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 Opened 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. 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
- High Continuous Current Capability
  ± 300 mA Through Each Switch
- Large Current Clamping Diodes at Analog Inputs
  ± 300 mA Continuous Current Capability
- Pb−Free Package is Available*

Applications

- Cell Phone
- Speaker Switching
- Power Switching
- Modems
- Automotive

*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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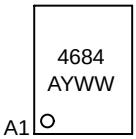
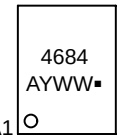
http://onsemi.com

MARKING DIAGRAMS

A1

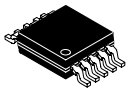
Microbump−10
CASE 489AA





1

QFN−10
CASE 485C



Micro10
CASE 846B

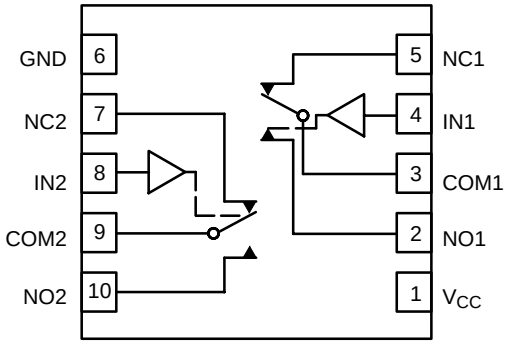
A = Assembly Location
L = Wafer Lot
Y = Year
WW, W = Work Week
▪ = Pb−Free Package

FUNCTION TABLE

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

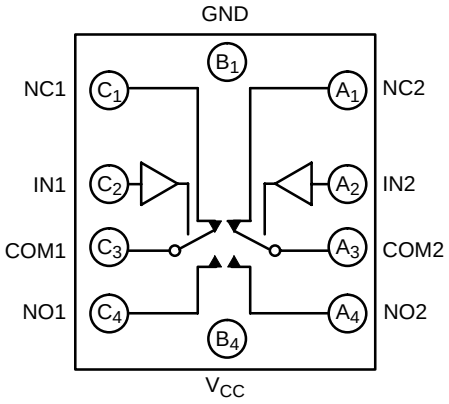
ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 11 of this data sheet.



(Top View)

Figure 1. Pin Connections and Logic Diagram (QFN−10 and Micro10)



(Top View)

Figure 2. Pin Connections and Logic Diagram (Microbump−10)

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	$-0.5 \le V_I \le +7.0$	V
I_{anl1}	Continuous DC Current from COM to NC/NO	±300	mA
$I_{anl-pk\ 1}$	Peak Current from COM to NC/NO, 10 duty cycle (Note 1)	±500	mA
I_{clmp}	Continuous DC Current into COM/NO/NC	±300	mA
$I_{clmp\ 1}$	Peak Current into Input Clamp Diodes at COM/NC/NO	±500	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		1.8	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 10)		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 10)		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 (Note 2)	Select and V_{IS} = V_{CC} or GND	5.5	± 50	± 200	± 200	nA

2. Guaranteed by design.

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 3)	$V_{IN} \le V_{IL}$ 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 3)	$V_{IN} \ge V_{IH}$ 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 3, 5)	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 3, 5)	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 3 and 4)	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 13) (Note 3)	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 13) (Note 3)	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	−2	2	−20	20	−200	200	nA

3. Guaranteed by design. Resistance measurements do not include test circuit or package resistance.
4. $\Delta R_{ON} = R_{ON(MAX)} - R_{ON(MIN)}$ 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.

AC ELECTRICAL CHARACTERISTICS (Input $t_r = t_f = 3.0$ ns) (Typical characteristics are at 25°C)

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 4 and 5)	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 4 and 5)	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 (Note 6)	V_{IS} = 3.0 R_L = 300 Ω, C_L = 35 pF (Figure 3)	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} On	NO On Capacitance, f = 1 MHz	330	

ADDITIONAL APPLICATION CHARACTERISTICS (Voltages Referenced to GND Unless Noted)

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 6)	NO	3.0	9.5	
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 6)		3.0	−0.05	dB
V_{ISO}	Off−Channel Isolation (Note 7)	f = 100 kHz; V_{IS} = 1 V RMS; C_L = 5 nF V_{IN} centered between V_{CC} and GND(Figure 6)		3.0	−65	dB
Q	Charge Injection Select Input to Common I/O (Figures 10 and 11)	V_{IN} = V_{CC} to GND, R_{IS} = 0 Ω, C_L = 1 nF Q = C_L − ΔV_{OUT} (Figure 7)		3.0	15	pC
THD	Total Harmonic Distortion THD + Noise (Figure 9)	F_{IS} = 20 Hz to 100 kHz, R_L = R_{gen} = 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 6)		3.0	−83	dB

6. −55°C specifications are guaranteed by design.
7. Off−Channel Isolation = 20log10 (Vcom/Vno) (See Figure 6).

