

NLAS7242

High-Speed USB 2.0 (480 Mbps) DPDT Switches

The NLAS7242 is a DPDT switch optimized for high-speed USB 2.0 applications within portable systems. It features ultra-low on capacitance, $C_{ON} = 7.5$ pF (typ), and a bandwidth above 950 MHz. It is optimized for applications that use a single USB interface connector to route multiple signal types. The C_{ON} and R_{ON} of both channels are suitably low to allow the NLAS7242 to pass any speed USB data or audio signals going to a moderately resistive terminal such as an external headset. The device is offered in a UQFN10 1.4 mm x 1.8 mm package.

Features

- Optimized Flow-Through Pinout
- R_{ON} : 5.0 Ω Typ @ $V_{CC} = 4.2$ V
- C_{ON} : 7.5 pF Typ @ $V_{CC} = 3.3$ V
- V_{CC} Range: 1.65 V to 4.5 V
- Typical Bandwidth: 950 MHz
- 1.4 mm x 1.8 mm x 0.50 mm UQFN10
- OVT on Common Signal Pins D+/D- up to 5.25 V
- 8 kV HBM ESD Protection on All Pins
- This is a Pb-Free Device

Typical Applications

- High Speed USB 2.0 Data
- Mobile Phones
- Portable Devices

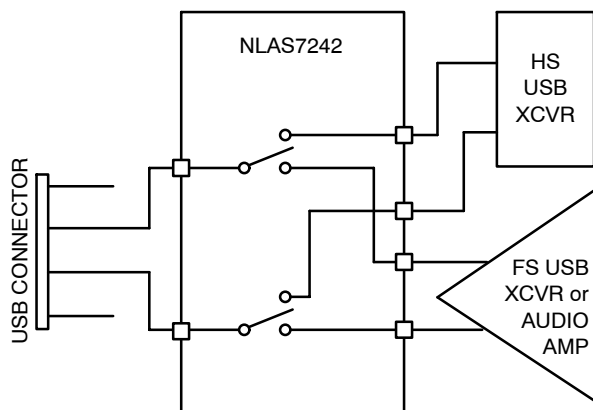


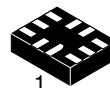
Figure 1. Application Diagram



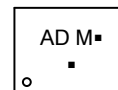
ON Semiconductor®

<http://onsemi.com>

MARKING DIAGRAM



UQFN10
CASE 488AT



AD = Device Code
M = Date Code
■ = Pb-Free Device

(Note: Microdot may be in either location)

ORDERING INFORMATION

| Device | Package | Shipping† |
|---------------|--------------------|------------------|
| NLAS7242MUTBG | UQFN0 (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 Specification Brochure, BRD8011/D.

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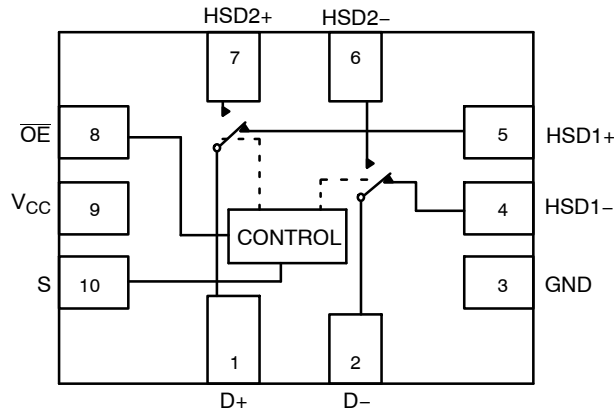


Figure 2. Pin Connections and Logic Diagram (Top View)

Table 1. PIN DESCRIPTION

| Pin | Function |
|------------------------------------|---------------|
| S | Control Input |
| \overline{OE} | Output Enable |
| HSD1+, HSD1-, HSD2+, HSD2-, D+, D- | Data Ports |

Table 2. TRUTH TABLE

| \overline{OE} | S | HSD1+, HSD1- | HSD2+, HSD2- |
|-----------------|---|--------------|--------------|
| 1 | X | OFF | OFF |
| 0 | 0 | ON | OFF |
| 0 | 1 | OFF | ON |

