

NCN3411

4-Differential Channel 1:2 Mux/Demux Switch for PCI Express Gen3

The NCN3411 is a 4-Channel differential SPDT switch designed to route PCI Express Gen3 signals. When used in a PCI Express application, the switch can handle up to two PCIe lanes. Due to the ultra-low ON-state capacitance (2 pF typ) and resistance (7.5 Ω typ), these switches are ideal for switching high frequency data signals up to a signal bit rate of 8 Gbps. This switch pinout is designed to be used in BTX form factor desktop PCs and is available in a space-saving 3.5 x 9 x 0.75 mm WQFN42 package.

Features

- V_{DD} Power Supply from 1.5 V to 2.0 V
- 4 Differential Channels 2:1 MUX/DEMUX
- Compatible with PCIe 3.0
- Data Rate: Supports 8 Gbps
- Low Crosstalk -30 dB @ 4 GHz
- Low Bit-to-Bit Skew: 5 ps
- Low R_{ON} Resistance: 13 Ω max
- Low C_{ON} Capacitance: 2 pF
- Low Supply Current: 200 μA
- Off Isolation: -20 dB @ 4 GHz
- Space Saving Small WQFN-42 Package
- This is a Pb-Free Device

Typical Applications

- Notebook Computer
- Desktop computer
- Server/Storage Area Network

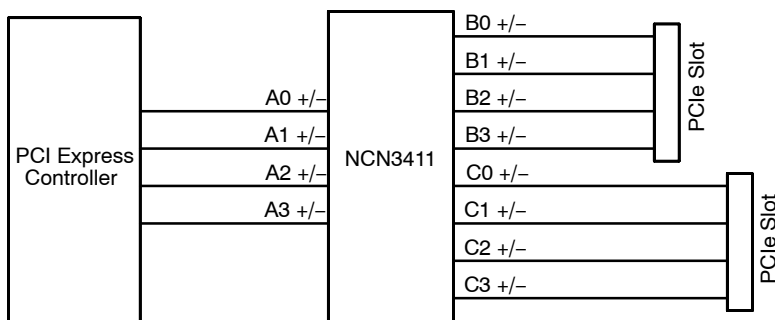
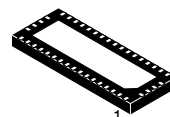


Figure 1. Application Schematic



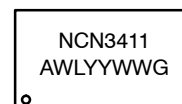
ON Semiconductor®

<http://onsemi.com>



WQFN42
CASE 510AP

MARKING DIAGRAM



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

ORDERING INFORMATION

Device	Package	Shipping†
NCN3411MTTWG	WQFN42 (Pb-Free)	2000 / 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.

