

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 Packages are Available

Applications

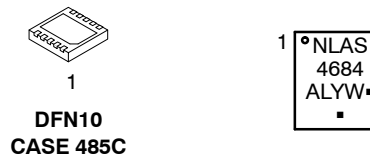
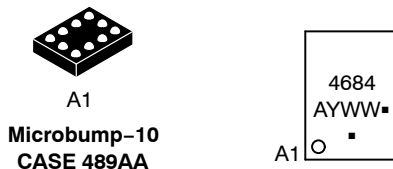
- Cell Phone
- Speaker Switching
- Power Switching
- Modems
- Automotive



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MARKING DIAGRAMS



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

(Note: Microdot may be in either location)

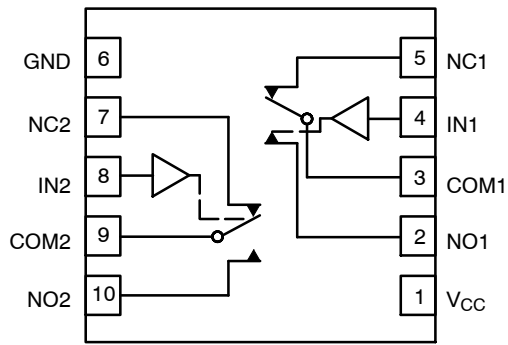
FUNCTION TABLE

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

ORDERING INFORMATION

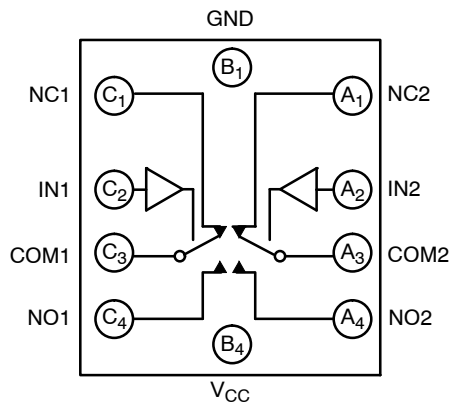
See detailed ordering and shipping information in the package dimensions section on page 11 of this data sheet.

NLAS4684



(Top View)

Figure 1. Pin Connections and Logic Diagram (DFN10 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 ≤ V _{IS} ≤ V _{CC} + 0.5 | V |
| V _{IN} | Digital Select Input Voltage | - 0.5 ≤ V _I ≤ +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 |

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

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 0 V _{CC} = 5.0 V ± 0.5 V 0 | 100 20 | ns/V |
| ESD | Human Body Model – All Pins | | 5 | kV |

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 9) | | 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 _{IL} | Maximum Low-Level Input Voltage, Select Inputs (Figure 9) | | 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 _{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 | ± 180 | ± 200 | ± 200 | nA |

2. Guaranteed by design.

NLAS4684

DC ELECTRICAL CHARACTERISTICS – Analog Section

| Symbol | Parameter | Condition | $V_{CC} \pm 10\%$ | 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) | $V_{IN} \leq V_{IL}$ $V_{IS} = \text{GND to } V_{CC}$ $ I_{IN} \leq 100 \text{ mA}$ | 2.5 | | 0.6 | | 0.7 | | 0.8 | Ω |
| | | | 3.0 | | 0.5 | | 0.5 | | 0.5 | |
| | | | 5.0 | | 0.4 | | 0.4 | | 0.5 | |
| R _{ON} (NO) | NO "ON" Resistance (Note 3) | $V_{IN} \geq V_{IH}$ $V_{IS} = \text{GND to } V_{CC}$ $ I_{IN} \leq 100 \text{ mA}$ | 2.5 | | 1.0 | | 1.0 | | 1.0 | Ω |
| | | | 3.0 | | 0.8 | | 0.8 | | 1.0 | |
| | | | 5.0 | | 0.8 | | 0.8 | | 0.9 | |
| R _{FLAT} (NC) | NC On-Resistance Flatness (Notes 3, 5) | $I_{COM} = 100 \text{ mA}$ $V_{IS} = 0 \text{ to } V_{CC}$ | 2.5 | | 0.15 | | 0.15 | | 0.15 | Ω |
| | | | 3.0 | | 0.15 | | 0.15 | | 0.15 | |
| | | | 5.0 | | 0.15 | | 0.15 | | 0.15 | |
| R _{FLAT} (NO) | NO On-Resistance Flatness (Notes 3, 5) | $I_{COM} = 100 \text{ mA}$ $V_{IS} = 0 \text{ to } V_{CC}$ | 2.5 | | 0.35 | | 0.35 | | 0.35 | Ω |
| | | | 3.0 | | 0.35 | | 0.35 | | 0.35 | |
| | | | 5.0 | | 0.35 | | 0.35 | | 0.35 | |
| ΔR_{ON} | On-Resistance Match Between Channels (Notes 3 and 4) | $V_{IS} = 1.3 \text{ V};$ $I_{COM} = 100 \text{ mA}$ $V_{IS} = 1.5 \text{ V};$ $I_{COM} = 100 \text{ mA}$ $V_{IS} = 2.8 \text{ V};$ $I_{COM} = 100 \text{ mA}$ | 2.5 | | 0.18 | | 0.18 | | 0.18 | Ω |
| | | | 3.0 | | 0.06 | | 0.06 | | 0.06 | |
| | | | 5.0 | | 0.06 | | 0.06 | | 0.06 | |
| I _{NC(OFF)} I _{NO(OFF)} | NC or NO Off Leakage Current (Figure 13) (Note 3) | $V_{IN} = V_{IL} \text{ or } V_{IH}$ $V_{NO} \text{ or } V_{NC} = 1.0$ $V_{COM} = 4.5 \text{ V}$ | 5.5 | -1 | 1 | -10 | 10 | -100 | 100 | nA |
| I _{COM(ON)} | COM ON Leakage Current (Figure 13) (Note 3) | $V_{IN} = V_{IL} \text{ or } V_{IH}$ $V_{NO} 1.0 \text{ V or } 4.5 \text{ V with}$ $V_{NC} \text{ floating or}$ $V_{NC} 1.0 \text{ V or } 4.5 \text{ V with}$ $V_{NO} \text{ floating}$ $V_{COM} = 1.0 \text{ V or } 4.5 \text{ V}$ | 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.

