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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.

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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.

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](#))

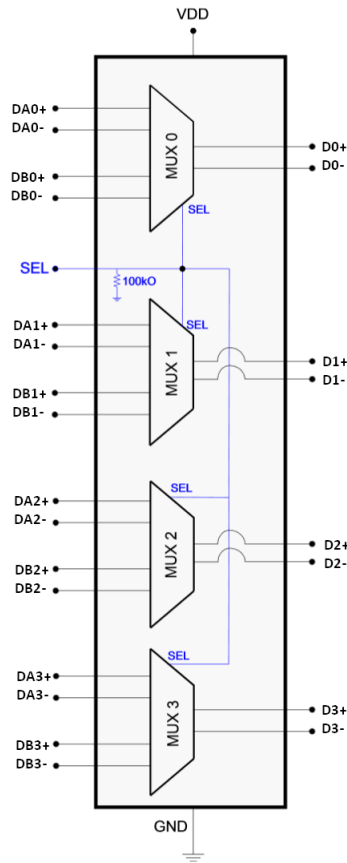


Figure 2-1. TMUXHS4412 Functional Block Diagram

3 Setup and Configuration

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

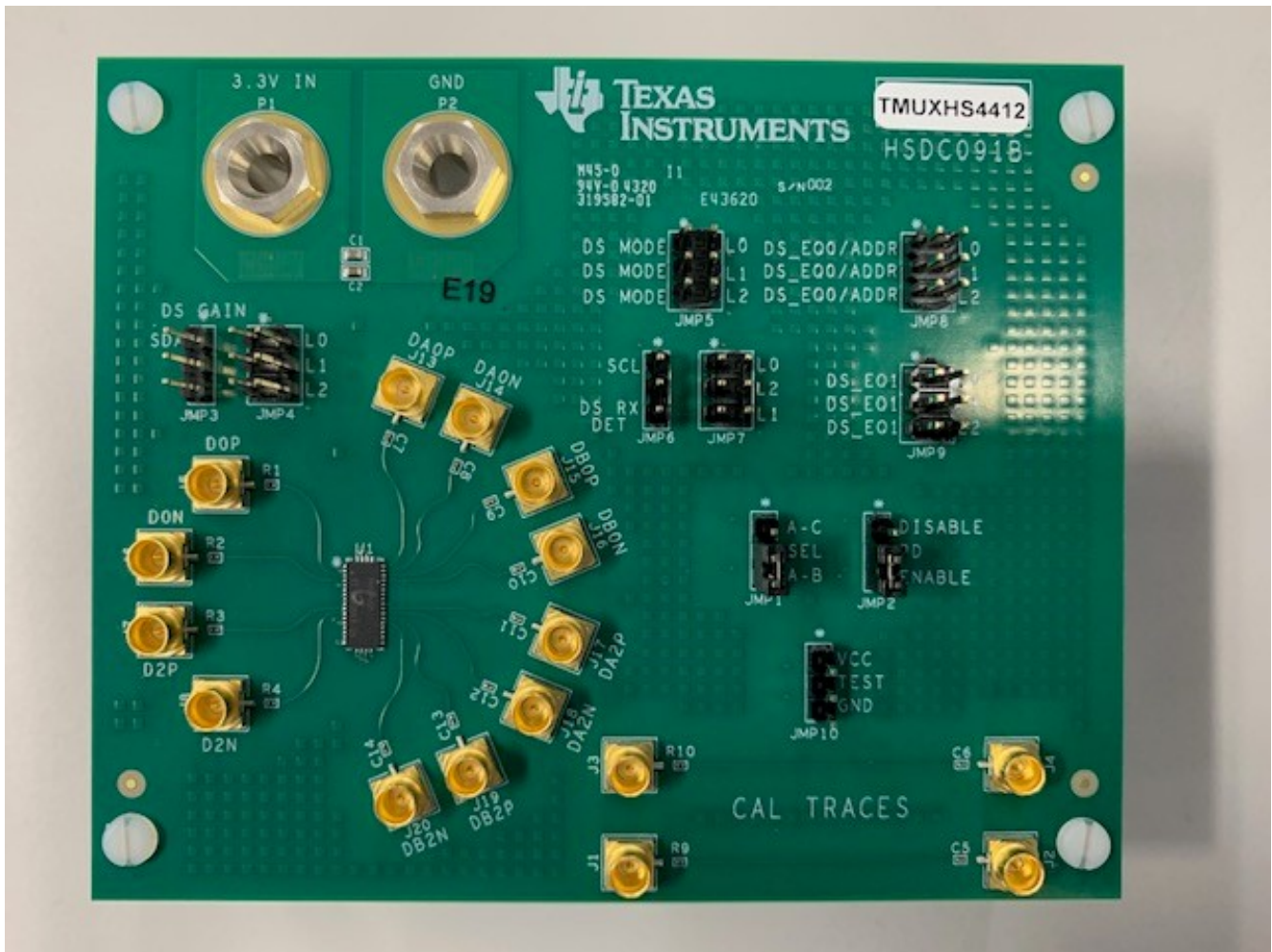


Figure 3-1. TMUXHS4412EVM

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.

