User's Guide
ISOUSB111DWX Full/Low Speed Isolated USB Repeater Evaluation Module

TEXAS INSTRUMENTS

ABSTRACT

This user's guide describes the ISOUSB111DWX 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 (DWX-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.

Table of Contents

List of Figures

List of Tables

Trademarks
All trademarks are the property of their respective owners.

1 Introduction

This user's guide describes EVM operation with respect to the ISOUSB111DWX 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 ISOUSB111DWX 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 SSOP-16 (DWX) package and a smaller SSOP-16 (DWX) package.

The EVM enables a user to evaluate ISOUSB111DWX 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 receptacles, 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 ISOUSB111DWX data sheet parameters like data-rate, current consumption and others. Some of the data sheet specifications require a different test setup configuration than the ISOUSB111DWXEVM 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 ISOUSB111DWX Full/Low Speed Isolated USB Repeater

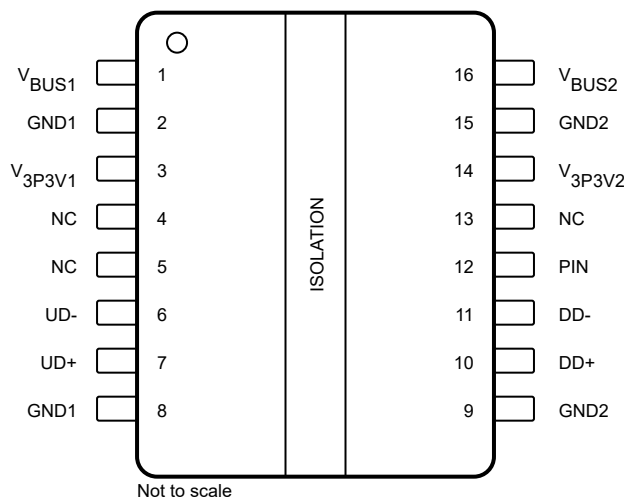Figure 3-1 shows the ISOUSB111DWX Full/Low Speed Isolated USB Repeater pin configuration.

Not to scale

Figure 3-1. ISOUSB111DWX 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 ISOUSB111DWXEVM using an USB 2.0 type-B receptacle.
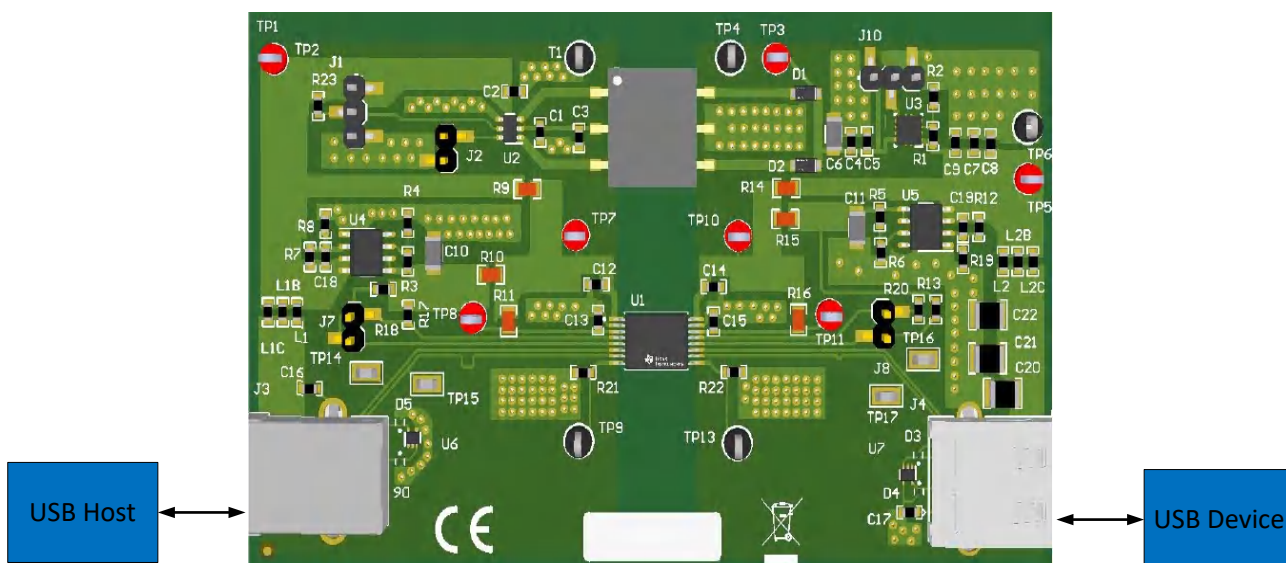

Figure 4-1. Typical EVM test setup

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 3.3 V. If an external 5 V 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.

