User's Guide

ISOUSB111 Full/Low Speed Isolated USB Repeater Evaluation Module

TEXAS INSTRUMENTS

ABSTRACT

This user's guide describes the ISOUSB111 full/low speed isolated USB repeater evaluation module (EVM). This EVM lets designers evaluate device performance for fast development and analysis of isolated systems. The EVM supports evaluation of any of the ISOUSB111 in a 16-pin wide body SOIC package (DW-16).

CAUTION

This evaluation module is made available for isolator parameter performance evaluation only and is not intended for isolation voltage testing. To prevent damage to the EVM, any voltage applied as a supply or digital input/output must be maintained within the 0-V to 5.5-V recommended operating range.

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1 Introduction

This user's guide describes EVM operation with respect to the ISOUSB111 full/low speed isolated USB repeater. This guide also describes the EVM BOM, EVM schematic, EVM PCB layout, and typical laboratory setup.

2 Overview

The ISOUSB111 device is a galvanically-isolated USB 2.0 compliant repeater supporting Low Speed (1.5 Mbps) and Full Speed (12 Mbps) signaling rates. The device supports automatic speed and connection detection, reflection of pull-ups/pull-downs, and link power management allowing drop-in USB hub, host, peripheral and cable isolation. The device also supports automatic role reversal – if after disconnect, if a new connect is detected on the Upstream facing port, then the Upstream and Downstream port definitions are reversed. This device uses a silicon dioxide (SiO_2) insulation barrier with a withstand voltage of 5700 V_{RMS} and a working voltage of 1060 V_{RMS}. Used in conjunction with isolated power supplies, the device protects against high voltage, and prevents noise currents from the bus from entering the local ground. The ISOUSB111 device is available for both basic and reinforced isolation (see reinforced and basic isolation options). The ISOUSB111 device supports a wide ambient temperature range of –40°C to +125°C. The device is available in the standard wide body SOIC-16 (DW) package and a smaller SOIC-16 (DWV) package.

The EVM enables a user to evaluate ISOUSB111 device thoroughly before incorporating the device into their design. To facilitate the EVM to be powered from various power sources including regulated power supplies, standard USB 2.0 connector, standard DC adapter, EVM includes a transformer driver (SN6501), a transformer (CMP-0030614-1), and three adjustable output LDOs (TPS76701 and TPS73701). This EVM can be configured to use the provided LDOs to power the 3.3-V power supplies, or bypass these external LDOs and use the internal LDOs to power the 3.3-V power supplies. The EVM can be configured to operate with and without external LDOs and test configurations details of which are provided in the following sections.

The EVM can be used to verify many of ISOUSB111 data sheet parameters like data-rate, current consumption and others. Some of the data sheet specifications require a different test setup configuration than the ISOUSB111DWEVM and hence, they cannot be verified from the EVM as is. The example parameters include maximum data rate, propagation delay, and other timing specifications.

3 Pin Configuration of the ISOUSB111 Full/Low Speed Isolated USB Repeater

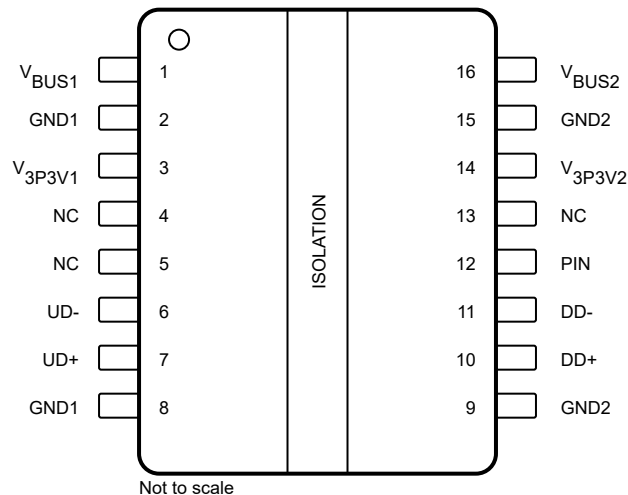Figure 3-1 shows the ISOUSB111 Full/Low Speed Isolated USB Repeater pin configuration.

