

## **TUSB501 EVM User's Guide**

This user's guide covers the TUSB501 evaluation module (EVM). The purpose of this guide is to facilitate an evaluation process of the TUSB501 USB 3.0 re-driver.

The contents of this user's guide are meant to provide an overview of the TUSB501 device, including: highlighting its key features, operating conditions, and how to setup this EVM for use in a system-level evaluation.

The construction of the TUSB501 EVM also serves as a reference design that can be modified for any intended application. Target applications include cell phones, computers, docking stations, TVs, and active cables. Schematic and layout information is included near the end of this guide.

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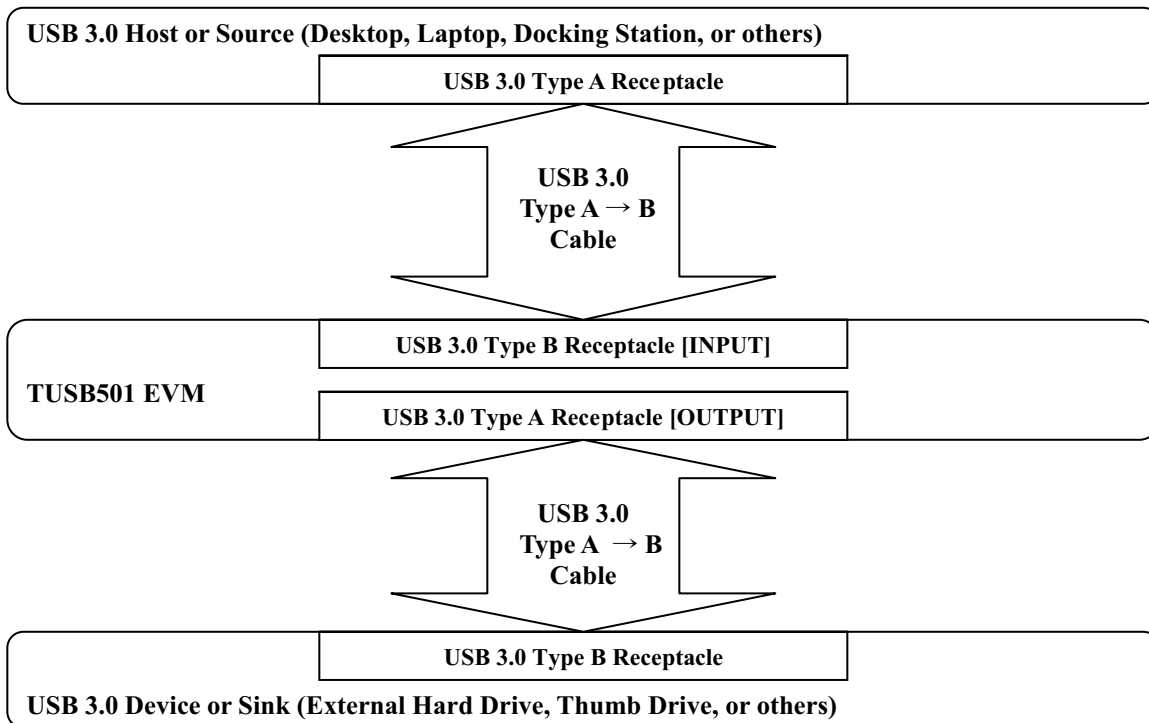
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## 1 Introduction

The TUSB501 device is a signal channel, USB 3.0 re-driver and signal conditioner supporting data rates of 5.0 Gbps. The device complies with USB 3.0 specification revision 1.0, supporting electrical idle condition and low frequency periodic signals (LFPS) for USB 3.0 power management modes.

The device offers programmable equalization, de-emphasis, and amplitude swing that extends the interconnect distance between two devices. Also, the device supports low power modes when unplugged. The device can also function in USB-compliance mode to test the transmitter for compliance to voltage and timing specifications per USB 3.0 compliance specifications.