MAXIMUM RATINGS

| Symbol | Pins | Parameter | Value | Unit |
|---------------|----------------------|---|------------------------|------|
| V_{CC} | V_{CC} | Positive DC Supply Voltage | -0.5 to +5.5 | V |
| V_{IS} | HSDn+, HSDn- | Analog Signal Voltage | -0.5 to $V_{CC} + 0.3$ | V |
| | D+, D- | | -0.5 to +5.25 | |
| V_{IN} | S, \overline{OE} | Control Input Voltage, Output Enable Voltage | -0.5 to +5.5 | V |
| I_{CC} | V_{CC} | Positive DC Supply Current | 50 | mA |
| T_S | | Storage Temperature | -65 to +150 | °C |
| I_{IS_CON} | HSDn+, HSDn-, D+, D- | Analog Signal Continuous Current-Closed Switch | ± 300 | mA |
| I_{IS_PK} | HSDn+, HSDn-, D+, D- | Analog Signal Continuous Current 10% Duty Cycle | ± 500 | mA |
| I_{IN} | S, \overline{OE} | Control Input Current, Output Enable Current | ± 20 | 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.

RECOMMENDED OPERATING CONDITIONS

| Symbol | Pins | Parameter | Min | Max | Unit |
|----------|--------------------|--|------|----------|------|
| V_{CC} | | Positive DC Supply Voltage | 1.65 | 4.5 | V |
| V_{IS} | HSDn+, HSDn- | Analog Signal Voltage | GND | V_{CC} | V |
| | D+, D- | | GND | 4.5 | |
| V_{IN} | S, \overline{OE} | Control Input Voltage, Output Enable Voltage | GND | V_{CC} | V |
| T_A | | Operating Temperature | -40 | +85 | °C |

Minimum and maximum values are guaranteed through test or design across the Recommended Operating Conditions, where applicable. Typical values are listed for guidance only and are based on the particular conditions listed for section, where applicable. These conditions are valid for all values found in the characteristics tables unless otherwise specified in the test conditions.

ESD PROTECTION

| Symbol | Parameter | Value | Unit |
|--------|-----------------------------|-------|------|
| ESD | Human Body Model - All Pins | 8.0 | kV |

DC ELECTRICAL CHARACTERISTICS

CONTROL INPUT, OUTPUT ENABLE VOLTAGE (Typical: T = 25°C)

| Symbol | Pins | Parameter | Test Conditions | V _{CC} (V) | -40°C to +85°C | | | Unit |
|-----------------|--------------------|---|---------------------------------------|---------------------|----------------|-----|------|------|
| | | | | | Min | Typ | Max | |
| V _{IH} | S, \overline{OE} | Control Input, Output Enable HIGH Voltage (See Figure 11) | | 2.7 | 1.25 | - | - | V |
| | | | | 3.3 | 1.3 | | | |
| | | | | 4.2 | 1.4 | | | |
| V _{IL} | S, \overline{OE} | Control Input, Output Enable LOW Voltage (See Figure 11) | | 2.7 | - | - | 0.35 | V |
| | | | | 3.3 | | | 0.4 | |
| | | | | 4.2 | | | 0.5 | |
| I _{IN} | S, \overline{OE} | Current Input, Output Enable Leakage Current | 0 ≤ V _{IS} ≤ V _{CC} | 1.65 – 4.5 | - | - | ±1.0 | μA |

SUPPLY CURRENT AND LEAKAGE (Typical: T = 25°C, V_{CC} = 3.3 V)

| Symbol | Pins | Parameter | Test Conditions | V _{CC} (V) | -40°C to +85°C | | | Unit |
|------------------|-----------------|---------------------------|--|---------------------|----------------|------|------|------|
| | | | | | Min | Typ | Max | |
| I _{CC} | V _{CC} | Quiescent Supply Current | 0 ≤ V _{IS} ≤ V _{CC} ; I _D = 0 A | 1.65 – 3.6 | - | - | 1.0 | μA |
| | | | 0 ≤ V _{IS} ≤ V _{CC} - 0.5 V | 3.6 – 4.5 | - | - | 1.0 | |
| I _{OZ} | | OFF State Leakage | 0 ≤ V _{IS} ≤ V _{CC} | 1.65 – 4.5 | - | ±0.1 | ±1.0 | μA |
| I _{OFF} | D+, D- | Power OFF Leakage Current | 0 ≤ V _{IS} ≤ V _{CC} | 0 | - | - | ±1.0 | μA |

