NLAS5223C, NLAS5223CL

Ultra-Low 0.35 Ω Dual SPDT Analog Switch

The NLAS5223C 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 0.35 Ω, at V_{CC} = 4.3 V.

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

Features

- Ultra−Low R_{ON}, 0.35 Ω (typ) at V_{CC} = 4.3 V
- NLAS5223C Interfaces with 2.8 V Chipset
- NLAS5223CL Interfaces with 1.8 V Chipset
- Single Supply Operation from 1.65−4.5 V
- 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
  - ♦ ±320 mA Through Each Switch
- Large Current Clamping Diodes at Analog Inputs
  - ♦ ±100 mA Continuous Current Capability
- Package:
  - ♦ 1.4 x 1.8 x 0.55 mm UQFN10 Pb−Free
- These are Pb−Free Devices

Applications

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

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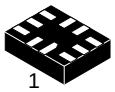
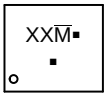
MARKING DIAGRAM

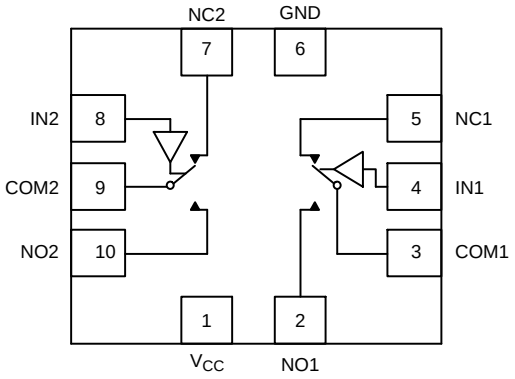


UQFN10
CASE 488AT



XX = Specific Device Code
M = Date Code/Assembly Location
▪ = 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, marking and shipping information in the package dimensions section on page 9 of this data sheet.

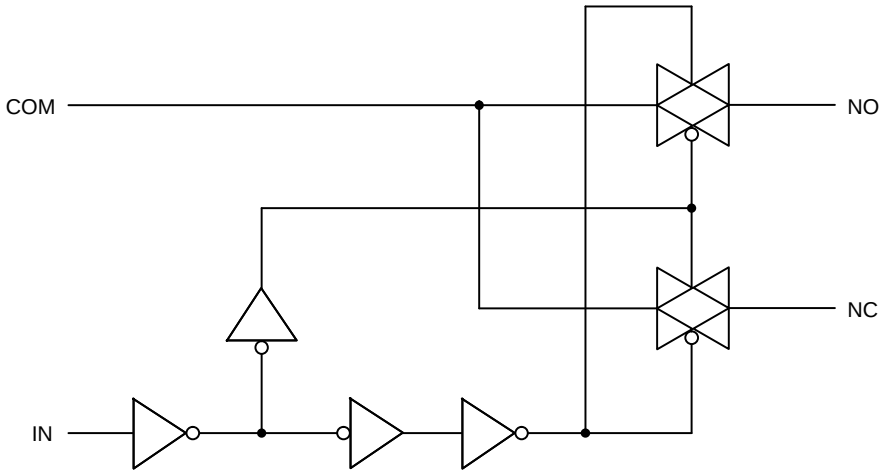


Figure 1. Logic Equivalent Circuit

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 +7.0	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	$-0.5 \le V_{IN} \le +5.5$	V
I_{anl1}	Continuous DC Current from COM to NC/NO	±320	mA
$I_{anl-pk1}$	Peak Current from COM to NC/NO, 10% Duty Cycle, 100 ms = t_{ON} (Note 1)	±600	mA
$I_{anl-pk2}$	Instantaneous Peak Current from COM to NC/NO, 10% Duty Cycle, t_{ON} < 1 μs	±850	mA
I_{clmp}	Continuous DC Current into COM/NO/NC with Respect to V_{CC} or GND	±100	mA
ESD	ESD Withstand Voltage Human Body Model (HBM)	>3000	V