This EVM is designed as a medium connection between a USB host and USB device. The interface to the EVM consists of a USB 3.0 type A receptacle and a USB 3.0 type B receptacle. Therefore, to connect the EVM to the system set-up, the user most likely needs 2 USB 3.0 Standard Type A → B cables. The test setup should look similar to [Figure 1](#):



**Figure 1. TUSB501 Functional System-Level Block Diagram**

## 2 TUSB501 EVM Configuration

### 2.1 TUSB501 EVM Kit Contents

This EVM kit should contain the following items:

- TUSB501 EVM board
- This user's guide

### 2.2 Description of the EVM Board

The TUSB501 EVM is designed to evaluate the TUSB501 device and 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 switches installed on this EVM and [Table 1](#) highlights their functionality and configuration.

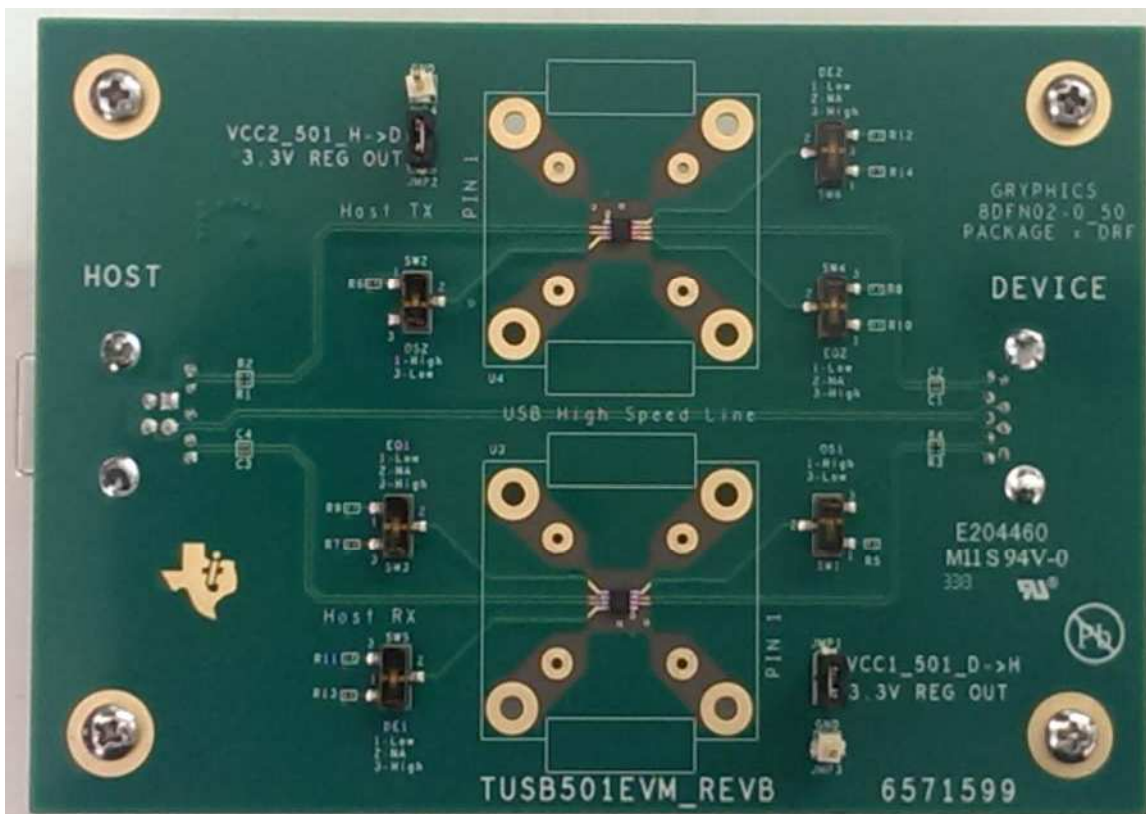


Figure 2. TUSB501 EVM With Jumpers and Switches Highlighted (Top-Side)