Figure 3-1. ISOUSB111 Full/Low Speed Isolated USB Repeater Pin Configuration

4 EVM Setup and Operation

This section describes the typical setup and operation of the EVM for device evaluation. Figure 4-1 shows a typical test configuration for operating the ISOUSB111DWEVM using an USB 2.0 type-B receptacle.
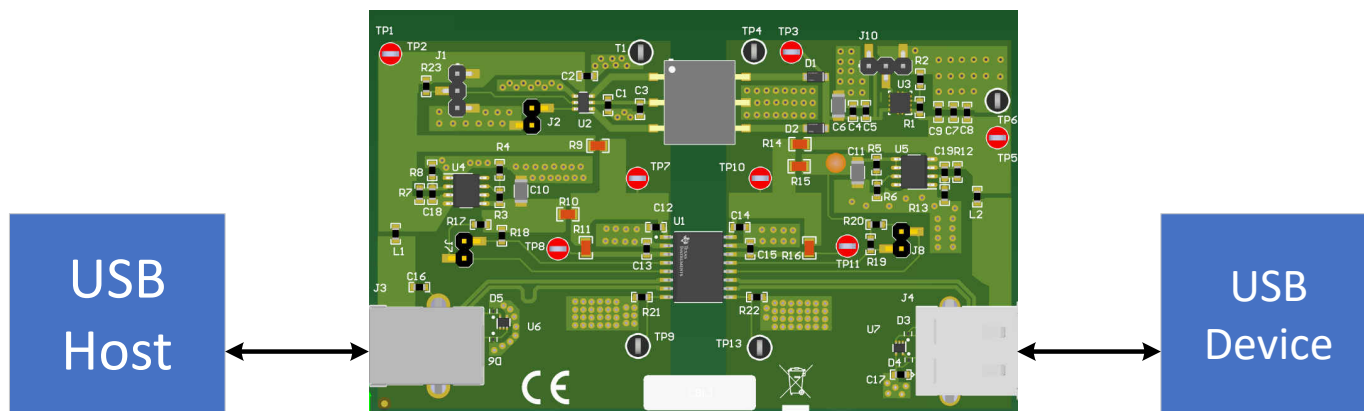

Figure 4-1. Typical EVM Test Setup

Use a jumper to connect pin 2 to pin 1 of J10 to enable the U3 LDO. The U3 LDO provides a 5 V supply to the USB device, and it also powers the U5 LDO to generate 3.3V. If an external 5V source is used to power the USB device through TP5, connect pin 2 to pin 3 of J10 to disable the U3 LDO and set its output to high impedance.

ISOUSB111DWEVM has many DNP resistors which can be populated or unpopulated to setup the EVM to desired operating test conditions. Table 4-1 lists and describes all the possible test configurations that can be achieved by populating various resistors.

Table 4-1. Resistor Configurations

Resistor	Description
R7	DNP is the default. To disable the U4 LDO, populate a zero ohm resistor on R7 and not populate R8.
R8	Connects U4 $\overline{EN}$ to ground to enable the LDO. When R8 is populated, R7 needs to be unpopulated.
R9	Connects V_{BUS1} to type-B receptacle VBUS. V_{BUS1} is power at 5 V when R9 is populated. When R9 is populated, R10 and R11 need to be unpopulated to disconnect the U4 LDO to VBUS1 and V3P3V1 pins. The internal LDO of ISOUSB111 will generate 3.3 V for V3P3V1 pin.
R10, R11	DNP is the default. Populating R10 and R11 connects the U4 LDO to V_{BUS1} and V_{3P3V1} pins. When these two resistors are populated, R9 need to be unpopulated. When R10 and R11 are populated, V_{BUS1} and V_{3P3V1} are set to 3.3 V.
R12	DNP is the default. To disable the U5 LDO, populate a zero ohm resistor on R12 and not populate R13.
R13	Connects U5 $\overline{EN}$ to ground to enable the LDO. When R8 is populated, R7 needs to be unpopulated.
R14	DNP is the default. It connects V_{BUS2} to the output of U3 LDO. V_{BUS2} is power at 5V when R14 is populated. R15 and R16 need to be unpopulated to disconnect the U5 LDO to V_{BUS2} and V_{3P3V2} pins. The internal LDO of ISOUSB111 will generate 3.3 V for V_{3P3V2} pin.
R15, R16	Populating R15 and R16 connects the U5 LDO to V_{BUS2} and V_{3P3V2} pins. When these two resistors are populated, R14 need to be unpopulated. When R15 and R16 are populated, V_{BUS2} and V_{3P3V2} are set to 3.3 V.
R17, R18, R19, R20	For internal debug purposes.

