

# TS3USB3031 EVM User's Guide

This document is the EVM user guide for TS3USB3031. The TS3USB3031 is a double-pole, triple throw (DP3T) multiplexer that includes a high speed Mobile High-Definition Link (MHL) switch and dual USB 2.0 High-Speed (480Mbps) switches in the same package.

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## 1 About this Manual

This user's guide describes the TS3USB3031 Evaluation Module (EVM) and its intended use. This guide contains the EVM schematics, bill of materials, and board layer information.

### 1.1 Information about Cautions and Warnings



### CAUTION

This EVM contains components that can potentially be damaged by electrostatic discharge. Always transport and store the EVM in its supplied ESD bag when not in use. Handle using an antistatic wristband. Operate on an antistatic work surface. For more information on proper handling, see the *Electrostatic Discharge (ESD)* application note ([SSYA008](#)).

The information in a caution or a warning is provided for your protection. Read each caution and warning carefully.

## 2 Introduction

The TS3USB3031EVM is an evaluation module for TI's 1:3 multiplexer/de-multiplexer high performance USB/MHL/myDP switch. It is specifically designed for high speed signal switching that supports bi-directional operation and offers a high bandwidth (5.5 GHz typ). When interfacing other USB/MHL/myDP devices with this EVM, the switch allows signals to pass with minimum edge and phase distortion as well as little or no signal attenuation.

The evaluation module is designed to demonstrate the small printed circuit board (PCB) areas that can be achieved when designing with the TS3USB3031 switch. See [Figure 1](#) for the EVM Block Diagram.

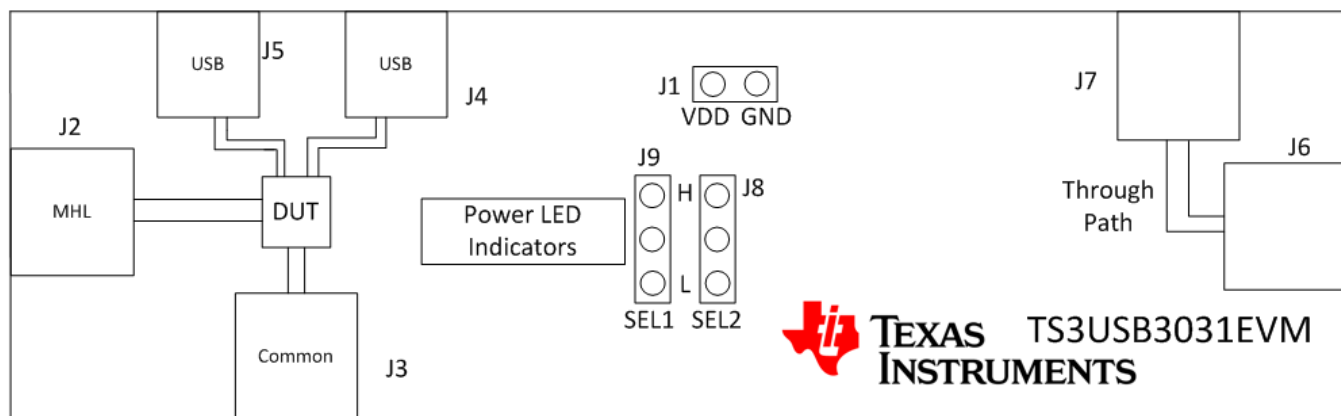


Figure 1. TS3USB3031 EVM Block Diagram

### 2.1 List of Hardware Items for Operation

The following items are required for EVM evaluation:

- TS3USB3031EVM
- USB cables with connector type depending on the surrounding system

The following items are optional for EVM evaluation:

- MHL/myDP source capable of interfacing through a female-to-male micro-B connection
- MHL-to-HDMI adapter (unnecessary if MHL-capable display is used)
- Display capable of displaying MHL/myDP/HDMI at appropriate frame rate

### 3 Quick Start Evaluation

#### 3.1 Evaluation Overview

Figure 2 provides a diagram of the setup for evaluation.