**Table 1. TUSB501 EVM Jumper and Switch Description and Settings**

Jumper or Switch Number	Functionality and Configuration
JMP1	<b>Power Source Selector for TUSB501_1</b> From regulator = Shunt installed From external = Do not install shunt
JMP2	<b>Power Source Selector for TUSB501_2</b> From regulator = Shunt installed From external = Do not install shunt
JMP3	<b>Ground</b> Ground for external power source
JMP4	<b>Ground</b> Ground for external power source
SW1	<b>Output Swing Control Selector for TUSB501_1</b> High (1300 mVpp) = Switch to pin 1 Low (930 mVpp) = Switch to pin 3
SW2	<b>Output Swing Control Selector for TUSB501_2</b> High (1300 mVpp) = Switch to pin 1 Low (930 mVpp) = Switch to pin 3
SW3	<b>Equalization Control Selector for TUSB501_1</b> High (9 dB) = Switch to pin 3 Mid-level (6 dB) = Do not switch Low (3 dB) = Switch to pin 1
SW4	<b>Equalization Control Selector for TUSB501_2</b> High (9 dB) = Switch to pin 3 Mid-Level (6 dB) = Do not switch Low (3 dB) = Switch to pin 1
SW5	<b>De-Emphasis Control Selector for TUSB501_1<sup>(1)</sup></b> High = Switch to pin 3 Mid-Level = Do not switch Low = Switch to pin 1
SW6	<b>De-Emphasis Control Selector for TUSB501_2<sup>(1)</sup></b> High = Switch to pin 3 Mid-Level = Do not switch Low = Switch to pin 1

<sup>(1)</sup> Refer to [Table 2](#) for actual de-emphasis level

### 2.3 Selecting De-Emphasis Level for TUSB501

The output de-emphasis level of each transmitter channel also depends on the output swing level selected for that channel. [Table 2](#) lists all possible de-emphasis levels that can be achieved with the TUSB501 device:

**Table 2. TUSB501 Device De-Emphasis Level Selector**

	OS Pin = Low	OS Pin = High
DE pin = Low	0 dB	-2.6 dB
DE pin = Floating	-3.5 dB	-5.9 dB
DE pin = High	-6.2 dB	-8.3 dB

## **2.4 Monitoring the Device Current**

One of the highlights of the TUSB501 device is its power-saving modes. To observe these savings in your device evaluation, the TUSB501 EVM includes the option of monitoring the current draw of the device. To enable this feature, the following steps must be taken:

1. Un-install the shunt located at JMP1 and JMP2.
2. Obtain a power supply with the ability to display its current draw (or connect a current meter in series to the power supply.)
3. Connect to 3.3 V of external power source to VCC1\_501\_D → H or VCC2\_501\_H → D of JMP1 and JMP2 and ground to JMP3 and JMP4.
4. Turn on the power supply and observe the measured current on your power supply display (or current meter).

## **2.5 PCB Construction**

This section discusses the construction of the EVM boards. The board schematics and layout files follow to show how the board is built.