ISOUSB111DWXEVM 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	Conn ects 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 ISOUSB11DWXXEVM is designed to accommodate any of the ISOUSB111DWX full/low speed isolated USB repeater in a 16-pin DWX SSOP package. Figure 5-1 shows the ISOUSB111DWXEVM schematic.

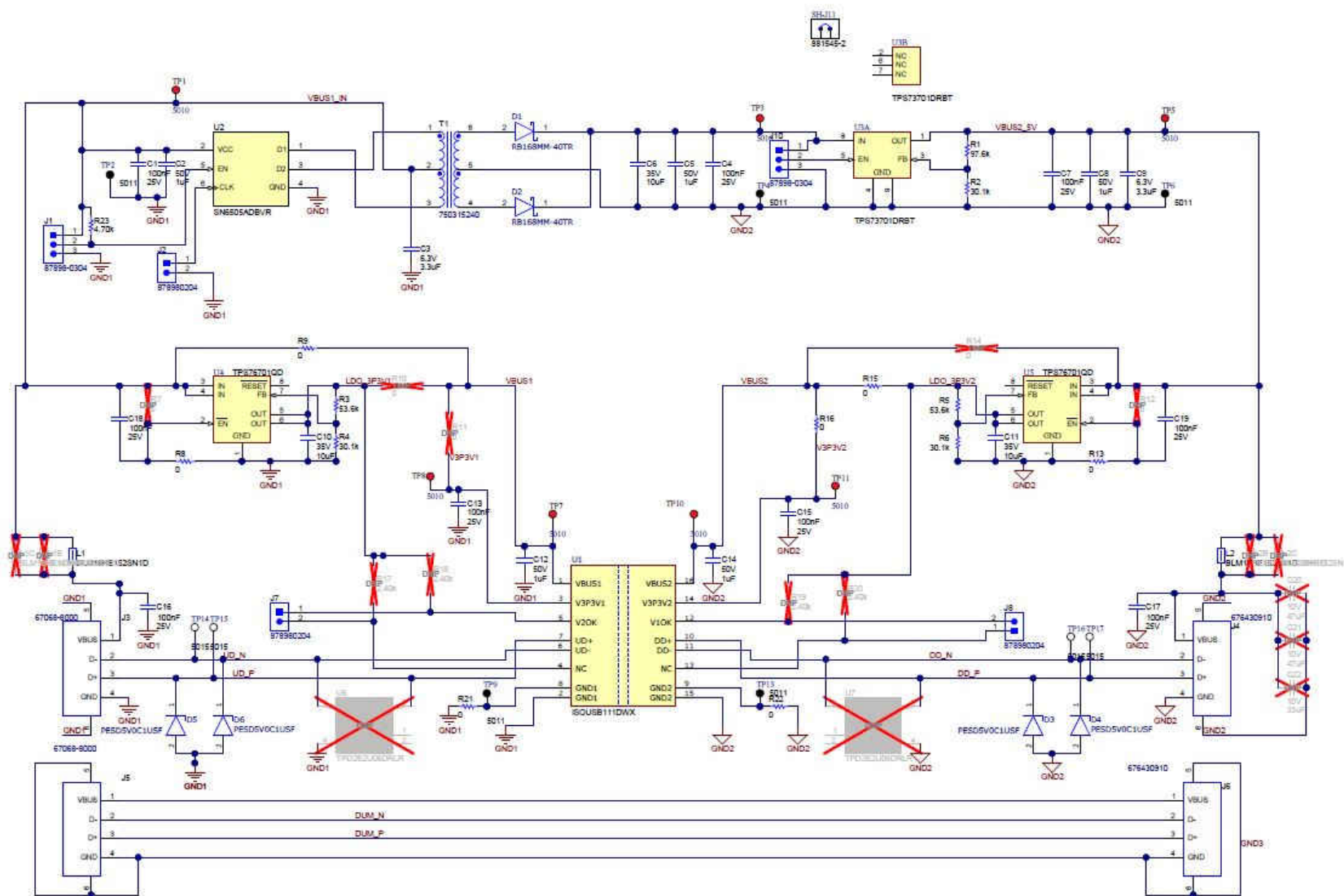**Figure 5-1. ISOUSB111DWXEVM Schematic**