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, 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	4.5	V
V_{IN}	Digital Select Input Voltage (OVT) Overvoltage Tolerance	GND	4.5	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 − 4.5 V		 20 10	ns/V

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

NLAS5223C 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 4.3	1.4 2.0	1.4 2.0	V
V_{IL}	Maximum Low−Level Input Voltage, Select Inputs		3.0 4.3	0.7 0.8	0.7 0.8	V
I_{IN}	Maximum Input Leakage Current, Select Inputs	V_{IN} = V_{CC} or GND	4.3	±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 4.5	±1.0	±2.0	μA

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

NLAS5223C 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 4.3		0.4 0.35		0.5 0.4	Ω
R_{FLAT}	NC/NO On−Resistance Flatness (Notes 3 and 4)	I_{COM} = 100 mA V_{IS} = 0 to V_{CC}	3.0 4.3		0.16 0.11		0.20 0.14	Ω
ΔR_{ON}	On−Resistance Match Between Channels (Notes 3 and 5)	V_{IS} = 1.5 V; I_{COM} = 100 mA V_{IS} = 2.2 V; I_{COM} = 100 mA	3.0 4.3		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} = 4.0 V	4.3	−5.0	5.0	−50	50	nA
$I_{COM(ON)}$	COM ON Leakage Current (Note 3)	V_{IN} = V_{IL} or V_{IH} V_{NO} 0.3 V or 4.0 V with V_{NC} floating or V_{NC} 0.3 V or 4.0 V with V_{NO} floating V_{COM} = 0.3 V or 4.0 V	4.3	−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_{ON} = $R_{ON(MAX)}$ − $R_{ON(MIN)}$ between NC1 and NC2 or between NO1 and NO2.

NLAS5223CL 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 4.3	1.3 1.6	1.3 1.6	V
V_{IL}	Maximum Low−Level Input Voltage, Select Inputs		3.0 4.3	0.5 0.6	0.5 0.6	V
I_{IN}	Maximum Input Leakage Current, Select Inputs	V_{IN} = 4.5 V or GND	4.3	±0.1	±1.0	μA
I_{OFF}	Power Off Leakage Current	V_{IN} = 4.5 V or GND	0	±0.5	±2.0	μA
I_{CC}	Maximum Quiescent Supply Current	Select and V_{IS} = V_{CC} or GND	1.65 to 4.5	±1.0	±2.0	μA
I_{CCV}	Maximum Quiescent Supply Current, Low Voltage Driving (Note 6)	V_{IS} = V_{CC} or GND V_{IN} = 1.65 V	4.3	±145	±150	μA
		V_{IS} = V_{CC} or GND V_{IN} = 1.80 V		±125	±130	
		V_{IS} = V_{CC} or GND V_{IN} = 2.60 V		±50	±55	

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

NLAS5223CL 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 4.3		0.4 0.35		0.5 0.4	Ω
R_{FLAT}	NC/NO On−Resistance Flatness (Notes 7 and 8)	I_{COM} = 100 mA V_{IS} = 0 to V_{CC}	3.0 4.3		0.16 0.11		0.20 0.14	Ω
ΔR_{ON}	On−Resistance Match Between Channels (Notes 7 and 9)	V_{IS} = 1.5 V; I_{COM} = 100 mA V_{IS} = 2.2 V; I_{COM} = 100 mA	3.0 4.3		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} = 4.0 V	4.3	−10	10	−100	100	nA
$I_{COM(ON)}$	COM ON Leakage Current (Note 7)	V_{IN} = V_{IL} or V_{IH} V_{NO} 0.3 V or 4.0 V with V_{NC} floating or V_{NC} 0.3 V or 4.0 V with V_{NO} floating V_{COM} = 0.3 V or 4.0 V	4.3	−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_{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 − 4.5	1.5			50		60	ns
t_{OFF}	Turn−Off Time	R_L = 50 Ω, C_L = 35 pF (Figures 3 and 4)	2.3 − 4.5	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
$C_{NO/NC}$	NO, NC Port Capacitance	60	pF
C_{COM}	COM Port Capacitance When Switch is Enabled	200	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 − 4.5	24	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 − 4.5	−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 − 4.5	−68	dB
Q	Charge Injection Select Input to Common I/O	V_{IN} = V_{CC} to GND, R_{IS} = 0 Ω, C_L = 1.0 nF Q = C_L x DV_{OUT} (Figure 6)	1.65 − 4.5	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	0.08	%
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 − 4.5	−70	dB

