ISO224EVM Evaluation Module

This user's guide describes the characteristics, operation, and use of the ISO224EVM. This evaluation module (EVM) is an evaluation and development kit for evaluating the ISO224 precision isolation amplifier. A complete circuit description as well as schematic diagram and bill of materials are included.

The following related documents are available through the Texas Instruments web site at www.ti.com.

Related Documentation

Device	Literature Number
ISO224	SBAS738
SN6501	SLLSEA0
TLV6001	SBOS779
OPA277	SBOS079

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1 EVM Overview

1.1 Features

This EVM supports the following features:

- Full-featured evaluation board for the ISO224 single-channel precision isolation amplifier
- Screw terminals for easy access to analog inputs and outputs
- Transformer and rectifiers to provide isolated power to VDD1 from VDD2
- Differential to Single-ended output options

1.2 Introduction

The ISO224 is a precision isolation amplifier with an output separated from the input circuitry by a silicon dioxide (SiO_2) barrier that is highly resistant to magnetic interference. This barrier has been certified to provide basic galvanic isolation of up to 7000 V_{PEAK} according to UL1577 and IEC60747-5-2 specifications.

The input of the ISO224 is optimized for accurate sensing of ±10 V signals that are widely used in industrial applications. The ISO224 operates on a single 5 V power supply on the high-side which dramatically simplifies the design of the isolated power supply which reduces overall system costs.

Throughout this document, the abbreviation *EVM* and the term *evaluation module* are synonymous with the ISO224EVM.

2 Analog Interface

The analog input to the ISO224 is routed from a two-wire screw terminal at J2 which provides access to the VINP terminal. An RC low-pass filter is provided between J2 and the VIN terminal (pin 2) of the ISO224.

2.1 Analog Inputs

The analog input to the ISO224EVM printed-circuit board (PCB) consists of screw terminal J2 and a low-pass RC filter circuit. The maximum input voltage range to the ISO224 is ±12 V. An example input circuit for the ISO224 is shown in Figure 1.

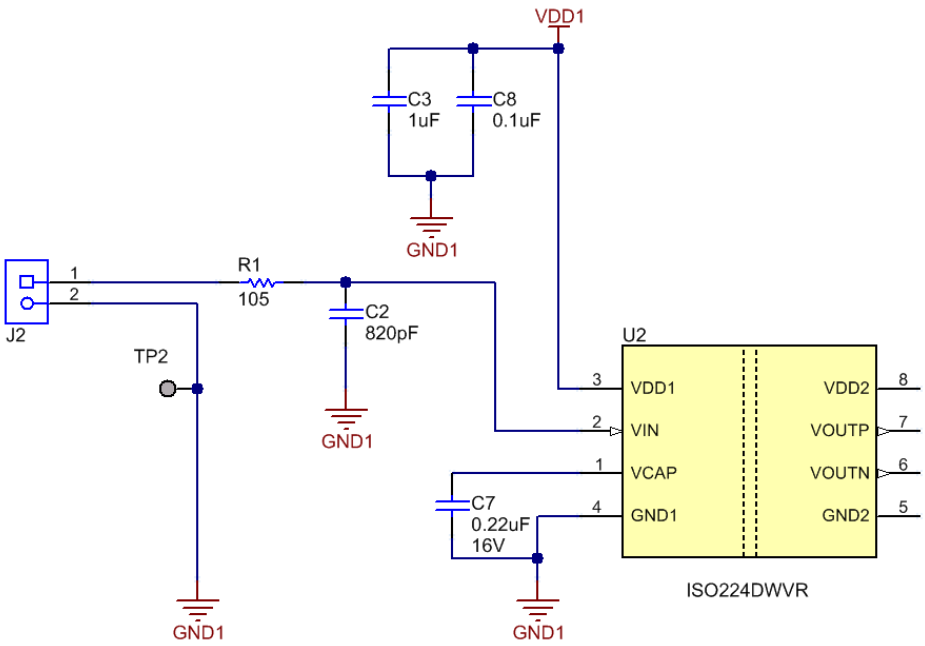


Figure 1. ISO224EVM Schematic: Analog Input Section

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2.2 Analog Output

The analog output from the ISO224EVM board is a fully-differential signal centered at VDD2/2. The output is available on test point TP3. Two differential to single ended output options are also included on the ISO224EVM. U4, an OPA277, provides a bi-polar output signal when the shunt on JP2 covers pins 1-2. U5, a TLV6001, provides a level shifted unipolar output when the shunt on JP2 covers pins 2-3. In either case, the single ended output is provided at the screw terminals of J4, as Figure 2 shows.

