

Evaluating the Isolated RS-485 Repeater Using the **ADM2587E** 2.5 kV rms Signal and Power Isolated RS-485/RS-422 Transceiver with ± 15 kV ESD Protection

FEATURES

- 2.5 kV rms power and signal isolated RS-485/RS-422 transceiver
- PCB layout optimized for EN55022 radiated emissions according to the [AN-1349 Application Note](#)
- 4-layer PCB layout that minimizes PCB material cost
- Convenient connections for power and signal through screw terminal blocks
- Configured as half-duplex
- 5 V or 3.3 V V_{CC} operation
- Flow control circuit removes the requirement for jumper connections
- Test points for measuring all signals

EVALUATION KIT CONTENTS

EVAL-ADM2587EEB2Z

DOCUMENTS NEEDED

[AN-1349 Application Note](#)

[AN-1458 Application Note](#)

[ADM2582E/ADM2587E](#) data sheet

GENERAL DESCRIPTION

Use the [ADM2587E](#) isolated repeater evaluation board to easily evaluate the [ADM2587E](#) power and signal isolated RS-485/RS-422 transceiver. Screw terminal blocks provide convenient connections for the power and signal connections. The evaluation board does not require jumper connections because flow control is implemented with a high speed comparator circuit. The board is configured as half-duplex and has a $120\ \Omega$ termination resistor fitted on the receiver inputs. Test points are included on the power and signal lines on both sides of the isolation barrier.

The [ADM2587E](#) evaluation board is designed to reduce emissions generated by the high frequency switching elements used by the *isoPower*® technology to transfer power through the [ADM2587E](#) integrated transformer. The layout of the evaluation board uses the guidelines provided in the [AN-1349 Application Note](#), *PCB Implementation Guidelines to Minimize Radiated Emissions on the ADM2582E/ADM2587E RS-485/RS-422 Transceivers*.

EVALUATION BOARD PHOTOGRAPH

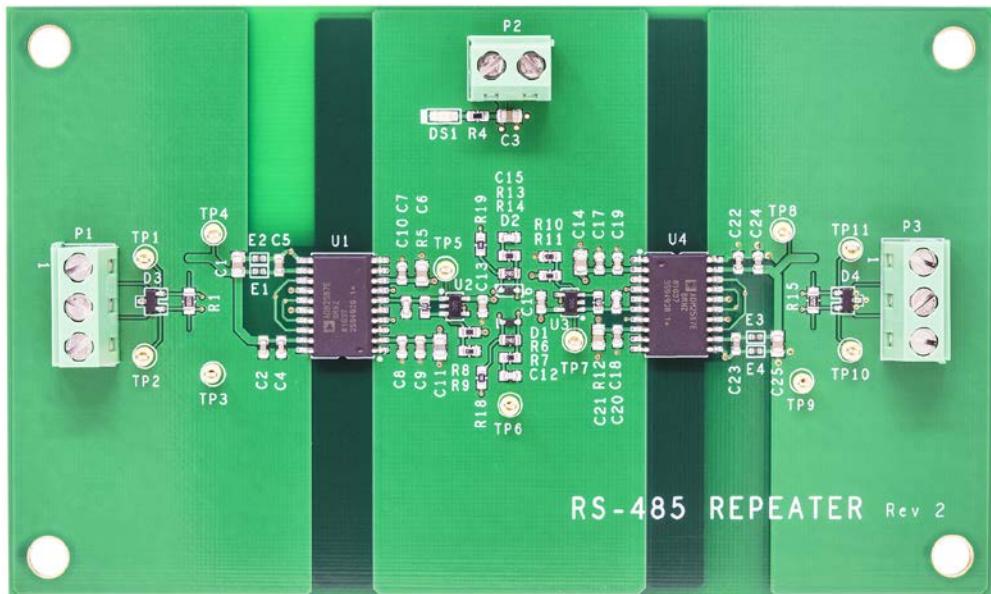


Figure 1.