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

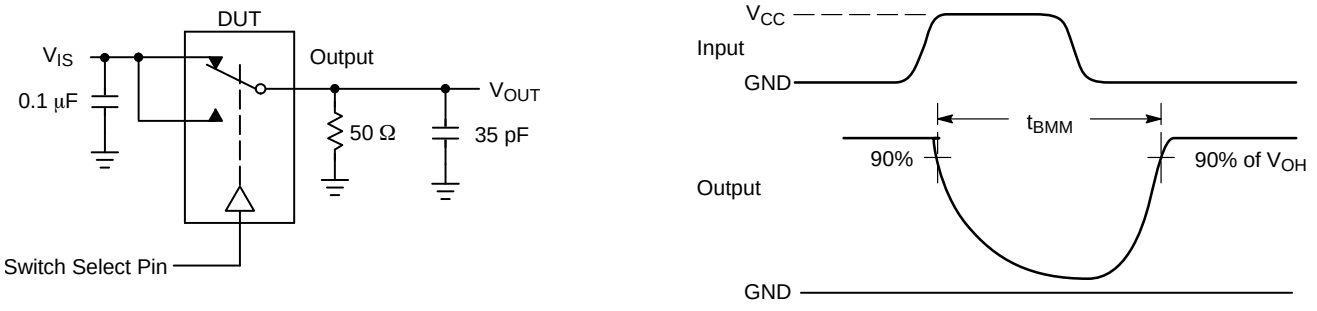


Figure 2. t_{BBM} (Time Break−Before−Make)