NLAS4684

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 | | | | Unit |
|---------------------|-------------------------------|---------------------------------------|--|--|--|------|
| C _{NC Off} | NC Off Capacitance, f = 1 MHz | 102 | | | | |
| 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 | Unit | |
|------------------|---|---|----------------------|---------|-------|-----|
| | | | | 25°C | | |
| 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 (V_{com}/V_{no}) (See Figure 6).

NLAS4684

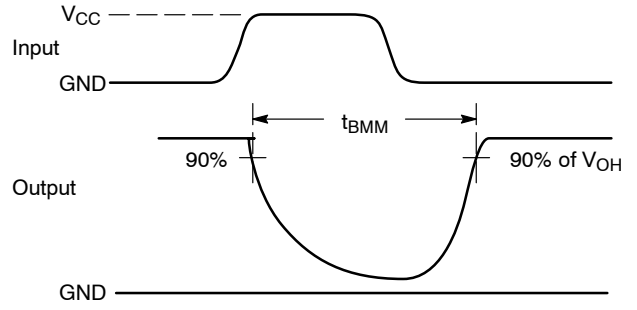
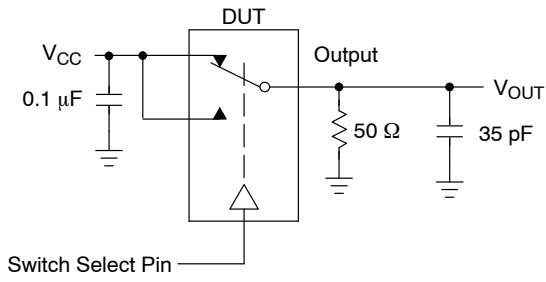


Figure 3. t_{BMM} (Time Break-Before-Make)

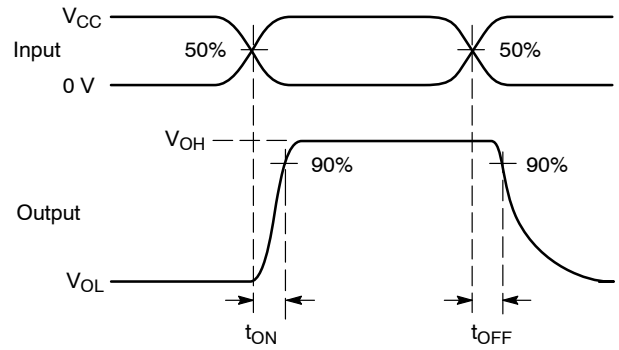
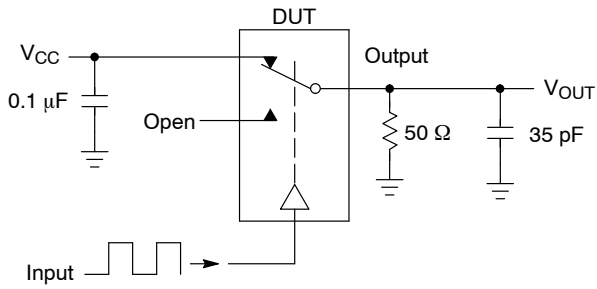


Figure 4. t_{ON}/t_{OFF}

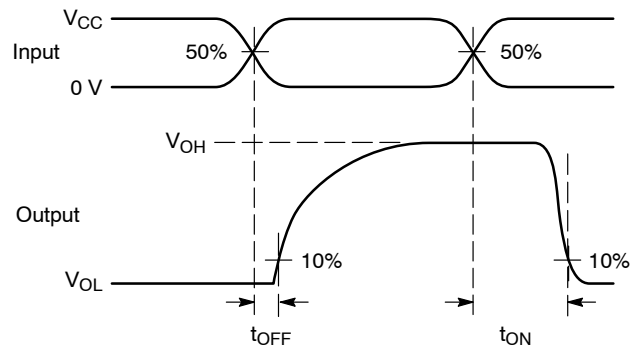
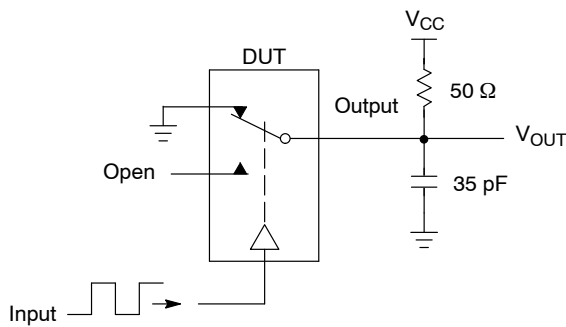
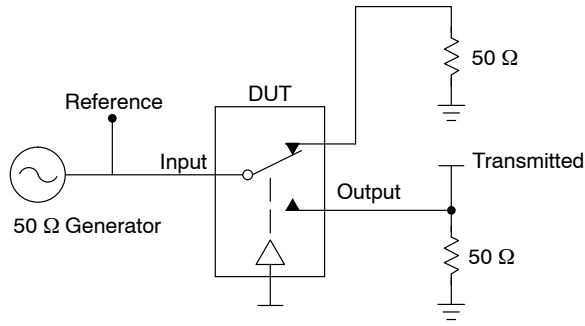


Figure 5. t_{ON}/t_{OFF}

NLAS4684



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.

