NLAS4684

Ultra-Low Resistance Dual SPDT Analog Switch

The NLAS4684 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, for the Normally Closed (NC) switch, and 0.8 Ω for the normally closed switch (NO) at 2.7 V.

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

The NLAS4684 is available in a 2.0 x 1.5 mm bumped die array, with a 3 x 4 arrangement of solder bumps. The pitch of the solder bumps is 0.5 mm for easy handling.

Features

- Ultra-Low R_{ON}, < 0.5 Ω at 2.7 V
- Threshold Adjusted to Function with 1.8 V Control at V_{CC} = 2.7-3.3 V
- Single Supply Operation from 1.8-5.5 V
- Tiny 2 x 1.5 mm Bumped Die
- Low Crosstalk, $<$ 83 dB at 100 kHz
- Full 0-V_{CC} Signal Handling Capability
- High Isolation, -65 dB at 100 kHz
- Low Standby Current, $<$ 50 nA
- Low Distortion, $<$ 0.14% THD
- R_{ON} Flatness of 0.15 Ω
- Pin for Pin Replacement for MAX4684

Applications

- Cell Phone
- Speaker Switching
- Power Switching (Up to 100 mA)
- Modems
- Automotive

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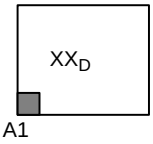
MARKING DIAGRAM

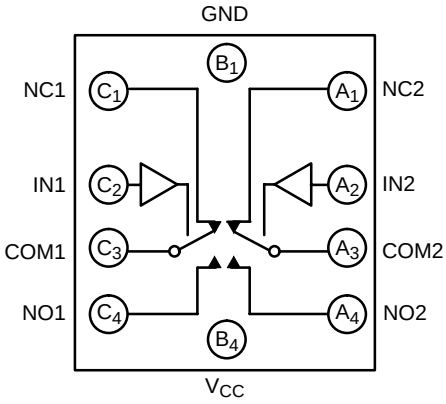
1

Microbump-10
CASE 489AA



XX = Device Code
D = Date Code

PIN CONNECTIONS AND LOGIC DIAGRAM



FUNCTION TABLE

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

ORDERING INFORMATION

Device	Package	Shipping
NLAS4684	Microbump-10	3000/Tape & Reel

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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}) (Note 1)	$-0.5 \le V_{IS} \le V_{CC} + 0.5$	V
V_{IN}	Digital Select Input Voltage	$-0.5 \le V_I \le +7.0$	V
I_{IK}	DC Current, Into or Out of Any Pin	±50	mA

1. Signal voltage on NC, NO, and COM exceeding VCC or GND are clamped by the internal diodes. Limit forward diode current to maximum current rating.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter		Min	Max	Unit
V_{CC}	DC Supply Voltage		1.8	5.5	V
V_{IN}	Digital Select Input Voltage		GND	5.5	V
V_{IS}	Analog Input Voltage (NC, NO, COM)		GND	V_{CC}	V
T_A	Operating Temperature Range		−55	+125	°C
t_r, t_f	Input Rise or Fall Time, SELECT	V_{CC} = 3.3 V ± 0.3 V V_{CC} = 5.0 V ± 0.5 V	0 0	100 20	ns/V

DC CHARACTERISTICS - Digital Section (Voltages Referenced to GND)

Symbol	Parameter	Condition	V_{CC} ±10%	Guaranteed Limit			Unit
				−55°C to 25°C	<85°C	<125°C	
V_{IH}	Minimum High- Level Input Voltage, Select Inputs (Figure 7)		2.0 2.5 3.0 5.0	1.4 1.4 1.4 2.0	1.4 1.4 1.4 2.0	1.4 1.4 1.4 2.0	V
V_{IL}	Maximum Low- Level Input Voltage, Select Inputs (Figure 7)		2.0 2.5 3.0 5.0	0.5 0.5 0.5 0.8	0.5 0.5 0.5 0.8	0.5 0.5 0.5 0.8	V
I_{IN}	Maximum Input Leakage Current, Select Inputs	V_{IN} = 5.5 V or GND	5.5	± 1.0	± 1.0	± 1.0	μA
I_{OFF}	Power Off Leakage Current	V_{IN} = 5.5 V or GND	0	±10	±10	±10	μA
I_{CC}	Maximum Quiescent Supply Current	Select and V_{IS} = V_{CC} or GND	5.5	± 50	± 200	± 200	nA

