

Certified Evaluation Board for the **ADM2795E** Robust 5 kV rms Isolated RS-485/RS-422 Transceiver with Level 4 EMC and Full ± 42 V Protection

FEATURES

- 5 kV rms signal isolated RS-485/RS-422 transceiver**
- Convenient connections for power supplies and signals through screw terminal blocks and jumper connections**
- 1.7 V to 5.5 V operating voltage range on VDD1 logic supply**
- 3 V to 5.5 V operating voltage range on VDD2**
- Certified RS-485 A, B bus pin protection, passing**
 - IEC 61000-4-5 surge to ± 4 kV
 - IEC 61000-4-4 electrical fast transient (EFT) to ± 2 kV
 - IEC 61000-4-2 electrostatic discharge (ESD) to ± 8 kV (contact)
 - ± 15 kV (air)
 - IEC 61000-4-6 conducted radio frequency (RF) immunity to Level 3 (10 V/m rms)
- Human body model (HBM) ESD to $> \pm 30$ kV**
- Certified IEC electromagnetic compatibility (EMC) immunity provided by isolation barrier, withstands**
 - IEC 61000-4-5 surge to ± 4 kV
 - IEC 61000-4-4 EFT to ± 2 kV
 - IEC 61000-4-2 ESD to ± 9 kV (contact)
 - ± 8 kV (air)
 - IEC 61000-4-6 conducted RF immunity Level 3 (10 V/m rms)
- Certified evaluation board, passing**
 - IEC 61000-4-3 radiated RF immunity Level 4 (30 V/m)
 - IEC 61000-4-8 magnetic field immunity Level 5 (100 A/m)
 - EN 55022 Class B radiated emissions with 6 dB μ V margin
- Provides A, B bus pin fault protection to ± 42 V ac/dc peak**

EVALUATION KIT CONTENTS

[EVAL-ADM2795EEBZ](#)

GENERAL DESCRIPTION

Use the [EVAL-ADM2795EEBZ](#) to easily evaluate the [ADM2795E](#) 5 kV rms signal isolated RS-485/RS-422 transceiver with Level 4 IEC EMC and 24 V supply fault protection. The [EVAL-ADM2795EEBZ](#) evaluation board is easily configured through jumper connections and screw terminal blocks for signal and power connections. The [EVAL-ADM2795EEBZ](#) can be powered with either a 9 V battery or a standard configurable bench top power supply. An on-board trimmer potentiometer and an on-board regulator circuit on both VDD1 and VDD2 allow easy power configuration when connected to a 9 V battery.

CERTIFIED IEC EMC RS-485 EVALUATION BOARD

The [EVAL-ADM2795EEBZ](#) evaluation board has been lab tested and certified to provide RS-485 A, B bus pin protection against IEC 61000-4-5 surges to ± 4 kV, IEC 61000-4-4 EFT to ± 2 kV, and IEC 61000-4-2 ESD to ± 8 kV for contact and ± 15 kV for air. The [ADM2795E](#) isolation barrier was also tested and certified to provide robust IEC EMC immunity. The [EVAL-ADM2795EEBZ](#) can withstand high voltage faults to ± 42 V ac/dc peak on RS-485 A, B bus pins. The [EVAL-ADM2795EEBZ](#) meets stringent EMI emissions targets with a 6 dB μ V margin from EN 55022 Class B limits, by using a 120 pF, 0603 body size capacitor on the printed circuit board (PCB) trace connected to the Rx/D pin.

EVALUATION BOARD PHOTOGRAPH

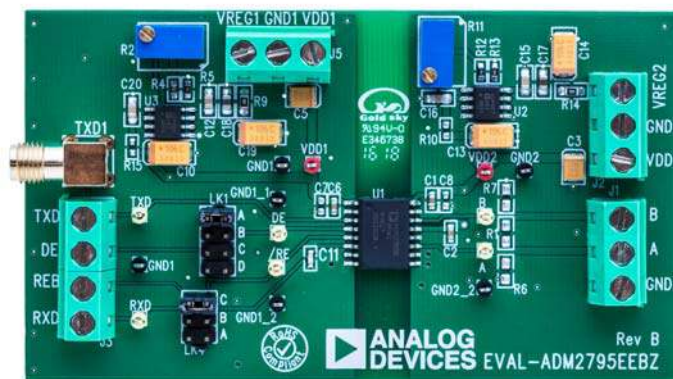


Figure 1.

