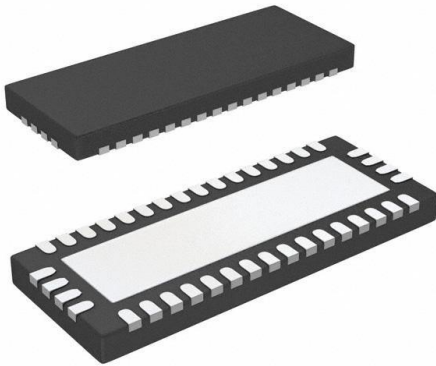


# HD3SS3412RUAT Datasheet

[www.digi-electronics.com](http://www.digi-electronics.com)



HD3SS3412RUAT

<https://www.DiGi-Electronics.com>

DiGi Electronics Part Number	HD3SS3412RUAT-DG
Manufacturer	<a href="#">Texas Instruments</a>
Manufacturer Product Number	HD3SS3412RUAT
Description	IC MUX 4 X 2:1 42WQFN
Detailed Description	PCI Express® Switch IC 4 Channel 42-WQFN (3.5x9)



Tel: +00 852-30501935

RFQ Email: [Info@DiGi-Electronics.com](mailto:Info@DiGi-Electronics.com)

DiGi is a global authorized distributor of electronic components.

## Purchase and inquiry

Manufacturer Product Number:

HD3SS3412RUAT

Series:

-

Applications:

PCI Express®

Switch Circuit:

-

On-State Resistance (Max):

80hm

Voltage - Supply, Dual (V±):

-

Features:

Bi-Directional

Mounting Type:

Surface Mount

Supplier Device Package:

42-WQFN (3.5x9)

Manufacturer:

Texas Instruments

Product Status:

Active

Multiplexer/Demultiplexer Circuit:

2:1

Number of Channels:

4

Voltage - Supply, Single (V+):

3V ~ 3.6V

-3db Bandwidth:

8GHz

Operating Temperature:

0°C ~ 70°C (TA)

Package / Case:

42-WFQFN Exposed Pad

Base Product Number:

HD3SS3412

## Environmental & Export classification

RoHS Status:

ROHS3 Compliant

REACH Status:

REACH Unaffected

HTSUS:

8542.39.0001

Moisture Sensitivity Level (MSL):

2 (1 Year)

ECCN:

EAR99

# HD3SS3412 4-Channel High-Performance Differential Switch

## 1 Features

- Compatible With Multiple Interface Standards Operating up to 12 Gbps Including PCI Express Gen III and USB 3.0
- Wide –3dB Differential BW of over 8 GHz
- Excellent Dynamic Characteristics (at 4 GHz)
  - Crosstalk = –35 dB
  - Off Isolation = –19 dB
  - Insertion Loss = –1.5 dB
  - Return Loss = –11 dB
- Bidirectional "MUX/De-MUX" Type Differential Switch
- VDD Operating Range 3.3 V ±10%
- Small 3.5-mm × 9.0-mm, 42-Pin WQFN Package
- Common Industry Standard Pinout
- Supports XAUI and SGMII

## 2 Applications

- Desktop and Notebook PCs
- Server and Storage Area Networks
- PCI Express Backplanes
- Shared I/O Ports

## 3 Description

The HD3SS3412 device is a high-speed passive switch capable of switching four differential channels, including applications such as two full PCI Express x1 lanes from one source to one of two target locations in a PC/server application. With its bidirectional capability the HD3SS3412 also supports applications that allow connections between one target and two source devices, such as a shared peripheral between two platforms. The HD3SS3412 has a single control line (SEL pin) which can be used to control the signal path between Port A and either Port B or Port C.

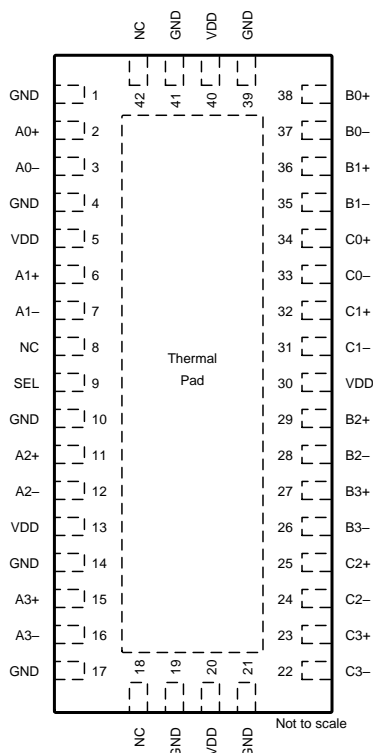
The HD3SS3412 is offered in an industry standard 42-pin WQFN package available in a common footprint shared by several other vendors. The device is specified to operate from a single supply voltage of 3.3 V over the full temperature range of -40°C to 85°C.

### Device Information<sup>(1)</sup>

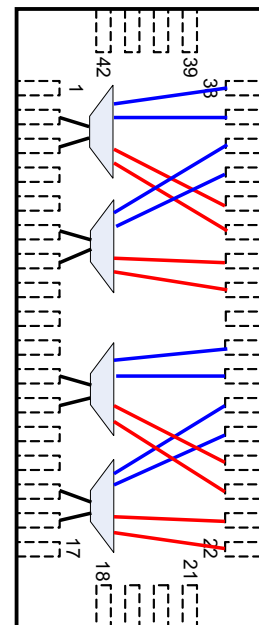
PART NUMBER	PACKAGE	BODY SIZE (NOM)
HD3SS3412	WQFN (42)	9.00 mm × 3.50 mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

**HD3SS3412 Pinout**



**HD3SS3412 Switch Flow Through Routing**



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## 4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision E (January 2015) to Revision F	Page
• Changed temperature range to $-40^{\circ}\text{C}$ to $85^{\circ}\text{C}$ from $0^{\circ}\text{C}$ to $70^{\circ}\text{C}$ .	1
• Changed $T_A$ To: $-40^{\circ}\text{C}$ MIN and $85^{\circ}\text{C}$ MAX From: $0^{\circ}\text{C}$ MIN and $70^{\circ}\text{C}$ MAX in the <i>Recommended Operating Conditions</i> table	7
• Changed the $P_D$ values From: MIN = 15.5, MAX = 21.6 To: MIN = 2.8, MAX = 4.4 in the <i>Dissipation Ratings</i> table	8
Changes from Revision D (December 2015) to Revision E	Page
• Changed "over the full industrial temperature range of $-40^{\circ}\text{C}$ to $70^{\circ}\text{C}$ " To: "over the commercial temperature range of $0^{\circ}\text{C}$ to $70^{\circ}\text{C}$ " in the <i>Overview</i> section	13
Changes from Revision C (July 2015) to Revision D	Page
• Changed "full industrial temperature range of $-40^{\circ}\text{C}$ to $85^{\circ}\text{C}$ " To: "full industrial temperature range of $0^{\circ}\text{C}$ to $70^{\circ}\text{C}$ " in the <i>Overview</i> section	13
Changes from Revision B (November 2013) to Revision C	Page
• Added <i>Pin Configuration and Functions</i> section, <i>ESD Ratings</i> table, <i>Feature Description</i> section, <i>Device Functional Modes</i> , <i>Application and Implementation</i> section, <i>Power Supply Recommendations</i> section, <i>Layout</i> section, <i>Device and Documentation Support</i> section, and <i>Mechanical, Packaging, and Orderable Information</i> section	1
• Removed <i>Ordering Information</i> table	1
Changes from Revision A (February 2012 ) to Revision B	Page
• Added additional feature: bidirectional "MUX/de-MUX" type differential switch	1
• Added that the device supports XAUI and SGMII	1
• Changed temperature range from $-40^{\circ}\text{C}$ to $85^{\circ}\text{C}$ to $0^{\circ}\text{C}$ to $70^{\circ}\text{C}$ and deleted "industrial" in <i>Description</i> section.	1

