NLAS5223, NLAS5223L

Ultra-Low 0.5 Ω Dual SPDT Analog Switch

The NLAS5223 is an advanced CMOS analog switch fabricated in Sub−micron silicon gate CMOS technology. The device is a dual Independent Single Pole Double Throw (SPDT) switch featuring Ultra−Low R_{ON} of 0.5 Ω, at V_{CC} = 3.0 ± 0.3 V.

The part also features guaranteed Break Before Make (BBM) switching, assuring the switches never short the driver.

Features

- Ultra−Low R_{ON}, < 0.5 Ω at V_{CC} = 3.0 ± 0.3 V
- NLAS5223 Interfaces with 2.8 V Chipset
- NLAS5223L Interfaces with 1.8 V Chipset
- Single Supply Operation from 1.65−3.6 V
- Smallest 1.4 x 1.8 x 0.75 mm Thin QFN Package
- Full 0−V_{CC} Signal Handling Capability
- High Off−Channel Isolation
- Low Standby Current, < 50 nA
- Low Distortion
- R_{ON} Flatness of 0.15 Ω
- High Continuous Current Capability
  ± 300 mA Through Each Switch
- Large Current Clamping Diodes at Analog Inputs
  ± 300 mA Continuous Current Capability
- ESD Human Body Model = 3000 V
- These are Pb−Free Devices

Applications

- Cell Phone Audio Block
- Speaker and Earphone Switching
- Ring−Tone Chip / Amplifier Switching
- Modems

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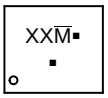
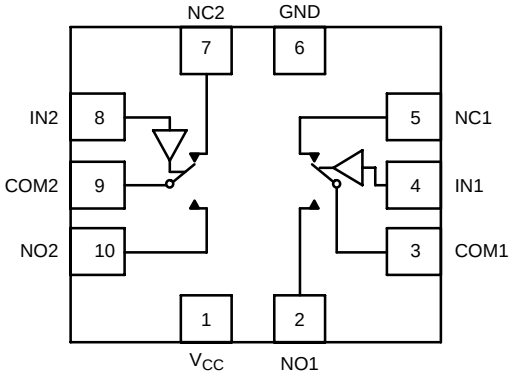
MARKING DIAGRAM

1

WQFN−10
CASE 488AQ



XX = Specific Device Code
AU = NLAS5223
AV = NLAS5223L
M = Date Code
▪ = Pb−Free Device
(Note: Microdot may be in either location)



FUNCTION TABLE

IN 1, 2	NO 1, 2	NC 1, 2
0	OFF	ON
1	ON	OFF

ORDERING INFORMATION

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

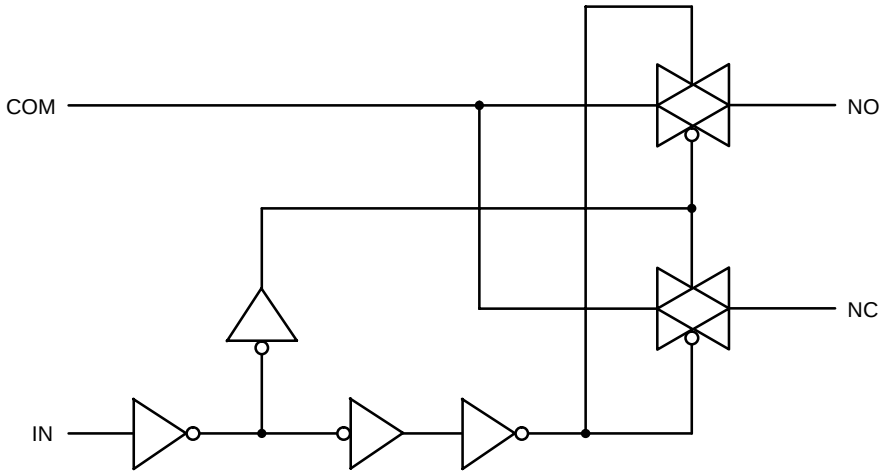


Figure 1. Logic Equivalent Circuit

PIN DESCRIPTION

QFN PIN #	Symbol	Name and Function
2, 5, 7, 10	NC1 to NC2, NO1 to NO2	Independent Channels
4, 8	IN1 and IN2	Controls
3, 9	COM1 and COM2	Common Channels
6	GND	Ground (V)
1	V_{CC}	Positive Supply Voltage

