

# NCN7201

## 2:1 Gigabit Ethernet LAN Switch with Power-down Feature

The NCN7201 is an 8-channel, bidirectional Ethernet switch featuring a power shutdown feature with minimal current consumption. The NCN7201 is an upgraded version of the NCN7200, offering improved performance on the data lines while still maintaining backwards compatibility. This switch is compatible with 10/100/1000 Base-T Ethernet standards, providing high bandwidth and low return loss. Three additional lines are provided for status indicator LEDs that switch. ESD protection is built into the switch. This device can be used to route signals between a single Ethernet transceiver and an RJ45 connector and a docking station. The NCN7201 comes in a 42-pin WQFN package (3.5 mm x 9 mm, 0.5 mm pitch).

### Features

- 2:1 Multiplexer/ Demultiplexer LAN Switch
- Three Additional Channels for LED Switching
- Fully Specified for Power Supply Range: 3 V to 3.6 V
- Power-down Feature Conserves Energy
- Insertion loss of  $-2.7$  dB at 1 GHz
- ESD Performance:  $\pm 8$  kV Human Body Model (JEDEC)  
 $\pm 8$  kV Contact Discharge (IEC61000-4-2)
- This is a Pb-Free Device

### Typical Applications

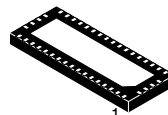
- Signal Routing for 10/100/1000 Mbps Ethernet



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### MARKING DIAGRAM



NCN7201  
AWLYYWWG

**WQFN42  
CASE 510AP**

A = Assembly Location  
WL = Wafer Lot  
YY = Year  
WW = Work Week  
G = Pb-Free Package

### ORDERING INFORMATION

| Device       | Package             | Shipping <sup>†</sup> |
|--------------|---------------------|-----------------------|
| NCN7201MTTWG | WQFN42<br>(Pb-Free) | 2000 / Tape & Reel    |

<sup>†</sup>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.

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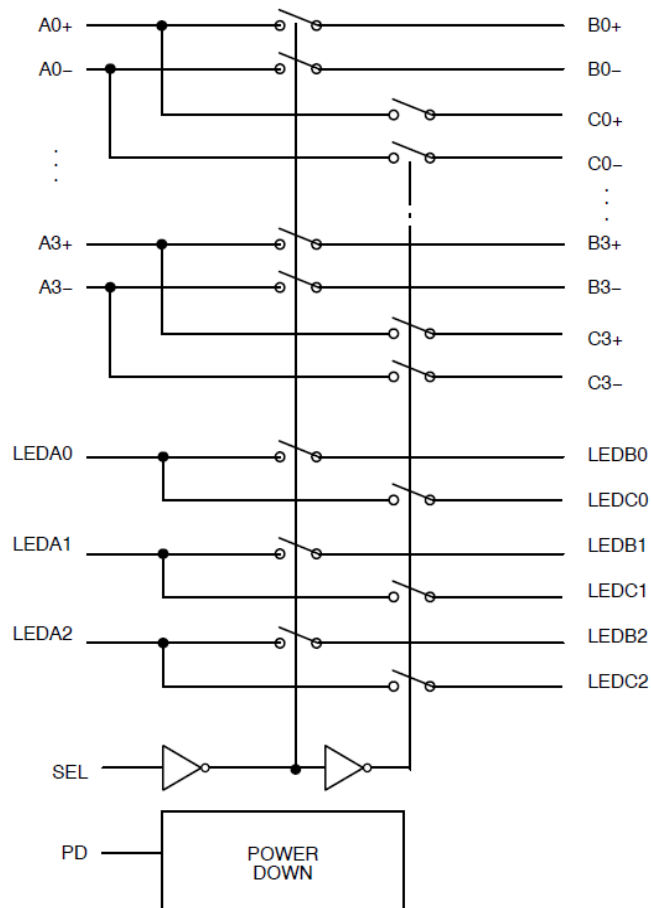


Figure 1. Block Diagram

## TRUTH TABLE

| PD | SEL | Function                 |
|----|-----|--------------------------|
| 0  | 0   | AX to BX; LEDAX to LEDBX |
| 0  | 1   | AX to CX; LEDAX to LEDCX |
| 1  | X   | Hi-Z                     |

