

## **TUSB1002A Evaluation Module**

This is the user guide for the evaluation module (EVM) of the TUSB1002A. The purpose of this user guide is to facilitate an easy evaluation process of our TUSB1002A USB 3.1 SuperSpeed (5 Gbps) and SuperSpeed Plus (10 Gbps) Re-Driver.

The contents of this user's guide are meant to provide an overview of the TUSB1002A, 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 TUSB1002A EVM also serves as a reference design that can be easily modified for any intended application. Target applications include Cell Phones, Computers, Docking Stations, TVs, and active Cables. Schematic and layout information is included at the end of this manual.

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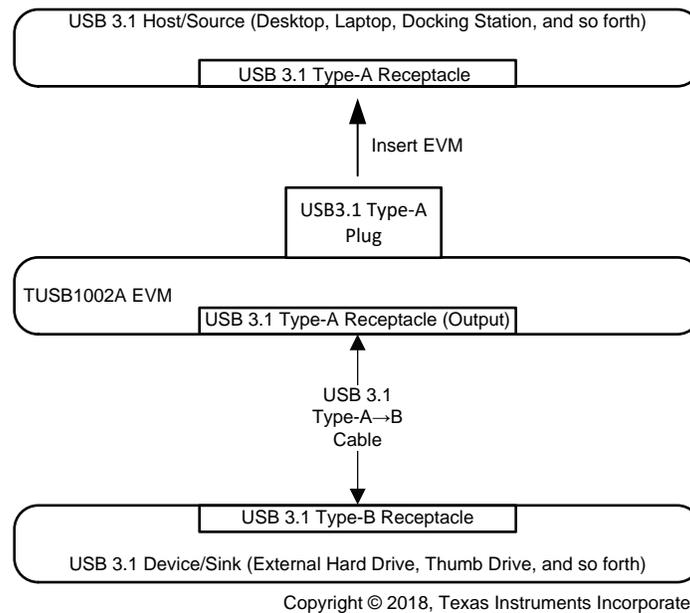
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## 1 Introduction

The TUSB1002A is a dual channel, USB 3.1 SuperSpeed Plus re-driver and signal conditioner supporting data rates of 10Gbps. The device complies with USB 3.1 spec revision 1.0, supporting electrical idle condition and low frequency periodic signals (LFPS) for USB 3.1 power management modes.

The device offers programmable equalization 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 3.1 compliance specs.

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 Plug and a USB 3.1 Type-A Receptacle. Because a USB3.1 Type-A plug is used, the TUSB1002A EVM board can be inserted directly into the system (desktop, laptop, docking station, hub, and so forth). The test setup should look similar to [Figure 1](#).



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**Figure 1. TUSB1002A Functional System Level Block Diagram**

## 2 TUSB1002A EVM Configuration

### 2.1 TUSB1002A EVM Kit Contents

This EVM kit should contain the following items:

- TUSB1002A EVM board
- This user's manual

### 2.2 Description of EVM Board

The TUSB1002A EVM is designed to provide easy evaluation of the TUSB1002A 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. TUSB1002A EVM (Top Side)**

**Table 1. TUSB1002A EVM Jumper / Switch Description and Settings**

Jumper	Functionality and Configuration
JMP1	CH1_EQ1
	1-2 = 1 (1 K to VCC) 3-4 = R (20 K to GND) 5-6 = 0 (1 K to GND) NC = F (No Connect)
JMP2	CH1_EQ2
	1-2 = 1 (1 K to VCC) 3-4 = R (20 K to GND) 5-6 = 0 (1 K to GND) NC = F (No Connect)
JMP3	CFG1
	1-2 = 1 (1 K to VCC) 3-4 = R (20 K to GND) 5-6 = 0 (1 K to GND) NC = F (No Connect)
JMP4	MODE
	1-2 = 1 (1K to VCC) 3-4 = R (20K to GND) 5-6 = 0 (1K to GND) NC = F (No Connect)