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})	$-0.5 \le V_{IS} \le V_{CC} + 0.5$	V
V_{IN}	Digital Select Input Voltage	$-0.5 \le V_{IN} \le +4.6$	V
I_{anl1}	Continuous DC Current from COM to NC/NO	±300	mA
$I_{anl-pk1}$	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

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 (OVT) Overvoltage Tolerance		GND	3.6	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		20 10	ns/V

NLAS5223 DC CHARACTERISTICS − DIGITAL SECTION (Voltages Referenced to GND)

Symbol	Parameter	Condition	V_{CC}	Guaranteed Limit		Unit
				25°C	−40°C to +85°C	
V_{IH}	Minimum High−Level Input Voltage, Select Inputs		3.0 3.6	1.4 1.7	1.4 1.7	V
V_{IL}	Maximum Low−Level Input Voltage, Select Inputs		3.0 3.6	0.7 0.8	0.7 0.8	V
I_{IN}	Maximum Input Leakage Current, Select Inputs	V_{IN} = 3.6 V or GND	3.6	±0.1	±1.0	μA
I_{OFF}	Power Off Leakage Current	V_{IN} = 3.6 V 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

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

NLAS5223 DC ELECTRICAL CHARACTERISTICS − ANALOG SECTION

Symbol	Parameter	Condition	V_{CC}	Guaranteed Maximum Limit				Unit
				25°C		−40°C to +85°C		
				Min	Max	Min	Max	
R_{ON}	NC/NO On−Resistance (Note 3)	V_{IN} = V_{IL} or V_{IN} = V_{IH} V_{IS} = GND to V_{CC} I_{COM} = 100 mA	3.0 3.6		0.5 0.5		0.5 0.5	Ω
R_{FLAT}	NC/NO On−Resistance Flatness (Notes 3 and 4)	I_{COM} = 100 mA V_{IS} = 0 to V_{CC}	3.0 3.6		0.15 0.15		0.15 0.15	Ω
ΔR_{ON}	On−Resistance Match Between Channels (Notes 3 and 5)	V_{IS} = 1.5 V; I_{COM} = 100 mA V_{IS} = 1.8 V; I_{COM} = 100 mA	3.0 3.6		0.05 0.05		0.05 0.05	Ω
$I_{NC(OFF)}$ $I_{NO(OFF)}$	NC or NO Off Leakage Current (Note 3)	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 3)	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

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. $\Delta R_{ON} = R_{ON(MAX)} - R_{ON(MIN)}$ between NC1 and NC2 or between NO1 and NO2.

NLAS5223L DC CHARACTERISTICS − DIGITAL SECTION (Voltages Referenced to GND)

Symbol	Parameter	Condition	V_{CC}	Guaranteed Limit		Unit
				25°C	−40°C to +85°C	
V_{IH}	Minimum High−Level Input Voltage, Select Inputs		3.0 3.6	1.1 1.3	1.1 1.3	V
V_{IL}	Maximum Low−Level Input Voltage, Select Inputs		3.0 3.6	0.5 0.5	0.5 0.5	V
I_{IN}	Maximum Input Leakage Current, Select Inputs	V_{IN} = 3.6 V or GND	3.6	±0.1	±1.0	μA
I_{OFF}	Power Off Leakage Current	V_{IN} = 3.6 V or GND	0	±0.5	±2.0	μA
I_{CC}	Maximum Quiescent Supply Current (Note 6)	Select and V_{IS} = V_{CC} or GND	1.65 to 3.6	±1.0	±2.0	μA