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REVISION HISTORY

9/2016—Revision 0: Initial Version

EVALUATION BOARD HARDWARE CONFIGURATION

TEST SETUP

The EVAL-ADM2795EEBZ evaluation board is shown in Figure 2 with the default jumper settings on LK1 and LK4 (driver and receiver enabled), power connections on J5 and J2, input signal connection on J3, and probes attached to RXD, TXD, A, and B for a loopback test.

JUMPER SETTINGS

Use the jumpers on the EVAL-ADM2795EEBZ evaluation board to configure the inputs on the ADM2795E (see Table 1). Do not place multiple jumper blocks on LK1 and LK4 because the input sources can short together. For each link, move a single jumper block from one position to another, as specified in Table 1.

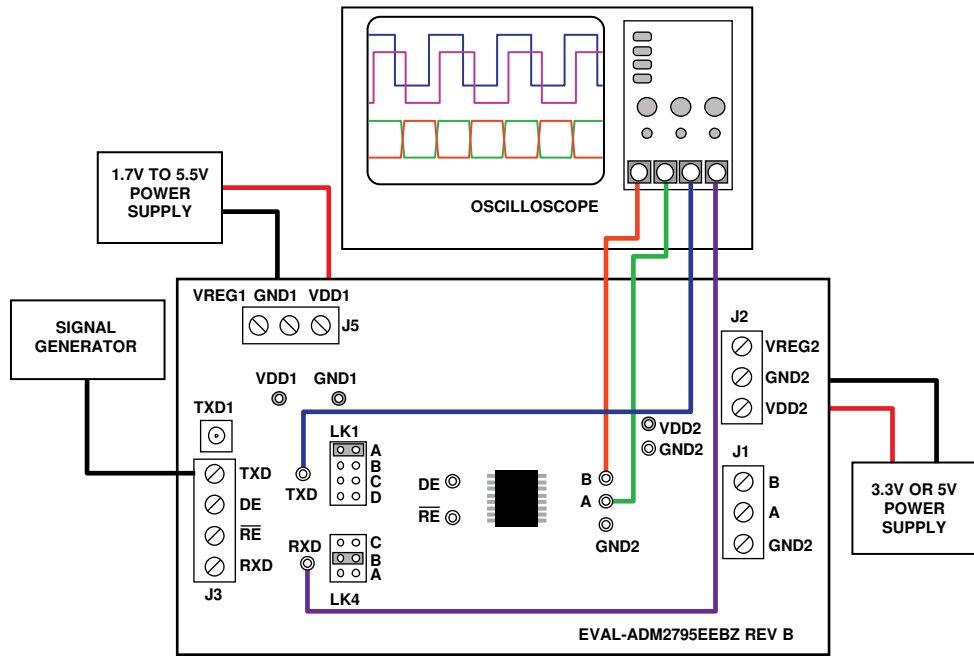


Figure 2. Basic Operation of the Evaluation Board for the ADM2795E Robust 5 kV rms Isolated RS-485 Transceiver with Level 4-EMC and Full ±42 V Protected

Table 1. Jumper Configuration

| Link | Connection | Description |
|------|------------|---|
| LK1 | A | Connects the driver enable input (DE) of the ADM2795E to V _{DD1} . This setting enables the driver. |
| | B | Connects the driver enable input (DE) of the ADM2795E to GND1. This setting disables the driver. |
| | C | Connects the driver enable input (DE) of the ADM2795E to the J3-2 terminal block connector. |
| | D | Connects the driver enable input (DE) of the ADM2795E to the receiver enable input ($\overline{\text{RE}}$); that is, LK7 sets the input for both $\overline{\text{RE}}$ and DE. This setting ensures that when the driver is enabled, the receiver is disabled, or when the driver is disabled, the receiver is enabled. |
| LK4 | A | Connects the receiver enable input ($\overline{\text{RE}}$) of the ADM2795E to V _{DD1} . This setting disables the receiver. |
| | B | Connects the receiver enable input ($\overline{\text{RE}}$) of the ADM2795E to GND1. This setting enables the receiver. |
| | C | Connects the receiver enable input ($\overline{\text{RE}}$) of the ADM2795E to the J3-3 terminal block connector. |

TERMINATION AND PULL-UP/PULL-DOWN RESISTORS

The [EVAL-ADM2795EEBZ](#) evaluation board includes a R1 footprint for fitting a termination resistor between the A and the B driver outputs/receiver inputs. By default, the [EVAL-ADM2795EEBZ](#) is not fitted with a 120 Ω resistor (R1) between the A and B pins. If the [EVAL-ADM2795EEBZ](#) is connected to a bus that is already terminated at both ends, remove this resistor. For more information about proper termination, see the [AN-960 Application Note, RS-485/RS-422 Circuit Implementation Guide](#).

