z-Z0
L	L	H	H	X-X1 Y-Y1 Z-Z0
L	H	L	L	X-X0 Y-Y0 Z-Z1
L	H	L	H	X-X1 Y-Y0 Z-Z1
L	H	H	L	X-X0 Y-Y1 Z-Z1
L	H	H	H	X-X1 Y-Y1 Z-Z1

1. Input and output pins are identical and interchangeable. Both pins can be considered input or output. Bidirectional signal pass.



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## DC CHARACTERISTICS – Digital Section (Voltages Referenced to GND)

Symbol	Parameter	Condition	V <sub>CC</sub>	Guaranteed Limit		Unit
				-40°C to 25°C	< 85°C	
V <sub>IH</sub>	Minimum High-Level Input Voltage, Select Inputs		1.65	1.0	1.0	V
			2.7	1.4	1.4	
			3.6	1.8	1.8	
V <sub>IL</sub>	Maximum Low-Level Input Voltage, Select Inputs		1.65	0.4	0.4	V
			2.7	0.5	0.5	
			3.6	0.6	0.6	
I <sub>IN</sub>	Maximum Input Leakage Current, Select Inputs	V <sub>IN</sub> = 3.6 V 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 3)	Select and V <sub>IS</sub> = V <sub>CC</sub> or GND	1.65 to 3.6	± 1.0	± 2.0	μA

## DC ELECTRICAL CHARACTERISTICS – Analog Section

Symbol	Parameter	Condition	V <sub>CC</sub>	Guaranteed Maximum Limit				Unit
				-40°C to 25°C		< 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	2.7 – 3.6		1.0		1.2	Ω
R <sub>FLAT</sub>	NC/NO On-Resistance Flatness (Notes 3, 5)	I <sub>COM</sub> = 100 mA V <sub>IS</sub> = 0 to V <sub>CC</sub>	2.7 – 3.6		0.2		0.2	Ω
ΔR <sub>ON</sub>	On-Resistance Match Between Channels (Notes 3 and 4)	V <sub>IS</sub> = 1.3 V; I <sub>COM</sub> = 100 mA	2.7 – 3.6		0.4		0.6	Ω
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	-5.0	5.0	-10	10	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. ΔR<sub>ON</sub> = R<sub>ON(MAX)</sub> – R<sub>ON(MIN)</sub> between NC1 and NC2 or between NO1 and NO2.

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

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## 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	$R_L = 50 \Omega$ , $C_L = 35$ pF (Figures 3 and 4)	2.3 – 3.6	1.5			25		27	ns
$t_{OFF}$	Turn-Off Time	$R_L = 50 \Omega$ , $C_L = 35$ pF (Figures 3 and 4)	2.3 – 3.6	1.5			15		20	ns
$t_{BBM}$	Minimum Break-Before-Make Time	$V_{IS} = 3.0$ $R_L = 300 \Omega$ , $C_L = 35$ pF (Figure 2)	3.0	1.5	2.0	8.0				ns

		Typical @ 25, $V_{CC} = 3.6$ V		
$C_{IN}$	Control Pin Input Capacitance	2.5		pF
$C_{SN}$	SN Port Capacitance	75		pF
$C_D$	D Port Capacitance When Switch is Enabled	240		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	$V_{IN}$ centered between $V_{CC}$ and GND (Figure 5)	1.65 – 3.6	17	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	-0.10	dB
$V_{ISO}$	Off-Channel Isolation	$f = 100$ kHz; $V_{IS} = 1$ V RMS; $C_L = 5$ nF $V_{IN}$ centered between $V_{CC}$ and GND (Figure 5) (Note 6)	1.65 – 3.6	-62	dB
Q	Charge Injection Select Input to Common I/O	$V_{IN} = V_{CC}$ to GND, $R_{IS} = 0 \Omega$ , $C_L = 1$ nF $Q = C_L \times \Delta V_{OUT}$ (Figure 6)	1.65 – 3.6	50	pC
THD	Total Harmonic Distortion THD + Noise	$F_{IS} = 20$ Hz to 20 kHz, $R_L = R_{gen} = 600 \Omega$ , $C_L = 50$ pF $V_{IS} = 2$ V RMS	3.0	0.015	%
VCT	Channel-to-Channel Crosstalk	$f = 100$ kHz; $V_{IS} = 1$ V RMS, $C_L = 5$ pF, $R_L = 50 \Omega$ $V_{IN}$ centered between $V_{CC}$ and GND (Figure 5)	1.65 – 3.6	-62	dB