- Changed pin description of NC From: Electrically not connected. To: Electrically not connected. May connect to VDD or GND, or leave unconnected ..... 6
- Added the *Application Information* section ..... 15

**Changes from Original (January 2012 ) to Revision A**

**Page**

- Changed Differential BW Feature bullet from "7.5GHZ" to "8GHZ"..... 1
- Changed Dynamic Characteristics Feature sub-bullet from "Isolation" to "Off Isolation" ..... 1
- Changed Dynamic Characteristics sub-bullet Return Loss from "–9 dB" to "–11 dB" ..... 1
- Deleted Dynamic Characteristics sub-bullet "Max Intra-Pair (Bit-Bit) Skew" ..... 1
- Changed ESD, Human body model, MAX voltage from "±2000" to "±4,000" in Absolute Maximum Ratings table ..... 7
- Changed I<sub>LK</sub> spec (Diff I/O pins) MAX value from "4 µA" to "130 µA" and added [Ports B and C] and [Port A] to Conditions statements. .... 8
- Changed t<sub>PD</sub> spec MAX delay from "50" ps to "85" ps in Device Parameters table..... 8
- Changed SEL-to-switch T<sub>on</sub> and T<sub>off</sub> spec TYP values from "175" ns to "70" ns; in the Device Parameters table..... 8
- Changed T<sub>SKEW\_Inter</sub> and T<sub>SKEW\_Intra</sub> spec MAX values from "5 ps" and "4 ps" respectively, to "20 ps" and "8 ps" respectively, in Electrical Characteristics table..... 8
- Changed R<sub>L</sub> spec TYP value from "–25" and "–9" dB to "–28" and "–11" dB for f=0.3 MHz and f=4000 MHz, respectively, in Electrical Characteristics table. .... 8
- Changed O<sub>IRR</sub> spec TYP value from "–70" to "–75" dB for f=0.3 MHz, in Electrical Characteristics table. .... 8
- Changed BW spec TYP value from "7.5" GHz to "8" GHz in Electrical Characteristics table. .... 8
- Changed graphic image for [Figure 3](#)..... 10
- Changed graphic image for [Figure 4](#)..... 10

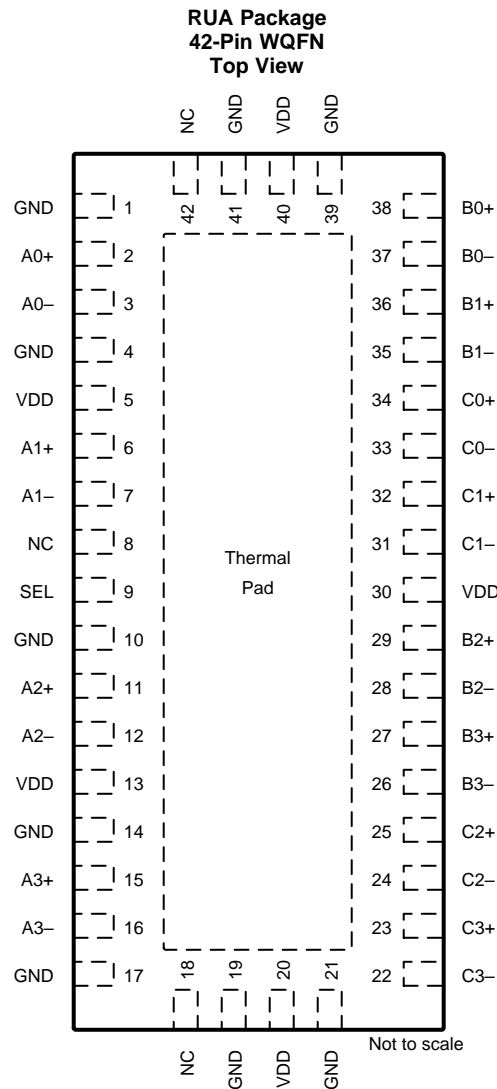
**HD3SS3412**

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[www.ti.com](http://www.ti.com)**5 Description (continued)**

The HD3SS3412 is a generic 4-CH high-speed MUX/de-MUX type of switch that can be used for routing high-speed signals between two different locations on a circuit board. Although it was designed specifically to address PCI Express Gen III applications, the HD3SS3412 will also support several other high-speed data protocols with a differential amplitude of <math><1800\text{ mVpp}</math> and a common-mode voltage of <math><2\text{ V}</math>, as with USB 3.0 and DisplayPort 1.2. The device's one select input (SEL) pin can easily be controlled by an available GPIO pin within a system or from a microcontroller.

## 6 Pin Configuration and Functions



### Pin Functions

PIN		I/O	DESCRIPTION
NAME	NO.		
<b>SWITCH PORT A</b>			
A0+	2	I/O	Port A, Channel 0, High-Speed Positive Signal
A0-	3	I/O	Port A, Channel 0, High-Speed Negative Signal
A1+	6	I/O	Port A, Channel 1, High-Speed Positive Signal
A1-	7	I/O	Port A, Channel 1, High-Speed Negative Signal
A2+	11	I/O	Port A, Channel 2, High-Speed Positive Signal
A2-	12	I/O	Port A, Channel 2, High-Speed Negative Signal
A3+	15	I/O	Port A, Channel 3, High-Speed Positive Signal
A3-	16	I/O	Port A, Channel 3, High-Speed Negative Signal
<b>SWITCH PORT B</b>			
B0+	38	I/O	Port B, Channel 0, High-Speed Positive Signal
B0-	37	I/O	Port B, Channel 0, High-Speed Negative Signal

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**Pin Functions (continued)**

PIN		I/O	DESCRIPTION
NAME	NO.		
B1+	36	I/O	Port B, Channel 1, High-Speed Positive Signal
B1–	35	I/O	Port B, Channel 1, High-Speed Negative Signal
B2+	29	I/O	Port B, Channel 2, High-Speed Positive Signal
B2–	28	I/O	Port B, Channel 2, High-Speed Negative Signal
B3+	27	I/O	Port B, Channel 3, High-Speed Positive Signal
B3–	26	I/O	Port B, Channel 3, High-Speed Negative Signal
<b>SWITCH PORT C</b>			
C0+	34	I/O	Port C, Channel 0, High-Speed Positive Signal
C0–	33	I/O	Port C, Channel 0, High-Speed Negative Signal
C1+	32	I/O	Port C, Channel 1, High-Speed Positive Signal
C1–	31	I/O	Port C, Channel 1, High-Speed Negative Signal
C2+	25	I/O	Port C, Channel 2, High-Speed Positive Signal
C2–	24	I/O	Port C, Channel 2, High-Speed Negative Signal
C3+	23	I/O	Port C, Channel 3, High-Speed Positive Signal
C3–	22	I/O	Port C, Channel 3, High-Speed Negative Signal
<b>CONTROL, SUPPLY, AND NO CONNECT</b>			
NC	8	—	Electrically not connected. May connect to VDD or GND, or leave unconnected.
	18		
	42		
GND	1	Supply	Negative power supply voltage
	4		
	10		
	14		
	17		
	19		
	21		
	39		
	41		
	Center Pad		
SEL	9	I	Select between port B or port C. Internally tied to GND through a 100-kΩ resistor
VDD	5	Supply	Positive power supply voltage
	13		
	20		
	30		
	40		

## 7 Specifications

### 7.1 Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted)<sup>(1)(2)</sup>

		MIN	MAX	UNIT
Supply voltage (V <sub>DD</sub> )	Absolute minimum/maximum supply voltage	-0.5	4	V
Voltage	Differential I/O	-0.5	4	V
	Control pin (SEL)	-0.5	V <sub>DD</sub> + 0.5	
Storage temperature, T <sub>stg</sub>		-65	150	°C

- (1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any conditions beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.
- (2) All voltage values, except differential voltages, are with respect to network ground terminal.