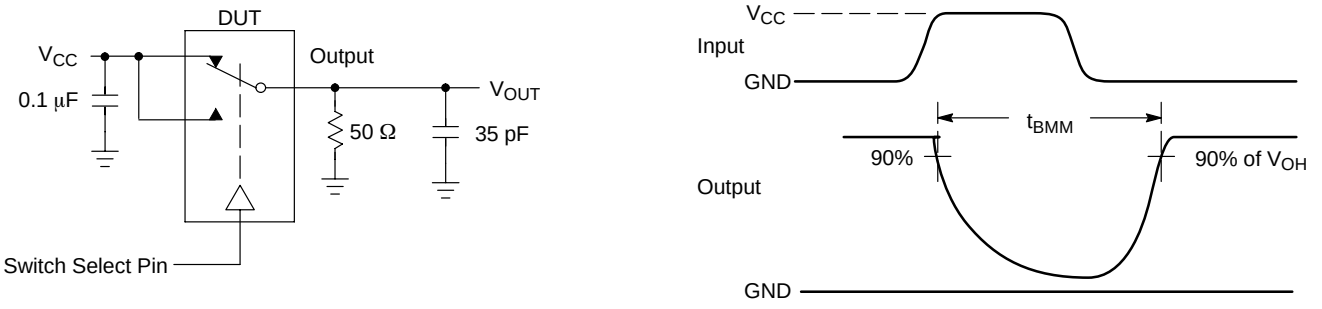


Figure 3. t_{BBM} (Time Break−Before−Make)

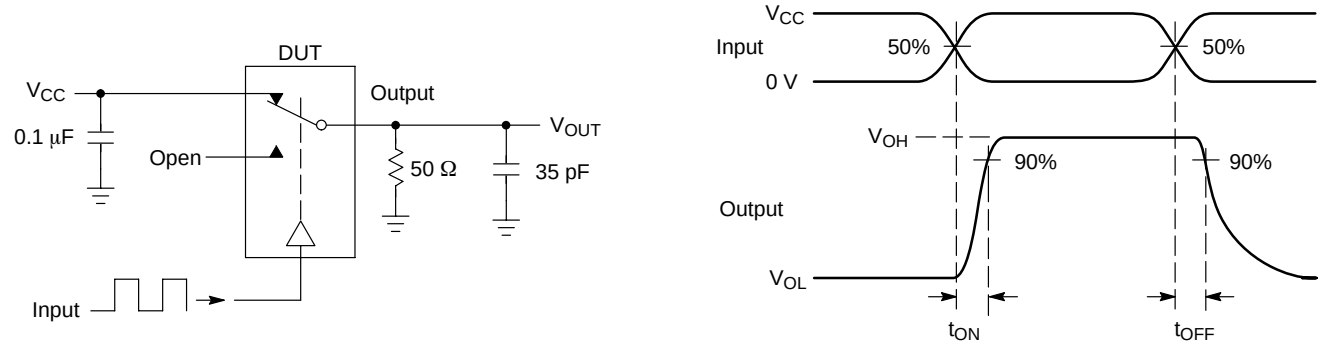


Figure 4. t_{ON}/t_{OFF}

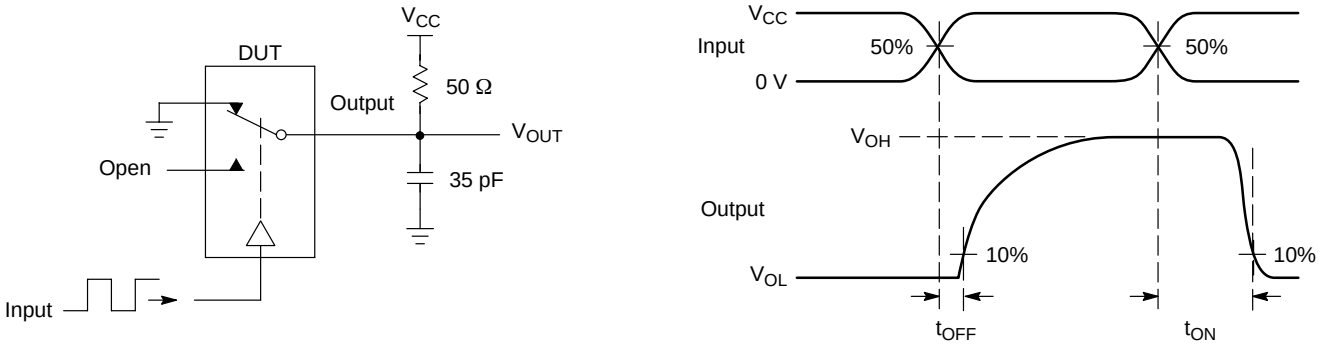
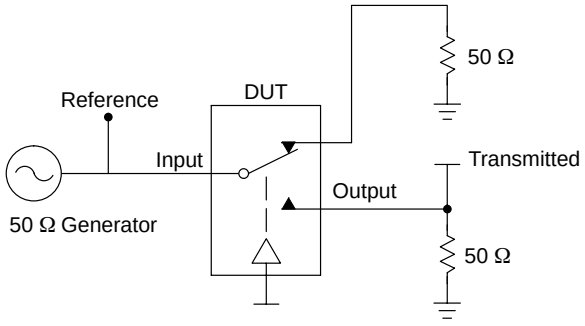