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

NLAS5223L DC ELECTRICAL CHARACTERISTICS − ANALOG SECTION

Symbol	Parameter	Condition	V_{CC}	Guaranteed Maximum Limit				Unit
				25°C		−40°C to +85°C		
				Min	Max	Min	Max	
R_{ON}	NC/NO On−Resistance (Note 7)	V_{IN} = V_{IL} or V_{IN} = V_{IH} V_{IS} = GND to V_{CC} I_{COM} = 100 mA	3.0 3.6		0.5 0.5		0.5 0.5	Ω
R_{FLAT}	NC/NO On−Resistance Flatness (Notes 7 and 8)	I_{COM} = 100 mA V_{IS} = 0 to V_{CC}	3.0 3.6		0.15 0.15		0.15 0.15	Ω
ΔR_{ON}	On−Resistance Match Between Channels (Notes 7 and 9)	V_{IS} = 1.5 V; I_{COM} = 100 mA V_{IS} = 1.8 V; I_{COM} = 100 mA	3.0 3.6		0.05 0.05		0.05 0.05	Ω
$I_{NC(OFF)}$ $I_{NO(OFF)}$	NC or NO Off Leakage Current (Note 7)	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 7)	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

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. $\Delta R_{ON} = R_{ON(MAX)} - R_{ON(MIN)}$ between NC1 and NC2 or between NO1 and NO2.

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
					25°C			−40°C to +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	3.5	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 −3 dB 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	−0.06	dB
V_{ISO}	Off−Channel Isolation	f = 100 kHz; V_{IS} = 1 V RMS; C_L = 5.0 pF V_{IN} centered between V_{CC} and GND (Figure 5)	1.65 − 3.6	−65	dB
Q	Charge Injection Select Input to Common I/O	V_{IN} = $V_{CC\ to}$ GND, R_{IS} = 0 W, C_L = 1.0 nF Q = C_L x DV_{OUT} (Figure 6)	1.65 − 3.6	38	pC
THD	Total Harmonic Distortion THD + Noise	F_{IS} = 20 Hz to 20 kHz, R_L = R_{gen} = 600 Ω, C_L = 50 pF V_{IS} = 2.0 V RMS	3.0	0.12	%
VCT	Channel−to−Channel Crosstalk	f = 100 kHz; V_{IS} = 1.0 V RMS, C_L = 5.0 pF, R_L = 50 Ω V_{IN} centered between V_{CC} and GND (Figure 5)	1.65 − 3.6	−70	dB

10. Off−Channel Isolation = 20log10 (V_{COM}/V_{NO}), V_{COM} = output, V_{NO} = input to off switch.

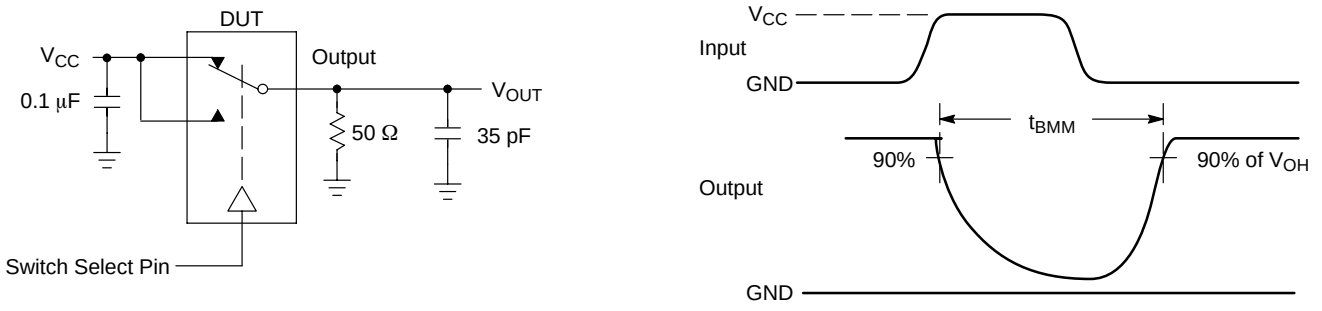


Figure 2. t_{BBM} (Time Break−Before−Make)