**Table 1. TUSB1002A EVM Jumper / Switch Description and Settings (continued)**

Jumper	Functionality and Configuration
JMP5	CH2_EQ1
	1-2 = 1 (1K to VCC) 3-4 = R (20K to GND) 5-6 = 0 (1K to GND) NC = F (No Connect)
JMP6	CH2_EQ2
	1-2 = 1 (1K to VCC) 3-4 = R (20K to GND) 5-6 = 0 (1K to GND) NC = F (No Connect)
JMP7	RSVD1
	NC = OUTPUT
JMP8	CFG2
	1-2 = 1 (1K to VCC) 3-4 = R (20K to GND) 5-6 = 0 (1K to GND) NC = F (No Connect)
J1 and SW1	EN_RXD (Shutdown Mode)
	J1: 1-2 = 1K to GND J1: NC = Internal Pull-up (Default) SW1 = Push to Short EN_RXD to GND
J2	DCBOOST#
	1-2 = 0 DC Gain increased by +1db NC = 1 DC gain by default
J3	VCC_3.3 V
	1-2 = VCC_3.3 V Provided from U2 (Default) NC = Provide external 3.3 V on Pin 2

### 3 Selecting Equalization Level for TUSB1002A

The equalization level of each channel is configured via the CHx\_CFG1 and CHx\_CFG2 pin states. Reference the [TUSB1002A](#) datasheet for details on these pins.

### 4 Monitoring the Device Current

The TUSB1002A EVM includes the option of monitoring the current draw of the device. In order to enable this feature, the following steps must be taken:

1. Un-install the shunt located at J3 and remove R26.
2. Obtain a DC power supply with the ability to display its current draw (or connect a current meter in series to the power supply). Suggest setting current limit for DC power supply to around 200mA.
3. Connect to 3.3 V of external DC power source to VCC\_3.3 V (J3-2) and GND of the external supply to a convenient GND location on the EVM (J2-2).
4. Turn on your power supply and observe the measured current on your power supply display (or current meter)

## 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 TUSB1002A EVM Board Schematics

Figure 3 and Figure 4 illustrate the EVM schematics

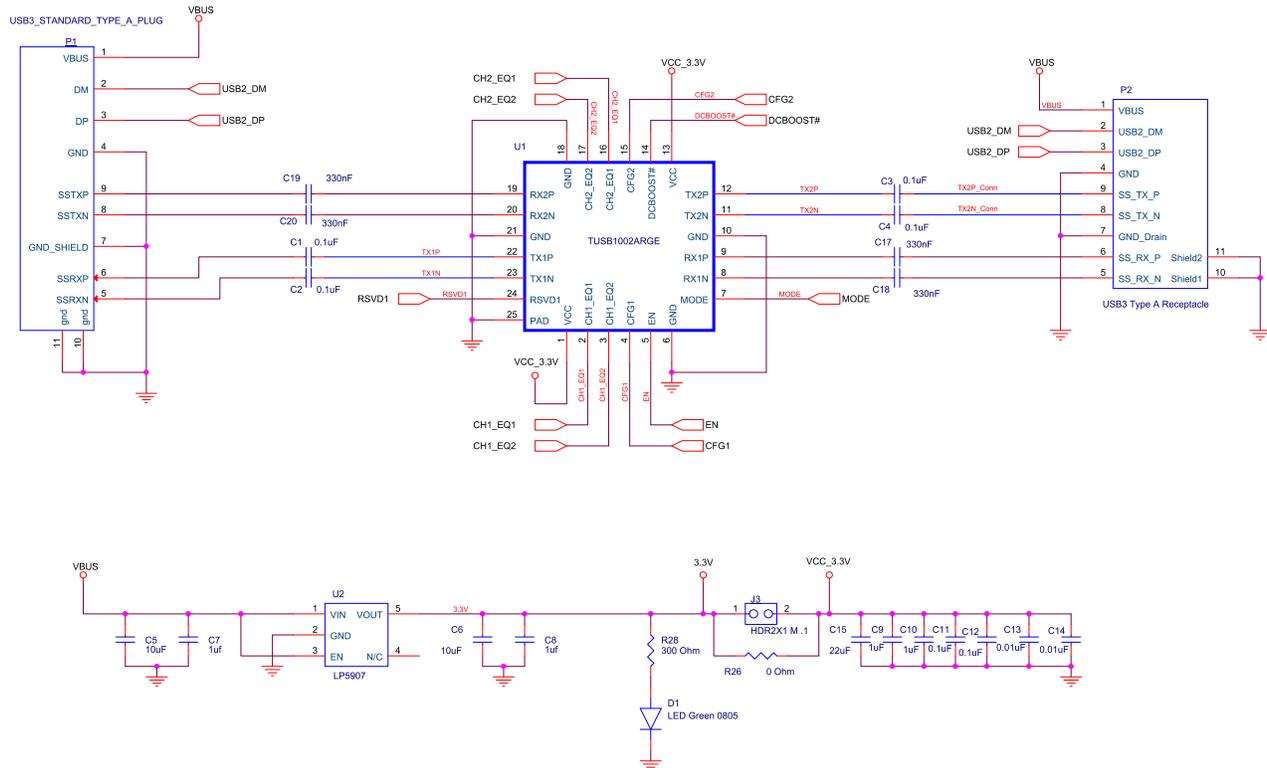


Figure 3. TUSB1002A EVM Schematic (High Speed Pins / Power)

