

## Evaluating the **ADM4168E** ±15 kV ESD Protected Dual RS-422 Transceiver

### FEATURES

- Easy evaluation of the **ADM4168E** dual RS-422 transceivers
- ±15 kV ESD protection on bus input/output pins
- Suitable for 5 V power supply applications
- Convenient connections through screw terminal blocks
- 5 V power supply connection
- Logic signals: DE1, DI1, RO1, DE2, DI2, RO2
- RS-422 receiver inputs: A1, B1, A2, B2
- RS-422 driver outputs: Y1, Z1, Y2, Z2
- Cable shield and ground connections
- Jumper-selectable driver enable settings
- Termination resistors (100 Ω) on RS-422 inputs/outputs
  - Options to switch termination resistors in/out using jumpers
- Test points for measuring all signals

### DOCUMENTS NEEDED

- ADM4168E** data sheet
- AN-960** application note

### GENERAL DESCRIPTION

The **EVAL-ADM4168EEBZ** allows easy and quick evaluation of the **ADM4168E** RS-422 dual transceiver. The evaluation board allows all of the input and output functions to be exercised without the need for external components. Screw terminal blocks provide convenient connections for bus or logic signals and power. The evaluation board is easily configured by using jumper connections.

The main device on the board, the **ADM4168E**, is designed for balanced transmission lines and complies with TIA/EIA-422-B. The differential driver outputs and receiver inputs feature electrostatic discharge circuitry that provides protection up to ±15 kV. The **ADM4168E** operates from a single 5 V power supply.

### EVALUATION BOARD DIAGRAM

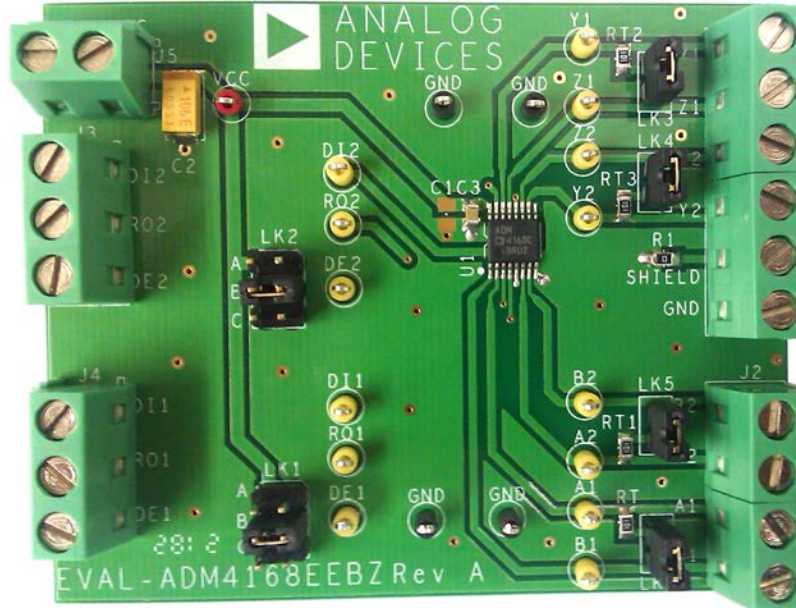


Figure 1.

**TABLE OF CONTENTS**

Features .....	1	Termination Resistors.....	5
Documents Needed.....	1	Decoupling Capacitors .....	5
General Description .....	1	Evaluation Board Schematics and Artwork.....	6
Evaluation Board Diagram.....	1	Assembly Drawings and Board Layout .....	7
Revision History .....	2	Ordering Information.....	8
Evaluation Board Hardware .....	3	Bill of Materials.....	8
Test Setup.....	3	Related Links.....	8
Jumper Settings.....	3		

**REVISION HISTORY**

8/12—Revision 0: Initial Version

## EVALUATION BOARD HARDWARE

### TEST SETUP

The EVAL-ADM4168EEBZ provides fast and easy evaluation of the ADM4168E RS-422 transceivers. Test points allow all inputs and outputs to be monitored.