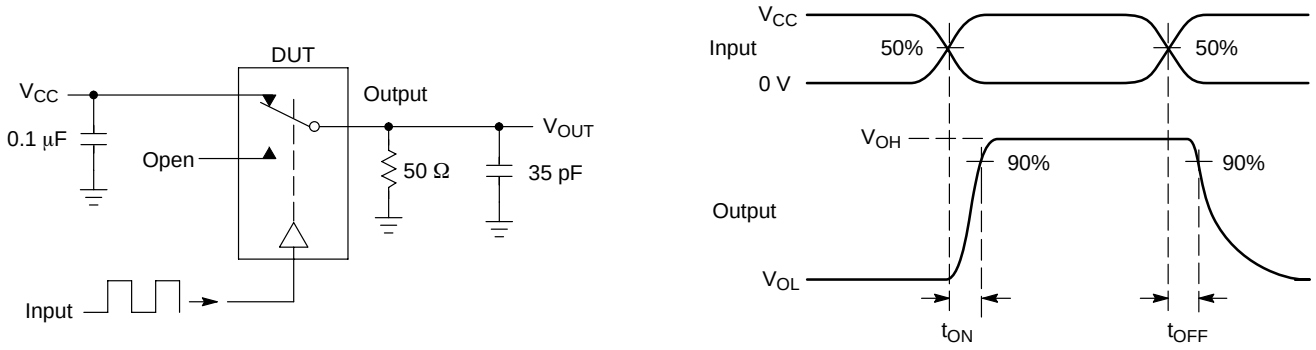


Figure 3. t_{ON}/t_{OFF}

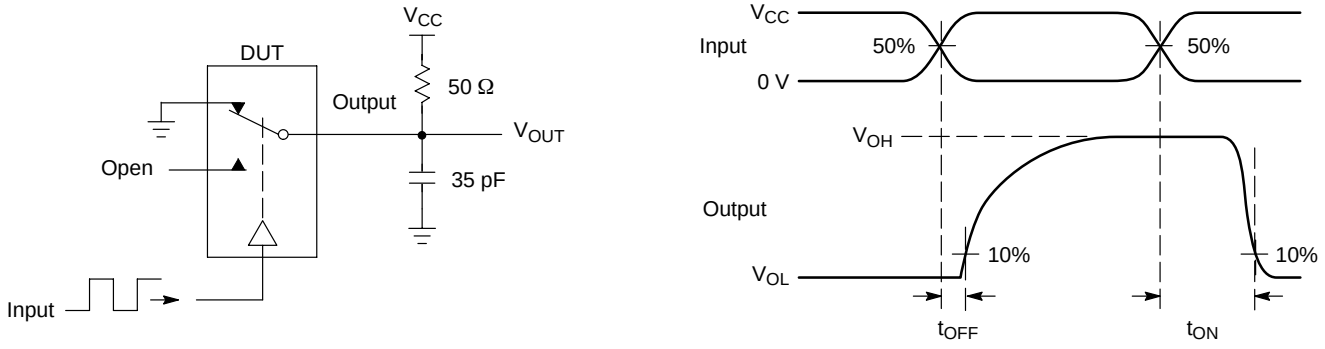
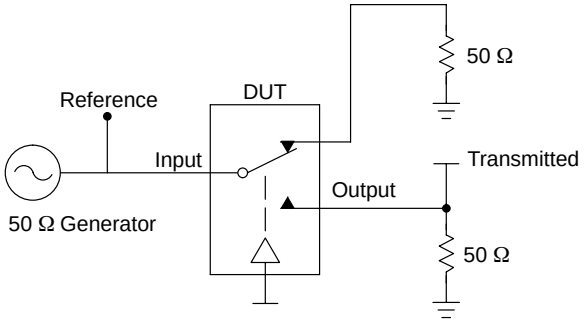


