

# NLAS4717

## Product Preview

### Low Voltage Dual SPDT Analog Switch

The NLAS4717 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 two Low  $R_{ON}$  of  $4.5\ \Omega$  at 2.7 V.

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

The NLAS4717 is available in a 2.0 x 1.5 mm bumped die array, with a 4 x 3 arrangement of solder bumps. The pitch of the solder bumps is 0.5 mm for easy handling.

#### Features

- Low  $R_{ON}$ ,  $<4.5\ \Omega$  at 2.7 V
- Threshold Adjusted to Function with 1.8 V Control at Supply = 2.7–3.3 V
- Single Supply Operation from 1.8–5.5 V
- Tiny 2.0 x 1.5 mm Bumped Die
- Low Crosstalk,  $<-80$  dB at 10 mHz
- Full 0– $V_{CC}$  Signal Handling Capability
- High Isolation,  $-55$  dB at 10 mHz
- Low Standby Current,  $<50$  nA
- Low Distortion,  $<0.03\%$  THD
- $R_{ON}$  Flatness of  $1.2\ \Omega$
- Pin for Pin Replacement for MAX4717

#### Applications

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

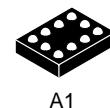
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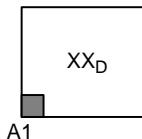
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#### MARKING DIAGRAM



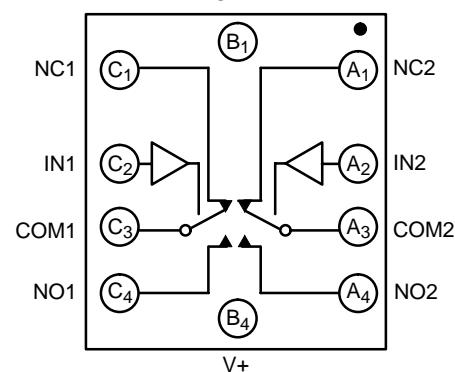
Microbump-10  
CASE 489AA



XX = Device Code  
D = Date Code

#### PIN CONNECTIONS AND LOGIC DIAGRAM

(Top View)



#### FUNCTION TABLE

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

#### ORDERING INFORMATION

Device	Package	Shipping
NLAS4717	Microbump-10	3000/Tape & Reel

## MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V <sub>+</sub>	Positive DC Supply Voltage	– 0.5 to + 7.0	V
V <sub>IS</sub>	Analog Input Voltage (V <sub>NO</sub> , V <sub>NC</sub> , or V <sub>COM</sub> ) (Note 1)	– 0.5 ≤ V <sub>IS</sub> ≤ V <sub>CC</sub> + 0.5	V
V <sub>IN</sub>	Digital Select Input Voltage	– 0.5 ≤ V <sub>I</sub> ≤ + 7.0	V
I <sub>IK</sub>	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 <sub>+</sub>	DC Supply Voltage	1.8	5.5	V
V <sub>IN</sub>	Digital Select Input Voltage	GND	5.5	V
V <sub>IS</sub>	Analog Input Voltage (NC, NO, COM)	GND	V <sub>CC</sub>	V
T <sub>A</sub>	Operating Temperature Range	– 55	+ 125	°C
t <sub>r</sub> , t <sub>f</sub>	Input Rise or Fall Time, SELECT V <sub>CC</sub> = 3.3 V ± 0.3 V V <sub>CC</sub> = 5.0 V ± 0.5 V	0 0	100 20	ns/V

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

Symbol	Parameter	Condition	V <sub>CC</sub> ± 10%	Guaranteed Limit			Unit
				– 55°C to 25°C	< 85°C	< 125°C	
V <sub>IH</sub>	Minimum High-Level Input Voltage, Select Inputs		2.0	1.4	1.4	1.4	V
			2.5	1.4	1.4	1.4	
			3.0	1.4	1.4	1.4	
			5.0	2.0	2.0	2.0	
V <sub>IL</sub>	Maximum Low-Level Input Voltage, Select Inputs		2.0	0.5	0.5	0.5	V
			2.5	0.5	0.5	0.5	
			3.0	0.5	0.5	0.5	
			5.0	0.8	0.8	0.8	
I <sub>IN</sub>	Maximum Input Leakage Current, Select Inputs	V <sub>IN</sub> = 5.5 V or GND	5.5	± 100	± 100	± 120	nA
I <sub>OFF</sub>	Power Off Leakage Current	V <sub>IN</sub> = 5.5 V or GND	0	± 10	± 10	± 10	µA
I <sub>CC</sub>	Maximum Quiescent Supply Current	Select and V <sub>IS</sub> = V <sub>CC</sub> or GND	5.5	± 50	± 200	± 200	nA