Although the [ADM2795E](#) has a built-in receiver fail-safe for the bus idle condition, there are footprints on the [EVAL-ADM2795EEBZ](#) evaluation board for fitting the R6 pull-up resistor to VDD2 on A, as well as the R7 pull-down resistor to GND2 on B. These resistors can be fitted when the user connects to other devices that require such external biasing resistors on the bus. The exact value required for a 200 mV minimum differential voltage in the bus idle condition depends on the VDD2 supply voltage (for example, 960 Ω for 3.3 V and 1440 Ω for 5 V). For more information about the bus idle fail-safe, see the [AN-960 Application Note, RS-485/RS-422 Circuit Implementation Guide](#).

DECOUPLING AND RESERVOIR CAPACITORS

The [EVAL-ADM2795EEBZ](#) uses the following decoupling and reservoir capacitors:

- On the logic side of the [EVAL-ADM2795EEBZ](#), the C5 and C6 capacitors must be 10 μ F tantalum and 100 nF ceramic capacitors, respectively, and the C7 capacitor must not be fitted.
- On the bus side of the [EVAL-ADM2795EEBZ](#), the C3 and C1 capacitors must be 10 μ F tantalum and 100 nF ceramic capacitors, respectively, and the C8 capacitor must not be fitted. A 100 nF ceramic capacitor (C2) must also be connected between Pin 12 and Pin 13.

Additional capacitors must be added for power regulation circuits:

- The C10, C13, C14, and C19 10 μ F tantalum capacitors must be added to the VDD1 power regulation circuit.
- The C17 and C18 10 μ F ceramic capacitors must be added to the VDD2 power regulation circuit.
- The C12, C15, C16, and C20 100 nF ceramic capacitors must be added to the power regulation circuits.

BOARD INTERNAL LAYER THICKNESS

The [EVAL-ADM2795EEBZ](#) evaluation board consists of two layers. The spacing between the top and bottom layer is 1.6 mm. The [EVAL-ADM2795EEBZ](#) PCB has greater than 0.4 mm between Layer 1 and Layer 2, meeting requirements for isolation standards IEC 61010 Third Edition and IEC 60950, as described in the [AN-1109 Application Note, Recommendations for Control of Radiated Emissions with iCoupler Devices](#).

IEC EMC ROBUST RS-485 EVALUATION BOARD

The [EVAL-ADM2795EEBZ](#) evaluation board has been lab tested and certified to provide RS-485 A, B bus pin protection for the following IEC system level standards and test levels:

- Protection against IEC 61000-4-5 surge to ± 4 kV
- Protection against IEC 61000-4-4 EFT to ± 2 kV
- Protection against IEC 61000-4-2 ESD to ± 8 kV for contact and ± 15 kV for air
- IEC 61000-4-6 conducted RF immunity to Level 3 (10 V/m rms)

The [EVAL-ADM2795EEBZ](#) was lab tested and confirmed to pass HBM ESD to $> \pm 30$ kV on the RS-485 A, B bus pins.

The [EVAL-ADM2795EEBZ](#) was lab tested and certified as follows to a number of IEC standards showing the robust EMC immunity provided by the isolation barrier:

- Withstands IEC 61000-4-5 surge to ± 4 kV
- Withstands IEC 61000-4-4 EFT to ± 2 kV
- Withstands IEC 61000-4-2 ESD ± 9 kV contact and ± 8 kV air
- IEC 61000-4-6 conducted RF immunity Level 3 (10 V/m)

The [EVAL-ADM2795EEBZ](#) evaluation board meets stringent EMI emissions targets (EN55022 Class B) with minimal PCB layout considerations. To achieve a 6 dB μ V/m margin from EN55022 Class B limits, a 120 pF, 0603 body size capacitor must be added on the PCB trace connected to the RxD pin. The [EVAL-ADM2795EEBZ](#) evaluation board also meets the following immunity standards:

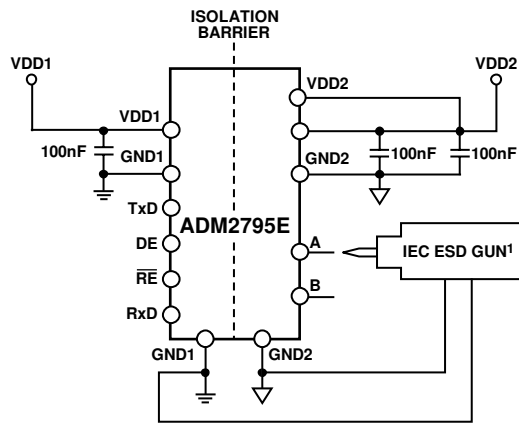
- IEC 61000-4-3 radiated RF immunity Level 4 (30 V/m)
- IEC 61000-4-8 magnetic field immunity Level 5 (100 A/m)

The [EVAL-ADM2795EEBZ](#) evaluation board can withstand high voltage faults to ± 42 V ac/dc peak on RS-485 A, B bus pins.

IEC 61000-4-2 ELECTROSTATIC DISCHARGE (ESD)

The IEC 61000-4-2 ESD standard describes the tests using two coupling methods: contact discharge and air gap discharge. Contact discharge implies a direct contact between the discharge gun and the unit under test. During air discharge testing, the charged electrode of the discharge gun moves toward the unit under test until a discharge occurs as an arc across the air gap. The discharge gun does not make direct contact with the unit under test. The ADM2795E data sheet provides additional information on the IEC 61000-4-2 ESD standard, including test waveforms. Figure 3 shows an example test setup where the EVAL-ADM2795EEBZ PCB was tested to both contact and air discharge IEC 61000-4-2 ESD. Testing was performed in normal transceiver operation, with the ADM2795E clocking data at 2.5 Mbps. Testing was performed with the IEC ESD gun connected to the Local Bus Ground 2 (GND2), and in this configuration, Table 2 shows that the ADM2795E protects against IEC 61000-4-2 Level 4.

In addition, testing was performed with an IEC ESD gun connected to the logic side, Ground 1 (GND1). Testing to GND1 demonstrates the robustness of the ADM2795E isolation barrier. The isolation barrier is capable of withstanding the IEC ESD test levels as described in Table 2. Table 11 details the Class B compliance of the ADM2795E to the IEC 61000-4-2 ESD.

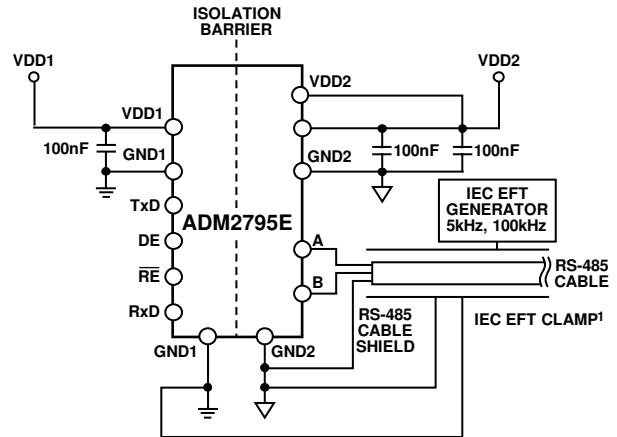


¹IEC ESD GUN GROUND RETURN PATH IS CONNECTED TO EITHER GND1 OR GND2
 Figure 3. IEC 61000-4-2 ESD Testing to GND1 or GND2

IEC 61000-4-4 ELECTRICAL FAST TRANSIENTS (EFT)

During IEC 61000-4-4 EFT testing, EFT fast burst transients were coupled onto RS-485 communication lines using a capacitive clamp, as shown in Figure 4. The IEC EFT clamp edge was placed at 50 cm away from the equipment under test, EUT (EVAL-ADM2795EEBZ). The EFT generator was setup for both 5 kHz and 100 kHz repetitive EFT bursts. The ADM2795E data sheet provides additional information on the IEC 61000-4-4 EFT standard, including test waveforms. Testing was performed in normal transceiver operation, with the ADM2795E clocking data at 2.5 Mbps.