Figure 4. t_{ON}/t_{OFF}



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}

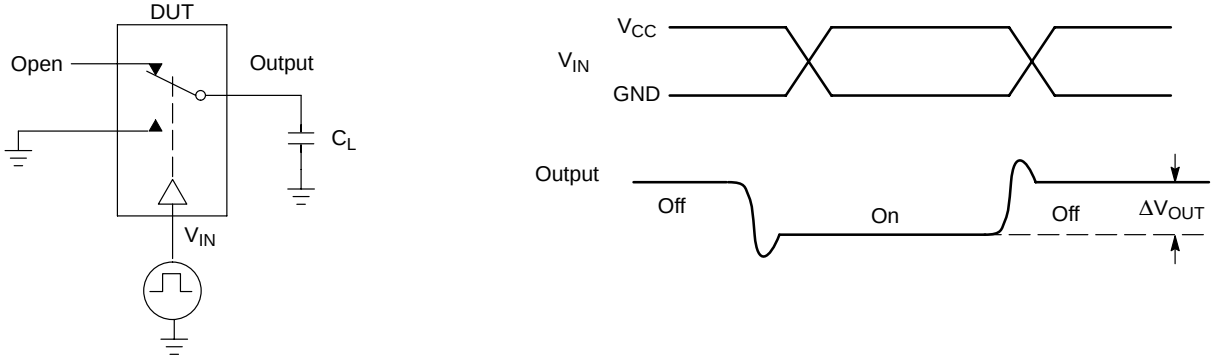


Figure 6. Charge Injection: (Q)