Figure 5. t_{ON}/t_{OFF}



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

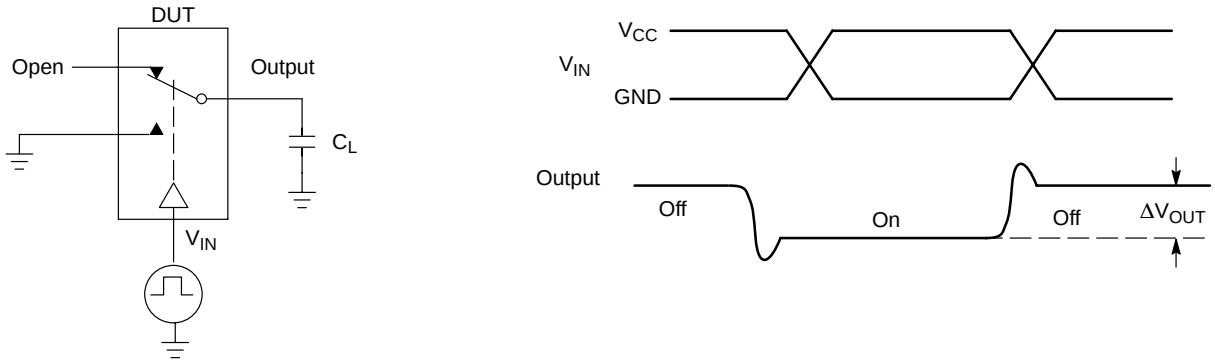


Figure 7. Charge Injection: (Q)

