User's Guide

TUSB217AEVM-BC Evaluation Module

ABSTRACT

This user guide is for the evaluation module (EVM) of the TUSB217A devices is available to provide an easy evaluation process of TI's TUSB217A USB High-Speed signal conditioners. It provides an overview of the EVM, which highlights key features, operating conditions, and how to set up for use in system-level evaluation. The construction of the EVM also serves as a reference design that is easily modified for any intended application. Target applications include cell phones, desktop or notebook computers, docking stations, televisions, and active cables. Additional schematic and layout information is available on TI.com.

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1 TUSB217AEVM-BC

The TUSB217A is a USB High-Speed signal conditioner designed to compensate both AC loss (due to capacitive load) and DC loss (due to resistive loss) in the transmission channel.

The TUSB217A speeds up the transition edges of a USB 2.0 high-speed signal with an edge booster and increases static levels with a DC boost function. The TUSB217A includes a pre-equalization function to improve the receiver sensitivity and compensate the inter-symbol interference (ISI) jitter. USB 2.0 low-speed and full-speed signal characteristics are unaffected by the TUSB217A.

The integrated Charging Downstream Port (CDP) mode and Dedicated Charging Port (DCP) mode BC 1.2 battery charging controller can be controlled via the DCP/CDP pin.

The TUSB217AEVM-BC was designed to be used as a path connection between a USB 2.0 host and a USB 2.0 device. The EVM is designed to provide multiple connector options to help eliminate the use of adapters. The upstream interface to the EVM consists of three possible input connectors: a USB 2.0 Mini-B Receptacle, a USB 3.1 Type B Receptacle, and a USB 3.1 Type-A Plug. The downstream interface to the EVM consists of three USB 3.1 Type-A Receptacle output connectors. Each section of the EVM is detachable from the main board along the board perforations. The EVM can be connected to the system using various cable lengths to verify system operation under different conditions.

2 TUSB217AEVM-BC Board Description

The TUSB217AEVM-BC (see Figure 2-1) is designed to provide easy evaluation of the TUSB217A device. It is also meant to serve as a reference design to show a practical example of how to use the device in a mass-production system.