NCN3411

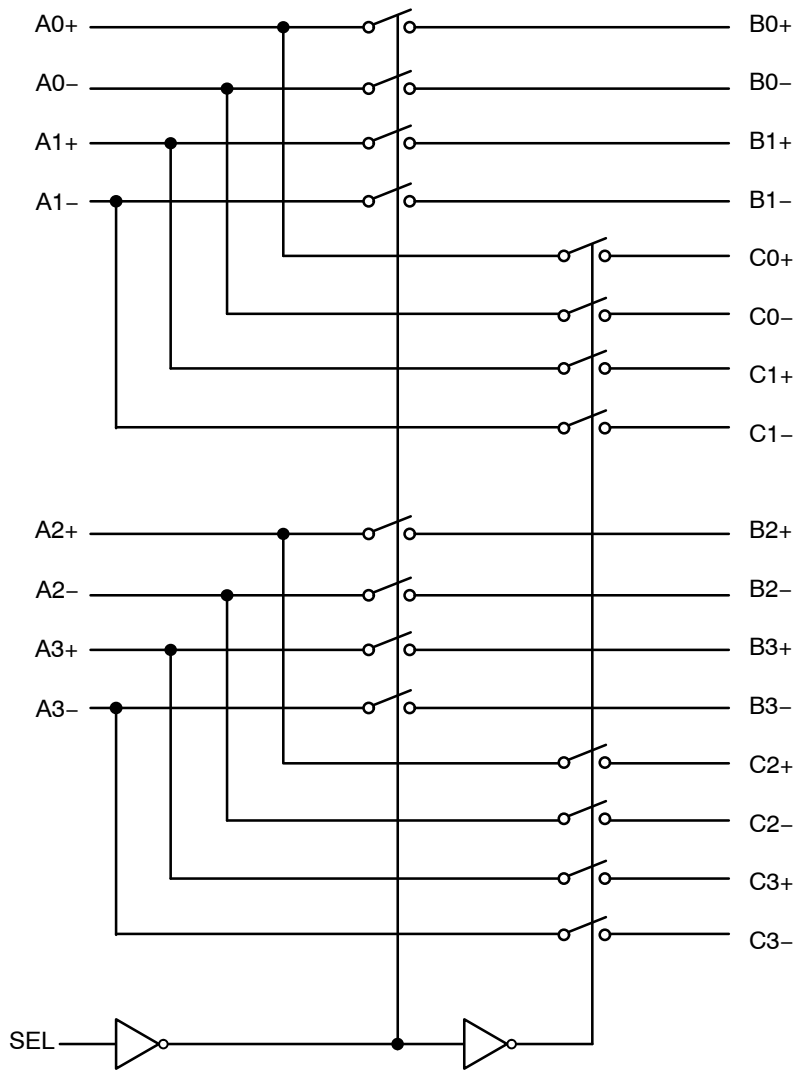
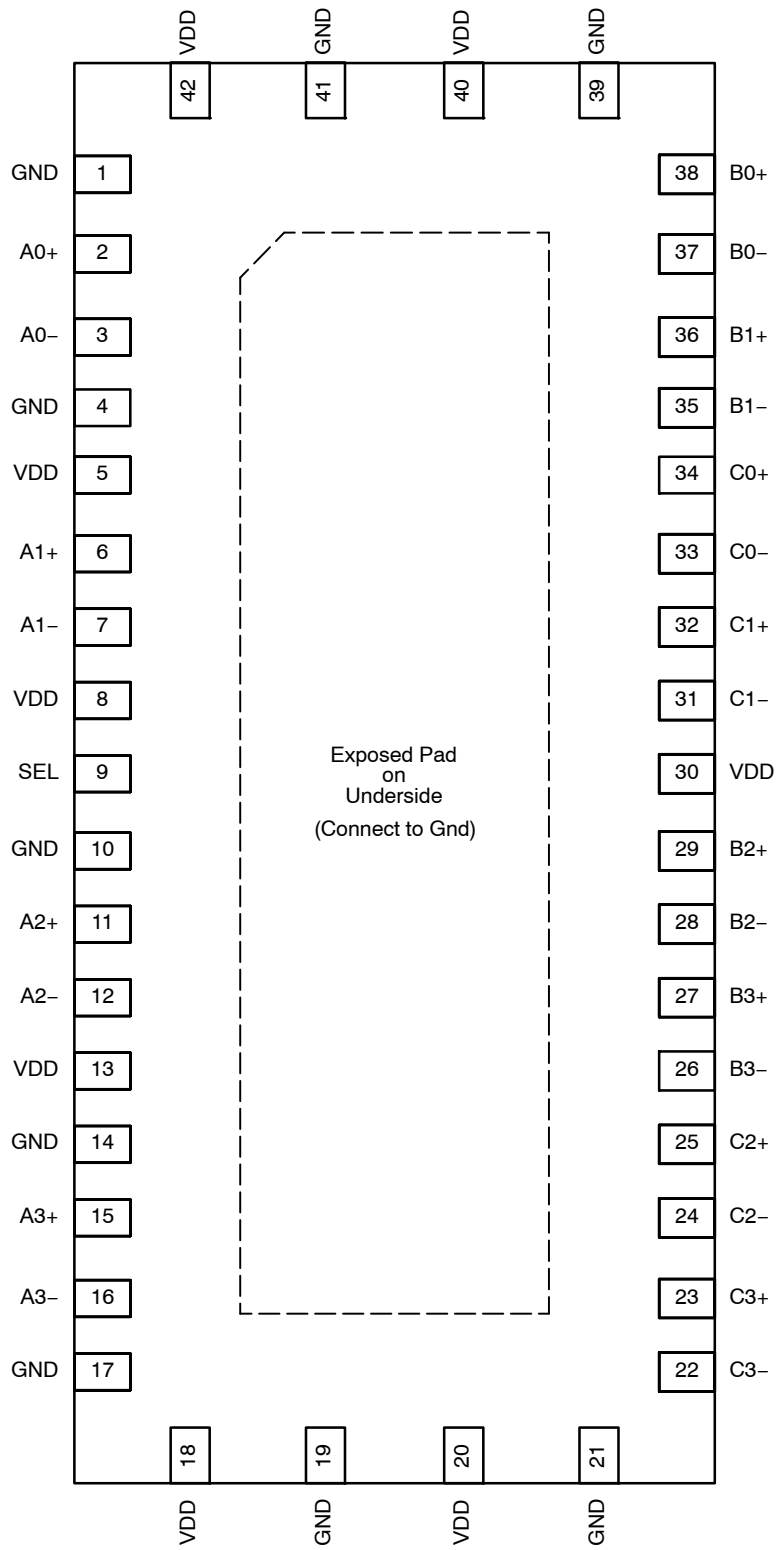


