User's Guide

ISO154xEVM Low-Power Bidirectional I²C Isolators Evaluation Module

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1 Introduction

This User's Guide details the ISO154x Evaluation Module (EVM) operation of the factory-installed ISO1540 and ISO1541 I^2C-compatible bidirectional isolators. The EVM may be reconfigured for use with two ISO1540 or two ISO1541 instead of one of each.

This Guide presents a typical laboratory setup used with this EVM.

CAUTION

This Evaluation Module (EVM) 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.

Exceeding the specified input voltage range may cause unexpected operation and irreversible damage to the EVM. If there are questions concerning the input voltage range, contact a TI field representative prior to connecting power.

Applying loads outside the specified output range may result in unintended operation and possible permanent damage to the EVM. If there is uncertainty as to the load specification, contact a TI field representative.

1.1 Overview

The ISO154x devices are low-power, bidirectional isolators that are compatible with I^2C interfaces. The logic input and output buffers on these devices are separated by TI's Isolation technology utilizing a silicon dioxide (SiO_2) barrier. When used in conjunction with isolated power supplies, these devices block high voltages, isolate grounds and prevent noise currents from entering the local ground and interfering with or damaging sensitive circuitry.

The ISO1540 has two isolated bidirectional channels for clock and data lines and is fit for multi-master applications. The ISO1541 has a bidirectional data and a unidirectional clock channel and is useful in applications that have a single master.

These devices achieve isolated bidirectional communication by introducing an offset, making the side 1 low-level output greater than the side 1 low-level input and thus preventing an internal logic latch that otherwise would occur with standard digital isolators.

1.2 ISO154xEVM Kit Contents

1. ISO154xEVM Circuit Board (PWB P/N 6547206)
2. ISO154xEVM User's Guide (SLLU166 - this document)
3. ISO154x Datasheet (SLLSEB6)

1.3 Functional Configuration

The pinouts of ISO1540 and ISO1541 are displayed in Figure 1-1. These devices have an input noise-filter that prevents transient pulses of up to 5 ns from being passed to the output of the device.

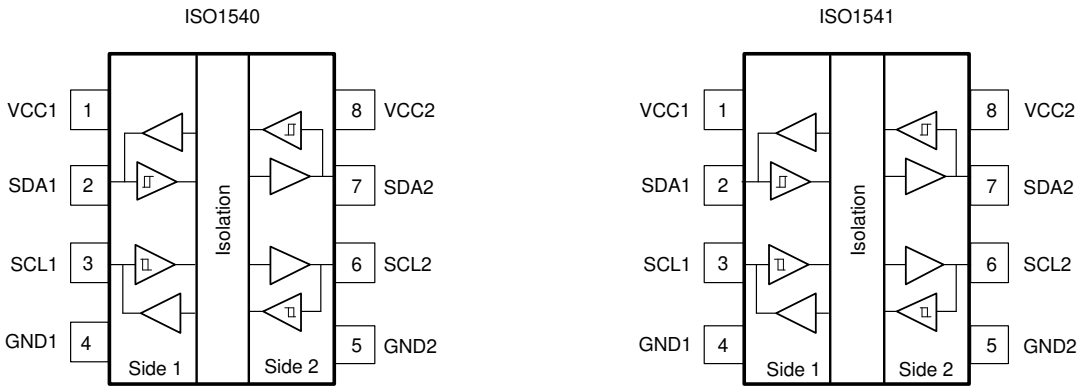


Figure 1-1. ISO1540 and ISO1541 Pinout

The EVM is shown in Figure 1-2, it comes with an ISO1540 and an ISO1541 installed in place of U1 and U2 respectively. However, this EVM can be configured for use with two ISO1540s or two ISO1541s.