DC ELECTRICAL CHARACTERISTICS - Analog Section

Symbol	Parameter	Condition	V_{CC} ±10%	Guaranteed Maximum Limit						Unit
				-55 °C to 25°C		< 85°C		< 125°C		
				Min	Max	Min	Max	Min	Max	
R_{ON} (NC)	NC "ON" Resistance (Note 2)	$V_{IN} \le V_{IL}$ V_{IS} = GND to V_{CC} $I_{IN}I \le$ 100 mA	2.5 3.0 5.0		0.6 0.5 0.4		0.7 0.5 0.4		0.8 0.5 0.5	Ω
R_{ON} (NO)	NO "ON" Resistance (Note 2)	$V_{IN} \ge V_{IH}$ V_{IS} = GND to V_{CC} $I_{IN}I \le$ 100 mA	2.5 3.0 5.0		2.0 0.8 0.8		2.0 0.8 0.8		2.0 1.0 0.9	Ω
$R_{FLAT\ (NC)}$	NC_On-Resistance Flatness (Notes 2, 4)	I_{COM} = 100 mA V_{IS} = 0 to V_{CC}	2.5 3.0 5.0		0.15 0.15 0.15		0.15 0.15 0.15		0.15 0.15 0.15	Ω
$R_{FLAT\ (NO)}$	NO_On-Resistance Flatness (Notes 2, 4)	I_{COM} = 100 mA V_{IS} = 0 to V_{CC}	2.5 3.0 5.0		0.35 0.35 0.35		0.35 0.35 0.35		0.35 0.35 0.35	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} = 2.8 V; I_{COM} = 100 mA	2.5 3.0 5.0		0.18 0.06 0.06		0.18 0.06 0.06		0.18 0.06 0.06	Ω
$I_{NC(OFF)}$ $I_{NO(OFF)}$	NC or NO Off Leakage Current (Figure 10)	$V_{IN} = V_{IL}$ or V_{IH} V_{NO} or V_{NC} = 1.0 V_{COM} = 4.5 V	5.5	-1	1	-10	10	-100	100	nA
$I_{COM(ON)}$	COM ON Leakage Current (Figure 10)	$V_{IN} = V_{IL}$ or V_{IH} V_{NO} 1.0 V or 4.5 V with V_{NC} floating or V_{NC} 1.0 V or 4.5 V with V_{NO} floating V_{COM} = 1.0 V or 4.5 V	5.5	-1	1	-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 NC1 and NC2 or between NO1 and NO2.
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
					−55°C to 25°C			<85°C		<125°C		
					Min	Typ*	Max	Min	Max	Min	Max	
t_{ON}	Turn-On Time	R_L = 50 Ω, C_L = 35 pF (Figures 2 and 3)	2.5	1.3			60		70		70	ns
			3.0	1.5			50		60		60	
			5.0	2.8			30		35		35	
t_{OFF}	Turn-Off Time	R_L = 50 Ω, C_L = 35 pF (Figures 2 and 3)	2.5	1.3			50		55		55	ns
			3.0	1.5			40		50		50	
			5.0	2.8			30		35		35	
t_{BBM}	Minimum Break- Before- Make Time	V_{IS} = 3.0 R_L = 300 Ω, C_L = 35 pF (Figure 1)	3.0	1.5	2	15						ns

		Typical @ 25, V_{CC} = 5.0 V	
C_{NC} Off	NC Off Capacitance, f = 1 MHz	102	pF
C_{NO} Off	NO Off Capacitance, f = 1 MHz	104	
C_{NC} On	NC On Capacitance, f = 1 MHz	322	
C_{NO} Off	NO On Capacitance, f = 1 MHz	330	

*Typical Characteristics are at 25°C.