Figure 2. NCN3411 Functional Block Diagram (Top View)

TRUTH TABLE

Function	SEL
A_N to B_N	L
A_N to C_N	H

NCN3411



**Figure 3. Pin Description
(Top View)**

NCN3411

PIN FUNCTION AND DESCRIPTION

Pin	Pin Name	Description
2 3	A0+ A0-	Signal I/O, Channel 0, Port A
6 7	A1+ A1-	Signal I/O, Channel 1, Port A
11 12	A2+ A2-	Signal I/O, Channel 2, Port A
15 16	A3+ A3-	Signal I/O, Channel 3, Port A
38 37	B0+ B0-	Signal I/O, Channel 0, Port B
36 35	B1+ B1-	Signal I/O, Channel 1, Port B
29 28	B2+ B2-	Signal I/O, Channel 2, Port B
27 26	B3+ B3-	Signal I/O, Channel 3, Port B
34 33	C0+ C0-	Signal I/O, Channel 0, Port C
32 31	C1+ C1-	Signal I/O, Channel 1, Port C
25 24	C2+ C2-	Signal I/O, Channel 2, Port C
23 22	C3+ C3-	Signal I/O, Channel 3, Port C
9	SEL	Operational Mode Select (When SEL = 0: A → B, When SEL = 1: A → C)
5, 8, 13, 18, 20, 30, 40, 42	VDD	DC Supply: 1.5 V to 2.0 V
1, 4, 10, 14, 17, 19, 21, 39, 41	GND	Power Ground
Exposed Pad	-	The exposed pad on the backside of package is internally connected to GND. Externally the pad should also be user-connected to GND.

NCN3411

MAXIMUM RATINGS

Parameter	Symbol	Rating	Units
Power Supply Voltage	V_{DD}	-0.5 to 2.5	V_{DC}
Input/Output Voltage Range of the Switch (A_N , B_N , C_N)	V_{IS}	-0.5 to V_{DD}	V_{DC}
Selection Pin Voltages	V_{SEL}	-0.5 to V_{DD}	V_{DC}
Continuous Current Through One Switch	I_{CC}	± 120	mA
Maximum Junction Temperature (Note 1)	T_J	150	$^{\circ}C$
Operating Ambient Temperature	T_A	-40 to +85	$^{\circ}C$
Storage Temperature Range	T_{stg}	-65 to +150	$^{\circ}C$
Thermal Resistance, Junction-to-Air	$R_{\theta JA}$	75	$^{\circ}C/W$
Latch-up Current (Note 2)	I_{LU}	± 100	mA
Human Body Model (HBM) ESD Rating (Note 3)	ESD HBM	7000	V
Machine Model (MM) ESD Rating (Note 3)	ESD MM	400	V
Moisture Sensitivity (Note 4)	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. Power dissipation must be considered to ensure maximum junction temperature (T_J) is not exceeded.
2. Latch up Current Maximum Rating: ± 100 mA per JEDEC standard: JESD78.
3. This device series contains ESD protection and passes the following tests:
Human Body Model (HBM) ± 7.0 kV per JEDEC standard: JESD22-A114 for all pins.
Machine Model (MM) ± 400 V per JEDEC standard: JESD22-A115 for all pins.
4. Moisture Sensitivity Level (MSL): 1 per IPC/JEDEC standard: J-STD-020A.

NCN3411

DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE ($T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$, $V_{DD} = 1.5\text{ V}$ to 2.0 V , $\text{GND} = 0\text{V}$)

Symbol	Pins	Parameters	Conditions (Note 5)	Min.	Typ (Note 6)	Max.	Units
--------	------	------------	---------------------	------	--------------	------	-------

POWER SUPPLY

V_{DD}	V_{DD} , GND	Supply Voltage Range	With respect to GND	1.5	1.8	2.0	V
I_{DD}	V_{DD} , GND	Quiescent Supply Current	$V_{DD} = 2\text{ V}$, $V_{SEL} = \text{GND}$ or V_{DD}		200	300	μA