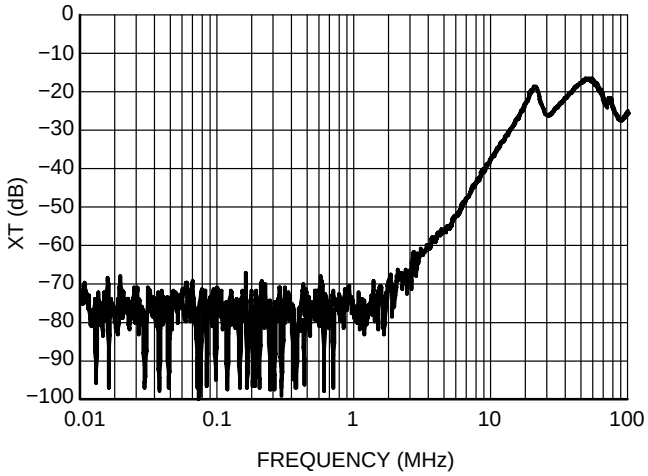


Figure 7. Cross Talk vs. Frequency @ V_{CC} = 3.6 V

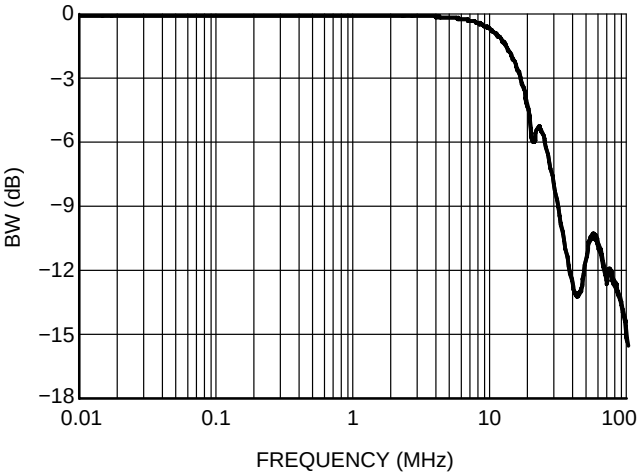


Figure 8. Bandwidth vs. Frequency

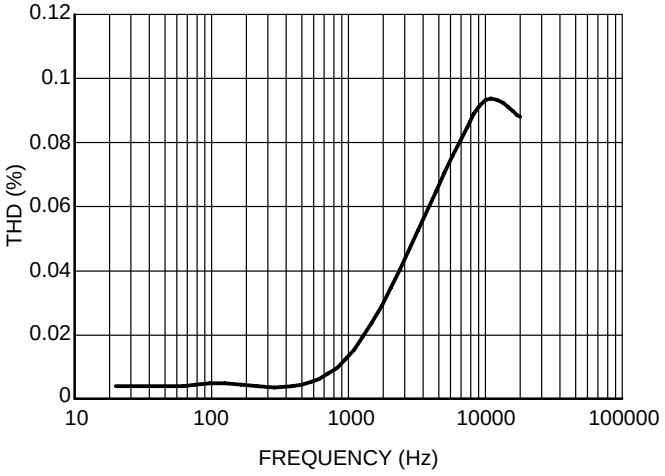


Figure 9. Total Harmonic Distortion

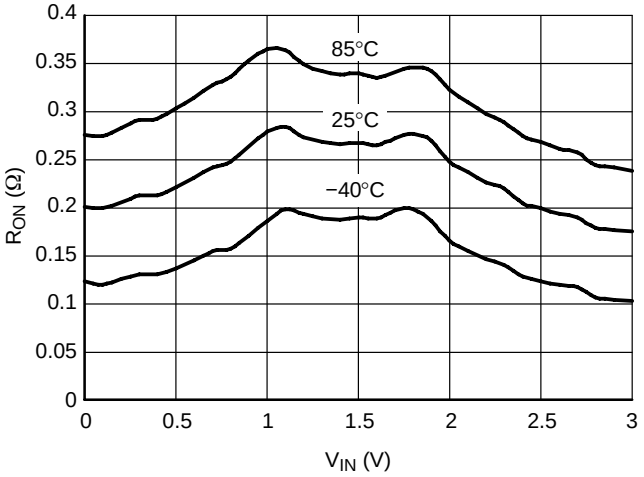


Figure 10. On−Resistance vs. Input Voltage @ V_{CC} = 3.0 V

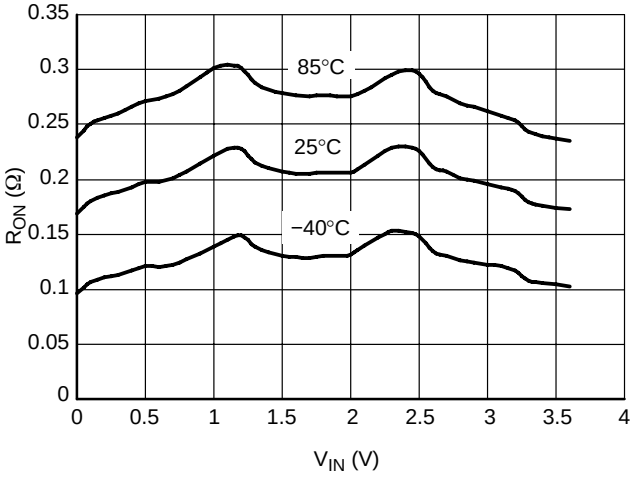


Figure 11. On−Resistance vs. Input Voltage @ V_{CC} = 3.6 V

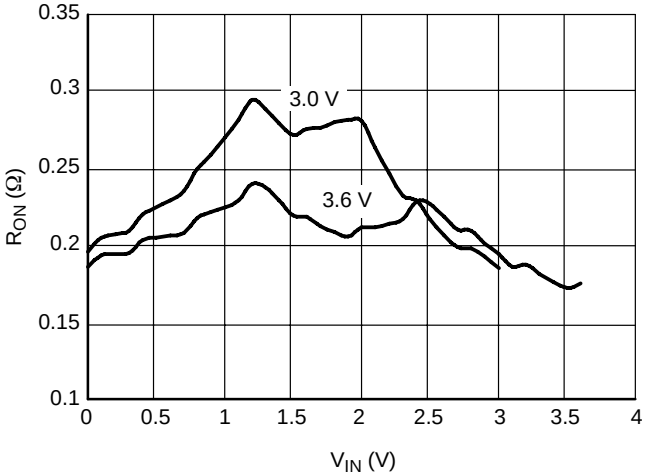


Figure 12. On−Resistance vs. Input Voltage

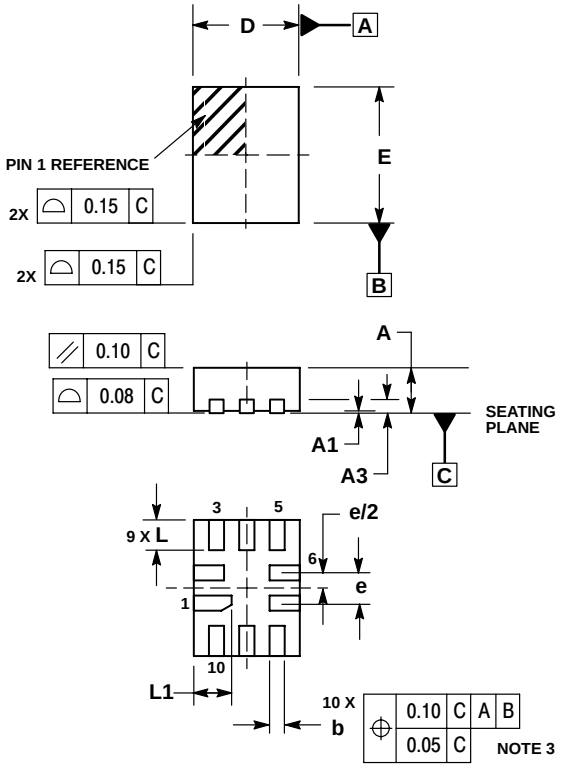
ORDERING INFORMATION

Device	Package	Shipping†