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

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

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 Ω

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

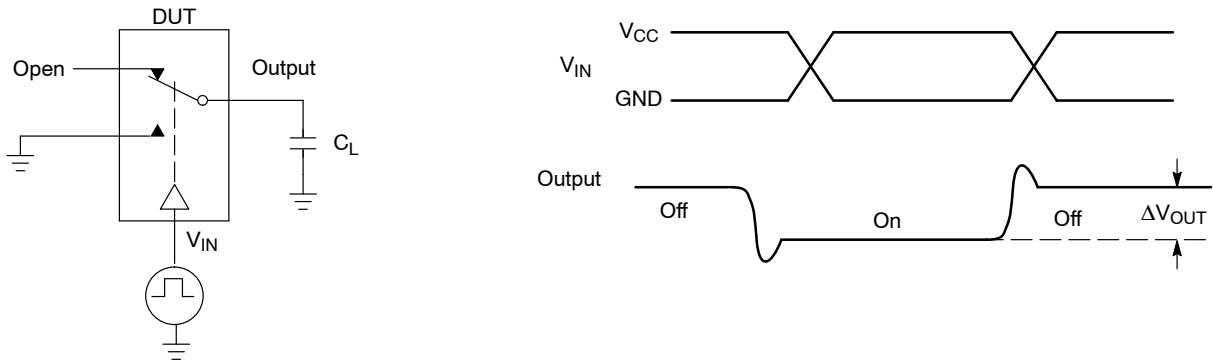


Figure 7. Charge Injection: (Q)

