

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 DBQ 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 ISO1500 family of devices is an isolated differential line transceiver for TIA/EIA 485/422 applications. This device has a 3-channel digital isolator and an RS-485 transceiver in an ultrasmall 16-pin SSOP package. The bus pins of this transceiver are protected against 8-kV of IEC ESD contact discharge events. The receiver output has a failsafe for bus open, short, and idle conditions. The small solution size of ISO1500 greatly reduces the board space required compared to other integrated isolated RS-485 solutions or discrete implementation with optocouplers and non-isolated RS-485 transceiver.

The device is used for long distance communications. Isolation breaks the ground loop between the communicating nodes, allowing for a much larger common mode voltage range. The symmetrical isolation barrier of each device is tested to provide 2500 VRMS of isolation for 1 minute per UL 1577 between the bus-line transceiver and the logic-level interface.

The ISO1500 device can operate from 1.71 V to 5.5 V on side 1 which lets the devices interface with low-voltage FPGAs and ASICs. The supply voltage on side 2 is from 4.5 V to 5.5 V. This device supports a wide operating ambient temperature range from -40°C to $+125^{\circ}\text{C}$.

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 ISO1500 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 block diagram of an isolated half-duplex RS485 transceiver. [Figure 2](#) shows the pin configuration of the ISO1500 device in the DBQ package. The ISO1500DBQEVM comes with the ISO1500DBQ device and all components installed for the basic tests.

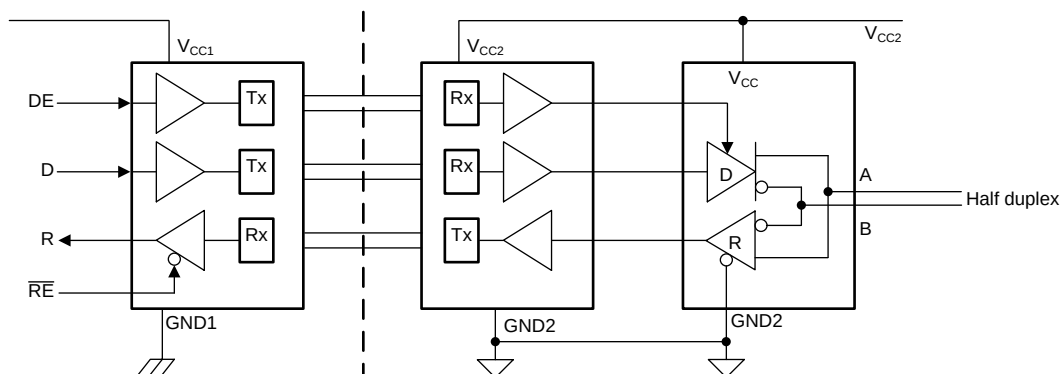


Figure 1. ISO1500DBQ Functional Block Diagram

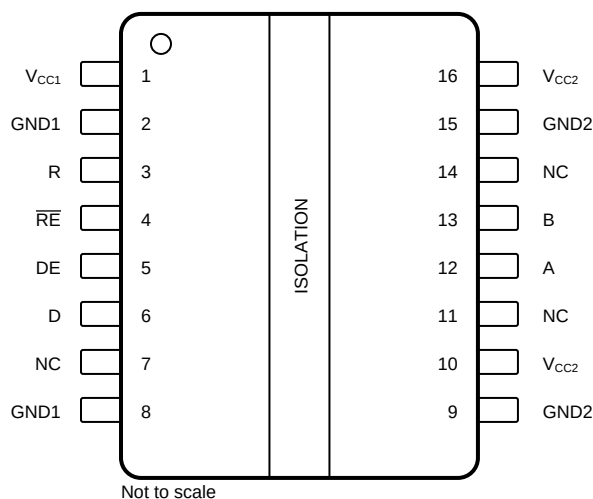


Figure 2. ISO1500 DBQ Package 16-Pin Configuration

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.