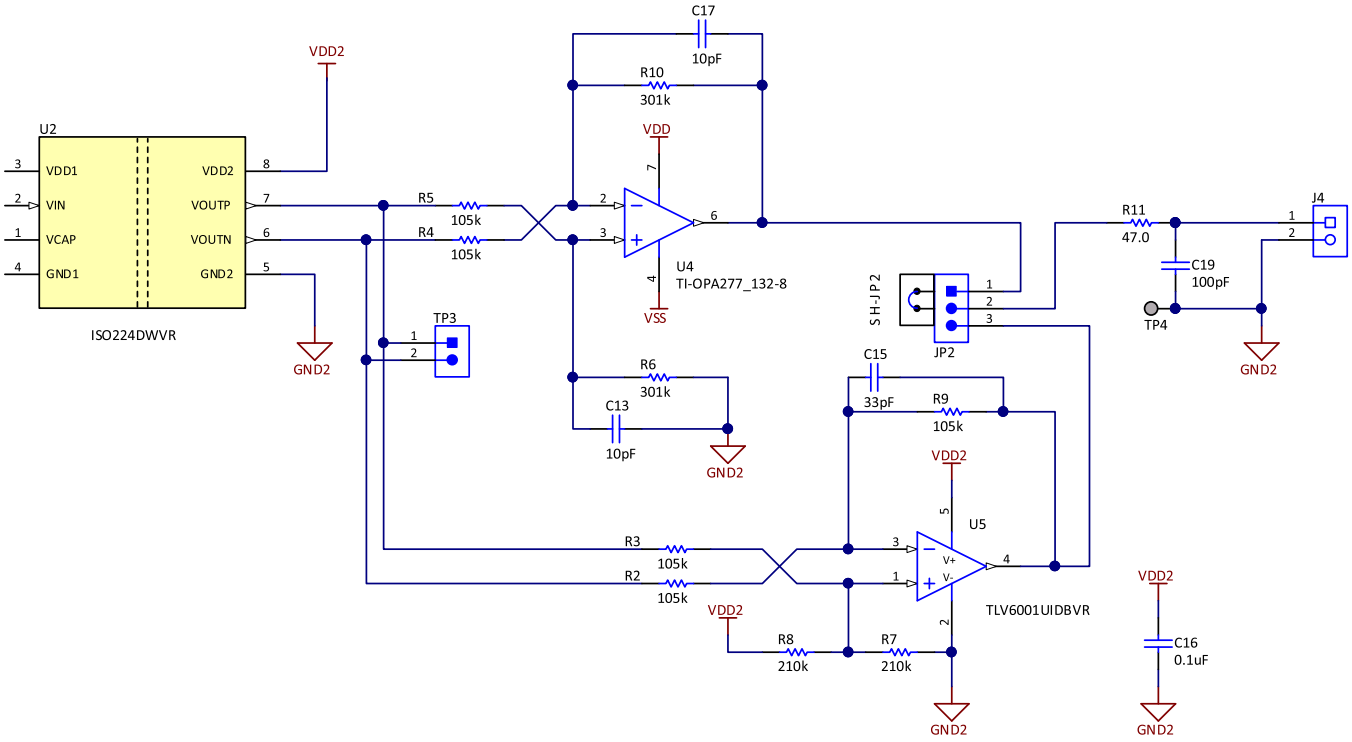


Figure 2. ISO224EVM Schematic: Analog Output Section

3 Power Supplies

The ISO224 requires two separate power rails, VDD1 and VDD2. VDD1 is on the high voltage side of the amplifier. VDD2 is on the user side of the amplifier.

3.1 VDD1 Input

J1 provides access to the to the VDD1 supply. For power provided from high-side isolated rails (such as from a gate-drive supply), move the shunt on jumper JP1 to cover pins 2 and 3. Use a voltage between 4.5 VDC and 18 VDC for the user-applied VDD1 supply. In the EVM default configuration, VDD1 is provided from VDD2 by means of U1, a 5 V LDO an isolation transformer and U3, an SN6501 transformer driver. In the default configuration, apply 5 V to VDD2 through J3. The input power is shown in Figure 3.