6. Off-Channel Isolation =  $20 \log_{10}(V_{com}/V_{no})$ ,  $V_{com}$  = output,  $V_{no}$  = input to off switch.

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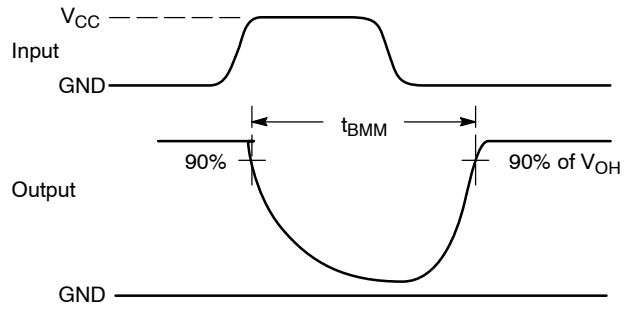
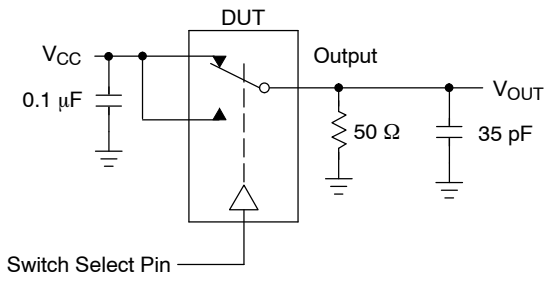


Figure 2.  $t_{BMM}$  (Time Break-Before-Make)

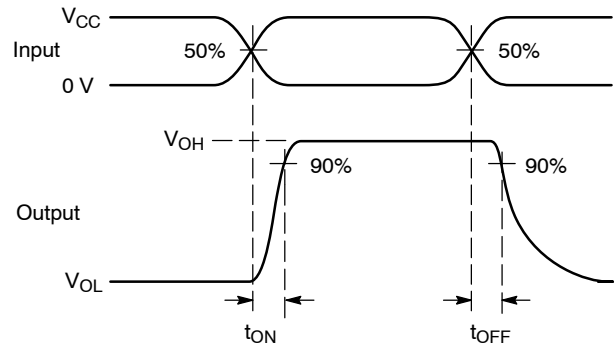
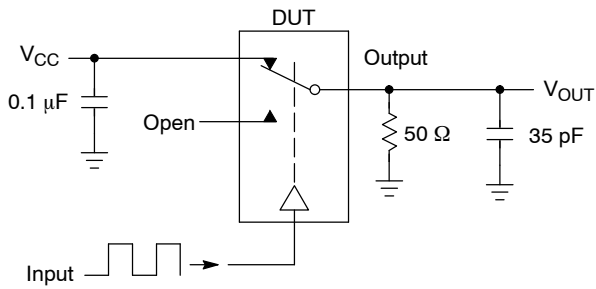