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REVISION HISTORY

4/2018—Revision 0: Initial Version

EVALUATION BOARD HARDWARE

TEST SETUP

Figure 2 shows the EVAL-ADM2587EEB2Z evaluation board. The evaluation board does not require jumper connections because flow control is implemented with an [ADCMP600](#) high speed comparator circuit. The board is configured as half-duplex and has a $120\ \Omega$ termination resistor fitted on the receiver inputs. Test points are included on the power and signal lines on both sides of the isolation barrier. Power the evaluation board with 3.3 V or 5 V on the P2 terminal block. Confirm basic operation of the evaluation board using a signal generator at the P1 terminal block. Refer to the Cable Connection and Bus Capacitance section for more information. Use an oscilloscope to confirm that the voltage waveforms at TP1 (A) and TP2 (B) match the output of the RS-485 repeater at TP10 (B) and TP11 (A).

CABLE CONNECTION AND BUS CAPACITANCE

Use the EVAL-ADM2587EEB2Z P1 and P3 terminal blocks to attach a Category 5e RS-485 cable to the [ADM2587E](#) A and B bus pins. Route the RS-485 cable to other RS-485 evaluation boards to create a multinode setup. Alternatively, use a signal generator to simulate bus differential voltage inputs to P1, as shown in Figure 2. In this configuration, insert a 1.5 nF wire wound capacitor between the A and B connectors on both the P1 and P3 terminal blocks. This 1.5 nF capacitor simulates the capacitance from 20 m of Category 5e RS-485 cable.