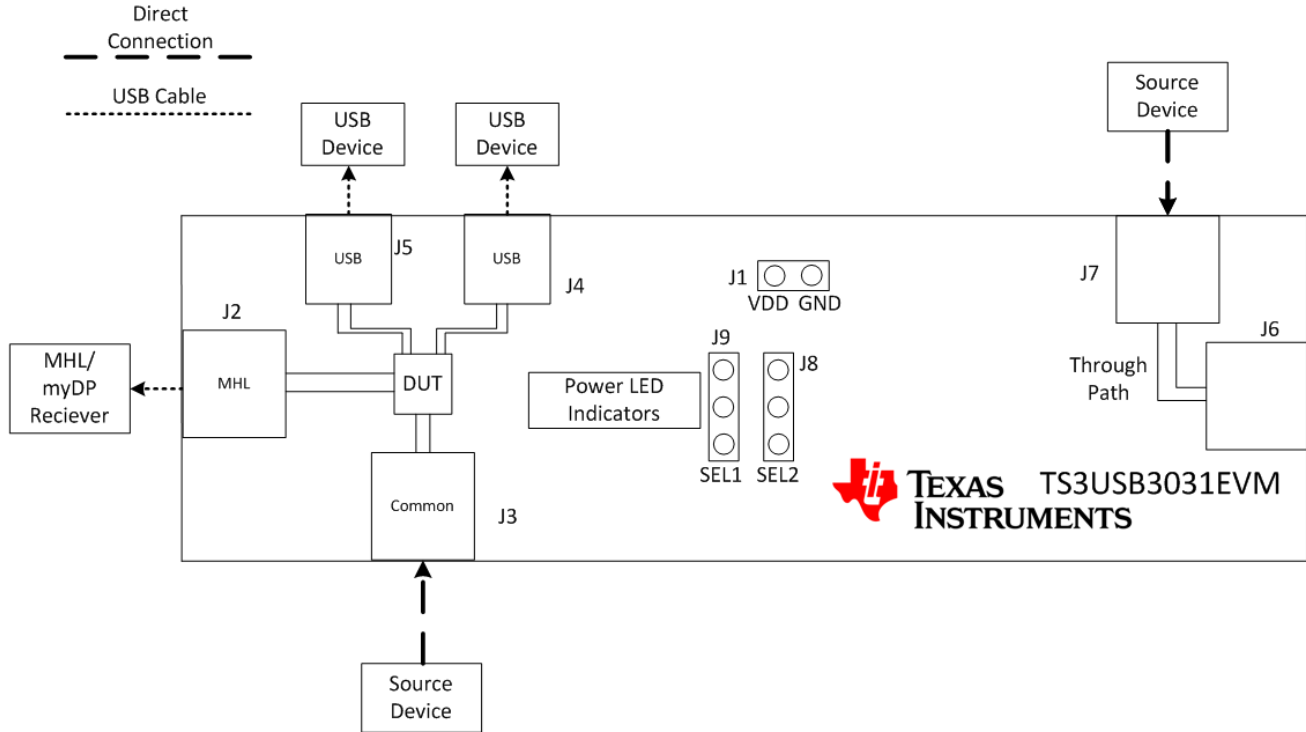


Figure 2. Quick Start Diagram

#### 3.2 Jumper Configuration Tables

Table 1 displays the jumper configuration for SEL1 and SEL2.

Table 1. SEL1 and SEL2 Jumper Configuration

SEL1	SEL2	Function
L	L	J3 to J5 (USB1)
L	H	J3 to J4 (USB2)
H	L	J3 to J2 (MHL)
H	H	No connection High-Z

### 3.3 USB Communication

Set up the USB communication for the EVM by following steps 1 through 5.

1. Configure the SEL1 and SEL2 jumpers so both are in the low position (shorting pins 1 and 2 of the headers)
2. Connect a power supply of 3.3 V to J1, across VDD and GND
3. Connect the TS3USB3031EVM J3 male connector to a USB device with a female micro-B receptacle
4. Connect a USB-A to micro-B cable from a powered PC to the J5 micro-B receptacle on the EVM
  - Test the other USB channel by switching SEL2 to high and by connecting the computer USB cable to J4
5. If the device is capable (not on low battery), USB communication should occur between the peripheral connector to J3 and the PC connected to J5 (or J4 depending on the jumper settings) through the TS3USB3031. The device may also begin charging.