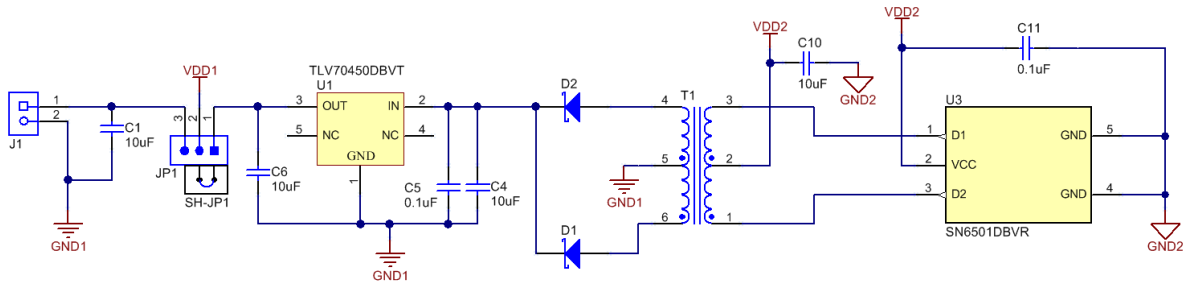


Figure 3. VDD1 Input

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3.2 VDD2 Input

The user side of the ISO224 isolation amplifier is rated for 4.5 V_{DC} to 5.5 V_{DC} and is applied to the amplifier using J3. Figure 4 illustrates the power input for VDD2. Power for U4 is provided via three-terminal screw connector J5. The typical voltage input for J5 would be ± 15 V_{DC}.

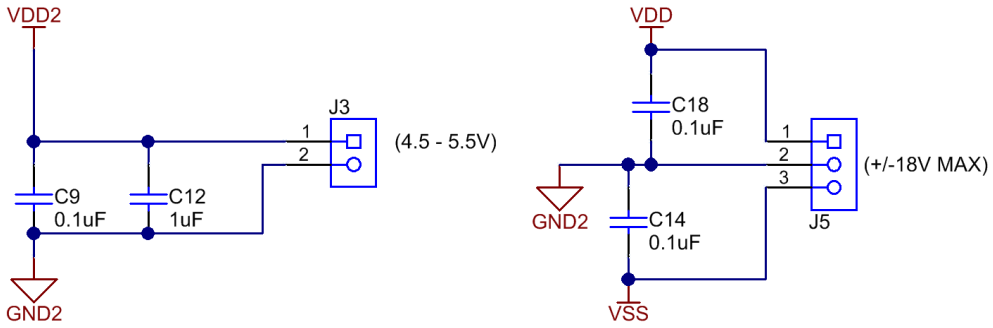


Figure 4. VDD2 and U4 Input Power Connector

4 EVM Operation

This section describes the general operation of the ISO224EVM.

4.1 Isolated Power and Analog Inputs: J1 and J2

The analog input to the ISO224EVM board can be applied directly to J2 pins 1 and 2.

CAUTION

For the limitations of the analog input range, and to ensure that the appropriate analog and digital voltages are applied before connecting any analog input to the EVM, see *ISO224x ±12-V Single-Ended Input Isolation Amplifier*.

Table 1 summarizes the details of J2.

Table 1. J2: Analog Input

Pin Number	Signal	Description
J2.1	VIN	Bipolar input to the ISO224 (pin 2)
J2.2	GND1	Ground reference for the analog input

The isolated power input to the ISO224 EVM PCB can be applied directly to J1, pins 1 and 2. Table 2 lists the details of J1.

Table 2. J1: Isolated Power

Pin Number	Signal	Description
J1.1	VDD1	Connection to the ISO224 VDD1 terminal (pin 3)
J1.2	GND1	Connection to the ISO224 GND1 terminal (pin 4)

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4.2 User Power and Analog Output: J3 and J4

The VDD2 power input to the ISO224EVM PCB can be applied directly to J3, pins 1 and 2. Table 3 lists the details of J3.

Table 3. J3: VDD2 Power

Pin Number	Signal	Description
J3.1	VDD2	Connection to the ISO224 VDD2 terminal (pin 8)
J3.2	GND2	Connection to the ISO224 GND2 terminal (pin 5)

The analog output from the ISO224EVM board is applied directly to J4, pins 1 and 2. Table 4 summarizes the details of J4.