### 7.2 ESD Ratings

		VALUE	UNIT
V <sub>(ESD)</sub> Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 <sup>(1)</sup>	±4000	V
	Charged-device model (CDM), per JEDEC specification JESD22-C101 <sup>(2)</sup>	±1500	

- (1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
- (2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

### 7.3 Recommended Operating Conditions

Typical values for all parameters are at V<sub>DD</sub> = 3.3 V and T<sub>A</sub> = 25°C. (Temperature limits are specified by design)

		MIN	NOM	MAX	UNIT	
V <sub>DD</sub>	Supply voltage	3	3.3	3.6	V	
V <sub>IH</sub>	Input high voltage (SEL pin)	2		V <sub>DD</sub>	V	
V <sub>IL</sub>	Input low voltage (SEL pin)	-0.1		0.8	V	
V <sub>I/O_Diff</sub>	Differential voltage (differential pins)	Switch I/O diff voltage		1.8	V <sub>PP</sub>	
V <sub>I/O_CM</sub>	Common voltage (differential pins)	Switch I/O common-mode voltage		2	V	
T <sub>A</sub>	Operating free-air temperature	Ambient temperature		-40	85	°C

### 7.4 Thermal Information

THERMAL METRIC <sup>(1)</sup>		HD3SS3412	UNIT
		RUA (WQFN)	
		42 PINS	
R <sub>θJA</sub>	Junction-to-ambient thermal resistance	53.8	°C/W
R <sub>θJC(top)</sub>	Junction-to-case (top) thermal resistance	38.2	°C/W
R <sub>θJB</sub>	Junction-to-board thermal resistance	21.9	°C/W
ψ <sub>JT</sub>	Junction-to-top characterization parameter	27.4	°C/W
ψ <sub>JB</sub>	Junction-to-board characterization parameter	5.6	°C/W
R <sub>θJC(bot)</sub>	Junction-to-case (bottom) thermal resistance	27.3	°C/W

- (1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC Package Thermal Metrics](#) application report.

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**7.5 Electrical Characteristics**

Over operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>DEVICE PARAMETERS</b>						
$I_{IH}$	Input High Voltage (SEL)	$V_{DD} = 3.6\text{ V}; V_{IN} = V_{DD}$			95	$\mu\text{A}$
$I_{IL}$	Input Low Voltage (SEL)	$V_{DD} = 3.6\text{ V}; V_{IN} = \text{GND}$			1	$\mu\text{A}$
$I_{LK}$	Leakage Current (Differential I/O pins)	$V_{DD} = 3.6\text{ V}; V_{IN} = 0\text{ V}; V_{OUT} = 2\text{ V}$ ( $I_{LK}$ On OPEN outputs) [Ports B and C]			130	$\mu\text{A}$
		$V_{DD} = 3.6\text{ V}, V_{IN} = 2\text{ V}; V_{OUT} = 0\text{ V}$ ( $I_{LK}$ On OPEN outputs) [Port A]			4	
$I_{DD}$	Supply Current	$V_{DD} = 3.6\text{ V}; \text{SEL} = V_{DD}/\text{GND}; \text{Outputs Floating}$		4.7	6	mA
$C_{ON}$	Outputs ON Capacitance	$V_{IN} = 0\text{ V}; \text{Outputs Open}; \text{Switch ON}$		1.5		pF
$C_{OFF}$	Outputs OFF Capacitance	$V_{IN} = 0\text{ V}; \text{Outputs Open}, \text{Switch OFF}$		1		pF
$R_{ON}$	Output ON resistance	$V_{DD} = 3.3\text{ V}; V_{CM} = 0.5\text{ V to } 1.5\text{ V}; I_O = -8\text{ mA}$		5	8	$\Omega$
$\Delta R_{ON}$	ON-resistance match between channels	$V_{DD} = 3.3\text{ V}; -0.35\text{ V} \leq V_{IN} \leq 1.2\text{ V}; I_O = -8\text{ mA}$			2	$\Omega$
	ON-resistance match between pairs of the same channel	$V_{DD} = 3.3\text{ V}; -0.35\text{ V} \leq V_{IN} \leq 1.2\text{ V}; I_O = -8\text{ mA}$			0.7	$\Omega$
$R_{FLAT\_ON}$	ON-resistance flatness ( $R_{ON(MAX)} - R_{ON(MAIN)}$ )	$V_{DD} = 3.3\text{ V}; -0.35\text{ V} \leq V_{IN} \leq 1.2\text{ V}$			1.15	$\Omega$
$t_{PD}$	Switch propagation delay	$R_{sc}$ and $R_{LOAD} = 50\ \Omega$			85	ps
	SEL-to-switch $T_{ON}$	$R_{sc}$ and $R_{LOAD} = 50\ \Omega$		70	250	ns
	SEL-to-switch $T_{OFF}$			70	250	
$T_{SKEW\_Inter}$	Inter-pair output skew (CH-CH)	$R_{sc}$ and $R_{LOAD} = 50\ \Omega$			20	ps
$T_{SKEW\_Intra}$	Intra-pair output skew (bit-bit)	$R_{sc}$ and $R_{LOAD} = 50\ \Omega$			8	ps
$R_L$	Differential return loss ( $V_{CM} = 0\text{ V}$ ) Also see <a href="#">Typical Characteristics</a>	$f = 0.3\text{ MHz}$		-28		dB
		$f = 2500\text{ MHz}$		-12		
		$f = 4000\text{ MHz}$		-11		
$X_{TALK}$	Differential Crosstalk ( $V_{CM} = 0\text{ V}$ ) Also see <a href="#">Typical Characteristics</a>	$f = 0.3\text{ MHz}$		-90		dB
		$f = 2500\text{ MHz}$		-39		
		$f = 4000\text{ MHz}$		-35		
$O_{IRR}$	Differential Off-Isolation ( $V_{CM} = 0\text{ V}$ ) Also see <a href="#">Typical Characteristics</a>	$f = 0.3\text{ MHz}$		-75		dB
		$f = 2500\text{ MHz}$		-22		
		$f = 4000\text{ MHz}$		-19		
$I_L$	Differential Insertion Loss ( $V_{CM} = 0\text{ V}$ ) Also see <a href="#">Typical Characteristics</a>	$f = 0.3\text{ MHz}$		-0.5		dB
		$f = 2500\text{ MHz}$		-1.1		
		$f = 4000\text{ MHz}$		-1.5		
BW	Bandwidth	At -3 dB		8		GHz

