# NLAS4717EP

# 4.5 Ω High Bandwidth, Dual SPDT Analog Switch

The NLAS4717EP 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 low $R_{DS(on)}$ of 4.5 Ω at 3.0 V.

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

The NLAS4717EP is available in two small size packages:

- ♦ Microbump: 2.0 x 1.5 mm
- ♦ WQFN−10: 1.4 x 1.8 mm

### Features

- Low $R_{DS(on)}$: 4.5 Ω @ 3.0 V
- Matching Between the Switches ±0.5 Ω
- Wide Voltage Range: 1.8 V to 5.5 V
- High Bandwidth > 90 MHz
- 1.65 V to 5.5 V Operating Range
- Low Threshold Voltages on Pins 4 and 8 (CTRL Pins)
- Ultra−Low Charge Injection ≤ 6.0 pC
- Low Standby Current: $I_{CC}$ = 1.0 nA (Max) @ $T_A$ = 25°C
- *OVT on Pins 4 and 8 (CTRL Logic Pins)
- These are Pb−Free Devices

### Typical Applications

- Cell Phones
- PDAs
- MP3s
- Digital Still Cameras
- USB 2.0 Full Speed (USB1.1) − 12 Mbps Compliant

### Important Information

- ESD Protection:
  - ♦ Human Body Model (HBM) = 2500 V,
  - ♦ Machine Model (MM) = 200 V
- Latchup Max Rating: 200 mA (Per JEDEC EIA/JESD78)
- Pin−to−Pin Compatible with MAX4717

### *OVT

- Overvoltage Tolerant (OVT) specific pins operate higher than normal supply voltages, with no damage to the devices or to signal integrity.

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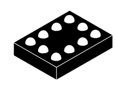
**MARKING DIAGRAMS**

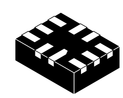


A1

**Microbump−10**
**CASE 489AA**

4717EP
AYWW▪
▪
A1

A = Assembly Location
Y = Year
W, WW = Work Week
▪ = Pb−Free Package
(Note: Microdot may be in either location)



1

**WQFN−10**
**CASE 488AQ**

AW$\overline{M}$▪
▪

AW = Specific Device Code
$\overline{M}$ = Date Code
▪ = Pb−Free Device
(Note: Microdot may be in either location)

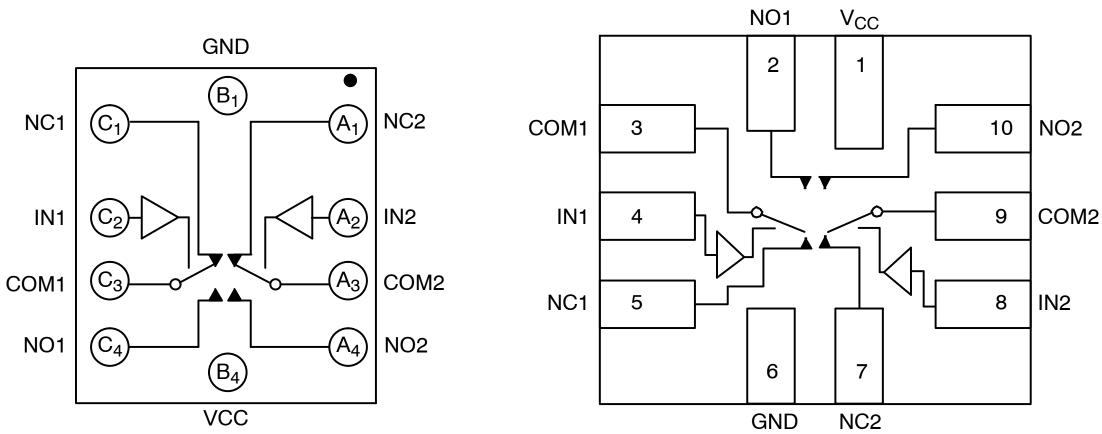
**FUNCTION TABLE**

| IN_ | NO_ | NC_ |
|---|---|---|
| 0 | OFF | ON |
| 1 | ON | OFF |

**ORDERING INFORMATION**

| Device | Package | Shipping† |
|---|---|---|
| NLAS4717EPFCT1G | Microbump−10 (Pb−Free) | 3000 / Tape & Reel |
| NLAS4717EPMTR2G | WQFN−10 (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.




