User's Guide

ISOW1044 Isolated CAN Transceiver with Integrated DC-DC Converter Evaluation Module

ABSTRACT

This user's guide describes the ISOW1044 isolated CAN transceiver with integrated DC-DC converter evaluation module (EVM). This EVM lets designers evaluate device performance for fast development and analysis of isolated systems. The EVM supports evaluation of the isolated CAN transceiver with integrated DC-DC converter ISOW1044 family in a 20-pin WB SOIC package (DFM-20).

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 supply to LDO inputs must be maintained within 0 V to 12 V range and any voltage applied to device supply or data input pins must be maintained within 0 V to 5.5 V range as specified in datasheet section "Recommonded Operating Conditions".

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Trademarks

All trademarks are the property of their respective owners.

1 Introduction

This user's guide describes EVM operation with respect to the ISOW1044 isolated CAN transceiver with integrated DC-DC converter in 20-pin WB SOIC package (DFM-20). This user guide also includes the EVM BoM, EVM schematic, EVM PCB layout, and typical laboratory setup.

2 Overview

The ISOW1044 device is a galvanically-isolated controller area network (CAN) transceiver with a built-in isolated DC-DC converter that meets the specifications of the ISO11898-2 (2016) standard. This device offers ±58 V DC bus fault protection and ±12 V common-mode voltage range. The device supports CAN FD data rates allowing much faster transfer of payload compared to classic CAN. Both signal and power paths are 5 kV_{RMS} isolated per UL1577 and are qualified for reinforced isolation per VDE, CSA and CQC. The bus pins of these devices can endure up to 8 kV of IEC 61000-4-2 electrostatic discharge (ESD). The low-emissions, isolated DC-DC converter ensures the final system is capable of meeting CISPR 32 radiated emissions Class B limit lines with just two ferrite beads and with simple layout on a two-layer PCB. The device can operate from a single supply voltage of 4.5 V to 5.5 V by connecting V_{IO} and V_{DD} together on PCB. If lower logic levels are required, these devices support 1.71 V to 5.5 V logic supply (V_{IO}) that can be independent from the power converter supply (V_{DD}) of 4.5 V to 5.5 V. This device supports a wide operating ambient temperature range from –40°C to +125°C and are available in 20-pin DFM (SOIC-20 footprint compatible package) offering a minimum of 8-mm creepage and clearance.

The EVM enables a user to evaluate ISOW1044 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 DC adaptors and batteries, EVM includes two adjustable output LDOs (LM317M) that are connected to V_{IO} and V_{DD} pins of ISOW1044. This allows the LDO inputs to be connected to a wider range of supply voltages, and the optimum voltage for normal operation of the EVM is between 9 V to 12 V. The EVM also includes an on-board oscillator (LTC6908-1) that can be connected to the input pins (TXD and IN) of ISOW1044 through 0 Ω resistors. The oscillator helps to provide a quick test signal to verify device operation. The EVM can be configured to operate in various power supply voltages and test configurations the details of which are provided in following sections.

The EVM can be used to verify many of ISOW1044 datasheet parameters like input threshold voltages, current consumption and others. Some of the datasheet specifications require a different test setup configuration with necessary terminations than the ISOW1044DFMEVM and hence, they might not be verifiable from the EVM as-is. The example parameters include propagation delay and other timing specifications.

3 Pin Configuration of the ISOW1044 Isolated CAN Transceiver with Integrated DC-DC Converter

Figure 3-1 shows the ISOW1044 Isolated CAN Transceiver with Integrated DC-DC Converter pin configuration.

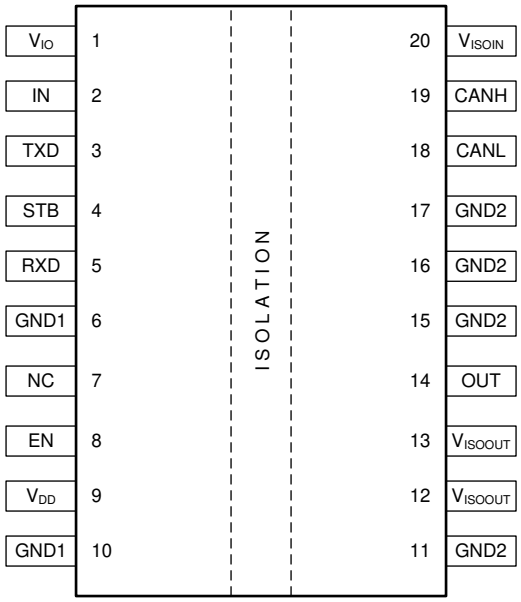

Figure 3-1. ISOW1044 Isolated CAN Transceiver with Integrated DC-DC Converter Pin Configuration

4 EVM Setup and Operation

This section describes the typical test setup and operation of the EVM for device evaluation. Figure 4-1 shows a typical test configuration for operating the ISOW1044DFMEVM using two power supplies.