ADDITIONAL APPLICATION CHARACTERISTICS (Voltages Referenced to GND Unless Noted) (Note 6)

Symbol	Parameter	Condition		V_{CC} V	Typical 25°C	Unit
BW	Maximum On-Channel -3dB Bandwidth or Minimum Frequency Response	V_{IN} = 0 dBm	NC	3.0	6.5	MHz
		V_{IN} centered between V_{CC} and GND (Figure 4)	NO	3.0	9.5	
V_{ONL}	Maximum Feedthrough On Loss	V_{IN} = 0 dBm @ 100 kHz to 50 MHz V_{IN} centered between V_{CC} and GND (Figure 4)		3.0	-0.05	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 4)		3.0	-93	dB
Q	Charge Injection Select Input to Common I/O (Figures 7 and 8)	V_{IN} = $V_{CC\ to}$ GND, R_{IS} = 0 Ω, C_L = 1 nF Q = C_L - ΔV_{OUT} (Figure 5)		3.0	20	pC
THD	Total Harmonic Distortion THD + Noise (Figure 6)	F_{IS} = 20 Hz to 100 kHz, R_L = Rgen = 600 Ω, C_L = 50 pF V_{IS} = 1 V RMS		3.0	0.14	%
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 4)		3.0	-83	dB

5. Off-Channel Isolation = 20log10 (Vcom/Vno), Vcom = output, Vno = input to off switch.
6. -40 °C specifications are guaranteed by design.

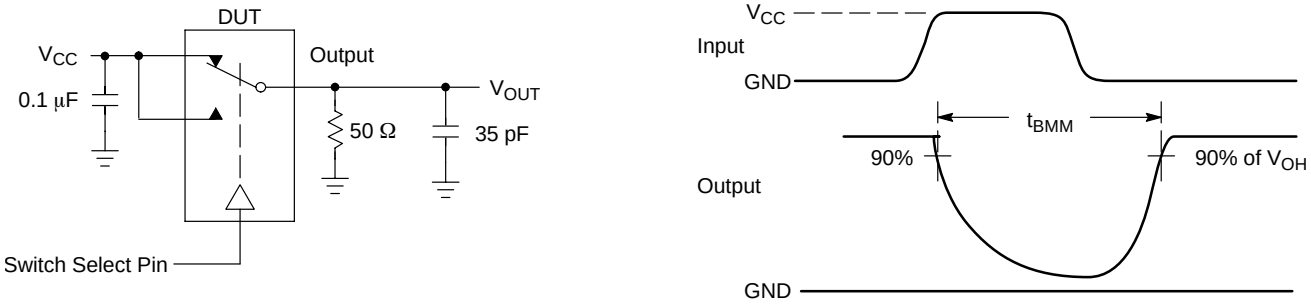


Figure 1. t_{BBM} (Time Break-Before-Make)