5 EVM Schematics

The ISOUSB11DWEVM is designed to accommodate any of the ISOUSB111 full/low speed isolated USB repeater in a 16-pin DW SOIC package. Figure 5-1 shows the ISOUSB111DWEVM schematic.

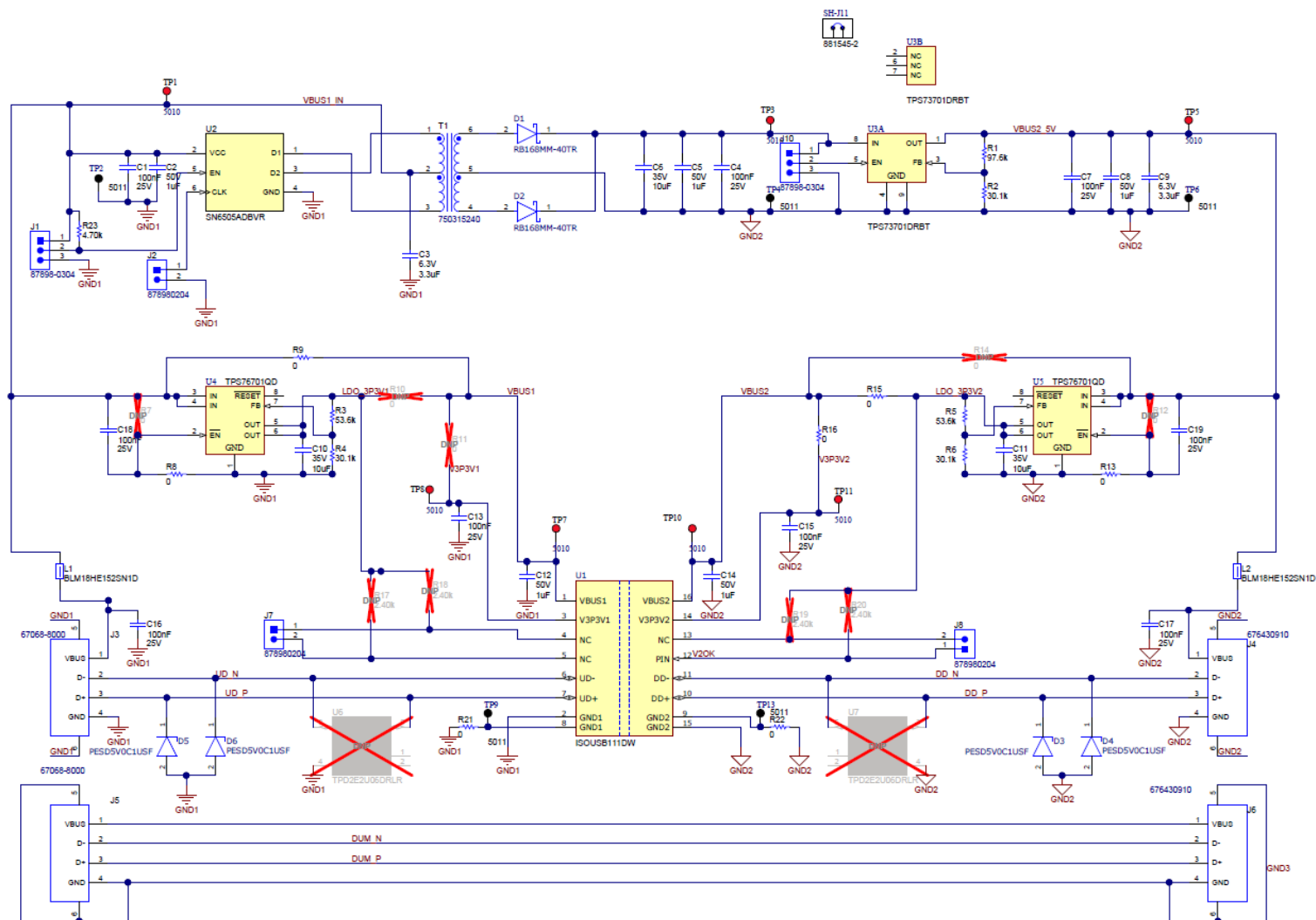**Figure 5-1. ISOUSB111DWEVM Schematic**

6 PCB Layout and 3D Diagram

Figure 6-1 and Figure 6-2 show the printed-circuit board (PCB) layout top and bottom