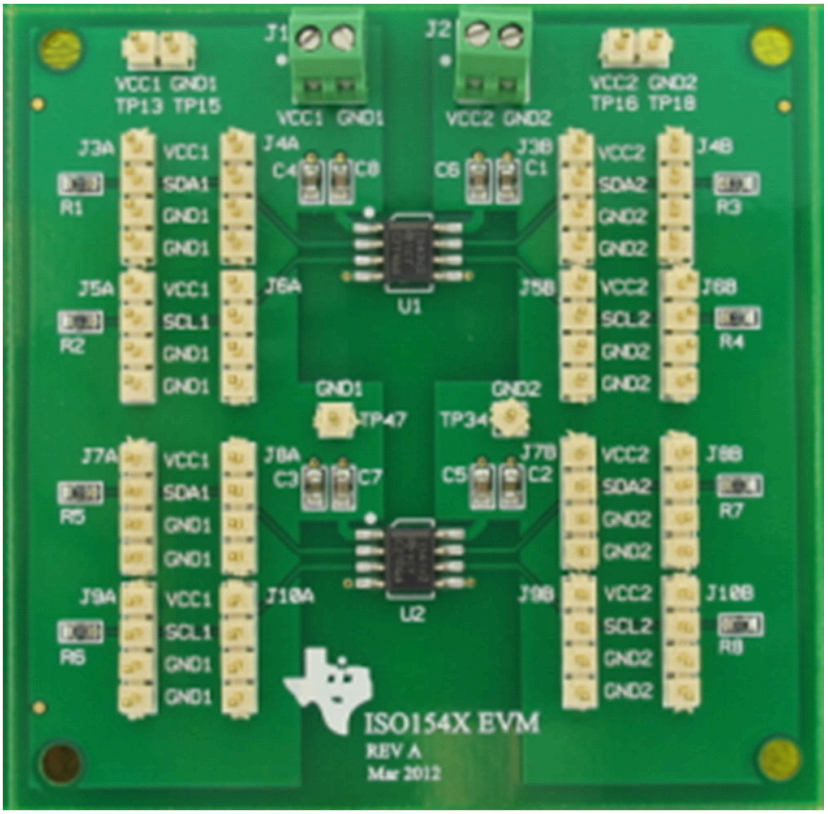


Figure 1-2. ISO154xEVM Top Photograph

An input or output pin can be tied either to supply voltage (VCCx) or Ground (GNDx) using the 4-pin jumpers on the EVM (J3A to J10A on side 1 and J3B to J10B on side 2). These jumpers also provide scope-probe access to each pin.

Each signal line (SDAx, SCLx) is configured with a 1-kΩ pull-up resistor (R1 to R8) to the corresponding power supply (VCCx). Reconfigure the value of this pull-up resistor as per the application requirement.

1.4 EVM Schematic

A schematic diagram for this EVM is presented in Figure 1-3.