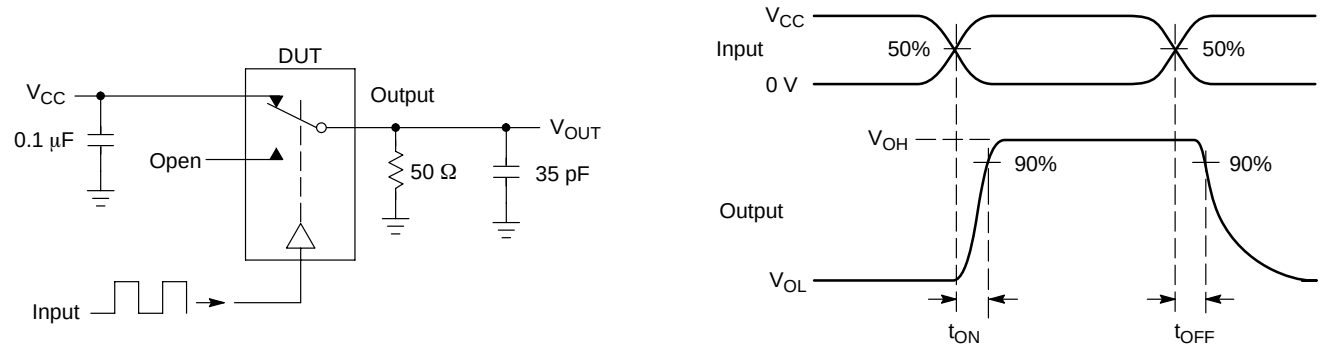


Figure 2. t_{ON}/t_{OFF}

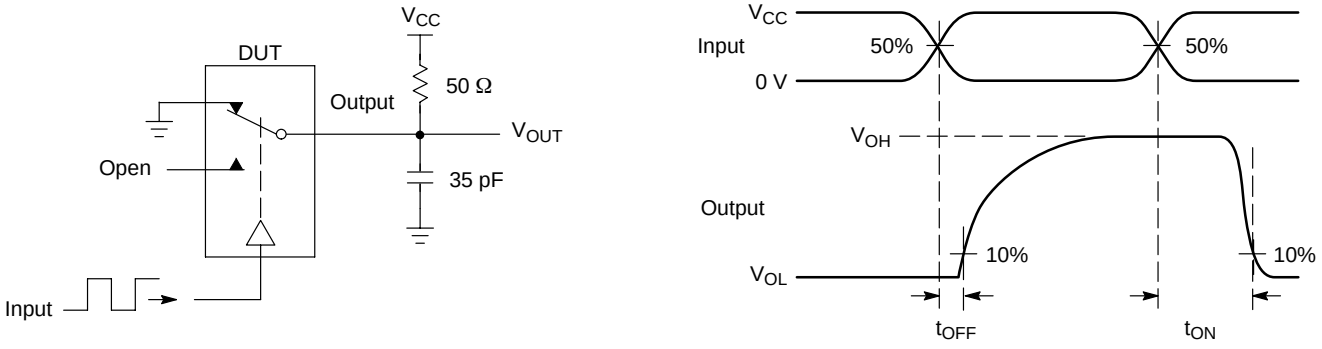
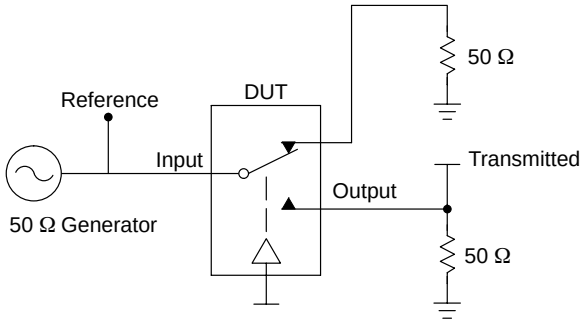


Figure 3. t_{ON}/t_{OFF}



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 4. Off Channel Isolation/On Channel Loss (BW)/Crosstalk (On Channel to Off Channel)/V_{ONL}

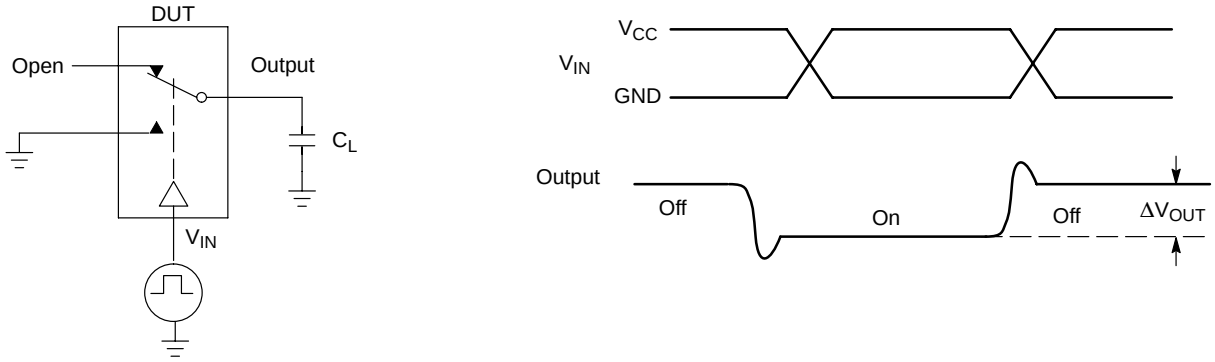


Figure 5. Charge Injection: (Q)