6 PCB Layout and 3D Diagram

ISOUSB111DWXEVM PCB Layout - Top Layerand 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.
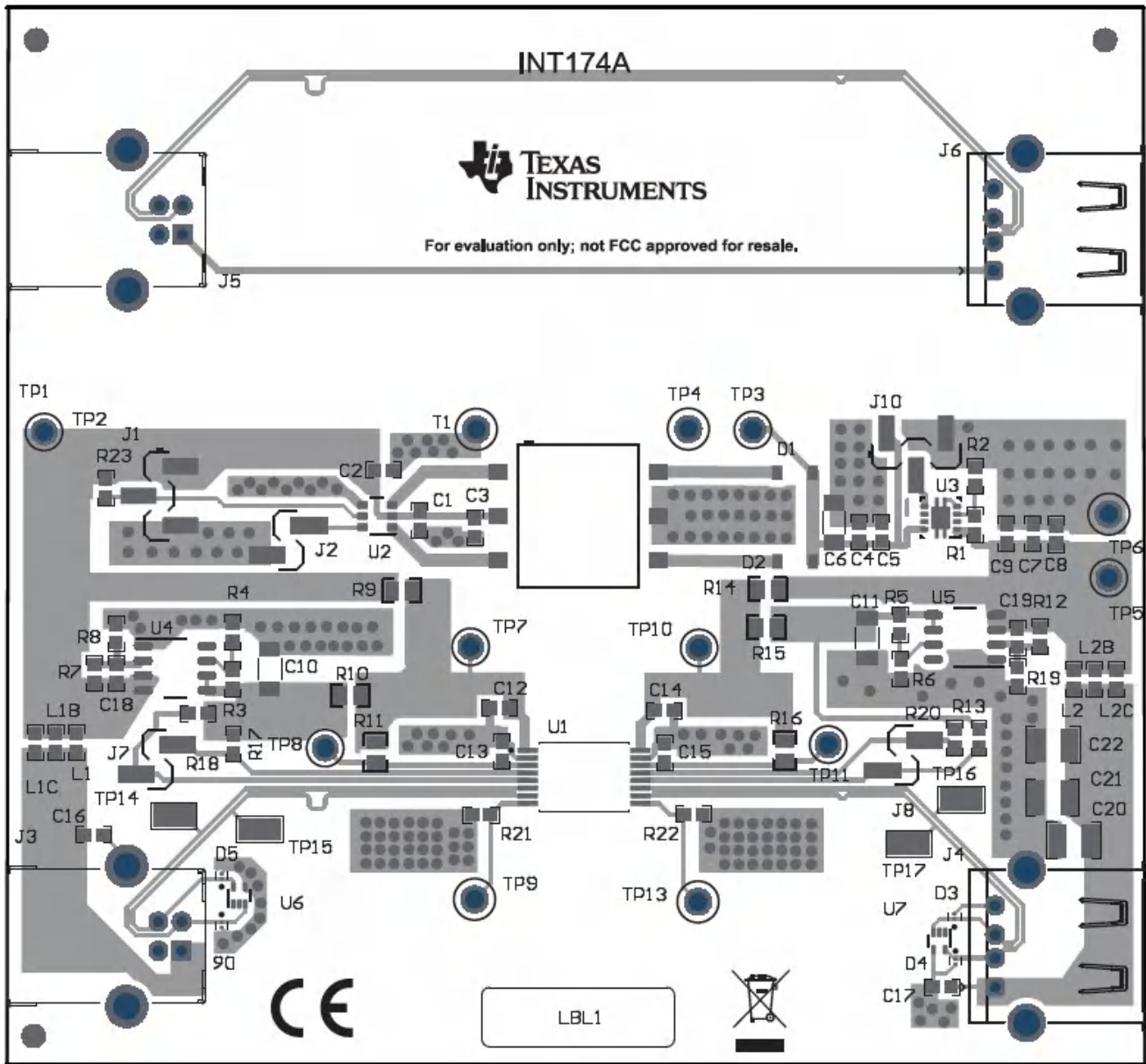