Figure 3.  $t_{ON}/t_{OFF}$

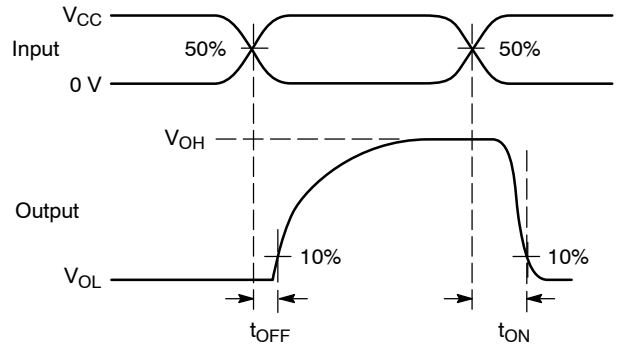
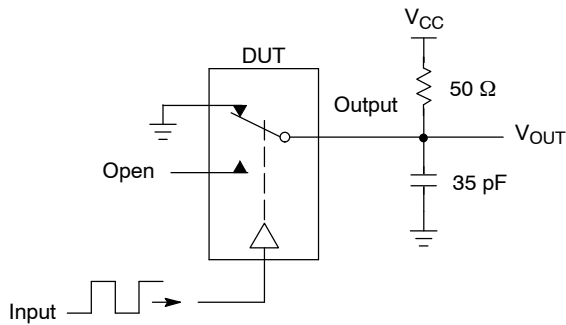
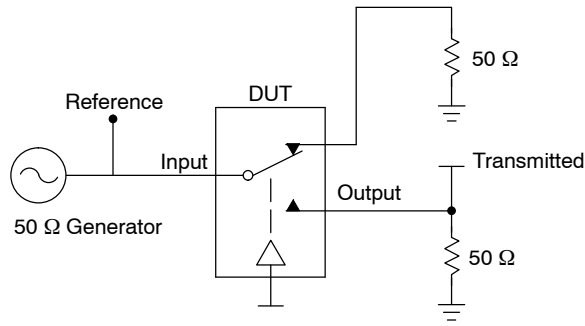


Figure 4.  $t_{ON}/t_{OFF}$

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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.

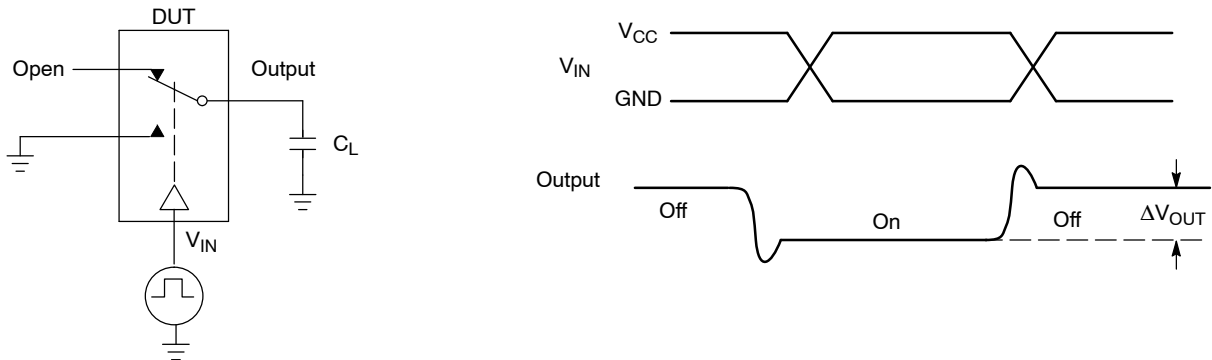
$$V_{ISO} = \text{Off Channel Isolation} = 20 \text{ Log} \left( \frac{V_{OUT}}{V_{IN}} \right) \text{ for } V_{IN} \text{ at } 100 \text{ kHz}$$

