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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 Ω 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 *iso*Power® 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

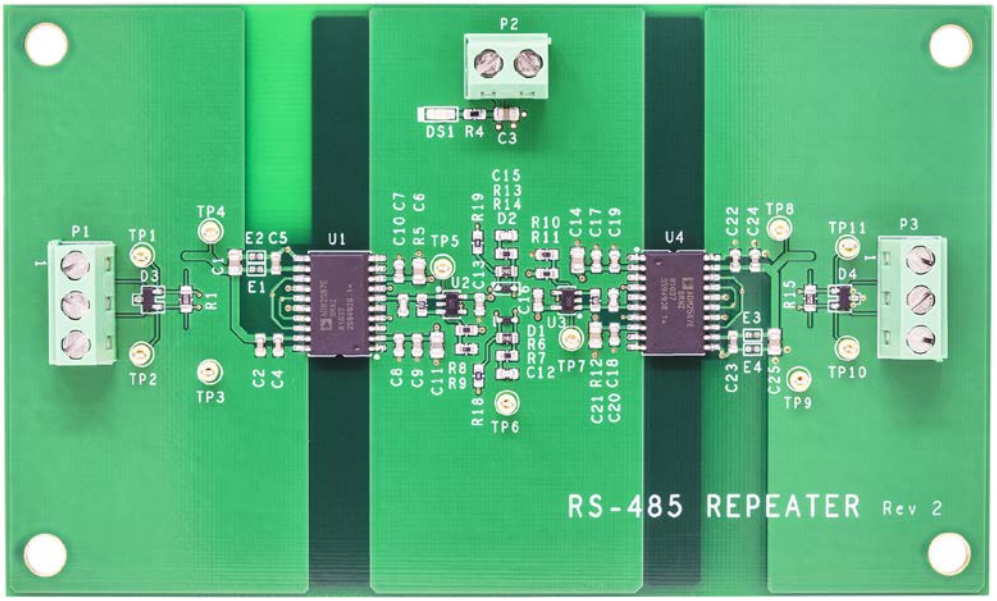

Figure 1.

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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 Ω 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.

