User's Guide

TMUXHS4412 Evaluation Module User's Guide

Brian Zhou

ABSTRACT

The TMUXHS4412 evaluation module (EVM) can be used to evaluate high-speed bidirectional passive switching for USB Type-C™ mux or demux applications supporting USB 3.x Gen 1/2 data rates. It is also compatible with MIPI® DSI/CSI, LVDS, and PCI Express® Gen 1/2/3/4 interface standards. This user guide describes how to setup and configure the EVM to test functionality and signal integrity.

Table of Contents

1 Trademarks....1
2 Introduction....2
3 Setup and Configuration....3
3.1 Signal Connection....3
3.2 AC Coupling Capacitors....4
3.3 Jumper Configuration....4
3.4 Power....4
3.5 Calibration....4
3.6 REACH Compliance....4
4 Schematics....5
5 Bill of Materials....6

1 Trademarks

USB Type-C™ is a trademark of USB Implementers Forum.
MIPI® is a registered trademark of MIPI Alliance, Inc.
PCI Express® is a registered trademark of PCI-SIG.
All trademarks are the property of their respective owners.

Copyright © 2020 Texas Instruments Incorporated

2 Introduction

The TMUXHS4412 is a 4-channel high-speed mux/demux switch that is compatible with any high-speed interface with a differential amplitude < 1800 mVpp and a common mode voltage < 2 V. The device provides switching on differential channels between Port DA or Port DB to Port D (see Figure 2-1)

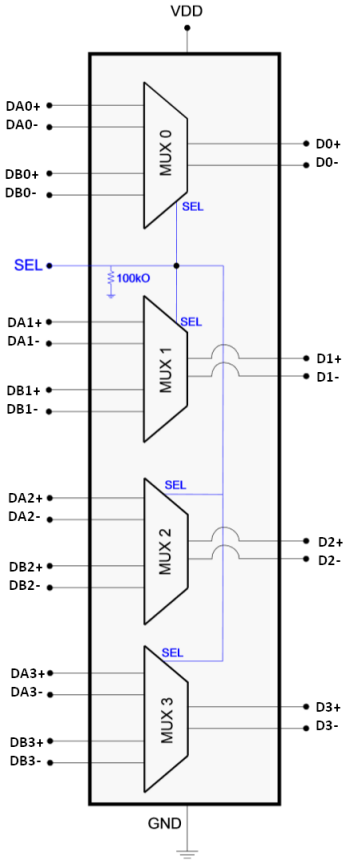

Figure 2-1. TMUXHS4412 Functional Block Diagram

Copyright © 2020 Texas Instruments Incorporated

3 Setup and Configuration

Figure 3-1 shows a top view photo of the EVM.