**Microbump**
(Top View)

**WQFN**
(Top View)

**Figure 1. Device Circuit Diagrams and Pin Configurations**

## MAXIMUM RATINGS

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| V+ | 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 (Continuous) | ±100 | mA |
| $I_{PK}$ | Peak Current (10% Duty Cycle) | ±200 | 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. 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+ | 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 | −40 | +85 | °C |
| $t_r$, $t_f$ | Input Rise or Fall Time, SELECT<br>$V_{CC}$ = 3.3 V ± 0.3 V<br>$V_{CC}$ = 5.0 V ± 0.5 V | <br>0<br>0 | <br>100<br>20 | ns/V |

### ANALOG SWITCH DC CHARACTERISTICS

| Symbol | Parameter | Condition | $V_{CC}$ (V) | −40°C to +85°C Min | −40°C to +85°C Max | Unit |
|---|---|---|---|---|---|---|
| $V_{IH}$ | Input Logic High Voltage | $V_{OUT}$ = 0.1 V<br>$I_{OUT} \leq 20\ \mu A$ | 1.65 to 2.2<br>2.7 to 3.6<br>4.5 to 5.5 | $V_{CC}$ x 0.55<br>$V_{CC}$ x 0.5<br>2.0 | –<br>–<br>– | V |
| $V_{IL}$ | Input Logic Low Voltage | $V_{OUT} = -V_{CC} - 0.1$ V<br>$I_{OUT} \leq 20\ \mu A$ | 1.65 to 2.2<br>2.7 to 3.6<br>4.5 to 5.5 | –<br>–<br>– | $V_{CC}$ x 0.2<br>$V_{CC}$ x 0.2<br>0.8 | V |
| $I_{IN}$ | Input Leakage Current | $V_{IN} = V_{CC}$ or GND | 5.5 | −100 | +100 | nA |
| $V_{CC}$ | Power Supply Range | All | – | 1.65 | 5.5 | V |
| $I_{CC}$ | Supply Current | $V_{IN} = V_{CC}$ or GND<br>$I_{OUT} = 0\ \mu A$ | 1.8<br>3.3<br>5.5 | –<br>–<br>– | 1.0<br>1.0<br>1.0 | μA |

### ANALOG SWITCH CHARACTERISTICS − Digital Section (Voltages Referenced to GND)

| Symbol | Parameter | Condition | $V_{CC}$ (V) | −40°C to +85°C Min | −40°C to +85°C Typ | −40°C to +85°C Max | Unit |
|---|---|---|---|---|---|---|---|
| $R_{ON}$ | ON Resistance (Note 2) | $I_{COM}$ = 10 mA<br>$V_{IS}$ = 0 to $V_{CC}$ | 3.0 | – | 3.2 | 4.5 | Ω |
| | | | 5.0 | – | 2.1 | 3.5 | |
| $\Delta R_{ON}$ | ON Resistance Match Between Channels (Note 2 and 3) | $I_{COM}$ = 10 mA<br>$V_{IS}$ = 0 to $V_{CC}$ | 3.0 | – | 0.1 | 0.4 | Ω |
| | | | 5.0 | – | 0.1 | 0.4 | |
| $R_{FLAT[ON]}$ | ON Resistance Flatness (Note 4) | $I_{COM}$ = 10 mA<br>$V_{IS}$ = 0 to $V_{CC}$ | 3.0 | – | 1.12 | 1.5 | Ω |
| | | | 5.0 | – | 0.55 | 1.36 | |
| $I_{NO\_[OFF]}$<br>$I_{NC\_[OFF]}$ | NO_, NC_ Off−Leakage Current (Note 5) | $V_{COM}$ = 0.3 V or 3.3 V<br>$V_{NO}$ or $V_{NC}$ = 0.3 V or 3.3 V | 3.6 | −1.0 | 0.01 | +1.0 | nA |
| | | $V_{COM}$ = 0 V or 5.0 V<br>$V_{NO}$ or $V_{NC}$ = 0 V or 5.0 V | 5.5 | −1.0 | 0.01 | +1.0 | |
| $I_{COM\_[ON]}$ | COM_ On−Leakage Current (Note 5) | $V_{COM}$ = 0.3 V or 3.3 V<br>$V_{NO}$ or $V_{NC}$ = 0.3 V or 3.3 V | 3.6 | −2.0 | 0.01 | +2.0 | nA |
| | | $V_{COM}$ = 0 V or 5.0 V<br>$V_{NO}$ or $V_{NC}$ = 0 V or 5.0 V | 5.5 | −2.0 | 0.01 | +2.0 | |