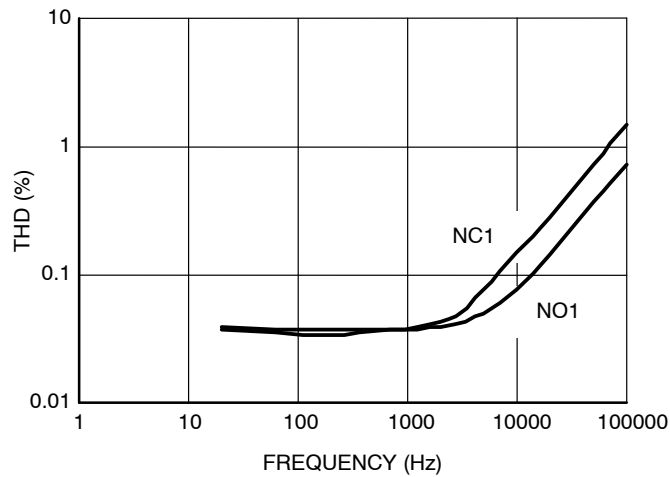


Figure 8. Total Harmonic Distortion Plus Noise Versus Frequency

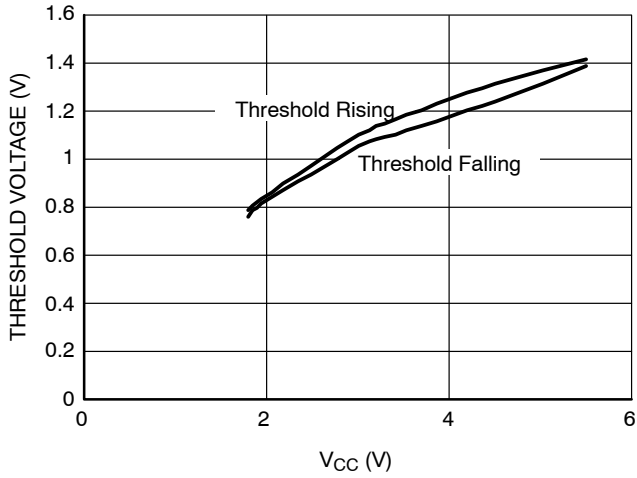


Figure 9. Voltage in Threshold on Logic Pins

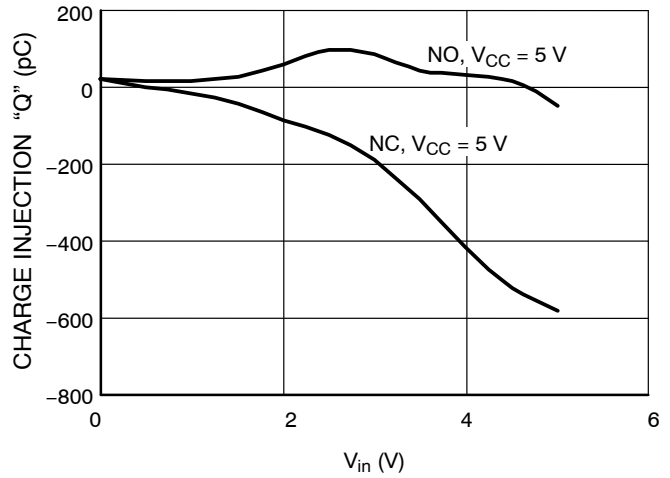


Figure 10. Charge Injection versus V_{IS}

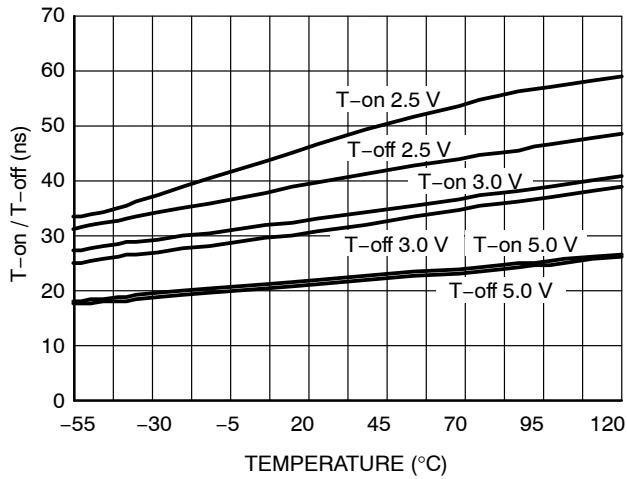


Figure 11. T-on / T-off Time versus Temperature

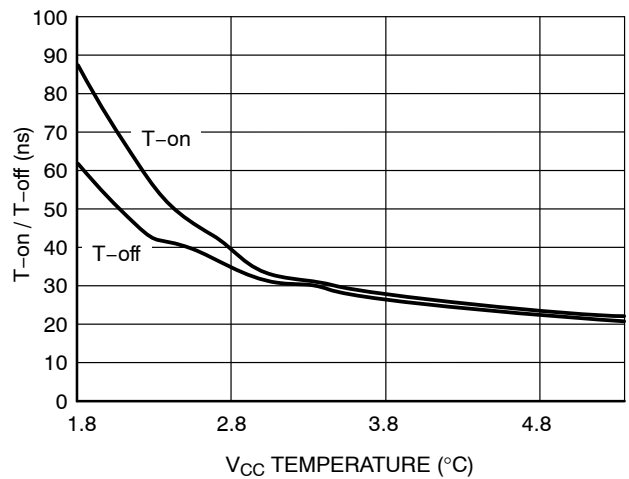


Figure 12. T-on / T-off Time versus Temperature

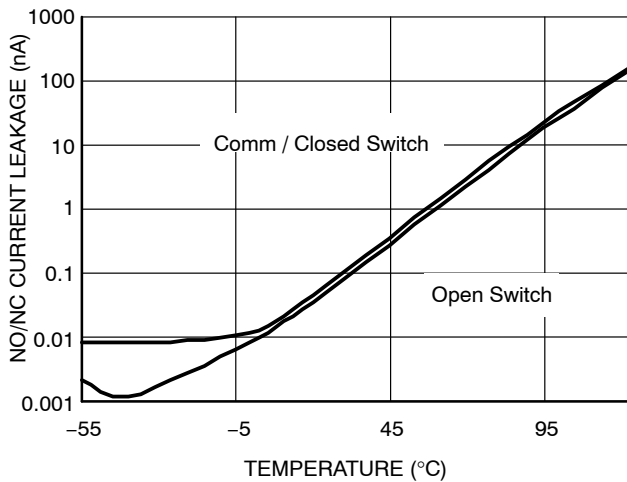


Figure 13. NO/NC Current Leakage Off and On, $V_{CC} = 5 V$

