Isolated RS-485 Half-Duplex Evaluation Module

This user's guide describes the evaluation module (EVM) for a RS-485 half-duplex transceiver. This EVM helps designers evaluate the device performance for fast development and analysis of data transmission systems using any of the TI RS-485 half-duplex devices in a 16-pin DW package.

CAUTION

Do not use this EVM for isolation voltage tests even though the half-duplex device has galvanic isolation of up to 4000 V. This EVM is designed for the evaluation of device operating parameters only. If a high voltage (greater than 5.5 V) is applied anywhere in the circuit, the EVM could be damaged.

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1 Introduction

The ISO141x family of devices is an isolated differential line transceiver for TIA/EIA 485/422 applications. The devices with the B suffix are 5-kV_{RMS}, basic isolated transceivers. The basic isolation devices can be used for long transmission lines because the ground loop is broken. The broken ground loop lets a much larger range of common-mode voltage be used in the design.

The symmetrical isolation barrier of the device is tested to give 5000 V_{RMS} of isolation for 60 s per UL 1577 between the bus-line transceiver and the logic-level interface. Any cabled I/O can have electrical noise transients from various sources. These noise transients can cause damage to the transceiver, nearby sensitive circuitry, or both if the transients are of sufficient magnitude and duration. These isolated devices can significantly increase protection and decrease the risk of damage to expensive control circuits. The bus pins can endure high levels of IEC ESD and EFT events. No additional components for system-level protection are needed because of this endurance.

This EVM can evaluate different system parameters of the devices. Test signals and sequences can be applied to the device and different performance characteristics such as propagation delay, power consumption, and different bus and driver conditions. Users can evaluate these parameters in their own lab environment.

The EVM has footprints named *DNI* for additional components that are not needed to test the standard functionality. Add components to these footprints for evaluation and to get specific system requirements. Refer to this users guide for the basic functionality that can be assessed with the EVM.

Go to the isolated RS-485 transceiver page on TI.com for data sheets and a detailed description of the ISO141x devices. Review the TI E2E™ Online Community for digital isolators to find technical support for this EVM and other isolated devices. This EVM is designed with the signal paths for the half-duplex operation.

2 Functional Configurations of the Isolated RS-485 Transceivers

2.1 Device Pin Functions and Configurations

Figure 1 shows a functional diagram of an isolated half-duplex RS485 transceiver. Figure 2 shows the pin configuration of the ISO1410 device in the DW package. The ISO1410DWEVM comes with the ISO1410DW device and all components installed for the basic tests.