## 4 EVM Configuration and Description

### 4.1 EVM Description

To conform to the HDMI specification, all four differential pairs on the board are impedance matched to a 100-Ω differential. The trace length of the through-path and the trace length through the TS3USB3031 switch are also matched for comparison purposes. The printed-circuit board (PCB) is a four-layer, top-side populated board (see the schematic and PCB layout in [Section 4.2](#) and [Section 4.3.1](#)). The major features of the hardware design are detailed in the following sections.

**NOTE:** The dielectric material between the signal and GND plane is Rogers 4350B. This is a high-performance PCB material and if FR-4 is used under the same conditions, the same results should not be expected due to the board losses of FR-4.

### 4.2 Schematics

The schematic for this EVM is illustrated in [Figure 3](#).

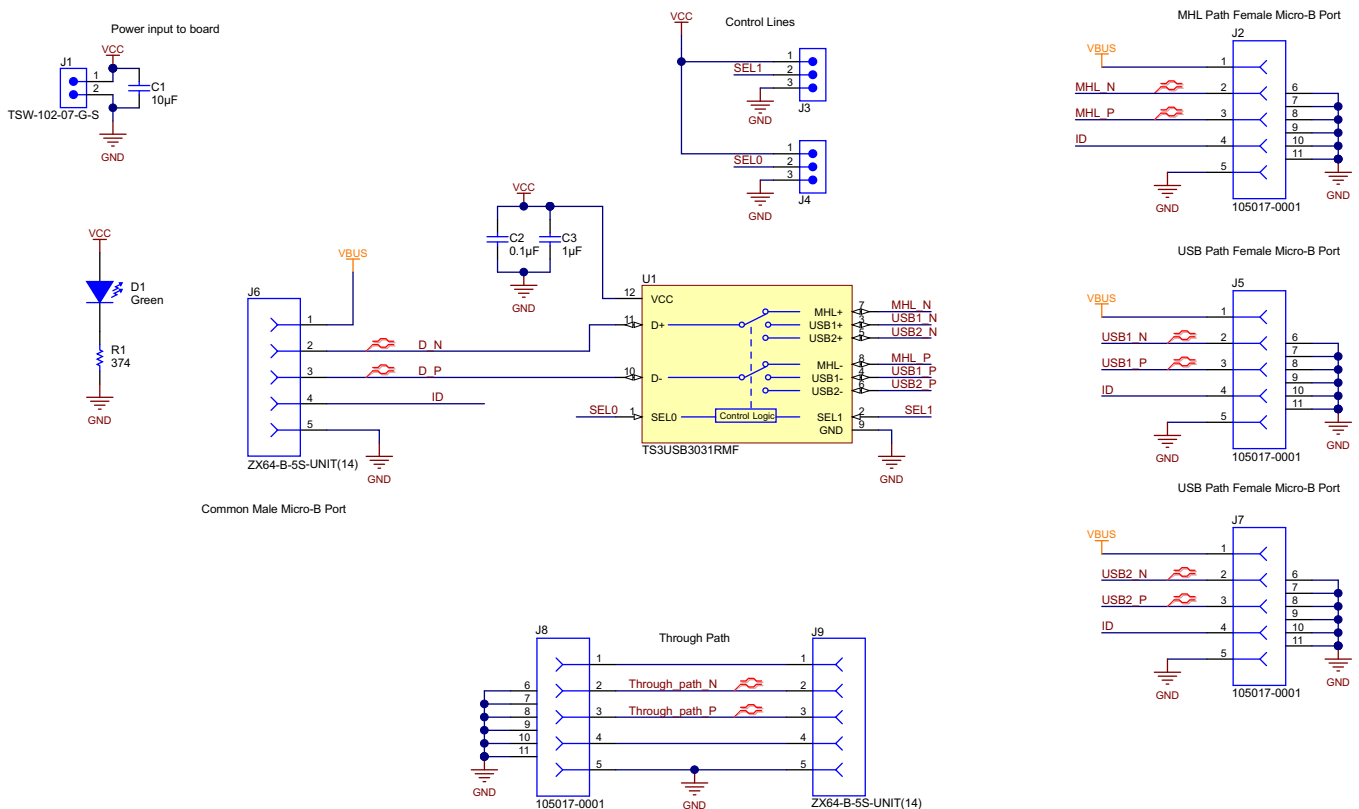


Figure 3. TS3USB3031 Schematic

### 4.3 Bill of Materials

The BOM for this EVM is listed in [Table 2](#).

**Table 2. Bill of Materials**

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