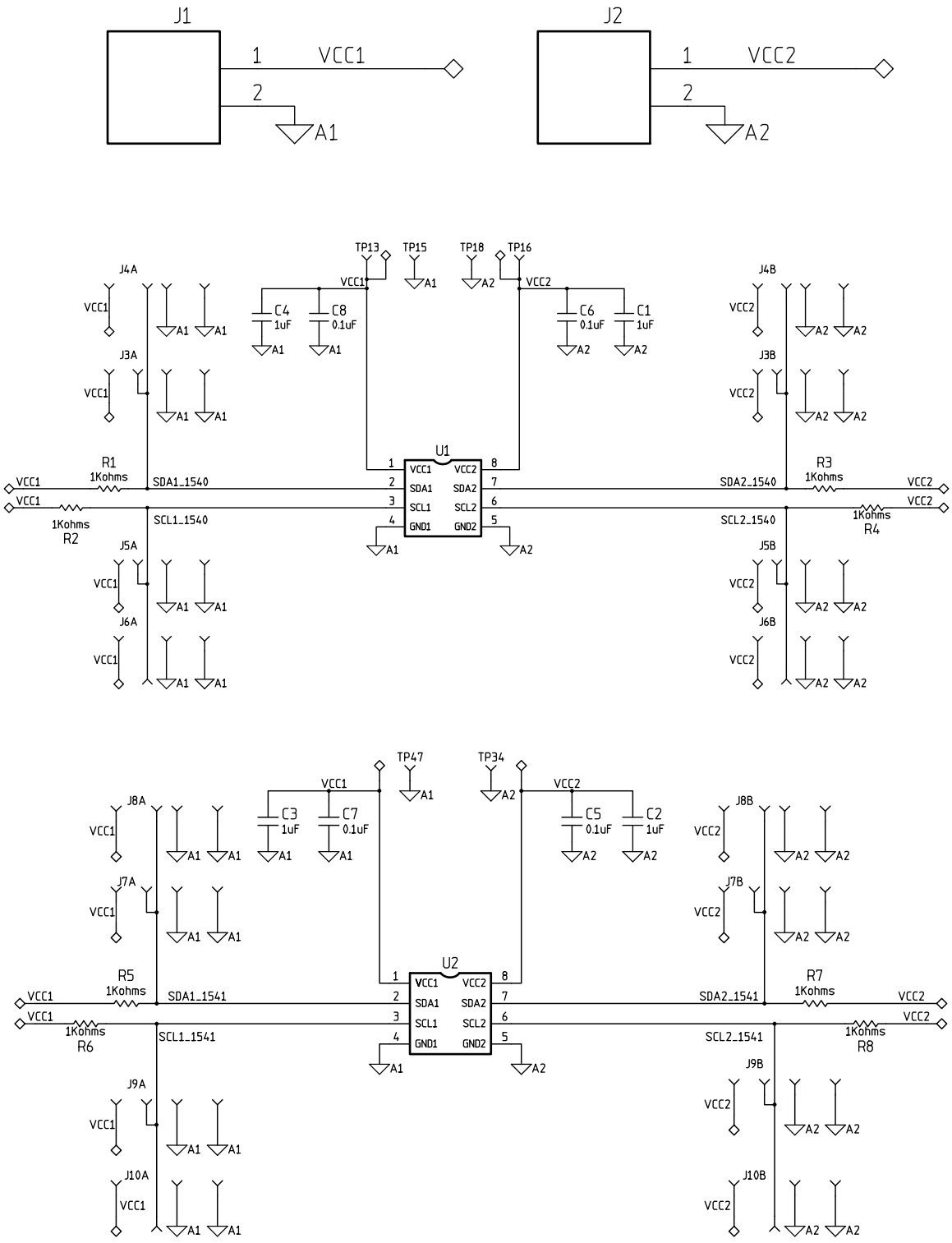


Figure 1-3. ISO154xEVM Schematic

Table 1-1. ISO154xEVM Description

Label	Description
U1	ISO154x, by default populated as ISO1540
U2	ISO154x, by default populated as ISO1541
J1	Side 1 power supply terminal block (VCC1)
J2	Side 2 power supply terminal block (VCC2)

Table 1-1. ISO154xEVM Description (continued)

Label	Description
TP15, TP47	Side 1 GND test point (GND1)
TP18, TP34	Side 2 GND test point (GND2)
TP13	VCC1 test point
TP16	VCC2 test point
J3A, J4A	4-pin jumper to VCC1, SDA1, GND1 for U1
J5A, J6A	4-pin jumper to VCC1, SCL1, GND1 for U1
J3B, J4B	4-pin jumper to VCC2, SDA2, GND2 for U1
J5B, J6B	4-pin jumper to VCC2, SCL2, GND2 for U1
J7A, J8A	4-pin jumper to VCC1, SDA1, GND1 for U2
J9A, J10A	4-pin jumper to VCC1, SCL1, GND1 for U2
J7B, J8B	4-pin jumper to VCC2, SDA2, GND2 for U2
J9B, J10B	4-pin jumper to VCC2, SCL2, GND2 for U2
C1, C2, C3, C4	1.0 µF filter capacitor
C5, C6, C7, C8	0.1 µF filter capacitor
R1, R2, R5, R6	1-kΩ 0603 footprint pull-up resistor to VCC1
R3, R4, R7, R8	1-kΩ 0603 footprint pull-up resistor to VCC2

2 EVM Setup and Operation

This section includes the setup and operation of the EVM for parameter performance evaluation. Typical input and output waveforms are included.

2.1 Overview

The basic setup in Figure 2-1 has the two power supplies required to evaluate isolator performance with any combination of 3.3 V or 5 V on either side. If both sides are evaluated at the same supply voltage, only one power supply is required and can be used to power both sides of the EVM.

CAUTION

Note that this EVM is for operating parameter performance evaluation only and not designed for isolation voltage testing. Any voltage applied above the 5.5-V maximum recommended operating voltage of the isolators may damage the EVM.

Please note that if the ISO1541 is used, providing an input signal on the SCL2 pin does not yield any output on SCL1, SCL1 remains pulled up to VCC1.