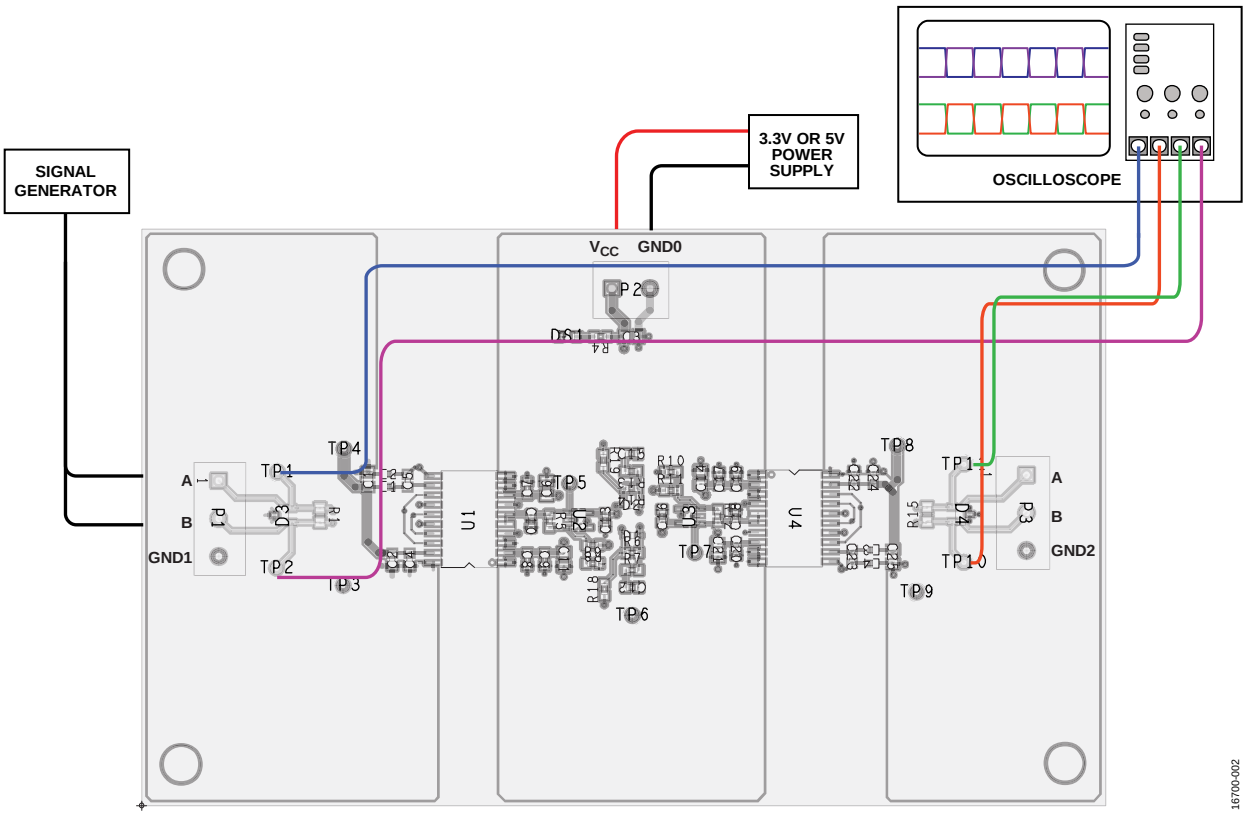

Figure 2. Basic Operation of the EVAL-ADM2587EEB2Z Isolated RS-485 Repeater Evaluation Board

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* i*Coupler® 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 *iso*Power 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.