**7.6 Dissipation Ratings**

		MIN	MAX	UNIT
$P_D$	Power Dissipation	2.8	4.4	mW

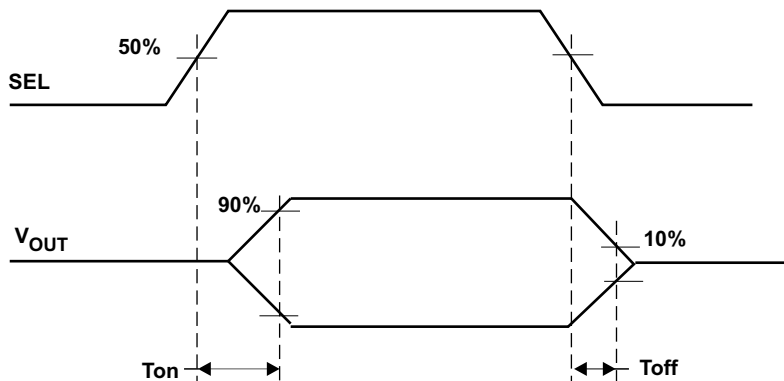
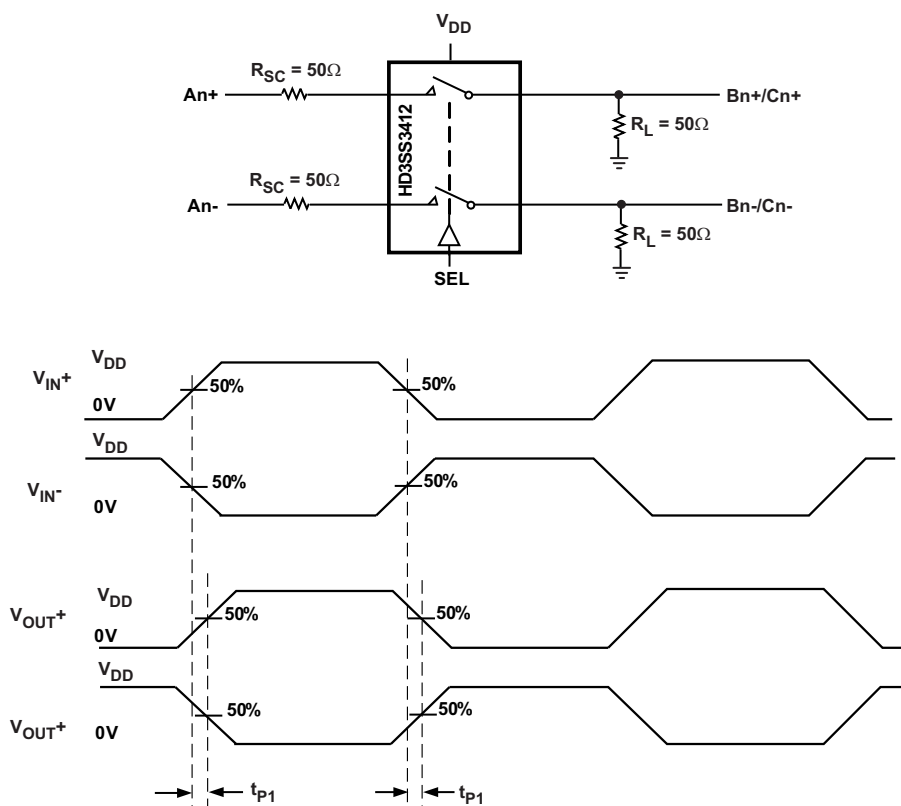


Figure 1. Switch ON and OFF Timing Diagram



$T_{\text{SKEWInter}}$  = Difference between  $t_{\text{PD}}$  for any two pairs of outputs

$T_{\text{SKEWIntra}}$  = Difference between  $t_{\text{P1}}$  and  $t_{\text{P2}}$  of same pair

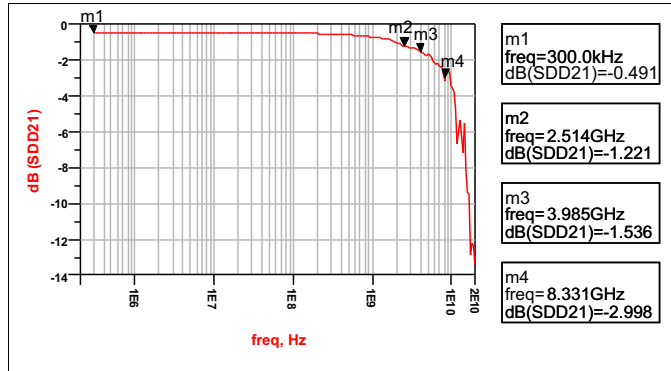
Figure 2. Propagation Delay Timing Diagram and Test Setup

**HD3SS3412**

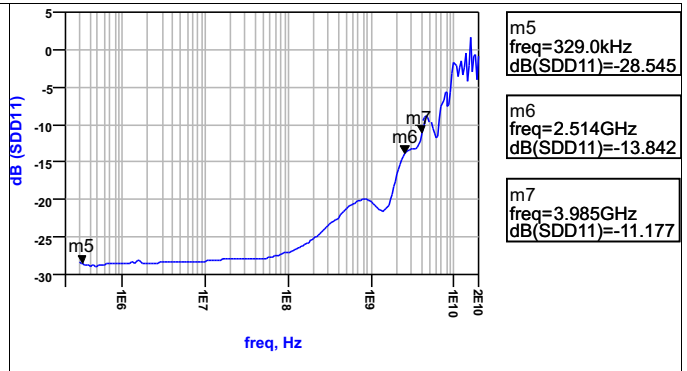
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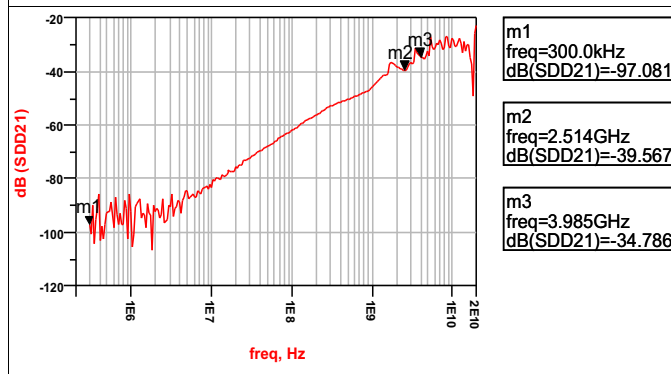
**7.7 Typical Characteristics**



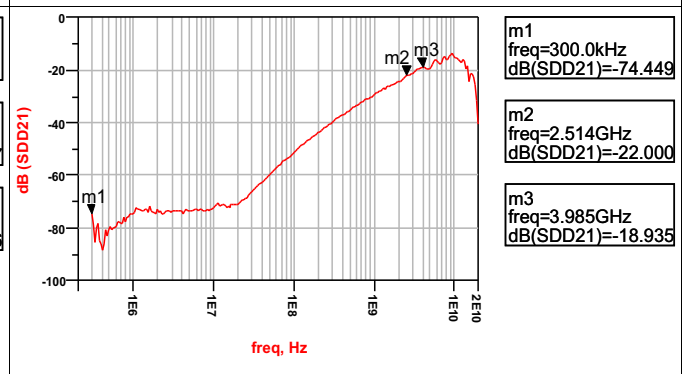
**Figure 3. Differential Insertion Loss**