## DC ELECTRICAL CHARACTERISTICS – Analog Section

Symbol	Parameter	Condition	V <sub>CC</sub> ± 10%	Guaranteed Maximum Limit						Unit	
				-55°C to 25°C		< 85°C		< 125°C			
				Min	Max	Min	Max	Min	Max		
R <sub>ON</sub> (NC, NO)	"ON" Resistance (Note 2)	V <sub>IN</sub> ≥ V <sub>IH</sub> V <sub>IS</sub> = GND to V <sub>CC</sub>  I <sub>IN</sub>   ≤ 100 mA	2.5 3.0 5.0	5.5	2.0	6.0	2.0	6.5	2.0	Ω	
				4.5		5.0		5.5			
				3.0		3.5		4.0			
R <sub>FLAT</sub> (NC, NO)	On-Resistance Flatness (Notes 2, 4)	I <sub>COM</sub> = 100 mA V <sub>IS</sub> = 0 to V <sub>CC</sub>	2.5 3.0 5.0	1.2		1.5		1.8		Ω	
				1.2		1.5	0.35	1.8			
				1.2		1.5		1.8			
ΔR <sub>ON</sub>	On-Resistance Match Between Channels (Notes 2 and 3)	V <sub>IS</sub> = 1.3 V; I <sub>COM</sub> = 100 mA V <sub>IS</sub> = 1.5 V; I <sub>COM</sub> = 100 mA V <sub>IS</sub> = 2.8 V; I <sub>COM</sub> = 100 mA	2.5 3.0 5.0		0.18 0.5 0.4 0.3		0.18 0.6 0.5 0.4		0.18 0.7 0.6 0.5	Ω	
I <sub>NC(OFF)</sub> I <sub>NO(OFF)</sub>	NC or NO Off Leakage Current (Figure 10)	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> V <sub>NO</sub> or V <sub>NC</sub> = 1.0 V <sub>COM</sub> = 4.5 V	5.5	-0.5	0.5	-1.0	1.0	-10	10	nA	
I <sub>COM(ON)</sub>	COM ON Leakage Current (Figure 10)	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> V <sub>NO</sub> 1.0 V or 4.5 V with V <sub>NC</sub> floating or V <sub>NC</sub> 1.0 V or 4.5 V with V <sub>NO</sub> floating V <sub>COM</sub> = 1.0 V or 4.5 V	5.5	-1.0	1.0	-2.0	2.0	-3.0	3	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 all switches.

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	$V_+ \pm 10\%$ (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	$R_L = 50 \Omega$ , $C_L = 35 \text{ pF}$ (Figures 2 and 3)	2.5 3.0 5.0	1.3 1.5 2.8		100 80 80	55 100 30	120 100 100	65 35 35	140 120 120	70 35 35	ns	
$t_{OFF}$	Turn-Off Time	$R_L = 50 \Omega$ , $C_L = 35 \text{ pF}$ (Figures 2 and 3)	2.5 3.0 5.0	1.3 1.5 2.8		60 40 40	55 50 25	70 50 50	65 30 30	80 60 60	70 30 30	ns	
$t_{BBM}$	Minimum Break-Before-Make Time	$V_{IS} = 3.0$ $R_L = 300 \Omega$ , $C_L = 35 \text{ pF}$ (Figure 1)	3.0	1.5	1.0	8.0						ns	

CNC Off CNO Off CNC On CNO On	NC Off Capacitance, $f = 1$ MHz NO Off Capacitance, $f = 1$ MHz NC On Capacitance, $f = 1$ MHz NO On Capacitance, $f = 1$ MHz	$V_+ = 3.0$ V			pF
		9	9	15	

\*Typical Characteristics are at 25°C.