With the IEC EFT clamp connected to GND2, the ADM2795E is robust to IEC EFT transients and protects against the highest level recognized in the Level 4 standard, which defines a voltage level of ±2 kV. With the IEC EFT clamp connected to GND1, the ADM2795E is robust to IEC EFT transients and withstands up to ±2 kV. Testing to GND1 demonstrates the robustness of the ADM2795E isolation barrier. Table 3 summarizes the IEC 61000-4-4 EFT certified test results. Table 3 results are valid for setup with or without an RS-485 cable shield connection to GND2. Table 11 details the Class B compliance of the ADM2795E to the IEC 61000-4-4 EFT.



¹IEC EFT CLAMP GROUND RETURN PATH IS CONNECTED TO EITHER GND1 OR GND2
 Figure 4. IEC 61000-4-4 EFT Testing to GND1 or GND2

Table 2. IEC 61000-4-2 ESD Certified Test Results

| ESD Gun Connection Point | IEC 61000-4-2 Test Result | Certified Result |
|--------------------------|--|------------------|
| GND2 | ±15 kV for air and ±8 kV for contact, Level 4 protection | Yes |
| GND1 | Withstands ±8 kV for air and ±9 kV for contact | Yes |

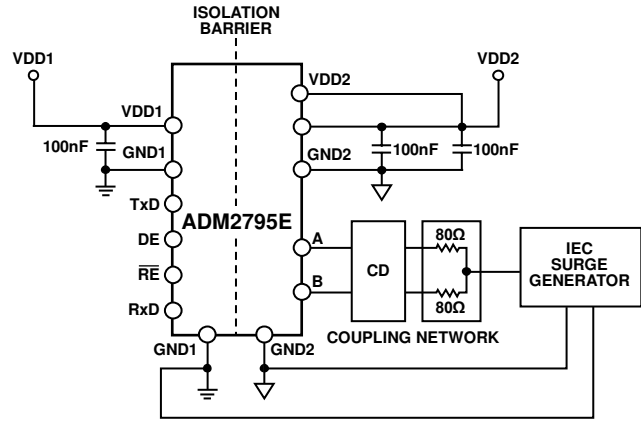
Table 3. IEC 61000-4-4 EFT Certified Test Results

| EFT Clamp Connection Point | IEC 61000-4-4 Test Result | Certified Result |
|----------------------------|---------------------------|------------------|
| GND2 | ±2 kV Level 4 protection | Yes |
| GND1 | Withstands ±2 kV | Yes |

IEC 61000-4-5 SURGE

IEC 61000-4-5 surge testing involved using a coupling network to couple the surge transient into the RS-485 A, B bus pins. The coupling network for a half duplex RS-485 device consists of an 80 Ω resistor on both the A and B lines and a coupling device. The total parallel sum of the resistance is 40 Ω. The coupling device (CD) can be capacitors, gas arrestors, clamping devices, or any method that allows the EUT to function correctly during the applied test. During the surge test, five positive and five negative pulses were applied to the data ports with a maximum time interval of one minute between each pulse. Testing was performed in normal transceiver operation with the [ADM2795E](#) clocking data at 2.5 Mbps. Figure 5 shows the test setup for surge testing. The [ADM2795E](#) data sheet provides additional information on the IEC 61000-4-5 surge, including test waveforms.

With the IEC surge generator connected to GND2, the [ADM2795E](#) is robust to IEC 61000-4-5 events and protects against the highest level recognized in the Level 4 standard, which defines a peak voltage of ±4 kV.



¹IEC SURGE GENERATOR GROUND RETURN PATH IS CONNECTED TO EITHER GND1 OR GND2

Figure 5. IEC 61000-4-5 Surge Testing to GND1 or GND2

With the IEC surge generator connected to GND1, the [ADM2795E](#) is robust to IEC 61000-4-5 events and withstands up to ±4.0 kV. Testing to GND1 demonstrates the robustness of the [ADM2795E](#) isolation barrier. Table 4 summarizes the certified test results. Table 11 details the Class B compliance of the [ADM2795E](#) to the IEC 61000-4-5 surge when tested to GND2, and Class A compliance of the [ADM2795E](#) to the IEC 61000-4-5 surge when tested to GND1.