Table 4. J4: Analog Output

Pin Number	Signal	Description
J4.1	VOUT	Analog output from U4 or U5 via JP2
J4.2	GND2	Ground reference for the analog output

Power for U4 may is applied through J5, pins 1, 2 and 3. Table 5 summarizes the details of J5.

Table 5. J5: U4 Power Input

Pin Number	Signal	Description
J5.1	VDD	Positive Supply Rail for U5
J5.2	GND2	Ground reference for the analog output
J5.3	VSS	Negative Supply Rail for U5

4.3 Device Operation

After the VDD1 and VDD2 power is applied to the ISO224EVM, the analog output is available with a fixed gain of 1/3 V/V and a dc offset equal to VDD2/2.

An analog input signal may be applied directly at screw terminal J2. Refer to Figure 1 and Table 1 for details. The single-ended analog input range, (VIN) is specified at ±12 V maximum.

The analog output has a nominal gain of 1/3 through the ISO224 isolation amplifier. With an input voltage of ±12 V, the nominal output is therefore ±4.0 V differential. The output voltage is centered on VDD2/2 and presented on TP3. To facilitate single-ended outputs, U4 and U5 are also included with the ISO224EVM. U4 provides a gain of 3 V/V to recover the original magnitude of the analog input signal. U5 provides level shifting and unity gain. The outputs of U4 or U5 are provided on J4 depending on the location of the shunt on JP2.

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5 Layout, BOM, and Schematic

This sections contains the PCB layout, bill of materials, and schematic of the ISO224EVM.

5.1 Layout

Figure 5 shows the ISO224 PCB layout.

NOTE: Board layout is not to scale. Figure 5 shows how the board is laid out. It is not intended to be used for manufacturing ISO224EVM PCBs.

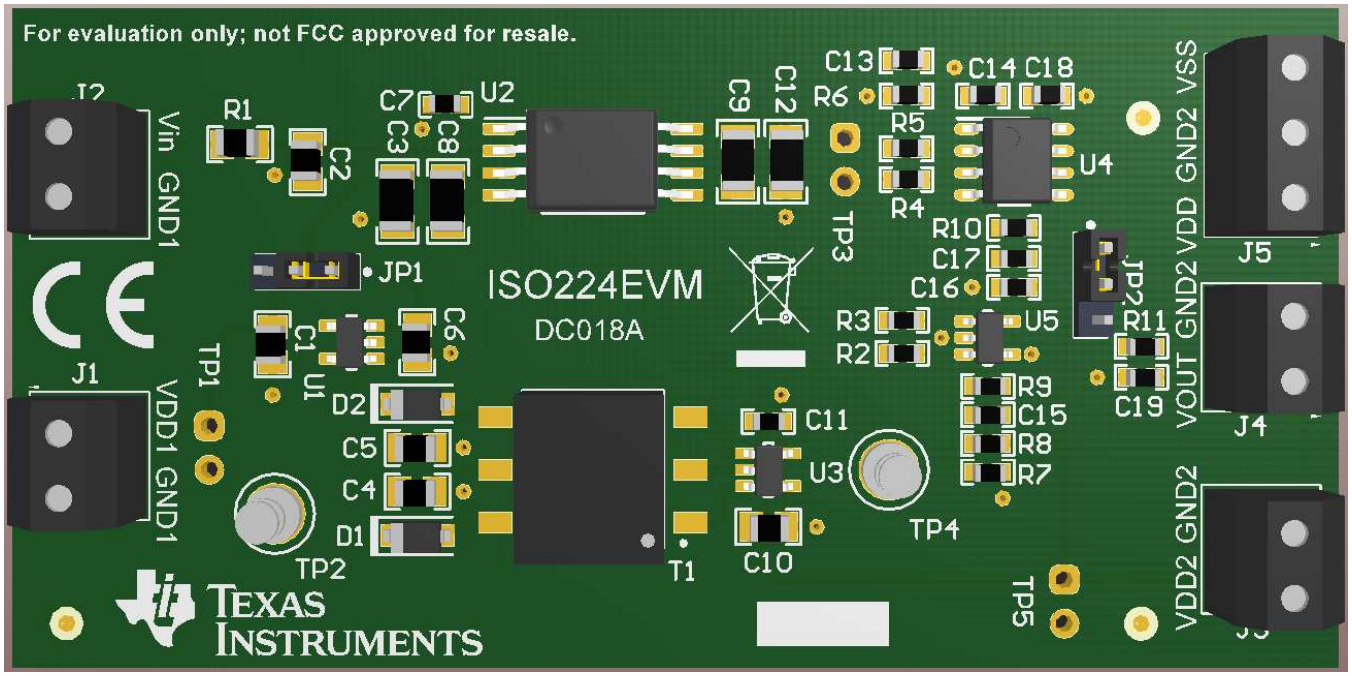


Figure 5. ISO224EVM Silkscreen Drawing

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5.2 Bill of Material

The bills of material is listed in Table 6.