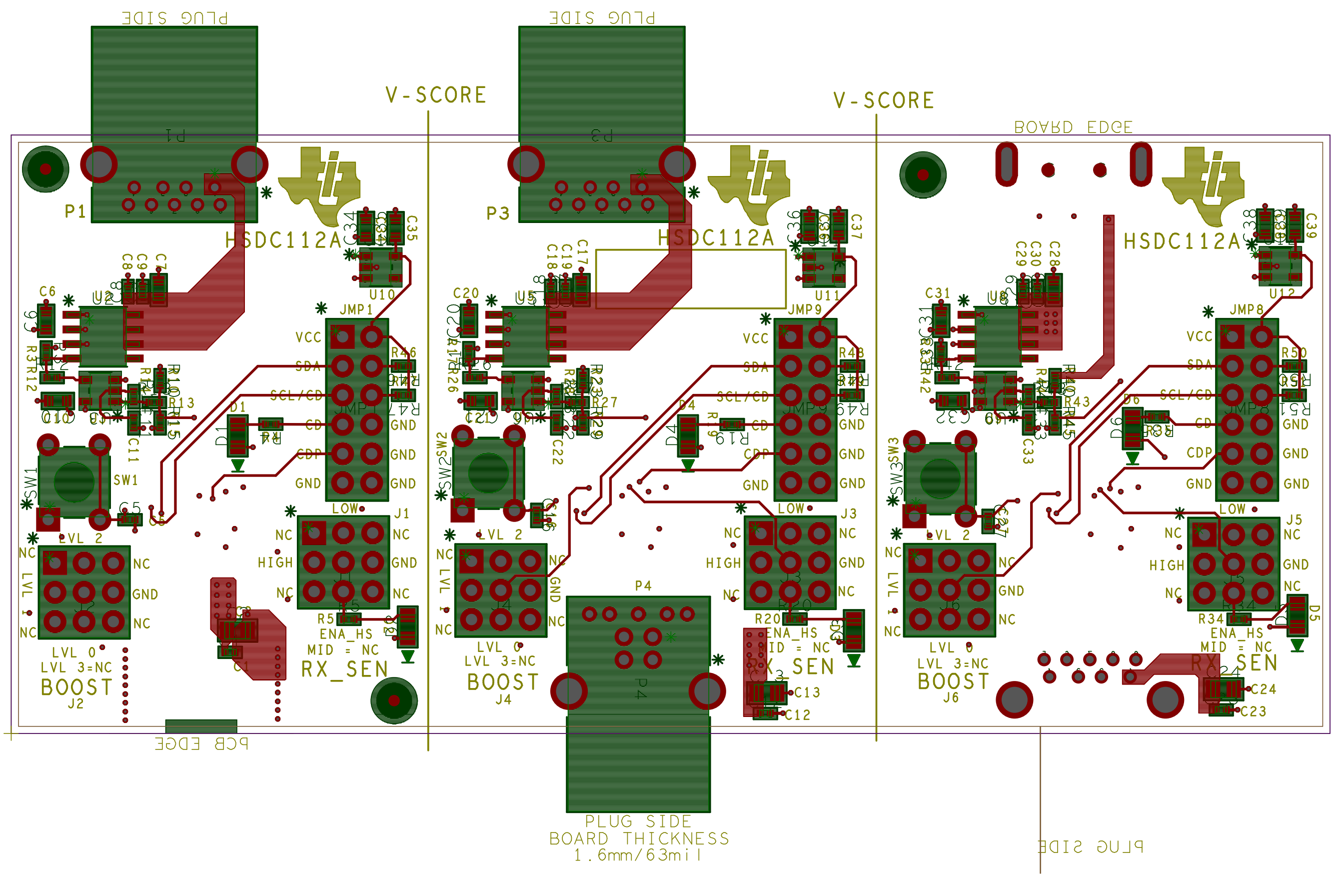

Figure 2-1. TUSB217AEVM-BC

3 TUSB217AEVM-BC Kit Contents

This EVM kit should contain the following items:

- TUSB217AEVM-BC board
- This user's manual

4 EVM Configuration

4.1 Setting EVM Jumpers

The TUSB217AEVM-BC has two 3 × 3 headers and a 6 × 2 header in each board partition to facilitate configuration changes.

The BOOST and RX_SEN 3 × 3 headers are arranged to allow for all possible device configurations, including connecting RX_SEN to an LED so that the ENA_HS status output can be viewed easily. The corner pins of the 3 × 3 headers are not connected.

The 6 × 2 header adds the ability to connect onboard pullups to the SDA and SCL pins to support I^2C operation. If I^2C mode is not needed, the SCL/CD pin can be connected to an LED so the CD status can be easily checked. Also, the 6 × 2 header provides connections for ground and to supply power manually to the EVM. In addition, the header adds the ability to enable CDP and DCP modes on the TUSB217A.

Table 4-1. 6 × 2 Configuration Header Pinout

Row 1	Row 2
VCC_EXT_Px -EVM External Power Input If used, the onboard 0-Ω resistor between VCC_US_Px and VCC_EXT_Px must be removed.	SW_VCC_Px - 3.3-V Power for I^2C Interface. Provided by an onboard regulator.
SDA_Px - I^2C Serial Data to TUSB217A	4.7-kΩ I^2C pullup - can be jumpered to SDA_Px. To enable I^2C mode, the pullups on both SDA and SCL must be connected at power on or after a reset.
SCL/CD_Px - I^2C Serial Clock or Connect Detect Output to TUSB217A	4.7-kΩ I^2C pullup - can be jumpered to SCL/CD_Px. To enable I^2C mode, the pullups on both SDA and SCL must be connected at power on or after a reset.
CD_Px - Connect Detect LED. The LED can be jumpered to SCL/CD_Px so USB connection status can be easily determined.	GND
CDP_DCP- BC 1.2 Mode configuration to TUSB217A. Jumpering this pin to GND enables DCP mode. CDP is enabled by internal pullup.	GND
GND	GND

Changing jumper settings without a complete understanding of the result is not recommended. Configuration inputs are only read by the TUSB217A during power on reset or after de-asserting the RSTN pin by pressing the provided onboard reset button (SW1, SW2, SW3). Changing settings while the EVM is powered on has no effect. Refer to the device data sheet for detailed pin descriptions and functionality along with EVM schematic for additional information.