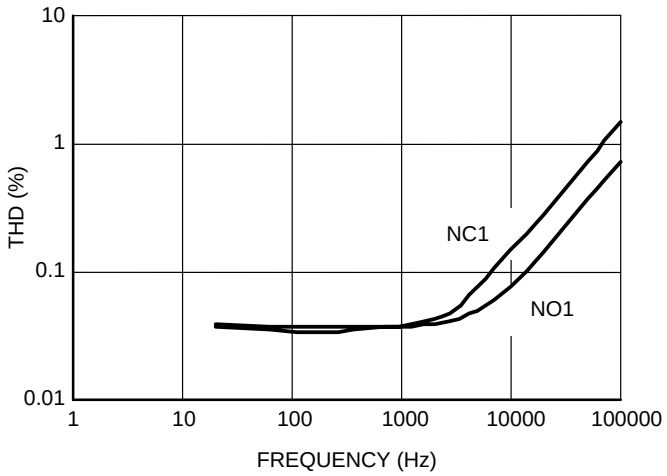


Figure 8. Total Harmonic Distortion Plus Noise Versus Frequency

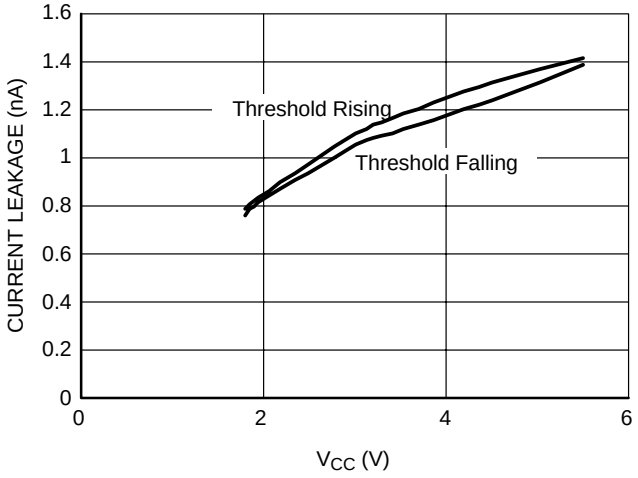


Figure 9. Voltage in Threshold on Logic Pins

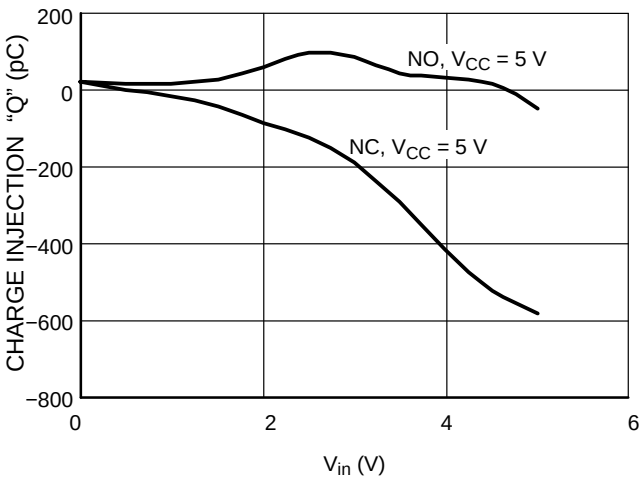


Figure 10. Charge Injection versus V_{is}

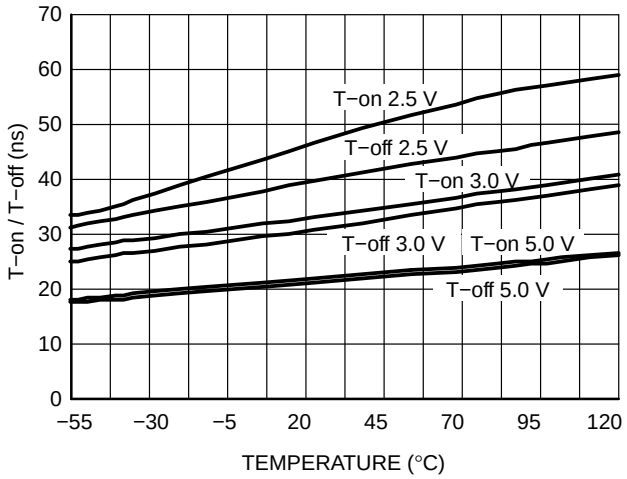


Figure 11. T−on / T−off Time versus Temperature

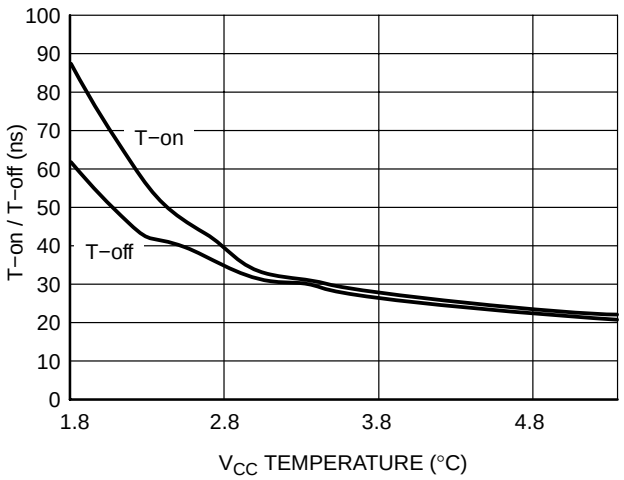


Figure 12. T−on / T−off Time versus Temperature

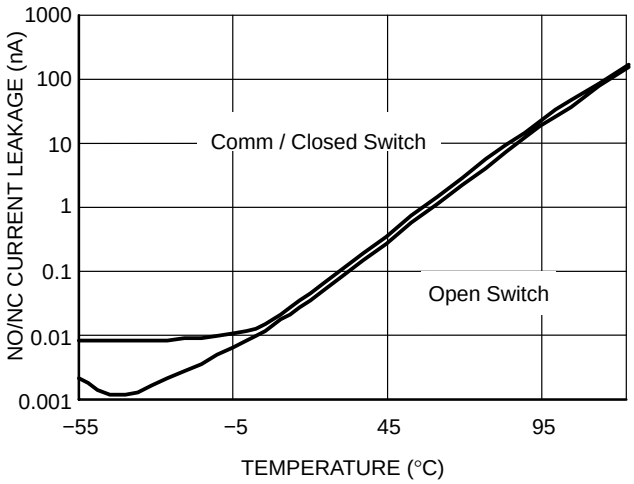


Figure 13. NO/NC Current Leakage Off and On, V_{CC} = 5 V