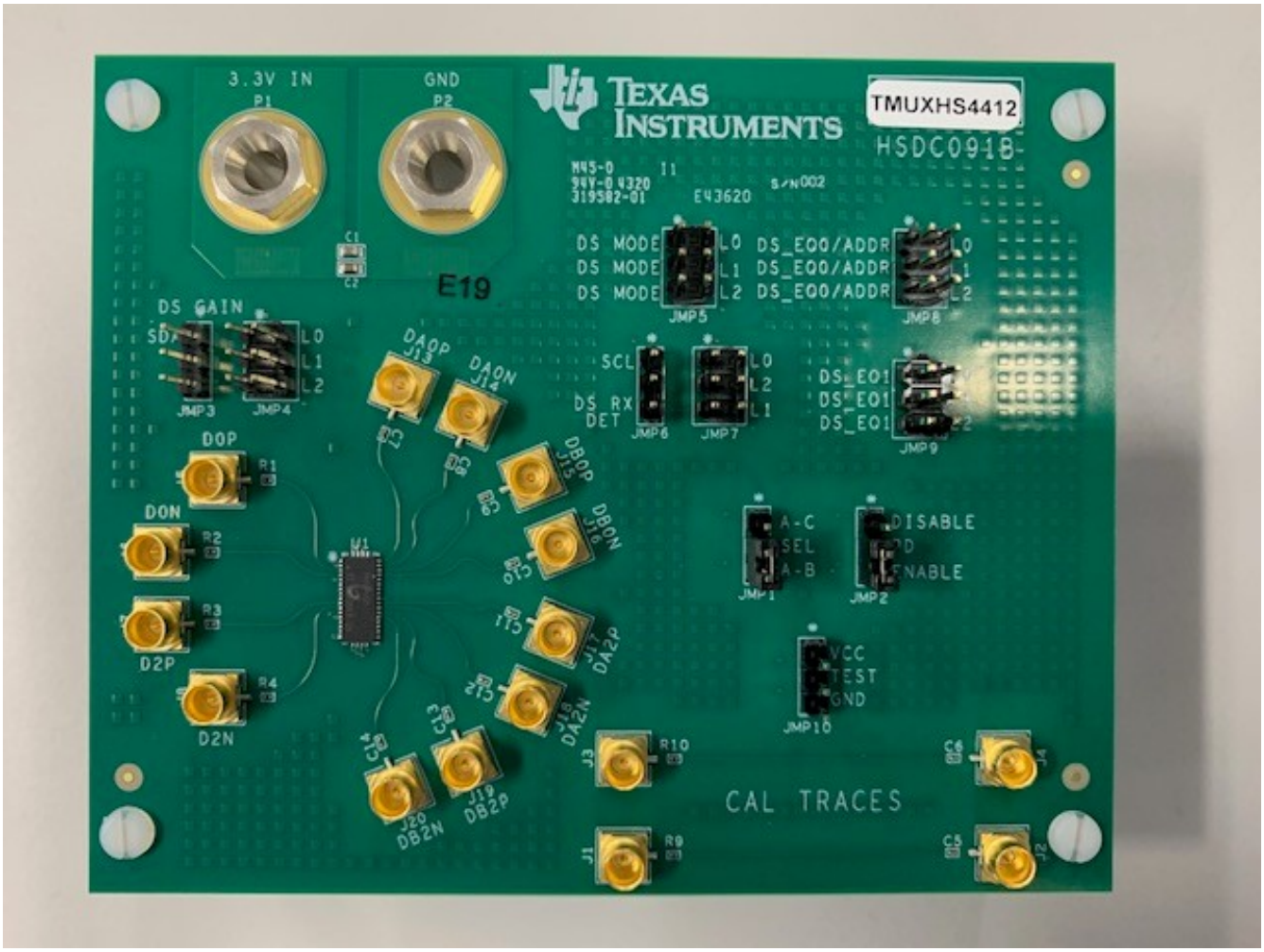

Figure 3-1. TMUXHS4412EVM

3.1 Signal Connection

The EVM provides SMP receptacles for the high-speed signal connections. Each SMP receptacle is labeled with the signal's port (DA, DB, or D), channel (0,1,2,3), and polarity (P or N). SMA to SMP cables may be required to connect to test equipment or fixtures. The signal traces are all equal length and have 50 Ω single-ended impedance.

Copyright © 2020 Texas Instruments Incorporated

3.2 AC Coupling Capacitors

Most interfaces require AC coupling between the transmitter and receiver. The USB 3.1 specification requires AC coupling capacitors in the range of 75 - 265 nF for Gen 1 and Gen 2 speeds. By default, the EVM is populated with 220 nF AC coupling capacitors on Ports DA and DB. The 220 nF value was chosen over the more typical 100 nF value to maintain spec compliance when the host or device attached to the EVM also has a capacitor in series. Port D is populated with 0 Ω resistors which can be replaced with capacitors if needed. However, the TMUXHS4412 switch requires a bias voltage so capacitors cannot be placed on both sides of the switch unless an external bias voltage of < 2 V is provided. The TMUXHS4412 Four-Channel Differential 2:1/1:2 USB3.1 Mux/Demux datasheet has additional information about implementing coupling capacitors and bias voltage for various applications.

3.3 Jumper Configuration

The TMUXHS4412 is controlled by an active-low enable signal and a port select signal. Jumper JMP2 is used to enable or disable the switch. Jumper JMP1 controls the port selection: Port D to Port DA, or Port D to Port DB. JMP6 should be in position 1-2. All jumpers and their operational positions are labeled with silkscreens on the EVM for ease of use.