Table 4. IEC 61000-4-5 Surge Certified Test Results

| Surge Generator Connection Point | IEC 61000-4-5 Test Result | Certified Result |
|----------------------------------|---------------------------|------------------|
| GND2 | ±4 kV Level 4 protection | Yes |
| GND1 | Withstands ±4 kV | Yes |

IEC 61000-4-6 CONDUCTED RF IMMUNITY

The EVAL-ADM2795EEBZ was lab tested and certified to pass IEC 61000-4-6 conducted RF immunity testing to Level 3 (10 V/m rms). The IEC 61000-4-6 conducted immunity test is applicable to products that operate in environments where RF fields are present, and where they are connected to the mains power supplies or other networks (signal or control lines). The source of conducted disturbances are electromagnetic fields, emanating from RF transmitters that may act on the whole length of cables connected to installed equipment. In the IEC 61000-4-6 test, the RF voltage swept and stepped from 150 kHz to 80 MHz. The RF voltage was amplitude modulated 80% at 1 kHz. The RF voltage was applied to the EUT (one EVAL-ADM2795EEBZ) using a clamp, as specified in Table 6. The clamp was placed on

a communications cable between two EVAL-ADM2795EEBZ. The ADM2795E was tested to Level 3, which is the highest test level of 10 V. For all testing, the equipment and EUT setup is described in Table 5 and Figure 6. For all tests, the IEC 61000-4-6 clamp was placed at the EVAL-ADM2795EEBZ EUT, and the cable shield was either floating or earthed. The second EVAL-ADM2795EEBZ (auxiliary equipment) was placed on the network to terminate the communications bus. Table 6 shows the test results where the EUT passed IEC 61000-4-6 to Level 3. The IEC 61000-4-6 generator clamp was connected to either GND1 or GND2 to provide a return current path for the IEC 61000-4-6 transient current.

Table 11 details the Class A compliance of the ADM2795E to the IEC 61000-4-6 conducted RF immunity.

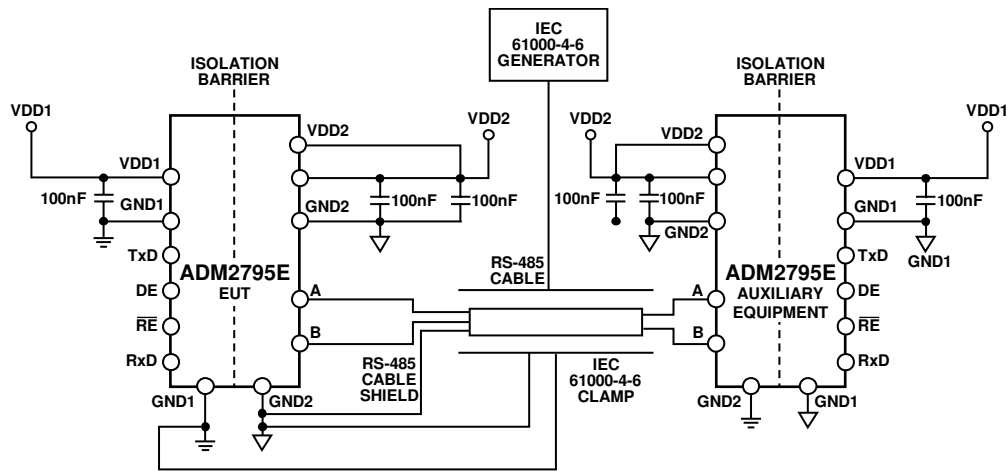


Figure 6. IEC 61000-4-6 Conducted RF Immunity Example Test Setup

Table 5. IEC 61000-4-6 EUT Set Up and Equipment

| Parameter | Details |
|--------------------------|---|
| IEC 61000-4-6 Clamp | Schaffner KEMZ 801, placed at 30 cm away from the EUT |
| IEC 61000-4-6 Test Level | Level 3, 0.15 MHz to 100 MHz, 10 V/m rms, 80% amplitude modulated by a 1 kHz sinusoidal |
| EUT | EVAL-ADM2795EEBZ |
| EUT Data Rate | 2.5 Mbps |
| EUT Power | 9 V battery at VDD1 and VDD2, regulated on EUT to 5 V |
| Cable Between EUT | 5 m, Unित्रonic ProfiBus, 22 American wire gauge (AWG) |
| Cable Termination | 120 Ω resistor at both cable ends |
| Pass/Fail Criteria | Pass: data at receiver with a pulse width distortion within 10% of mean |

