TUSB213 Evaluation Module

This is the user guide for the evaluation module (EVM) of the TUSB213. The purpose of this user guide is to facilitate an easy evaluation process of our TUSB213 USB High-Speed signal conditioner.

The contents of this user's guide are meant to provide an overview of the TUSB213, which includes highlighting its key features, operating conditions, and how to setup this EVM for use in a system level evaluation.

The construction of the TUSB213 EVM also serves as a reference design that can be easily modified for any intended application. Target applications include cell phones, desktop or notebook computers, docking stations, TVs, and active cables. Schematic and layout information is included at the end of this manual.

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1 Introduction

The TUSB213 is a USB high-speed (HS) signal conditioner, designed to compensate for ISI signal loss in a transmission channel.

The TUSB213 design is agnostic to USB low and full-speed signals and does not affect full-speed (FS) and low-speed (LS) signaling. High-speed signals are compensated along with programmable DC gain to fine-tune device performance to optimize the HS 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, in order to connect the EVM to your system set up, you will most likely need 2 USB 3.1 Standard Type A → B cables. Your test setup should look similar to Figure 1:

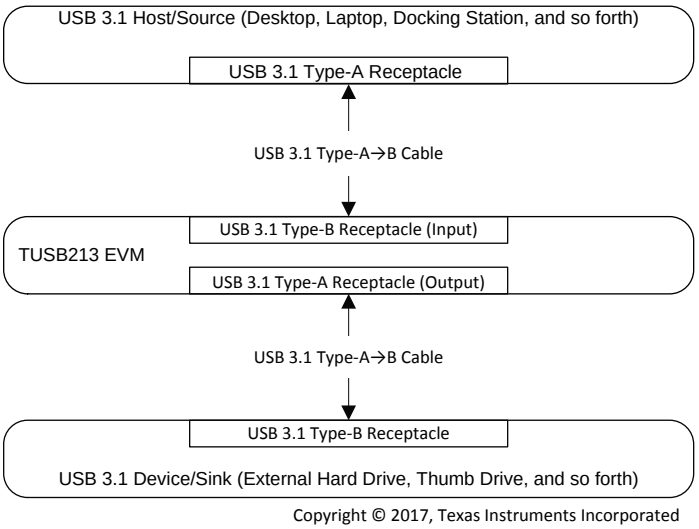


Figure 1. Functional System Level Block Diagram

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2 TUSB213 EVM Configuration

2.1 TUSB213 EVM Kit Contents

This EVM kit contains the following items:

- TUSB213 EVM board
- This user's manual

2.2 Description of EVM Board

The TUSB213 EVM is designed to provide easy evaluation of the 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 highlights the jumpers and switch installed on this EVM and Table 1 highlights their functionality and configuration.

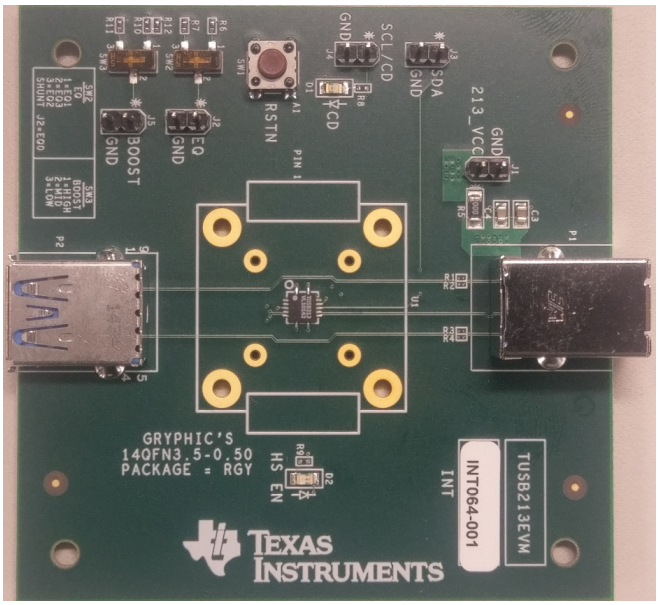


Figure 2. TUSB213 EVM

2.3 Configuration Switches

The TUSB213 has three switches to facilitate configuration changes. Changing these switch settings without a complete understanding of the result is not recommended. Configuration inputs are only read by the TUSB213 during power on reset or after de-asserting the RSTN pin, changing these switch settings while the EVM is powered on will have no effect. Please refer to the device data sheet for detailed pin descriptions and functionality along with EVM schematic for additional information.