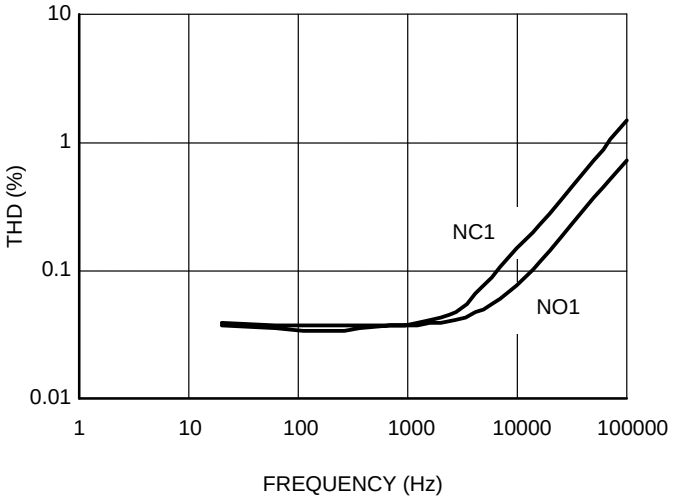


Figure 6. Total Harmonic Distortion Plus Noise Versus Frequency

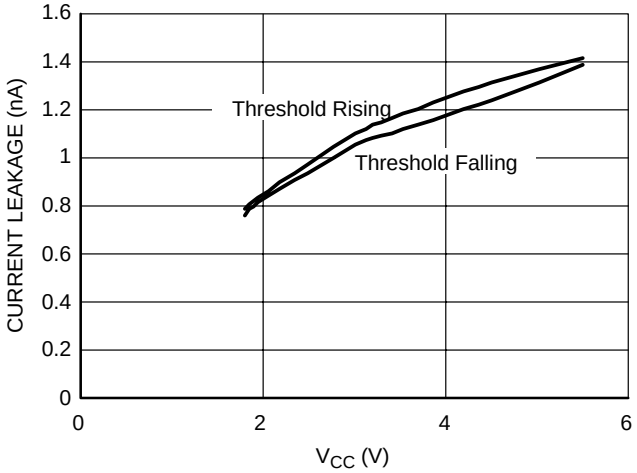


Figure 7. Voltage in Threshold on Logic Pins

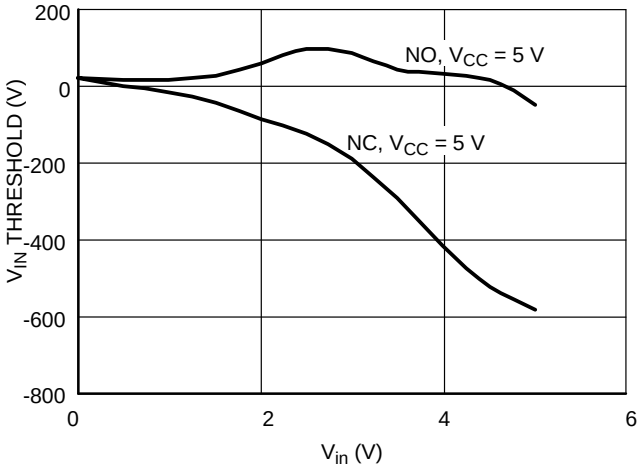


Figure 8. Charge Injection versus V_{is}

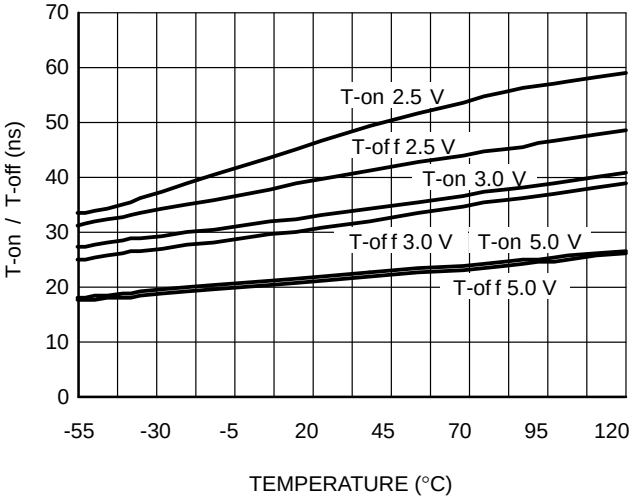


Figure 9. T-on / T-off Time versus Temperature

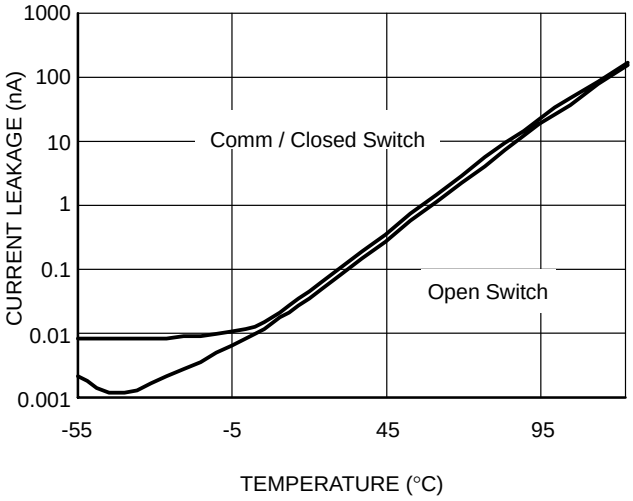