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

Symbol	Parameter	Condition	$V_+$ V	Typical		Unit
				25°C		
BW	Maximum On-Channel −3dB Bandwidth or Minimum Frequency Response	$V_{IN} = 0$ dBm $V_{IN}$ centered between $V_{CC}$ and GND (Figure 4)	NC/NO	3.0	300	MHz
$V_{ONL}$	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	$f = 10$ mHz; $V_{IS} = 1$ V RMS; $C_L = 5$ nF $V_{IN}$ centered between $V_{CC}$ and GND (Figure 4)		3.0	−55	dB
Q	Charge Injection Select Input to Common I/O	$V_{IN} = V_{CC}$ to GND, $R_{IS} = 0 \Omega$ , $C_L = 1$ nF $Q = C_L - \Delta V_{OUT}$ (Figure 5)		3.0 5.0	5.0 10	pC
THD	Total Harmonic Distortion THD + Noise	$F_{IS} = 20$ Hz to 20 kHz, $R_L = R_{gen} = 600 \Omega$ , $C_L = 50$ pF $V_{IS} = 1$ V RMS		3.0	0.03	%
VCT	Channel-to-Channel Crosstalk	$f = 10$ mHz; $V_{IS} = 1$ V RMS, $C_L = 5$ pF, $R_L = 50 \Omega$ $V_{IN}$ centered between $V_{CC}$ and GND (Figure 4)		3.0	−80	dB

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

6. −40°C specifications are guaranteed by design.

# NLAS4717

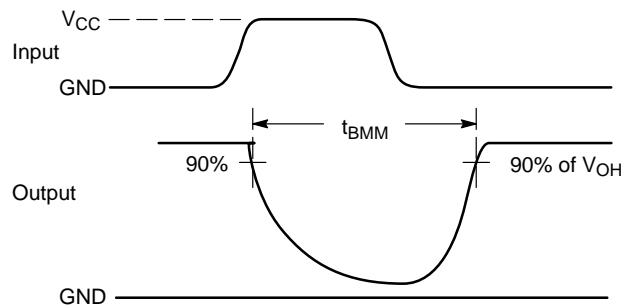
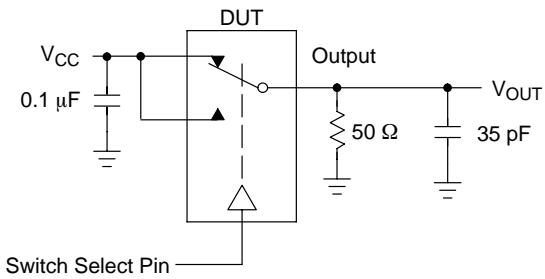


Figure 1.  $t_{BMM}$  (Time Break-Before-Make)

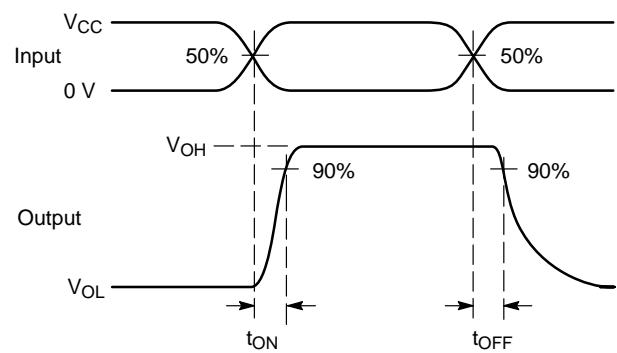
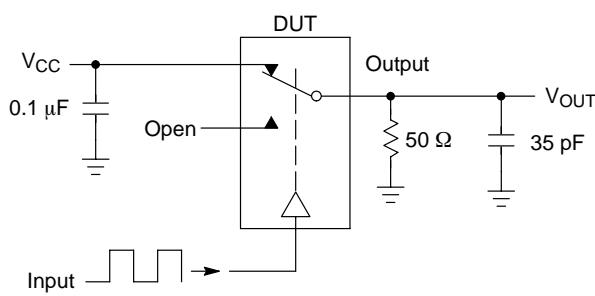


