TUSB214 Evaluation Module

This user's guide is for the evaluation module (EVM) of the TUSB214. The purpose of this user's guide is to facilitate an easy evaluation process of the TUSB214 USB high-speed signal conditioner from TI.

The contents of this user's guide are meant to provide an overview of the TUSB214 device, which includes highlighting its key features, operating conditions, and how to set up this EVM for use in system-level evaluation.

The construction of the TUSB214EVM also serves as a reference design that can easily be modified for any intended application. Target applications include the following:

- Cell phones
- Desktop or notebook computers
- Docking stations
- Televisions
- Active cables

Schematic and board layout information is also included at the end of this manual.

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1 Introduction

The TUSB214 device is a USB high-speed signal conditioner, designed to compensate for ISI signal loss in a transmission channel.

The design of the TUSB214 device is agnostic to USB low and full-speed signals and does not affect FS and LS signaling. High-speed signals are compensated along with programmable DC gain, to fine-tune device performance to optimize the high-speed signals at the connector.

This EVM was designed to be used as a medium connection between a USB host and a USB device. The interface to the EVM consists of a USB 3.1 Type A Receptacle and a USB 3.1 Type B Receptacle. Therefore, to connect the EVM to your system setup, you will likely need two USB 3.1 Standard Type A → B cables. Your test setup should look similar to Figure 1.

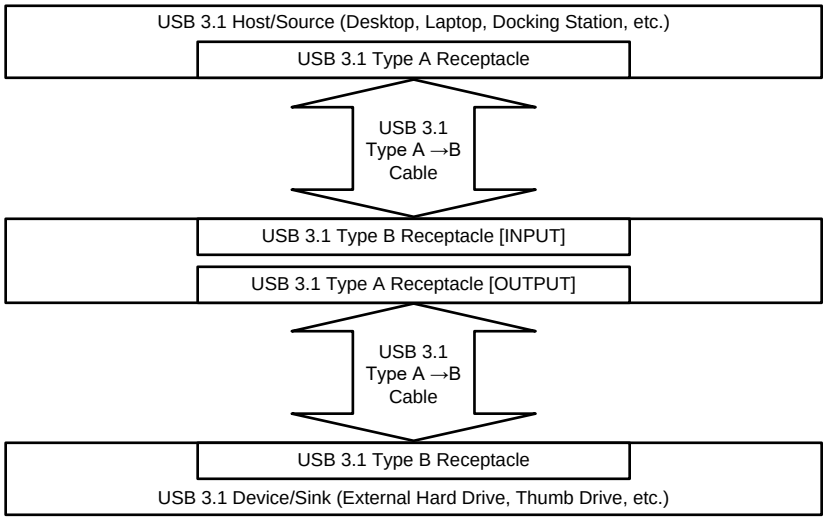


Figure 1. TUSB214 Functional System Level Block Diagram

1.1 TUSB214EVM Kit Contents

This EVM kit contains the following items:

- TUSB214EVM board
- TUSB214EVM user's guide

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1.1.1 Description of EVM Board

The TUSB214EVM is designed to provide easy evaluation of the TUSB214 device. The TUSB214EVM 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 highlights the jumpers and switch installed on this EVM, and Table 1 lists their functionality and configuration.

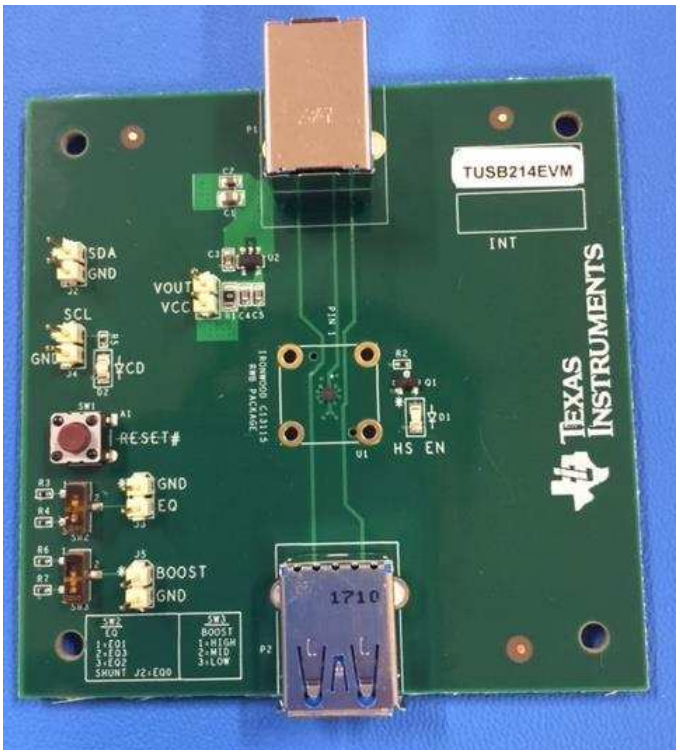


Figure 2. TUSB214EVM Board

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2 Test Setup and Results

2.1 Configuration Switches

The TUSB214 device has three switches to facilitate configuration changes. TI does not recommend changing these switch settings without a complete understanding of the result. Configuration inputs are read by the TUSB214 device only during power on reset or after deasserting the RSTN pin. Changing these switch settings while the EVM is powered on has no effect. See the device data sheet for detailed pin descriptions and functionality, along with the EVM schematic for additional information.