### ANALOG SWITCH AC CHARACTERISTICS

| Symbol | Parameter | Condition | $V_{CC}$ (V) | −40°C to +85°C | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | |
| $t_{ON}$ | Turn−On Time | $V_{NC\_}$, $V_{NO\_}$ = $V_{IH}$ or $V_{IL}$<br>$R_L$ = 300 Ω, $C_L$ = 35 pF<br>$V_{IN[x]}$ = $V_{IH}$ or $V_{IL}$ | 1.8 to 5.5 | – | – | 30 | nS |
| $t_{OFF}$ | Turn−Off Time | $V_{NC\_}$, $V_{NO\_}$ = $V_{IH}$ or $V_{IL}$<br>$R_L$ = 300 Ω, $C_L$ = 35 pF<br>$V_{IN[x]}$ = $V_{IH}$ or $V_{IL}$ | 1.8 to 5.5 | – | – | 40 | nS |
| $t_{BBM}$ | Break−Before−Make Time Delay (Note 5) | $V_{NC\_}$, $V_{NO\_}$ = 1.5 V<br>$R_L$ = 300 Ω, $C_L$ = 35 pF | – | – | 8.0 | – | nS |
| $t_{SKEW}$ | Skew (Note 5) | $R_S$ = 39 Ω, $C_L$ = 50 pF | – | – | 0.15 | 2.0 | nS |

2. $R_{ON}$ characterized for $V_{CC}$ range (1.65 V to 5.5 V).
3. $\Delta R_{ON} = R_{ON}(MAX) - R_{ON}(MIN)$.
4. $R_{FLAT[ON]} = R_{ON}(MAX) - R_{ON}(MIN)$, measured over $V_{CC}$ range.
5. Guaranteed by design.

### ANALOG SWITCH APPLICATION CHARACTERISTICS

| Symbol | Parameter | Condition | $V_{CC}$ (V) | −40°C to +85°C | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | |
| Q | Charge Injection | $V_{IN}$ = $V_{CC}$ to GND<br>$R_{In}$ = 0 Ω, $C_L$ = 1.0 nF<br>Q = $C_L$ − $\Delta V_{OUT}$ | 3.0<br>5.0 | | 6.0<br>9.0 | | pC |
| VISO | Off−Isolation | f = 10 MHz<br>$V_{NO\_}$, $V_{NC\_}$ = 1.0 Vp−p<br>$R_L$ = 50 Ω, $C_L$ = 5.0 pF | 1.65 to 5.5 | | −50 | | dB |
| | | f = 1.0 MHz<br>$V_{NO\_}$, $V_{NC\_}$ = 1.0 Vp−p<br>$R_L$ = 50 Ω, $C_L$ = 5.0 pF | | | −75 | | |
| VCT | Cross−Talk | f = 10 MHz<br>$V_{NO\_}$, $V_{NC\_}$ = 1.0 Vp−p<br>$R_L$ = 50 Ω, $C_L$ = 5.0 pF | 1.65 to 5.5 | | −80 | | dB |
| | | f = 1.0 MHz<br>$V_{NO\_}$, $V_{NC\_}$ = 1.0 Vp−p<br>$R_L$ = 50 Ω, $C_L$ = 5.0 pF | | | −110 | | |
| BW | On−Channel −3.0 db Bandwidth | Signal = 0 dB<br>$R_L$ = 50 Ω, $C_L$ = 5.0 pF | 1.8 to 5.0 | | 90 | | MHz |
| THD | Total Harmonic Distortion | $V_{COM}$ = 2.0 Vp−p,<br>RL = 600 Ω, $T_A$ = 25°C | – | | 0.02 | | % |
| $C_{NO\_[OFF]}$<br>$C_{NC\_[OFF]}$ | NO_, NC_ OFF−Capacitance | F = 1.0 MHz | – | | 15 | | pF |
| $C_{NO\_[ON]}$<br>$C_{NC\_[ON]}$ | NO_, NC_ ON−Capacitance | F = 1.0 MHz | – | | 38 | | pF |