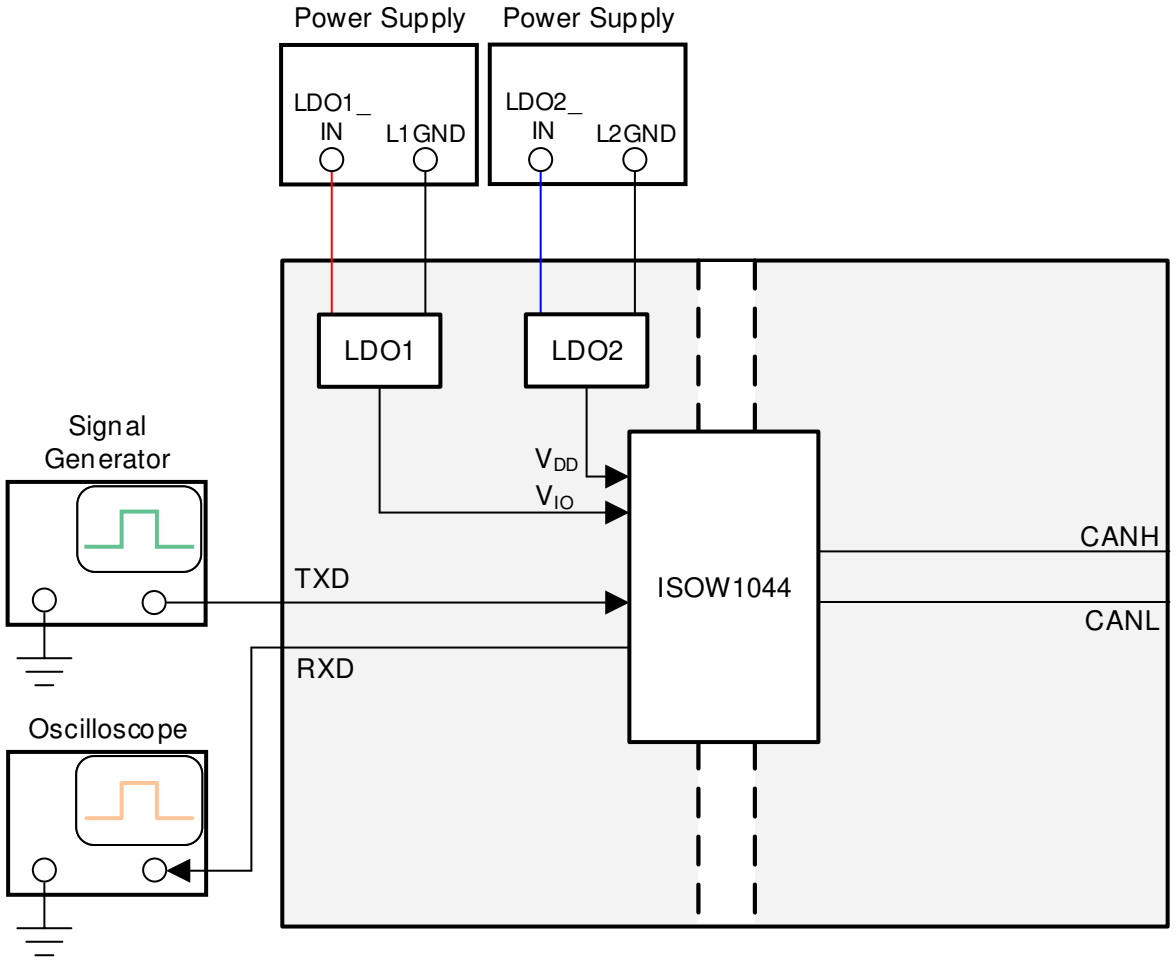

Figure 4-1. Typical EVM Test Setup

ISOW1044DFMEVM 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 acheived by populating jumpers, resistors or other components.