DATA SWITCH PERFORMANCE

V_{IS}	A_N , B_N , C_N	Data Input/Output Voltage Range		0		1.2	V
R_{ON}	B_N	On Resistance (B_N)	$V_{DD} = 1.5\text{ V}$, $V_{IS} = 0\text{ V}$ to 1.2 V , $I_{IS} = 15\text{ mA}$		7.5	13	Ω
R_{ON}	C_N	On Resistance (C_N)	$V_{DD} = 1.5\text{ V}$, $V_{IS} = 0\text{ V}$ to 1.2 V , $I_{IS} = 15\text{ mA}$		8.0	13	Ω
$R_{ON(\text{flat})}$	B_N	On Resistance Flatness	$V_{DD} = 1.5\text{ V}$, $V_{IS} = 0\text{ V}$ to 1.2 V , $I_{IS} = 15\text{ mA}$ (Note 7)		0.1	1.24	Ω
$R_{ON(\text{flat})}$	C_N	On Resistance Flatness	$V_{DD} = 1.5\text{ V}$, $V_{IS} = 0\text{ V}$ to 1.2 V , $I_{IS} = 15\text{ mA}$ (Note 7)		0.1	1.24	Ω
ΔR_{ON}	B_N	On Resistance Matching(B_N)	$V_{DD} = 1.5\text{ V}$, $V_{IS} = 0\text{ V}$, $I_{IS} = 15\text{ mA}$ (Note 7)			0.35	Ω
ΔR_{ON}	C_N	On Resistance Matching(C_N)	$V_{DD} = 1.5\text{ V}$, $V_{IS} = 0\text{ V}$, $I_{IS} = 15\text{ mA}$ (Note 7)			0.35	Ω
C_{ON}	A_N to B_N , A_N to C_N	On Capacitance	$f = 1\text{ MHz}$, Switch On, Open Output		2.0		pF
C_{OFF}	A_N to B_N , A_N to C_N	Off Capacitance	$f = 1\text{ MHz}$, Switch Off		1.5		pF
I_{ON}	A_N to B_N , A_N to C_N	On Leakage Current	$V_{DD} = 2\text{ V}$, $V_{AN} = 0\text{ V}$, 1.2 V , Switch On to B_N/C_N , B_N/C_N pins are unconnected	-1		+1	μA
I_{OFF}	A_N to B_N , A_N to C_N	Off Leakage Current	$V_{DD} = 2\text{ V}$, $V_{AN} = 0\text{ V}$, 1.2 V , Switch Off to B_N/C_N , $V_{BN}/V_{CN} = 1.2\text{ V}$, 0 V	-1		+1	μA

LOGIC INPUT CHARACTERISTICS (SEL Pin)

V_{IH}	SEL	Input HIGH Voltage	(Note 7)	$0.65 \times V_{DD}$		V_{DD}	V
V_{IL}	SEL	Input LOW Voltage	(Note 7)	0		$0.35 \times V_{DD}$	V
V_{IK}	SEL	Clamp Diode Voltage	$V_{DD} = \text{Max}$, $I_{SEL} = -18\text{ mA}$		-0.7	-1.2	V
I_{IH}	SEL	Input HIGH Current	$V_{DD} = \text{Max}$, $V_{SEL} = V_{DD}$			± 5	μA
I_{IL}	SEL	Input LOW Current	$V_{DD} = \text{Max}$, $V_{SEL} = \text{GND}$			± 5	μA

SWITCHING CHARACTERISTICS

t_{SELON}	SEL, A_N , B_N/C_N	Line Enable Time	SEL to A_N , B_N , C_N $R_L = 50\ \Omega$, $C_L = 20\ \text{pF}$		8.0		ns
t_{SELOFF}	SEL, A_N , B_N/C_N	Line Disable Time	SEL to A_N , B_N , C_N $R_L = 50\ \Omega$, $C_L = 20\ \text{pF}$		5.0		ns
t_{b-b}	A_N , B_N/C_N	Bit-to-bit skew	Within the same differential pair		5.0		ps
t_{ch-ch}	A_N , B_N	Channel-to channel skew	Maximum skew between all channels		50		ps

5. For Max. or Min. conditions, use appropriate value specified under Electrical Characteristics for the applicable device type.

6. Typical values are at $V_{DD} = 1.8\text{ V}$, $T_A = 25^{\circ}\text{C}$ ambient and maximum loading.

7. Guaranteed by design and/or characterization.

NCN3411

DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE ($T_A = -40^{\circ}\text{C}$ to $+85^{\circ}\text{C}$, $V_{DD} = 1.5\text{ V}$ to 2.0 V , $\text{GND} = 0\text{V}$)

Symbol	Pins	Parameters	Conditions (Note 5)	Min.	Typ (Note 6)	Max.	Units
--------	------	------------	---------------------	------	--------------	------	-------

DYNAMIC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

BR	A_N to B_N , A_N to C_N	Signal Bit Rate			8.0		Gbps
D _{IL}	A_N to B_N , A_N to C_N	Differential Insertion Loss	$f = 4\text{ GHz}$		-2.0		dB
			$f = 100\text{ MHz}$		-0.7		dB
D _{CTK}	A_N , B_N , C_N	Differential Crosstalk	$f = 4\text{ GHz}$		-30		dB
			$f = 100\text{ MHz}$		-58		dB
D _{ISO}	A_N to B_N , A_N to C_N	Differential Off Isolation	$f = 4\text{ GHz}$		-20		dB
			$f = 100\text{ MHz}$		-58		dB
D _{RL}	A_N to B_N , A_N to C_N	Differential Return Loss	$f = 4\text{ GHz}$		-9.0		dB
			$f = 100\text{ MHz}$		-22		dB

- For Max. or Min. conditions, use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at $V_{DD} = 1.8\text{ V}$, $T_A = 25^{\circ}\text{C}$ ambient and maximum loading.
- Guaranteed by design and/or characterization.