NLAS5223MNR2G	WQFN−10 (Pb−Free)	3000 / Tape & Reel
NLAS5223LMNR2G	WQFN−10 (Pb−Free)	3000 / Tape & 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

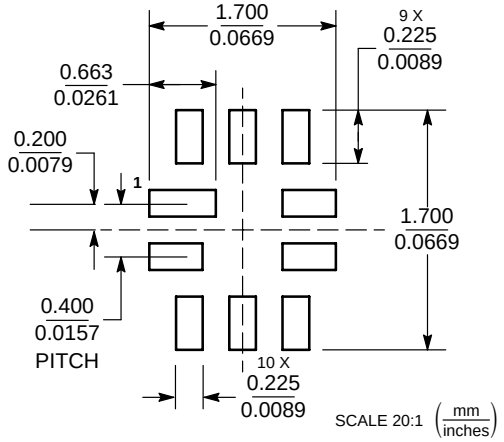
WQFN10, 1.4x1.8x0.4P
CASE 488AQ−01
ISSUE A



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. EXPOSED PADS CONNECTED TO DIE FLAG. USED AS TEST CONTACTS.

	MILLIMETERS	
DIM	MIN	MAX
A	0.70	0.80
A1	0.00	0.050
A3	0.20 REF	
b	0.15	0.25
D	1.40 BSC	
E	1.80 BSC	
e	0.40 BSC	
L	0.30	0.50
L1	0.40	0.60

SOLDERING 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.

PUBLICATION ORDERING INFORMATION

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NLAS5223/D