Figure 2.  $t_{ON}/t_{OFF}$

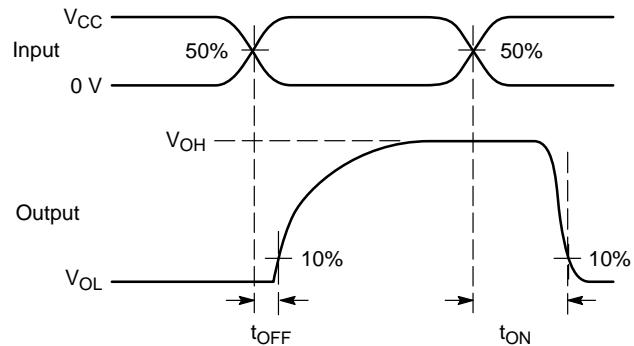
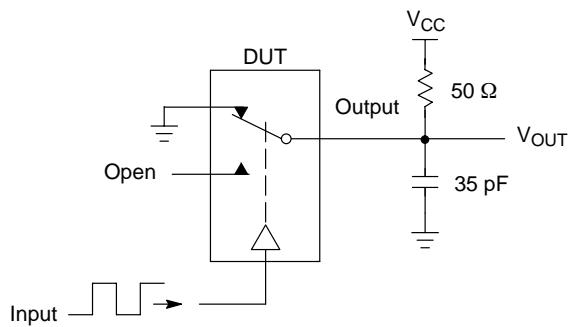
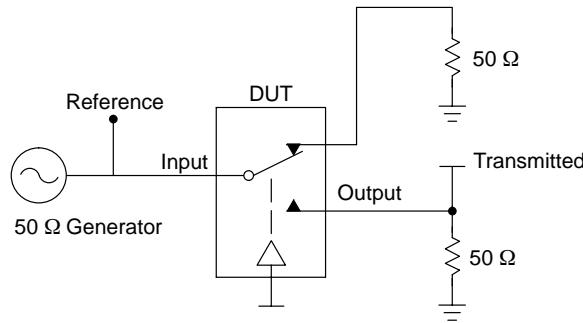


Figure 3.  $t_{ON}/t_{OFF}$



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.

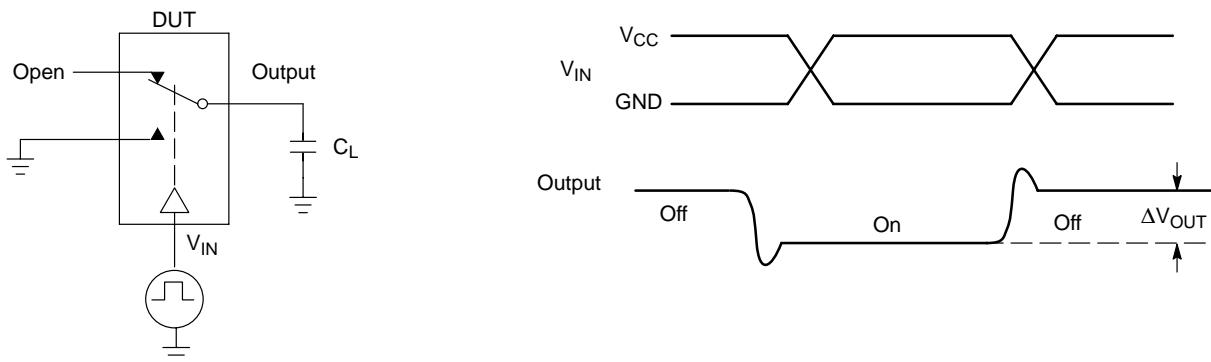
$$V_{ISO} = \text{Off Channel Isolation} = 20 \log \left( \frac{V_{OUT}}{V_{IN}} \right) \text{ for } V_{IN} \text{ at } 100 \text{ kHz}$$