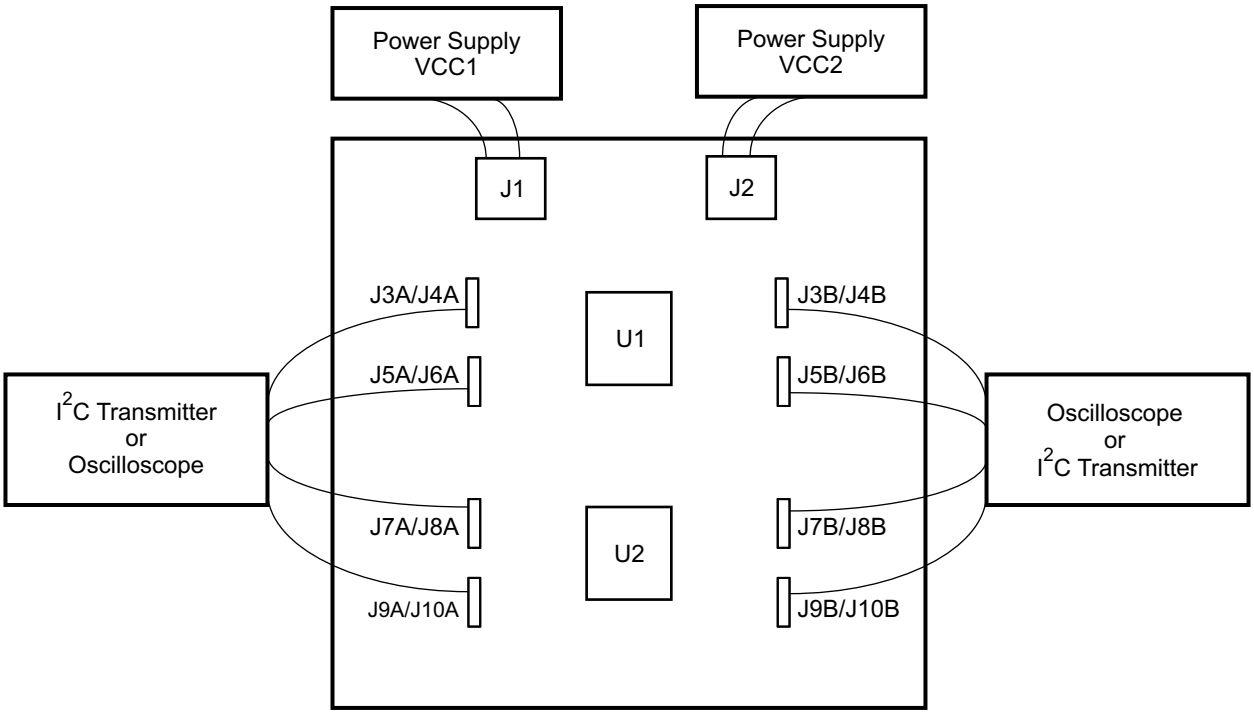
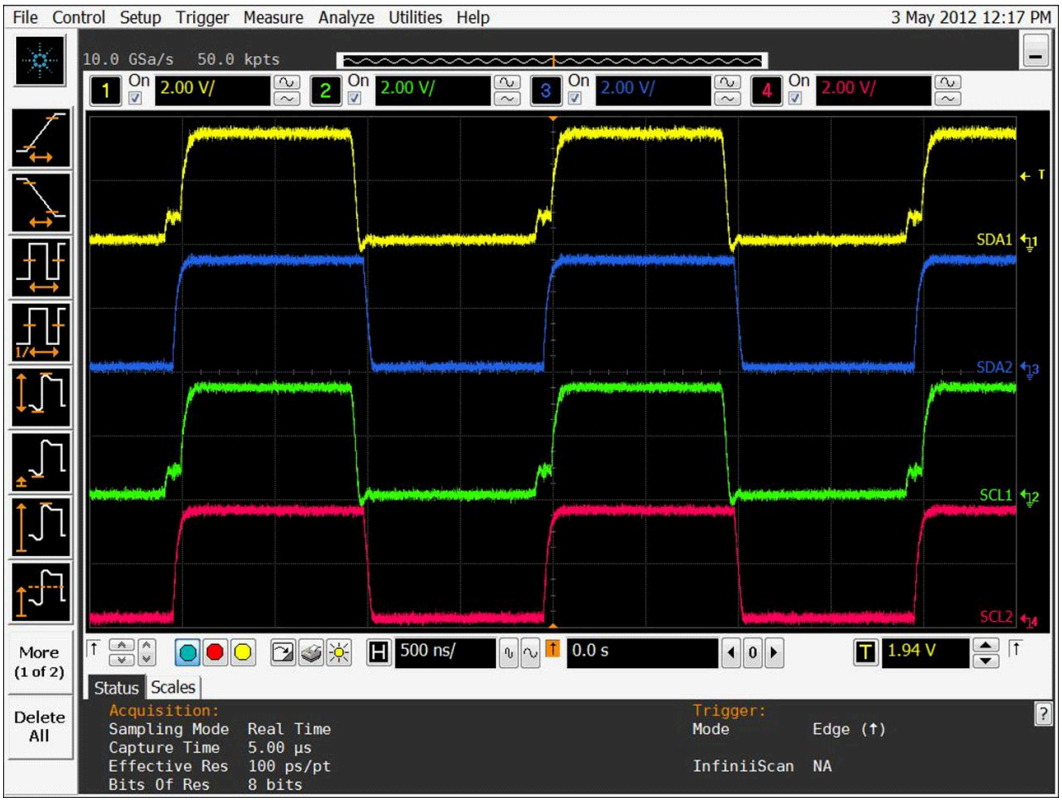