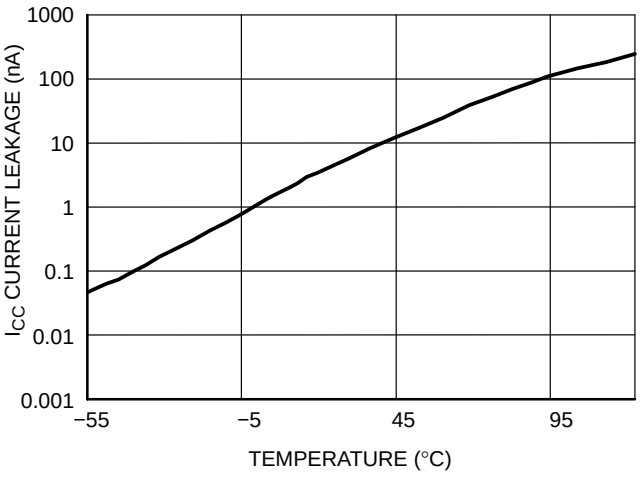


Figure 14. I_{CC} Current Leakage versus Temperature V_{CC} = 5.5 V

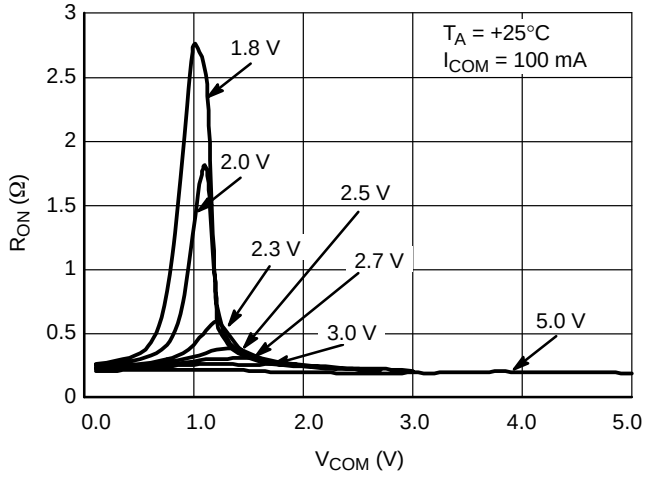


Figure 15. NC On−Resistance versus COM Voltage

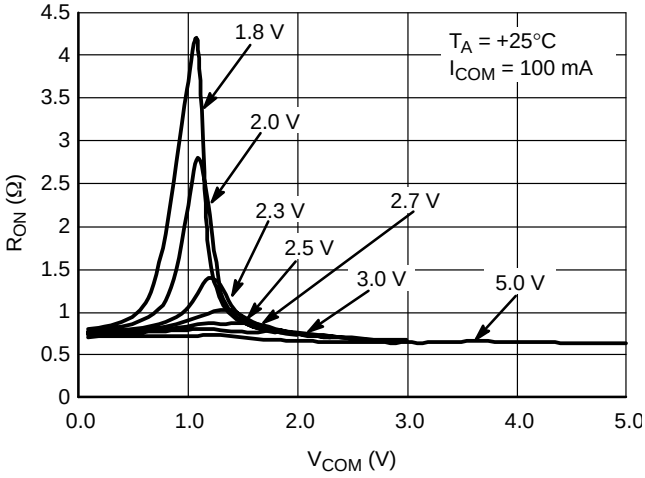


Figure 16. NO On−Resistance versus COM Voltage

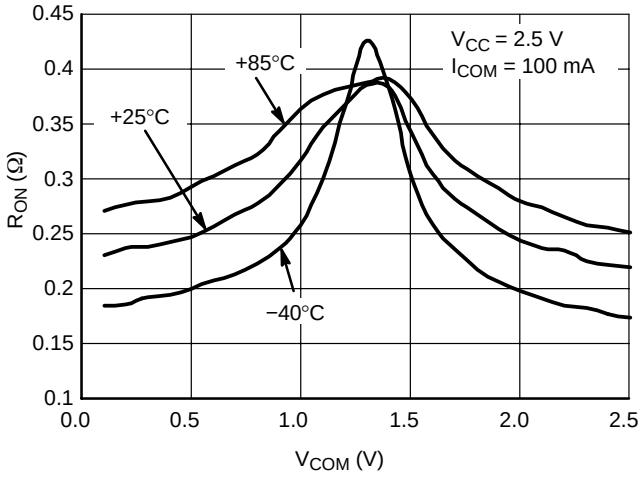


Figure 17. NC On−Resistance versus COM Voltage

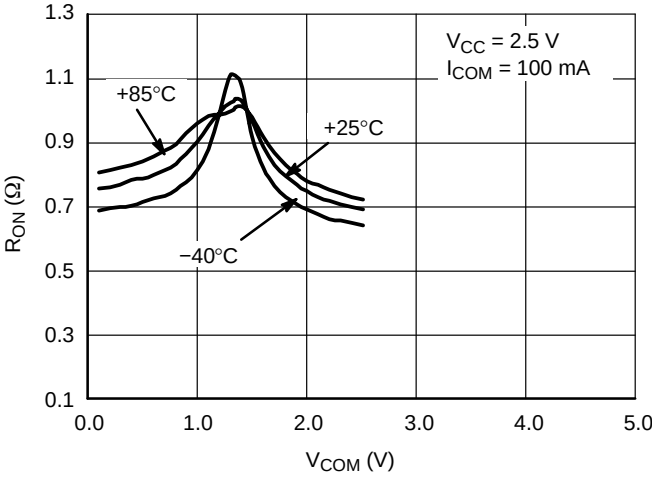


Figure 18. NO On−Resistance versus COM Voltage

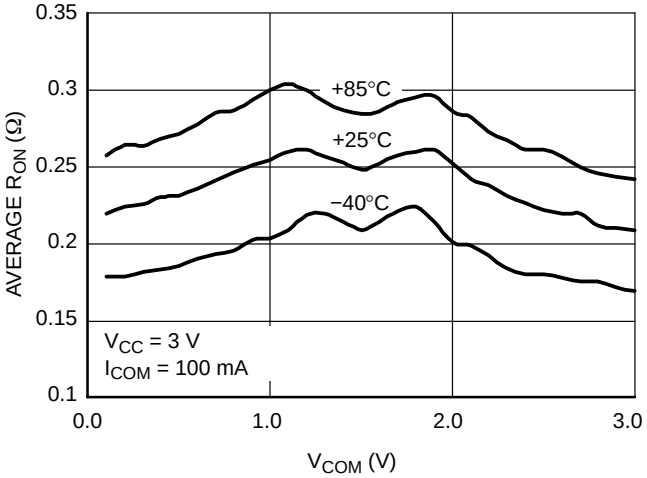