### 3 TUSB501 EVM Board Schematics

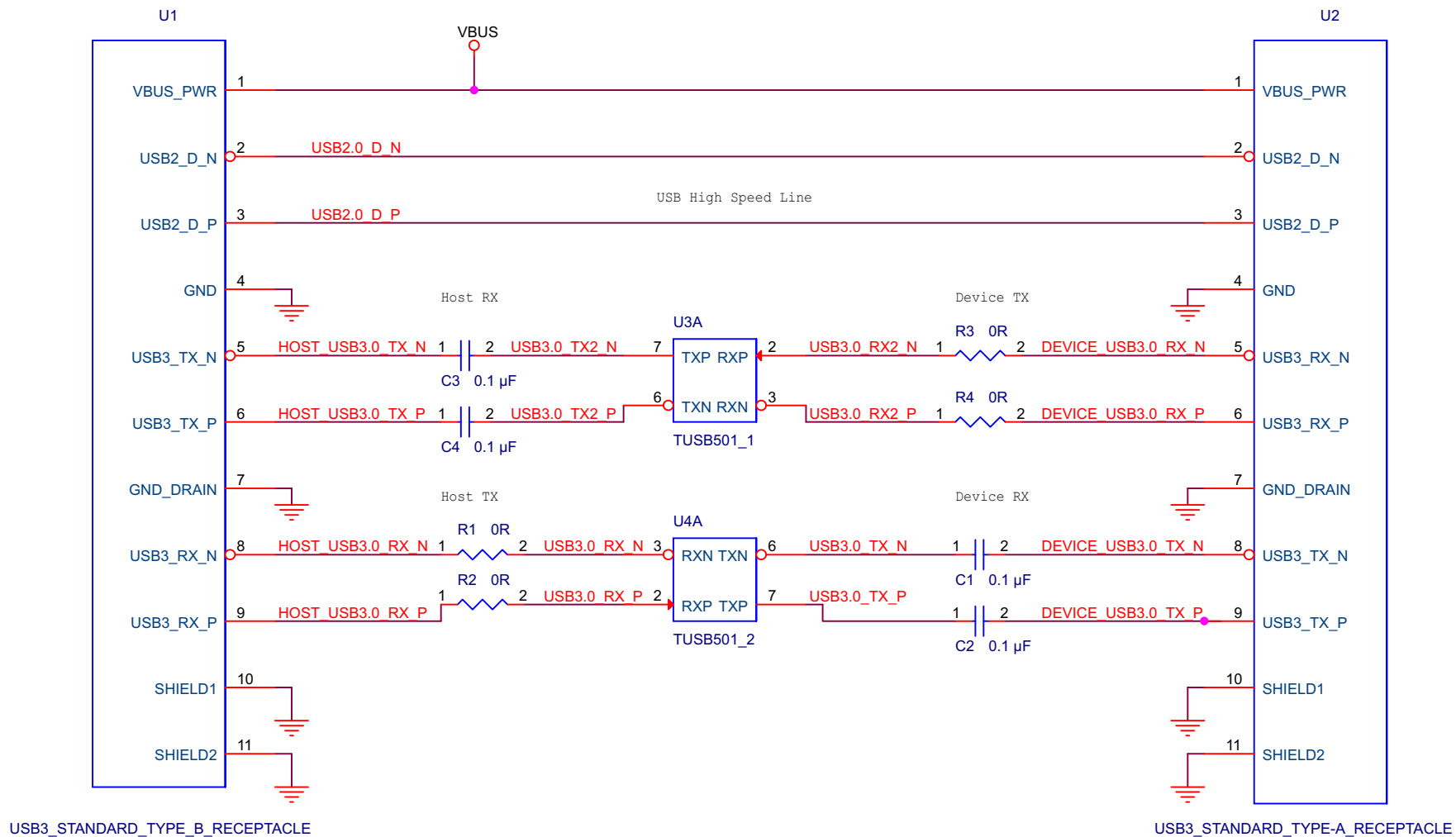


Figure 3. TUSB501 EVM Schematic (High-Speed Pins)