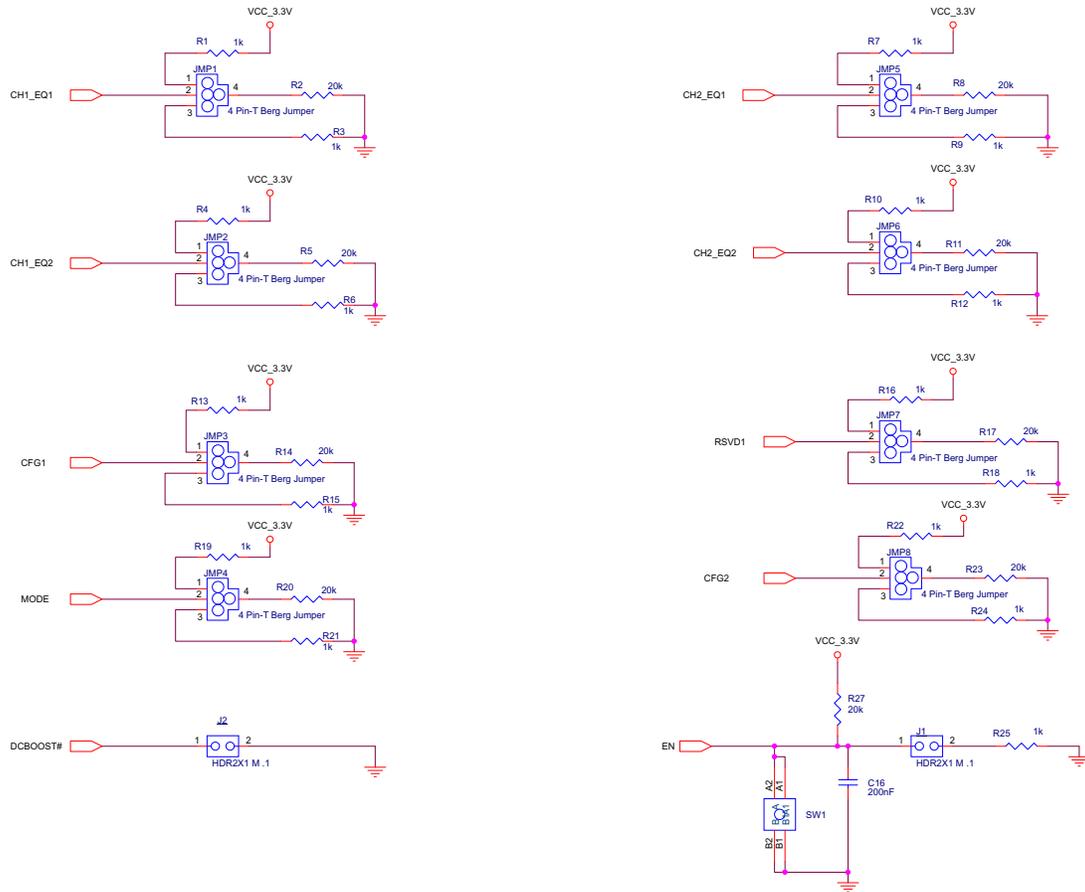


Figure 4. USB1002A EVM Schematic (Device Control Pins)

## 5.2 TUSB1002A EVM Board Layout

This EVM was designed to show the implementation on a 4-layer board.