Table 4-1. Jumper, Reseistor and other Test Configurations

Resistor	Description
J3 [5:6]	Populating a jumper on pins 5 and 6 of connector J3 will connect STB pin to V_{IO} and pull it HIGH thereby making the device go to standby mode. Depopulating the jumper or leaving the pins 5 and 6 of J3 OPEN will keep device in active mode.
J3 [9:10]	Populating a jumper on pins 9 and 10 of connector J3 will connect EN pin to GND and pull it LOW thereby disabling the DC-DC converter and all the circuit powered by the DC-DC converter. Depopulating the jumper or leaving the pins 5 and 6 of J3 OPEN will keep the DC-DC converter enabled and operating.
R1	It connects LDOs U1, U2 inputs together allowing only one power supply to be used instead of two power supplies.
R2, R5, R6, R9	Sets LDO U2 output voltage to 5 V, 3.3 V, 2.5 V or 1.8 V, respectively. Only one of the four resistors needs to be populated.
L1, L2, L5	Either ferrtie beads (L1 & L5, default) or common-mode choke (L2, ACT45B-510-2P-TL003) can be populated to test the EVM for EMC, especially for radiated emissions. Both ferrite beads and common-mode choke should not be populated at the same time.
R10, R3, R14	Populating R10 bypasses LDO U1 allowing V_{DD} to be powered directly from external power supply. When R10 is populated, R3 and R14 need to be unpopulated to disconnect the LDO. When LDO is not bypassed, the recommended input voltage to LDO should be between 9 V and 12 V.

Table 4-1. Jumper, Reseistor and other Test Configurations (continued)

Resistor	Description
R12, R4, R15	Populating R12 bypasses LDO U2 allowing V_{IO} to be powered directly from external power supply. When R12 is populated, R4 and R15 need to be unpopulated to disconnect the LDO. When LDO is not bypassed, the recommended input voltage to LDO should be between 9 V and 12 V.
R13	This resistor connects TXD pin to IN pin allowing only one external input signal to be applied to both channels.
R21	It connects oscillator U3 output signal to U4 TXD input allowing EVM to be tested using a test signal without needing any external test signal input.
R23	Default resistance value of 200 kΩ on R23 sets U3 output signal frequency to 0.5 MHz (1 Mbps) and changing this default value to 40 kΩ sets the output signal frequency to 2.5 MHz (5 Mbps).
L11, R28, R29	Provision for common-mode choke (L11, ACT45B-510-2P-TL003) has been provided to allow some EMC testing and evaluation, like radiated emissions testing. When L11 is populated, R28 and R29 should be depopulated.
R30, R31, R32, C21	R30 is a single termination resistor while R31 and R32 provide split termination along with C21 that filters unwanted high frequency noise. Either R30 alone or R31, R32 & C21 should be populated at any point of time.
C22, C23	These capacitors can be populated for additional noise filtering.
D1	D1 (PESD2CAN, 215) can be populated to provide additional EMC protection to CAN bus of device ISOW1044
R33	This resistor can be populated to facilate additional external load to V_{ISOOUT} other than the loading by CAN bus.

5 EVM Schematic

Figure 5-1 shows the ISOW1044DFMEVM schematic.