C1	1	10uF	CAP, CERM, 10uF, 10V, +/-10%, C0G/NP0, 0603	0603	C1608X5R1A106M	TDK
C2	1	0.1uF	CAP, CERM, 0.1uF, 6.3V, +/-10%, X5R, 0402	0402	C1005X5R0J104K	TDK
C3	1	1uF	CAP, CERM, 1uF, 6.3V, +/-20%, X5R, 0402	0402	C1005X5R0J105M	TDK
D1	1	Green	LED, Green, SMD	1.6x0.8x0.8mm	LTST-C190GKT	Lite-On
J1	1		Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	TSW-102-07-G-S	TSW-102-07-G-S	Samtec, Inc.
J2, J5, J7, J8	4		Receptacle, Micro-USB-B, Right Angle, SMD	Micro USB receptacle	105017-0001	Molex
J3, J4	2		Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator	TSW-103-07-G-S	TSW-103-07-G-S	Samtec, Inc.
J6, J9	2		Connector, micro USB Type B, Receptacle, R/A, SMD	Micro USB-B receptacle	ZX64-B-5S-UNIT(14)	Hirose Electric Co. Ltd.
R1	1	374	RES, 374 ohm, 1%, 0.063W, 0402	0402	CRCW0402374RKF ED	Vishay-Dale
U1	1		DUAL USB 2.0 HIGH-SPEED (480Mbps) AND MOBILE HIGH-DEFINITION LINK (MHL) SWITCH, RMF0012A	RMF	TS3USB3031RMF	Texas Instruments

### 4.3.1 PCB Layout

The PCB layouts for this EVM are displayed in [Figure 4](#) through [Figure 7](#).