The switch definitions are as follows:

- SW1 RSTN Pushbutton Switch:
  1. Push the button to place the TUSB214 device in RESET.
  2. Release the button to deassert RESET.
- SW2 Equalization (EQ):
  - 1: Sets TUSB214 to EQ1 level
  - 2: Sets TUSB214 to EQ3 level (maximum)
  - 3: Sets TUSB214 to EQ2 level
  - Shunt across J3 sets TUSB214 to EQ0 level (minimum)
- SW3 Boost:
  - 1: Pull-up (high boost)
  - 2: NC (mid boost)
  - 3: GND (low boost)

Table 1. TUSB214 EVM Jumper Descriptions

Jumper	Functionality and Configuration	
J1	213_VCC	1 = 3.3-V regulator output
		2 = TUSB214 V_{CC}
J2	SDA	1 = SDA
		2 = GND
J3	EQ	1 = GND
		2 = EQ
J4	SCL/CD	1 = SCL/CD
		2 = GND
J5	Boost/ENA_HS	1 = Boost/ENA_HS
		2 = GND

2.2 Selecting Equalization and Boost Level for TUSB214

The primary purpose of the TUSB214 device is to restore the signal integrity of a USB high-speed channel up to the USB connector. The platform goal is to pass the USB near-end or far-end eye Mask with the TUSB214 in the best location.

A typical use case is to place the TUSB214 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.

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Table 2 lists typical EQ and boost recommendations based on cable length (28AWG USB cable).

Table 2. EQ/Boost Setting Based on Cable Length

Cable Length	TUSB214 EQ	TUSB214 Boost
0 m - 1 m	EQ1	Low
1 m – 2 m	EQ2	Mid
2 m – 3 m	EQ2	Mid
3 m – 5 m	EQ3	High

2.3 EVM Operation

To install the EVM, perform the following steps:

1. Attach a USB2 or USB3 cable from a host PC Type A connector to the Type B connector (P1) of the TUSB214EVM.
2. Attach a USB device, either using cable or directly plugged into the Type A receptacle connector (P2) on the TUSB214EVM.

2.4 USB 2.0 High-Speed Eye Diagram Testing

When performing USB 2.0 compliance eye-diagram testing with a host or the downstream port of a HUB with the TUSB214, a scenario can occur where the TUSB214 signal boosting is not enabled. This can occur when the test packets are being transmitted before the USB test fixture is connected to the TUSB214. This scenario does not occur during device compliance eye-diagram testing, because the USB test fixture must always be connected while testing a device. This scenario only occurs during the compliance testing with the USB test fixtures and does not affect normal operation with a host, HUB, or device.

Closely following the test procedures provided by the scope equipment vendor and USB-If (links provided) helps avoid this scenario. Specifically, the USB HS test fixture should be connected prior to executing the test packets using the HSETT test tool. Alternatively, if the test fixture is hot-plugged to the host or downstream HUB port after the command to send test packets has already been entered using the HSETT tool, it is necessary to select TEST PACKETS and click “Execute” again after the test fixture is connected to ensure the TUSB214 detects a compliance test set-up.

The following generic procedure can be used to take the USB 2.0 compliance eye-diagrams (see the Test Procedure documents referenced for details):

1. Connect the USB test fixture to the host, downstream HUB (+ TUSB214) port, or device under test.
2. Configure the host, HUB, or device using xHSETT or HSETT to send test packets using the procedure detailed in the HSETT documentation.
3. Start sending test packets.
4. Capture the test packet on the scope to display the eye (running compliance software on the scope).

USB 2.0 compliance eye-diagrams can be taken on host, device and HUB platform ports configured with the TUSB214 using the EHCI and xHCI High-Speed Electrical Test Tool application provided by the USB Implementers Forum.

Details for setting up and running the application are detailed in the Test Tool Setup Instruction document provided by the USB-IF.