TYPICAL OPERATING CHARACTERISTICS

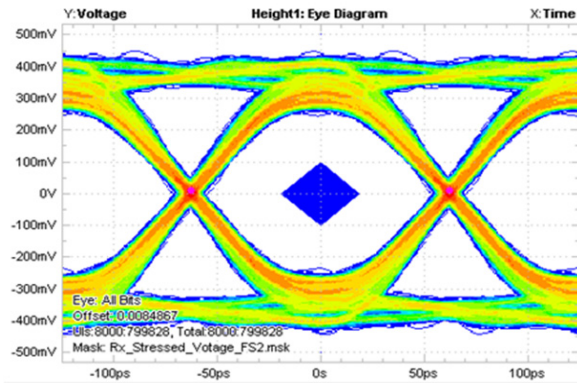


Figure 4. Reference PCIe 3.0 Eye Diagram without Switch at 8 Gbps, 800 mV_{pp} Differential Swing

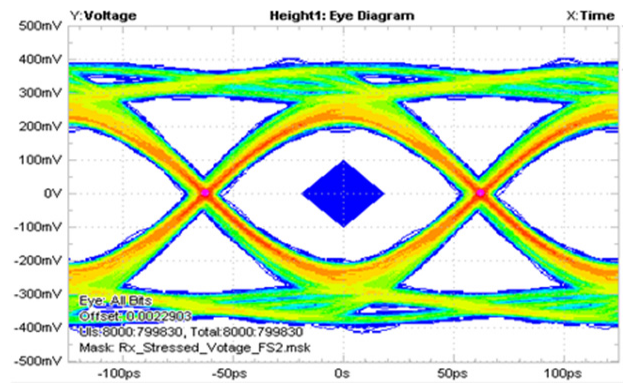


Figure 5. PCIe 3.0 Eye Diagram through NCN3411 at 8 Gbps, 800 mV_{pp} Differential Swing