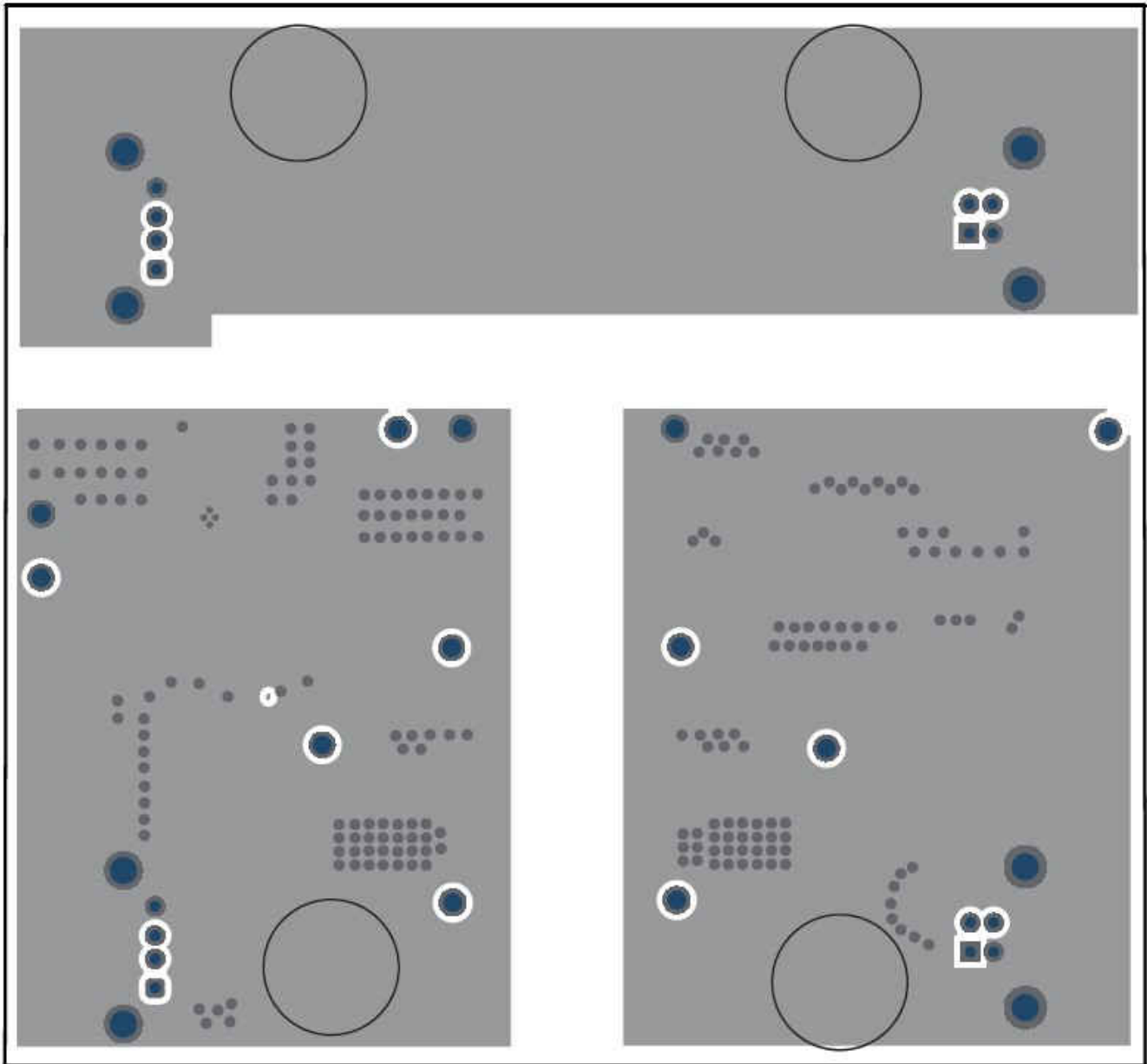**Figure 6-1. ISOUSB111DWXEVM PCB Layout - Top Layer**