Figure 10. NO/NC Current Leakage Off and On, V_{CC} = 5 V

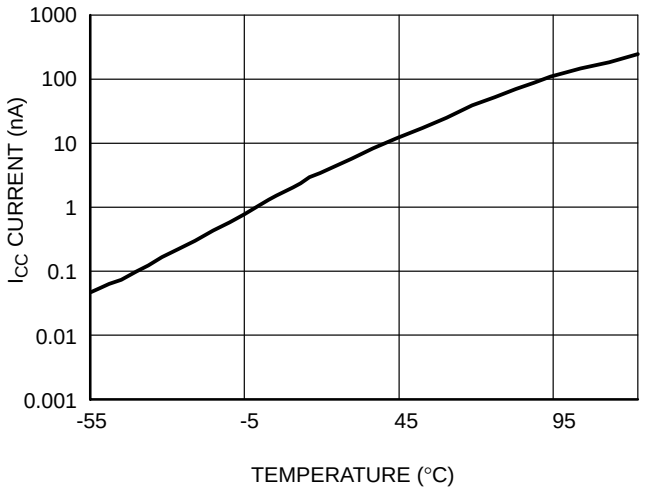


Figure 11. I_{CC} Current Leakage versus Temperature V_{CC} = 5.5 V

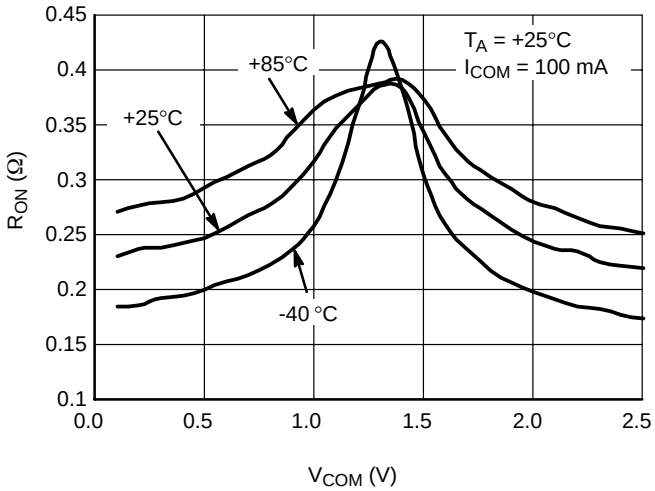


Figure 12. NC On-Resistance versus COM Voltage

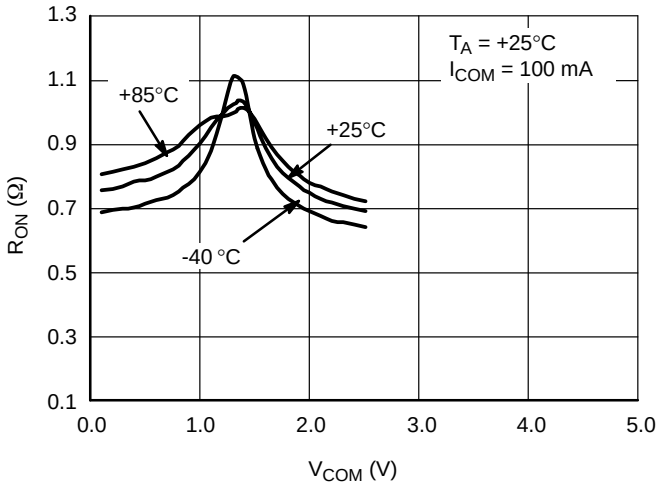


Figure 13. NO On-Resistance versus COM Voltage

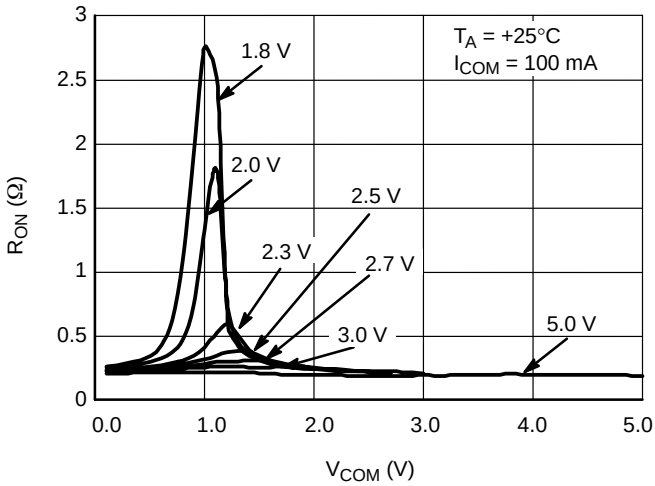


Figure 14. NC On-Resistance versus COM Voltage