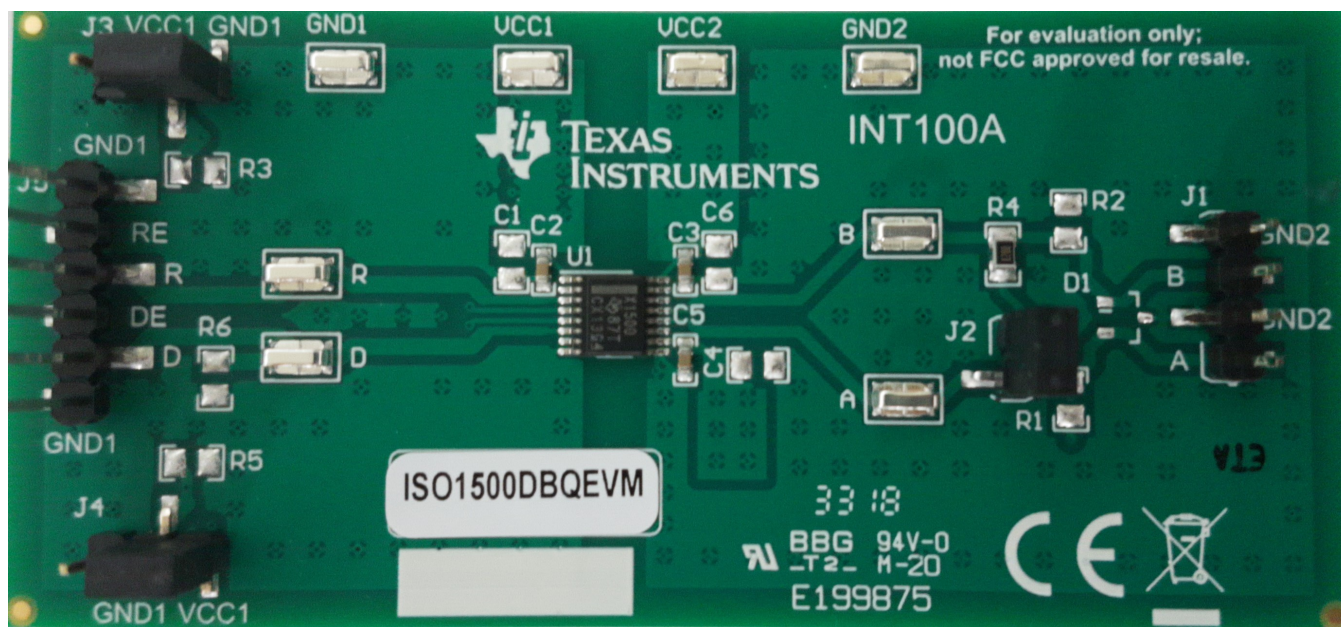


Figure 3. Board Layout

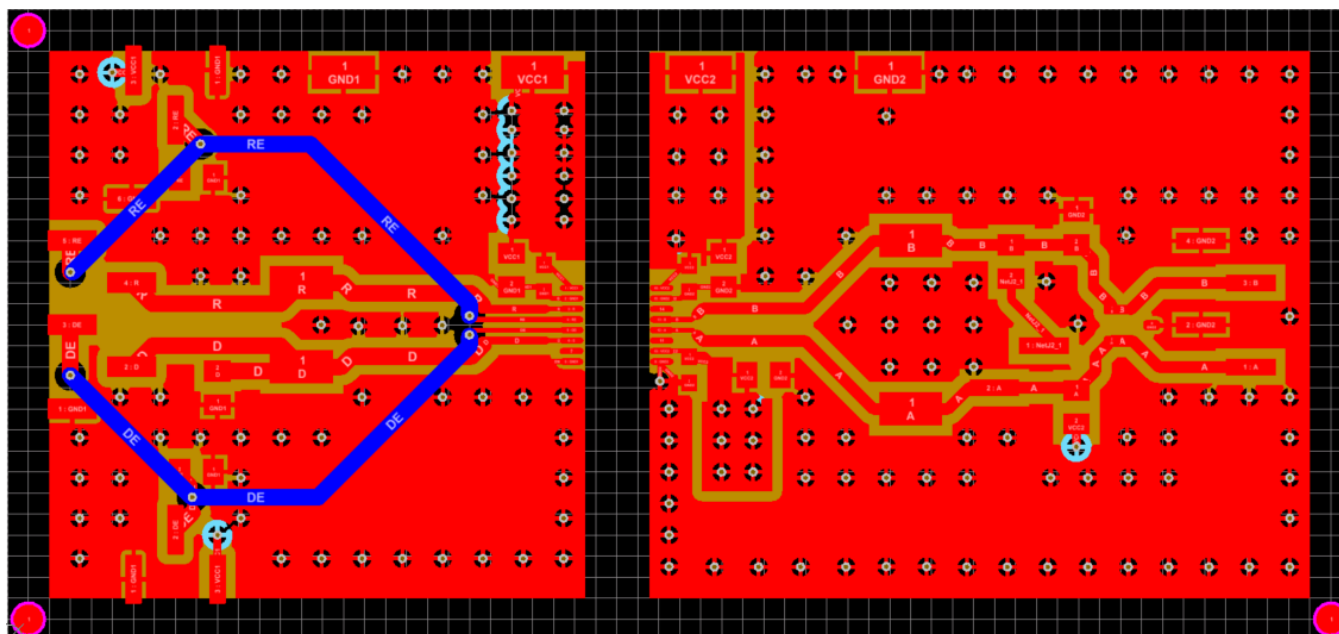


Figure 4. Signal-Layer View Half Duplex Isolated RS-485 EVM