The ADM4168E is powered by a 5 V supply connected to J5. Signals to be transmitted on the RS-422 outputs (Y1, Z1, Y2, and Z2 on J1) can be connected to DI1 and/or DI2 on J4 and J3, respectively.

RS-422 signals are input to the device by connecting to A1, B1, A2, and B2 on J2. Connect driver enable signals to DE1 and/or DE2 on J4 and J3, respectively (see the Jumper Settings section to select these inputs).

Jumpers also allow the 100 Ω termination resistors to be switched in or out on the receiver inputs and/or the driver outputs. Consequently, the device can be evaluated on its own with standard loads or in a bus application where termination is already present elsewhere on the bus.

### JUMPER SETTINGS

The inputs to the ADM4168E can be configured using the jumpers on the evaluation board (see Table 1). Note, do not place multiple jumper blocks on LK1 and LK2 because the input sources may be shorted together. For each link, a single jumper block can be moved from one position to another, as specified in Table 1.

The driver outputs can be configured either as terminated or not terminated using LK3 and LK4 on the evaluation board (see Table 1). The receiver inputs can also be configured as terminated or not terminated using LK5 and LK6 on the evaluation board.

An example operation of the EVAL-ADM4168EEBZ is shown in Figure 2, where Channel 1 of the transceiver is being tested.

- A signal generator is connected to DI1, A1 is connected to Y1, and B1 is connected to Z1.
- DE1 is enabled with LK1 in Position A. Termination resistors are present on the receiver inputs with the LK6 jumper closed and LK3 open to disconnect termination resistors on the driver outputs.
- The oscilloscope monitors DI1, A1, B1, and RO1.