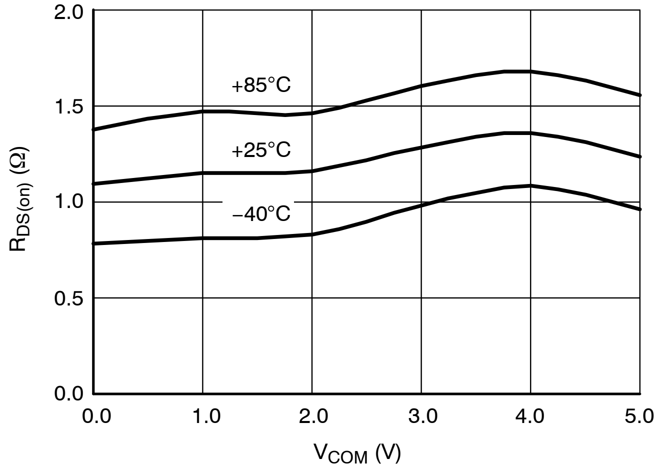



**Figure 2. $R_{DS(on)}$ @ $V_{CC}$ = 5.0 V**

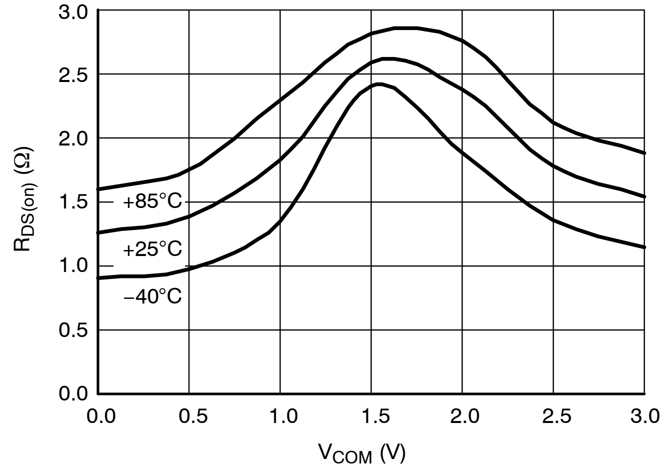



**Figure 3. $R_{DS(on)}$ @ $V_{CC}$ = 3.0 V**

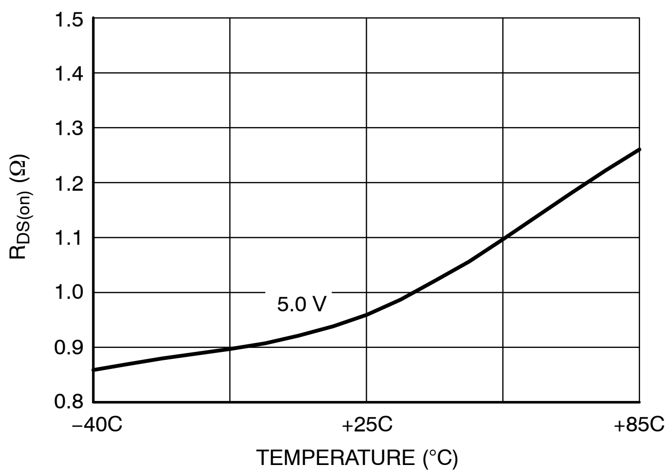



**Figure 4. Delta $R_{DS(on)}$ @ $V_{CC}$ = 5.0 V**

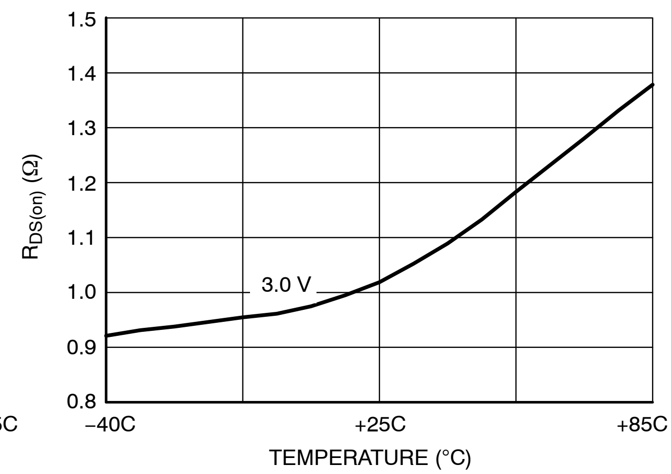