Table 4-2. 3 × 3 Boost Header

No Connect	3.6 kΩ to GND	No Connect
1.8 kΩ to GND	BOOST to TUSB217A	GND
No Connect	0 Ω to GND	No Connect

BOOST jumper settings as defined in Table 4-2.

1. Center pin to the bottom position sets BOOST Level 0
2. Center pin to the left position sets BOOST Level 1
3. Center pin to the top position sets BOOST Level 2
4. No connect of the center pin sets BOOST Level 3

The right position of the BOOST jumper is short to GND.

Table 4-3. 3 × 3 RX_SEN Header

No Connect	27 kΩ to GND	No Connect
13 kΩ, 39-kΩ divider	RX_SEN to TUSB217A	GND
No Connect	ENA_HS LED	No Connect

RX_SEN jumper settings as defined in Table 4-3.

1. The top position sets low RX sensitivity.
2. No connect of the center pin sets mid RX sensitivity.
3. The center pin to the left position sets high RX sensitivity.
4. The center pin to the bottom position enables the ENA_HS status LED.

Right Position of RX_SEN jumper is short to GND.

4.2 Selecting Configuration Levels

The primary purpose of the USB 2.0 signal conditioner is to restore the signal integrity of a USB High-Speed channel to USB 2.0 compliant levels. The platform goal is to pass the USB Near-End or Far-End Eye Mask with the device in the best location.

A typical use case is to place the USB 2.0 signal conditioner close to the USB connector on a host platform to pass Near-End Eye Mask testing. This includes systems where the USB connector may be placed at the far-end of a cable.

Typical RX sensitivity and boost recommendations based on cable length (28 AWG USB cable) are shown in Table 4-4. TI recommends starting with the lower settings first

Table 4-4. RX_SEN, BOOST Setting Based on Cable Length

Cable Length	BOOST	RX_SEN
0 m - 2 m	Level 0	MID
3 m - 5 m	Level 1	MID, HIGH

4.3 Battery Charging Functions of TUSB217A

The DCP/CDP pin of the TUSB217A is a battery charging 1.2 Dedicated Charging Port (DCP) and Charging Downstream Port (CDP) function enable. In the shared TUSB216IEVM and TUSB217AEVM-BC schematic, this pin is listed as CDP_ENZ. By default, the TUSB217A has the battery charging 1.2 CDP function enabled with a 500-kΩ internal pullup.

When TUSB217A is disconnected from the USB 2.0 data stream, the DCP mode of the TUSB217A can then be enabled to allow the DCP handshake to be performed. It is recommended that when the TUSB217A switches from CDP to DCP mode or back, that downstream VBUS is toggled so any downstream devices reconnect.

4.3.1 Automatic DCP/CDP Test Setup

To test these features on the TUSB217AEVM-BC:

1. Remove the 0-Ω resistor connecting the upstream VBUS and the EVM power (R1, R16, R31).
2. Externally power the EVM, by providing power to pin 1 of the 6 × 2 header (VCC_EXT_Px). This power source should be able to provide up to 1.5 A at 5 V DC. TI recommends setting the voltage slightly above 5 V to prevent droop issues.
3. There is an VBUS toggle circuit on the EVM that should provide an adequate VBUS toggle to force connected downstream devices to disconnect and reconnect when transitioning between CDP and DCP mode in most cases. This toggle length will vary depending on the voltage and bulk capacitance of the system, and may not work for all applications. If it does not, see Manual DCP/CDP Test Setup.
4. Verify that the charging device power consumption is as expected.