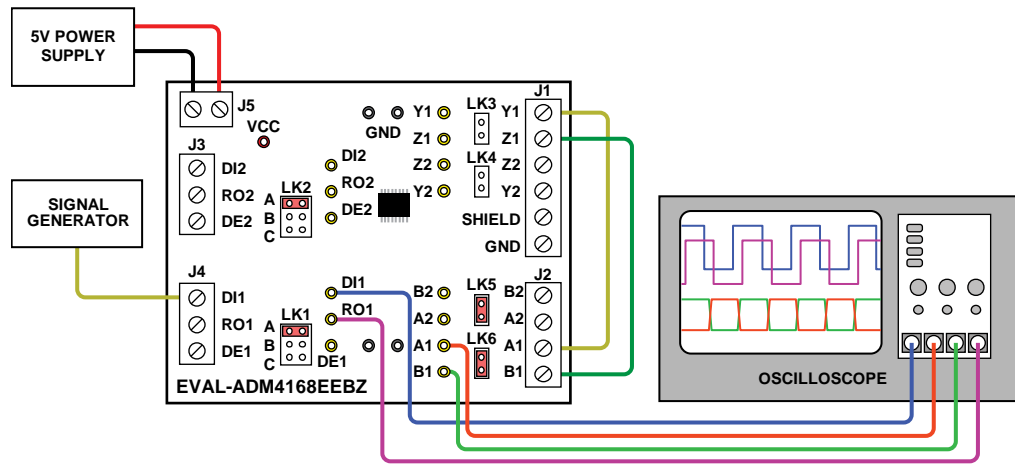


Figure 2. Basic Test, Channel 1

10972-002

Table 1. Jumper Configuration

Link	Connection	Description
LK1	A	Connects the driver enable input (DE1) of the <a href="#">ADM4168E</a> to VCC. This setting enables the driver.
	B	Connects the driver enable input (DE1) of the <a href="#">ADM4168E</a> to GND. This setting disables the driver.
	C	Connects the driver enable input (DE1) of the <a href="#">ADM4168E</a> to Pin 3 of the J3 terminal block connector.
LK2	A	Connects the driver enable input (DE2) of the <a href="#">ADM4168E</a> to VCC. This setting enables the driver.
	B	Connects the driver enable input (DE2) of the <a href="#">ADM4168E</a> to GND. This setting disables the driver.
	C	Connects the driver enable input (DE2) of the <a href="#">ADM4168E</a> to Pin 3 of the J4 terminal block connector.
LK3	Closed	When closed, LK3 connects a 100 $\Omega$ termination resistor between Driver Output Y1 and Driver Output Z1. This allows termination of Driver 1 without the <a href="#">ADM4168E</a> being connected into a bus.
	Open	When LK3 is open, Driver 1 has no termination resistor. This allows the driver to connect to a bus that has already been terminated correctly.
LK4	Closed	When closed, LK4 connects a 100 $\Omega$ termination resistor between Driver Output Y2 and Driver Output Z2. This allows termination of Driver 2 without the <a href="#">ADM4168E</a> being connected into a bus.
	Open	When LK4 is open, Driver 2 has no termination resistor. This allows the driver to connect to a bus that has already been terminated correctly.
LK5	Closed	When closed, LK5 connects a 100 $\Omega$ termination resistor between Receiver Input A1 and Receiver Input B1. This allows termination of Receiver 1 for connection into a bus that is not terminated.
	Open	When LK5 is open, Driver 1 has no termination resistor. This allows the driver to connect to a bus that has already been terminated correctly.
LK6	Closed	When closed, LK6 connects a 100 $\Omega$ termination resistor between Receiver Input A2 and Receiver Input B2. This allows termination of Receiver 2 for connection into a bus that is not terminated.
	Open	When LK6 is open, Receiver 2 has no termination. This allows the receiver to connect to a bus that has already been terminated correctly.

**TERMINATION RESISTORS**

The [EVAL-ADM4168EEBZ](#) evaluation board includes the RT and RT1 footprints for termination resistors between the receiver inputs (A and B) on each channel. The evaluation board also includes the RT2 and RT3 footprints for termination resistors between the driver outputs (Y and Z) on each channel.

In addition to switching these resistors in or out on the driver outputs and receiver inputs, using the jumper settings, the

resistors can be removed or replaced with another value of termination resistor to suit application testing requirements.

For more information about proper termination, see the [AN-960 Application Note](#), *RS-485/RS-422 Circuit Implementation Guide*.

**DECOUPLING CAPACITORS**

The evaluation board uses the following decoupling capacitors:

- 10  $\mu$ F tantalum capacitor for C2
- 100 nF ceramic capacitor for C3

EVALUATION BOARD SCHEMATICS AND ARTWORK

10972-003

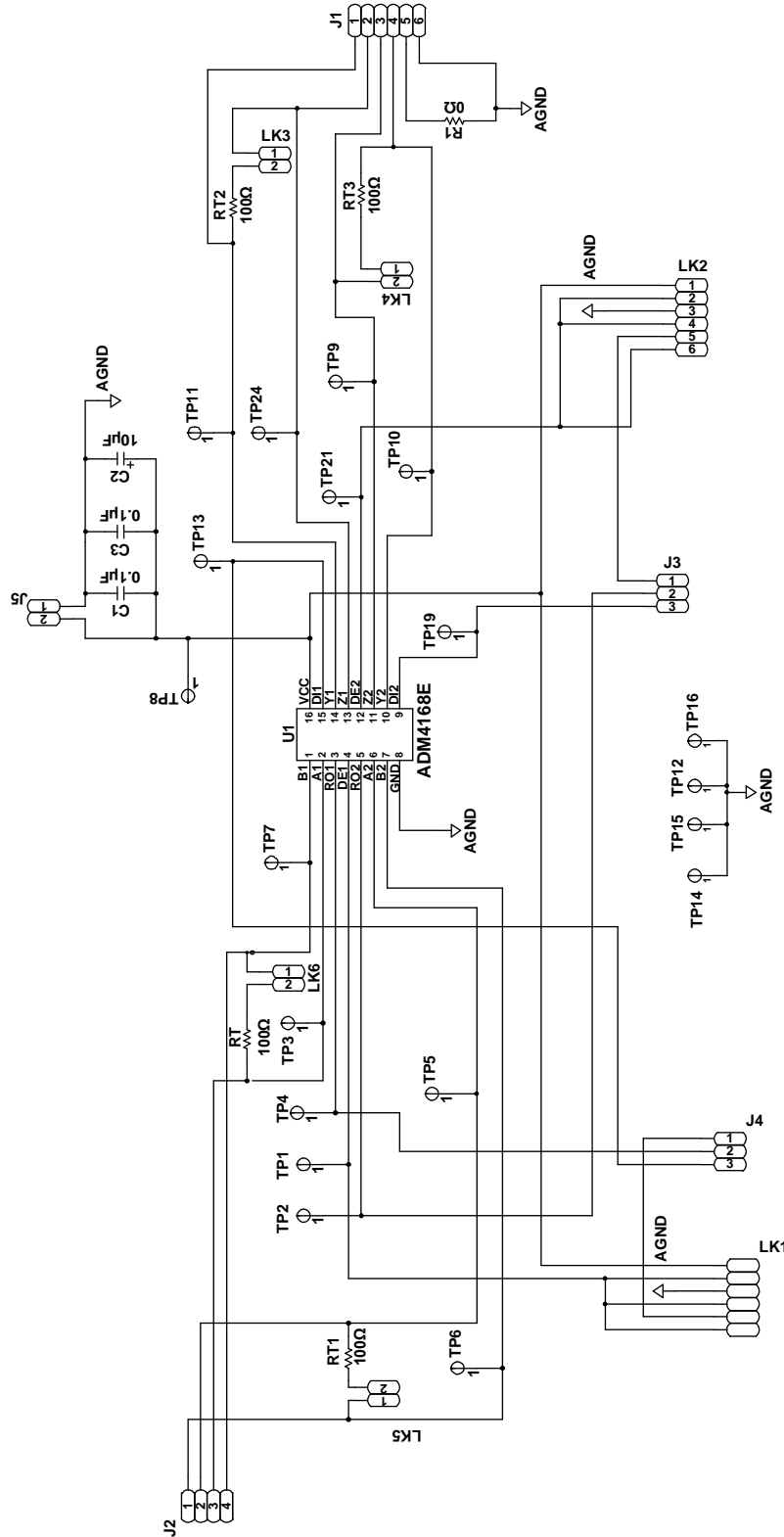


Figure 3. Evaluation Board Schematic

ASSEMBLY DRAWINGS AND BOARD LAYOUT

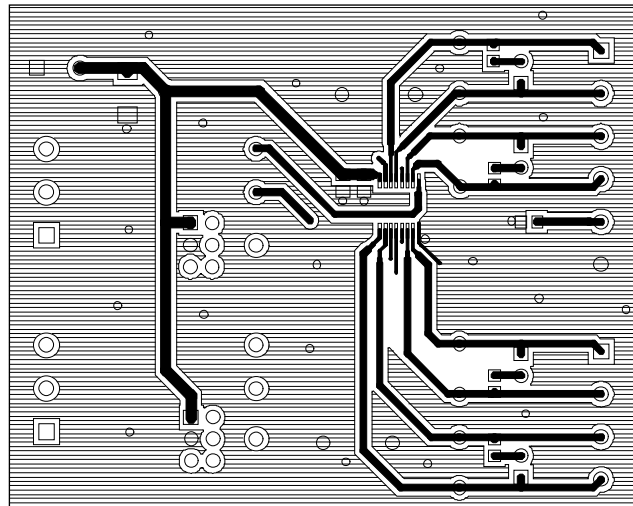


Figure 4. Top Layer PCB

10972-004

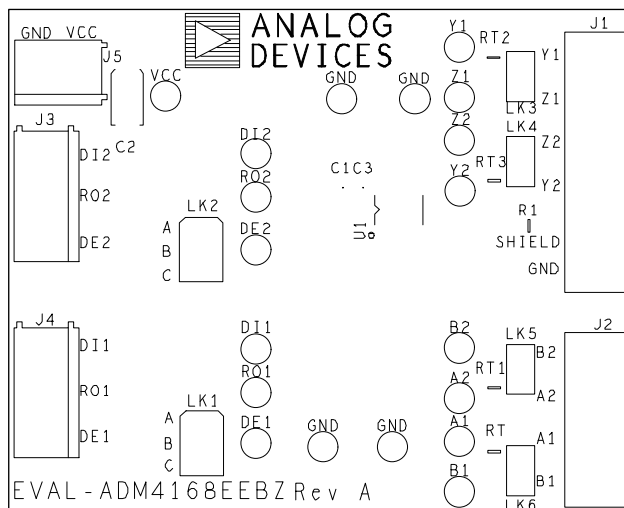


Figure 5. Silkscreen PCB

10972-005

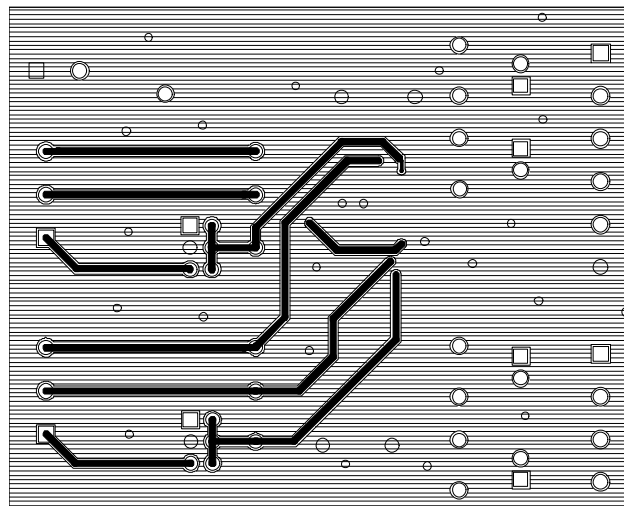


Figure 6. Bottom Layer PCB

10972-006

## ORDERING INFORMATION

## BILL OF MATERIALS

Table 2.

Quantity	Reference Designator	Description	Supplier	Part No.
1	R4	Resistor, 0 $\Omega$ , Size 0805	Yageo/Phycomp	RC0805JR-070RL
4	RT, RT1, RT2, RT3	Resistor, 100 $\Omega$ , Size 0805	Yageo/Phycomp	RC0805JR-07100RL
1	C1	Capacitor, Size 0805 (not inserted)	N/A <sup>1</sup>	N/A <sup>1</sup>
1	C3	Capacitor, Size 0805, 100 nF	Yageo/Phycomp	CC0805KRX7R7BB104
1	C2	Capacitor, Size Case C, 10 $\mu$ F	AVX	TPSC106K025R0300
1	J1	Power Connector 6, 6-pin terminal block	Lumberg	KRM 06
1	J2	Power Connector 4, 4-pin terminal block	Lumberg	KRM 04
2	J3, J4	Power Connector 3, 3-pin terminal block	Lumberg	KRM 03
1	J5	Power Connector 2, 2-pin terminal block	Lumberg	KRM 02
2	LK1, LK2	6-pin (3 $\times$ 2), 2.54 mm header	Harwin	M20-9953646
		Shorting block	Harwin	M7567-05
2	LK3, LK4, LK5, LK6	2-pin (1 $\times$ 2), 2.54 mm header	Harwin	M20-9993646
		Shorting block	Harwin	M7567-05
1	U1	16-lead, TSSOP	Analog Devices, Inc.	<a href="#">ADM4168E</a>
4	GND	Test point, black	Vero Technologies	20-2137
1	VCC	Test point, red	Vero Technologies	20-313137
14	DE1, DE2, DI1, DI2, Y1, Z1, Y2, Z2, A1, B1, A2, B2, RO1, RO2	Test point, yellow	Vero Technologies	20-313140

<sup>1</sup> N/A means not applicable.