**Figure 5. Delta $R_{DS(on)}$ @ $V_{CC}$ = 3.0 V**

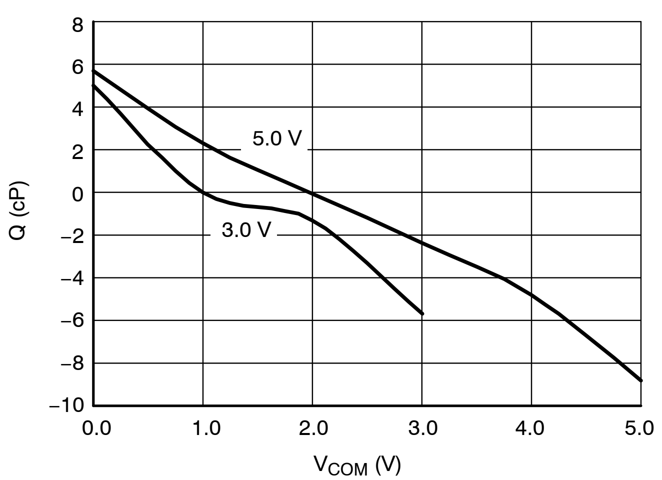



**Figure 6. Charge Injection**

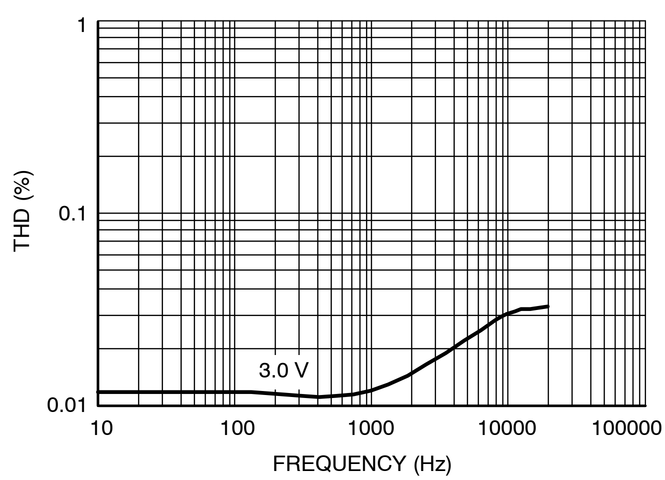



**Figure 7. Total Harmonic Distortion**

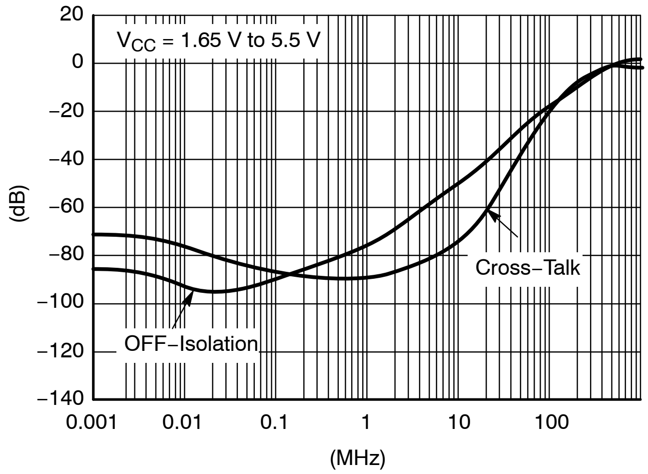



**Figure 8. Frequency Response**

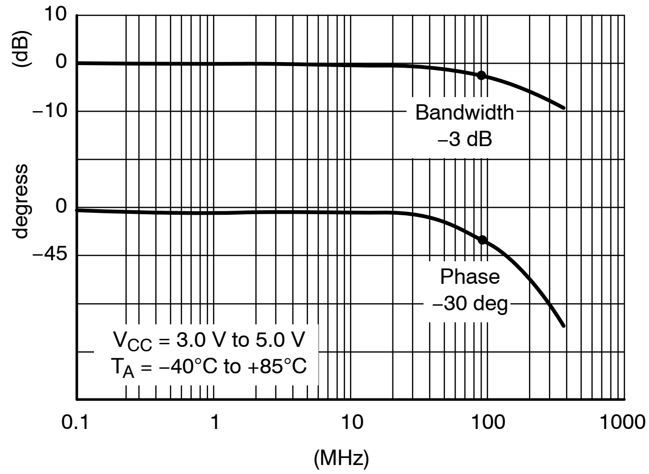