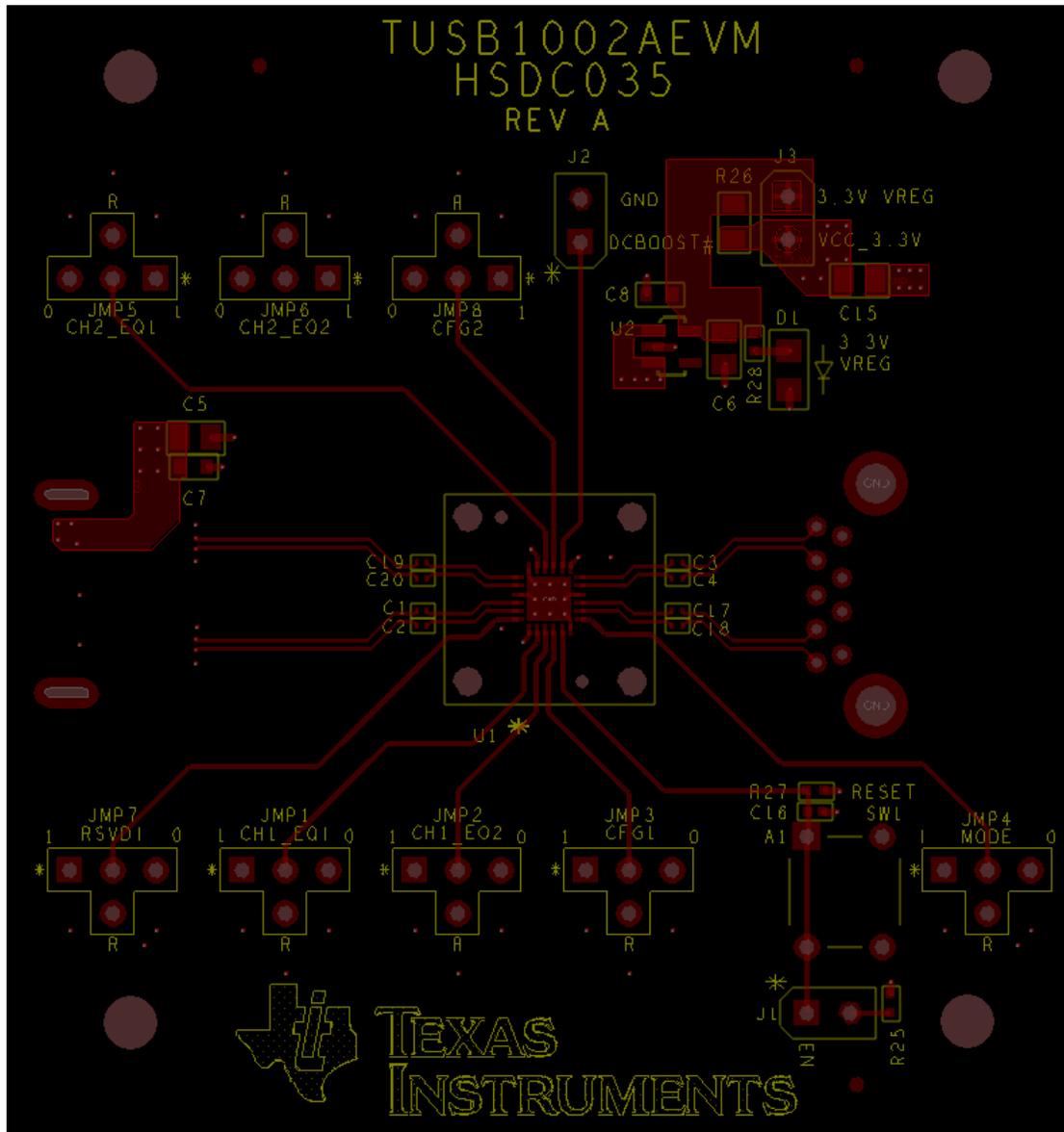


Figure 5. TUSB1002A EVM Layout Layer 1 (Top)