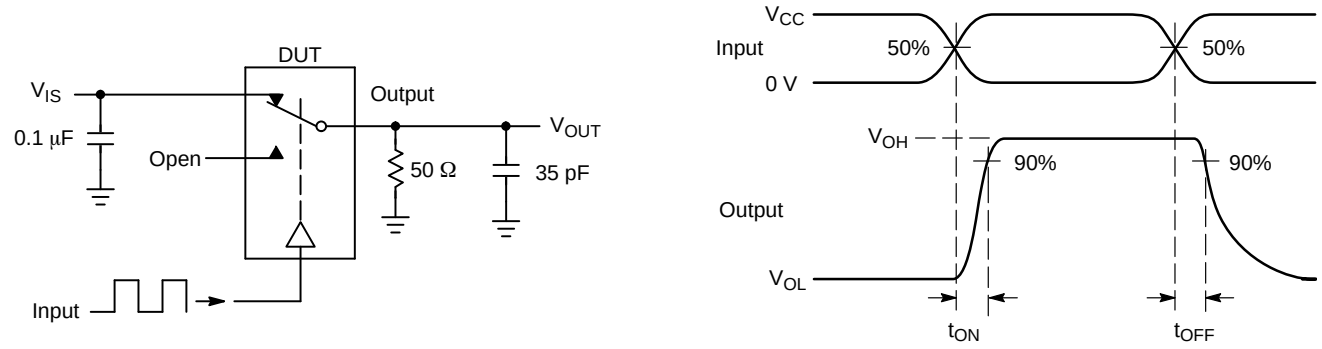


Figure 3. t_{ON}/t_{OFF}

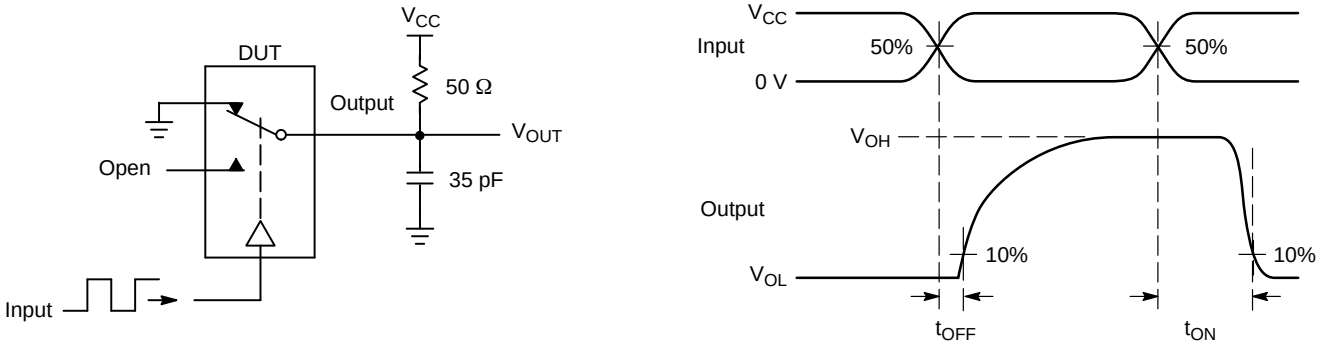
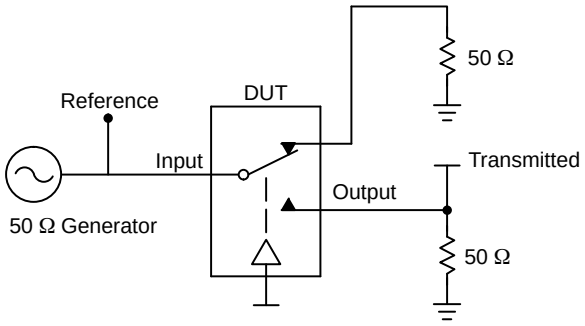


Figure 4. t_{ON}/t_{OFF}



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

V_{ONL} = On Channel Loss = $20\ \text{Log}\left(\frac{V_{OUT}}{V_{IN}}\right)$ 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}

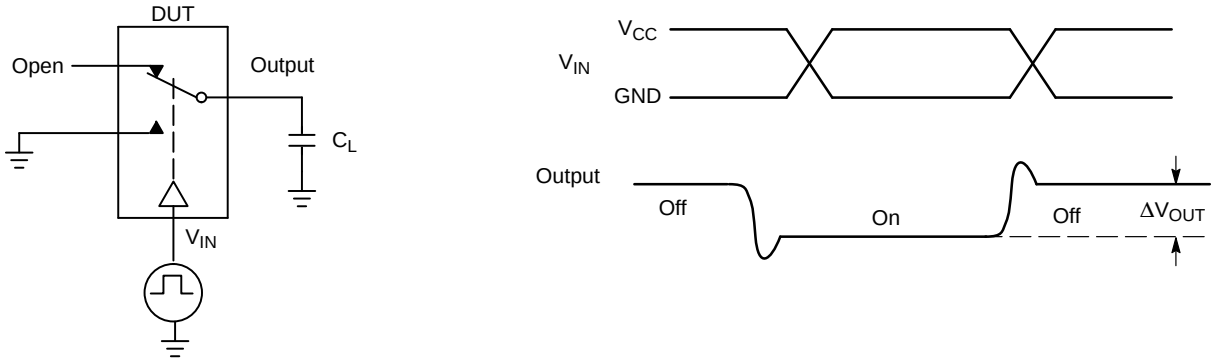


Figure 6. Charge Injection: (Q)