**Figure 4. Differential Return Loss**



**Figure 5. Differential Crosstalk**



**Figure 6. Differential Off Isolation**

## 8 Parameter Measurement Information

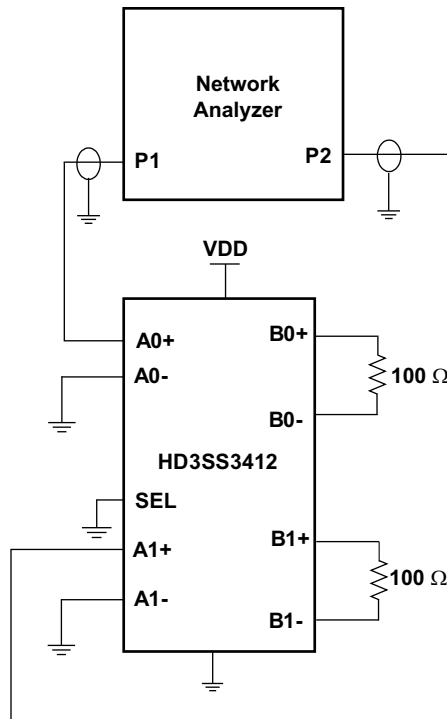


Figure 7. Cross Talk Measurement Setup

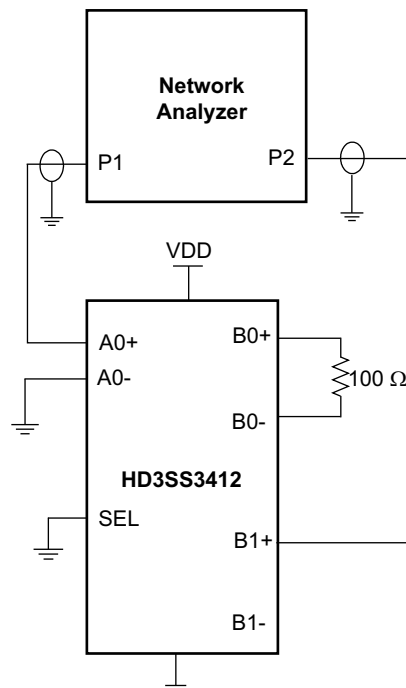
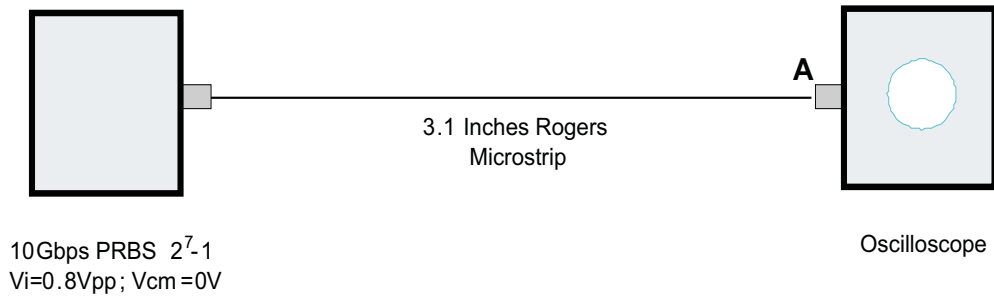
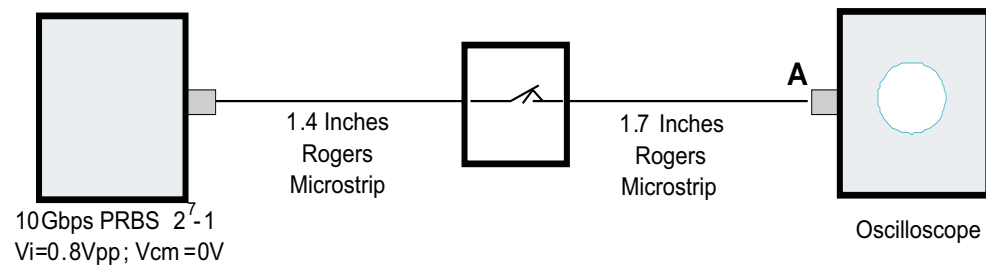


Figure 8. Off Isolation Measurement Setup

**Parameter Measurement Information (continued)**



**Figure 9. Source Eye Diagram Test Setup**



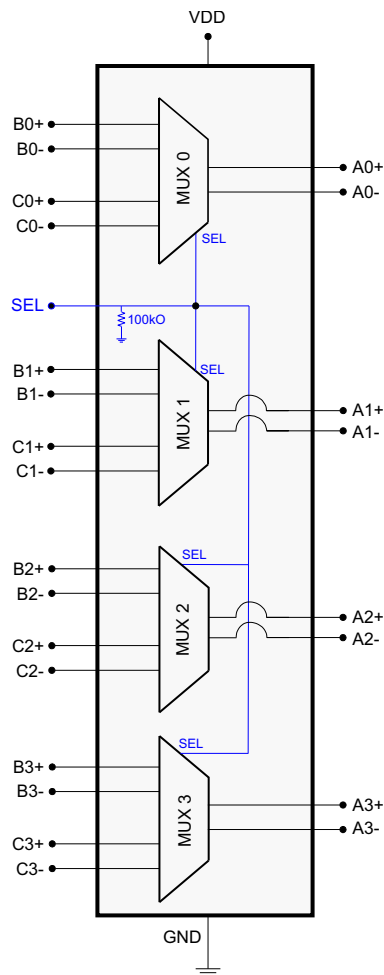
**Figure 10. Output Eye Diagram Test Setup**

## 9 Detailed Description

### 9.1 Overview

The HD3SS3412 is a high-speed passive switch offered in an industry standard 42-pin WQFN package available in a common footprint shared by several other vendors. The device is specified to operate from a single supply voltage of 3.3 V over the commercial temperature range of 0°C to 70°C. The HD3SS3412 is a generic 4-CH high-speed mux/demux type of switch that can be used for routing high-speed PCI signals between two different locations on a circuit board. Although it was designed specifically to address PCI Express Gen III applications, the HD3SS3412 will also support several other high-speed data protocols with a differential amplitude of < 1800 mVpp and a common-mode voltage of < 2.0 V, as with USB 3.0 and DisplayPort 1.2. The device's one select input (SEL) pin can easily be controlled by an available GPIO pin within a system or from a microcontroller.

### 9.2 Functional Block Diagram



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[www.ti.com](http://www.ti.com)**9.3 Feature Description**

The HD3SS3412 has a single control line (SEL Pin) which can be used to control the signal path between Port A and either Port B or Port C. The one select input (SEL) pin of the device can easily be controlled by an available GPIO pin within a system or from a microcontroller. The input signal is selected using the SEL pin.

**Table 1. Mux Pin Connections<sup>(1)</sup>**

PORT A CHANNEL	PORT B OR PORT C CHANNEL CONNECTED TO PORT A CHANNEL	
	SEL = L	SEL = H
A0+	B0+	C0+
A0–	B0–	C0–
A1+	B1+	C1+
A1–	B1–	C1–
A2+	B2+	C2+
A2–	B2–	C2–
A3+	B3+	C3+
A3–	B3–	C3–

(1) The HD3SS3412 can tolerate polarity inversions for all differential signals on Ports A, B, and C. Take care to ensure the same polarity is maintained on Port A versus Port B/C.

**9.4 Device Functional Modes**

[Table 2](#) lists the functional modes for the HD3SS3412.

**Table 2. HD3SS3412 Control Logic**

CONTROL PIN (SEL)	PORT A TO PORT B CONNECTION STATUS	PORT A TO PORT C CONNECTION STATUS
L (Default State)	Connected	Disconnected
H	Disconnected	Connected

## 10 Application and Implementation

### NOTE

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

### 10.1 Application Information

#### 10.1.1 AC Coupling Caps

Many interfaces require AC coupling between the transmitter and receiver. The 0402 capacitors are the preferred option to provide AC coupling, and the 0603 size capacitors also work. The 0805 size capacitors and C-packs should be avoided. When placing AC coupling capacitors symmetric placement is best. A capacitor value of 0.1  $\mu$ F is best and the value should be match for the  $\pm$  signal pair. The placement should be along the TX pairs on the system board, which are usually routed on the top layer of the board.

There are several placement options for the AC coupling capacitors. Because the switch requires a bias voltage, the capacitors must only be placed on one side of the switch. If they are placed on both sides of the switch, a biasing voltage should be provided. A few placement options are shown below. In [Figure 11](#), the coupling capacitors are placed between the switch and endpoint. In this situation, the switch is biased by the system/host controller.

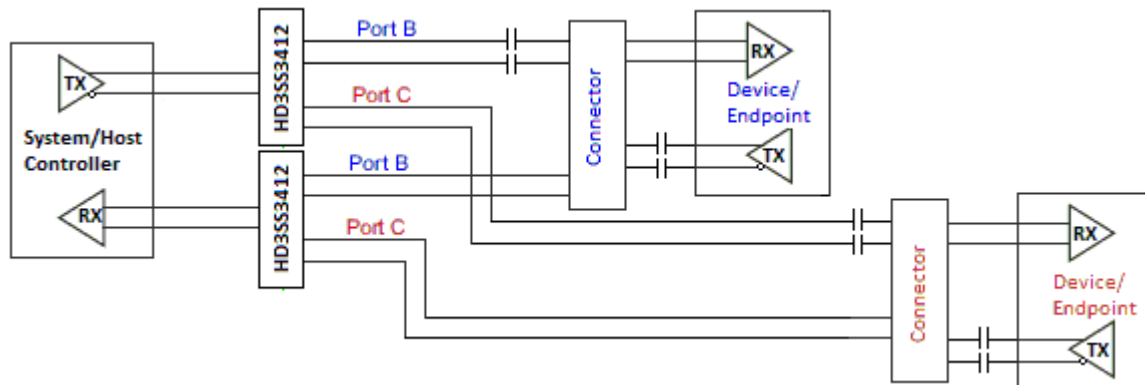


Figure 11. AC Coupling Capacitors Between Switch Tx and Endpoint Tx

In [Figure 12](#), the coupling capacitors are placed on the host transmit pair and endpoint transmit pair. In this situation, the switch on the top is biased by the endpoint and the lower switch is biased by the host controller.