**Figure 9. Bandwidth and Phase**

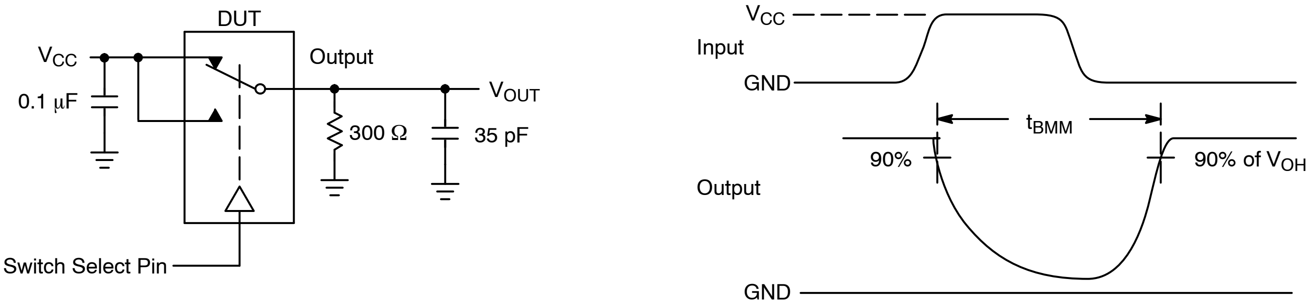



**Figure 10. $t_{BBM}$ (Time Break−Before−Make)**

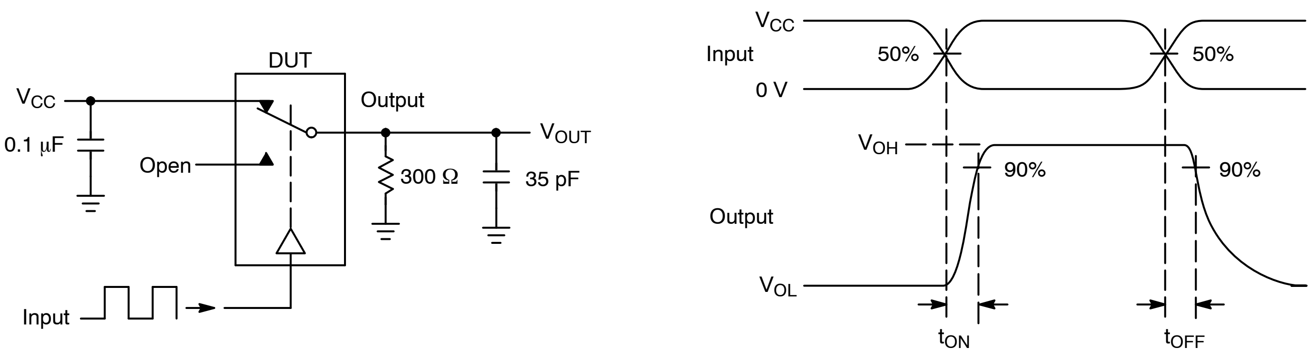



**Figure 11. $t_{ON}$/$t_{OFF}$**

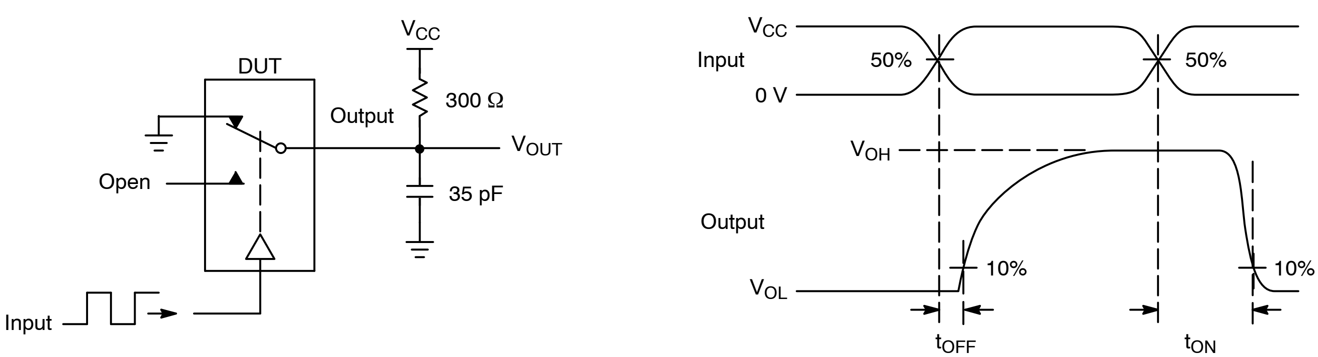
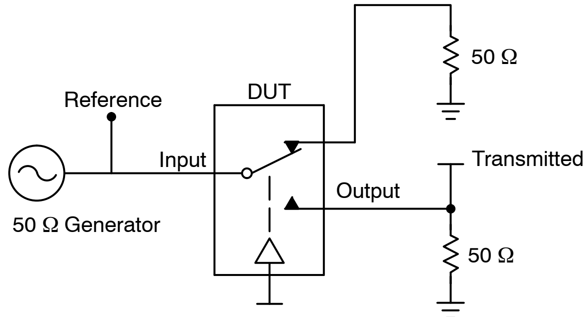