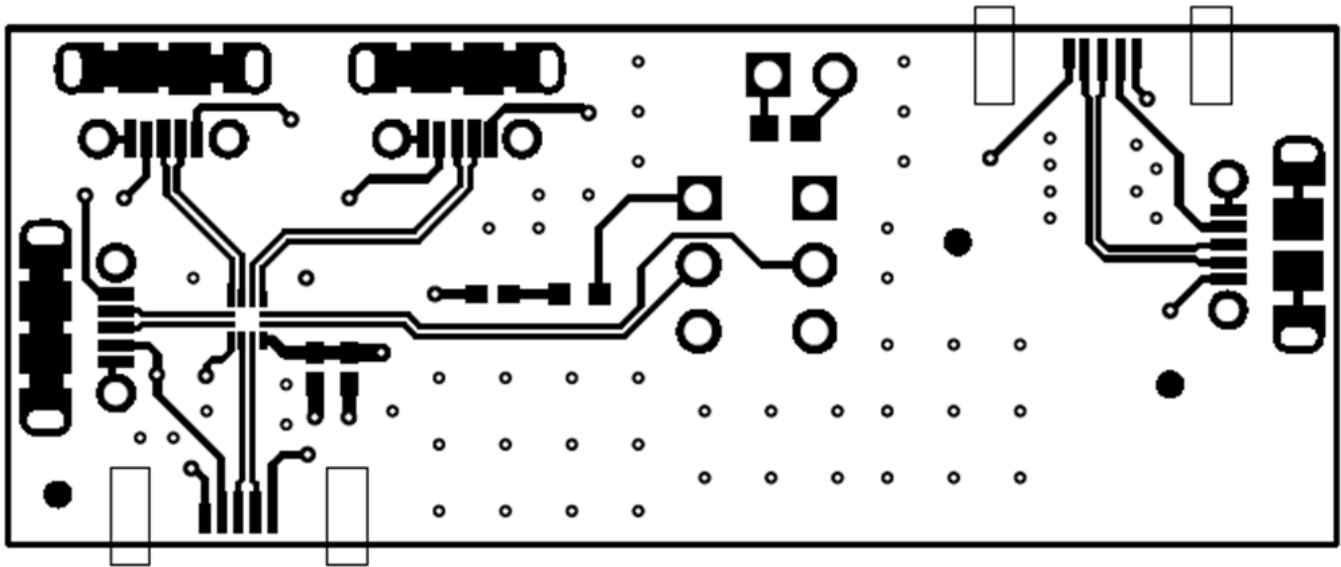


Figure 4. Top Layer

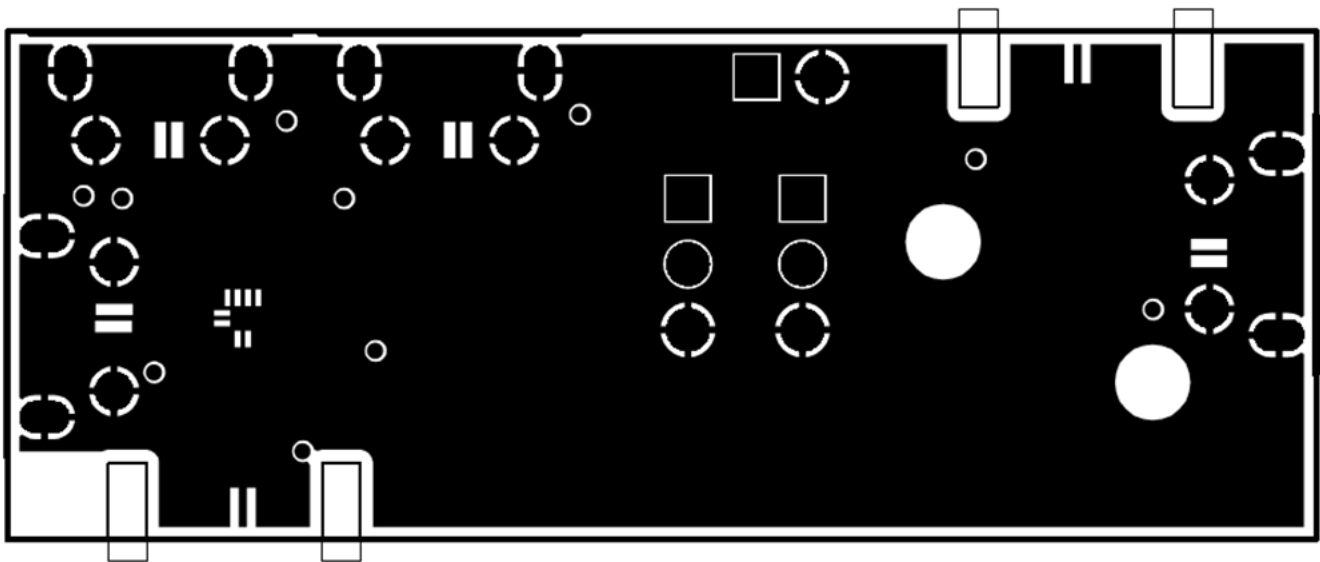


Figure 5. Ground Plane

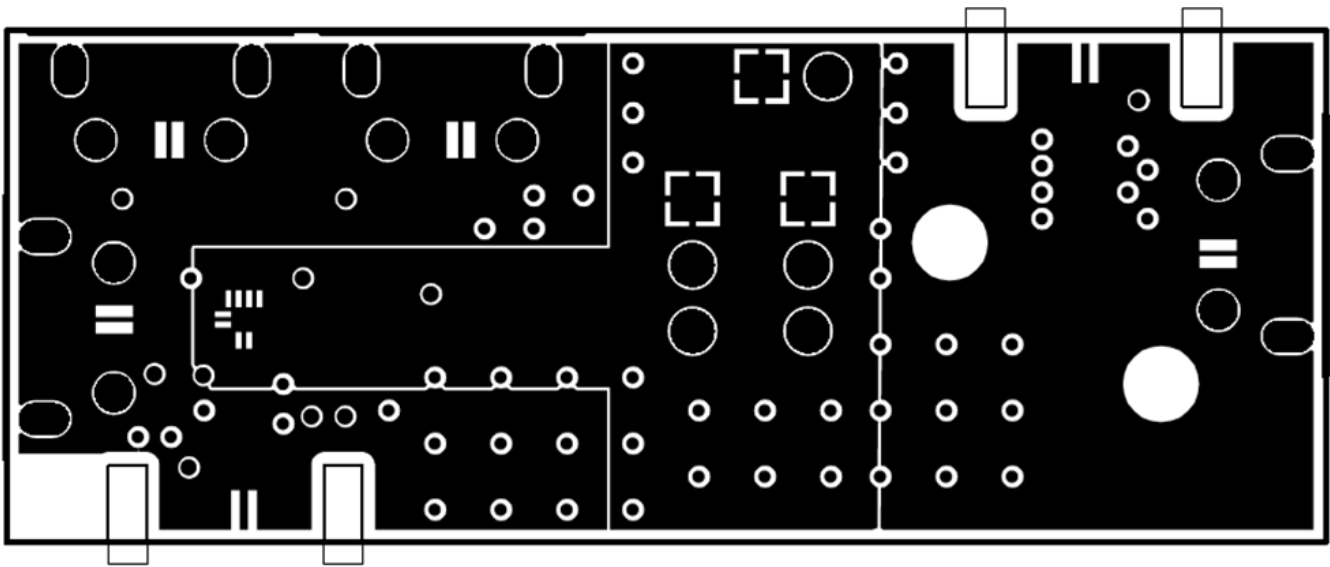


Figure 6. Power Plane

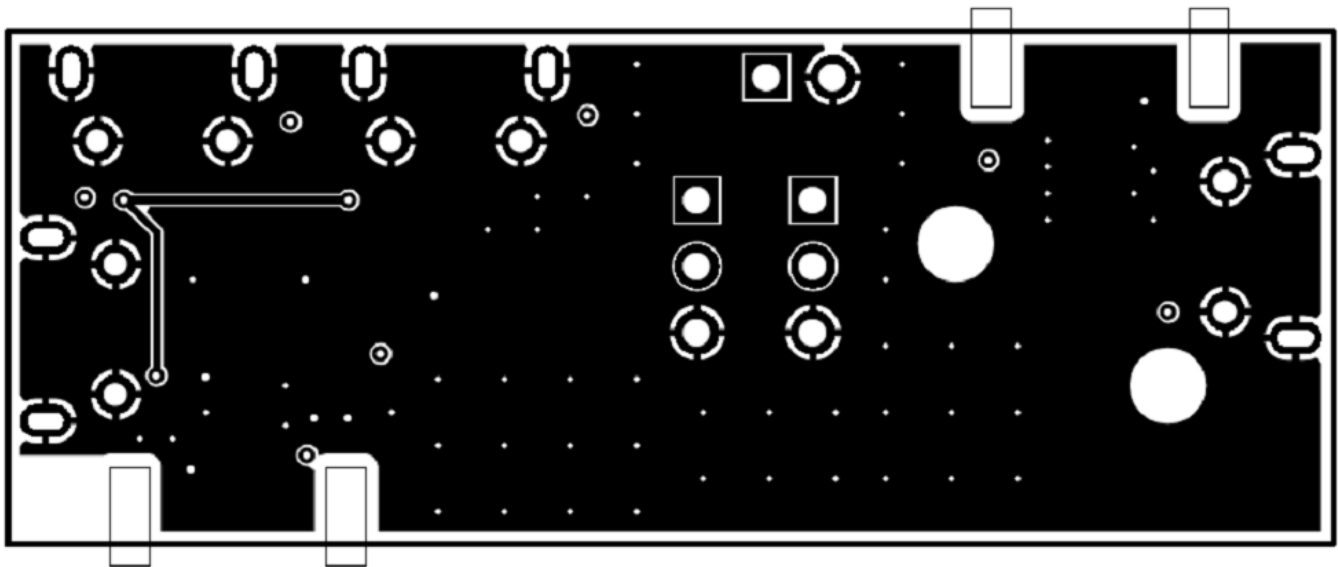


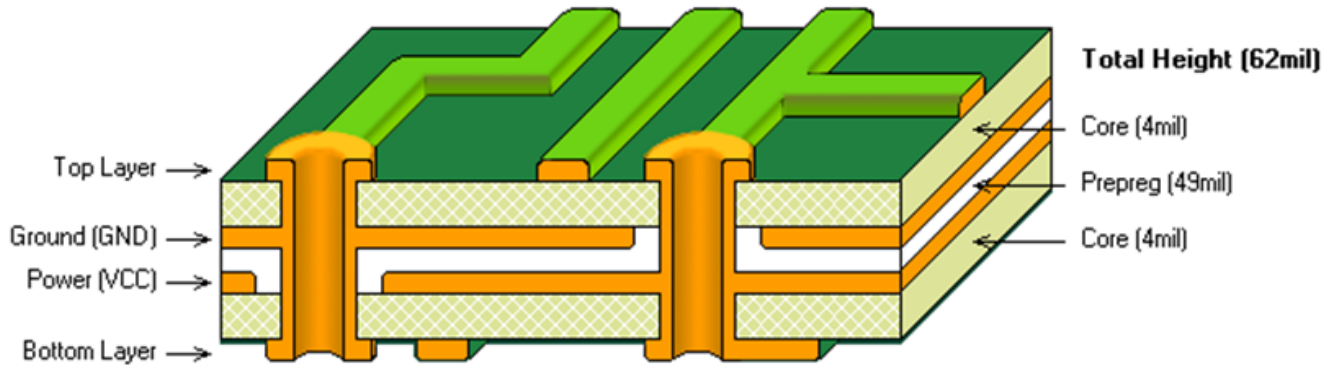
Figure 7. Bottom Layer



**4.3.2 Board Stackup**

Figure 8 depicts the board stackup. Table 3 lists the stackup along with the dielectric material.

- Core: ROGERS4350B
- Prepreg: FR-4



**Figure 8. Board Stackup**

**Table 3. Board Stackup and Dielectric Material**

	Layer	Type	Thickness (mils)	Copper Weight	Dielectric Constant	Loss Tangent	Coupling type	Width (mils)	Spacing (mils)	Diff Z <sub>o</sub> (Ω)
1		Surface	0.4							
2	Top	Conductor	0.7	0.5 oz			Coupled MS	7	7	98.6
3		Dielectric	4		3.66	0.0037				
4	Ground	Plane	1.4	1 oz						
5		Dielectric	49		4.5	0.035				
6	Power	Plane	1.4	1 oz						
7		Dielectric	4		3.66	0.007				
8	Bottom	Conductor	0.7	0.5 oz						
9		Surface	0.4							

**4.3.3 Related Documentation**

TS3USB3031: Dual USB 2.0 High-Speed (480 Mbps) and Mobile High-Definition Link (MHL) Switch ([SCDS348](#))

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### 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

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.

### **For EVMs annotated as IC – INDUSTRY CANADA Compliant**

This Class A or B digital apparatus complies with Canadian ICES-003.

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

### **Concerning EVMs including radio transmitters**

This device complies with Industry Canada licence-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.

### **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.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

### **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.

### **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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1. Use this product 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 this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

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3. Since the EVM is not a completed product, it may not meet all applicable regulatory and safety compliance standards (such as UL, CSA, VDE, CE, RoHS and WEEE) which may normally be associated with similar items. You assume full responsibility to determine and/or assure compliance with any such standards and related certifications as may be applicable. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
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Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Applications Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
Wireless Connectivity	<a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a>

### Applications

Automotive and Transportation	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
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