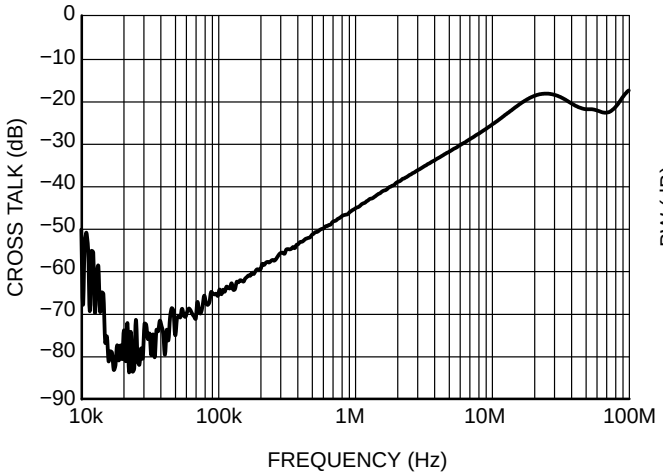


Figure 7. Cross Talk vs. Frequency (V_{CC} = 3.0 V)

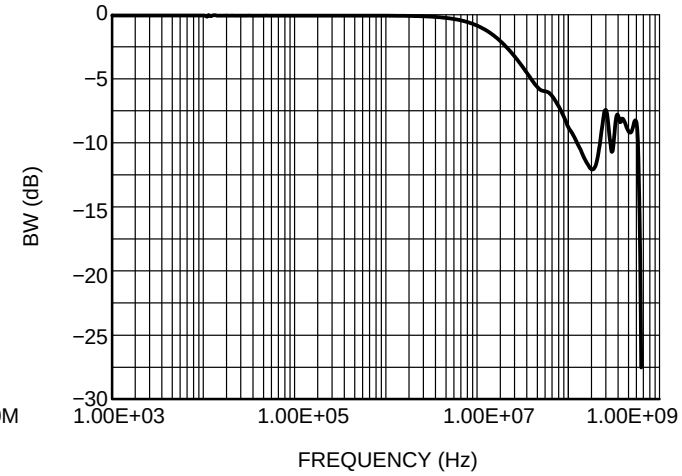


Figure 8. Bandwidth (V_{CC} = 3.0 V)

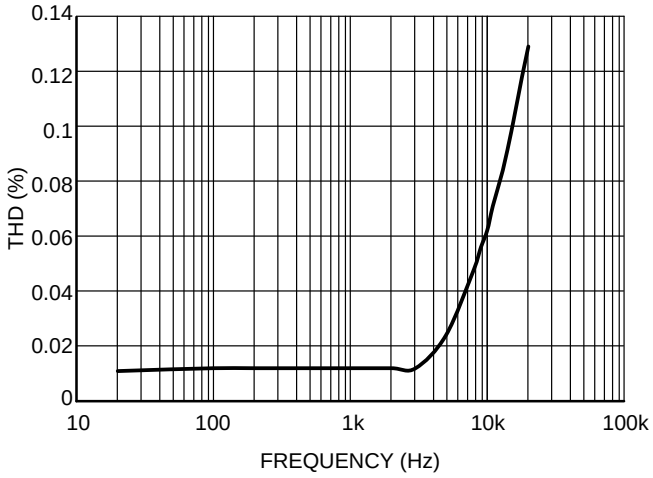


Figure 9. Total Harmonic Distortion (V_{CC} = 3.0 V)

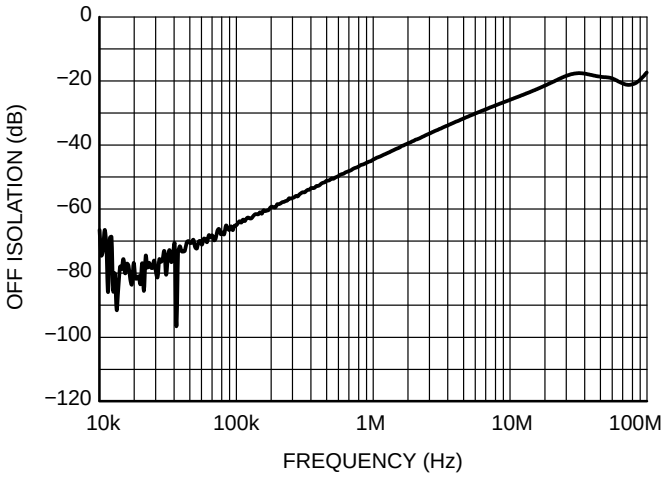


Figure 10. Off Isolation (V_{CC} = 3.0 V)