**Figure 12. $t_{ON}$/$t_{OFF}$**




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 3.0 dB below $V_{ONL}$
$V_{CT}$ = Use $V_{ISO}$ setup and test to all other switch analog input/outputs terminated with 50 Ω

**Figure 13. Off Channel Isolation/On Channel Loss (BW)/Crosstalk (On Channel to Off Channel)/$V_{ONL}$**

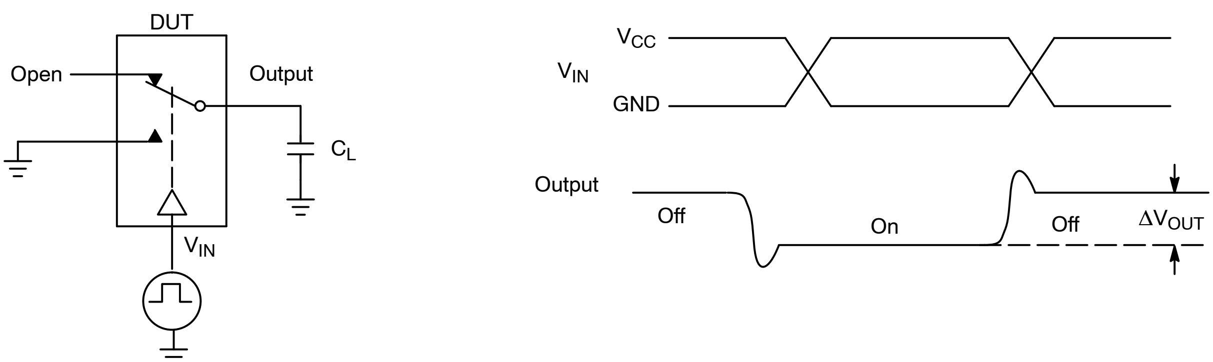
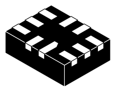



**Figure 14. Charge Injection: (Q)**



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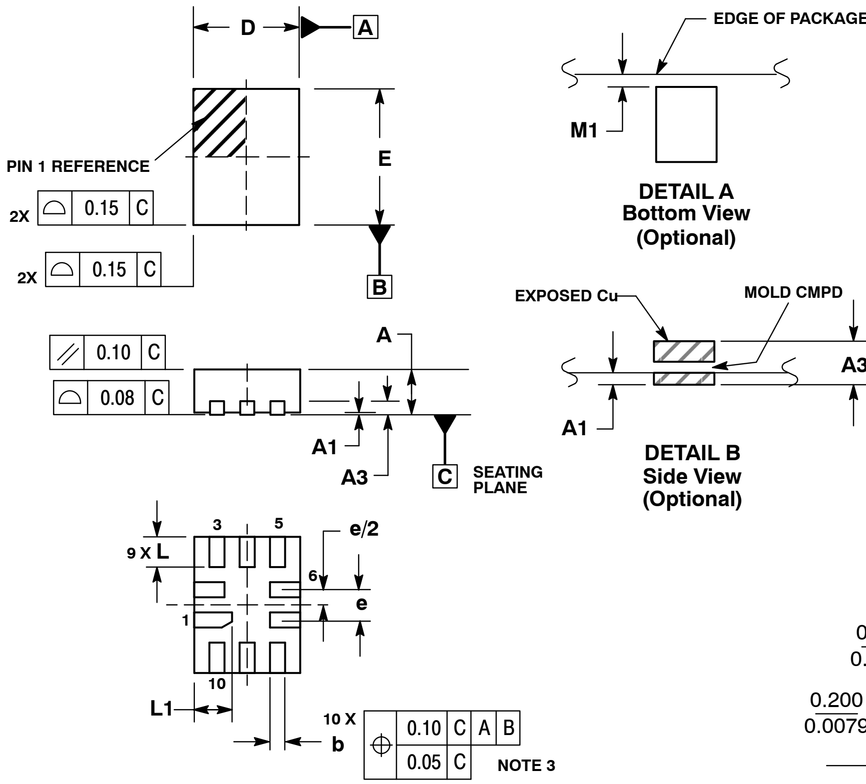
**SCALE 5:1**