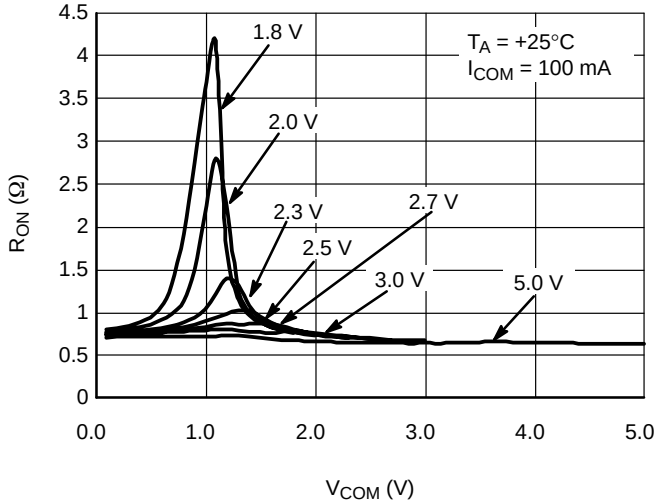


Figure 15. NO On-Resistance versus COM Voltage

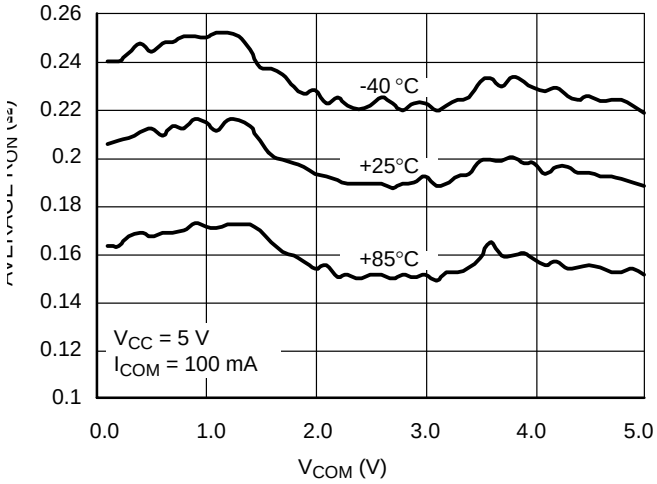


Figure 16. NC On-Resistance versus COM Voltage

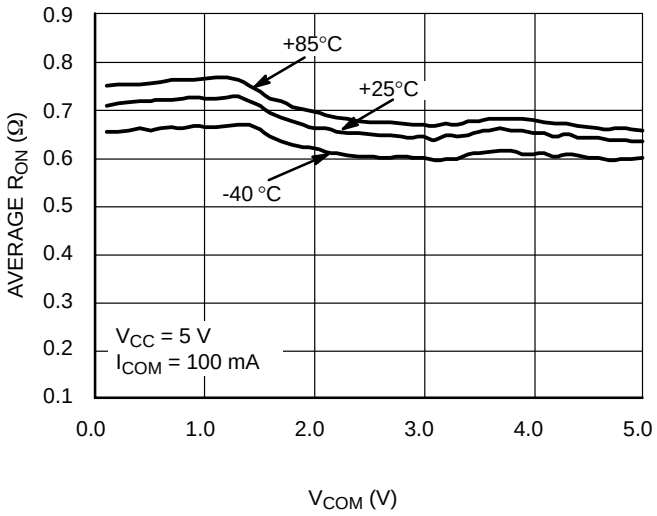


Figure 17. NO On-Resistance versus COM Voltage

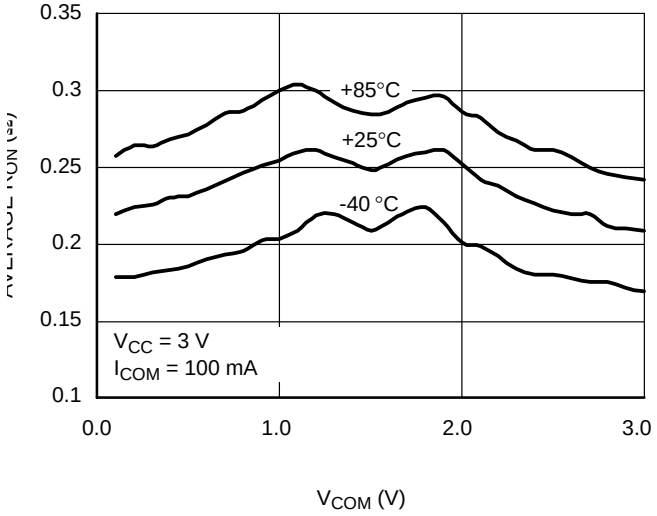


Figure 18. NC On-Resistance versus COM Voltage

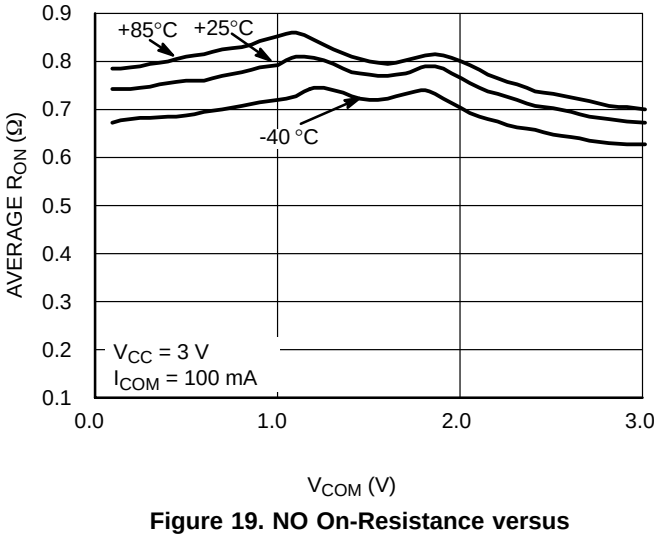
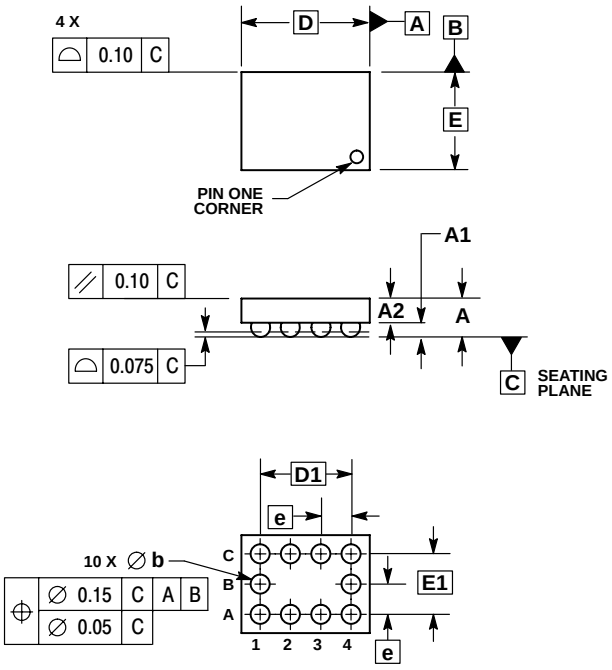


Figure 19. NO On-Resistance versus COM Voltage

PACKAGE DIMENSIONS

Microbump-10
CASE 489AA-01
ISSUE O



NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. COPLANARITY APPLIES TO SPHERICAL CROWNS OF SOLDER BALLS.

	MILLIMETERS	
DIM	MIN	MAX
A	---	0.650
A1	0.210	0.270
A2	0.280	0.380
D	1.965 BSC	
E	1.465 BSC	
b	0.250	0.350
e	0.500 BSC	
D1	1.500 BSC	
E1	1.000 BSC	

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