## NCN7201

### PIN FUNCTION DESCRIPTION

| Pin No.                        | Pin Name  | Description                                                                                                                                                                                               |
|--------------------------------|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1, 4, 8, 14, 30, 39            | VDD       | Power Supply Pin. It is recommended that a bypass capacitor of at least 0.1 $\mu$ F is placed as close as possible to each VDD pin.                                                                       |
| 5                              | PD        | Power Down Pin. When PD is logic high, the device enters Power Down mode. All switch paths are high impedance. There is no internal pull-up or pull-down resistor; therefore, this pin cannot be floated. |
| 13                             | SEL       | Channel Select Pin. When PD is logic low, the SEL pin controls whether the AX pins are connected to BX or CX. There is no internal pull-up or pull-down resistor; therefore, this pin cannot be floated.  |
| 2, 3, 6, 7, 9, 10, 11, 12      | AX+, AX – | Data Port A. This is the common side of the data switch.                                                                                                                                                  |
| 24, 25, 28, 29, 33, 34, 37, 38 | BX+, BX – | Data Port B. This is a switchable port of the data switch.                                                                                                                                                |
| 22, 23, 26, 27, 31, 32, 35, 36 | CX+, CX – | Data Port C. This is a switchable port of the data switch.                                                                                                                                                |
| 15, 16, 42                     | LEDAX     | LED Port A. This is the common side of the LED switch.                                                                                                                                                    |
| 17, 18, 41                     | LEDBX     | LED Port B. This is a switchable port of the LED switch.                                                                                                                                                  |
| 19, 20, 40                     | LEDCX     | LED Port C. This is a switchable port of the LED switch.                                                                                                                                                  |
| Exposed Pad on Underside       | GND       | Ground Supply. The exposed pad provides ground reference to the device.                                                                                                                                   |