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

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 Ω

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



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



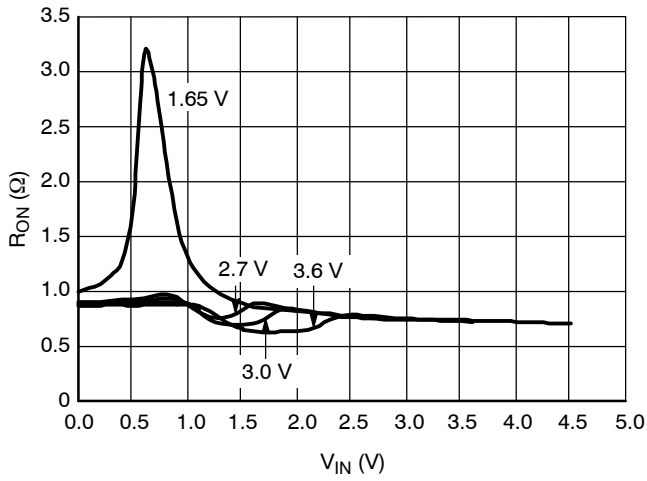


Figure 7. On-Resistance vs. Input Voltage

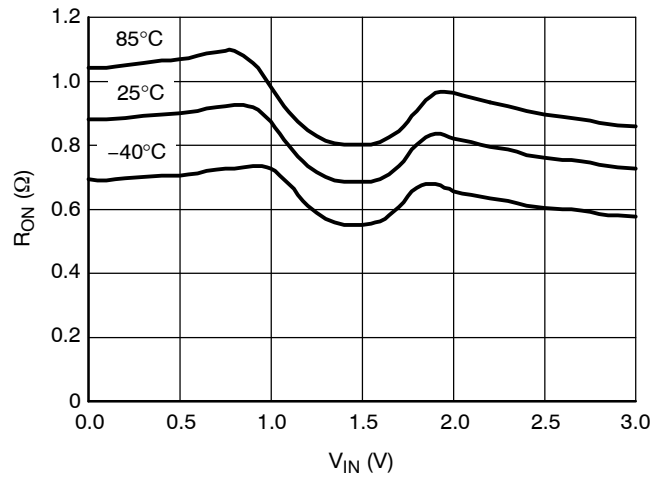


Figure 8.  $R_{ON}$  vs.  $V_{IN}$  vs. Temperature @  $V_{CC} = 3.0$  V

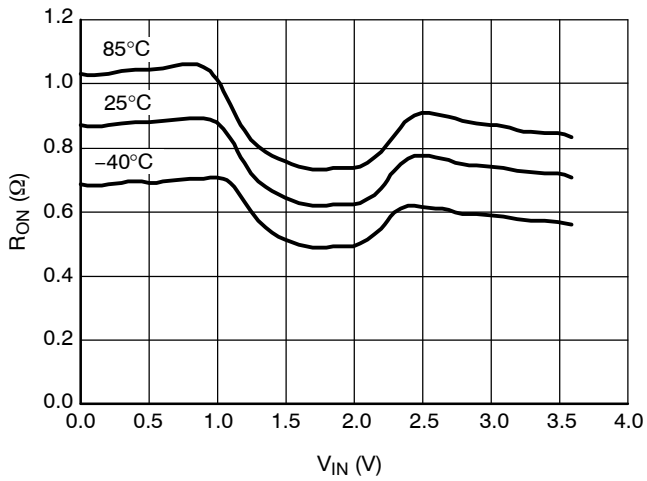


Figure 9.  $R_{ON}$  vs.  $V_{IN}$  vs. Temperature @  $V_{CC} = 3.6$  V

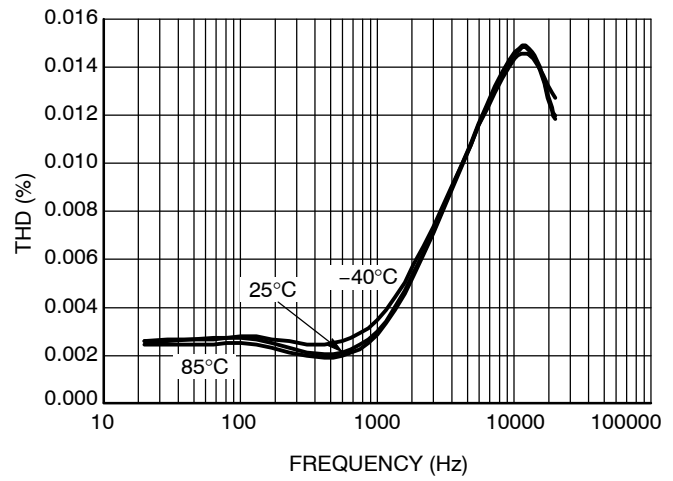


Figure 10. Total Harmonic Distortion vs. Frequency

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## ORDERING INFORMATION