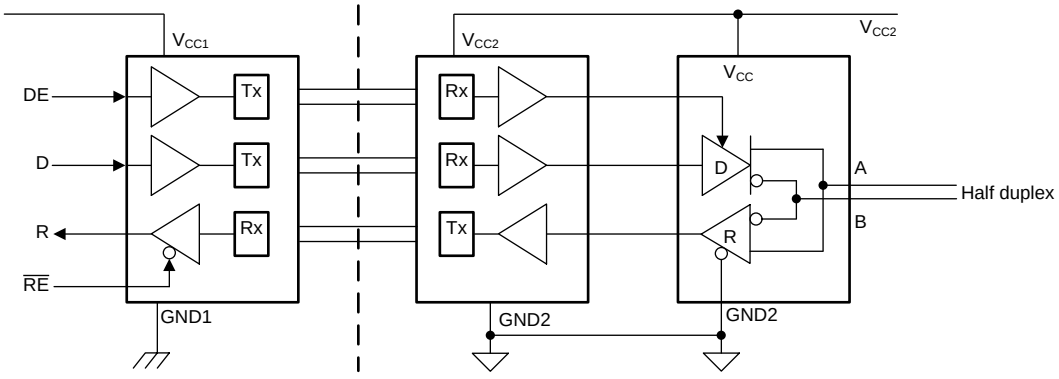


Figure 1. ISO1410 Functional Block Diagram

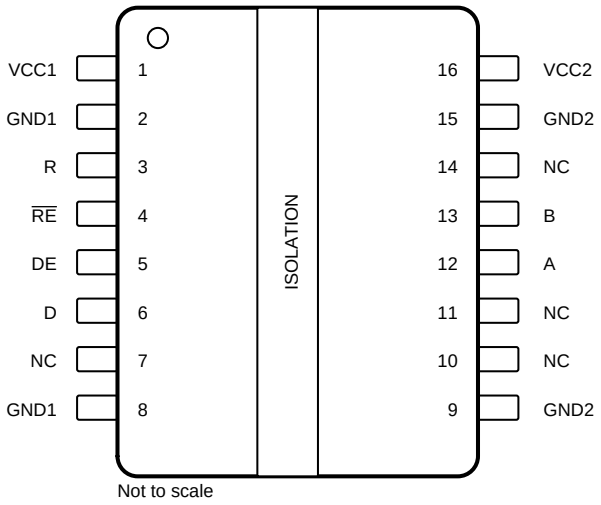


Figure 2. ISO1410 DW Package 16-Pin SOIC Pin Configuration

3 Isolated RS-485 EVM Schematic and Layout

Figure 3 shows the board layout of the isolated half-duplex RS-485 EVM. Figure 4 shows the board layout of the half-duplex isolated RS-485 EVM. Figure 5 shows the schematic of the half-duplex isolated RS-485 EVM.