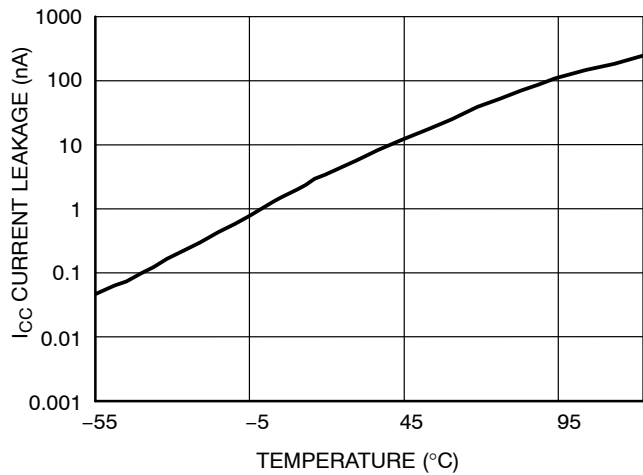


Figure 14. I_{CC} Current Leakage versus Temperature $V_{CC} = 5.5 V$

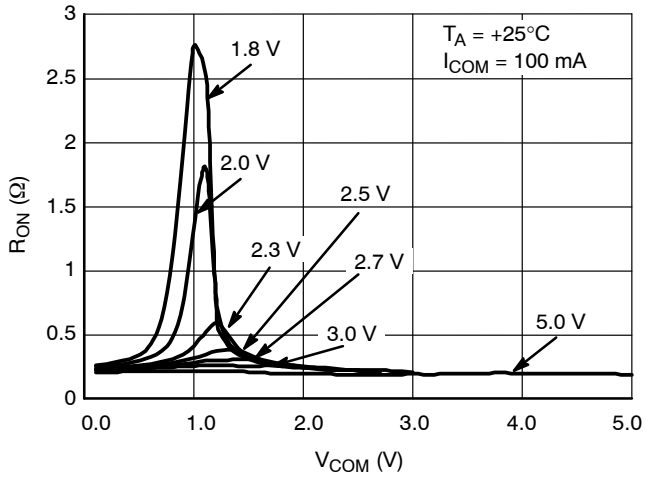


Figure 15. NC On-Resistance versus COM Voltage

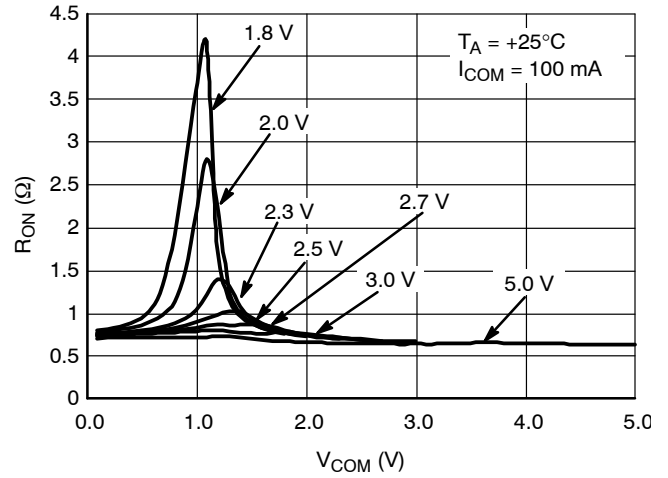


Figure 16. NO On-Resistance versus COM Voltage

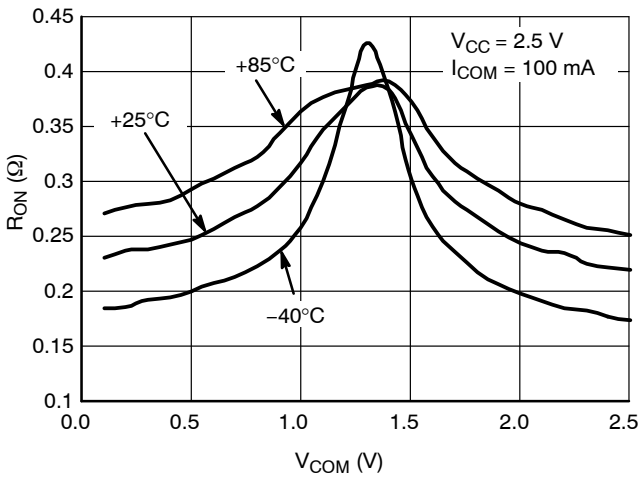


Figure 17. NC On-Resistance versus COM Voltage

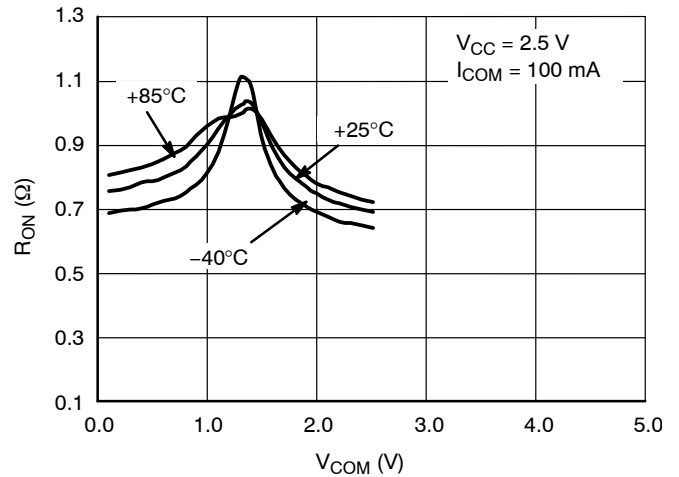


Figure 18. NO On-Resistance versus COM Voltage

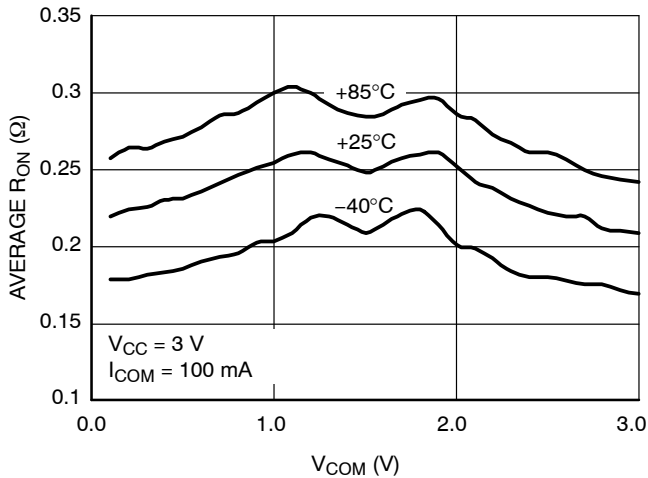


Figure 19. NC On-Resistance versus COM Voltage

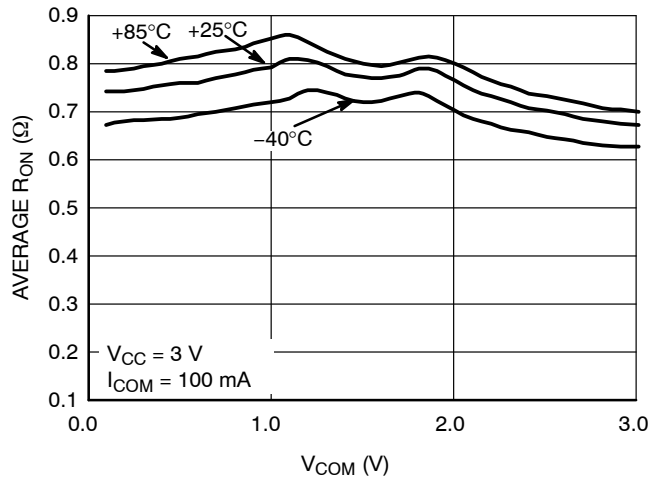