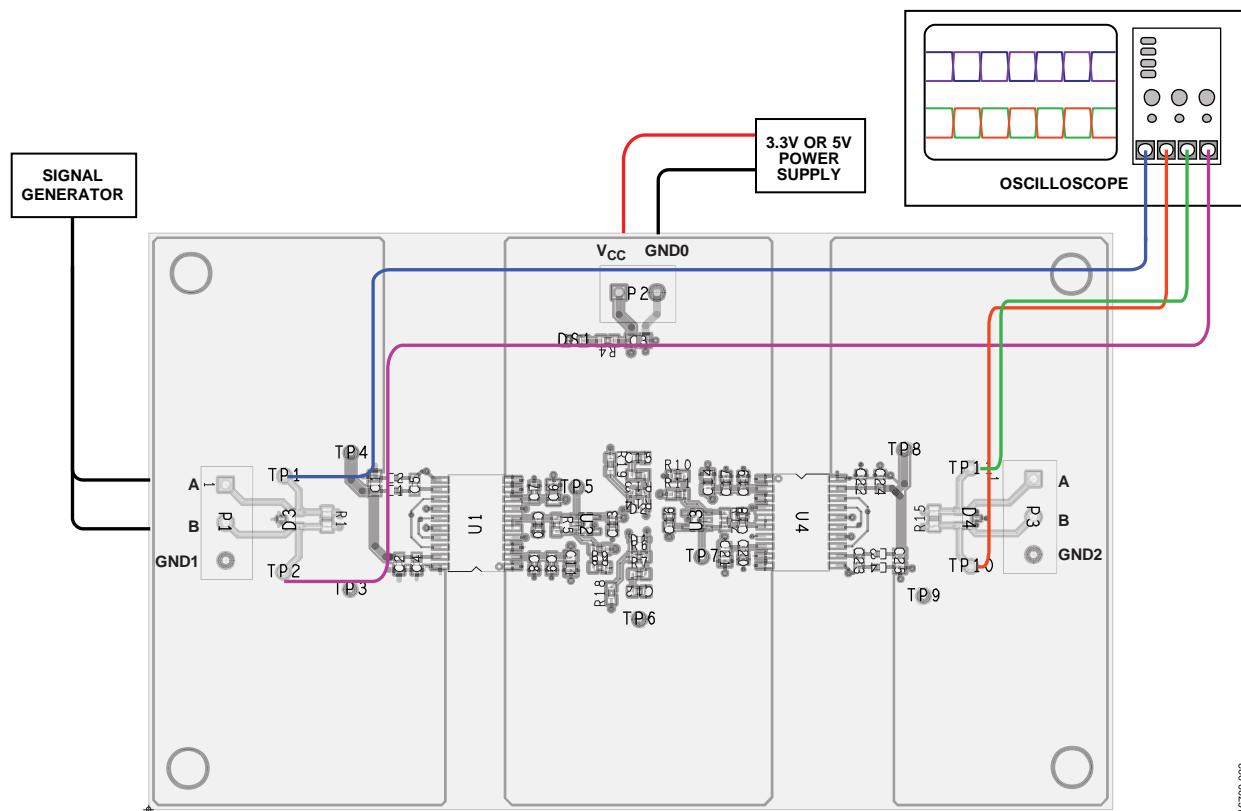


Figure 2. Basic Operation of the EVAL-ADM2587EEB2Z Isolated RS-485 Repeater Evaluation Board

BOARD INTERNAL LAYER THICKNESS

The EVAL-ADM2587EEB2Z evaluation board consists of four layers. The spacing between the top and bottom layer is 1.6 mm. The EVAL-ADM2587EEB2Z printed circuit board (PCB) has a minimum distance of 0.4 mm of insulation along a bonded surface, meeting requirements for IEC 61010, third edition, and IEC 60950 isolation standards as described in the [AN-1109 Application Note, Recommendations for Control of Radiated Emissions with iCoupler® Devices](#).

OVERLAPPING STITCHING CAPACITOR

The evaluation board implements an embedded stitching capacitor structure. An embedded PCB capacitor is created when two metal planes in a PCB overlap each other and are separated by dielectric material. This embedded stitching capacitor is formed by extending the internal reference planes from the primary and secondary layers (which are used for creepage on the PCB surface) across the area. This capacitor provides a return path for high frequency common-mode noise currents across the isolation gap. The layout and implementation of embedded stitching capacitors is explained in detail in the [AN-0971 Application Note](#).

PCB LAYOUT RECOMMENDATIONS

The EVAL-ADM2587EEB2Z evaluation board reduces emissions generated by the high frequency switching elements used by the *isoPower* technology to transfer power through the **ADM2587E** integrated transformer. The layout of the evaluation board is generated using the guidelines provided in the [AN-1349 Application Note](#).