Figure 19. NC On−Resistance versus COM Voltage

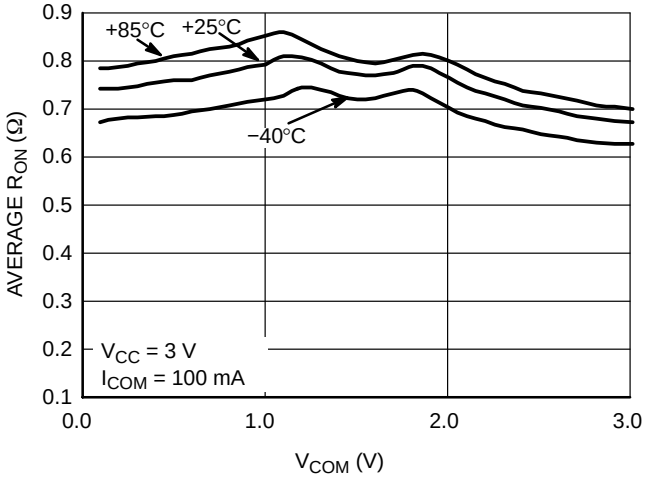


Figure 20. NC On−Resistance versus COM Voltage

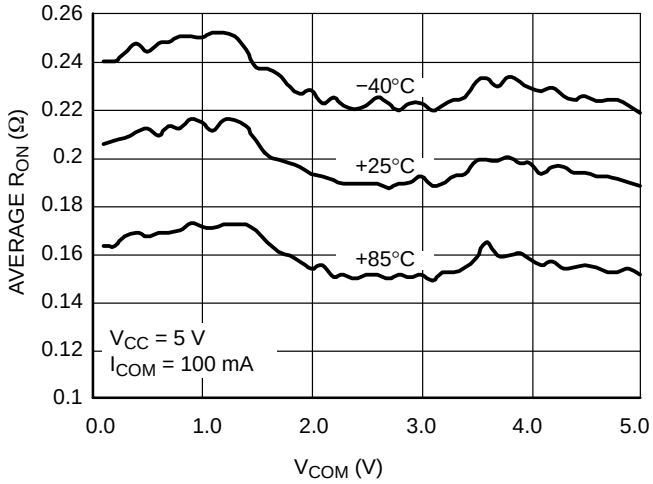


Figure 21. NC On−Resistance versus COM Voltage

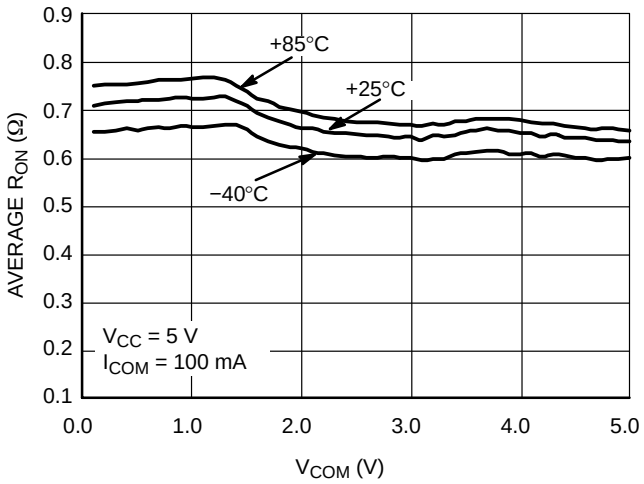


Figure 22. NO On−Resistance versus COM Voltage

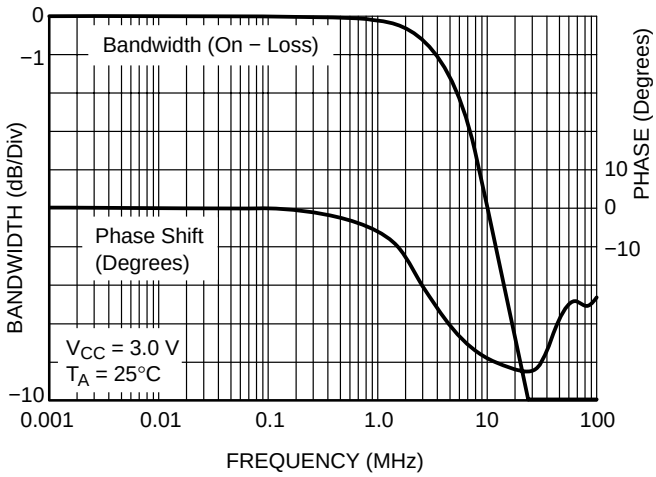


Figure 23. NC Bandwidth and Phase Shift versus Frequency

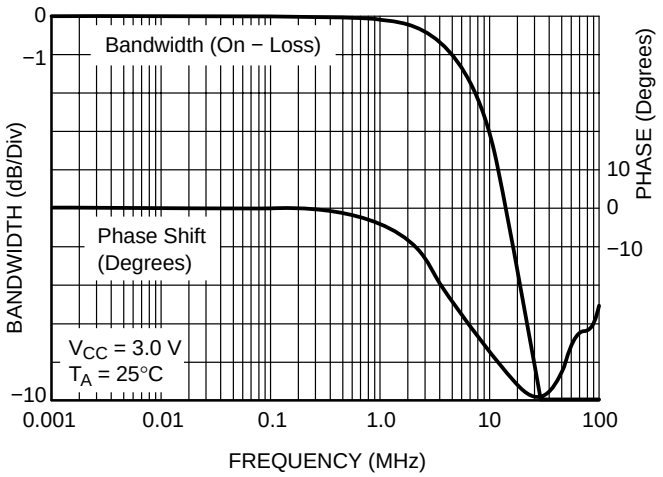


Figure 24. NO Bandwidth and Phase Shift versus Frequency

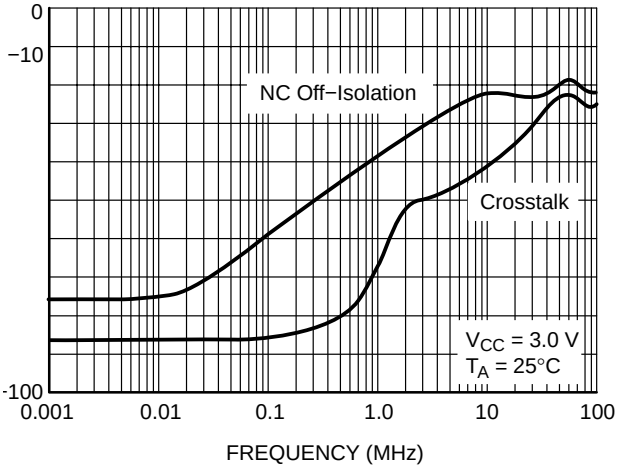