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

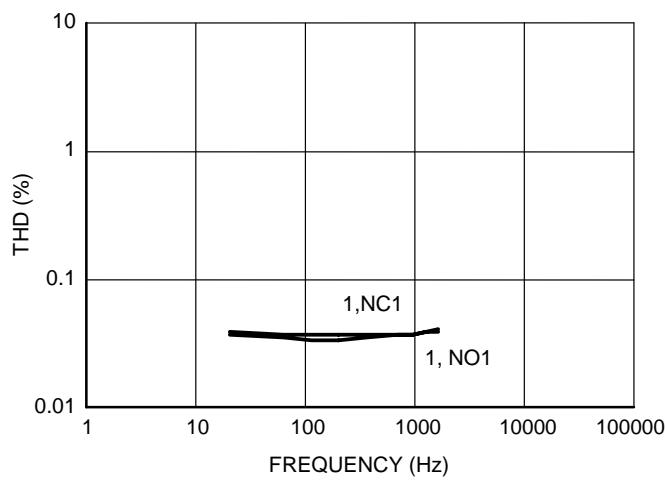
Bandwidth (BW) = the frequency 3 dB below  $V_{ONL}$

$V_{CT}$  = Use  $V_{ISO}$  setup and test to all other switch analog input/outputs terminated with  $50 \Omega$

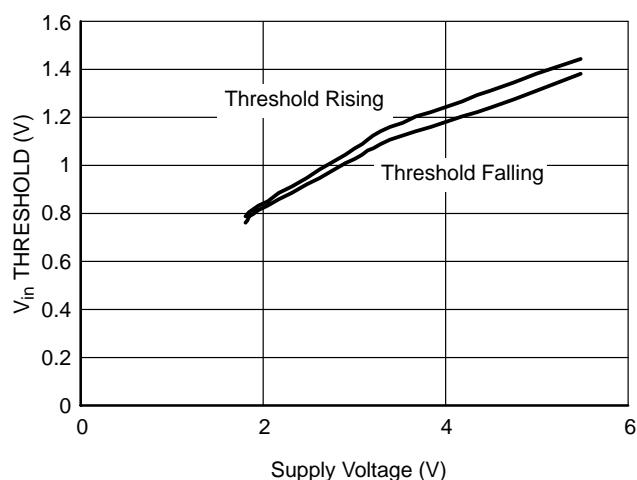
**Figure 4. Off Channel Isolation/On Channel Loss (BW)/Crosstalk  
(On Channel to Off Channel)/ $V_{ONL}$**



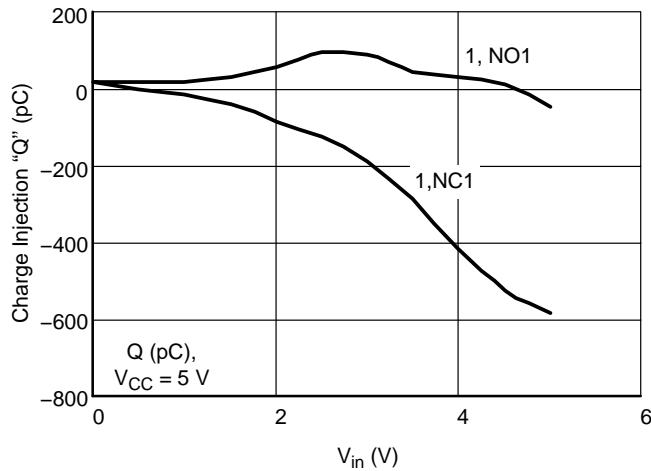
**Figure 5. Charge Injection: (Q)**



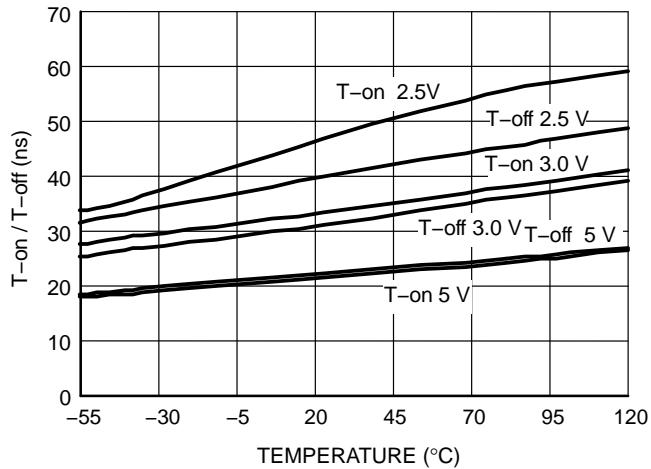
**Figure 6. Total Harmonic Distortion Plus Noise versus Frequency**