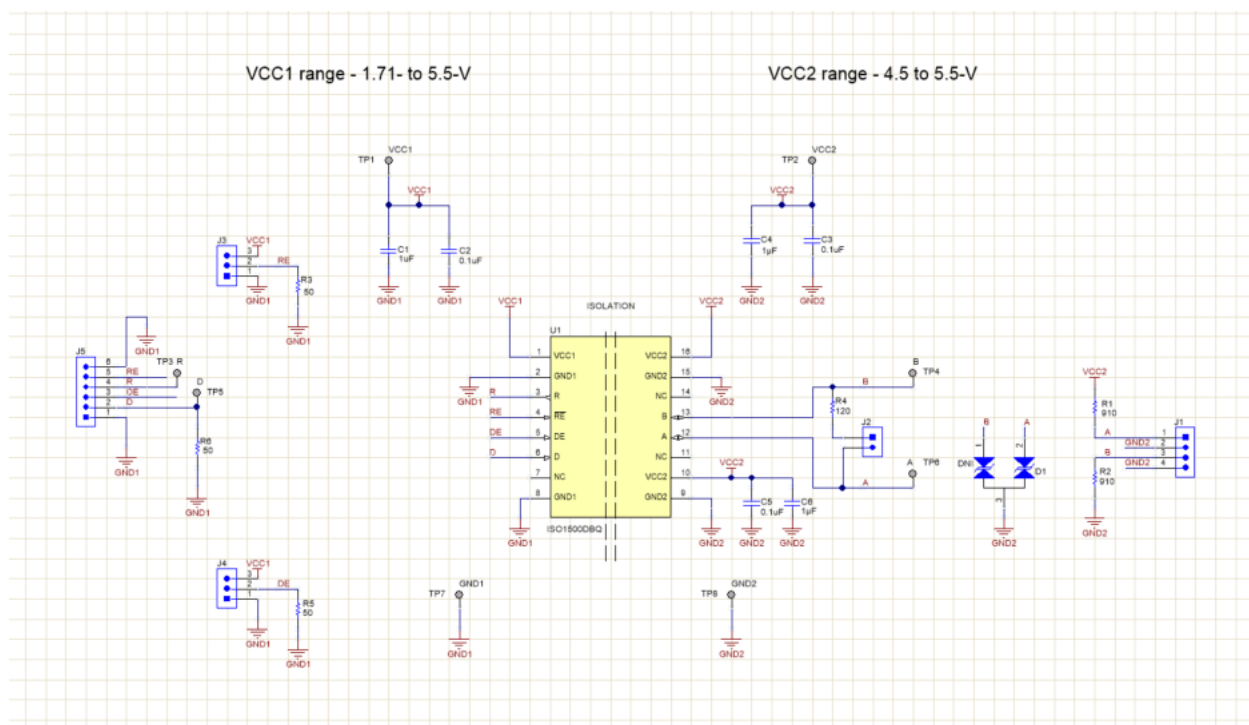


Figure 5. ISO1500DBQ Schematic

4 Bill of Materials

Table 1 shows the bill of materials for the EVM.