# NCN7201

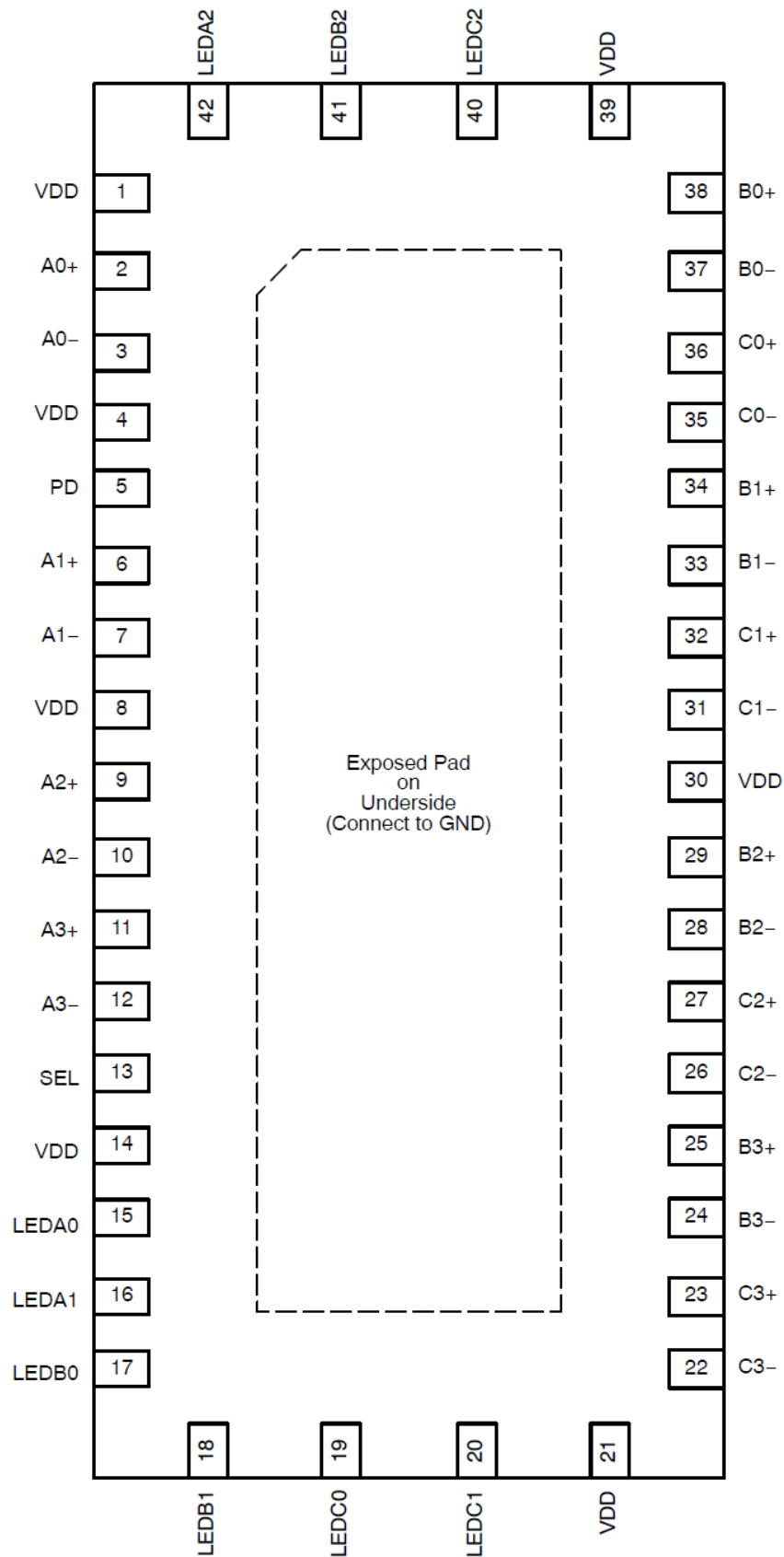


Figure 2. Pin Description  
(Top View)

# NCN7201

## ABSOLUTE MAXIMUM RATINGS (Note 1)

| Rating                                |                                                           | Symbol                                                        | Value                        | Unit |
|---------------------------------------|-----------------------------------------------------------|---------------------------------------------------------------|------------------------------|------|
| Maximum Supply Voltage Range          |                                                           | V <sub>DD</sub>                                               | −0.5 to 4.0                  | V    |
| Maximum Analog Signal Voltage Range   |                                                           | V <sub>IS</sub>                                               | −0.5 to V <sub>DD</sub> +0.5 | V    |
| Maximum Voltage Range on Control Pins |                                                           | V <sub>IN</sub>                                               | −0.5 to 6.0                  | V    |
| Continuous Switch Current             |                                                           | I <sub>IS</sub>                                               | 120                          | mA   |
| Maximum Junction Temperature          |                                                           | T <sub>J(max)</sub>                                           | 150                          | °C   |
| Storage Temperature Range             |                                                           | T <sub>STG</sub>                                              | −65 to 150                   | °C   |
| Power Dissipation                     |                                                           | P <sub>d</sub>                                                | 0.5                          | W    |
| ESD Capability (Note 2)               | Human Body Model<br>Machine Model<br>Charged Device Model | ESD <sub>HBM</sub><br>ESD <sub>MM</sub><br>ESD <sub>CDM</sub> | 8000<br>400<br>2000          | V    |
| Latch-up Current (Note 2)             |                                                           | I <sub>LU</sub>                                               | 150                          | mA   |
| Moisture Sensitivity Level (Note 3)   |                                                           | MSL                                                           | Level 1                      |      |

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. Refer to ELECTRICAL CHARACTERISTICS and APPLICATION INFORMATION for Safe Operating Area.
2. This device series incorporates ESD protection and is tested by the following methods:  
 ESD Human Body Model tested per AEC-Q100-002 (JEDEC standard: JESD22-A114)  
 ESD Machine Model tested per AEC-Q100-003 (JEDEC standard: JESD22-A115)  
 ESD Charged Device Model tested per AEC-Q1000-005 (JEDEC standard: JESD22-C101E)  
 Latch-up Current tested per JEDEC standard: JESD78
3. Moisture Sensitivity Level tested per IPC/JEDEC standard: J – STD – 020A

## OPERATING RANGES

| Rating                              | Symbol   | Min | Max      | Unit |
|-------------------------------------|----------|-----|----------|------|
| Supply Voltage                      | $V_{DD}$ | 3.0 | 3.6      | V    |
| Analog Signal Voltage               | $V_{IS}$ | 0   | $V_{DD}$ | V    |
| Control Input Voltage on PD and SEL | $V_{IN}$ | 0   | $V_{DD}$ | V    |
| Ambient Temperature                 | $T_A$    | -40 | 85       | °C   |

# ELECTRICAL CHARACTERISTICS

Typical values are referenced to  $T_A = 25^{\circ}\text{C}$  and  $V_{DD} = 3.3\text{ V}$ , unless otherwise noted. Min/max values apply from  $T_A = -40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ , unless otherwise noted. (Notes 4 and 5)

| Parameter | Test Conditions | Symbol | Min | Typ | Max | Unit |
|-----------|-----------------|--------|-----|-----|-----|------|
|-----------|-----------------|--------|-----|-----|-----|------|