NOTE: All components should be RoHS compliant. Some part numbers may be either leaded or RoHS. Verify that purchased components are RoHS compliant.

Table 6. ISO224EVM Bill of Materials

Item	Qty	Ref Des	Description	Manufacturer	Part Number
1	4	C1, C4, C6, C10	CAP, CERM, 10 uF, 16 V, +/- 10%, X5R, 0805	TDK	C2012X5R1H475K125AB
2	1	C2	CAP, CERM, 820 pF, 50 V, +/- 5%, C0G/NP0, 0805	AVX	08055A821JAT2A
3	2	C3, C12	CAP, CERM, 1 uF, 25 V, +/- 10%, X7R, 1206	AVX	12063C105KAT2A
4	1	C5	CAP, CERM, 0.1 uF, 25 V, +/- 10%, X7R, 0805	Kemet	C0805C104K3RACTU
5	1	C7	CAP, CERM, 0.22 uF, 16 V, +/- 10%, X7R, 0603	Wurth Elektronik	885012206048
6	2	C8, C9	CAP, CERM, 0.1 uF, 100 V, +/- 5%, X7R, 1206	AVX	12061C104JAT2A
7	4	C11, C14, C16, C18	CAP, CERM, 0.1 uF, 25 V, +/- 5%, X7R, 0603	AVX	06033C104JAT2A
8	2	C13, C17	CAP, CERM, 10 pF, 50 V, +/- 5%, C0G/NP0, 0603	Kemet	C0603C100J5GACTU
9	1	C15	CAP, CERM, 33 pF, 50 V, +/- 5%, C0G/NP0, 0603	Kemet	C0603C330J5GACTU
10	1	C19	CAP, CERM, 100 pF, 10 V, +/- 10%, X7R, 0603	AVX	0603ZC101KAT2A
11	2	D1, D2	Diode, Schottky, 20 V, 0.5 A, SOD-123	ON Semiconductor	MBR0520LT1G
12	4	J1, J2, J3, J4	Terminal Block, 3.5mm Pitch, 2x1, TH	On-Shore Technology	ED555/2DS
13	1	J5	Terminal Block, 3.5mm Pitch, 3x1, TH	On-Shore Technology	ED555/3DS
14	2	JP1, JP2	Header, 2mm, 3x1, Tin, TH	Samtec	TMM-103-01-T-S
15	1	R1	RES, 105, 1%, 0.125 W, AEC-Q200 Grade 0, 0805	Vishay-Dale	CRCW0805105RFKEA
16	5	R2, R3, R4, R5, R9	RES, 105 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	Vishay-Dale	CRCW0603105KFKEA
17	2	R6, R10	RES, 301 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	Vishay-Dale	CRCW0603301KFKEA
18	2	R7, R8	RES, 210 k, 1%, 0.1 W, 0603	Yageo America	RC0603FR-07210KL
19	1	R11	RES, 47.0, 1%, 0.1 W, 0603	Yageo America	RC0603FR-0747RL
20	2	SH-JP1, SH-JP2	Shunt, 2mm, Gold plated, Black	Samtec	2SN-BK-G
21	1	T1	Transformer, 340uH, SMT	Wurth Elektronik	750313769
22	2	TP2, TP4	Terminal, Turret, TH, Double	Keystone	1502-2
23	1	U1	Single Output LDO, 150 mA, Fixed 5 V Output	Texas Instruments	TLV70450DBVT
24	1	U2	Isolated Amplifier with ±12 V Input and Differential Output	Texas Instruments	ISO224DWVR
25	1	U3	Low-Noise 350 mA, 410 kHz Transformer Driver	Texas Instruments	SN6501DBVR
26	1	U4	High Precision Operational Amplifier, 4 to 36 V	Texas Instruments	OPA277UA
27	1	U5	1-MHz, Low-Power Operational Amplifier	Texas Instruments	TLV6001UIDBVR

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5.3 Schematic

Figure 6 illustrates the ISO224EVM schematic.