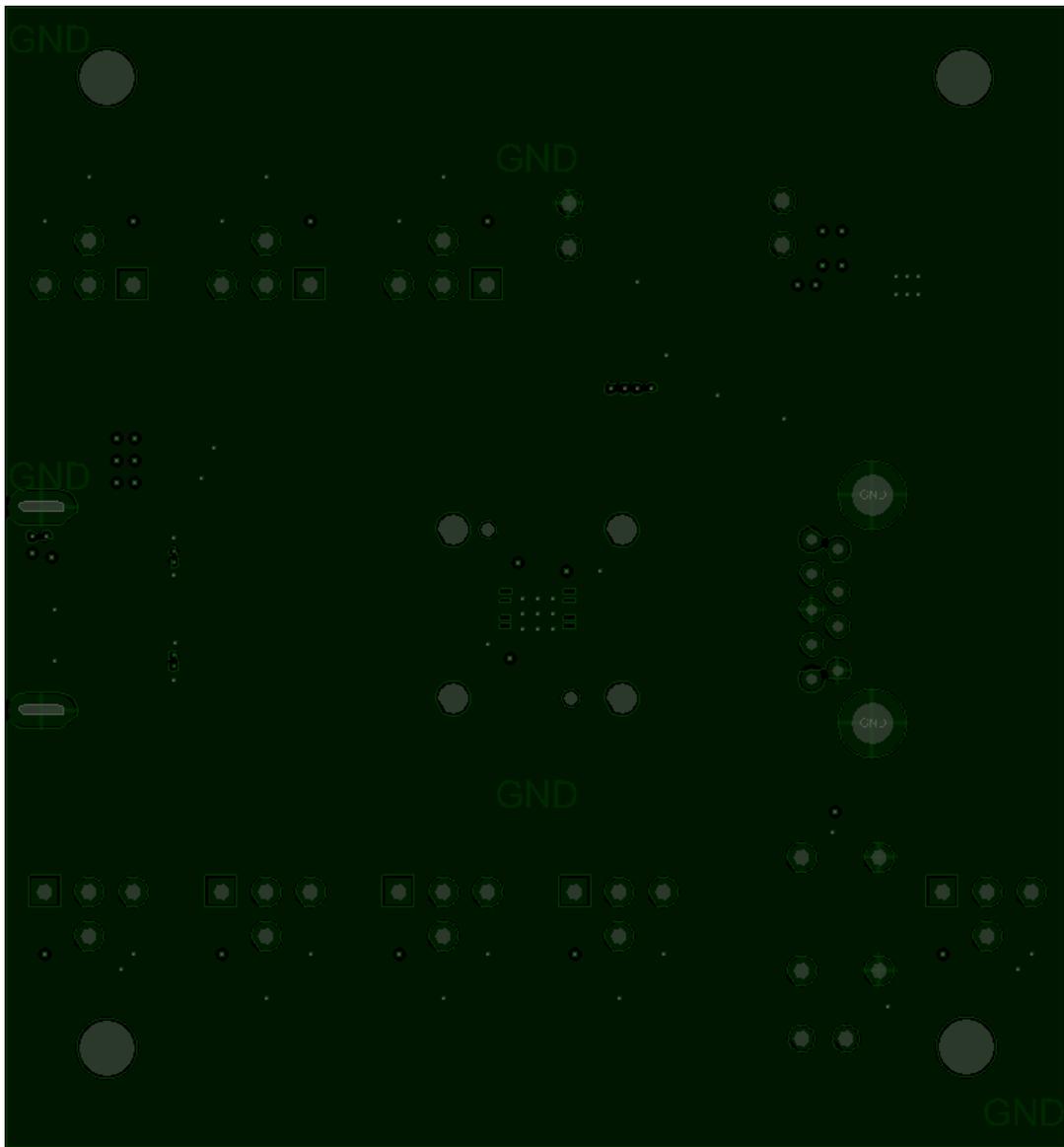


Figure 6. TUSB1002A EVM Layout Layer 2 (GND)