LIMITED V_{IS} SWING ON RESISTANCE (Typical: T = 25°C)

| Symbol | Pins | Parameter | Test Conditions | V _{CC} (V) | -40°C to +85°C | | | Unit |
|-------------------|------|--|--|---------------------|----------------|------|-----|------|
| | | | | | Min | Typ | Max | |
| R _{ON} | | On-Resistance (Note 1) | I _{ON} = 8 mA V _{IS} = 0 V to 0.4 V | 2.7 | - | 6.0 | 8.6 | Ω |
| | | | | 3.3 | | 5.5 | 7.6 | |
| | | | | 4.2 | | 5.0 | 7.0 | |
| R _{FLAT} | | On-Resistance Flatness (Notes 1 and 2) | I _{ON} = 8 mA V _{IS} = 0 V to 0.4 V | 2.7 | - | 0.55 | - | Ω |
| | | | | 3.3 | | 0.30 | | |
| | | | | 4.2 | | 0.20 | | |
| ΔR _{ON} | | On-Resistance Matching (Notes 1 and 3) | I _{ON} = 8 mA V _{IS} = 0 V to 0.4 V | 2.7 | - | 0.60 | - | Ω |
| | | | | 3.3 | | 0.60 | | |
| | | | | 4.2 | | 0.60 | | |

1. Guaranteed by design.
2. Flatness is defined as the difference between the maximum and minimum value of On-Resistance as measured over the specified analog signal ranges.
3. ΔR_{ON} = R_{ON(max)} - R_{ON(min)} between HSD1+ and HSD1- or HSD2+ and HSD2-.

FULL V_{IS} SWING ON RESISTANCE (Typical: T = 25°C)

| Symbol | Pins | Parameter | Test Conditions | V _{CC} (V) | -40°C to +85°C | | | Unit |
|-------------------|------|--|--|---------------------|----------------|------|------|------|
| | | | | | Min | Typ | Max | |
| R _{ON} | | On-Resistance | I _{ON} = 8 mA V _{IS} = 0 V to V _{CC} | 2.7 | - | 10 | 13.5 | Ω |
| | | | | 3.3 | | 8.0 | 9.75 | |
| | | | | 4.2 | | 7.0 | 8.50 | |
| R _{FLAT} | | On-Resistance Flatness (Notes 4 and 5) | I _{ON} = 8 mA V _{IS} = 0 V to V _{CC} | 2.7 | - | 4.5 | - | Ω |
| | | | | 3.3 | | 3.0 | | |
| | | | | 4.2 | | 2.5 | | |
| ΔR _{ON} | | On-Resistance (Note 4 and 6) | I _{ON} = 8 mA V _{IS} = 0 V to V _{CC} | 2.7 | - | 0.60 | - | Ω |
| | | | | 3.3 | | 0.60 | | |
| | | | | 4.2 | | 0.60 | | |

4. Guaranteed by design.
5. Flatness is defined as the difference between the maximum and minimum value of On-Resistance as measured over the specified analog signal ranges.
6. ΔR_{ON} = R_{ON(max)} - R_{ON(min)} between HSD1+ and HSD1- or HSD2+ and HSD2-.

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AC ELECTRICAL CHARACTERISTICS

TIMING/FREQUENCY (Typical: T = 25°C, V_{CC} = 3.3 V, R_L = 50 Ω, C_L = 35 pF, f = 1 MHz)

| Symbol | Pins | Parameter | Test Conditions | V _{CC} (V) | -40°C to +85°C | | | Unit |
|------------------|----------------|--|-----------------------|---------------------|----------------|------|------|------|
| | | | | | Min | Typ | Max | |
| t _{ON} | Closed to Open | Turn-ON Time (See Figures 4 and 5) | | 1.65 – 4.5 | – | 13.0 | 30.0 | ns |
| t _{OFF} | Open to Closed | Turn-OFF Time (See Figures 4 and 5) | | 1.65 – 4.5 | – | 12.0 | 25.0 | ns |
| T _{BBM} | | Break-Before-Make Time (See Figure 3) | | 1.65 – 4.5 | 2.0 | – | – | ns |
| BW | | -3 dB Bandwidth (See Figure 10) | C _L = 5 pF | 1.65 – 4.5 | – | 950 | – | MHz |

ISOLATION (Typical: T = 25°C, V_{CC} = 3.3 V, R_L = 50 Ω, C_L = 5 pF)

| Symbol | Pins | Parameter | Test Conditions | V _{CC} (V) | -40°C to +85°C | | | Unit |
|-------------------|----------------|-----------------------------------|-----------------|---------------------|----------------|-----|-----|------|
| | | | | | Min | Typ | Max | |
| O _{IRR} | Open | OFF-Isolation (See Figure 6) | f = 240 MHz | 1.65 – 4.5 | – | -22 | – | dB |
| X _{TALK} | HSDn+ to HSDn- | Non-Adjacent Channel Crosstalk | f = 240 MHz | 1.65 – 4.5 | – | -24 | – | dB |