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

4 Schematics

Figure 4-1 shows the EVM schematic.

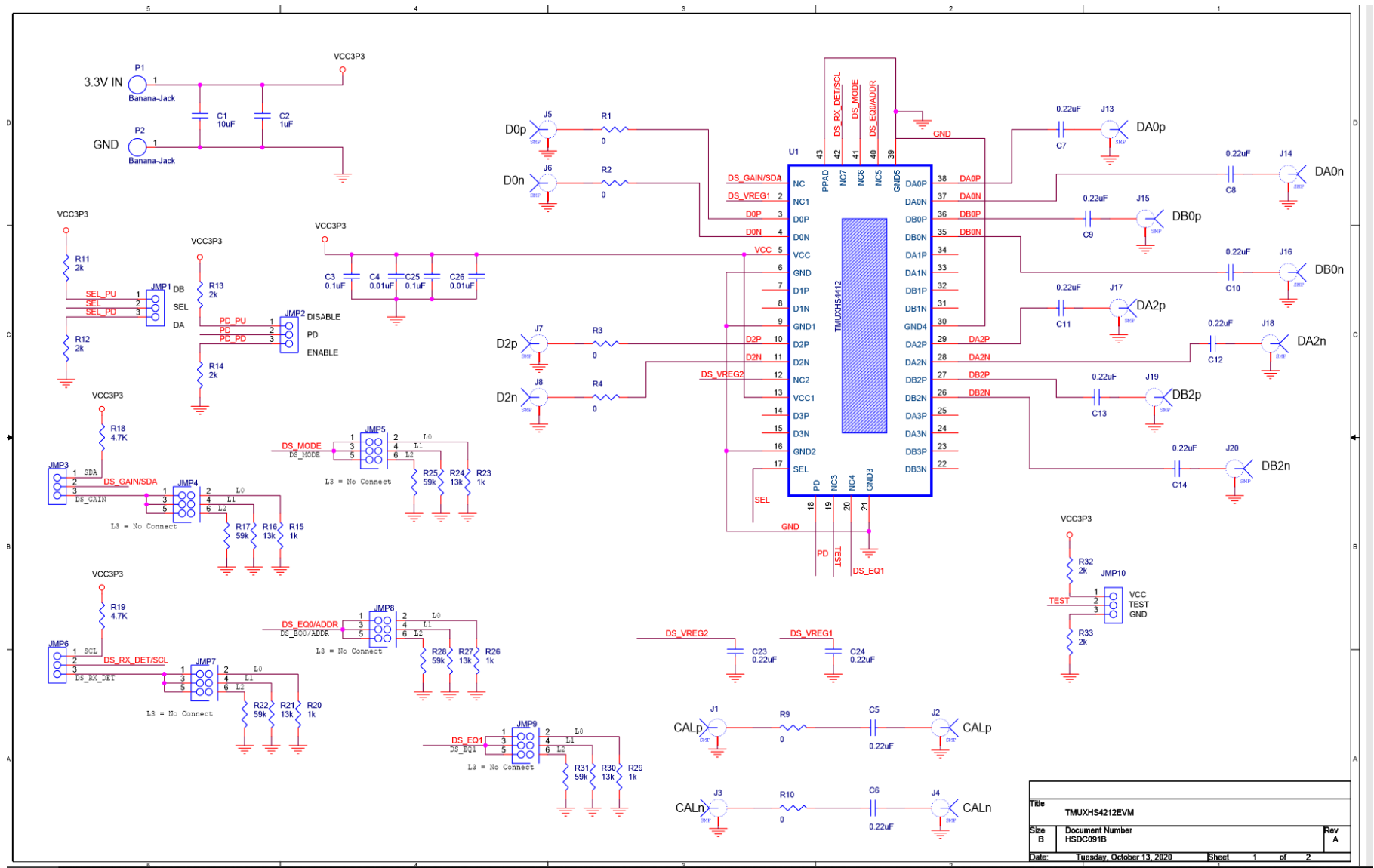


Figure 4-1. TMUXHS4212EVM Schematic

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_87 1
9	5	JMP4, JMP5, JMP7, JMP8, JMP9	HDR3X1 M .1	Samtec	TSW103-07-G-D	HDR_THVT_1x3_254_87 1
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

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