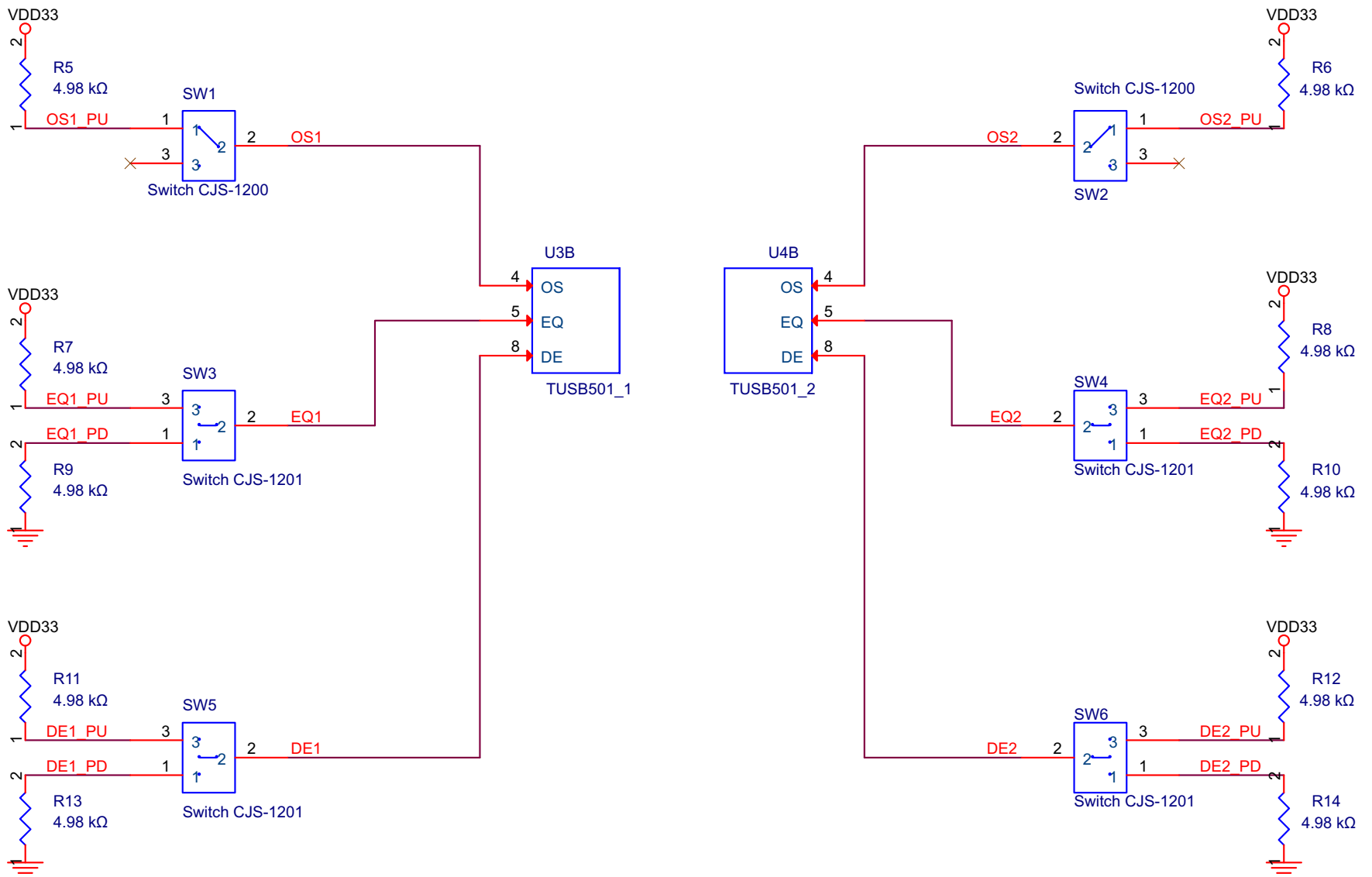


Figure 4. TUSB501 EVM Schematic (Device-Control Pins)