Figure 20. NC On-Resistance versus COM Voltage

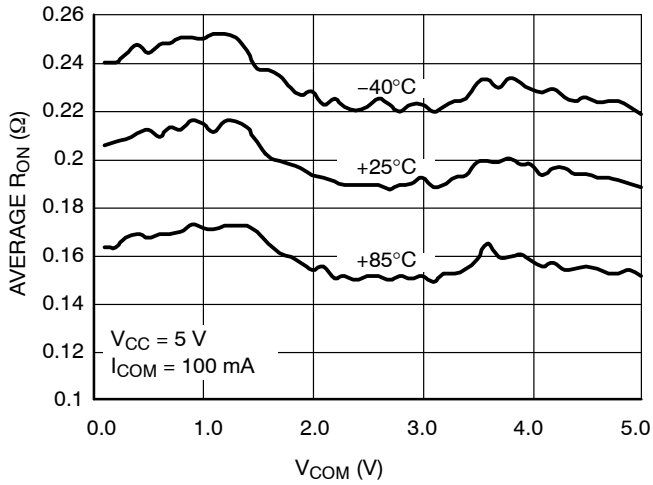


Figure 21. NC On-Resistance versus COM Voltage

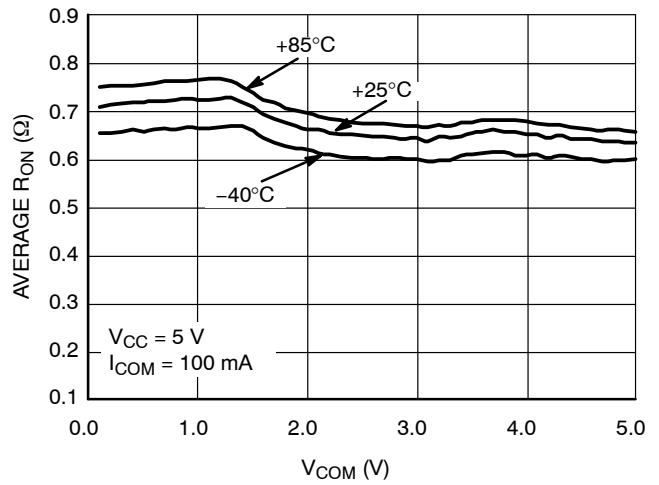


Figure 22. NO On-Resistance versus COM Voltage

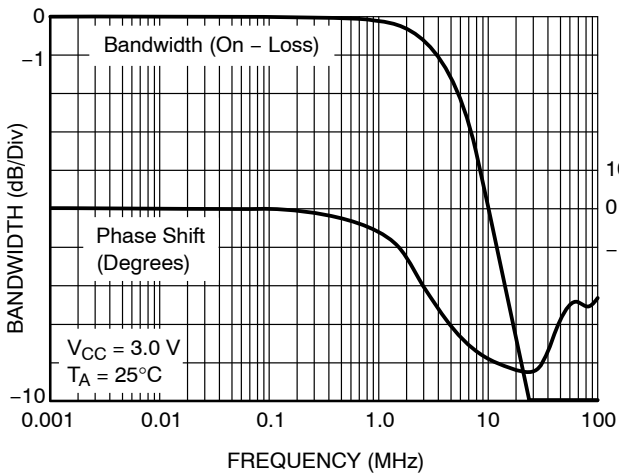


Figure 23. NC Bandwidth and Phase Shift versus Frequency

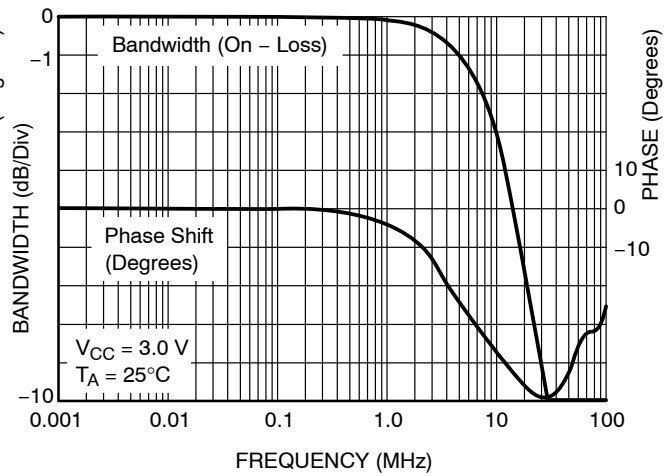


Figure 24. NO Bandwidth and Phase Shift versus Frequency

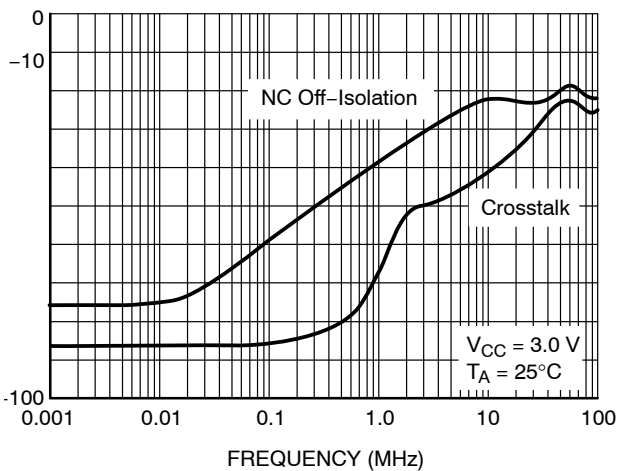


Figure 25. NC Off Isolation and Crosstalk

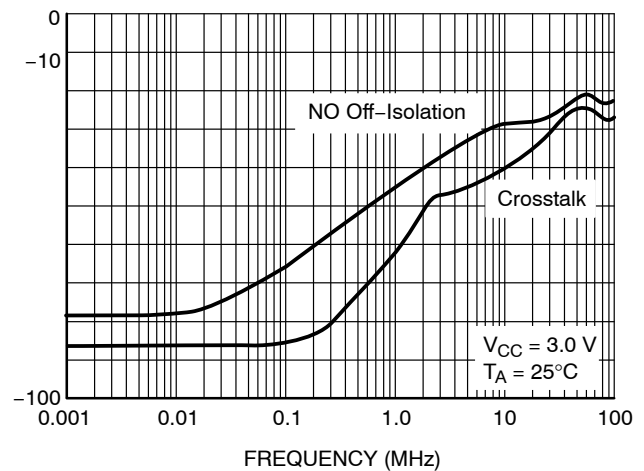


Figure 26. NO Off Isolation and Crosstalk