## RELATED LINKS

Resource	Description
<a href="#">ADM4168E</a>	Product Page, <a href="#">ADM4168E</a> $\pm$ 15 kV ESD Protected Dual RS-422 Transceiver
<a href="#">AN-960</a>	Application Note, <i>RS-485/RS-422 Circuit Implementation Guide</i>

**ESD Caution**

**ESD (electrostatic discharge) sensitive device.** Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

**Legal Terms and Conditions**

By using the evaluation board discussed herein (together with any tools, components documentation or support materials, the "Evaluation Board"), you are agreeing to be bound by the terms and conditions set forth below ("Agreement") unless you have purchased the Evaluation Board, in which case the Analog Devices Standard Terms and Conditions of Sale shall govern. Do not use the Evaluation Board until you have read and agreed to the Agreement. Your use of the Evaluation Board shall signify your acceptance of the Agreement. This Agreement is made by and between you ("Customer") and Analog Devices, Inc. ("ADI"), with its principal place of business at One Technology Way, Norwood, MA 02062, USA. Subject to the terms and conditions of the Agreement, ADI hereby grants to Customer a free, limited, personal, temporary, non-exclusive, non-sublicensable, non-transferable license to use the Evaluation Board FOR EVALUATION PURPOSES ONLY. Customer understands and agrees that the Evaluation Board is provided for the sole and exclusive purpose referenced above, and agrees not to use the Evaluation Board for any other purpose. Furthermore, the license granted is expressly made subject to the following additional limitations: Customer shall not (i) rent, lease, display, sell, transfer, assign, sublicense, or distribute the Evaluation Board; and (ii) permit any Third Party to access the Evaluation Board. As used herein, the term "Third Party" includes any entity other than ADI, Customer, their employees, affiliates and in-house consultants. The Evaluation Board is NOT sold to Customer; all rights not expressly granted herein, including ownership of the Evaluation Board, are reserved by ADI. CONFIDENTIALITY. This Agreement and the Evaluation Board shall all be considered the confidential and proprietary information of ADI. Customer may not disclose or transfer any portion of the Evaluation Board to any other party for any reason. Upon discontinuation of use of the Evaluation Board or termination of this Agreement, Customer agrees to promptly return the Evaluation Board to ADI. ADDITIONAL RESTRICTIONS. Customer may not disassemble, decompile or reverse engineer chips on the Evaluation Board. Customer shall inform ADI of any occurred damages or any modifications or alterations it makes to the Evaluation Board, including but not limited to soldering or any other activity that affects the material content of the Evaluation Board. Modifications to the Evaluation Board must comply with applicable law, including but not limited to the RoHS Directive. TERMINATION. ADI may terminate this Agreement at any time upon giving written notice to Customer. Customer agrees to return to ADI the Evaluation Board at that time. LIMITATION OF LIABILITY. THE EVALUATION BOARD PROVIDED HEREUNDER IS PROVIDED "AS IS" AND ADI MAKES NO WARRANTIES OR REPRESENTATIONS OF ANY KIND WITH RESPECT TO IT. ADI SPECIFICALLY DISCLAIMS ANY REPRESENTATIONS, ENDORSEMENTS, GUARANTEES, OR WARRANTIES, EXPRESS OR IMPLIED, RELATED TO THE EVALUATION BOARD INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTY OF MERCHANTABILITY, TITLE, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. IN NO EVENT WILL ADI AND ITS LICENSORS BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT, OR CONSEQUENTIAL DAMAGES RESULTING FROM CUSTOMER'S POSSESSION OR USE OF THE EVALUATION BOARD, INCLUDING BUT NOT LIMITED TO LOST PROFITS, DELAY COSTS, LABOR COSTS OR LOSS OF GOODWILL. ADI'S TOTAL LIABILITY FROM ANY AND ALL CAUSES SHALL BE LIMITED TO THE AMOUNT OF ONE HUNDRED US DOLLARS (\$100.00). EXPORT. Customer agrees that it will not directly or indirectly export the Evaluation Board to another country, and that it will comply with all applicable United States federal laws and regulations relating to exports. GOVERNING LAW. This Agreement shall be governed by and construed in accordance with the substantive laws of the Commonwealth of Massachusetts (excluding conflict of law rules). Any legal action regarding this Agreement will be heard in the state or federal courts having jurisdiction in Suffolk County, Massachusetts, and Customer hereby submits to the personal jurisdiction and venue of such courts. The United Nations Convention on Contracts for the International Sale of Goods shall not apply to this Agreement and is expressly disclaimed.