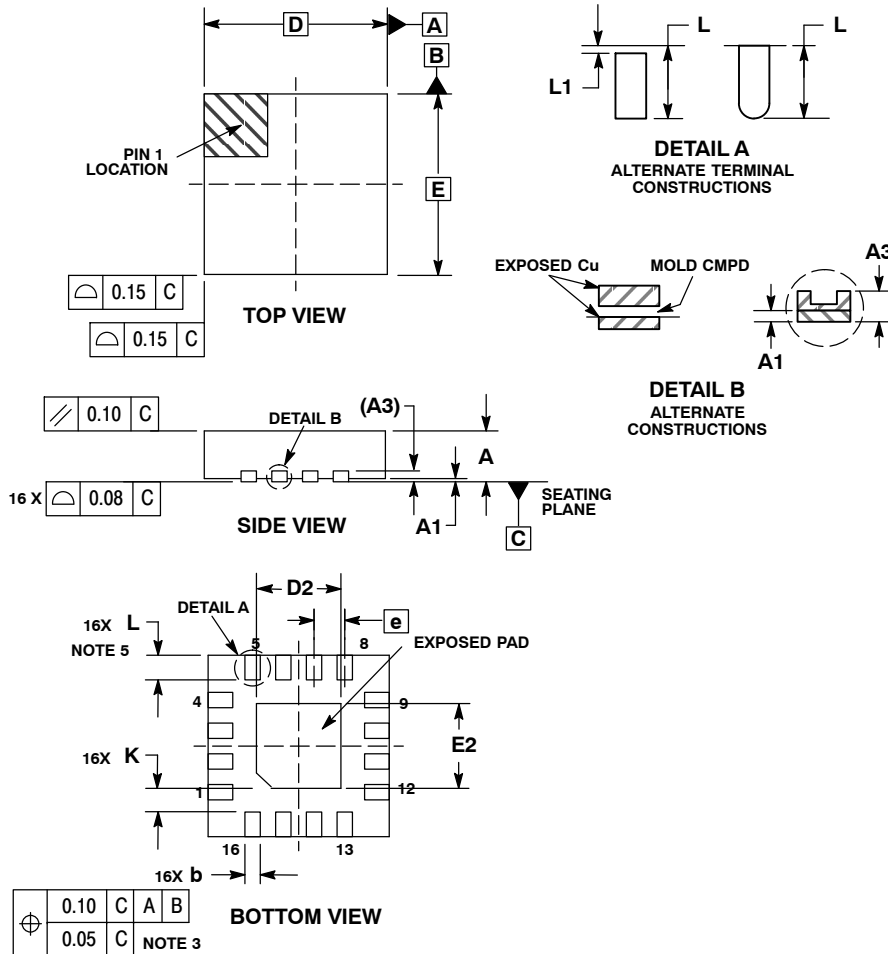
Device Order Number	Device Nomenclature				Package Type	Tape & Reel Size <sup>†</sup>
	Circuit Indicator	Technology	Device Function	Tape & Reel Suffix		
NLAS4783MN1R2G	NL	AS	4783	R2	QFN (Pb-Free)	3000 Tape & Reel

<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

QFN16 3x3, 0.5P  
CASE 485AE-01  
ISSUE A



**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.

DIM	MILLIMETERS		
	MIN	NOM	MAX
A	0.80	0.90	1.00
A1	0.00	0.03	0.05
A3	0.20 REF		
b	0.18	0.25	0.30
D	3.00 BSC		
D2	1.25	1.40	1.55
E	3.00 BSC		
E2	1.25	1.40	1.55
e	0.50 BSC		
K	0.20	---	---
L	0.30	0.40	0.50
L1	0.00	---	0.15

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