The switch definitions are as follows:

- SW1 RSTN Pushbutton Switch:
  - Pushbutton to place TUSB213 device in RESET
  - Release to de-assert RESET

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- SW2 EQ:
  1. Sets TUSB213 to EQ1 Level
  2. Sets TUSB213 to EQ3 Level (Maximum)
  3. Sets TUSB213 to EQ2 Level

  Shunt across J2 Sets TUSB213 to EQ0 Level (Minimum)
- SW3 Boost:
  1. VCC (High Boost)
  2. NC (Mid Boost)
  3. GND (Low Boost)

Table 1. TUSB213 EVM Jumper Descriptions

Jumper	Functionality and Configuration
J1	213_VCC 1 = TUSB213 VCC 2 = GND
J2	EQ 1 = EQ 2 = GND
J3	SDA 1 = SDA 2 = GND
J4	SCL and CD 1 = SCL and CD 2 = GND
J5	Boost and ENA_HS 1 = Boost and ENA_HS 2 = GND

2.4 Selecting Equalization and Boost Level for TUSB213

The primary purpose of the TUSB213 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 TUSB213 in the best location.

A typical use case is to place the TUSB213 close to the USB connector on a host platform in order 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 EQ and Boost recommendations based on cable length (28-AWG USB cable).

Table 2. EQ and Boost Setting Based on Cable Length

Cable Length	TUSB213 EQ	TUSB213 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

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3 EVM Operation

Install the EVM using 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 TUSB213 EVM.
2. Attach a USB device either via cable or directly plugged into the Type A receptacle connector (P2) on the TUSB213 EVM.

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 TUSB213, a scenario can occur where the TUSB213 signal boosting is not enabled. This can occur when the test packets are being transmitted before the USB test fixture is connected to the TUSB213. This scenario does not occur during device compliance eye-diagram testing as 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 in Section 4.1) will 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 TUSB213 detects a compliance test set-up.

The following generic procedure can be used to take the USB 2.0 compliance eye-diagrams (refer to Section 4.1 for details):

1. Connect the USB test fixture to the host, downstream HUB (+ TUSB213) port or device under test.
2. Configure the host, or 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 test packet on scope to display 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 TUSB213 using the *EHCI and xHCI High-speed Electrical Test Tool Setup Instruction* document provided by the *USB Implementers Forum*.

4.1 Test Procedure Document Links

Details for setting up and running the application are contained in the *EHCI and xHCI High-speed Electrical Test Tool Setup Instruction* document provided by the USB-IF at the following link:
http://www.usb.org/developers/tools/HSETT_Instruction_0_4_1.pdf

xHCI (USB 3.0 Host) – XHSETT test application:
http://www.usb.org/developers/tools/

EHCI (USB 2.0 Host) – EHSETT test application:
http://www.usb.org/developers/tools/usb20_tools/

Vendor-Specific Test Procedures:
http://www.usb.org/developers/compliance/electrical_tests/