layers, respectively, and Figure 6-3 shows a 3D diagram of the PCB indicating how a finished board looks like.
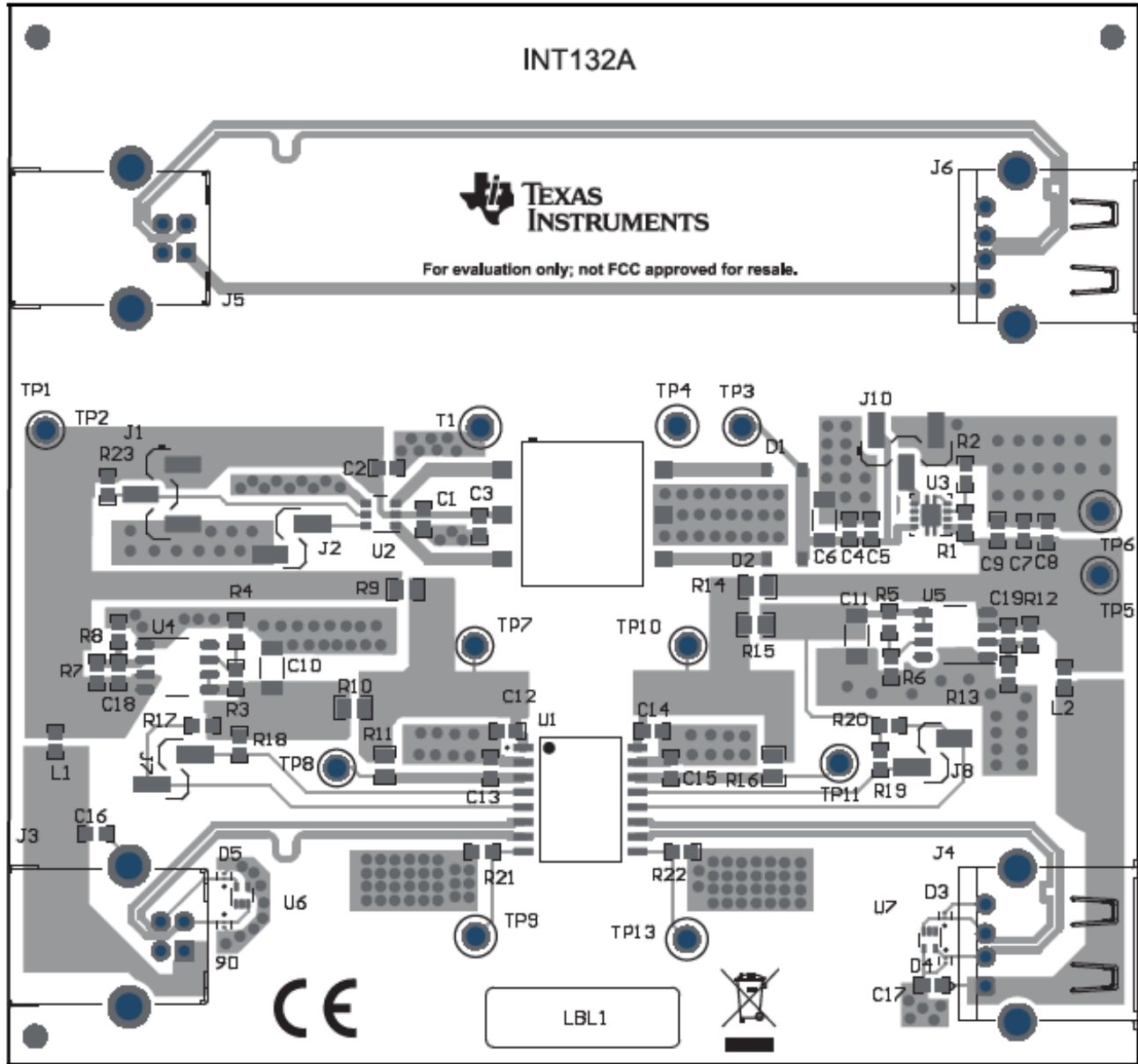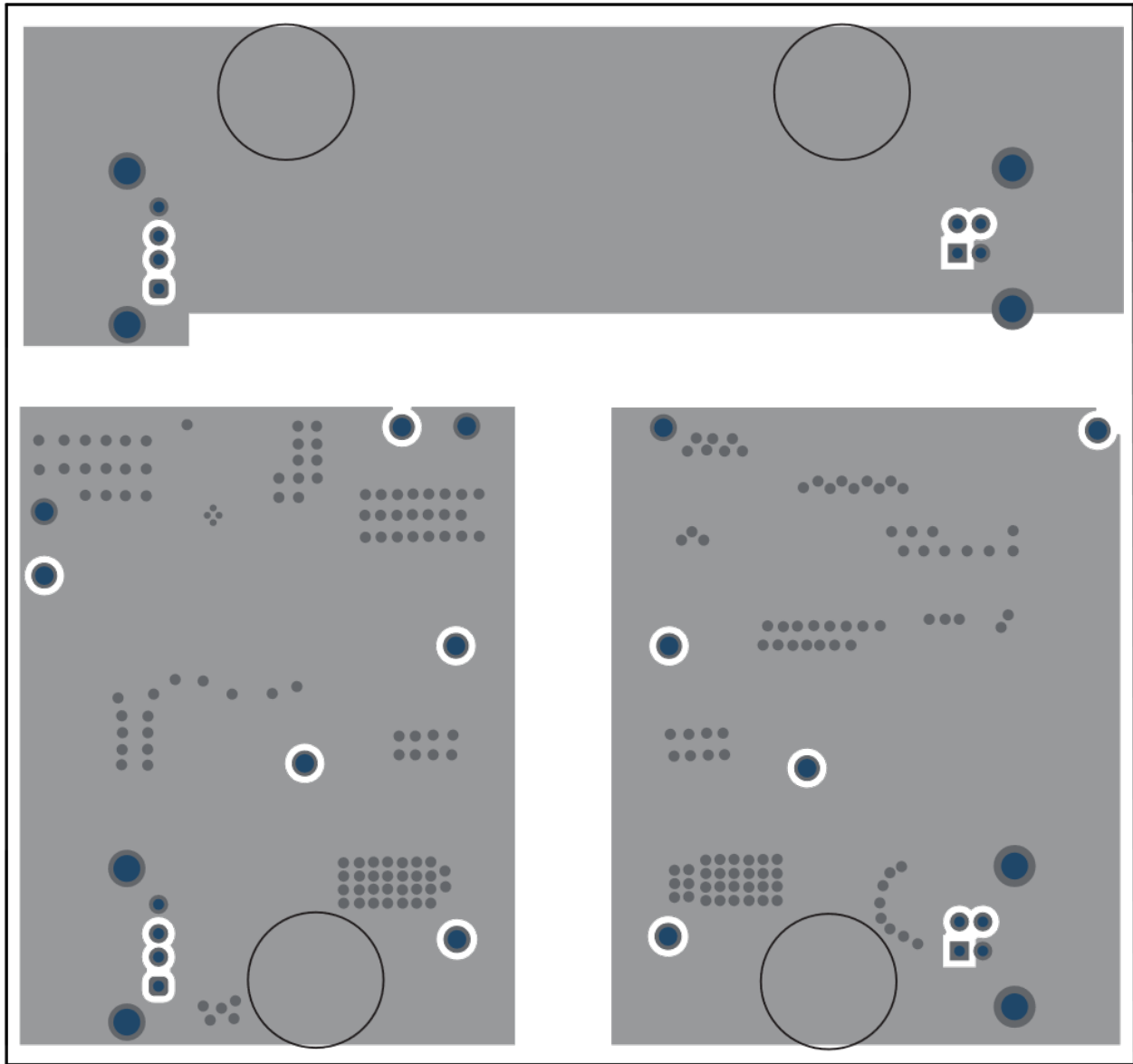

