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.

Contents
1 Introduction .................................................................................................................. 2
2 Functional Configurations of the Isolated RS-485 Transceivers ................................................. 2
3 Isolated RS-485 EVM Schematic and Layout ........................................................................... 3
4 Bill of Materials ........................................................................................................... 5
5 EVM Setup and Operation ............................................................................................. 6
6 References .................................................................................................................. 7

List of Figures
1 ISO1500DBQ Functional Block Diagram .................................................................................. 2
2 ISO1500 DBQ Package 16-Pin Configuration ........................................................................ 3
3 Board Layout ................................................................................................................ 3
4 Signal-Layer View Half Duplex Isolated RS-485 EVM ............................................................. 4
5 ISO1500DBQ Schematic .................................................................................................... 4
6 Basic EVM Setup and Jumper Configurations ........................................................................ 6
7 Example scope capture at 250-kHz and VCC1,2 at 5 V ............................................................ 7

List of Tables
1 Bill of Materials .............................................................................................................. 5
2 Jumper configuration ...................................................................................................... 6

Trademarks
TI E2E is a trademark of Texas Instruments. All other trademarks are the property of their respective owners.
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°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](image-url)
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 4. Signal-Layer View Half Duplex Isolated RS-485 EVM

Figure 5. ISO1500DBQ Schematic
## Bill of Materials

Table 1 shows the bill of materials for the EVM.

### Table 1. Bill of Materials

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Designator</th>
<th>Description</th>
<th>Manufacturer</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>J1</td>
<td>Header, 2.54mm, 4x1, SMT</td>
<td>Wurth Elektronik</td>
<td>61000418221</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>J2</td>
<td>Header, 2.54mm, 2x1, SMT</td>
<td>Wurth Elektronik</td>
<td>61000218321</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>J3, J4</td>
<td>Header, 2.54mm, 3x1, SMT</td>
<td>Wurth Elektronik</td>
<td>61000318221</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>J5</td>
<td>Header, 2.54mm, 6x1, SMT</td>
<td>Molex</td>
<td>87898-0657</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>C2, C3, C5</td>
<td>CAP, CERM, 0.1 uF, 25 V, +/- 5%, X7R, 0603</td>
<td>AVX</td>
<td>06033C104JAT2A</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>C1, C4, C6</td>
<td>CAP, CERM, 1uF, 25 V, +/- 10%, X7R, 0805</td>
<td>Kemet</td>
<td>C0805C105K3RACTU</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>R1, R2</td>
<td>RES, 910, 0.5%, 0.1 W, 0805</td>
<td>Susumu Co Ltd</td>
<td>RR1220P-911-D</td>
</tr>
<tr>
<td>8</td>
<td>3</td>
<td>R3, R5, R6</td>
<td>RES, 49.9, 1%, 0.125 W, AEC-Q200 Grade 0, 0805</td>
<td>Vishay-Dale</td>
<td>CRCW080549R9FKEA</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>R4</td>
<td>RES, 120, 1%, 0.4 W, 0805</td>
<td>Rohm</td>
<td>ESR10EZPF1200</td>
</tr>
<tr>
<td>10</td>
<td>8</td>
<td>A, B, D, GND1, GND2, R, VCC1, VCC2</td>
<td>Test Point, Miniature, SMT</td>
<td>Keystone</td>
<td>5019</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>D1</td>
<td>TVS Diode according to requirements</td>
<td>DNI</td>
<td>DNI</td>
</tr>
<tr>
<td>12</td>
<td>4</td>
<td>H1, H2, H3, H4</td>
<td>Bumpon, Hemisphere, 0.44 X 0.20, Clear</td>
<td>3M</td>
<td>SJ-5303 (CLEAR)</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>U1</td>
<td>ISO1500 2.5-kV RMS Basic Isolated RS-485/RS-422 Transceiver in Ultra-Small Package</td>
<td>Texas Instruments</td>
<td>ISO1500DBQ</td>
</tr>
</tbody>
</table>

(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 sides 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.

![Diagram of EVM setup](image)

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

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

Table 2. Jumper configuration

<table>
<thead>
<tr>
<th>Connection</th>
<th>Label</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>J2</td>
<td>J2</td>
<td>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.</td>
</tr>
<tr>
<td>J3</td>
<td>$V_{CC1}$, GND1</td>
<td>Connect this jumper between the middle pin and GND1 to tie the RE pin low. The receiver is enabled when the RE pin is low. Tie the RE pin to GND1 for full operation tests. Connect this jumper between the middle pin and $V_{CC1}$ to tie the RE pin high. The receiver is disabled when the RE pin is high.</td>
</tr>
<tr>
<td>J4</td>
<td>$V_{CC1}$, GND1</td>
<td>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.</td>
</tr>
</tbody>
</table>
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*
IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to TI's Terms of Sale (www.ti.com/legal/termsofsale.html) or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2020, Texas Instruments Incorporated