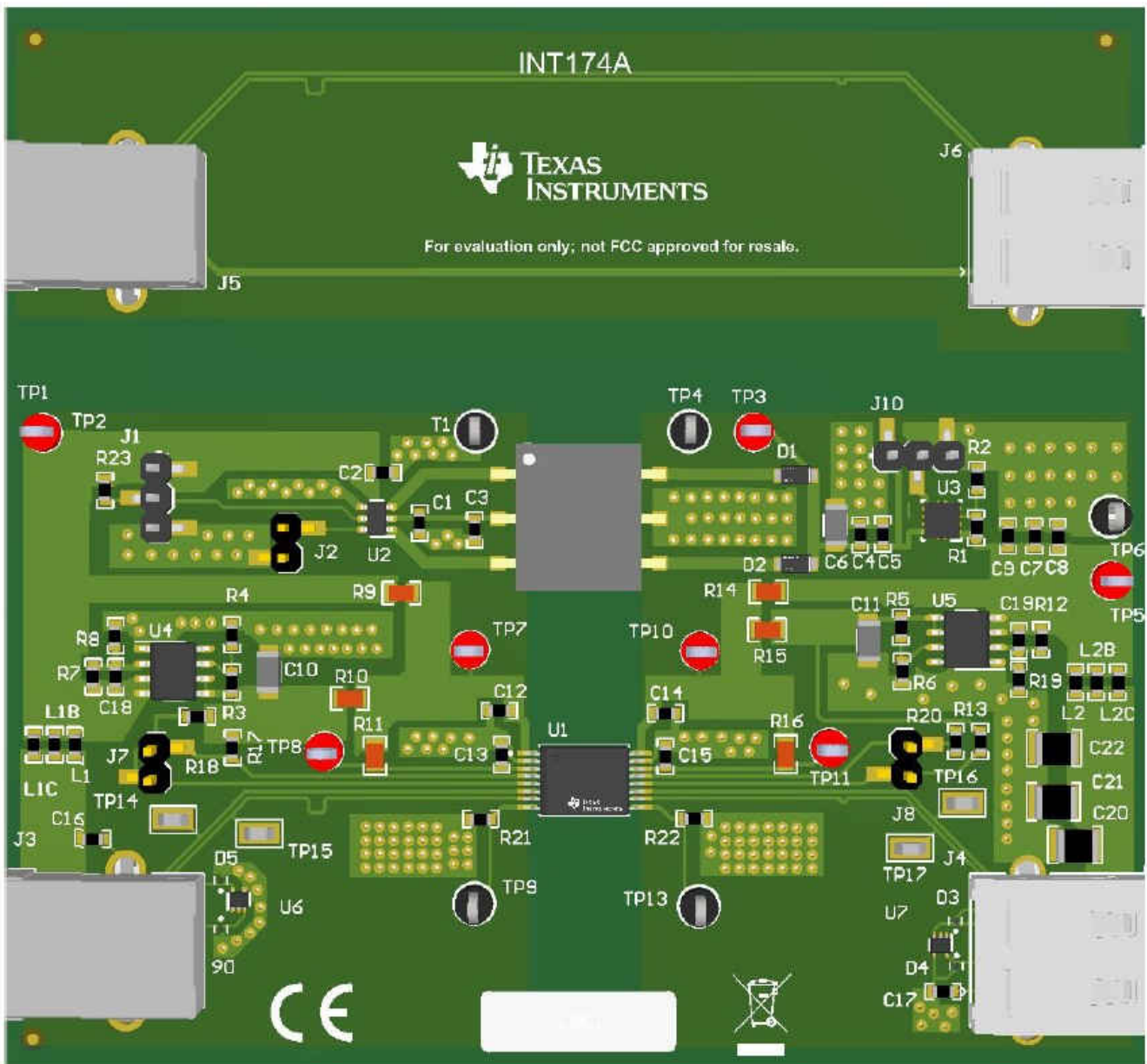**Figure 6-2. ISOUSB111DWXEVM PCB Layout - Bottom Layer**

Figure 6-3. ISOUSB111DWXEVM - 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
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	ISOUSB111DWX
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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User shall operate the Evaluation Kit within TI's recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI's recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI's instructions for electrical ratings of interface circuits such as input, output and electrical loads.

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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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3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/lsds/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   *EVM Use Restrictions and Warnings:*

4.1   EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

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.

4.3   *Safety-Related Warnings and Restrictions:*

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4.3.2   EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

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7.   *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS LICENSORS AND THEIR REPRESENTATIVES HARMLESS FROM AND AGAINST ANY AND ALL CLAIMS, DAMAGES, LOSSES, EXPENSES, COSTS AND LIABILITIES (COLLECTIVELY, "CLAIMS") ARISING OUT OF OR IN CONNECTION WITH ANY HANDLING OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.

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   8.1 *General Limitations.* IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS OR THE USE OF THE EVMS , REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

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9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.

10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

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