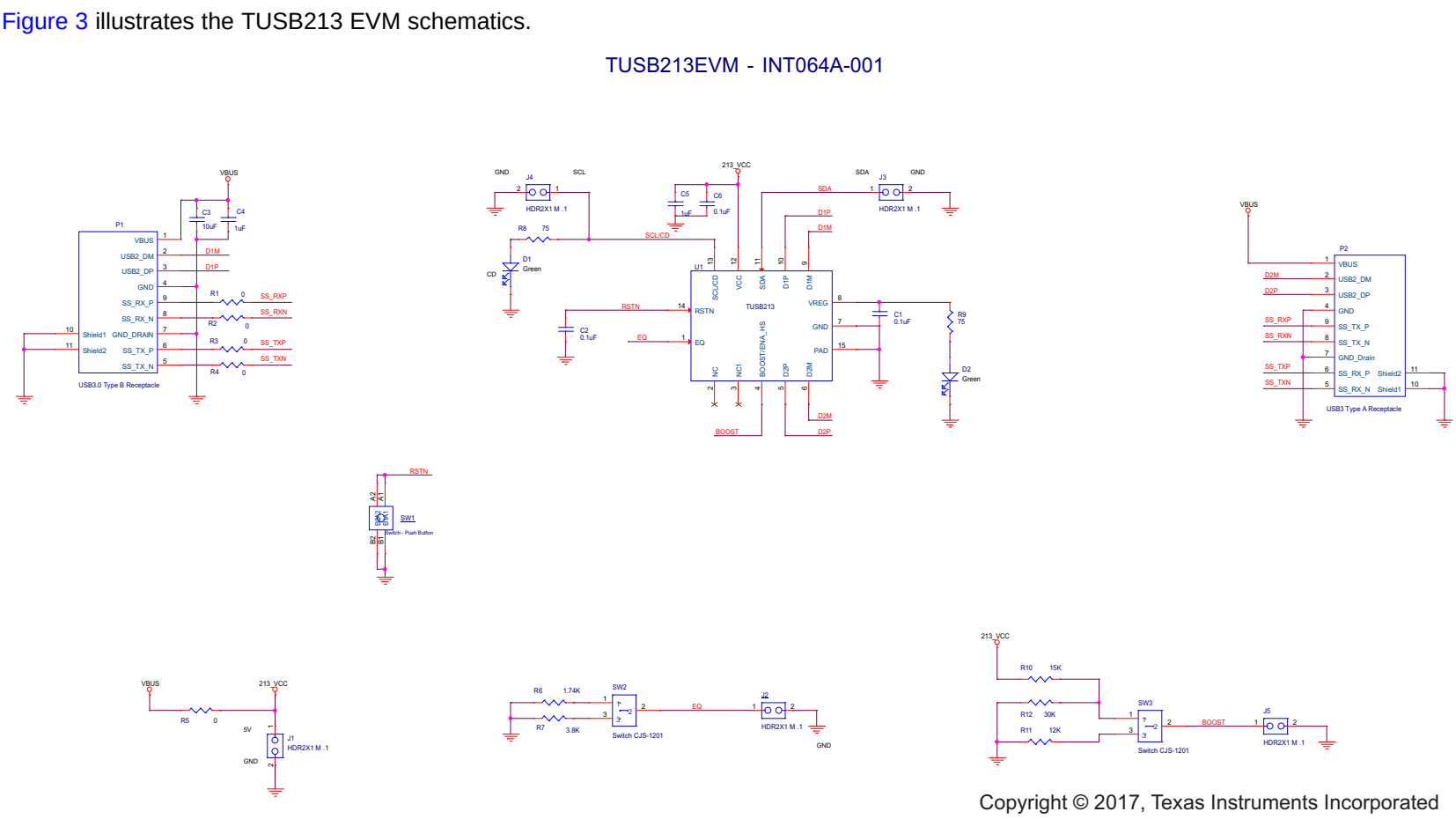
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5 PCB Construction

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

5.1 TUSB213 EVM Board Schematics

Figure 3 illustrates the TUSB213 EVM schematics.



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Figure 3. TUSB213 EVM Schematic

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5.2 TUSB213 EVM Material Listing

lists the complete BOM for the TUSB213 EVM.

Table 3. TUSB213 EVM Bill of Materials

Item	Quantity	Reference	Part
1	3	C1,C2,C6	0.1uF
2	1	C3	10uF
3	1	C4	1uF
4	1	C5	1uF
5	2	D1,D2	LED
6	5	J1,J2,J3,J4,J5	HDR2X1 M .1
7	1	P1	USB3.0 Type B Receptacle
8	1	P2	USB3 Type A Receptacle
9	4	R1,R2,R3,R4	0
10	1	R5	0
11	1	R6	1.7K
12	1	R7	3.8K
13	2	R8,R9	75
14	1	R10	15K
15	1	R11	12K
16	1	R12	30K
17	1	SW1	Switch - Push Button
18	2	SW2,SW3	Switch CJS-1201
19	1	U1	TUSB213

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      CAUTION

      This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

      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

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *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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(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

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Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

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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3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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