## CURRENT CONSUMPTION

|                             |                                                              |                 |      |     |     |               |
|-----------------------------|--------------------------------------------------------------|-----------------|------|-----|-----|---------------|
| Quiescent Supply Current    | $V_{DD} = 3.6\text{ V}$ , $V_{IN} = 0\text{ V}$ or $V_{DD}$  | $I_{DD-Q}$      |      | 380 | 450 | $\mu\text{A}$ |
| Power Down Supply Current   | $V_{DD} = 3.6\text{ V}$ , $V_{PD} = V_{DD}$                  | $I_{DD-PD}$     |      | 130 | 160 | $\mu\text{A}$ |
| Active Power Supply Current | $V_{DD} = 3.6\text{ V}$ , $V_{SEL} = 0\text{ V}$ or $V_{DD}$ | $I_{DD-ACTIVE}$ |      | 1   | 1.5 | $\text{mA}$   |
| Power Off Leakage Current   | $V_{DD} = 0\text{ V}$ , $V_{IN} = 0\text{ V}$ or $V_{DD}$    | $I_{OFF}$       | -0.1 |     | 0.1 | $\mu\text{A}$ |

## CONTROL LOGIC (SEL and PD Pins)

|                                    |                                                                                                         |          |              |      |            |               |
|------------------------------------|---------------------------------------------------------------------------------------------------------|----------|--------------|------|------------|---------------|
| High Voltage Input Threshold       | $V_{DD} = 3.2\text{ V}$ to $3.6\text{ V}$                                                               | $V_{IH}$ | 2            |      |            | $\text{V}$    |
| Low Voltage Input Threshold        | $V_{DD} = 3.2\text{ V}$ to $3.6\text{ V}$                                                               | $V_{IL}$ |              |      | 0.8        | $\text{V}$    |
| Clamp Diode Voltage                | $V_{DD} = 3.6\text{ V}$ , $I_{IN} = -18\text{ mA}$                                                      | $V_{IK}$ | -1.4         | -0.9 |            | $\text{V}$    |
| Control Input Leakage – Logic High | $V_{DD} = 3.6\text{ V}$ , $V_{SEL} = 3.6\text{ V}$<br>$V_{DD} = 3.6\text{ V}$ , $V_{PD} = 3.6\text{ V}$ | $I_{IN}$ | -0.1<br>-1.2 |      | 0.1<br>1.2 | $\mu\text{A}$ |
| Control Input Leakage – Logic Low  | $V_{DD} = 3.6\text{ V}$ , $V_{IN} = 0\text{ V}$                                                         | $I_{IN}$ | -0.1         |      | 0.1        | $\mu\text{A}$ |
| Control Input Capacitance          | $f = 1\text{ MHz}$                                                                                      | $C_{IN}$ |              | 2.5  |            | $\text{pF}$   |

## DATA SWITCH DC CHARACTERISTICS (AX, BX, and CX Pins)

|                        |                                                                                                                          |                 |      |            |        |               |
|------------------------|--------------------------------------------------------------------------------------------------------------------------|-----------------|------|------------|--------|---------------|
| On Resistance          | $V_{DD} = 3.0\text{ V}$ , $I_{IS} = 40\text{ mA}$ ,<br>$V_{IS} = 1.5\text{ V}$<br>$V_{IS} = V_{DD}$                      | $R_{ON}$        |      | 2.9<br>4.2 | 6<br>6 | $\Omega$      |
| On Resistance Flatness | $V_{DD} = 3.0\text{ V}$ , $I_{IS} = 40\text{ mA}$ ,<br>$V_{IS} = 0$ to $2\text{ V}$<br>$V_{IS} = 2\text{ V}$ to $V_{DD}$ | $R_{ON-FLAT}$   |      | 0.1<br>1.2 |        | $\Omega$      |
| On Resistance Matching | $V_{DD} = 3.0\text{ V}$ , $I_{IS} = 40\text{ mA}$ ,<br>$V_{IS} = 1.5\text{ V}$<br>$V_{IS} = V_{DD}$                      | $\Delta R_{ON}$ |      | 0.6<br>0.7 |        | $\Omega$      |
| Switch Off Leakage     | $V_{DD} = 3.6\text{ V}$ , $V_{IS} = 0$ to $3.6\text{ V}$                                                                 | $I_{SW\_OFF}$   | -0.1 |            | 0.1    | $\mu\text{A}$ |
| Switch On Leakage      | $V_{DD} = 3.6\text{ V}$ , $V_{IS} = 0$ to $3.6\text{ V}$                                                                 | $I_{SW\_ON}$    | -0.1 |            | 0.1    | $\mu\text{A}$ |