CAPACITANCE (Typical: T = 25°C, V_{CC} = 3.3 V, R_L = 50 Ω, C_L = 5 pF)

| Symbol | Pins | Parameter | Test Conditions | -40°C to +85°C | | | Unit |
|------------------|----------------------------|---|--|----------------|-----|-----|------|
| | | | | Min | Typ | Max | |
| C _{IN} | S, \overline{OE} | Control Pin, Output Enable Input Capacitance | V _{CC} = 0 V, f = 1 MHz | – | 1.5 | – | pF |
| | | | V _{CC} = 0 V, f = 10 MHz | – | 1.0 | – | |
| C _{ON} | D+ to HSD1+ or HSD2+ | ON Capacitance | V _{CC} = 3.3 V; \overline{OE} = 0 V, f = 1 MHz S = 0 V or 3.3 V | – | 7.5 | – | pF |
| | | | V _{CC} = 3.3 V; \overline{OE} = 0 V, f = 10 MHz S = 0 V or 3.3 V | – | 6.5 | – | |
| C _{OFF} | HSD1n or HSD2n | OFF Capacitance | V _{CC} = V _{IS} = 3.3 V; \overline{OE} = 0 V, S = 3.3 V or 0 V, f = 1 MHz | – | 3.8 | – | pF |
| | | | V _{CC} = V _{IS} = 3.3 V; \overline{OE} = 0 V, S = 3.3 V or 0 V, f = 10 MHz | – | 2.0 | – | |

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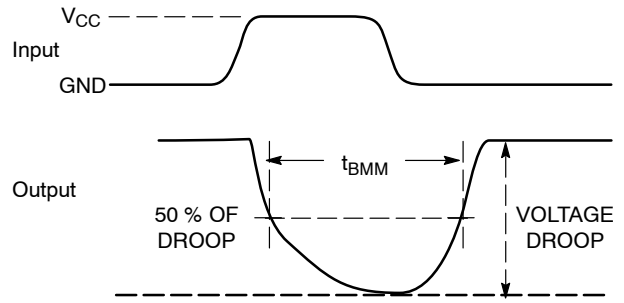
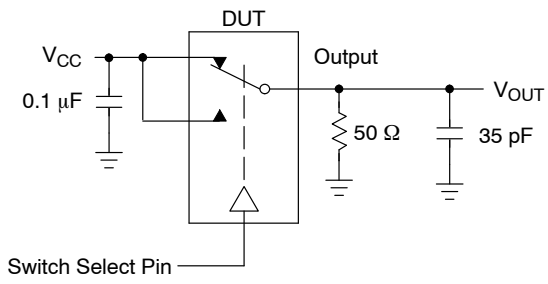


Figure 3. t_{BMM} (Time Break-Before-Make)

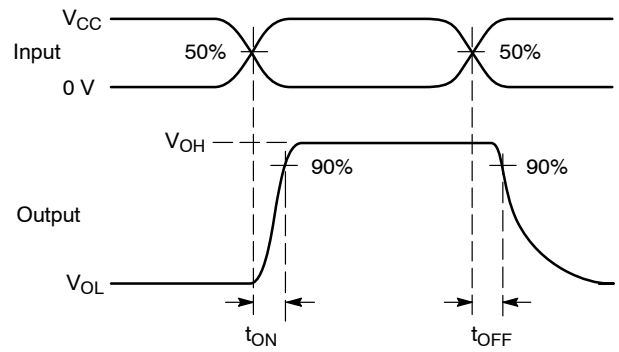
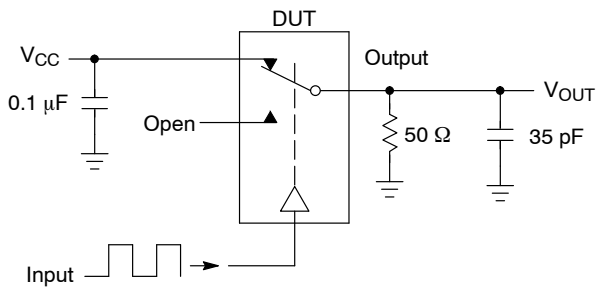