Table 6. IEC 61000-4-6 Conducted RF Immunity Certified Test Results

| Clamp Location | Cable Shield | Current Return Path | IEC 61000-4-6 Test Frequency (MHz) | Certified Result |
|----------------|--------------|---------------------|------------------------------------|------------------|
| 30 cm from EUT | Floating | GND1 | 0.15 to 80 | Pass |
| 30 cm from EUT | Earthed | GND1 | 0.15 to 80 | Pass |
| 30 cm from EUT | Floating | GND2 | 0.15 to 80 | Pass |
| 30 cm from EUT | Earthed | GND2 | 0.15 to 80 | Pass |

IEC 61000-4-3 RADIATED RF IMMUNITY

Testing to IEC 61000-4-3 ensures that electronic equipment is immune to commonly occurring radiated RF fields. Some commonly occurring unintentional RF emitting devices in an industrial application are electric motors and welders.

In the IEC 61000-4-3 test, an antenna in a shielded anechoic chamber using a precalibrated field, swept from 80 MHz to 2.7 GHz, generated a radiated RF field. The RF voltage was amplitude modulated 80% at 1 kHz. Each face of the EUT was subjected to vertical and horizontal polarizations.

Figure 7 shows the IEC 61000-4-3 radiated RF immunity test setup with the EUT (EVAL-ADM2795EEBZ) placed in an anechoic chamber, powered with two 9 V batteries. The EVAL-ADM2795EEBZ on-board regulators power VDD1 and VDD2 at 5 V. The EVAL-ADM2795EEBZ is loaded with a R1 termination 120 Ω resistance (see Figure 12) for the duration of the test. A pattern generator provides 2.5 Mbps of data input to the ADM2795E TxD pin. The ADM2795E receiver output (RxD) was monitored with an oscilloscope.

The pass criteria is less than a 10% change in the bit width of the RxD signal in the presence of the IEC 61000-4-3 radiated RF field.

The EVAL-ADM2795EEBZ was tested and certified to pass the IEC 61000-4-3 radiated RF immunity testing to Level 4 (30 V/m). Level 4 is the highest level in the IEC 61000-4-3 standard. Table 11 details the Class A compliance of the ADM2795E to the IEC 61000-4-3 radiated RF immunity.

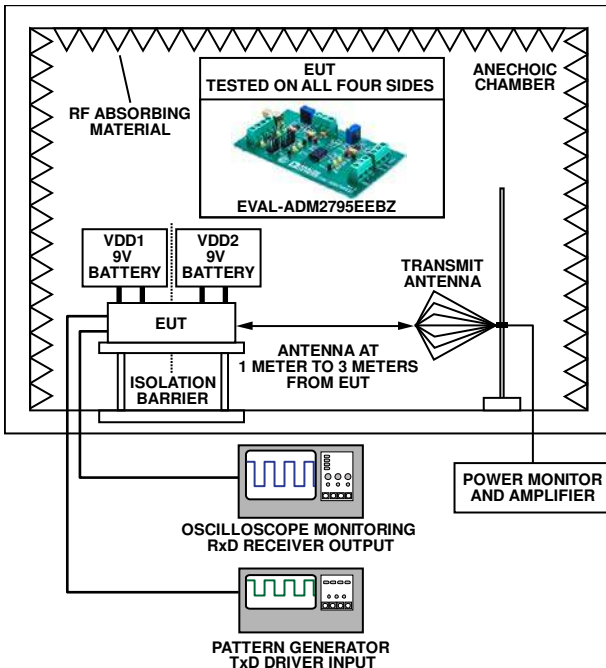


Figure 7. IEC 61000-4-3 Radiated RF Immunity Test Setup

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IEC 61000-4-8 MAGNETIC IMMUNITY

Testing to IEC 61000-4-8 ensures that electronic equipment is immune to commonly occurring magnetic fields. The source of magnetic fields in typical industrial communication applications is a power line current or 50/60 Hz transformers in close proximity to equipment.

In the IEC 61000-4-8 test, a controlled magnetic field of defined field strength was produced by driving a large coil (induction coil) with a test generator. The EUT was placed at the center of the induction coil, subjecting the EUT to a magnetic field.