TYPICAL OPERATING CHARACTERISTICS

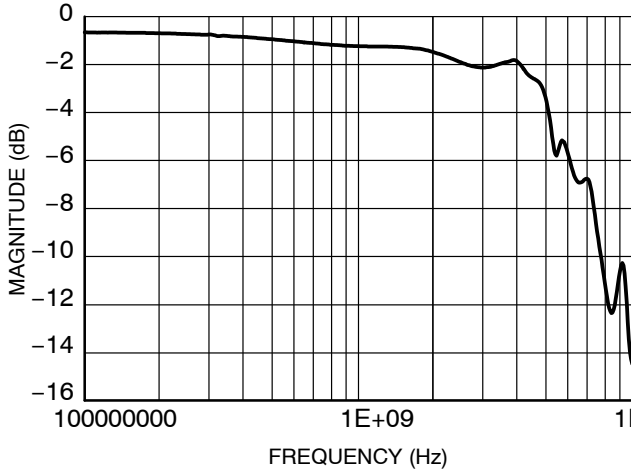


Figure 6. Differential Insertion Loss

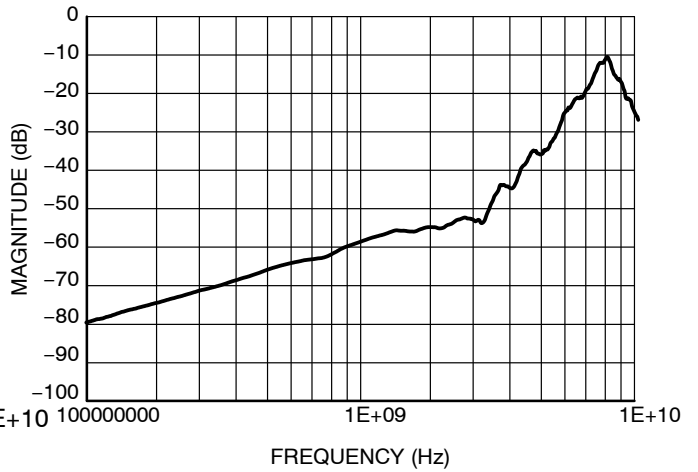


Figure 7. Differential Crosstalk

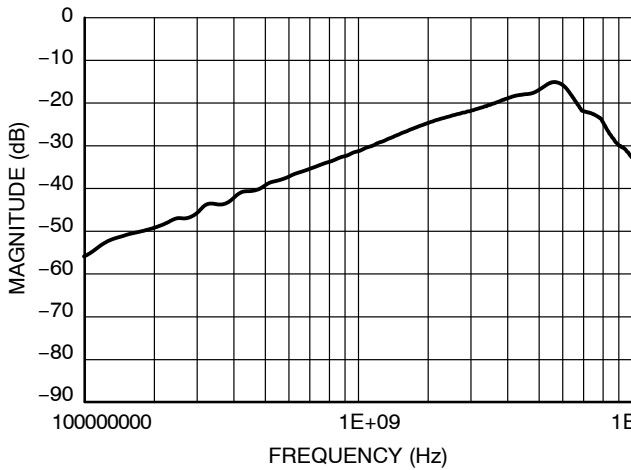


Figure 8. Differential Off Isolation

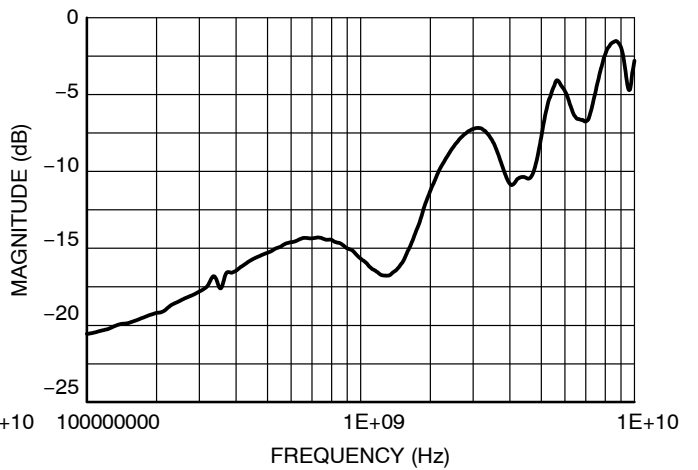


Figure 9. Differential Return Loss

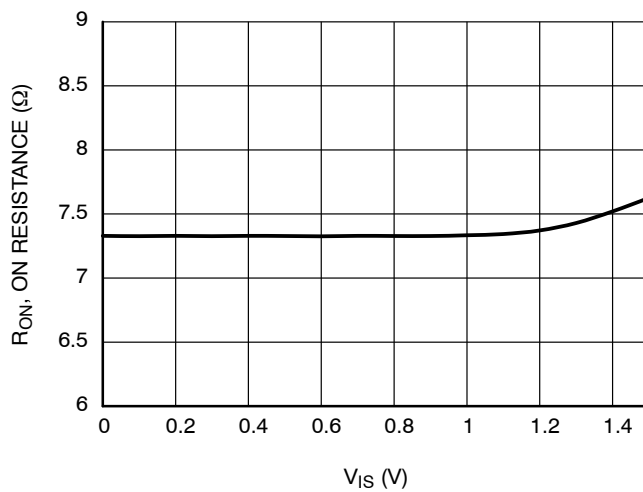


Figure 10. RON vs. VIS

PARAMETER MEASUREMENT INFORMATION

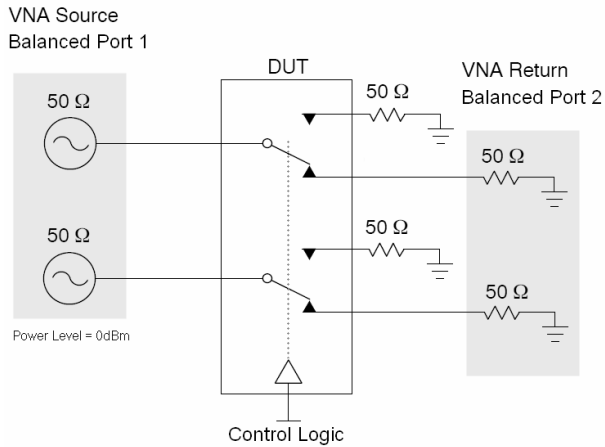


Figure 11. Differential Insertion Loss (S_{DD21}) and Differential Return Loss (S_{DD11})