Figure 4. t_{ON}/t_{OFF}

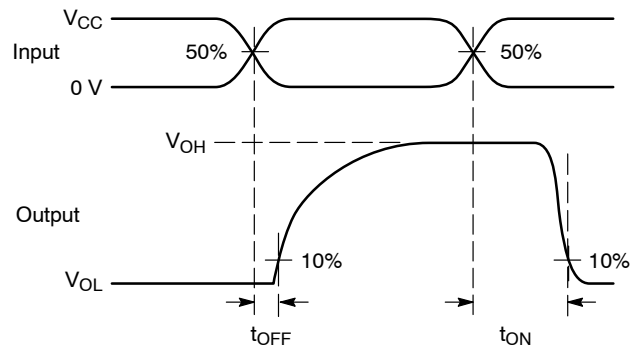
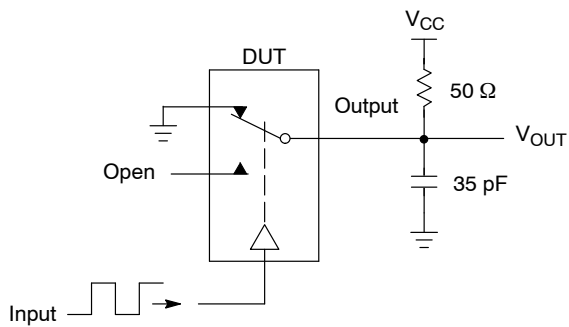
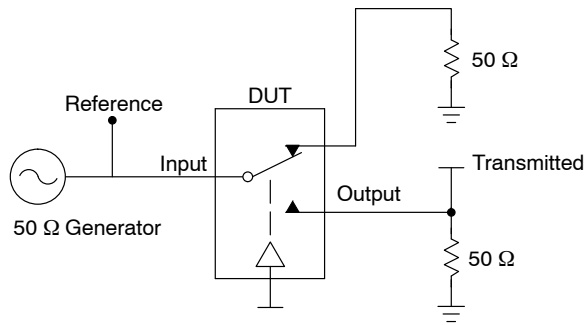


Figure 5. t_{ON}/t_{OFF}

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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}

DETAILED DESCRIPTION

High Speed (480Mbps) USB 2.0 Optimized

The NLAS7242 is a DPDT switch designed for USB applications within portable systems. The R_{ON} and C_{ON} of both switches are maintained at industry-leading low levels in order to ensure maximum signal integrity for USB 2.0 high speed data communication. The NLAS7242 switch can be used to switch between high speed (480Mbps) USB signals and a variety of audio or data signals such as full speed USB, UART or even a moderately resistive audio terminal.

Over Voltage Tolerant

The NLAS7242 features over voltage tolerant I/O protection on the common signal pins D+/D-. This allows the switch to interface directly with a USB connector. The D+/D- pins can withstand a short to V_{BUS} , up to 5.25 V, continuous DC current for up to 24 hours as specified in the USB 2.0 specification. This protection is achieved without the need for any external resistors or protection devices.

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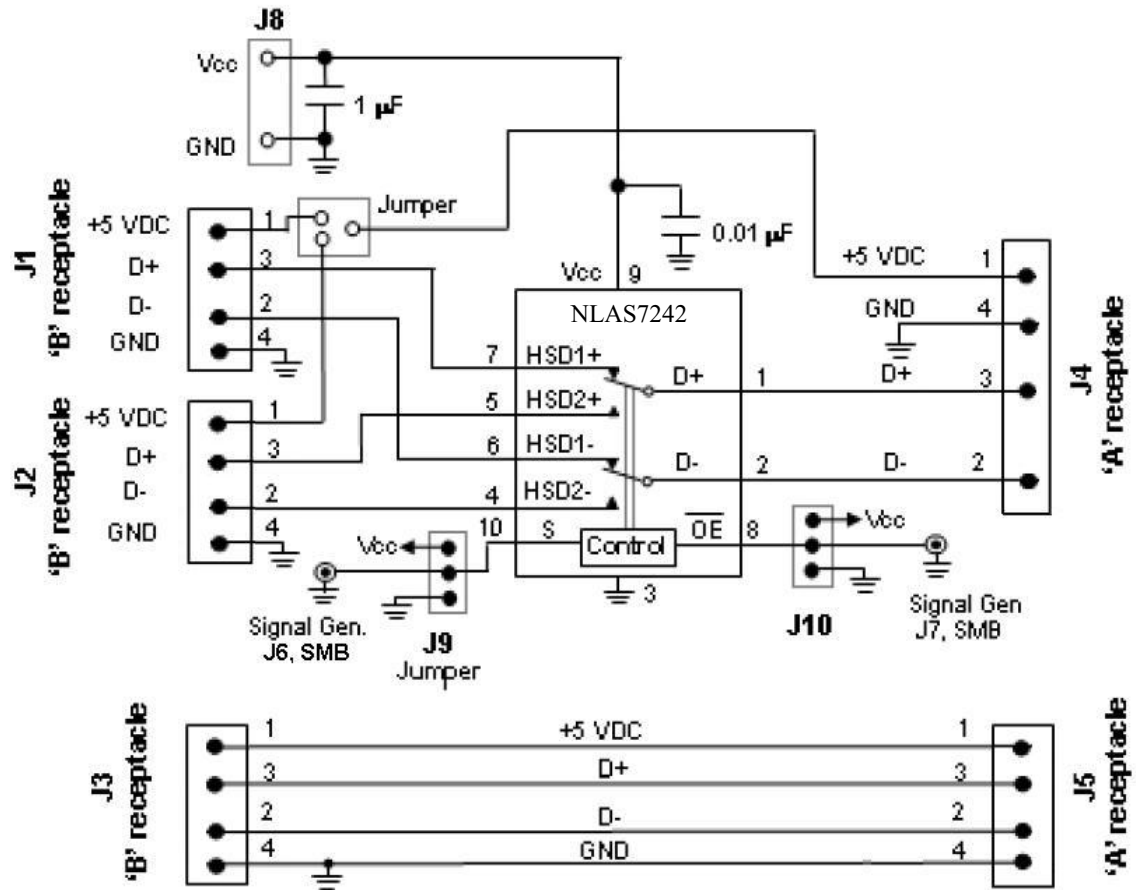