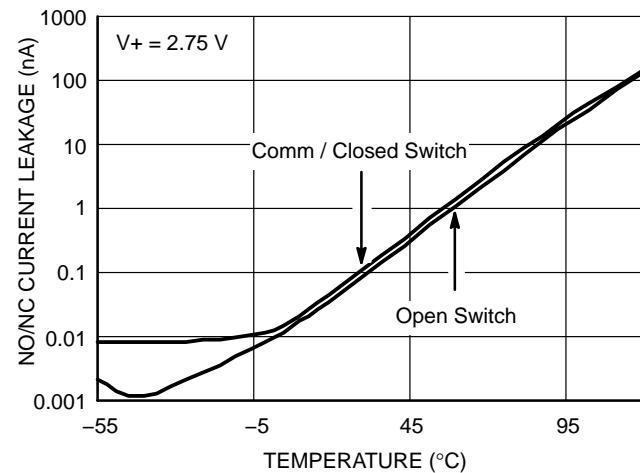
**Figure 7. Voltage in Threshold on Logic Pins**



**Figure 8. Charge Injection versus V<sub>is</sub>**



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



**Figure 10. NO/NC Current Leakage Off and On, V<sub>CC</sub> = 5 V**

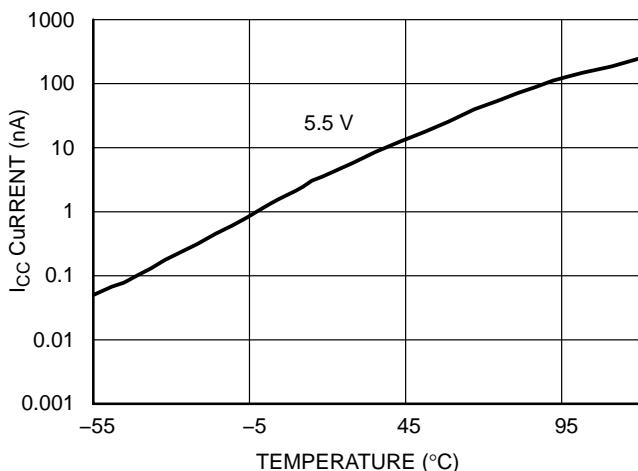


Figure 11.  $I_{CC}$  Current Leakage versus Temperature  $V_{CC} = 5.5$  V