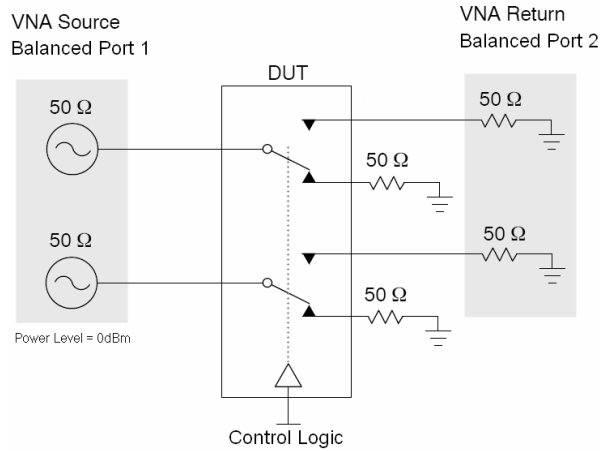


Figure 12. Differential Off Isolation (S_{DD21})

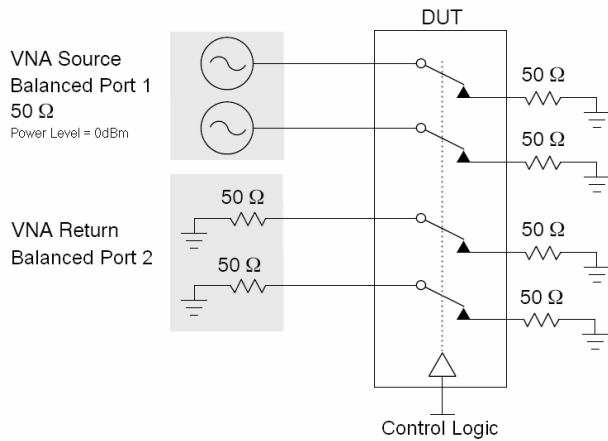


Figure 13. Differential Crosstalk (S_{DD21})

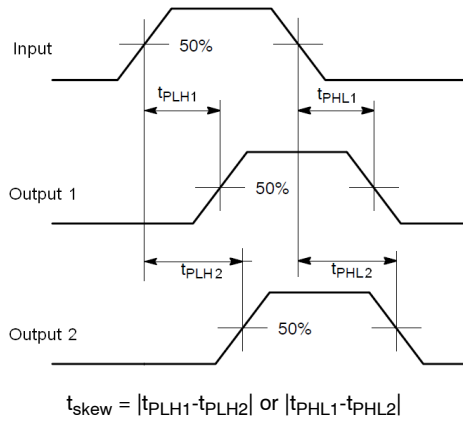


Figure 14. Bit-to-Bit and Channel-to-Channel Skew

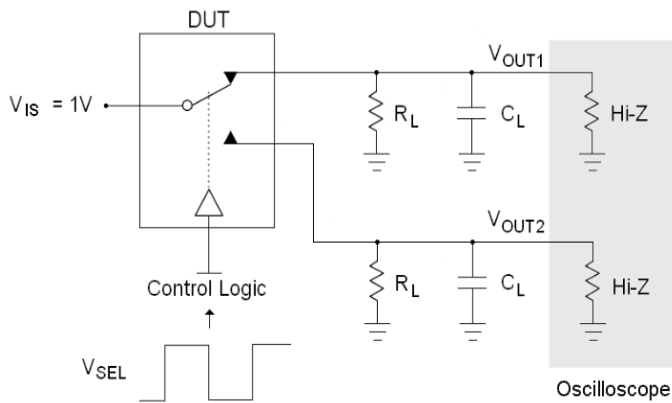


Figure 15. t_{ON} and t_{OFF}

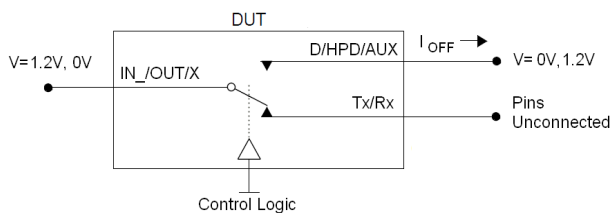
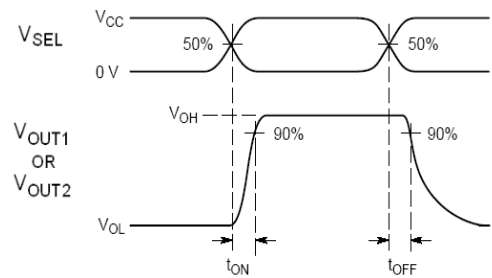


Figure 16. Off State Leakage

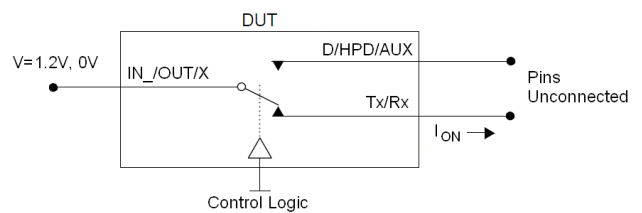
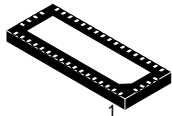