3.4 Power

The EVM is designed to operate from an external 3.3 V power supply using standard banana jack plug cables. Terminal P1 should be connected to the supply positive output and P2 to ground. A power supply current limit of 100 mA is more than adequate to power the EVM.

3.5 Calibration

The EVM provides a pair of calibration traces to allow the EVM to be de-embedded from the TMUXHS4412 chip during measurement. The calibration traces are length matched to the combined length of the input and output traces to the TMUXHS4412. They are also populated with the same capacitors and resistors.

3.6 REACH Compliance

In compliance with the Article 33 provision of the EU REACH regulation we are notifying you that this EVM includes component(s) containing at least one Substance of Very High Concern (SVHC) above 0.1%. These uses from Texas Instruments do not exceed 1 ton per year. The SVHC is shown in Table 3-1:

Table 3-1. Component List

Component manufacturer	Component type	Component part number	SVHC Substance	SVHC CAS (when available)
Rosenberger	Connector	19S101-40ML5	Lead	7439-92-1

Copyright © 2020 Texas Instruments Incorporated

4 Schematics

Figure 4-1 shows the EVM schematic.

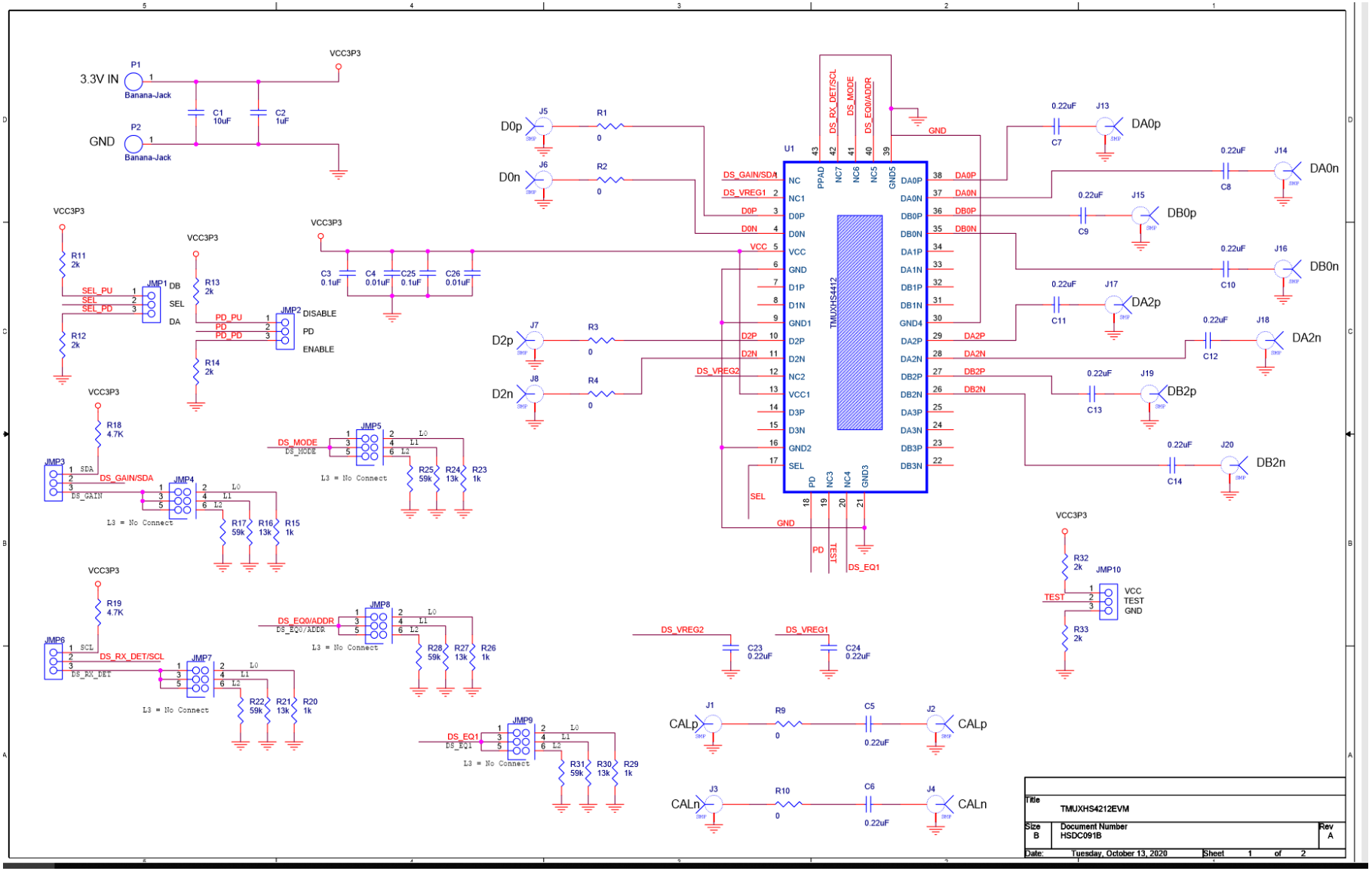

Figure 4-1. TMUXHS4212EVM Schematic

Copyright © 2020 Texas Instruments Incorporated

5 Bill of Materials

Table 5-1 shows the EVM Bill of Materials.

Table 5-1. TMUXHS4412EVM BOM

Item	Quantity	Reference	Value	Manufacturer	Part Number	Footprint
1	1	C1	10 uF	Murata	GRM188R61A106KE69D	603
2	1	C2	1 uF	Taiyo Yuden	LMK107B7105KA-T	603
3	10	C5, C6, C7, C8, C9, C10, C11, C12, C13, C14	0.22 uF	Taiyo Yuden	LMK063BJ224MP-F	201