4.3.2 Manual DCP/CDP Test Setup

To manually test DCP/CDP features on the TUSB217AEVM-BC:

If the downstream device is not getting adequate VBUS toggle, to force a reconnect event the downstream device can be disconnected and reconnected or the external EVM power manually toggled:

Entering CDP mode from DCP mode:

- No jumper on Header 6 × 2, pin 9 (CDP_ENZ in the schematic)
- Power cycle the VCC_EXT_Px to the EVM or disconnect and reconnect the downstream device

Entering DCP mode from CDP mode:

- Jumper on header 6 × 2, pin 9 (CDP_ENZ in the schematic) to GND (pin 10 or 11).
- Power cycle the VCC_EXT_Px to the EVM or disconnect and reconnect the downstream device

Note

The VBUS toggle circuit on the TUSB217AEVM-BC should not be used as a reference design. The resistor divider used to sense upstream VBUS will back drive voltage on upstream VBUS due to the internal pullup on DCP/CDP. A design with a comparator is recommended.

5 EVM Operation

To install the EVM, perform the following steps:

1. Upstream connection: attach a USB cable from a host PC Type A connector to the Type B connector (P2 or P4) of the EVM or connect P6 directly to the host PC.
2. Downstream connection: attach a USB device directly or via a USB cable plugged into the Type A receptacle connector (P1, P3 or P5) on the EVM.
3. The upstream connection and downstream connections must be on the same board section of the EVM.

The TUSB217A will only re-drive USB 2.0 high-speed signals.

6 TUSB217AEVM-BC Schematics

Figure 6-1 through Figure 6-4 show the EVM schematics.