Figure 2-1. Basic EVM Operation

2.2 Input/Output Signal Characteristics

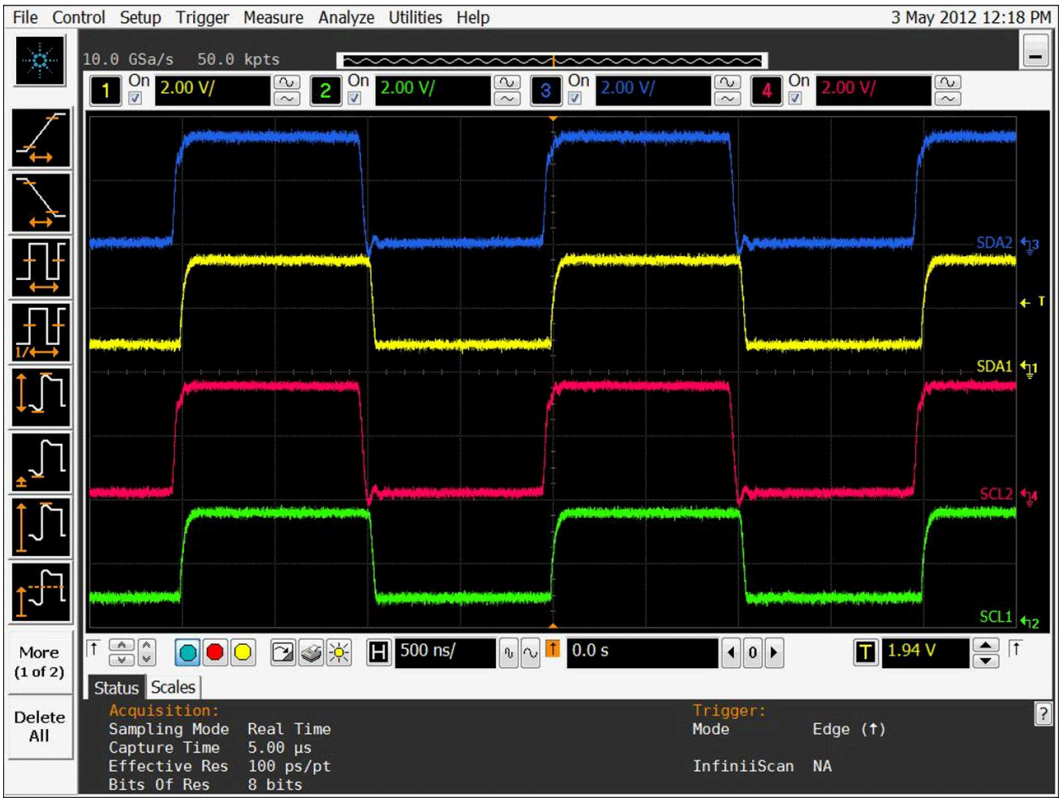
Figure 2-2 illustrates SDA1 and SCL1 of U1 being treated as inputs and driven by an I^2C transmitter connected to J3A/J4A (for SDA1) and J5A/J6A (for SCL1). The output waveforms at SDA2 and SCL2 are captured on the oscilloscope at J3B/J4B and J5B/J6B respectively. Note the step in the rising edge of the input waveforms at SDA1 and SCL1 indicative of the tLOOP parameter of the device and demonstrating the effect of the difference in the low levels for the side 1 output and input enabling the device to avoid a latch-up state.