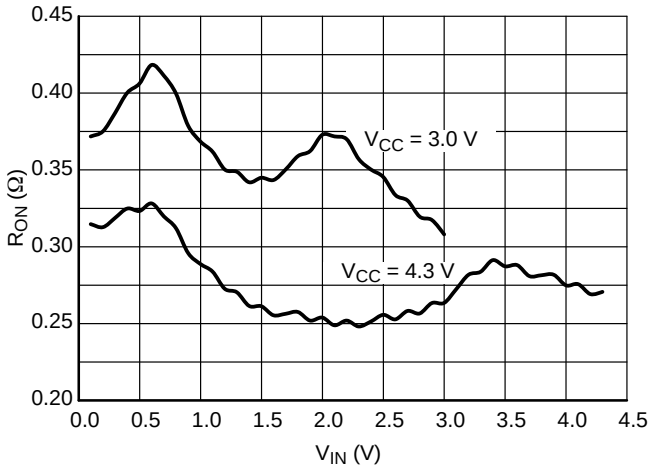


Figure 11. On−Resistance vs. Input Voltage @ 25°C and V_{CC} = 3.0 V and 4.3 V

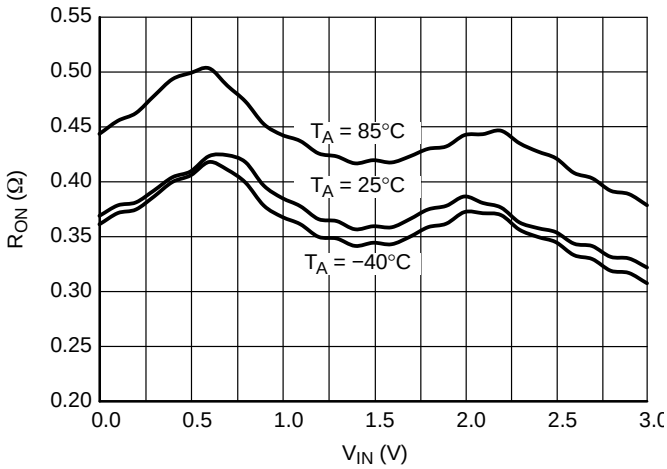


Figure 12. On−Resistance vs. Input Voltage @ V_{CC} = 3.0 V, T_A = −40°C to 85°C

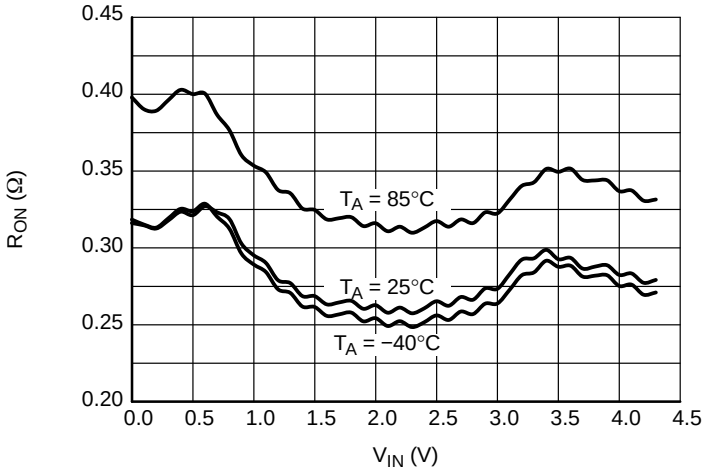


Figure 13. On−Resistance vs. Input Voltage @ V_{CC} = 3.0 V, T_A = −40°C to 85°C

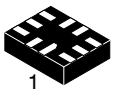
ORDERING INFORMATION

Device	Marking	Package	Shipping†
NLAS5223CMUTAG	AK	UQFN10 (Pb−Free)	3000 / Tape & Reel
NLAS5223CLMUTAG	AU	UQFN10 (Pb−Free)	3000 / Tape & Reel