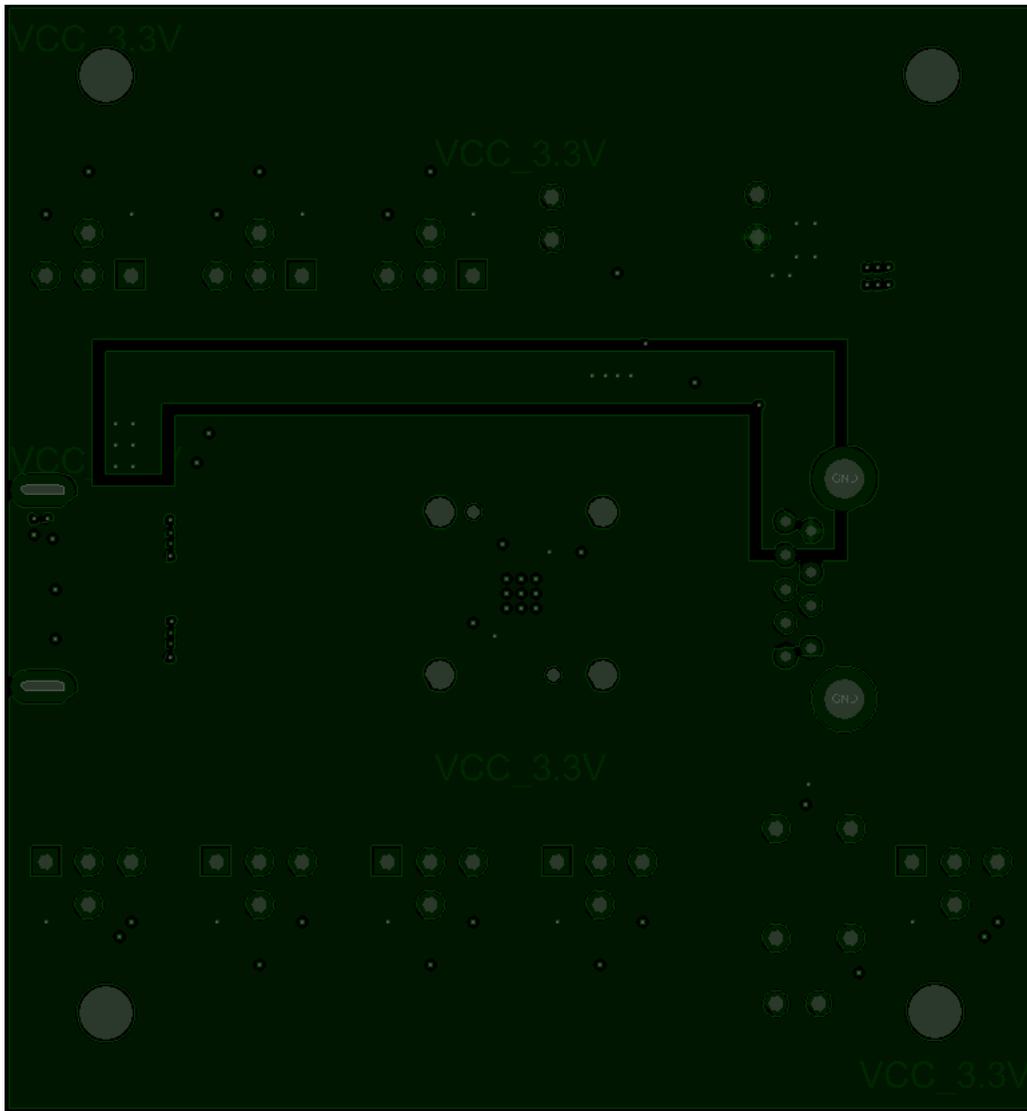


Figure 7. TUSB1002A EVM Layout Layer 3 (VCC)