Note the t_{LOOP} effect on the rising edge of the input waveforms on SDA1 and SCL1.

Figure 2-2. Typical Waveforms, Inputs on Side 1

Figure 2-3 illustrates SDA2 and SCL2 of U1 being treated as inputs and driven by an I^2C transmitter connected to J3B/J4B (for SDA2) and J5B/J6B (for SCL2). The output waveforms for SDA1 and SCL1 are captured on the oscilloscope at J3A/J4A and J5A/J6A respectively. Note the low level of the SDA1 and SCL1 outputs offset from the ground level. This is due to the high output low level on side 1 designed to prevent a latch-up state.



Note the offset of the output low level voltage from ground on SDA1 and SCL1.

Figure 2-3. Typical Waveforms, Inputs on Side 2

In addition to the cases shown here, the SDA and SCL signals also propagate in mutually opposing directions. However, if using ISO1541, the SCL line is unidirectional and only allows the signal to propagate from SCL1 to SCL2 and not vice-versa.

3 Bill of Materials

The parts list for the ISO154xEVM is shown in Table 3-1.

Table 3-1. ISO154x EVM Bill of Materials

Item	Qty.	References	Part	Manufacturer
1	4	C1,C2,C3,C4	CAPACITOR, SMT, 0603, CERAMIC, 1.0 µF, 25 V, 10%, X5R	TAIYO_YUDEN/ANY
2	4	C5,C6,C7,C8	CAPACITOR, SMT, 0603, CERAMIC, 1.0 µF, 25 V, 10%, X5R	TAIYO_YUDEN/ANY
3	2	J1,J2	CONNECTOR, THU, TERMINAL BLOCK, 2.54 mm LS, 2P	TYCO/ANY
4	8	R1,R2,R3,R4,R5,R6,R7,R8	RESISTOR, SMT, 0603, 1.0 kΩ, 0.1%, 1/10W	PANASONIC/ANY
5	70	TP1,TP2,TP3,TP4,TP5,TP6,TP7,TP8,TP9, TP10,TP11,TP12,TP13,TP14,TP15,TP16, TP17,TP18,TP19,TP20,TP21,TP22,TP23, TP24,TP25,TP26,TP27,TP28,TP29,TP30, TP31,TP32,TP33,TP34,TP35,TP36,TP37, TP38,TP39,TP40,TP41,TP42,TP43, TP44, TP45,TP46,TP47,TP48,TP49,TP50,TP51, TP52,TP53,TP54,TP55,TP56,TP57,TP58, TP59,TP60,TP61,TP62,TP63,TP64,TP65, TP66,TP67,TP68,TP69,TP70	HEADER, THU, 1P, MALE, SINGLE ROW	SAMTEC/ANY
6	1	U1	IC, ISO1540, SMT, SOIC8D	TI
7	1	U2	IC, ISO1541, SMT, SOIC8D	TI
8	4		Rubber feet, SJ5303, Bumpon hemisphere	2M

Notes:
1. J3A on EVM silkscreen is TP30, TP63, TP33, TP32 grouped as single row 4-pin jumper.
2. J4A on EVM silkscreen is TP23, TP5, TP17, TP25 grouped as single row 4-pin jumper.
3. J5A on EVM silkscreen is TP36, TP65, TP39, TP38 grouped as single row 4-pin jumper
4. J6A on EVM silkscreen is TP27, TP6, TP20, TP24 grouped as single row 4-pin jumper.
5. J3B on EVM silkscreen is TP35, TP66, TP34, TP37 grouped as single row 4-pin jumper.
6. J4B on EVM silkscreen is TP29, TP7, TP2, TP26 grouped as single row 4-pin jumper.
7. J5B on EVM silkscreen is TP41, TP64, TP40, TP43 grouped as single row 4-pin jumper.
8. J6B on EVM silkscreen is TP31, TP8, TP4, TP28 grouped as single row 4-pin jumper
9. J7A on EVM silkscreen is TP44, TP68, TP47, TP46 grouped as single row 4-pin jumper.
10. J8A on EVM silkscreen is TP42, TP9, TP19, TP45 grouped as single row 4-pin jumper.
11. J9A on EVM silkscreen is TP49, TP69, TP51, TP50 grouped as single row 4-pin jumper.
12. J10A on EVM silkscreen is TP48, TP10, TP22, TP53 grouped as single row 4-pin jumper.
13. J7B on EVM silkscreen is TP54, TP70, TP57, TP56 grouped as single row 4-pin jumper.
14. J8B on EVM silkscreen is TP52, TP11, TP3, TP55 grouped as single row 4-pin jumper.
15. J9B on EVM silkscreen is TP61, TP67, TP60, TP62 grouped as single row 4-pin jumper.
16. J10B on EVM silkscreen is TP58, TP12, TP1, TP59 grouped as single row 4-pin jumper.
17. SJ5303 Bumpon Hemisphere: one each to be assembled at every corner of the board on the bottom side.