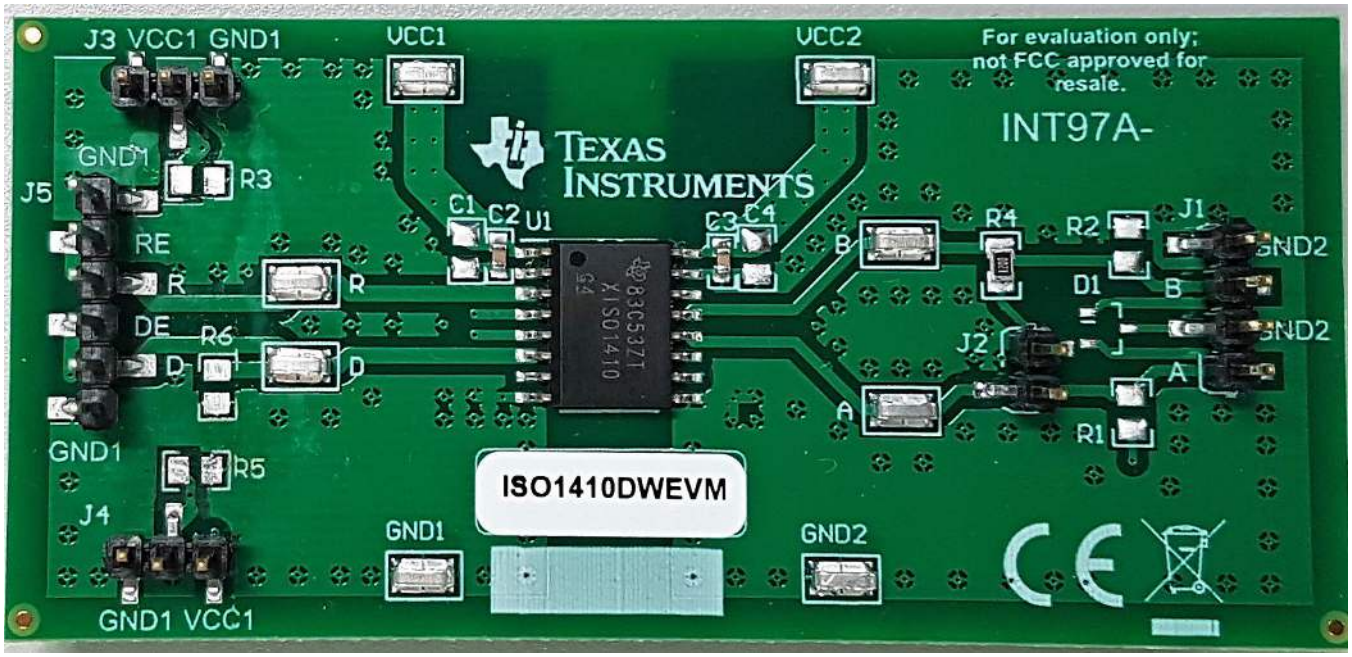


Figure 3. Board Layout

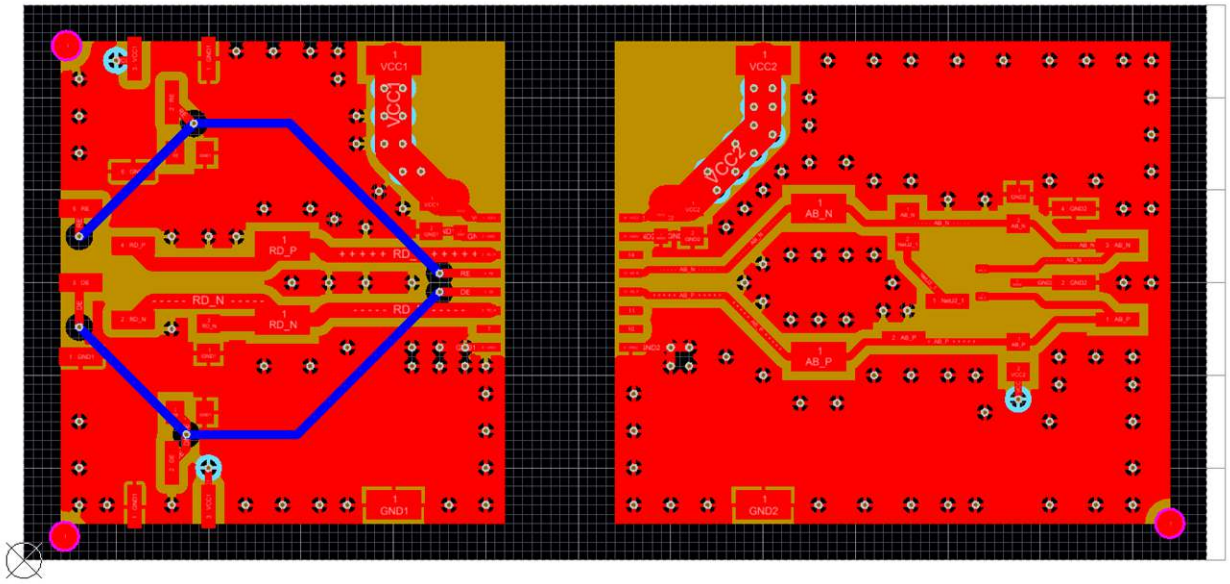


Figure 4. Signal-Layer View Half Duplex Isolated RS-485 EVM