NLAS4684

ORDERING INFORMATION

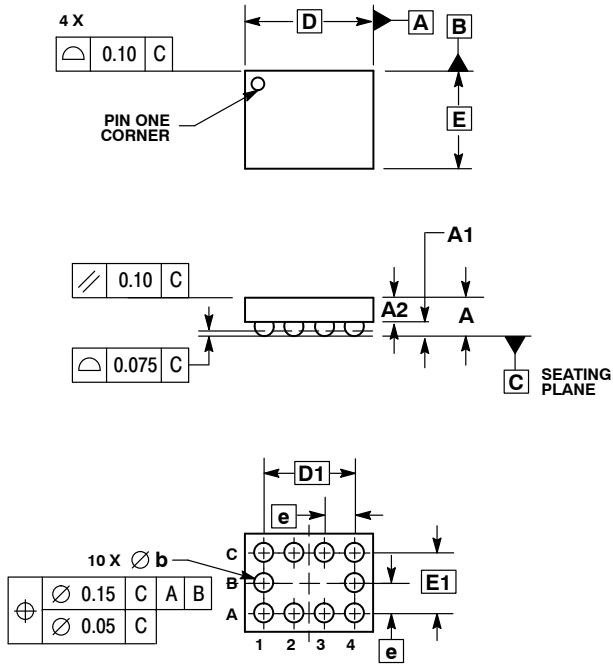
| Device | Package | Shipping† |
|---------------|---------------------------|--------------------|
| NLAS4684FCT1 | Microbump-10 | 3000 / Tape & Reel |
| NLAS4684FCT1G | Microbump-10 (Pb-Free) | 3000 / Tape & Reel |
| NLAS4684FCTCG | Microbump-10 (Pb-Free) | 3000 / Tape & Reel |
| NLAS4684MNR2 | DFN10 | 3000 / Tape & Reel |
| NLAS4684MNR2G | DFN10 (Pb-Free) | 3000 / 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.

NLAS4684

PACKAGE DIMENSIONS

Microbump-10
CASE 489AA-01
ISSUE A



NOTES:

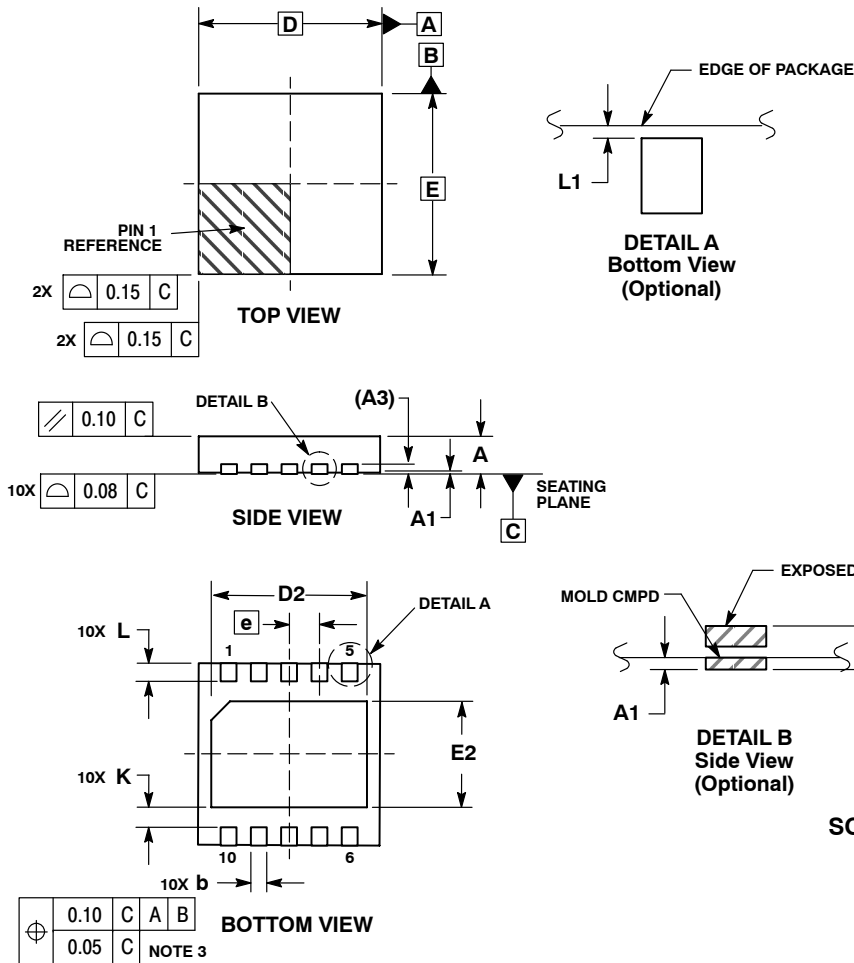
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. COPLANARITY APPLIES TO SPHERICAL CROWNS OF SOLDER BALLS.

| 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 | |

NLAS4684

PACKAGE DIMENSIONS

DFN10, 3 x 3mm, 0.5mm Pitch
CASE 485C-01
ISSUE A

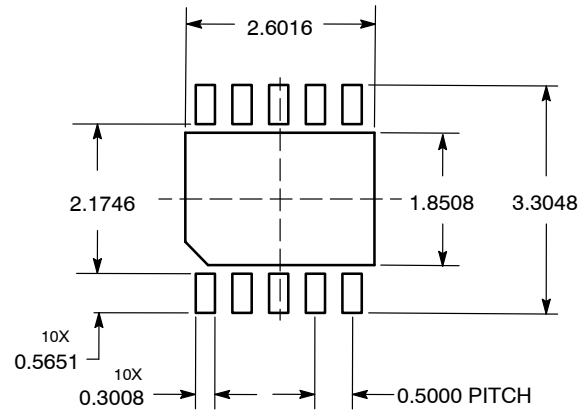


NOTES:

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. TERMINAL b MAY HAVE MOLD COMPOUND MATERIAL ALONG SIDE EDGE. MOLD FLASHING MAY NOT EXCEED 30 MICRONS ONTO BOTTOM SURFACE OF TERMINAL b.
6. DETAILS A AND B SHOW OPTIONAL VIEWS FOR END OF TERMINAL LEAD AT EDGE OF PACKAGE.

| DIM | MILLIMETERS | |
|-----|-------------|------|
| | MIN | MAX |
| A | 0.80 | 1.00 |
| A1 | 0.00 | 0.05 |
| A3 | 0.20 | REF |
| b | 0.18 | 0.30 |
| D | 3.00 | BSC |
| D2 | 2.45 | 2.55 |
| E | 3.00 | BSC |
| E2 | 1.75 | 1.85 |
| e | 0.50 | BSC |
| K | 0.19 | TYP |
| L | 0.35 | 0.45 |
| L1 | 0.00 | 0.03 |

SOLDERING FOOTPRINT*



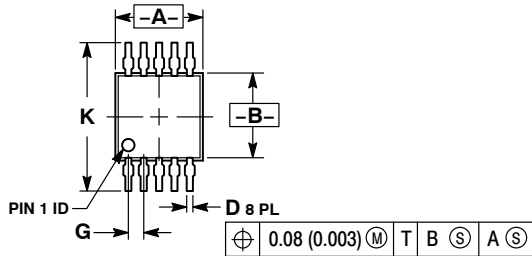
DIMENSIONS: MILLIMETERS

*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

NLAS4684

PACKAGE DIMENSIONS

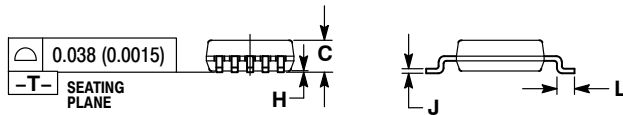
Micro10 CASE 846B-03 ISSUE D



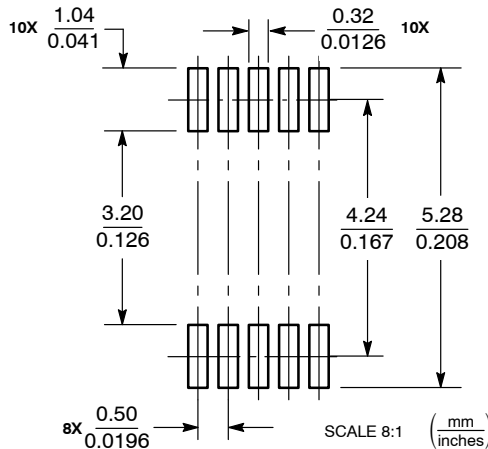
NOTES:

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

| DIM | MILLIMETERS | | INCHES | |
|-----|-------------|------|-----------|-------|
| | 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 |



SOLDERING FOOTPRINT*



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