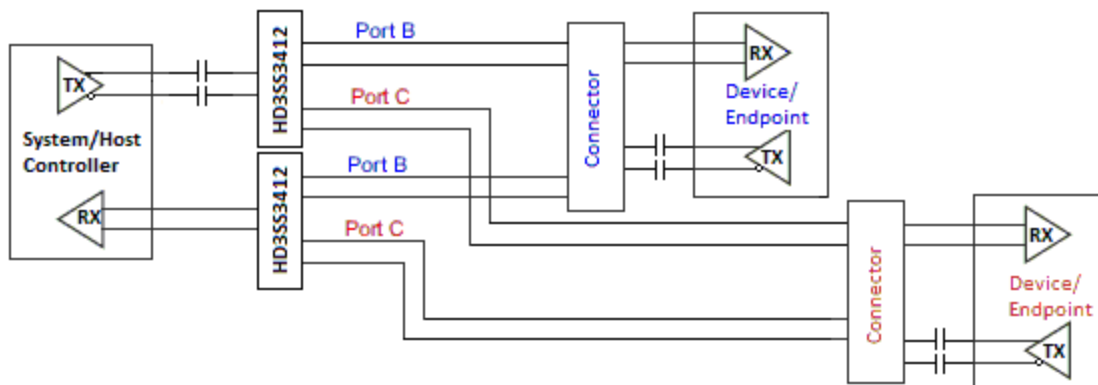


Figure 12. AC Coupling Capacitors on Host Tx and Endpoint Tx

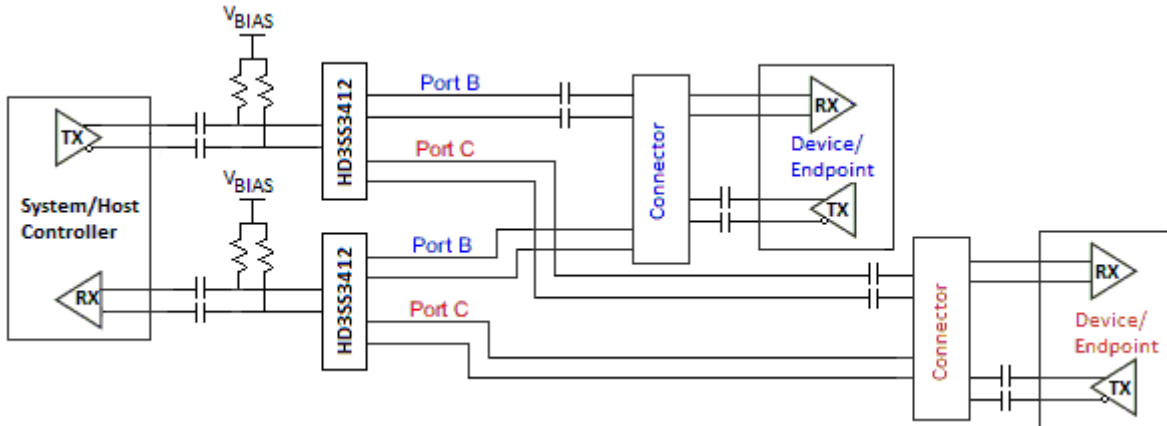
**HD3SS3412**

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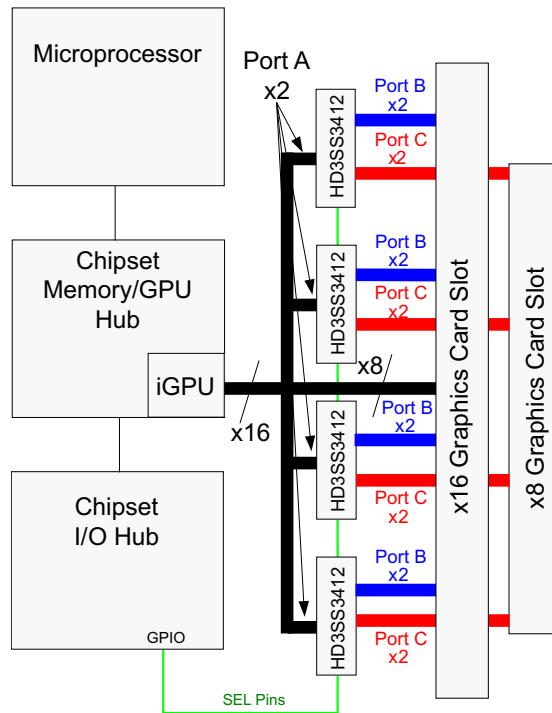
**Application Information (continued)**

If the common-mode voltage in the system is higher than 2 V, the coupling capacitors are placed on both sides of the switch (shown in Figure 13). A biasing voltage of less than 2 V is required in this case.



**Figure 13. AC Coupling Capacitors on Both Sides of Switch**

**10.2 Typical Application**



**Figure 14. Typical Application Block Diagram**

## Typical Application (continued)

### 10.2.1 Design Requirements

Table 3 lists the design parameters of this example.

Table 3. Design Parameters

DESIGN PARAMETERS	EXAMPLE VALUE
Input voltage range	3.3 V
Decoupling capacitors	0.1 $\mu$ F
AC capacitors	75 nF – 200 nF (100 nF shown) USBAA TX p and n lines require AC capacitors. Alternate mode signals may or may not require AC capacitors

### 10.2.2 Detailed Design Procedure

- Connect VDD and GND pins to the power and ground planes of the printed circuit board, with 0.1-uF bypass capacitor
- Use +3.3-V TTL/CMOS logic level at SEL
- Use controlled-impedance transmission media for all the differential signals
- Ensure the received complimentary signals are with a differential amplitude of <1800 mVpp and a common-mode voltage of <2 V

### 10.2.3 Application Curves

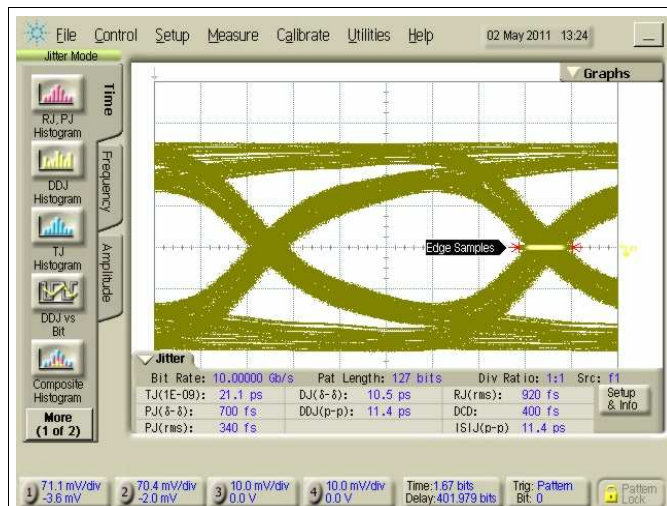


Figure 15. 10-gbps Source Eye Diagram at a:  $V_{ID} = 800$  Mvpp;  $2^7-1$  Prbs;  $V_{CM} = 0$  V

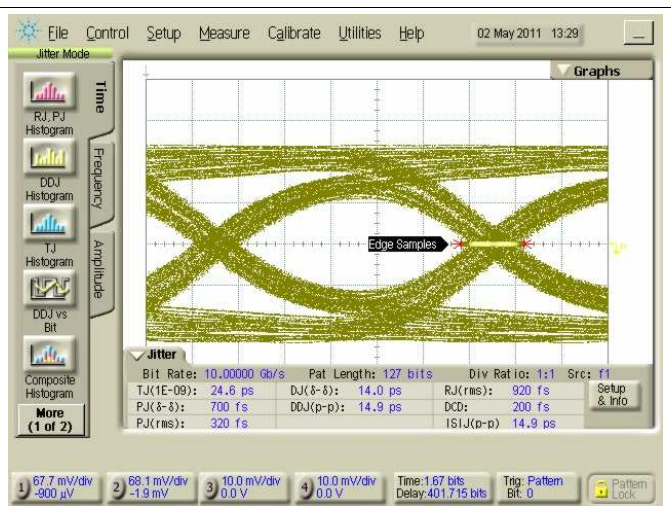


Figure 16. 10-gbps Output Eye Diagram at a:  $V_{ID} = 800$  Mvpp;  $2^7-1$  Prbs;  $V_{CM} = 0$ v;  $V_{DD} = 3.3$  V; Sel= 0 V

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## 11 Power Supply Recommendations

The HD3SS3412 requires +3.3-V digital power sources. VDD 3.3 supply must have 0.1- $\mu$ F bypass capacitors to VSS (ground) in order for proper operation. The recommendation is one capacitor for each power terminal. Place the capacitor as close as possible to the terminal on the device and keep trace length to a minimum. Smaller value capacitors like 0.01- $\mu$ F are also recommended on the digital supply terminals.