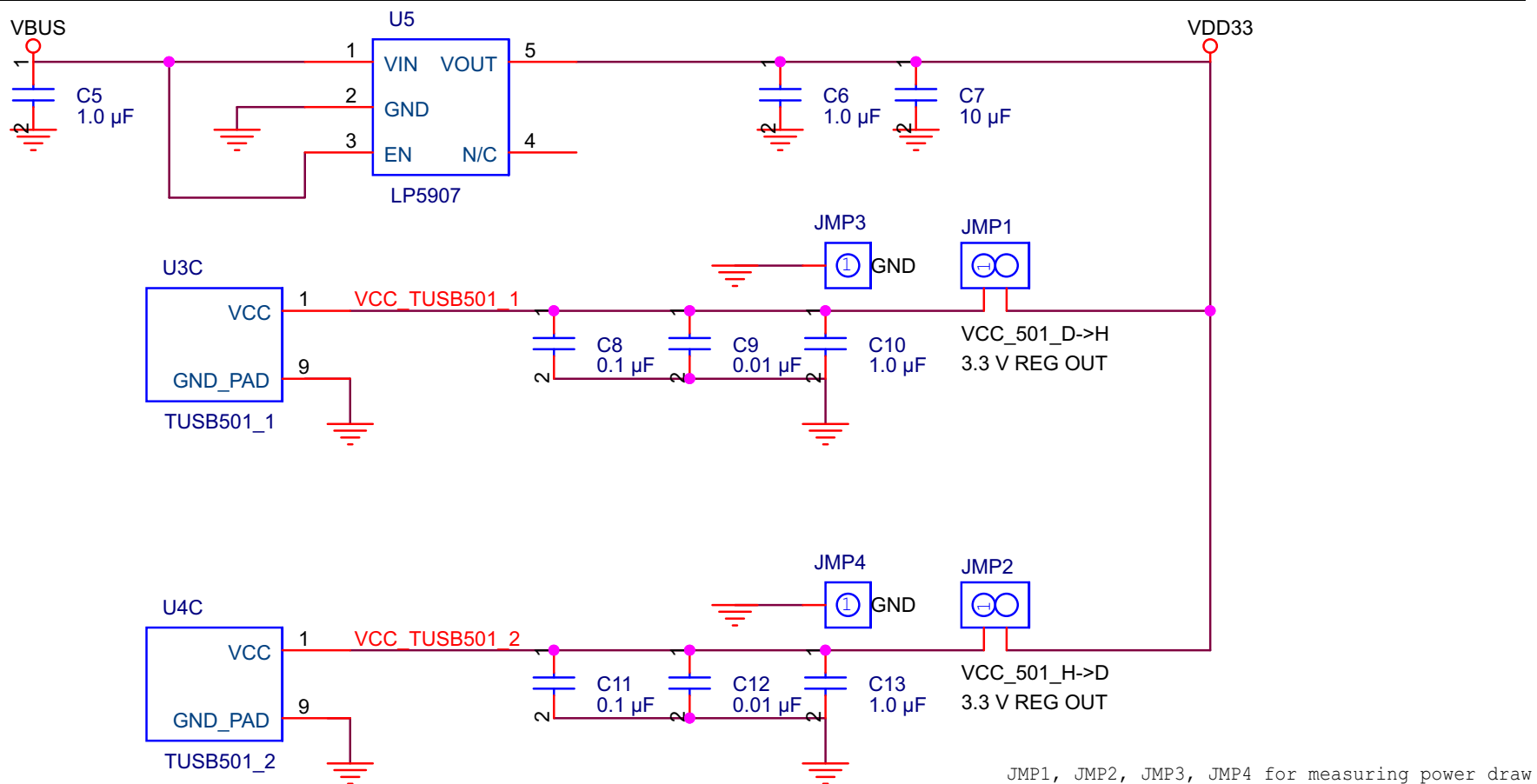


Figure 5. TUSB501 EVM Schematic (Power and GND Pins)



#### 4 TUSB501 EVM Board Layout

This EVM design shows the implementation on a 4-layer board.