The [AN-1349 Application Note](#) provides examples of 4-layer PCBs. The EVAL-ADM2587EEB2Z PCB layout is a 4-layer PCB.

To pass EN55022 Class B on a 4-layer PCB, the following layout guidelines are recommended:

1. Ensure that there is sufficient decoupling on the PCB. Use the decoupling capacitors recommended in Figure 4.
2. Place a ferrite bead between the PCB trace connections and the following IC pins: V_{ISOOUT} (Pin 12) and GND_2 (Pin 11 and Pin 14).
3. Do not connect the V_{ISOOUT} pin to a power plane; connect between V_{ISOOUT} and V_{ISOIN} using a PCB trace. Ensure that V_{ISOIN} (Pin 19) is connected through the E1 ferrite to V_{ISOOUT} (Pin 12).
4. Place an embedded stitching capacitor between the GND_1 and GND_2 pins using internal layers of the PCB planes (see the Overlapping Stitching Capacitor section).

The following additional notes apply to the PCB layout (refer to the Evaluation Board Schematics and Artwork section):

- Ensure that GND_2 (Pin 14) is connected to GND_2 (Pin 11) on the inside (device side) of the C5 100 nF capacitor.
- Ensure that the C5 100 nF capacitor is connected between V_{ISOOUT} (Pin 12) and GND_2 (Pin 11) on the device side of the E2 and E1 ferrites.
- Ensure that GND_2 (Pin 16) is connected to GND_2 (Pin 11) on the outside (bus side) of the E2 ferrite, as shown in Figure 3.
- Ensure that there is a keep out area for the GND_2 plane in the PCB layout around the E2 and E1 ferrites. The keep out area means there must not be a GND_2 fill on any layer below the E2 and E1 ferrites.