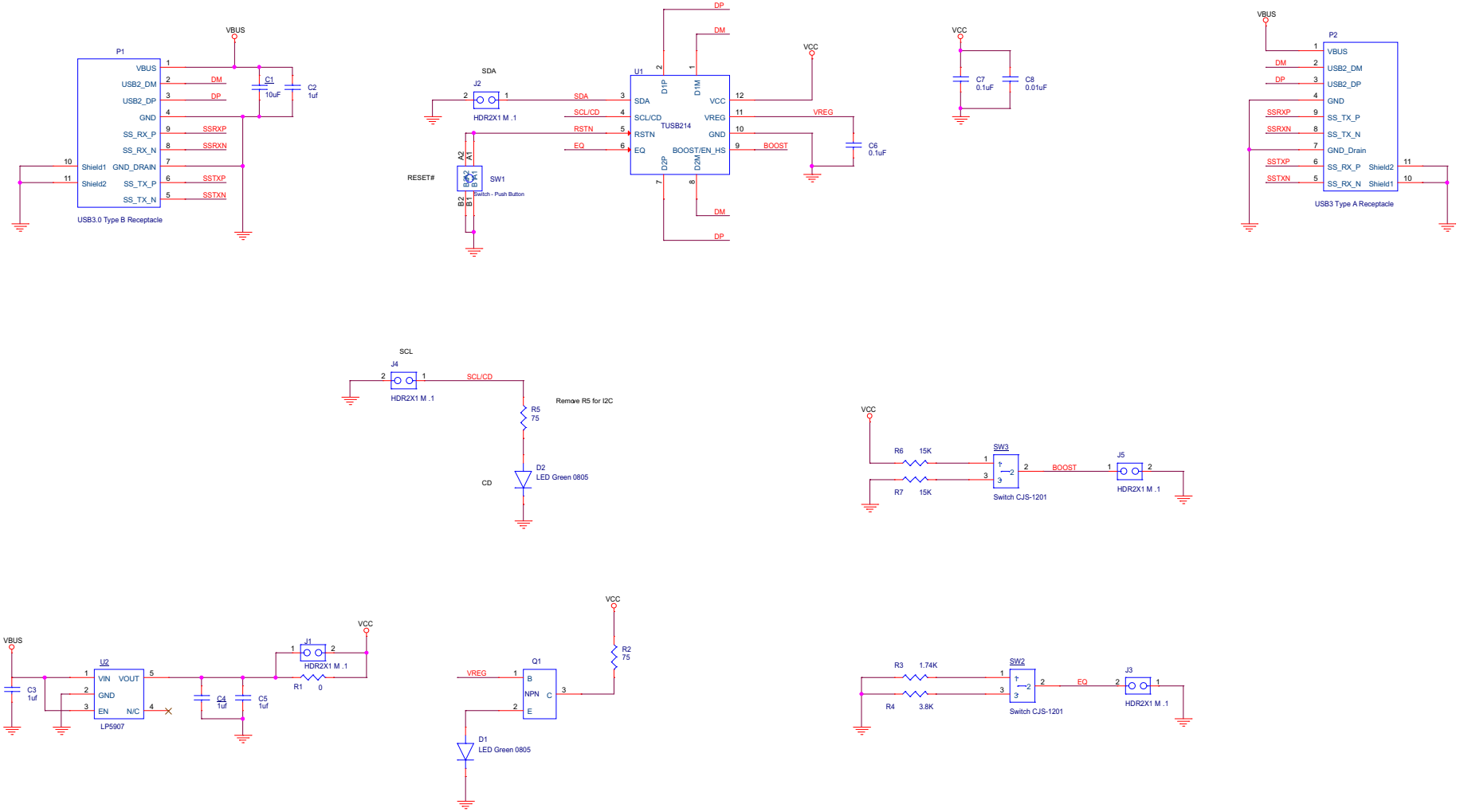
- xHCI (USB 3.0 Host) – XHSETT test application
- EHCI (USB 2.0 Host) – EHSETT test application
- Vendor-Specific Test Procedures

3 PCB Construction

This section discusses the construction of the EVM boards. It includes the board schematics and layout files to show how the board was built.

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3.1 TUSB214EVM Board Schematics



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Figure 3. TUSB214EVM Schematic

3.2 TUSB214EVM Material Listing

Table 3 list the complete BOM for the TUSB214EVM.

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Table 3. Bill of Materials

Item	Quantity	Reference	Part
1	1	C1	10 µF
2	4	C2, C3, C4, C5	1 µf
3	2	C6, C7	0.1 µF
4	1	C8	0.01 µF
5	2	D1, D2	LED Green 0805
6	5	J1, J2, J3, J4, J5	HDR 2 × 1 M .1
7	1	P1	USB3.0 Type B Receptacle
8	1	P2	USB3 Type A Receptacle
9	1	Q1	NPN
10	1	R1	0
11	2	R2, R5	75
12	1	R3	1.7K
13	1	R4	3.8K
14	2	R6, R7	15K
15	2	SW2, SW3	Switch CJS-1201
16	1	SW1	Switch - push button
17	1	U1	TUSB214
18	1	U2	LP5907

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      CAUTION

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      Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

      FCC Interference Statement for Class A EVM devices

      NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

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- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

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Concerning EVMs Including Radio Transmitters:

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Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

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