## 12 Layout

### 12.1 Layout Guidelines

- Decoupling caps should be placed next to each power terminal on the HD3SS3412. Take care to minimize the stub length of the trace connecting the capacitor to the power pin.
- Avoid sharing vias between multiple decoupling caps
- Place vias as close as possible to the decoupling cap solder pad
- Widen VDD/GND planes to reduce effect of static and dynamic IR drop
- The VBUS traces/planes must be wide enough to carry maximum of 2-A current

### 12.2 Layout Example

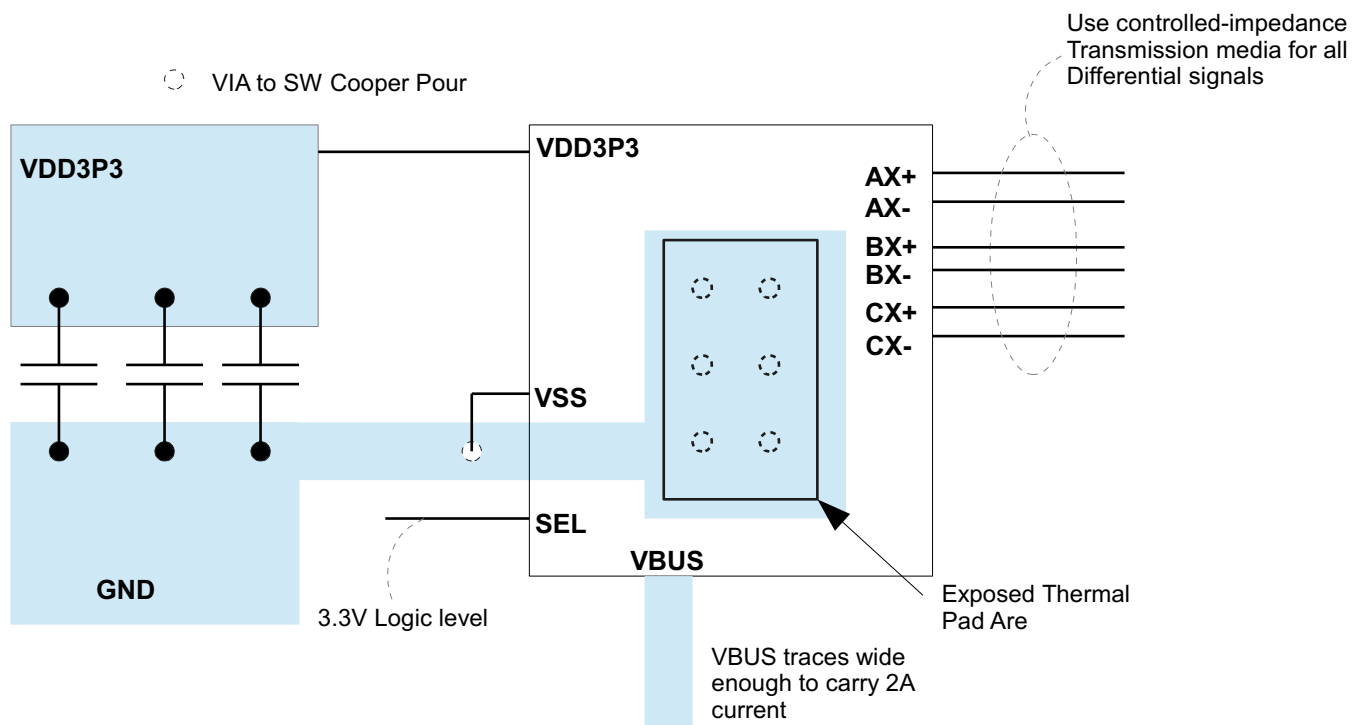


Figure 17. Layout Example

## 13 Device and Documentation Support

### 13.1 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on *Alert me* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

### 13.2 Community Resources

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

**TI E2E™ Online Community** *TI's Engineer-to-Engineer (E2E) Community*. Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

**Design Support** *TI's Design Support* Quickly find helpful E2E forums along with design support tools and contact information for technical support.

### 13.3 Trademarks

E2E is a trademark of Texas Instruments.  
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### 13.4 Electrostatic Discharge Caution



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

### 13.5 Glossary

[SLYZ022](#) — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

## 14 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

**PACKAGING INFORMATION**

Orderable part number	Status (1)	Material type (2)	Package   Pins	Package qty   Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
<a href="#">HD3SS3412RUAR</a>	Active	Production	WQFN (RUA)   42	3000   LARGE T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	0 to 70	HD3SS3412
<a href="#">HD3SS3412RUAT</a>	Active	Production	WQFN (RUA)   42	250   SMALL T&R	Yes	NIPDAU	Level-2-260C-1 YEAR	0 to 70	XHD3SS3412 HD3SS3412

(1) **Status:** For more details on status, see our [product life cycle](#).

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

(4) **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

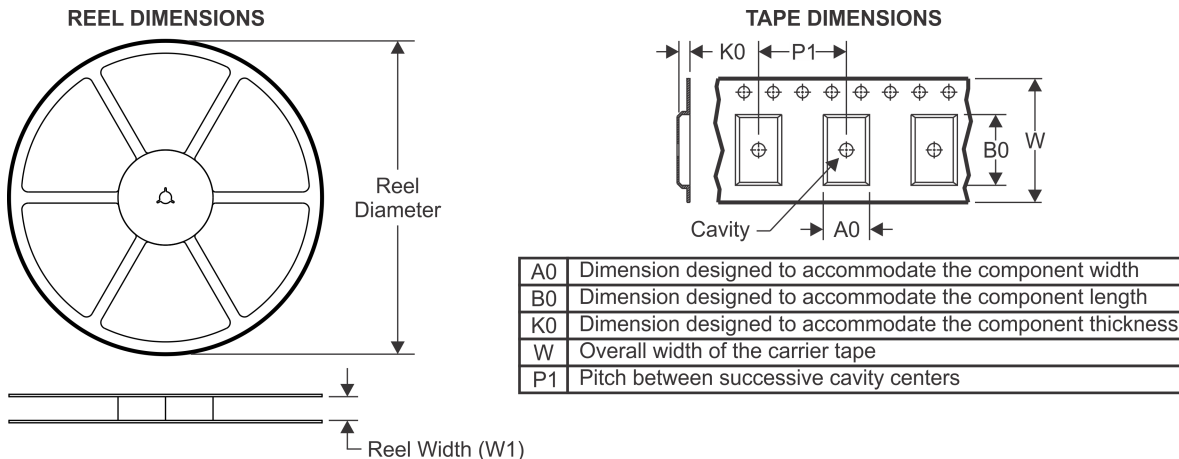
(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "-" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