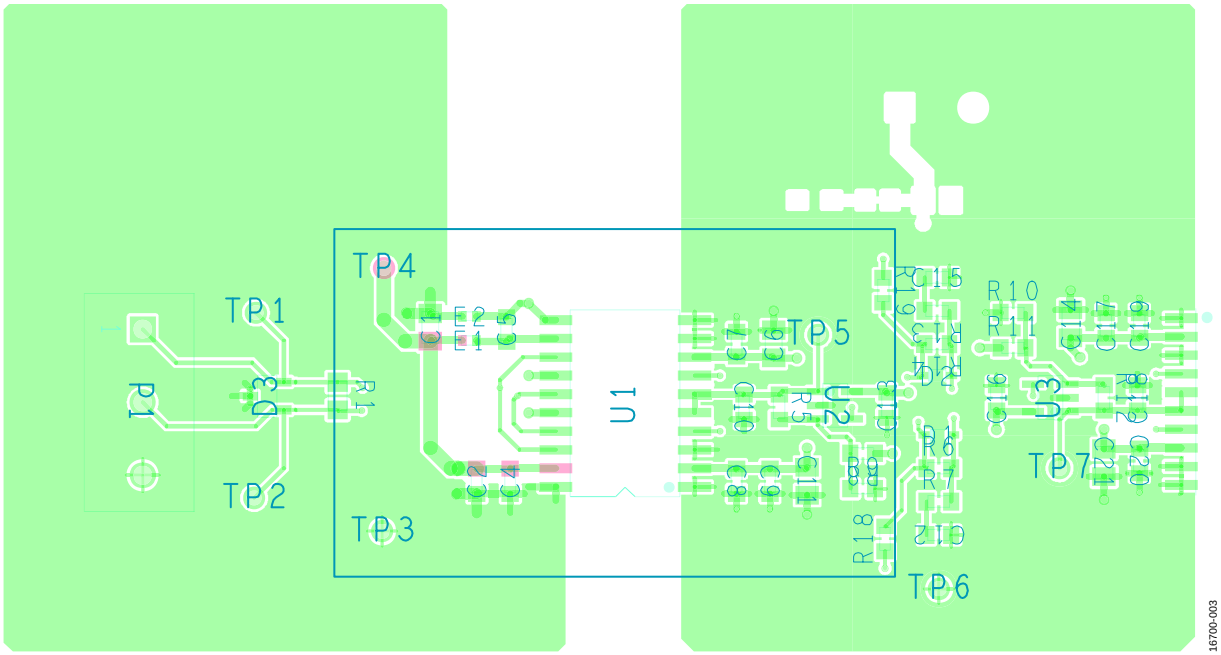

Figure 3. Layout of the EVAL-ADM2587EEB2Z

EVALUATION BOARD SCHEMATICS AND ARTWORK

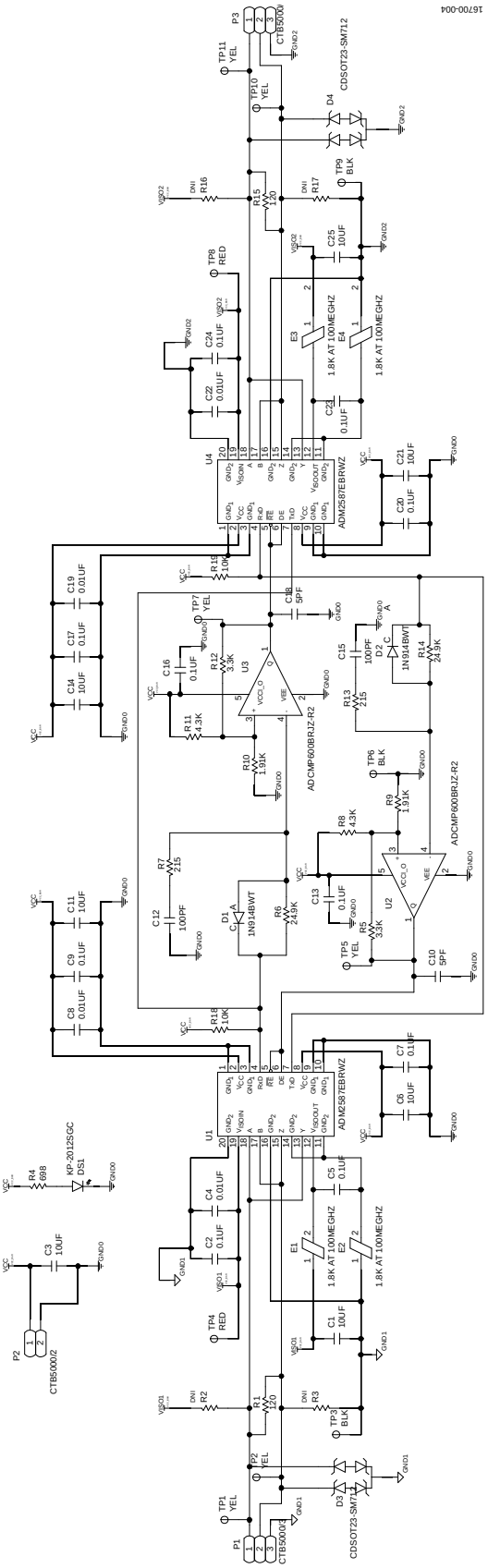

Figure 4. Schematic of the EVAL-ADM2587EEB1Z Evaluation Board

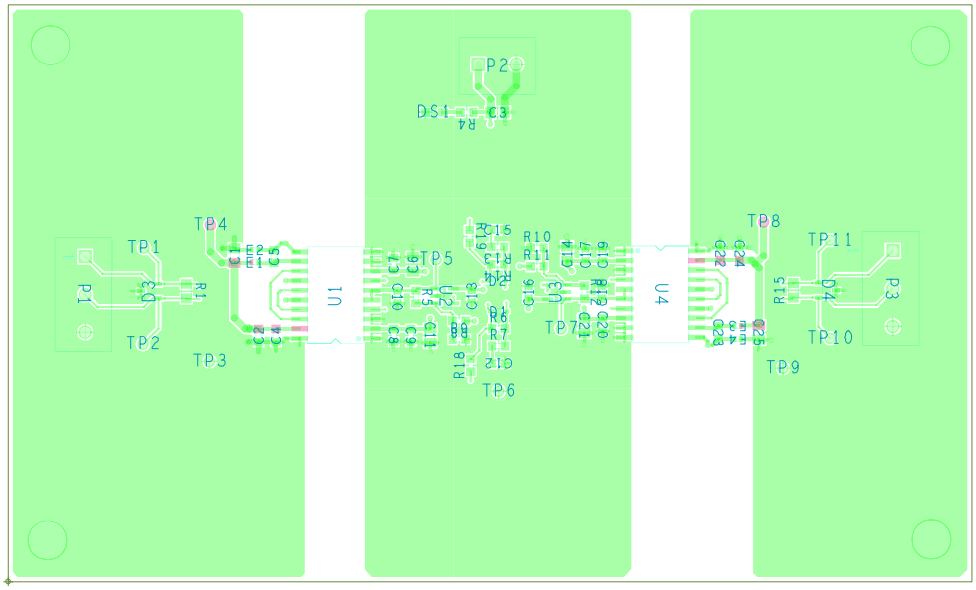