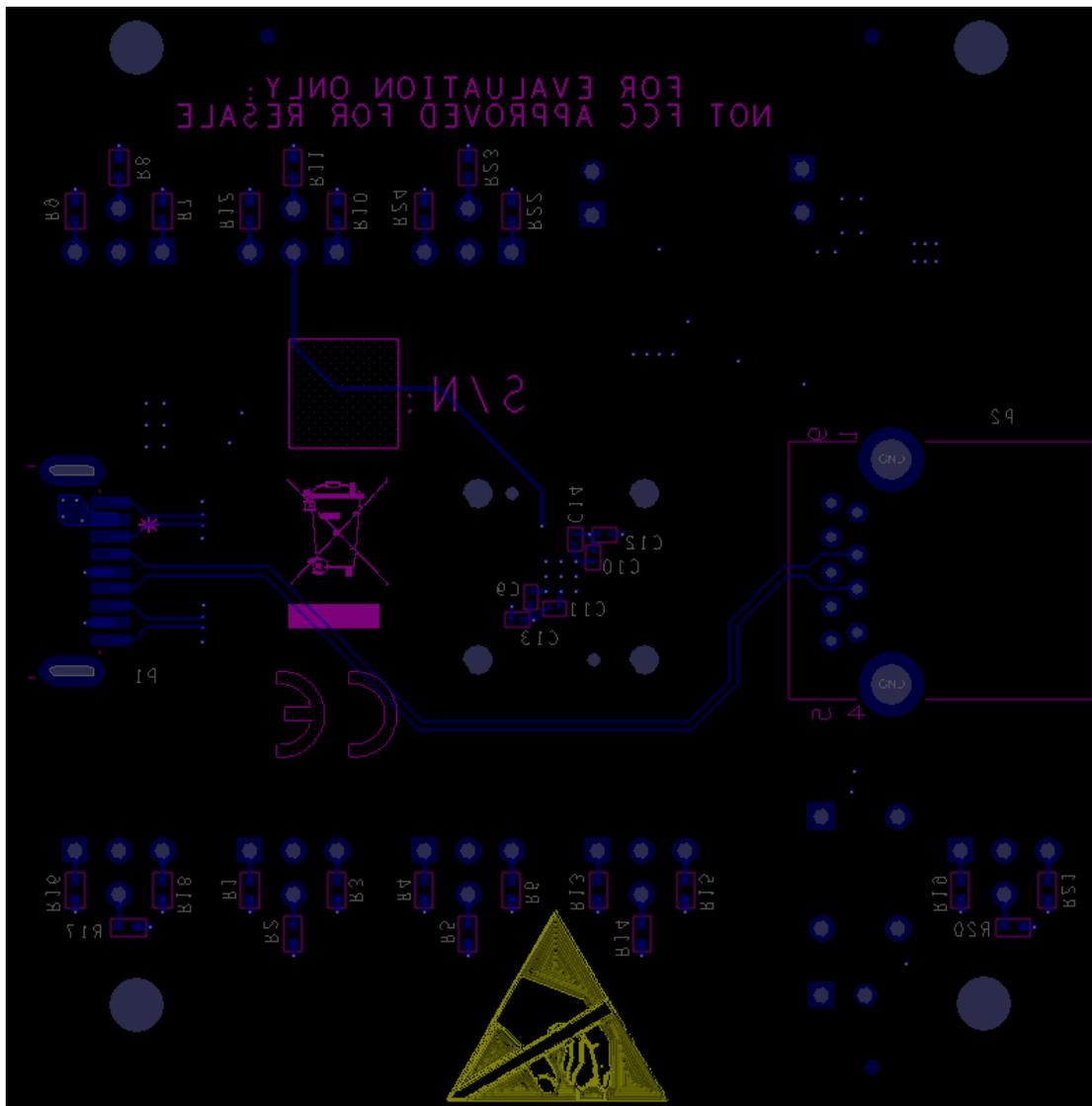


Figure 8. TUSB1002A EVM Layout Layer 4 (BOTTOM)

### 5.3 TUSB1002A EVM Material Listing

Table 2 lists the complete BOM for the TUSB1002A EVM.

**Table 2. TUSB1002A EVM Bill of Materials**

Item	Quantity	Reference	Part
1	6	C1,C2,C3,C4,C11,C12	0.1 $\mu$ F
2	2	C5,C6	10 $\mu$ F
3	4	C7,C8,C9,C10	1 $\mu$ F
4	2	C13,C14	0.01 $\mu$ F
5	1	C15	22 $\mu$ F
6	1	C16	0.22 $\mu$ F
7	4	C17,C18,C19,C20	0.33 $\mu$ F
8	1	D1	LED Green 0805
9	8	JMP1,JMP2,JMP3,JMP4,JMP5,JMP6,JMP7,JMP8	4 pin-T Berg Jumper
10	3	J1,J2,J3	HDR2 x 1 M 0.1
11	1	P1	USB 3.1 Type A Plug
12	1	P2	USB 3.1 Type A Receptacle
13	17	R1,R3,R4,R6,R7,R9,R10,R12,R13,R15,R16,R18,R19,R21,R22, R24,R25	1 k $\Omega$
14	9	R2,R5,R8,R11,R14,R17,R20,R23,R27	20 k $\Omega$
15	1	R26	0 $\Omega$
16	1	R28	300 $\Omega$
17	1	SW1	Switch - Push Button
18	1	U1	TUSB1002ARGE
19	1	U2	LP5907

### Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original (April 2018) to A Revision	Page
• Changed the 3rd paragraph under the <i>Introduction</i> .....	2
• Changed <a href="#">Figure 1</a> .....	2
• Deleted table: <i>TUSB1002A Equalization Selection</i> .....	4
• Changed <a href="#">Figure 3</a> and <a href="#">Figure 4</a> .....	5
• Changed <a href="#">Figure 5</a> through <a href="#">Figure 8</a> .....	7
• In BOM changed C17, C18, C19, and C20 from 0.22 $\mu$ F to 0.33 $\mu$ F. ....	11
• In BOM changed P1 from USB 3.1 Type B receptacle to USB3.1 Type-A Plug. ....	11

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**FCC NOTICE:** 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.
    - 3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

### 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.

### 3.2 Canada

3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247

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

This device complies with Industry Canada license-exempt RSSs. 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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If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

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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##### 3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive):*

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

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