Figure 6-1. ISOUSB111DWEVM PCB Layout – Top Layer

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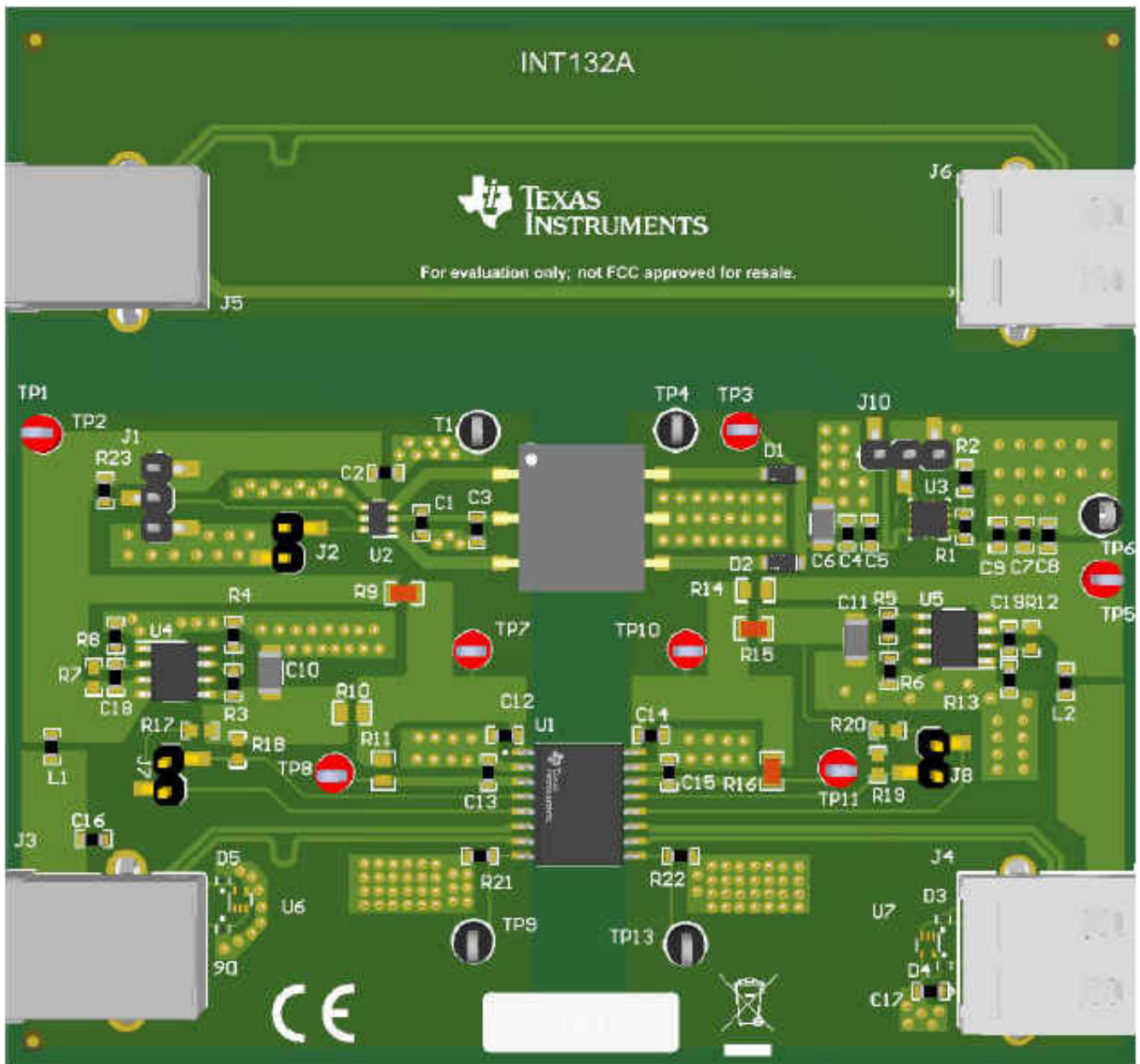**Figure 6-2. ISOUSB111DWEVM PCB Layout – Bottom Layer**

Figure 6-3. ISOUSB111DWEVM PCB – 3D Diagram

7 Bill of Materials

Table 7-1 lists the bill of materials (BOM) for this EVM.