Figure 7. Board Schematic

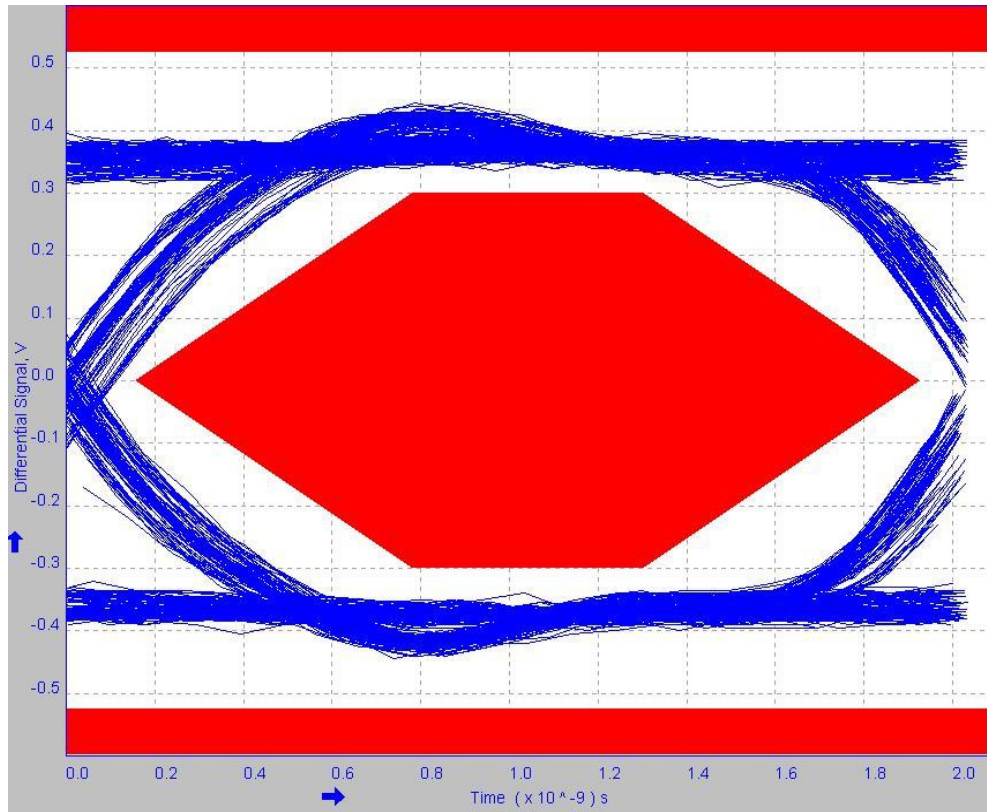


Figure 8. Signal Quality

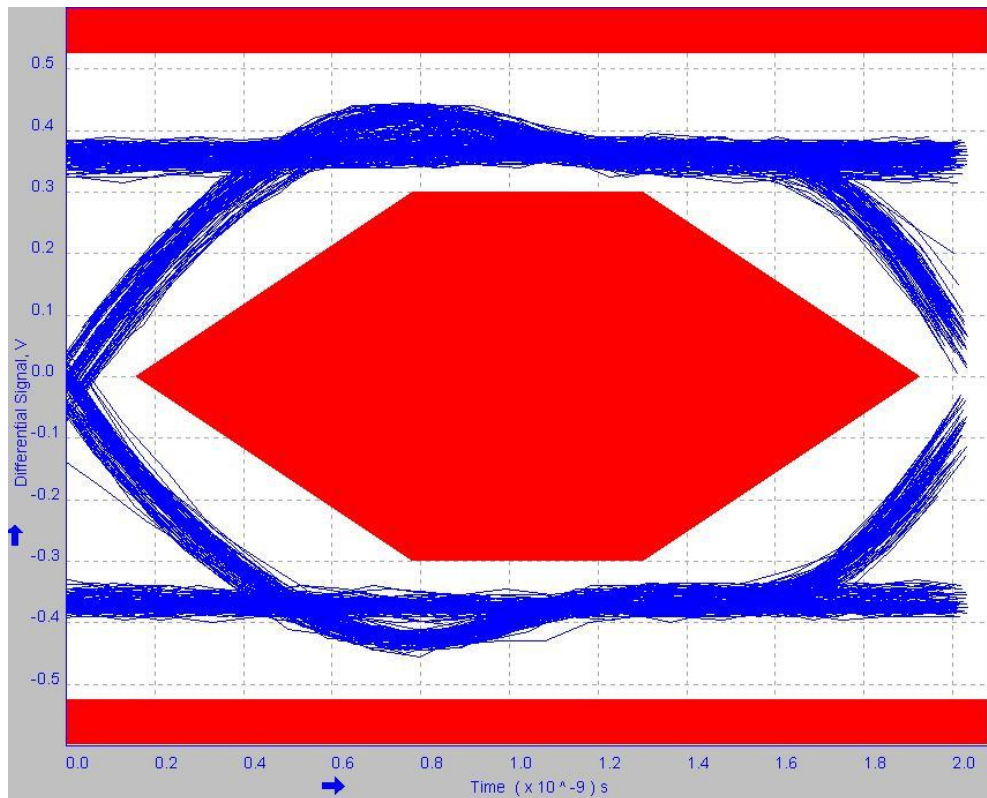
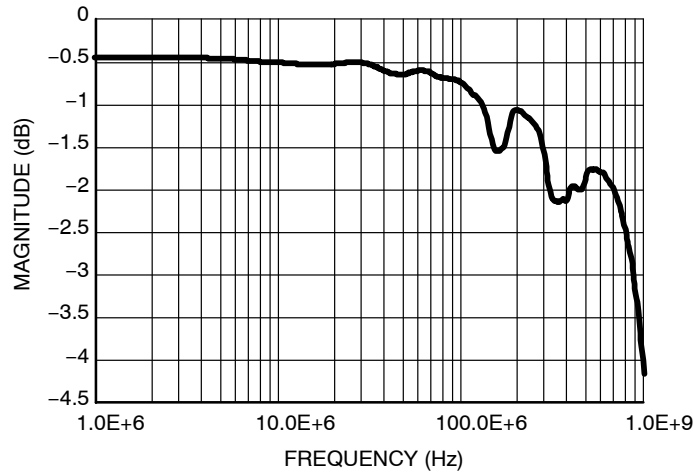


Figure 9. Near End Eye Diagram

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| Near End Test Data: | | | | | Min | Max |
|---------------------|--------------------------|--------|-------|----|---------|---------|
| Std. | Consecutive jitter range | -54.37 | 73.21 | ps | -200 ps | +200 ps |
| | Paired JK jitter range | -59.14 | 59.56 | ps | | |
| | Paired KJ jitter range | -50.79 | 34.57 | ps | | |
| N.C. | Consecutive jitter range | -74.43 | 81.65 | ps | -200 ps | +200 ps |
| | Paired JK jitter range | -61.60 | 58.55 | ps | | |
| | Paired KJ jitter range | -55.31 | 48.43 | ps | | |
| N.O. | Consecutive jitter range | -82.55 | 80.33 | ps | -200 ps | +200 ps |
| | Paired JK jitter range | -53.50 | 71.65 | ps | | |
| | Paired KJ jitter range | -62.60 | 47.30 | ps | | |