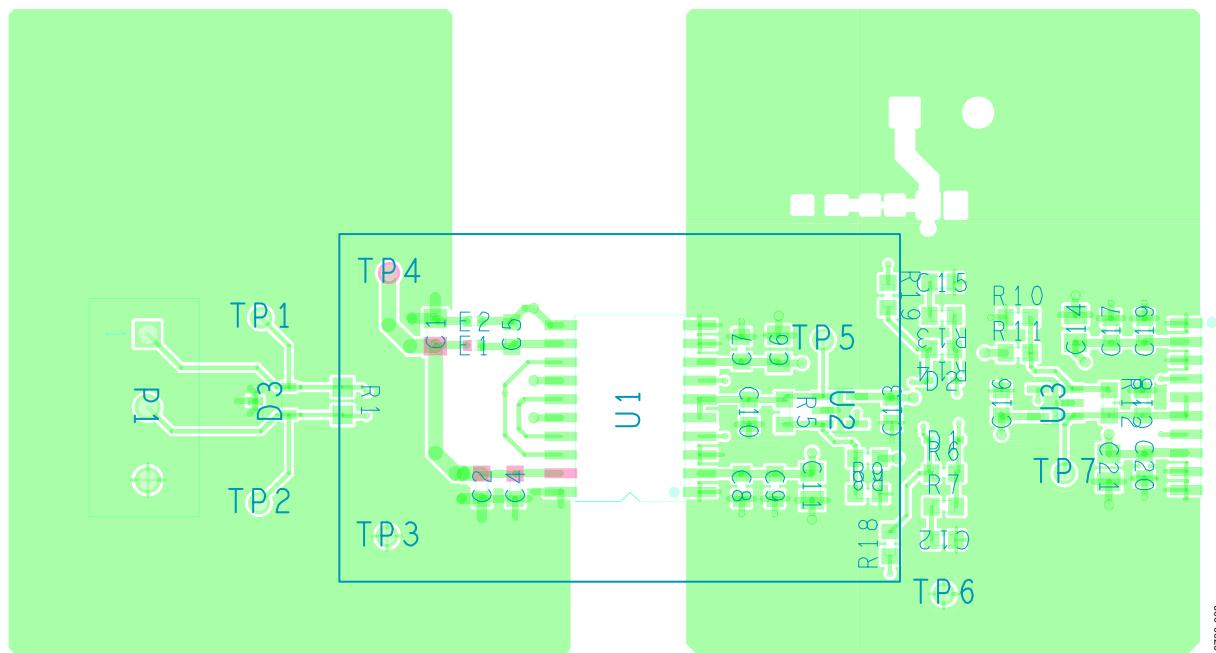


Figure 3. Layout of the EVAL-ADM2587EEB2Z

EVALUATION BOARD SCHEMATICS AND ARTWORK

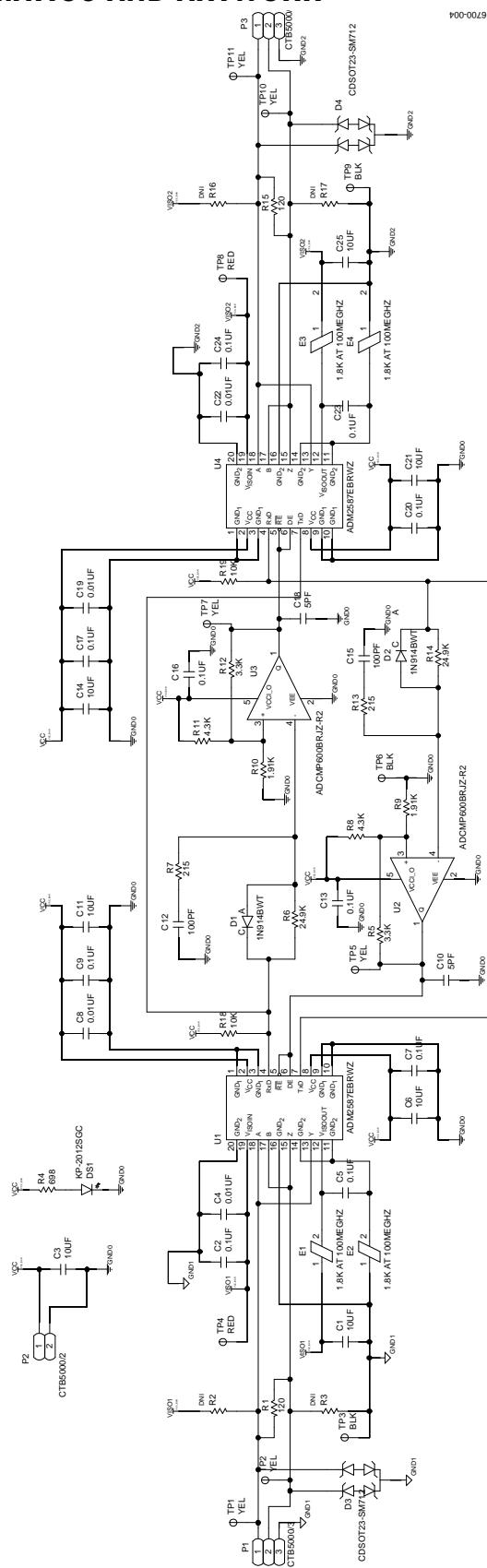