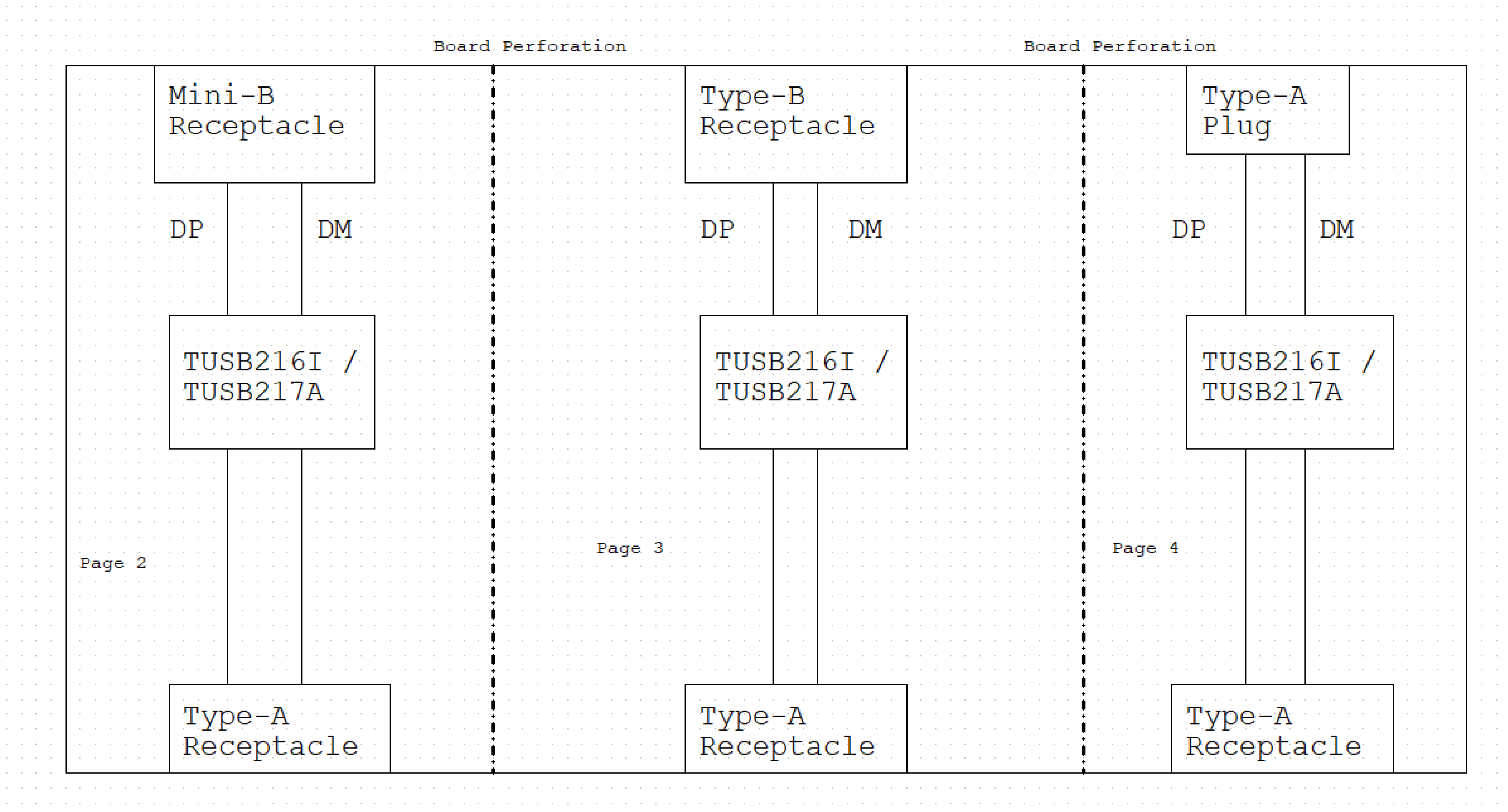

Figure 6-1. TUSB217AEVM-BC Block Diagram

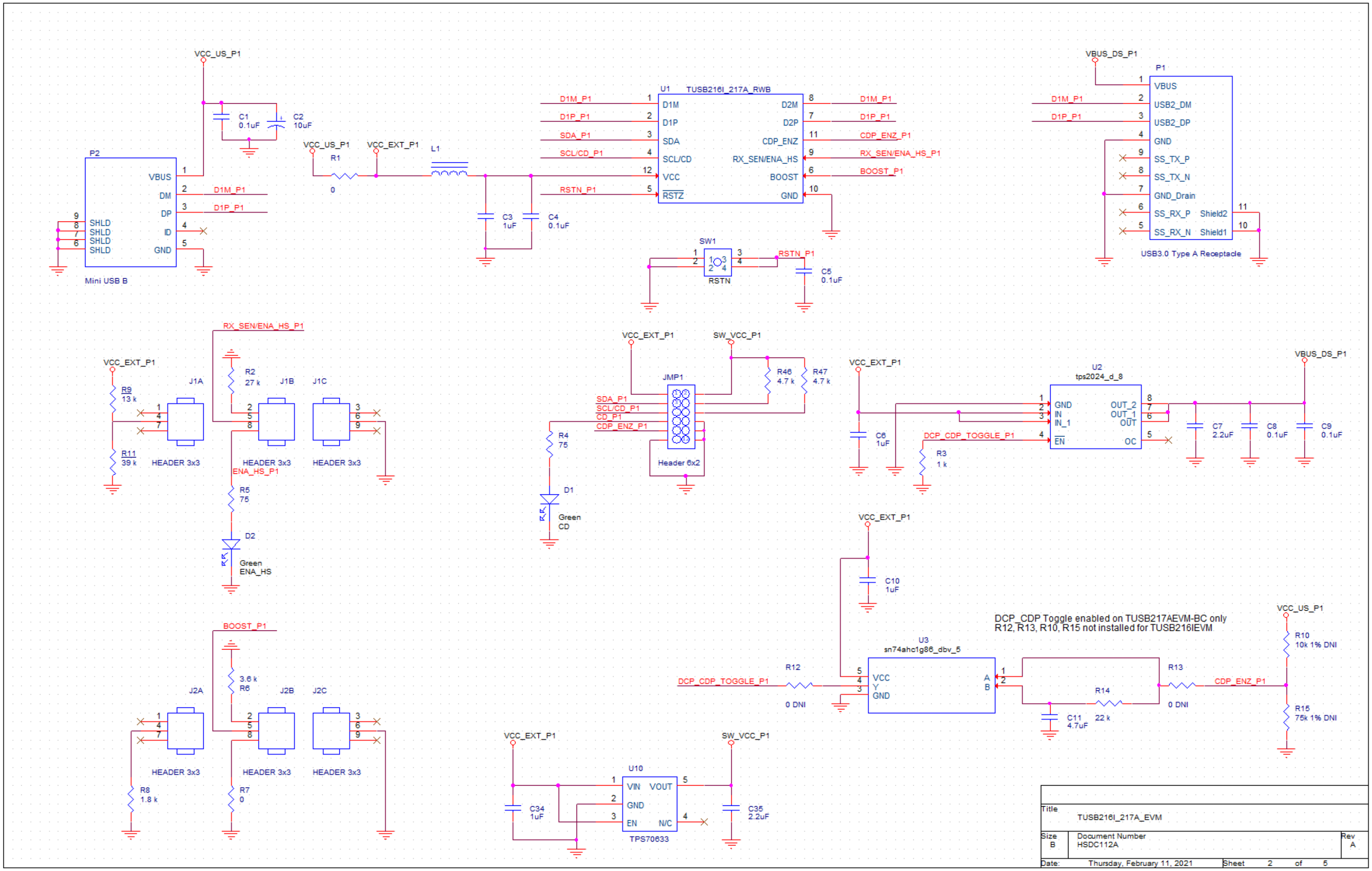

Figure 6-2. TUSB217AEVM-BC Mini-B Receptacle Section

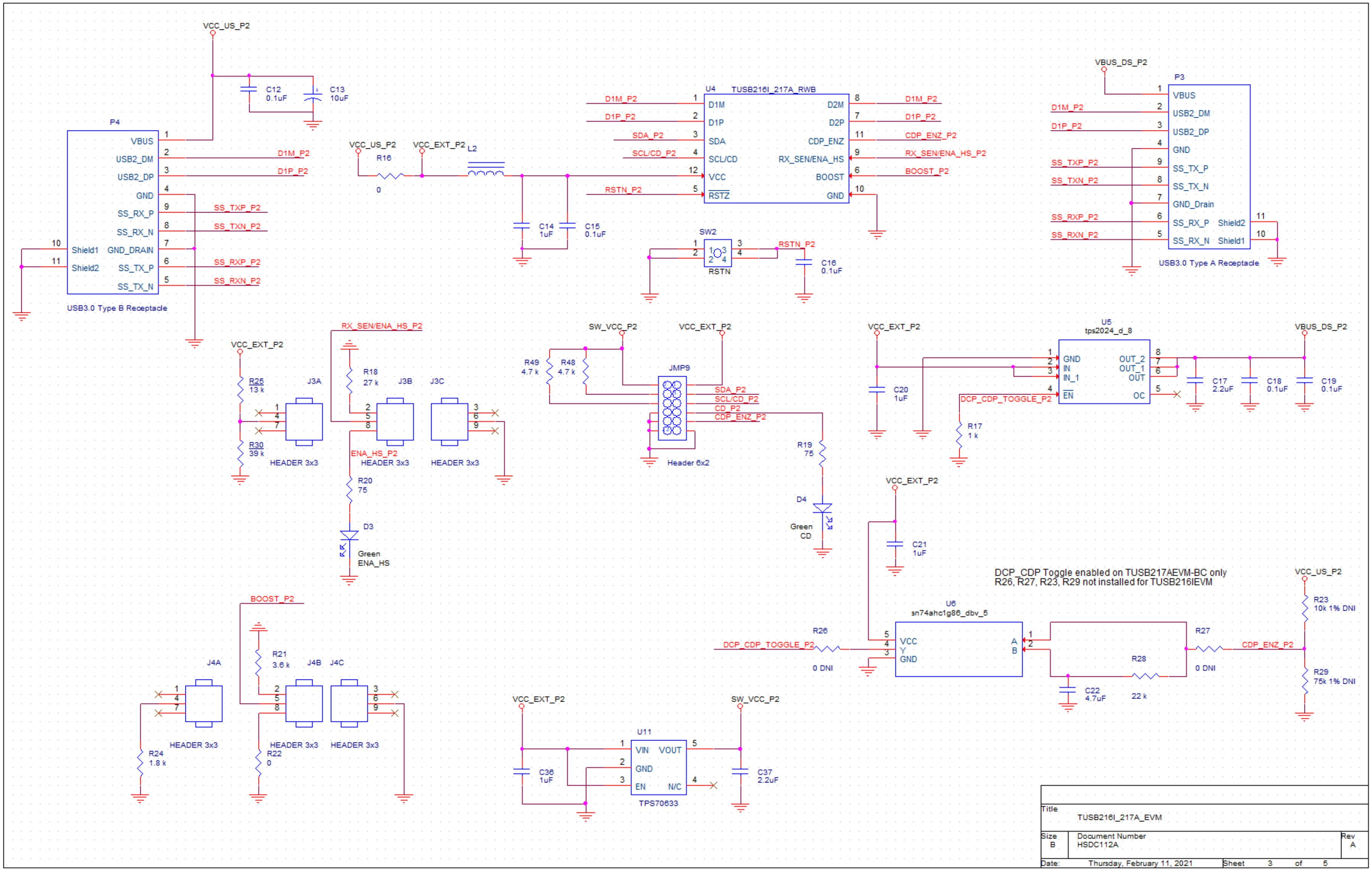

Figure 6-3. TUSB217AEVM-BC Type-B Receptacle Section

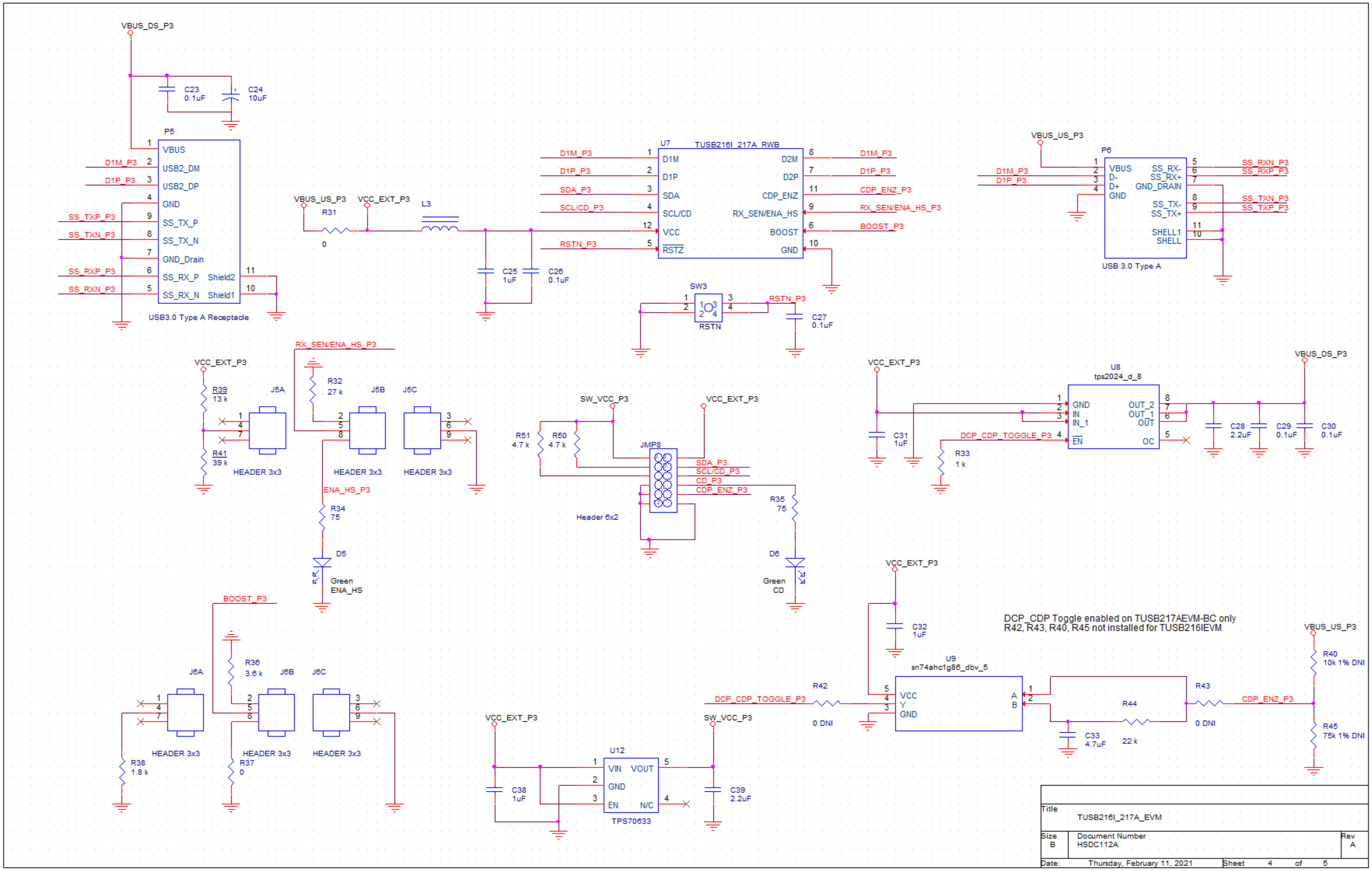

Figure 6-4. TUSB217AEVM-BC Type-A Plug Section

7 TUSB217AEVM-BC Bill of Materials (BOM)