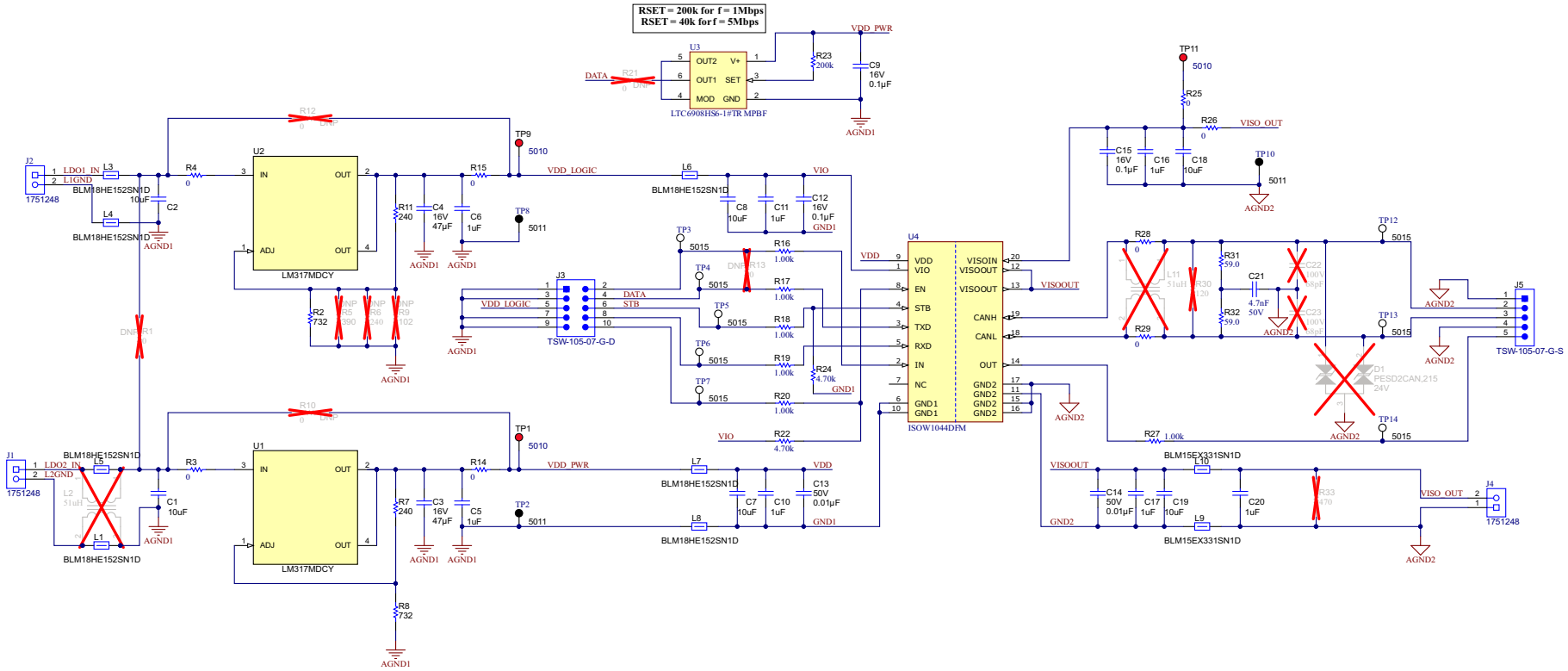

Figure 5-1. ISOW1044DFMEVM Schematic

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 will look.