## DATA SWITCH AC CHARACTERISTICS (AX, BX, and CX Pins)

|                                          |                                                                    |           |  |                      |  |              |
|------------------------------------------|--------------------------------------------------------------------|-----------|--|----------------------|--|--------------|
| On Capacitance                           | $f = 1\text{ MHz}$                                                 | $C_{ON}$  |  | 3.5                  |  | $\text{pF}$  |
| Off Capacitance                          | $f = 1\text{ MHz}$                                                 | $C_{OFF}$ |  | 2.0                  |  | $\text{pF}$  |
| Differential Bandwidth                   |                                                                    | $D_{BW}$  |  | 1.1                  |  | $\text{GHz}$ |
| Differential Insertion Loss              | $f = 250\text{ MHz}$<br>$f = 500\text{ MHz}$<br>$f = 1\text{ GHz}$ | $D_{IL}$  |  | -1.0<br>-0.9<br>-2.7 |  | $\text{dB}$  |
| Differential Return Loss                 | $f = 40\text{ MHz}$<br>$f = 100\text{ MHz}$                        | $D_{RL}$  |  | -24<br>-16           |  | $\text{dB}$  |
| Differential Crosstalk, Adjacent Channel | $f = 250\text{ MHz}$<br>$f = 500\text{ MHz}$<br>$f = 1\text{ GHz}$ | $D_{CTK}$ |  | -46<br>-39<br>-30    |  | $\text{dB}$  |
| Differential Off Isolation               | $f = 250\text{ MHz}$<br>$f = 500\text{ MHz}$<br>$f = 1\text{ GHz}$ | $D_{ISO}$ |  | -35<br>-28<br>-22    |  | $\text{dB}$  |

4. Refer to ABSOLUTE MAXIMUM RATINGS and APPLICATION INFORMATION for Safe Operating Area.
5. Performance guaranteed over the indicated operating temperature range by design and/or characterization tested at  $T_J = T_A = 25^{\circ}\text{C}$ .
6. Guaranteed by design.

# **ELECTRICAL CHARACTERISTICS**

Typical values are referenced to  $T_A = 25^{\circ}\text{C}$  and  $V_{DD} = 3.3\text{ V}$ , unless otherwise noted. Min/max values apply from  $T_A = -40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ , unless otherwise noted. (Notes 4 and 5)

| Parameter | Test Conditions | Symbol | Min | Typ | Max | Unit |
|-----------|-----------------|--------|-----|-----|-----|------|
|-----------|-----------------|--------|-----|-----|-----|------|

## **LED SWITCH DC CHARACTERISTICS (LEDAX, LEDBX, and LEDCX Pins)**

|                        |                                                                                                     |                 |      |            |          |               |
|------------------------|-----------------------------------------------------------------------------------------------------|-----------------|------|------------|----------|---------------|
| On Resistance          | $V_{DD} = 3.0\text{ V}$ , $I_{IS} = 40\text{ mA}$ ,<br>$V_{IS} = 1.5\text{ V}$<br>$V_{IS} = V_{DD}$ | $R_{ON}$        |      | 17<br>12   | 25<br>25 | $\Omega$      |
| On Resistance Flatness | $V_{DD} = 3.0\text{ V}$ , $I_{IS} = 40\text{ mA}$ ,<br>$V_{IS} = 0$ to $V_{DD}$                     | $R_{ON-FLAT}$   |      | 8.4        |          | $\Omega$      |
| On Resistance Matching | $V_{DD} = 3.0\text{ V}$ , $I_{IS} = 40\text{ mA}$<br>$V_{IS} = 1.5\text{ V}$<br>$V_{IS} = V_{DD}$   | $\Delta R_{ON}$ |      | 1.4<br>1.2 |          | $\Omega$      |
| Switch Off Leakage     | $V_{DD} = 3.6\text{ V}$ , $V_{IS} = 0$ to $3.6\text{ V}$                                            | $I_{SW\_OFF}$   | -0.1 |            | 0.1      | $\mu\text{A}$ |
| Switch On Leakage      | $V_{DD} = 3.6\text{ V}$ , $V_{IS} = 0$ to $3.6\text{ V}$                                            | $I_{SW\_ON}$    | -0.1 |            | 0.1      | $\mu\text{A}$ |

## **LED SWITCH AC CHARACTERISTICS (LEDAX, LEDBX, and LEDCX Pins)**

|                            |                      |           |  |     |  |     |
|----------------------------|----------------------|-----------|--|-----|--|-----|
| On Capacitance             | $f = 1\text{ MHz}$   | $C_{ON}$  |  | 4.5 |  | pF  |
| Off Capacitance            | $f = 1\text{ MHz}$   | $C_{OFF}$ |  | 1.5 |  | pF  |
| Bandwidth                  |                      | BW        |  | 750 |  | MHz |
| Adjacent Channel Crosstalk | $f = 250\text{ MHz}$ | CTK       |  | -29 |  | dB  |
| Off Isolation              | $f = 250\text{ MHz}$ | ISO       |  | -31 |  | dB  |