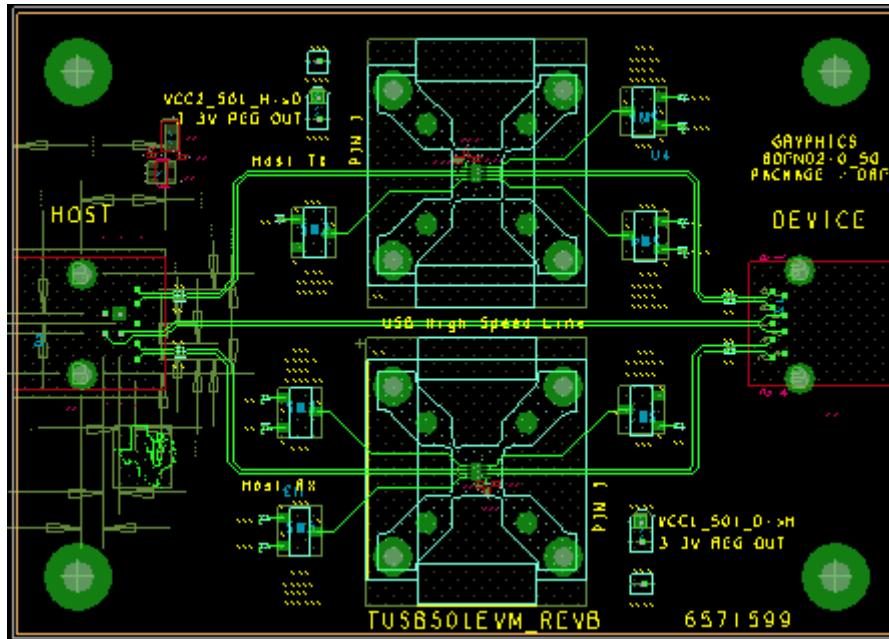


Figure 6. TUSB501 EVM Layout Layer 1 (Top-View)

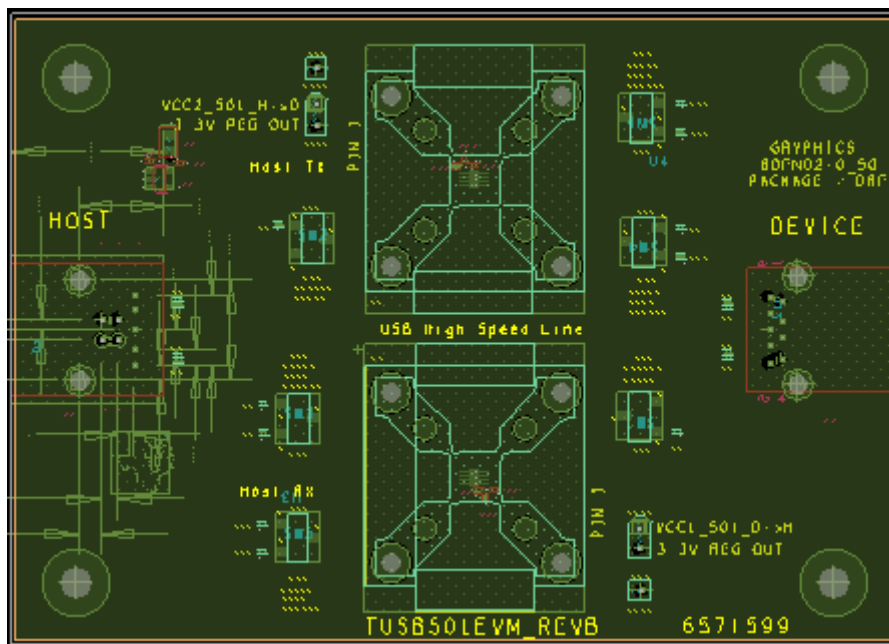


Figure 7. TUSB501 EVM Layout Layer 2 (GND)