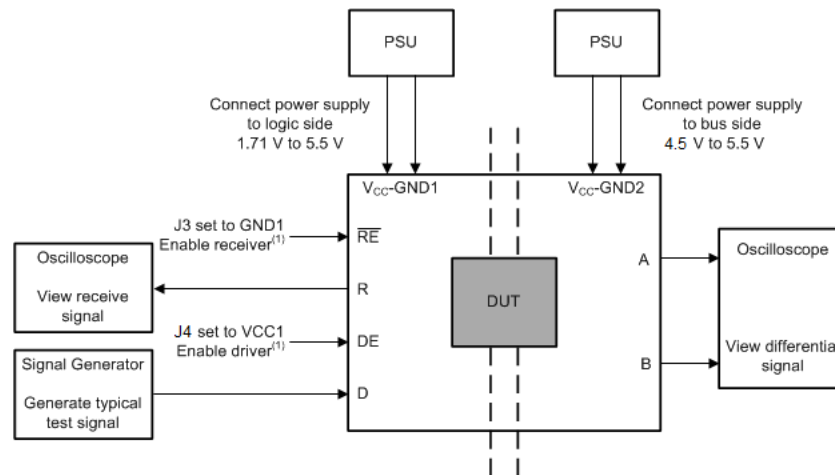
Table 1. Bill of Materials

Item	Quantity	Designator	Description	Manufacturer	Part Number
1	1	J1	Header, 2.54mm, 4x1, SMT	Würth Elektronik	61000418221
2	1	J2	Header, 2.54mm, 2x1, SMT	Würth Elektronik	61000218321
3	2	J3,J4	Header, 2.54mm, 3x1, SMT	Würth Elektronik	61000318221
4	1	J5	Header, 2.54mm, 6x1, SMT	Molex	87898-0657
5	1	C2, C3, C5	CAP, CERM, 0.1 μ F, 25 V, +/- 5%, X7R, 0603	AVX	06033C104JAT2A
6	2	C1, C4,C6	CAP, CERM, 1 μ F, 25 V, +/- 10%, X7R, 0805	Kemet	C0805C105K3RACTU
7	2	R1,R2	RES, 910, 0.5%, 0.1 W, 0805	Susumu Co Ltd	RR1220P-911-D
8	3	R3,R5,R6 ⁽¹⁾	RES, 49.9, 1%, 0.125 W, AEC-Q200 Grade 0, 0805	Vishay-Dale	CRCW080549R9FKEA
9	1	R4	RES, 120, 1%, 0.4 W, 0805	Rohm	ESR10EZPF1200
10	8	A, B, D, GND1, GND2, R, V _{CC1} , V _{CC2}	Test Point, Miniature, SMT	Keystone	5019
11	1	D1	TVS Diode according to requirements	DNI	DNI
12	4	H1, H2, H3, H4	Bumpon, Hemisphere, 0.44 X 0.20, Clear	3M	SJ-5303 (CLEAR)
13	1	U1	ISO1500 2.5-kVRMS Basic Isolated RS-485/RS-422 Transceiver in Ultra-Small Package	Texas Instruments	ISO1500DBQ

⁽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 the 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 receivers 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	V_{CC1} , 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 V_{CC1} to tie the $\overline{RE}$ pin high. The receiver is disabled when the $\overline{RE}$ pin is high.
J4	V_{CC1} , 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 V_{CC1} to tie the DE pin high. The driver input is enabled when the DE pin is high. Tie the DE pin to V_{CC1} for full operation tests.

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

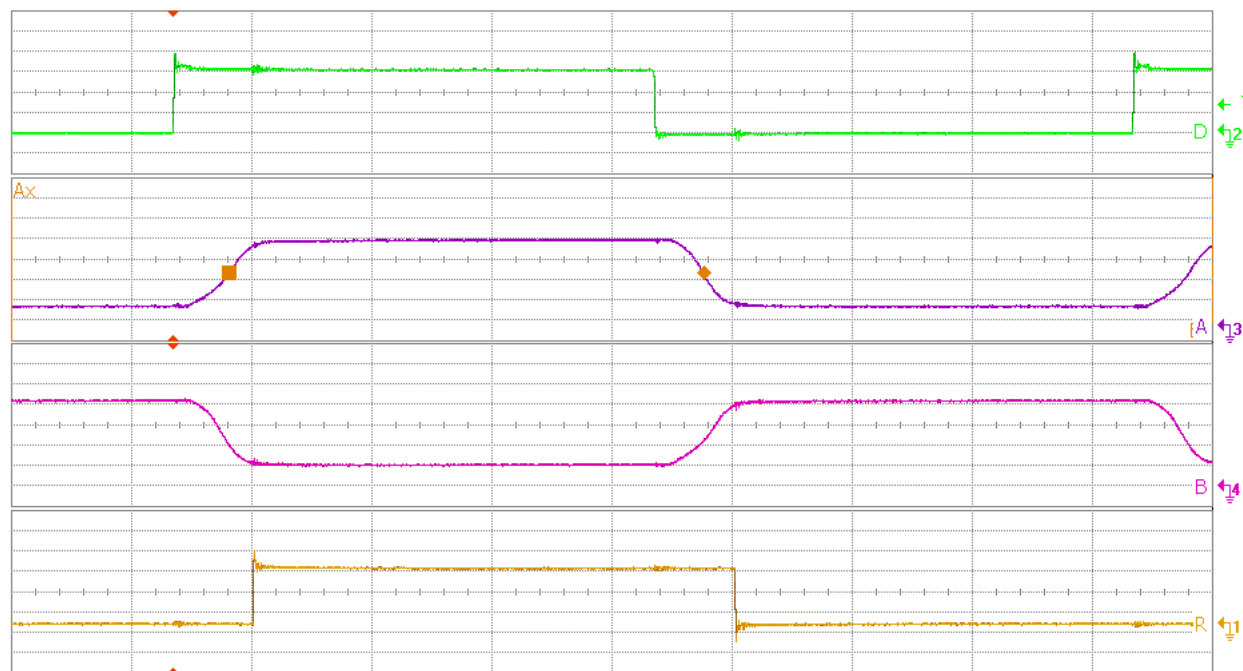


Figure 7. Example scope capture at 250-kHz and VCC1,2 at 5 V

6 References

Refer to these references for more information:

- Texas Instruments, [Digital Isolator Design Guide](#)
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