## WQFN10, 1.4x1.8, 0.4P
CASE 488AQ−01
ISSUE C

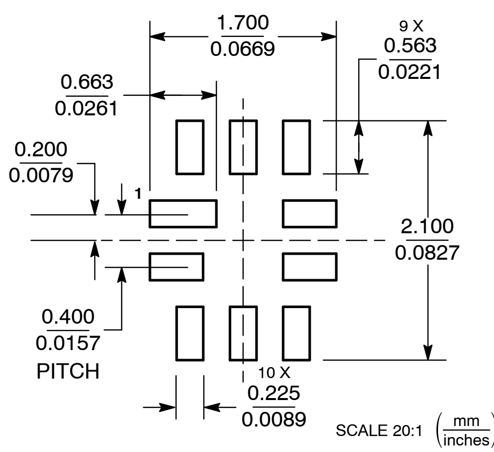
DATE 19 JUN 2007




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. EXPOSED PADS CONNECTED TO DIE FLAG. USED AS TEST CONTACTS.

| | MILLIMETERS | |
|---|---|---|
| DIM | MIN | MAX |
| A | 0.70 | 0.80 |
| A1 | 0.00 | 0.050 |
| A3 | 0.20 REF | |
| b | 0.15 | 0.25 |
| D | 1.40 BSC | |
| E | 1.80 BSC | |
| e | 0.40 BSC | |
| L | 0.30 | 0.50 |
| L1 | 0.40 | 0.60 |
| M1 | 0.00 | 0.05 |

## MOUNTING FOOTPRINT

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|---|---|---|---|
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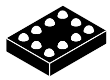
| DESCRIPTION: | WQFN10, 1.4 X 1.8, 0.4P | | PAGE 1 OF 1 |

**10 PIN FLIP−CHIP**
CASE 489AA−01
ISSUE A



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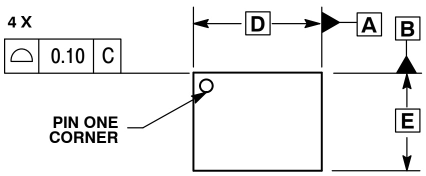
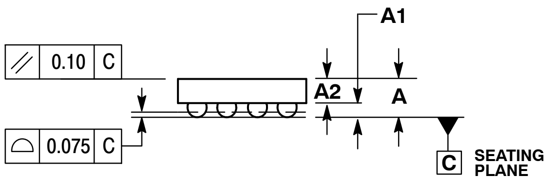
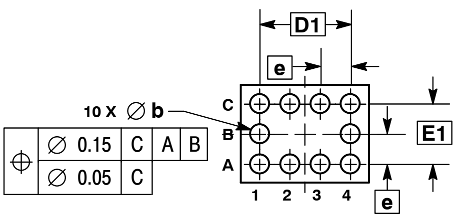
DATE 04 MAY 2004

**SCALE 4:1**



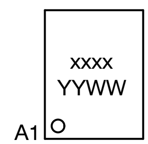




NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. COPLANARITY APPLIES TO SPHERICAL CROWNS OF SOLDER BALLS.

| | 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 | |

**GENERIC MARKING DIAGRAM***




xxxx = Specific Device Code
YY = Year
WW = Work Week

*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.

| | | |
|---|---|---|
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| **DESCRIPTION:** | **10 PIN FLIP−CHIP** | **PAGE 1 OF 1** |

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**North American Technical Support:**
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Phone: 011 421 33 790 2910

**Europe, Middle East and Africa Technical Support:**
Phone: 00421 33 790 2910
For additional information, please contact your local Sales Representative