Table 7-1 displays the EVM BOM.

Table 7-1. TUSB217AEVM-BC BOM

Item	Quantity	Reference	Part
1	15	C1, C4, C5, C8, C9, C12, C15, C16, C18, C19, C23, C26, C27, C29, C30	0.1uF
2	3	C2, C13, C24	10uF
3	12	C3, C6, C10, C14, C20, C21, C25, C31, C32, C34, C36, C38	1uF
4	6	C7, C17, C28, C35, C37, C39	2.2uF
5	3	C11, C22, C33	4.7uF
6	6	D1, D2, D3, D4, D5, D6	LED
7	3	JMP1, JMP8, JMP9	Header 6x2
8	6	J1, J2, J3, J4, J5, J6	Header 3x3
9	1	LBL1	THT-14-423-10
10	3	L1, L2, L3	100 Ohms Ferrite Bead
11	1	PCB1	HSDC112
12	2	P1, P3, P5	USB3.0 Type A Receptacle
13	1	P2	Mini USB B
14	1	P4	USB3.0 Type B Receptacle
15	1	P6	USB 3.0 Type A
16	6	R1, R7, R16, R22, R31, R37	0
17	3	R2, R18, R32	27K
18	3	R3, R17, R33	1K
19	6	R4, R5, R19, R20, R34, R35	75
20	3	R6, R21, R36	3.6K
21	3	R8, R24, R38	1.8K
22	3	R9, R25, R39	39K
23	3	R10, R23, R40	10K 1%
24	3	R11, R30, R41	13K
25	6	R12, R13, R26, R27, R42, R43	0
26	3	R14, R28, R44	22K
27	3	R15, R29, R45	75K 1%
28	6	R46, R47, R48, R49, R50, R51	4.7k
29	6	SHNT1, SHNT2, SHNT3, SHNT4, SHNT5, SHNT6	QPC02SXGN-RC
30	3	SW1, SW2, SW3	Switch - Push Button
31	3	U1, U4, U7	TUSB217ARWB
32	3	U2, U5, U8	TPS2024D
33	3	U3, U6, U9	SN74AHC1G86DBV
34	3	U10, U11, U12	TPS70633