Figure 5. Top Layer/Component Placement

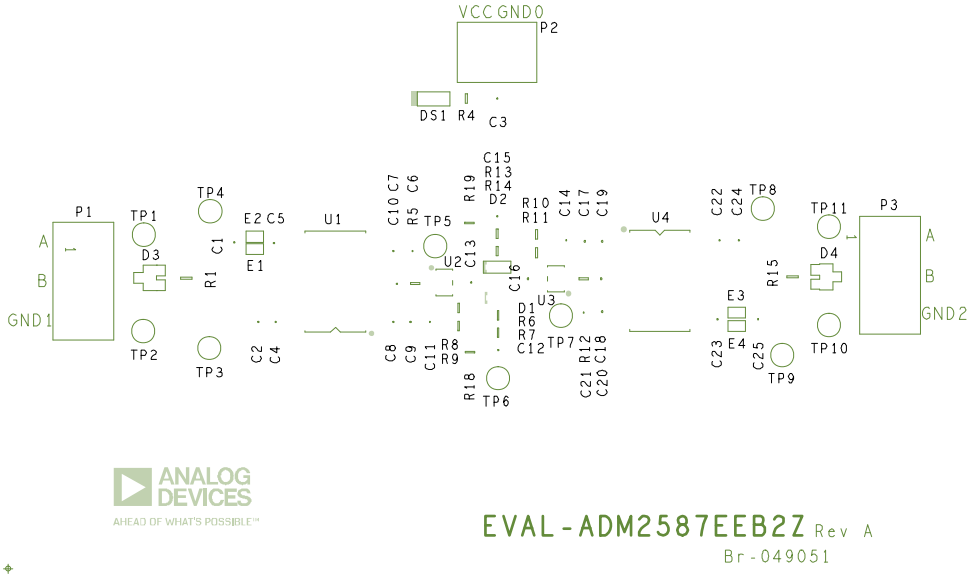

Figure 6. Silkscreen

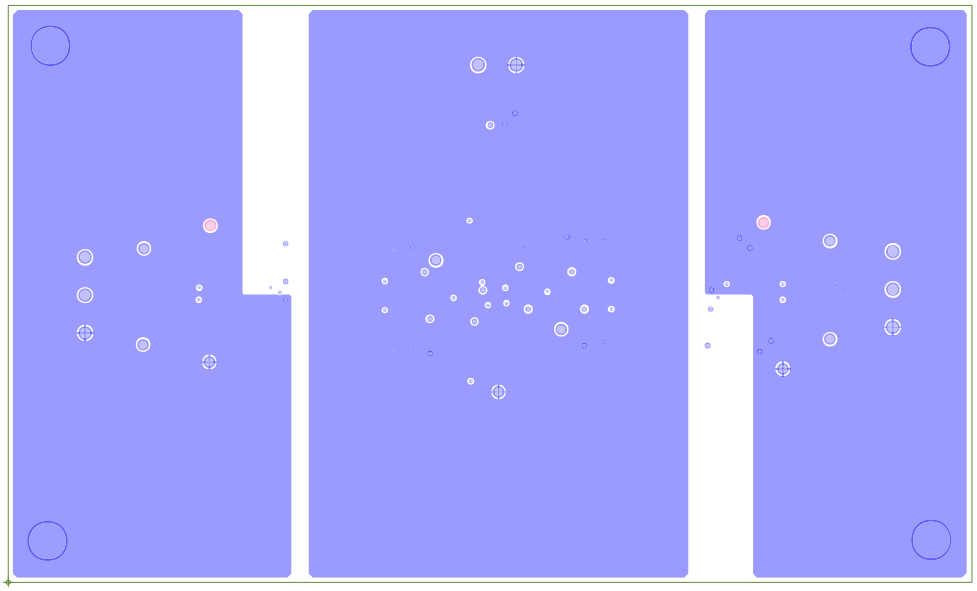

Figure 7. Second Layer

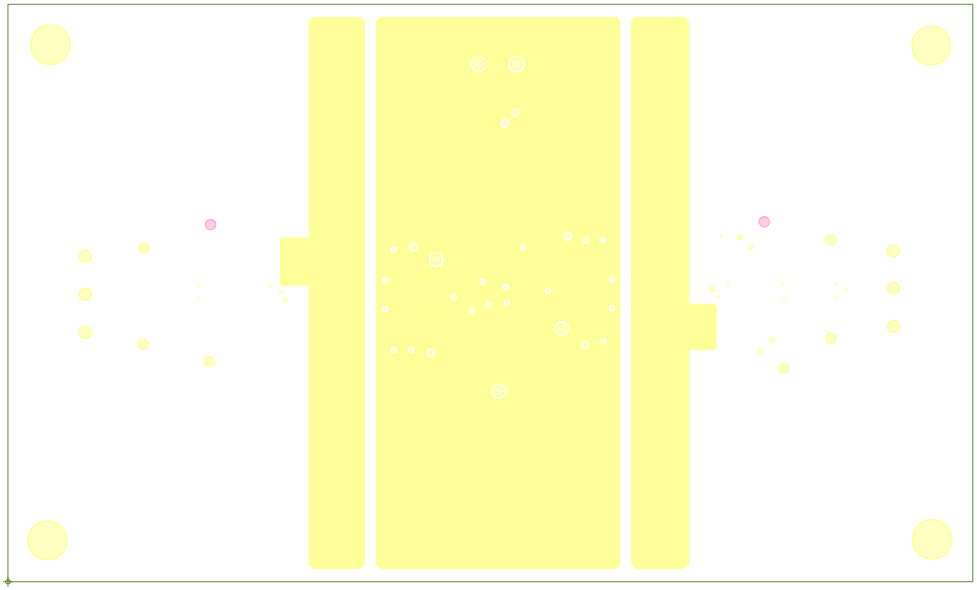

Figure 8. Third Layer

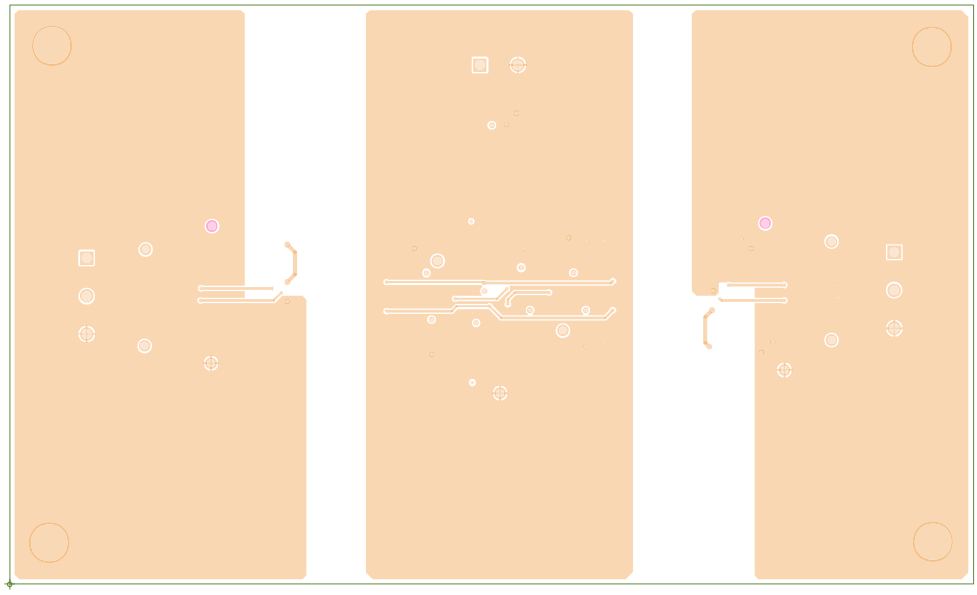

Figure 9. Bottom Layer

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*Coupler Devices
AN-0971	Recommendations for Control of Radiated Emissions with *iso*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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