## **DATA SWITCH TIMING CHARACTERISTICS**

|                         |                                                 |                       |  |      |  |    |
|-------------------------|-------------------------------------------------|-----------------------|--|------|--|----|
| Propagation Delay       | (Note 6)                                        | $t_{PD}$              |  | 0.25 |  | ns |
| Line Enable Time        | $C_L = 10\text{ pF}$ , $R_L = 50\text{ }\Omega$ | $t_{PZH}$ , $t_{PZL}$ |  | 30   |  | ns |
| Line Disable Time       | $C_L = 10\text{ pF}$ , $R_L = 50\text{ }\Omega$ | $t_{PHZ}$ , $t_{PLZ}$ |  | 6    |  | ns |
| Bit-to-Bit Skew         | $C_L = 10\text{ pF}$ , $R_L = 50\text{ }\Omega$ | $t_{B-B}$             |  | 0.1  |  | ns |
| Channel-to-Channel Skew | $C_L = 10\text{ pF}$ , $R_L = 50\text{ }\Omega$ | $t_{CH-CH}$           |  | 0.1  |  | ns |

4. Refer to ABSOLUTE MAXIMUM RATINGS and APPLICATION INFORMATION for Safe Operating Area.
5. Performance guaranteed over the indicated operating temperature range by design and/or characterization tested at  $T_J = T_A = 25^{\circ}\text{C}$ .
6. Guaranteed by design.