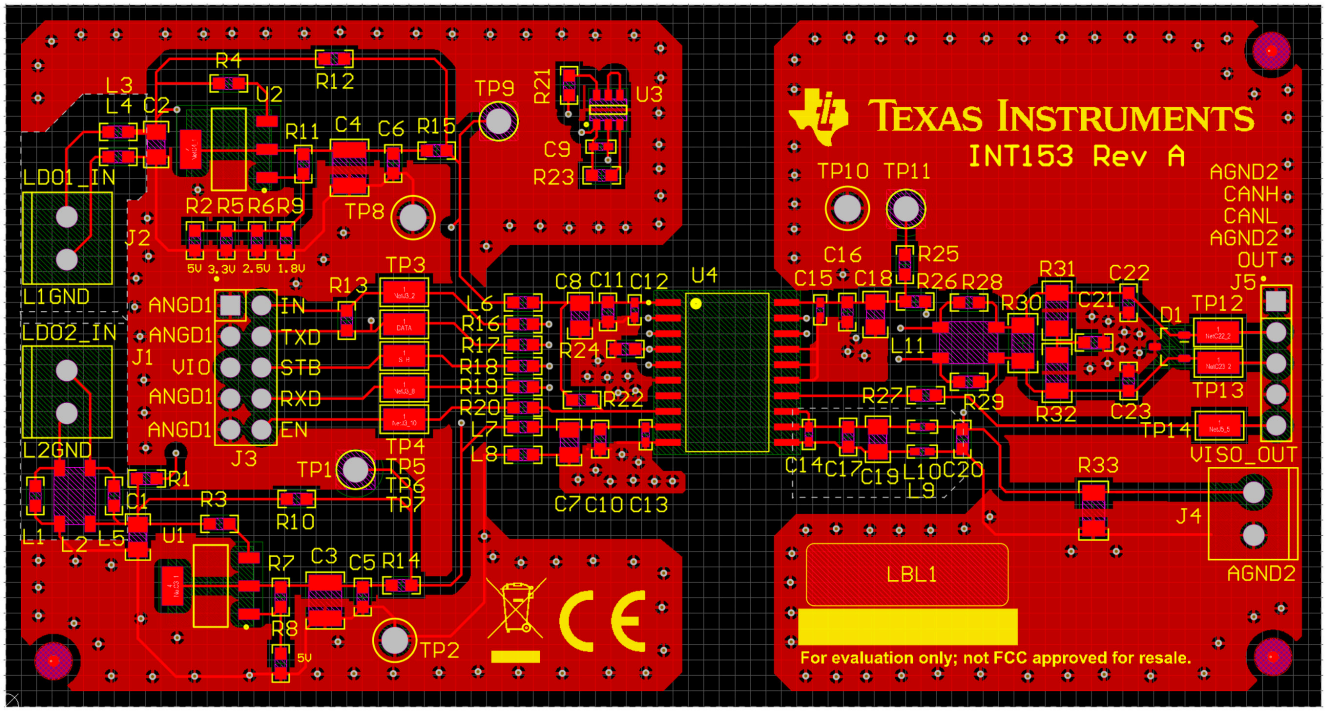

Figure 6-1. ISOW1044DFMEVM PCB Layout - Top Layer

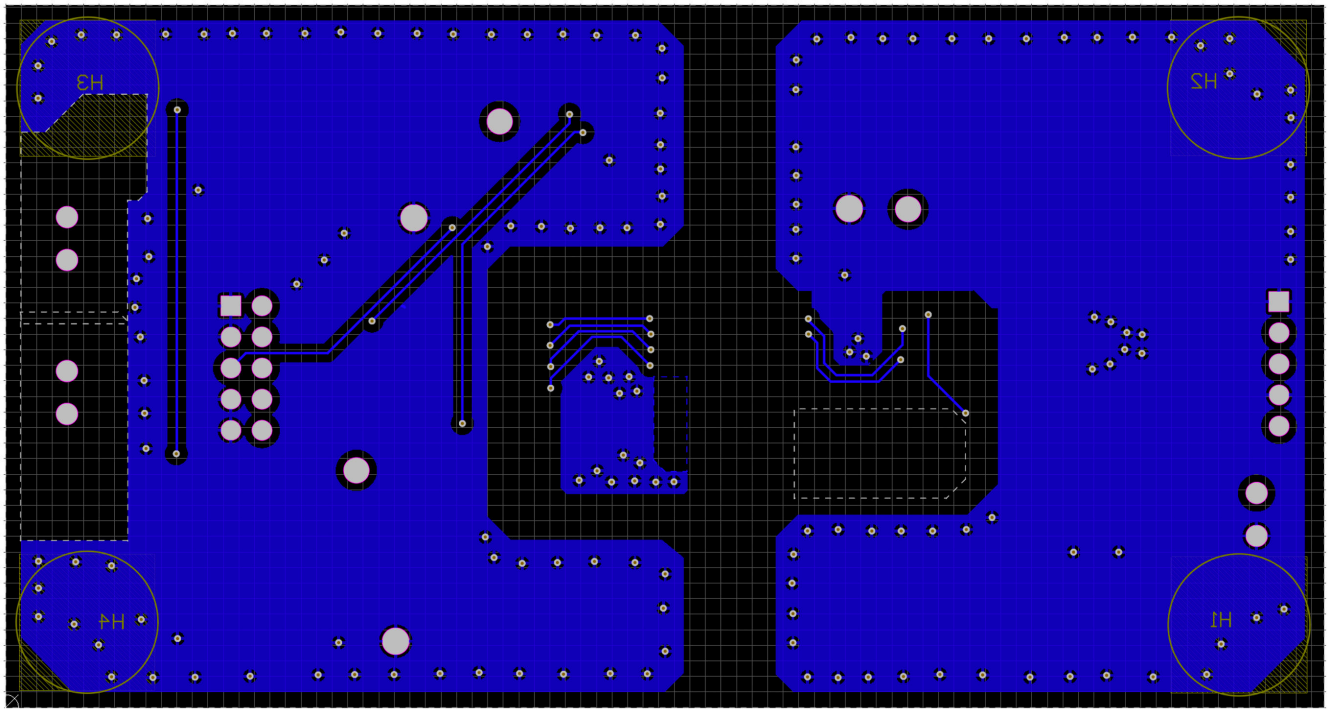

Figure 6-2. ISOW1044DFMEVM PCB Layout - Bottom Layer

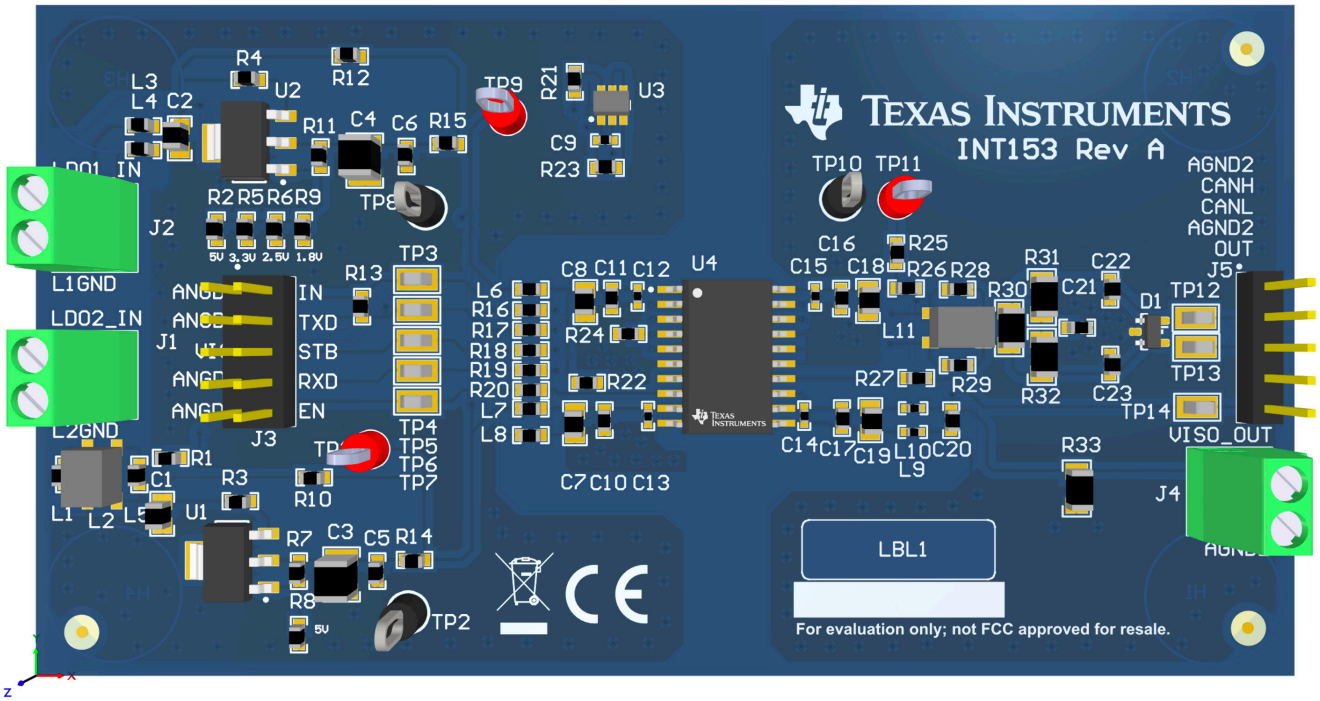

Figure 6-3. ISOW1044DFMEVM PCB 3D Diagram

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	Quantity
1	C1, C2, C7, C8, C18, C19	CAP, CERM, 10 uF, 35 V, +/- 10%, X5R, 0805	MuRata	GRM21BR6YA106KE43L	6
2	C3, C4	CAP, CERM, 47 µF, 16 V,+/- 10%, X5R, 1210	Samsung Electro-Mechanics	CL32A476KOJNNNE	2
3	C5, C6, C10, C11, C16, C17, C20	CAP, CERM, 1 uF, 50 V, +/- 10%, X5R, 0603	Samsung Electro-Mechanics	CL10A105KA8NNNC	7
4	C9, C12, C15	CAP, CERM, 0.1 µF, 16 V,+/- 10%, X7R, 0402	Walsin	CL05B104KO5NNNC	3
5	C13, C14	CAP, CERM, 0.01 µF, 50 V,+/- 10%, X7R, 0402	Walsin	0402B103K500CT	2
6	C21	CAP, CERM, 4700 pF, 50 V, +/- 10%, X7R, 0603	Kemet	C0603C472K5RACTU	1
7	H1, H2, H3, H4	Bumpon, Hemisphere, 0.44 X 0.20, Clear	3M	SJ-5303 (CLEAR)	4
8	J1, J2, J4	Conn Term Block, 2POS, 3.5mm, TH	Phoenix Contact	1751248	3
9	J3	Header, 100mil, 5x2, Gold, TH	Samtec	TSW-105-07-G-D	1
10	J5	Header, 100mil, 5x1, Gold, TH	Samtec	TSW-105-07-G-S	1
11	L1, L3, L4, L5, L6, L7, L8	Ferrite Bead, 1500 ohm @ 100 MHz, 0.5 A, 0603	MuRata	BLM18HE152SN1D	7
12	L9, L10	Ferrite Bead, 330 ohm @ 100 MHz, 1.1 A, 0402	MuRata	BLM15EX331SN1D	2
13	LBL1	Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	Brady	THT-14-423-10	1
14	R2, R8	RES, 732, 1%, 0.1 W, 0603	Yageo	RC0603FR-07732RL	2