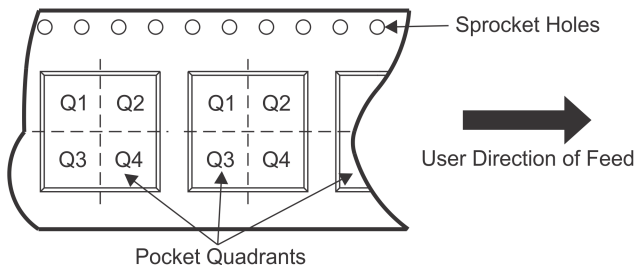
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## TAPE AND REEL INFORMATION



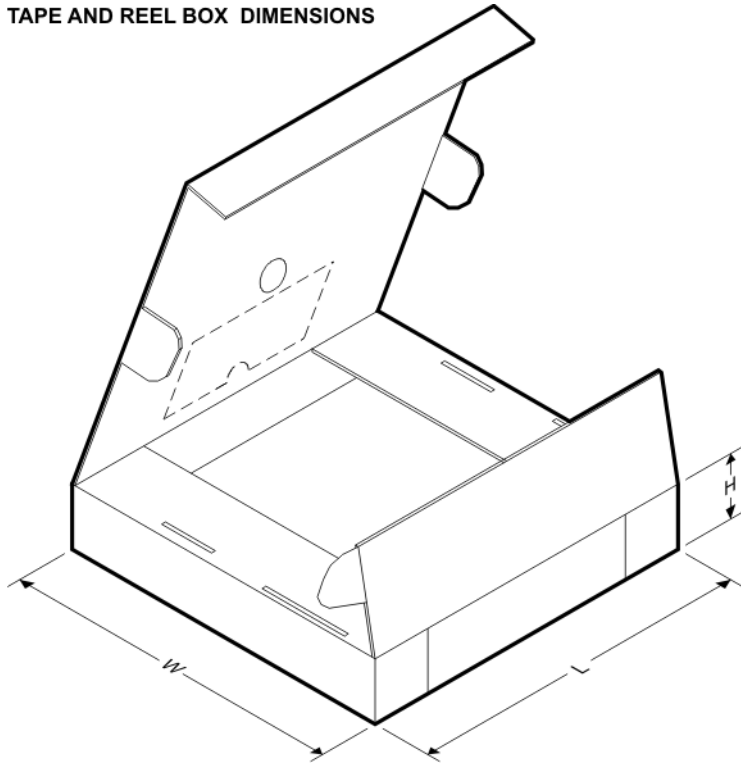
### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
HD3SS3412RUAR	WQFN	RUA	42	3000	330.0	16.4	3.8	9.3	1.0	8.0	16.0	Q1
HD3SS3412RUAT	WQFN	RUA	42	250	180.0	16.4	3.8	9.3	1.0	8.0	16.0	Q1

## TAPE AND REEL BOX DIMENSIONS



\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
HD3SS3412RUAR	WQFN	RUA	42	3000	367.0	367.0	38.0
HD3SS3412RUAT	WQFN	RUA	42	250	210.0	185.0	35.0

## GENERIC PACKAGE VIEW

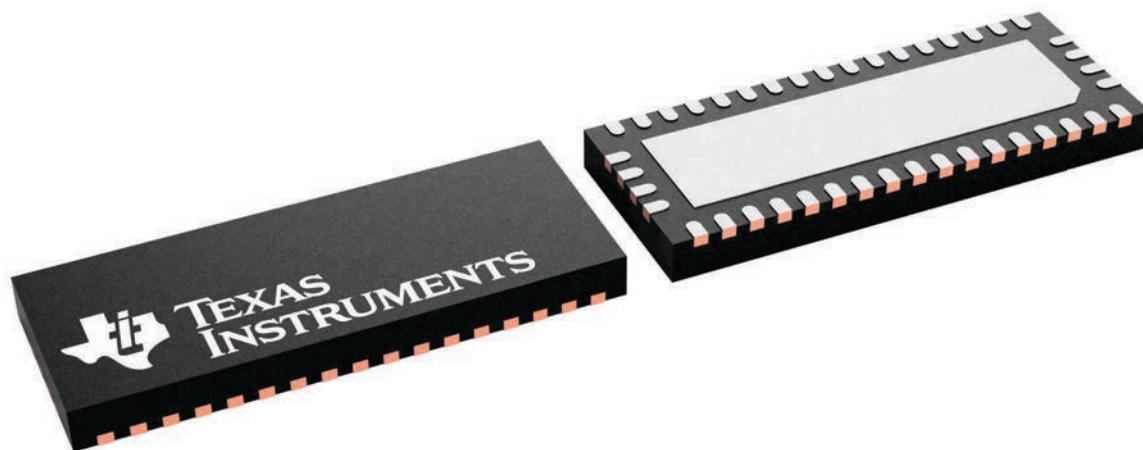
**RUA 42**

**WQFN - 0.8 mm max height**

9 x 3.5, 0.5 mm pitch

PLASTIC QUAD FLATPACK - NO LEAD

This image is a representation of the package family, actual package may vary.  
Refer to the product data sheet for package details.





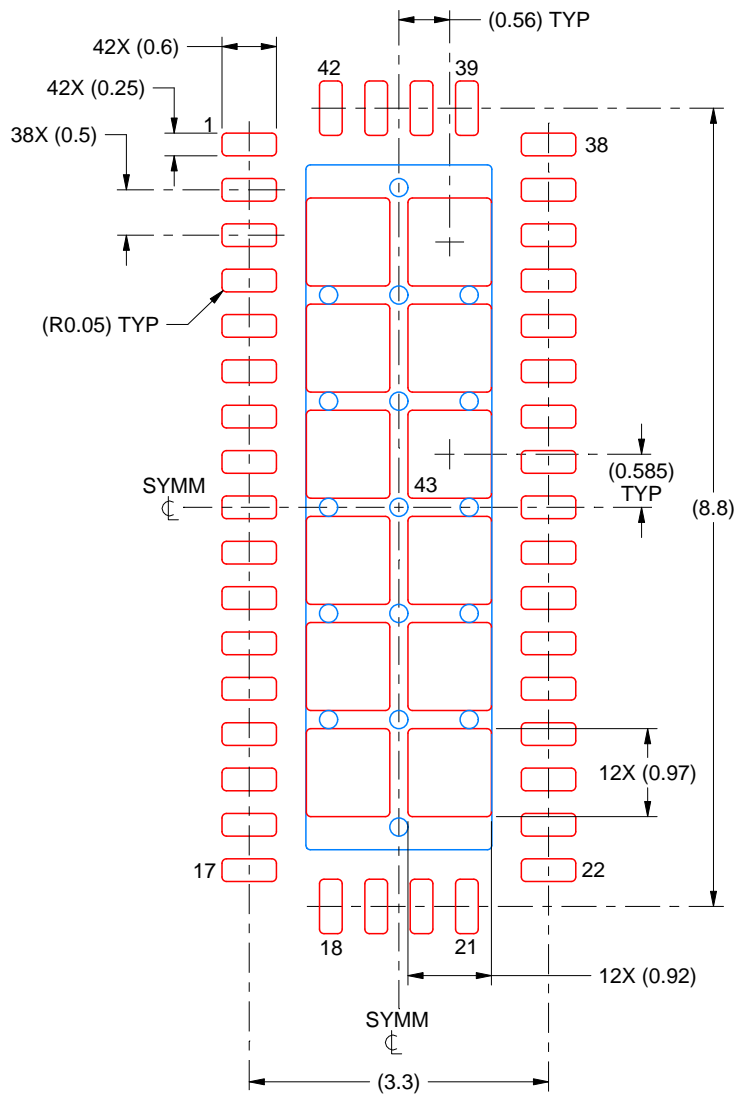


# EXAMPLE STENCIL DESIGN

RUA0042A

WQFN - 0.8 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



SOLDER PASTE EXAMPLE  
 BASED ON 0.125 MM THICK STENCIL  
 SCALE: 12X

EXPOSED PAD 43  
 69% PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE

4219139/A 03/2020

NOTES: (continued)

- 6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

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