TYPICAL OPERATING CHARACTERISTICS

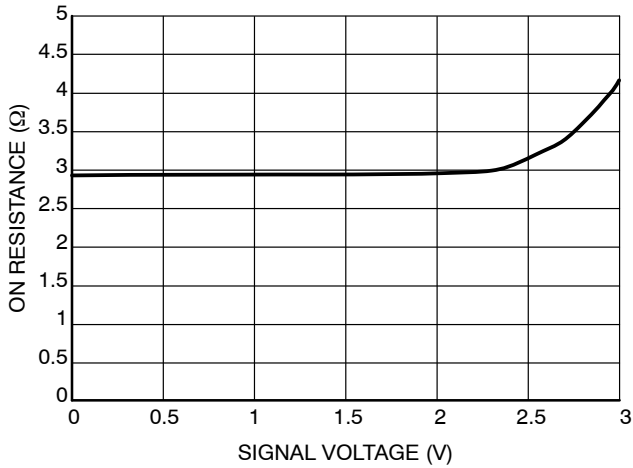


Figure 3. Data Path On Resistance at  $V_{CC} = 3\text{ V}$

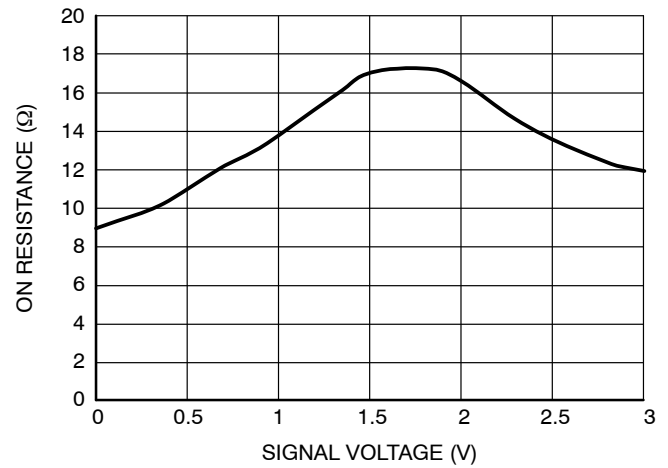


Figure 4. LED Path On Resistance at  $V_{CC} = 3\text{ V}$

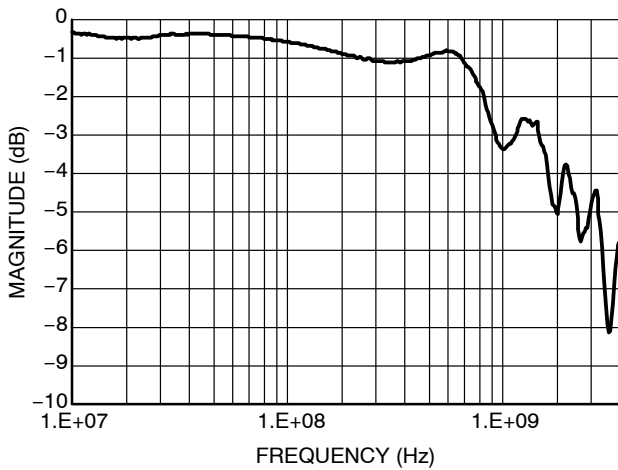


Figure 5. Data Switch Differential Insertion Loss

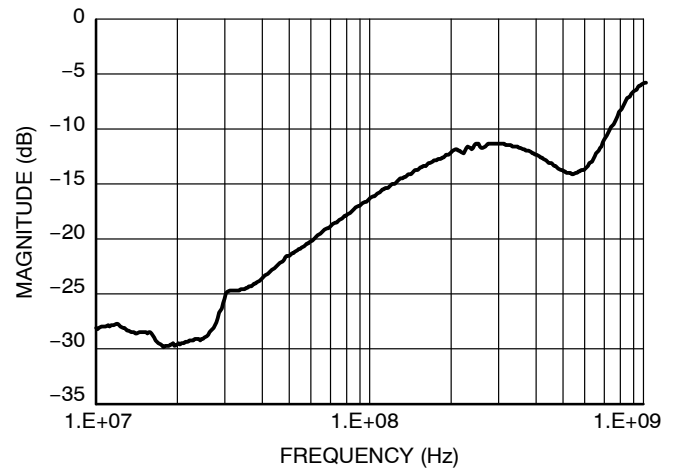


Figure 6. Data Switch Return Loss

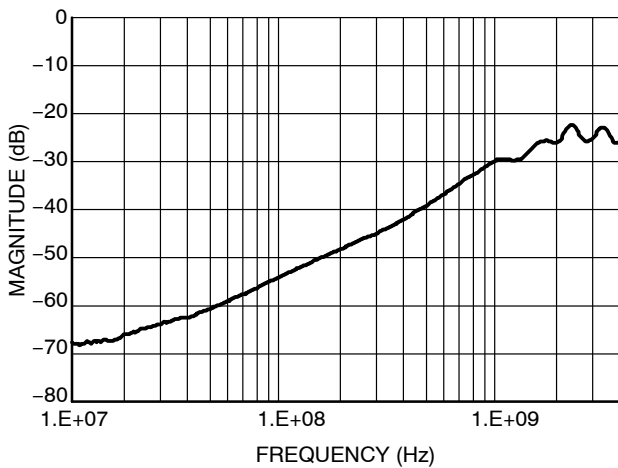


Figure 7. Data Switch Differential Crosstalk on Adjacent Channels

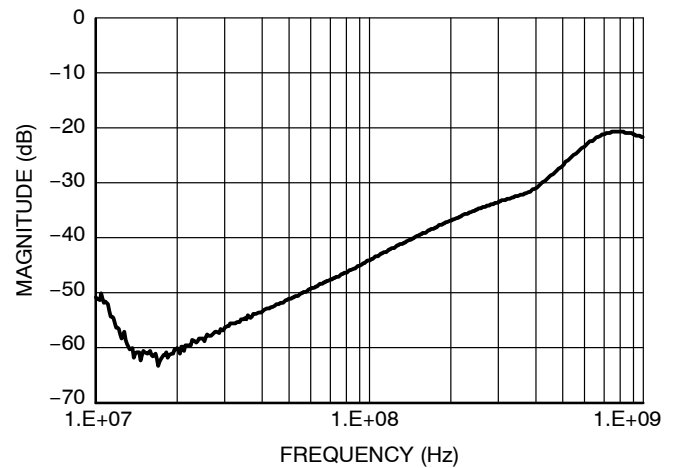


Figure 8. Data Switch Differential Off Isolation