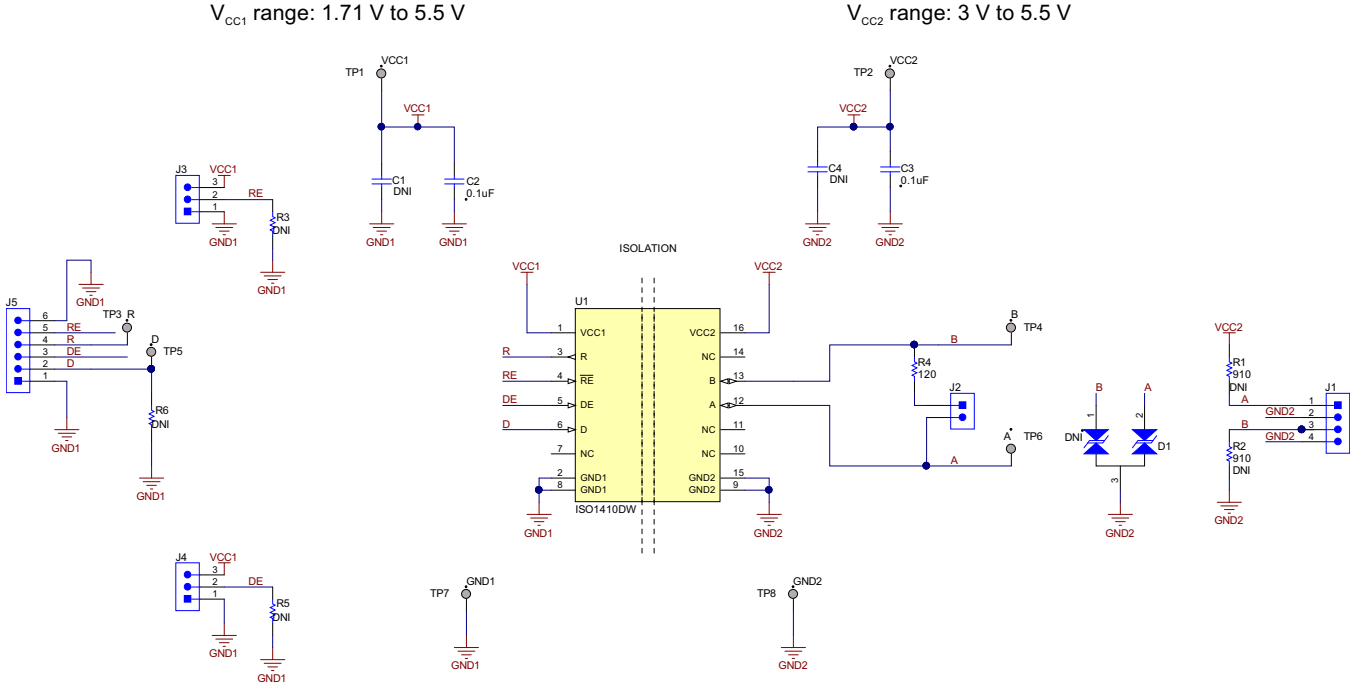


Figure 5. ISO1410DWEVM Schematic

4 Bill of Materials

Table 1 shows the bill of materials for the EVM.