15	R3, R4, R14, R15, R25, R26, R28, R29	RES, 0, 5%, 0.1 W, 0603	Yageo	RC0603JR-070RL	8
16	R7, R11	RES, 240, 1%, 0.1 W, 0603	Yageo	RC0603FR-07240RL	2
17	R16, R17, R18, R19, R20, R27	RES, 1.00 k, 1%, 0.1 W, 0603	Yageo	RC0603FR-071KL	6
18	R22, R24	RES, 4.70 k, 1%, 0.1 W, 0603	Yageo	RC0603FR-074K7L	2
19	R23	RES, 200 k, 1%, 0.1 W, 0603	Yageo	RC0603FR-07200KL	1
20	R31, R32	RES, 59.0, 1%, 0.25 W, AEC-Q200 Grade 0, 1206	Vishay-Dale	CRCW120659R0FKEA	2
21	TP1, TP9, TP11	Test Point, Red, Through Hole, RoHS, Bulk	Keystone	5010	3
22	TP2, TP8, TP10	Test Point, Multipurpose, Black, TH	Keystone	5011	3
23	TP3, TP4, TP5, TP6, TP7, TP12, TP13, TP14	Test Point, Miniature, SMT	Keystone	5015	8
24	U1, U2	3/4 Pin 500mA Adjustable Positive Voltage Regulator, DCY0004A (SOT-223-4)	Texas Instruments	LM317MDCY	2
25	U3	Resistor Set SOT-23 Oscillator, 2.7 to 5.5 V, 6-pin SOT23 (S6-6), -40 to 85 degC, Pb-Free	Linear Technology	LTC6908HS6-1#TRMPBF	1
26	U4	Reinforced 5-kVRMS Isolated CAN Transceiver with Integrated lowemissions DC-DC Converter	Texas Instruments	ISOW1044DFM	1
27	C22, C23	CAP, CERM, 68 pF, 100 V, +/- 5%, C0G/NP0, 0603	MuRata	GRM1885C2A680JA01D	0
28	D1	Diode, TVS, Bi, 24 V, 41 Vc, AEC-Q101, SOT-23	NXP Semiconductor	PESD2CAN,215	0
30	L11	Coupled inductor, 51 µH, 0.2 A, 1 ohm, AEC-Q200 Grade 0, SMD	TDK	ACT45B-510-2P-TL003	0
35	R30	RES, 120, 5%, 0.25 W, AEC-Q200 Grade 0, 1206	Vishay-Dale	CRCW1206120RJNEA	0

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1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an “EVM” or “EVMs”) to the User (“User”) in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.

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   1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

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   2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

   2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

   2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

WARNING

Evaluation Kits 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 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.

NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGREDATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

3 *Regulatory Notices:*

3.1 *United States*

3.1.1 *Notice applicable to EVMs not FCC-Approved:*

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

3.3 *Japan*

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。

https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

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 *European Union*

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.

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:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

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4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

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