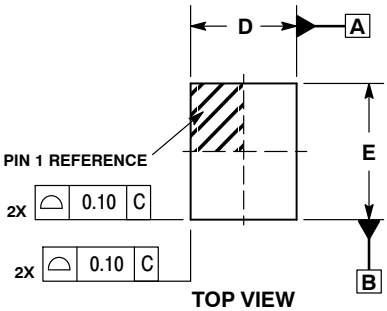
†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

UQFN10 1.4x1.8, 0.4P
CASE 488AT
ISSUE A

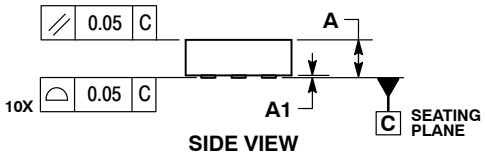
DATE 01 AUG 2007



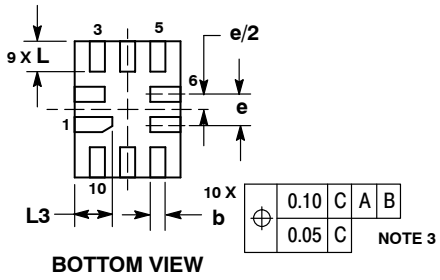
SCALE 5:1



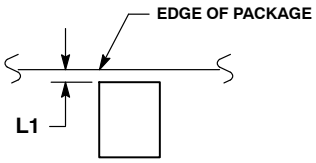
TOP VIEW



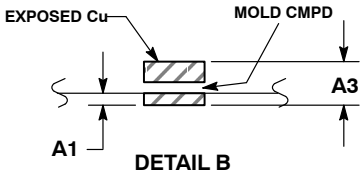
SIDE VIEW



BOTTOM VIEW



DETAIL A
Bottom View
(Optional)

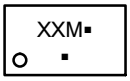


DETAIL B
Side View
(Optional)

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.

	MILLIMETERS	
DIM	MIN	MAX
A	0.45	0.60
A1	0.00	0.05
A3	0.127 REF	
b	0.15	0.25
D	1.40 BSC	
E	1.80 BSC	
e	0.40 BSC	
L	0.30	0.50
L1	0.00	0.15
L3	0.40	0.60

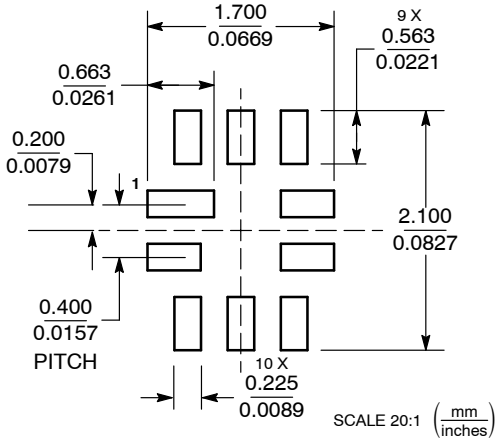
GENERIC
MARKING DIAGRAM*



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

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, “G” or microdot “ ▪”, may or may not be present.

MOUNTING FOOTPRINT



SCALE 20:1 (mm / inches)

DOCUMENT NUMBER:	**98AON22493D**	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped “CONTROLLED COPY” in red.
DESCRIPTION:	**10 PIN UQFN, 1.4 X 1.8, 0.4P**	**PAGE 1 OF 1**

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:
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