4 ISO154xEVM Layout

Figure 4-1 shows the top-layer routing of the ISO154xEVM.

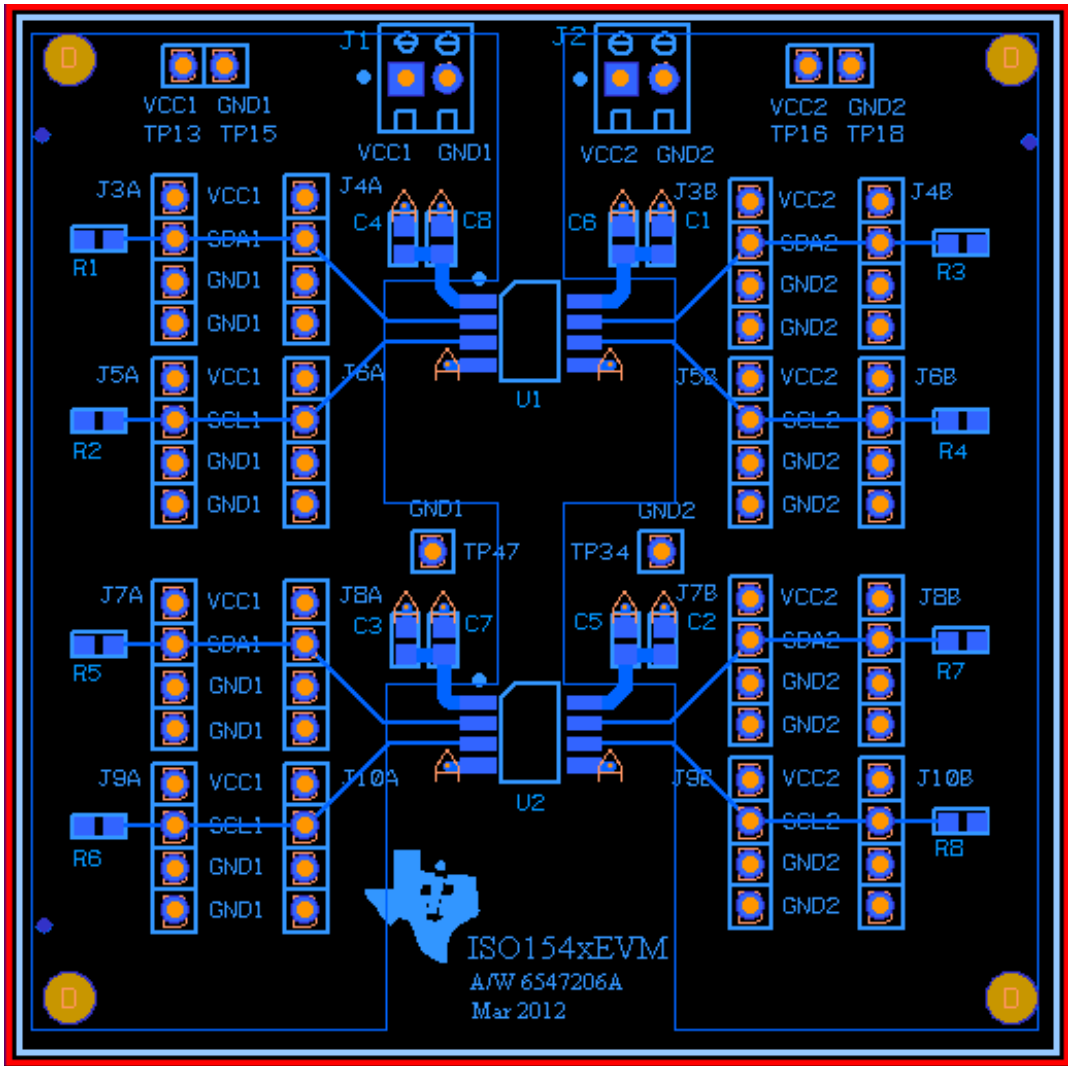


Figure 4-1. ISO154xEVM Top-layer Routing

Figure 4-2 shows the bottom-layer ground planes (shaded areas).