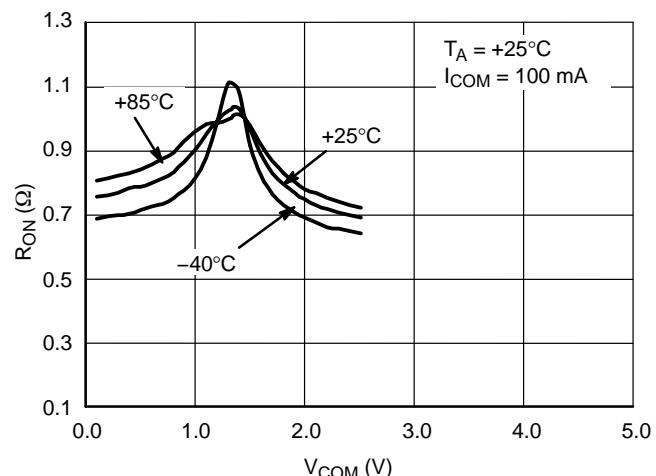


Figure 12. NC/NO On-Resistance versus COM Voltage

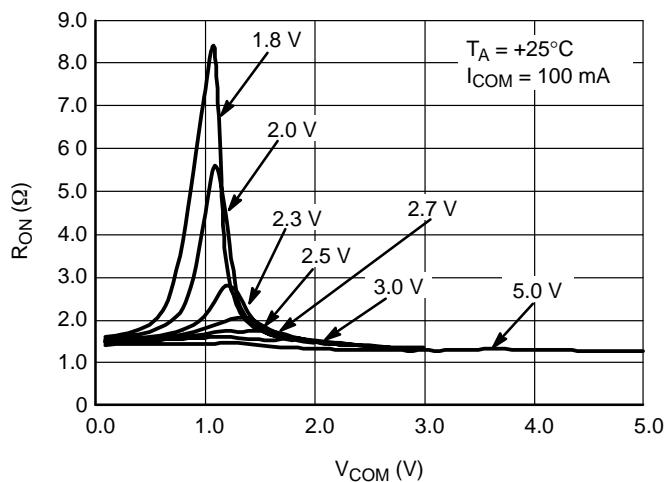


Figure 13. NC/NO On-Resistance versus COM Voltage

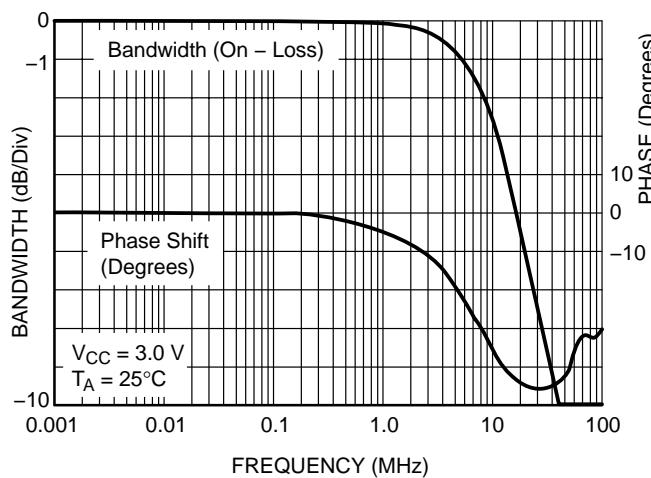


Figure 14. NC/NO Bandwidth and Phase Shift versus Frequency

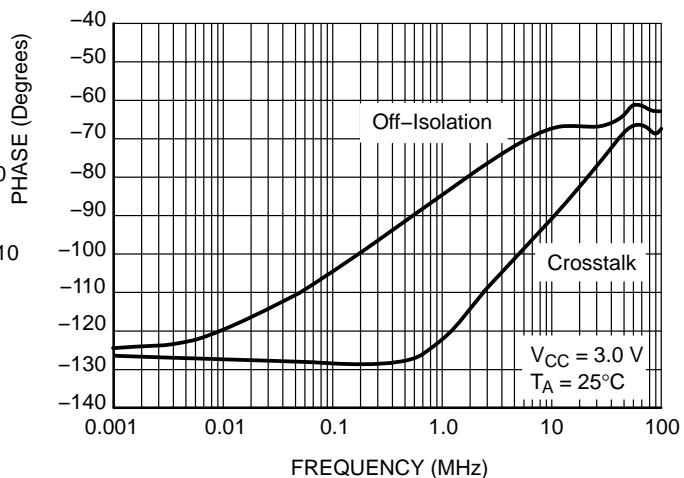
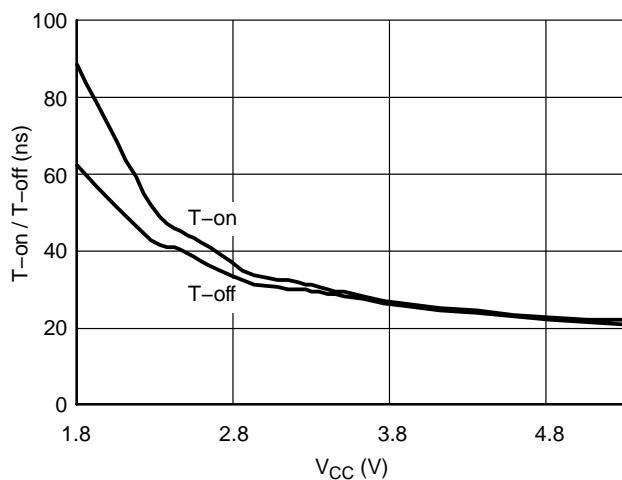
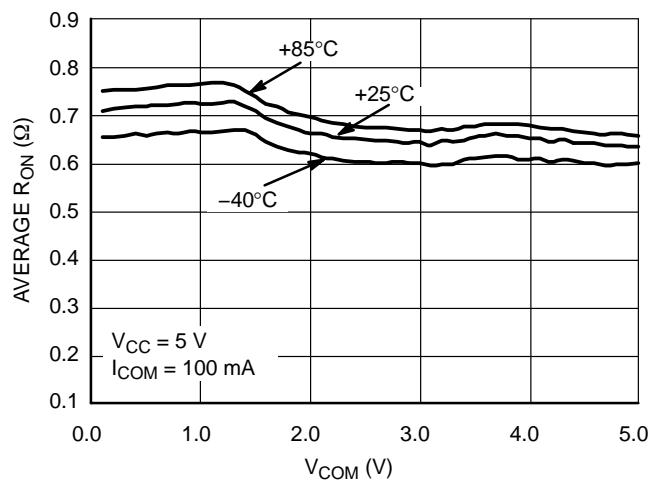