Figure 4. Schematic of the EVAL-ADM2587EEB1Z Evaluation Board

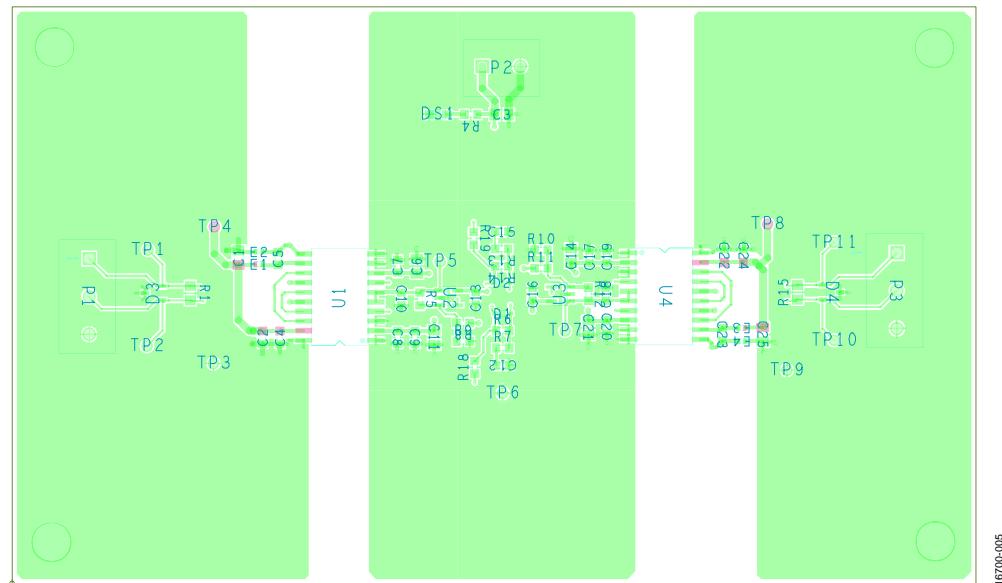
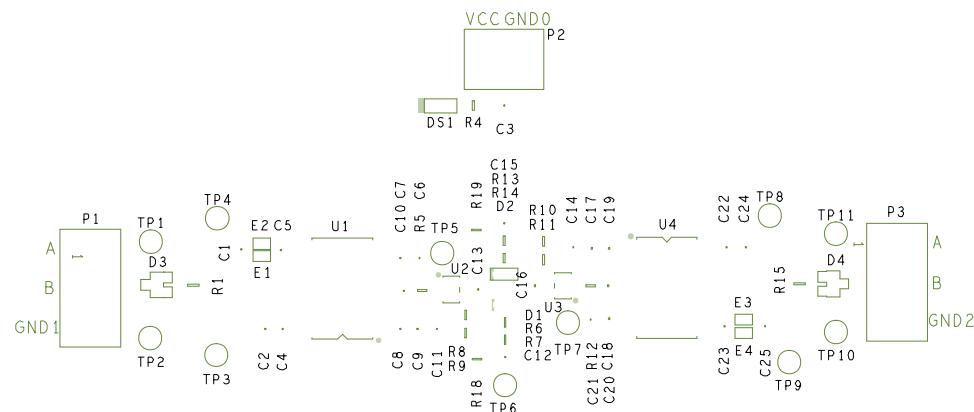