**Figure 10. Magnitude vs. Frequency
@ V_{CC} = 3.3 V, All Temperatures**

I_{CC} Leakage Current as a Function of V_{IN} Voltage (25°C)

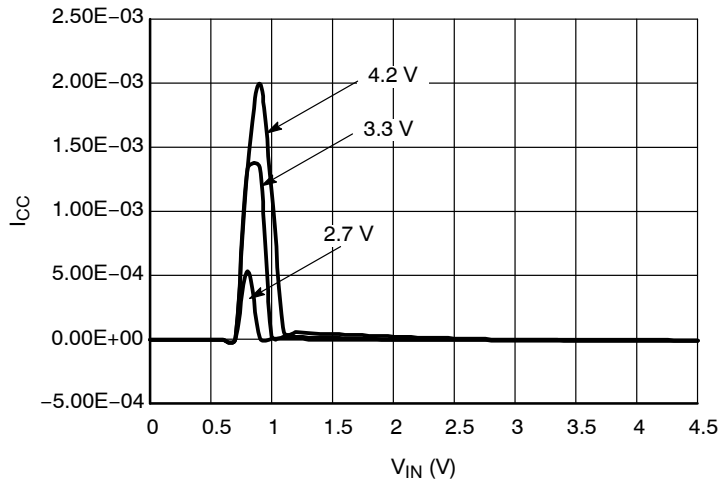


Figure 11. I_{CC} vs. V_{IN}, Select Pin, All V_{CC}'s, 25°C

MECHANICAL CASE OUTLINE

PACKAGE DIMENSIONS

ON Semiconductor®



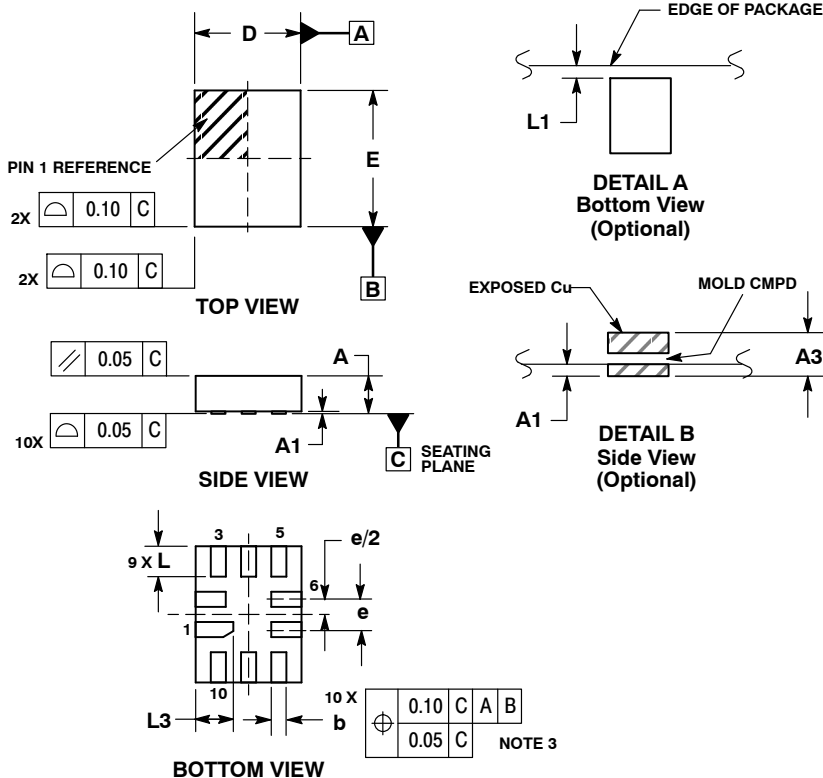
UQFN10 1.4x1.8, 0.4P

CASE 488AT-01
ISSUE A

DATE 01 AUG 2007

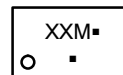


SCALE 5:1



- NOTES:
- DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
 - CONTROLLING DIMENSION: MILLIMETERS
 - DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.25 AND 0.30 MM FROM TERMINAL.
 - COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

GENERIC MARKING DIAGRAM*



- XX = Specific Device Code
 - M = Date Code
 - = Pb-Free Package
- (Note: Microdot may be in either location)

*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.

MOUNTING FOOTPRINT



| | | |
|-------------------------|-------------------------------------|--|
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| DESCRIPTION: | 10 PIN UQFN, 1.4 X 1.8, 0.4P | PAGE 1 OF 1 |

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