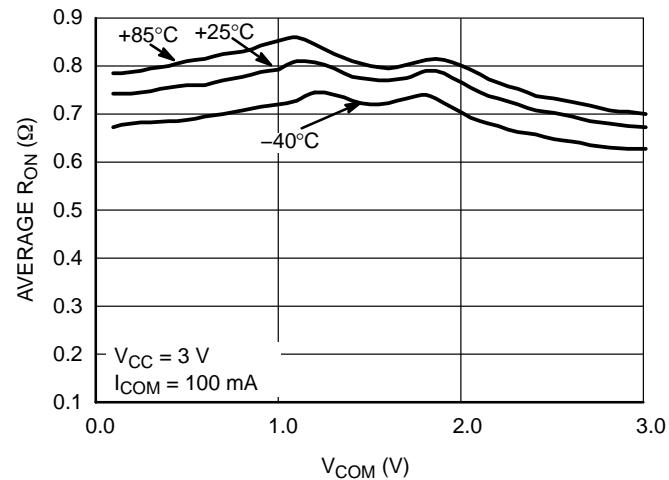
Figure 15. NC/NO Off Isolation and Crosstalk



**Figure 16. T-on/T-off versus V<sub>CC</sub>**



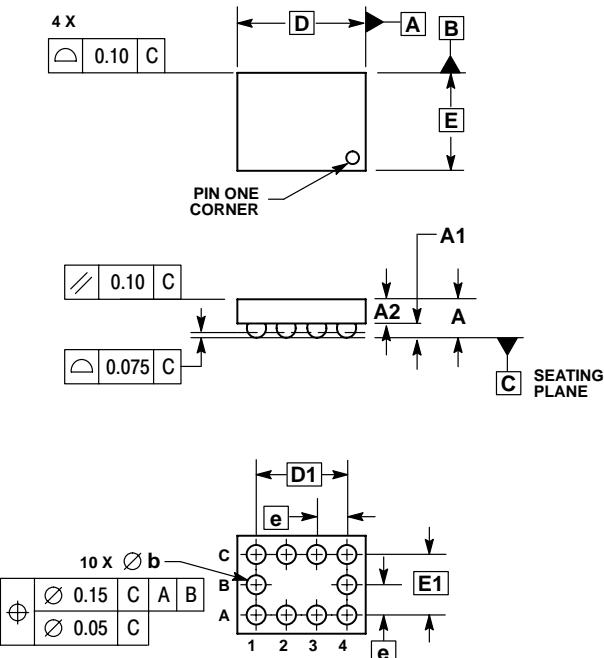
**Figure 17. NC/NO On-Resistance versus COM Voltage**



**Figure 18. NC/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.

DIM	MILLIMETERS	
	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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