Figure 5. Top Layer/Component Placement



AHEAD OF WHAT'S POSSIBLE™

EVAL-ADM2587EEB2Z Rev A

Br - 049051

16700-006

Figure 6. Silkscreen

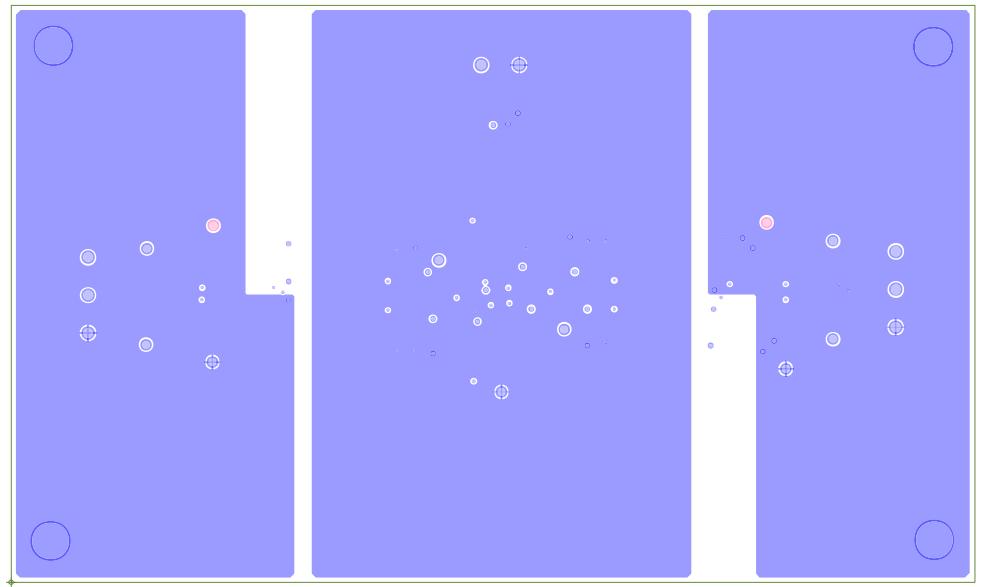


Figure 7. Second Layer

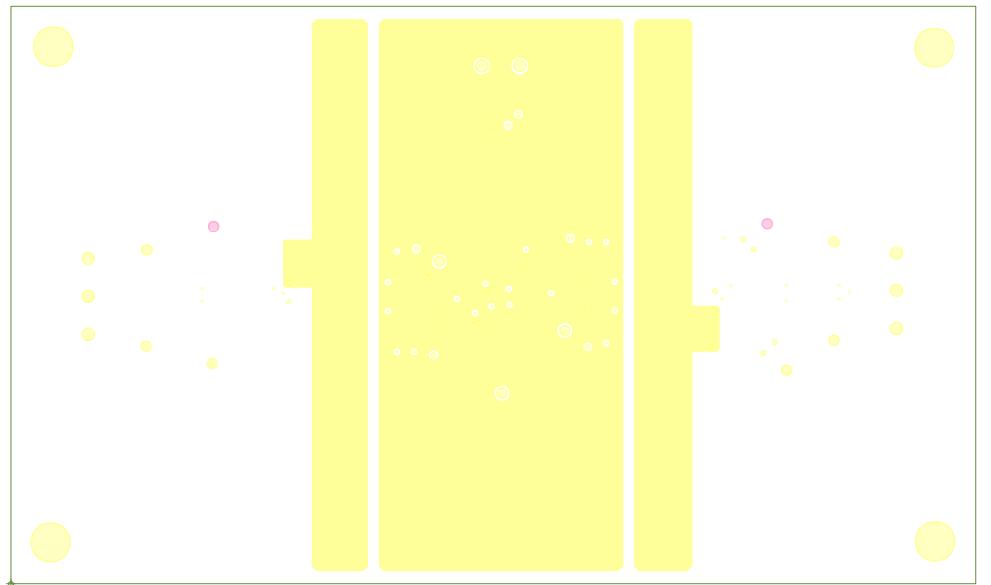


Figure 8. Third Layer

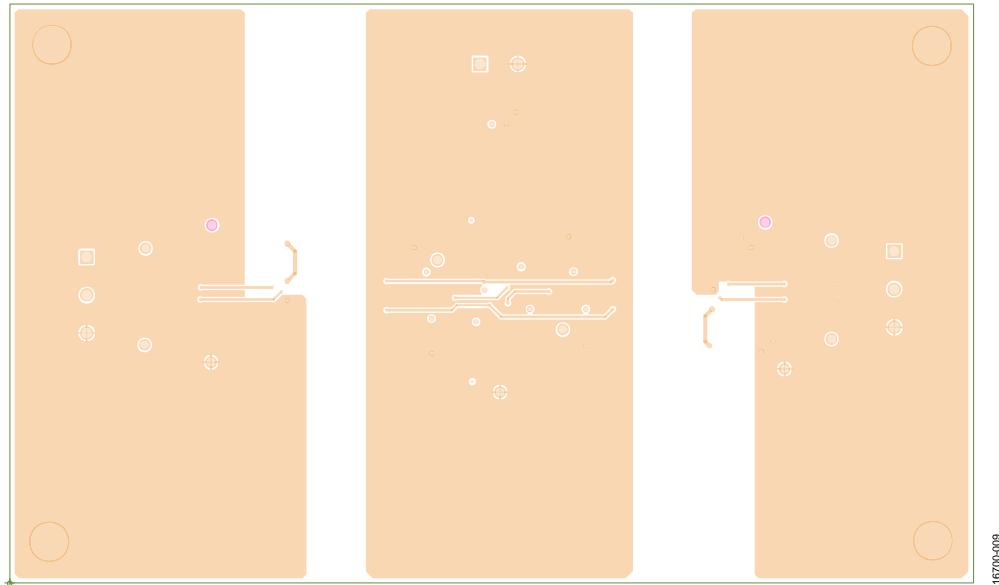


Figure 9. Bottom Layer

ORDERING INFORMATION

BILL OF MATERIALS

Table 1. EVAL-ADM2587EEB2Z Bill of Materials

| Qty | Reference Designator | Description | Manufacturer | Part Number |
|-----|--|---|-------------------------|---------------------------------|
| 7 | C1, C3, C6, C11, C14, C21, C25 | Ceramic X7R capacitor | Würth Elektronik | 885012000000 |
| 2 | C10, C18 | Ceramic NP0 0603 capacitor | AVX | 06035A5R0JAT2A |
| 2 | C12, C15 | Ceramic, multilayer X7R capacitor | KEMET | C0603C101K5RAC |
| 10 | C2, C5, C7, C9, C13, C16, C17, C20, C23, C24 | Ceramic X7R 0603 capacitor | AVX | 06035C104KAT2A |
| 4 | C4, C8, C19, C22 | Ceramic C0G capacitor | TDK | C1608C0G1H103K080AA |
| 2 | D1, D2 | High conductance diode | Fairchild Semiconductor | 1N914BWT |
| 2 | D3, D4 | Transient voltage suppressor diode | Bourns | CDSOT23-SM712 |
| 1 | DS1 | Light emitting diode, surface-mount type D lamp, green | Kingbright | KP-2012SGC |
| 4 | E1, E2, E3, E4 | 0.2 A inductor ferrite bead, 2 Ω maximum dc resistance | Taiyo Yuden | BKH1005LM182-T |
| 2 | P1, P3 | 5 mm pitch, terminal block connector PCB | CamdenBoss Ltd | CTB5000/3 |
| 1 | P2 | 5 mm pitch, terminal block connector PCB | CamdenBoss Ltd | CTB5000/2 |
| 2 | R1, R15 | Film SMD resistor 0805 | Multicomp (SPC) | MC 0.1W 0805 1% 120R. |
| 2 | R9, R10 | Precision, thick film chip resistor 0603 | Panasonic | ERJ-3EKF1911V |
| 2 | R8, R11 | Precision, thick film chip resistor | Panasonic | ERJ-3EKF4301V |