Figure 25. NC Off Isolation and Crosstalk

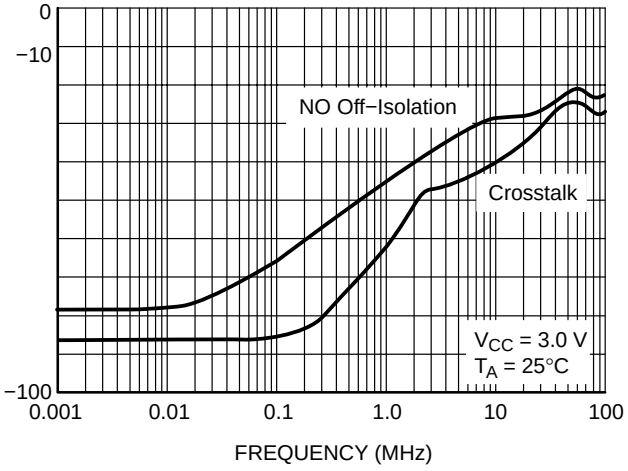


Figure 26. NO Off Isolation and Crosstalk

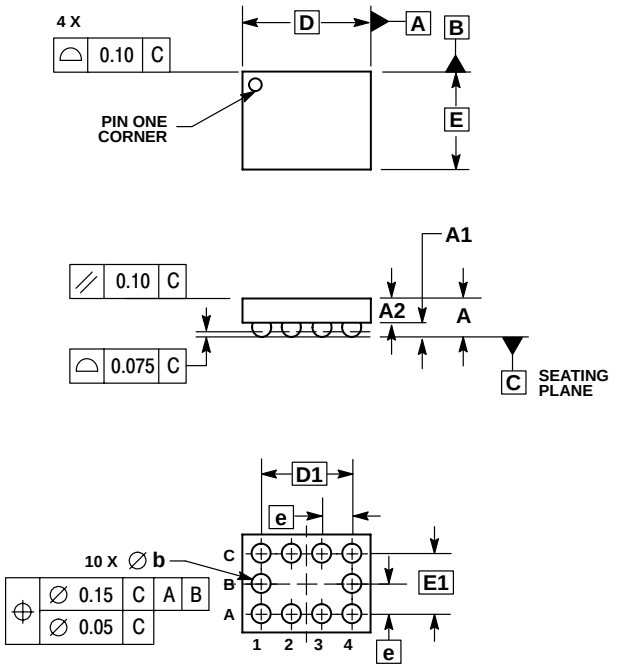
ORDERING INFORMATION

Device	Package	Shipping†
NLAS4684FCT1	Microbump−10	3000 / Tape & Reel
NLAS4684FCT1G	Microbump−10 (Pb−Free)	3000 / Tape & Reel
NLAS4684MNR2	QFN−10	2500 / Tape & Reel
NLAS4684MNR2G	QFN−10 (Pb−Free)	2500 / Tape & Reel
NLAS4684MR2	Micro10	4000 / Tape & Reel
NLAS4684MR2G	Micro10 (Pb−Free)	4000 / 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