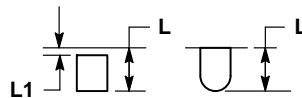
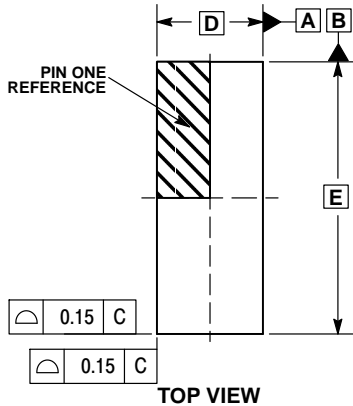
Figure 17. On State Leakage



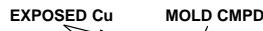
SCALE 2:1

WQFN42 3.5x9, 0.5P
CASE 510AP
ISSUE O

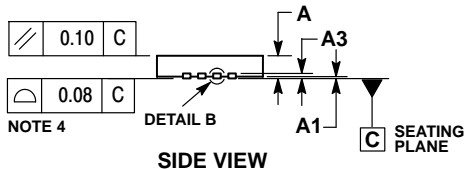
DATE 15 FEB 2010



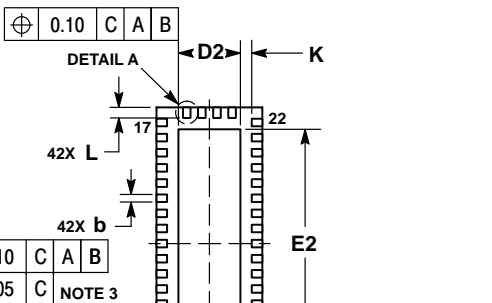
DETAIL A
ALTERNATE TERMINAL
CONSTRUCTIONS



DETAIL B
ALTERNATE
CONSTRUCTION



SIDE VIEW



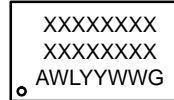
BOTTOM VIEW

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 0.15 AND 0.30 MM FROM TERMINAL TIP.
4. COPLANARITY APPLIES TO THE EXPOSED PAD AS WELL AS THE TERMINALS.

DIM	MILLIMETERS	
	MIN	MAX
A	0.70	0.80
A1	0.00	0.05
A3	0.20 REF	
b	0.20	0.30
D	3.50 BSC	
D2	1.95	2.15
E	9.00 BSC	
E2	7.45	7.65
e	0.50 BSC	
K	0.20	---
L	0.30	0.50
L1	0.00	0.15

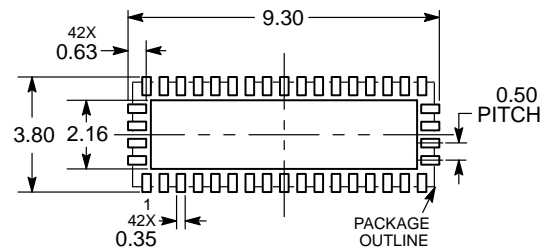
GENERIC
MARKING DIAGRAM*



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

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G", may or not be present.

RECOMMENDED
MOUNTING FOOTPRINT



DIMENSIONS: MILLIMETERS

DOCUMENT NUMBER:	98AON48316E	Electronic versions are uncontrolled except when accessed directly from the Document Repository. Printed versions are uncontrolled except when stamped "CONTROLLED COPY" in red.
DESCRIPTION:	WQFN42 3.5X9, 0.5P	PAGE 1 OF 1

onsemi and ONSEMI are trademarks of Semiconductor Components Industries, LLC dba onsemi or its subsidiaries in the United States and/or other countries. onsemi reserves the right to make changes without further notice to any products herein. onsemi makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does onsemi assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. onsemi does not convey any license under its patent rights nor the rights of others.

onsemi, **Onsemi**, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent-Marking.pdf. **onsemi** reserves the right to make changes at any time to any products or information herein, without notice. The information herein is provided "as-is" and **onsemi** makes no warranty, representation or guarantee regarding the accuracy of the information, product features, availability, functionality, or suitability of its products for any particular purpose, nor does **onsemi** assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using **onsemi** products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by **onsemi**. "Typical" parameters which may be provided in **onsemi** data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. **onsemi** does not convey any license under any of its intellectual property rights nor the rights of others. **onsemi** products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use **onsemi** products for any such unintended or unauthorized application, Buyer shall indemnify and hold **onsemi** and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of the part. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:

Technical Library: www.onsemi.com/design/resources/technical-documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support

For additional information, please contact your local Sales Representative at www.onsemi.com/support/sales