| 2 | R5, R12 | Film SMD resistor 0603 | Multicomp (SPC) | MC 0.063W 0603 1% 3K3. |
| 2 | R7, R13 | Precision, thick film chip resistor R0603 | Panasonic | ERJ-3EKF2150V |
| 2 | R6, R14 | General-purpose chip resistor | Yageo | RC0603FR-0724K9L |
| 2 | R18, R19 | General-purpose, thick film chip resistor | Yageo | RC0603JR-0710KL |
| 1 | R4 | Precision, thick film chip resistor | Panasonic | ERJ-3EKF6980V |
| 6 | TP1, TP2, TP5, TP7, TP10, TP11 | Test point, yellow connector PCB | Vero Technologies Ltd | 20-313140 |
| 3 | TP3, TP6, TP9 | Test point, black connector PCB | Vero Technologies Ltd | 20-2137 |
| 2 | TP4, TP8 | Test point, red connector PCB | Vero Technologies Ltd | 20-313137 |
| 2 | U1, U4 | Analog Devices, Inc., integrated circuit, signal and power isolated RS-485, XCVR ESD protection | Analog Devices | ADM2587EBRWZ |
| 2 | U2, U3 | Analog Devices integrated circuit, single supply, TTL/CMOS comparator | Analog Devices | ADCMP600BRJZ-R2 |

RELATED LINKS

| Resource | Description |
|--------------------------|--|
| ADM2587E | 2.5 kV Signal and Power Isolated, ± 15 kV ESD Protected, Full/Half-Duplex RS-485 Transceiver (500 kbps) |
| AN-1458 | Application Note, Isolated RS-485 Repeater with Automatic Direction Control |
| AN-1349 | Application Note, PCB Implementation Guidelines to Minimize Radiated Emissions on the ADM2582E/ADM2587E RS-485/RS-422 Transceivers |
| AN-960 | Application Note, RS-485/RS-422 Circuit Implementation Guide |
| AN-1109 | Application Note, Recommendations for Control of Radiated Emissions with <i>i</i> Coupler Devices |
| AN-0971 | Recommendations for Control of Radiated Emissions with <i>iso</i> Power Devices |



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.

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