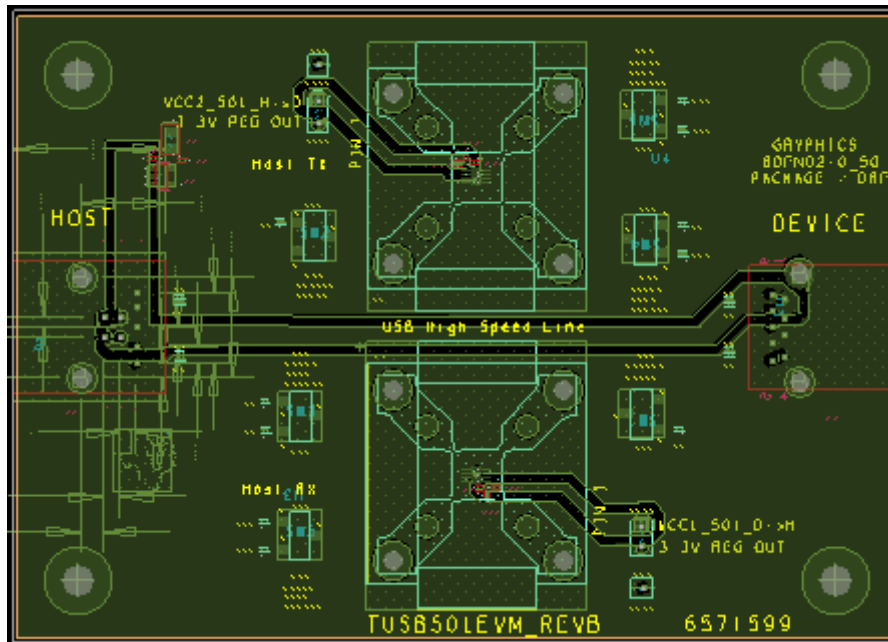


Figure 8. TUSB501 EVM Layout Layer 3 (VCC)

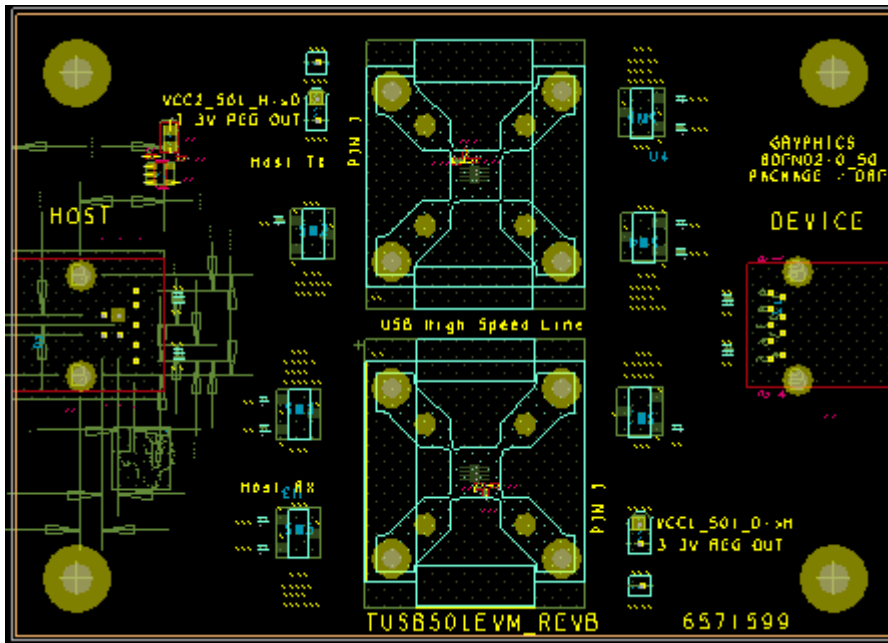


Figure 9. TUSB501 EVM Layout Layer 4 (Bottom-View)

## 5 Bill of Materials

The following table lists the bill of materials for the TUSB501 EVM.

Item	Quantity	Reference	Value
1	6	C1, C2, C3, C4, C8, C11	0.1 $\mu$ F
2	4	C5, C6, C10, C13	1.0 $\mu$ F
3	1	C7	10 $\mu$ F
4	2	C9, C12	0.01 $\mu$ F
5	2	JMP1, JMP2	Header 1x2
6	2	JMP3, JMP4	Header 1x1
7	4	R1, R2, R3, R4	0 R
8	10	R5, R6, R7, R8, R9, R10, R11, R12, R13, R14	4.98 K
9	2	SW1, SW2	Switch CJS-1200
10	4	SW3, SW4, SW5, SW6	Switch CJS-1201
11	1	U1	USB3_STANDARD_TYPE_B_RECEPTACLE
12	1	U2	USB3_STANDARD_TYPE-A_RECEPTACLE
13	1	U3	TUSB501_1
14	1	U4	TUSB501_2
15	1	U5	LP5907

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This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.
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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.

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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.

### 3.2 Canada

#### 3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210

##### **Concerning EVMs Including Radio Transmitters:**

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions: (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.

##### **Concernant les EVMs avec appareils radio:**

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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[http://www.tij.co.jp/lstds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page)

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1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
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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4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

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