PARAMETER MEASUREMENT INFORMATION

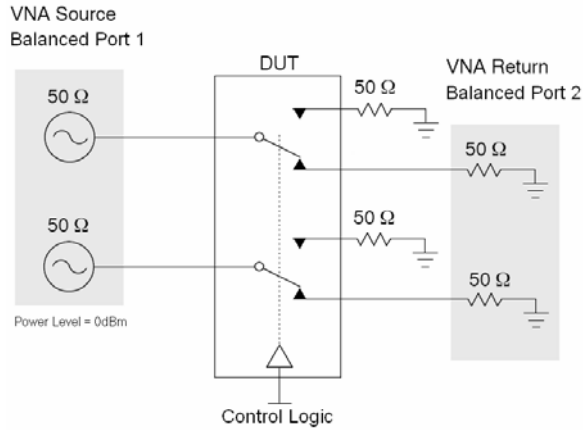


Figure 9. Differential Insertion Loss and Return Loss

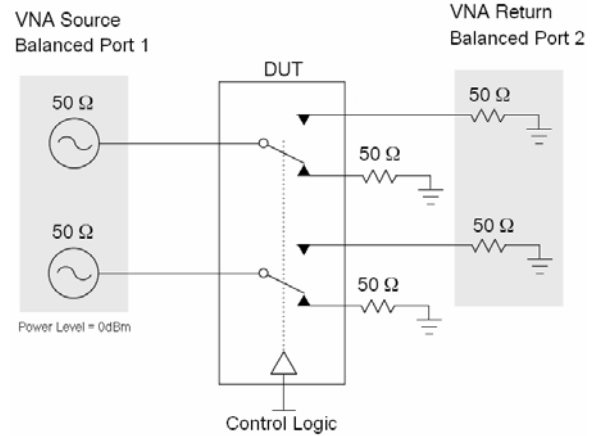


Figure 10. Differential Off Isolation

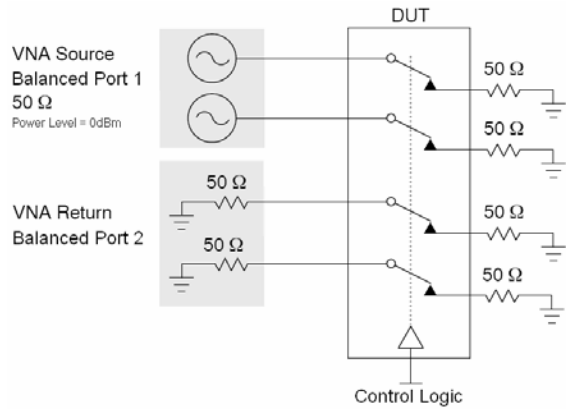


Figure 11. Differential Crosstalk

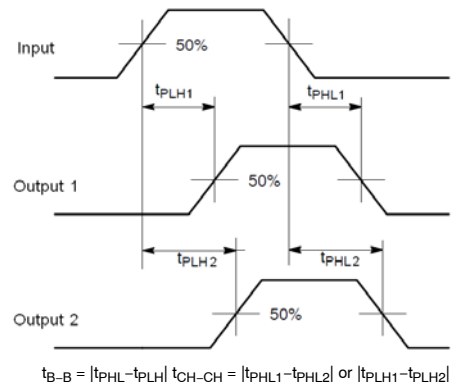


Figure 12. Bit-to-Bit and Channel-to-Channel Skew

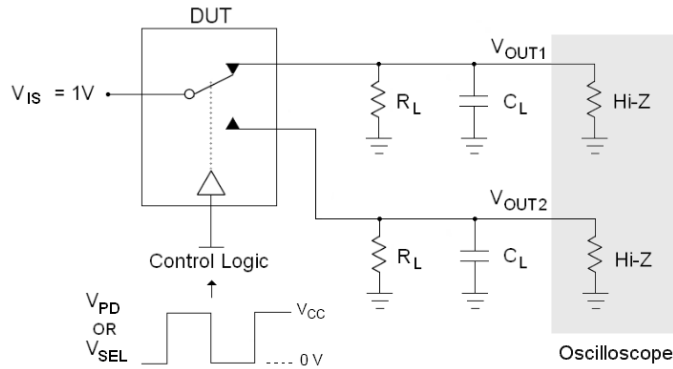


Figure 13. Line Enable and Disable Times

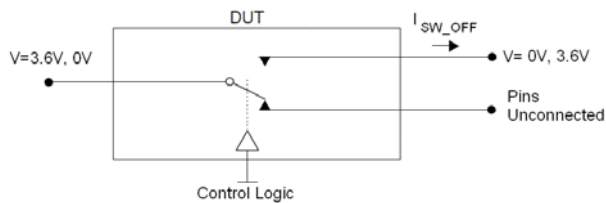


Figure 14. Off State Leakage

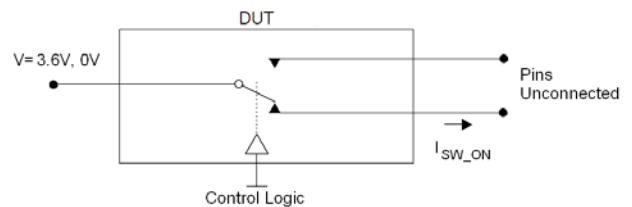


Figure 15. On State Leakage