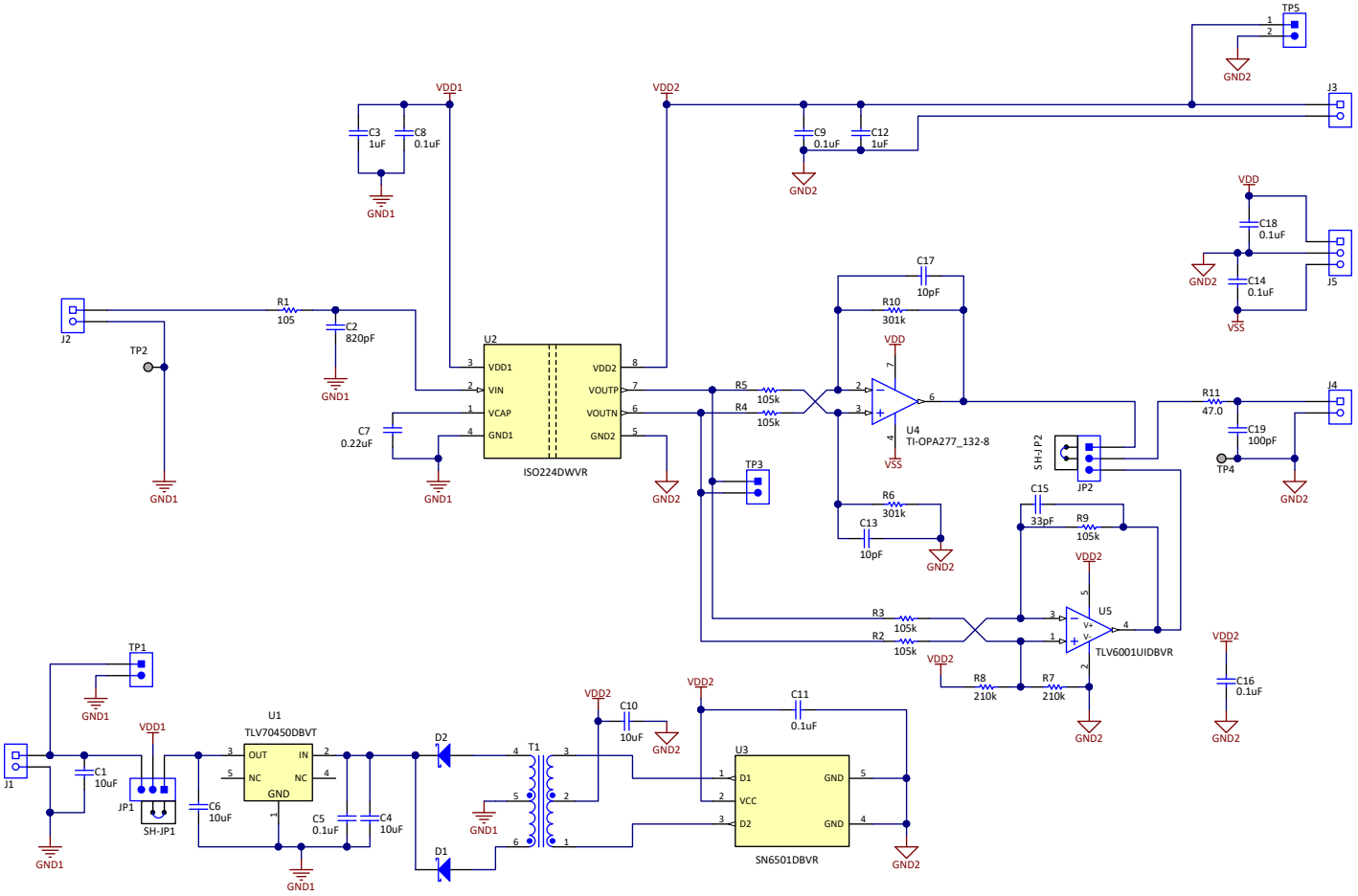


Figure 6. ISO224EVM Schematic

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      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.

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      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.

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      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.

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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.*

3.2 *Canada*

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

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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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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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4.1 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.

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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.

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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