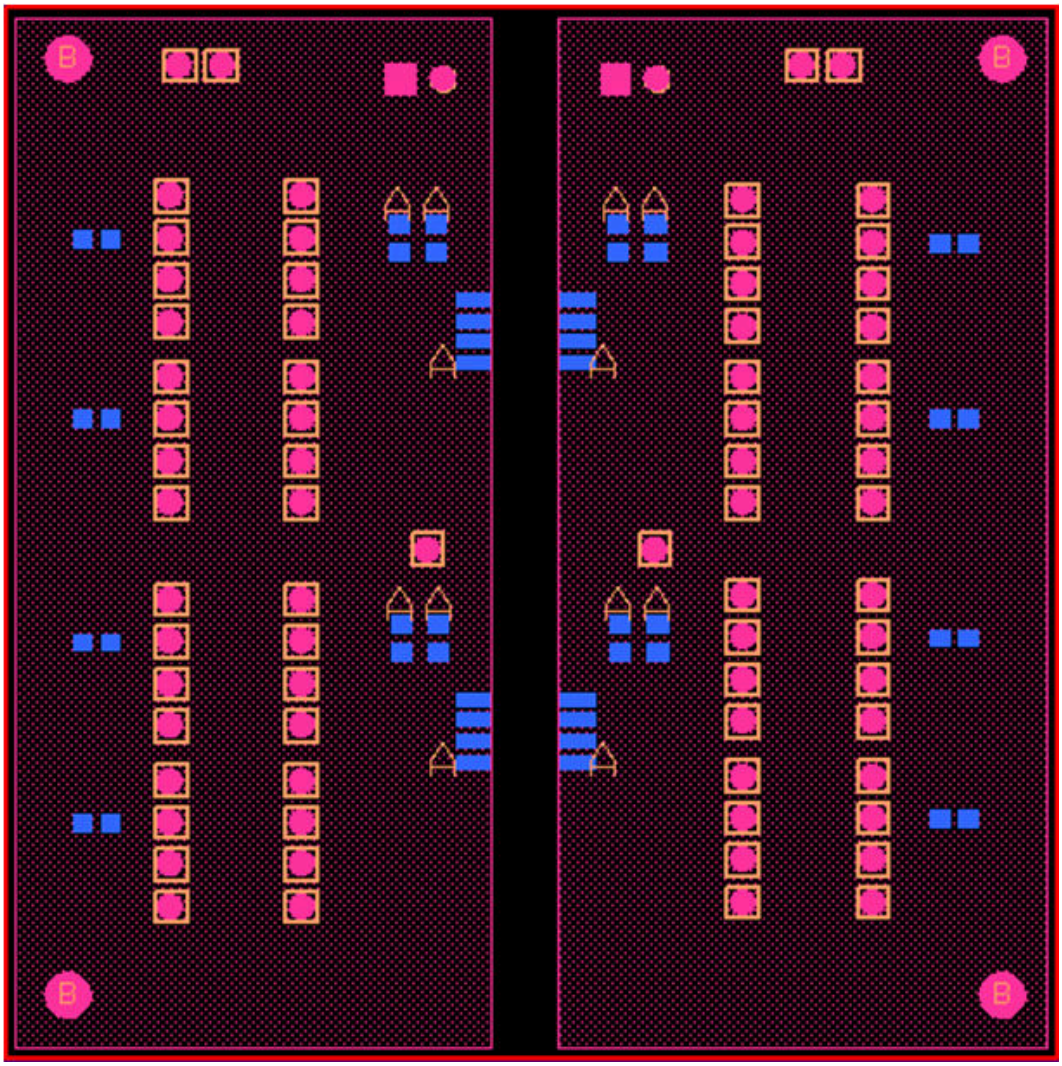


Figure 4-2. ISO154xEVM Bottom-layer Ground Planes

5 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision * (June 2012) to Revision A (September 2022)	Page
• Replaced Capacitor with SiO_2	2

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   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。
http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

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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