Table 7-1. Bill of Materials

Item	Designator	Description	Manufacturer	PartNumber
1	C1, C4, C7, C13, C15, C16, C17, C18, C19	CAP, CERM, 0.1 uF, 25 V, +/- 5%, X7R, 0603	AVX	06033C104JAT2A
2	C2, C5, C8, C12, C14	CAP, CERM, 1 uF, 50 V, +/- 10%, X5R, 0603	TDK	C1608X5R1H105K080AB
3	C3, C9	CAP, CERM, 3.3 uF, 6.3 V, +/- 10%, X5R, 0603	Kemet	C0603C335K9PACTU
4	C6, C10, C11	CAP, CERM, 10 uF, 35 V, +/- 10%, X7R, AEC-Q200 Grade 1, 1206_190	TDK	CGA5L1X7R1V106K160AC
5	D1, D2	DIODE SCHOTTKY 40V 1A PMDU	Rohm	RB168MM-40TR
6	D3, D4, D5, D6	3V Clamp 9A (8/20µs) Ipp Tvs Diode Surface Mount DSN0603-2	Nexperia	PESD5V0C1USF
7	FID1, FID2, FID3	Fiducial mark. There is nothing to buy or mount.	N/A	N/A
8	H9, H10, H11, H12	Bumpon, Hemisphere, 0.44 X 0.20, Clear	3M	SJ-5303 (CLEAR)
9	J1, J10	Header, 2.54mm, 3x1, Gold, SMT	Molex	87898-0304
10	J2, J7, J8	Header, 2.54 mm, 2x1, Gold, R/A, SMT	Molex	878980204
11	J3, J5	Connector, Receptacle, USB TYPE B, R/A, Top Mount TH	Molex	67068-8000
12	J4, J6	Connector, Receptacle, USB Standard, R/A, Top Mount TH	Molex	676430910
13	L1, L2	Ferrite Bead, 1500 ohm @ 100 MHz, 0.5 A, 0603	MuRata	BLM18HE152SN1D
14	LBL1	Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	Brady	THT-14-423-10
15	R1	RES, 97.6 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	Vishay-Dale	CRCW060397K6FKEA
16	R2, R4, R6	RES, 30.1 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	Vishay-Dale	CRCW060330K1FKEA
17	R3, R5	RES, 53.6 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	Vishay-Dale	CRCW060353K6FKEA
18	R7, R8, R12, R13, R21, R22	RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	Vishay-Dale	CRCW06030000Z0EA
19	R9, R10, R11, R14, R15, R16	RES, 0, 1%, 0.5 W, 0805	Keystone	5106
20	R17, R18, R19, R20	RES, 2.40 k, 0.1%, 0.1 W, 0603	Susumu Co Ltd	RG1608P-242-B-T5
21	R23	RES, 4.70 k, 0.1%, 0.1 W, 0603	Yageo America	RT0603BRD074K7L
22	T1	Transformer, 110 uH, SMT	Wurth Elektronik	750315240
23	TP1, TP3, TP5, TP7, TP8, TP10, TP11	Test Point, Red, Through Hole, RoHS, Bulk	Keystone	
24	TP2, TP4, TP6, TP9, TP13	Test Point, Multipurpose, Black, TH	Keystone	5011
25	U1	Full/Low Speed Isolated USB Repeater, SOIC16-Wide	Texas Instruments	ISOUSB111DW
26	U2	Low-Noise 1-A Transformer Driver for Isolated Power Supplies, Internal Clock-160kHz, DBV0006A (SOT-23-6)	Texas Instruments	SN6505ADBVR
27	U3	Single Output LDO, 1A, Adj. (1.2 to 5.0V), Reverse Current Protection, DRB0008A (VSON-8)	Texas Instruments	TPS73701DRBT
28	U4, U5	Single Output Fast Transient Response LDO, 1 A, Adjustable 1.5 to 5.5 V Output, 2.7 to 10 V Input, with Low IQ, 8-pin SOIC (D), -40 to 125 degC, Green (RoHS & no Sb/Br)	Texas Instruments	TPS76701QD
29	U6, U7	Dual-Channel High-Speed ESD Protection, DRL0005A (SOT-OTHER-5)	Texas Instruments	TPD2E2U06DRLR
30	SH-J11	Shunt, 100mil, Gold plated, Black	TE Connectivity	881545-2

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