4	2	C3, C25	0.1 uF	KEMET	C0402C104M8RACTU	402
5	12	C4,C26	0.01 uF	KEMET	C0402C103K8RACTU	402
6	2	C23,C24	0.22 uF	Taiyo Yuden	LMK107B7105KA-T	603
7	16	J1, J2, J3, J4, J5, J6, J7, J8, J13, J14, J15, J16, J17, J18, J19, J20	SMP	Rosenberger	19S101-40ML5	CON_19 S101-40M_R04350
8	5	JMP1,JMP2,JMP3, JMP6,JMP10	HDR3X1 M .1	Samtec	TSW103-07-G-D	HDR_THVT_1x3_254_871
9	5	JMP4,JMP5,JMP7,JMP8,JMP9	HDR3X1 M .1	Samtec	TSW103-07-G-D	HDR_THVT_1x3_254_871
10	1	LB1	PCB Label 0.650 ≈ x 0.200"W	Brady	THT-14-423-10	rectangle
11	1	PCB1	HSDC091B	Any	HSDC091B	n/a
12	2	P1, P2	Banana-Jack	Pomona	3267	bjack
13	6	R1, R2, R3, R4, R9, R10	0	Vishay Dale	CRCW02010000Z0ED	r0201
14	6	R11, R12, R13, R14,R32,R33	2k	Yageo	RC0402JR-072KL	r0402
15	5	R15,R20,R23,R26,R29	1k	Yageo	RC0402JR-071KL	r0402
16	5	R16,R21,R24,R27,R30	13k	Yageo	RC0402JR-0713KL	r0402
17	5	R17,R22,R25,R28,R31	59k	Yageo	RC0402JR-0759KL	r0402
18	2	R18,R19	4.7k	Yageo	RC0402JR-074k7L	r0402
19	4	SCRW1, SCRW2, SCRW3, SCRW4	NY PMS 440 005 PH	B&F Fastener	NY PMS 440 005 PH	screw
20	2	SHNT1, SHNT2	QPC02 SXGN-RC	Sullins	QPC02SXGN-RC	0.1
21	4	STDOFF1, STDOFF2, STDOFF3, STDOFF4	1902E	Keystone	1902E	Standoff
22	1	U1	TMUXHS4412	Texas Instruments	TMUXHS4412IRKS	RUA0042BA_205x755

Copyright © 2020 Texas Instruments Incorporated

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI’s products are provided subject to TI’s Terms of Sale or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI’s provision of these resources does not expand or otherwise alter TI’s applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2022, Texas Instruments Incorporated