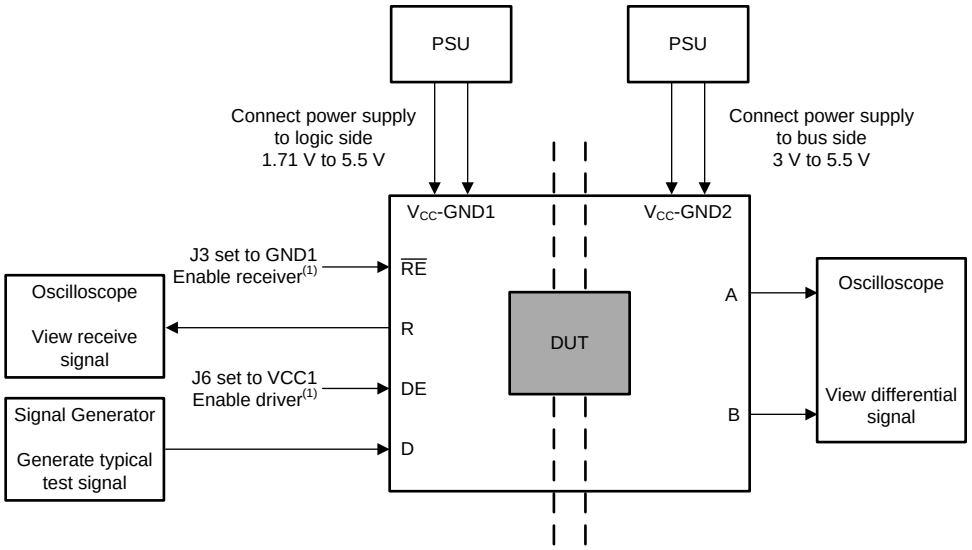
Table 1. Bill of Materials

Item	Quantity	Designator	Description	Manufacturer	Part Number
1	1	J1	Header, 2.54mm, 4x1, SMT	Wurth Elektronik	61000418221
2	1	J2	Header, 2.54mm, 2x1, SMT	Wurth Elektronik	61000218321
3	2	J3,J4	Header, 2.54mm, 3x1, SMT	Wurth Elektronik	61000318221
4	1	J5	Header, 2.54mm, 6x1, SMT	Molex	87898-0657
5	1	C2,C3	CAP, CERM, 0.1 uF, 25 V, +/- 5%, X7R, 0603	AVX	06033C104JAT2A
6	2	C1, C4	CAP, CERM, 1uF, 25 V, +/- 10%, X7R, 0805	Kemet	C0805C105K3RACTU
7	2	C2,C3	CAP, CERM, 0.1 uF, 25 V, +/- 5%, X7R, 0603	AVX	06033C104JAT2A
8	2	R1,R2	RES, 910, 0.5%, 0.1 W, 0805	Susumu Co Ltd	RR1220P-911-D
9	3	R3,R5,R6(1)	RES, 49.9, 1%, 0.125 W, AEC-Q200 Grade 0, 0805	Vishay-Dale	CRCW080549R9FKEA
10	1	R4	RES, 120, 1%, 0.4 W, 0805	Rohm	ESR10EZPF1200
11	8	A, B, D, GND1, GND2, R, VCC1, VCC2	Test Point, Miniature, SMT	Keystone	5019
12	1	D1	TVS Diode according to requirements	DNI	DNI
13	4	H1, H2, H3, H4	Bumpon, Hemisphere, 0.44 X 0.20, Clear	3M	SJ-5303 (CLEAR)
14	1	U1	5-kV_{RMS} Reinforced and Basic Isolated RS-485/RS-422 Transceiver With Robust-EMC, DW0016B (SOIC-16)	Texas Instruments	ISO1410DW

(1) The 50-Ω resistors R3, R5, and R6, have the index n.a., indicating that these components are not assembled. Because signal generators have a typical source impedance of 50 Ω, their output signal is twice the required signal voltage and assumes that the on board 50-Ω resistors divide this voltage down to the correct signal level.
J3 and J4 can only be used when these resistors are not populated.

5 EVM Setup and Operation

Figure 6 shows the basic setup of the EVM with two power supplies needed to evaluate isolator performance. Use voltages that are within the range given in the device data sheet. The typical voltages for the V_{CC1} and V_{CC2} supplies are 3.3 V and 5 V. Separate power supplies generate each supply voltage. The supply voltages do not need to have the same value. If both side are to be evaluated at the same supply voltage, only one power supply is required. This one power supply can power both sides of the EVM.



(1) Normal transceiver operation requires both the driver and the resections to be active. Set the enable pin ($\overline{RE}$) to logic low and the driver enable pin (DE) to logic high.

Figure 6. Basic EVM Setup and Jumper Configurations

Table 2 shows the information on jumper configuration for basic tests.

Table 2. Jumper configuration

Connection	Label	Description
J2	J2	Connect this jumper to enable the 120-Ω termination resistor. Disconnect this jumper to disable the 120-Ω termination resistor. The bus lines should be 120-Ω terminated (jumper connected) to assess full performance.
J3	VCC1, GND1	Connect this jumper between the middle pin and GND1 to tie the $\overline{RE}$ pin low. The receiver is enabled when the $\overline{RE}$ pin is low. Tie the $\overline{RE}$ pin to GND1 for full operation tests. Connect this jumper between the middle pin and VCC1 to tie the $\overline{RE}$ pin high. The receiver is disabled when the $\overline{RE}$ pin is high.
J6	VCC1, GND1	Connect this jumper between the middle pin and GND1 to tie the DE pin low. The driver input is disabled when the DE pin is low. Connect this jumper between the middle pin and VCC1 to tie the DE pin high. The driver input is enabled when the DE pin is high. Tie the DE pin to VCC1 for full operation tests.

Figure 7 shows the typical waveform that was observed on the oscilloscope.

Figure 7. Example scope capture at 250-kHz and VCC1,2 at 3.3 V

6 References

Refer to these references for more information:

- Texas Instruments, *Digital Isolator Design Guide*
- Texas Instruments, *ISO141x 5-kV$_{RMS}$ Isolated RS-485/RS-422 Transceiver With Robust EMC* data sheet

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      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*

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

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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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