Microbump−10
CASE 489AA−01
ISSUE A

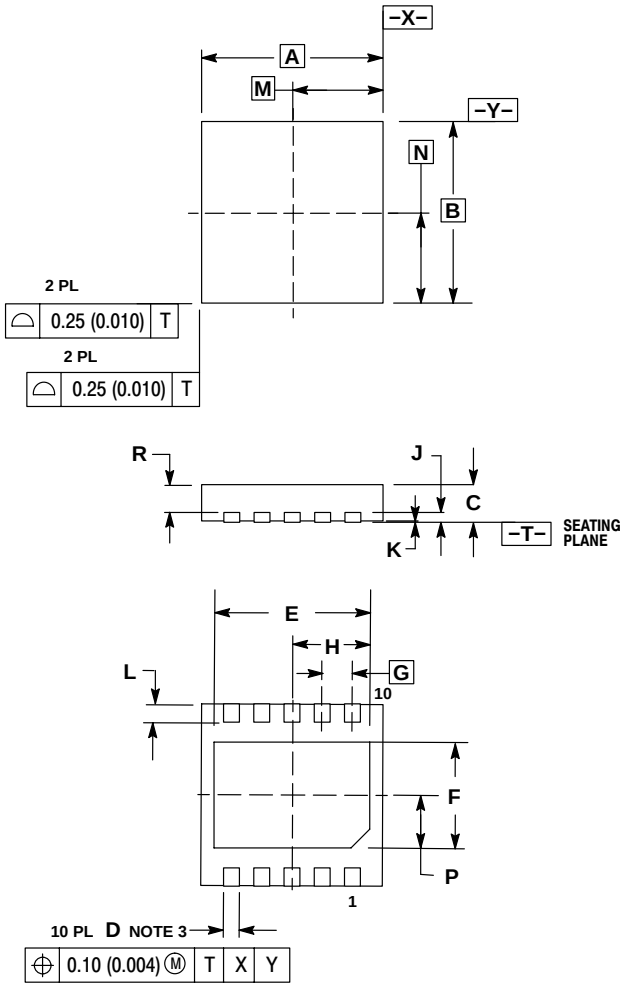


NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. COPLANARITY APPLIES TO SPHERICAL CROWNS OF SOLDER BALLS.

	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	

PACKAGE DIMENSIONS

QFN−10 (DUAL SIDED)
CASE 485C−01
ISSUE O

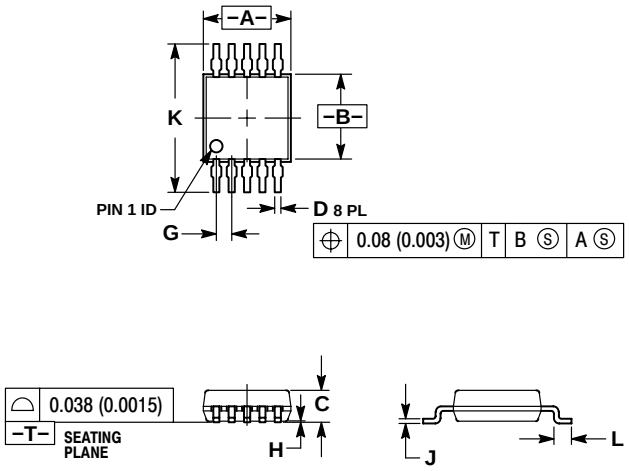


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION D APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.25 AND 0.30 MM FROM TERMINAL.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	3.00 BSC		0.118 BSC	
B	3.00 BSC		0.118 BSC	
C	0.80	1.00	0.031	0.039
D	0.20	0.30	0.008	0.012
E	2.45	2.55	0.096	0.100
F	1.75	1.85	0.069	0.073
G	0.50 BSC		0.020 BSC	
H	1.23	1.28	0.048	0.050
J	0.20 REF		0.008 REF	
K	0.00	0.05	0.000	0.002
L	0.35	0.45	0.014	0.018
M	1.50 BSC		0.059 BSC	
N	1.50 BSC		0.059 BSC	
P	0.88	0.93	0.035	0.037
R	0.60	0.80	0.024	0.031

PACKAGE DIMENSIONS

Micro10
CASE 846B−03
ISSUE C



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSION “A” DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. DIMENSION “B” DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
5. 846B−01 OBSOLETE. NEW STANDARD 846B−02

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	2.90	3.10	0.114	0.122
B	2.90	3.10	0.114	0.122
C	0.95	1.10	0.037	0.043
D	0.20	0.30	0.008	0.012
G	0.50 BSC		0.020 BSC	
H	0.05	0.15	0.002	0.006
J	0.10	0.21	0.004	0.008
K	4.75	5.05	0.187	0.199
L	0.40	0.70	0.016	0.028

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