Figure 8 shows the IEC 61000-4-8 magnetic immunity test setup with the EUT (EVAL-ADM2795EEBZ) placed in an anechoic chamber, powered with two 9 V batteries. The EVAL-ADM2795EEBZ on-board regulators power VDD1 and VDD2 at 5 V. The EVAL-ADM2795EEBZ is loaded with a R1 termination 120 Ω resistance (see Figure 12) for the duration of the test. A pattern generator provides 2.5 Mbps of data input to the ADM2795E TxD pin. The ADM2795E receiver output (RxD) was monitored with an oscilloscope. The pass criteria is less than a 10% change in the bit width of the RxD signal in the presence of the IEC 61000-4-8 magnetic field.

The EVAL-ADM2795EEBZ was tested and certified to pass IEC 61000-4-8 magnetic immunity testing to Level 5 (100 A/m). Level 5 is the highest level specified in the IEC 61000-4-8 standard. Table 11 details the Class A compliance of the ADM2795E to the IEC 61000-4-8 magnetic immunity.

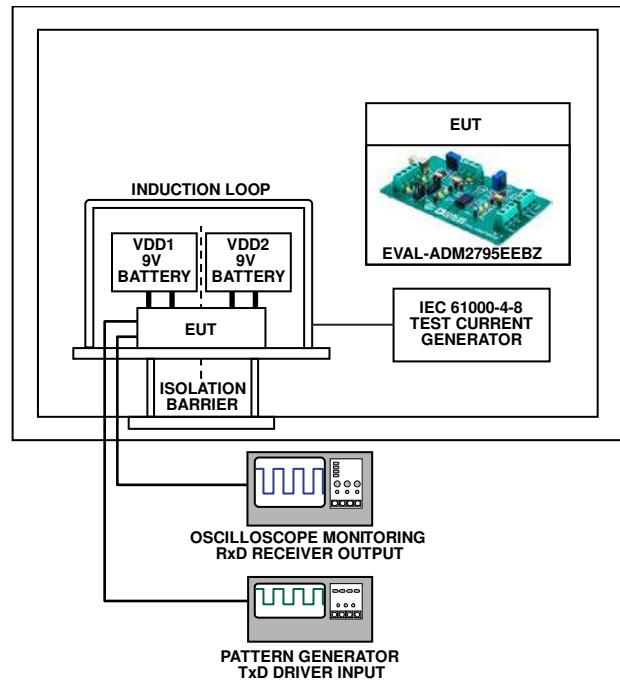


Figure 8. IEC 61000-4-8 Magnetic Immunity Test Setup

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±42 V FAULT PROTECTION

The ADM2795E is protected against high voltage miswire events when it operates on a bus that does not have RS-485 termination or bus biasing resistors installed. A typical miswire event is where a high voltage 24 V ac/dc power supply is connected directly to RS-485 bus pin connectors. The ADM2795E can withstand miswiring faults of up to ±42 V peak on the RS-485 bus pins with respect to GND₂ without damage. Miswiring protection is guaranteed on the ADM2795E RS-485 A, B bus pins and is guaranteed in the case of a hot swap of connectors to the bus pins. Table 7 and Table 8 provide a summary of the high voltage miswire protection offered by the ADM2795E. The EVAL-ADM2795EEBZ was tested with ±42 V dc and with ±24 V ± 20% rms, 50 Hz/60Hz, with both a hot plug and dc ramp test waveforms. The test was performed in both powered and unpowered/floating power supply cases, and at a range of different states for the RS-485 Tx/D input and DE/RE enable pins. The RS-485 bus pins survive a high voltage miswire from Pin A to ground, from Pin B to ground, and between Pin A and Pin B.

Table 7. Miswire Protection Table Abbreviations

| Letter | Description |
|--------|------------------------------|
| H | High level for logic pin |
| L | Low level for logic pin |
| X | On or off power supply state |

Table 8. High Voltage Miswire Protection

| Supply | | Inputs | | | Miswire Protection at RS-485 Outputs Pins ^{1,2} |
|------------------|------------------|--------|-----|-----|--|
| V _{DD1} | V _{DD2} | DE | RE | TxD | |
| X | X | H/L | H/L | H/L | -42 V dc ≤ V _A ≤ +42 V dc |
| X | X | H/L | H/L | H/L | -42 V dc ≤ V _B ≤ +42 V dc |
| X | X | H/L | H/L | H/L | -42 V ac ≤ V _A ≤ +42 V ac |
| X | X | H/L | H/L | H/L | -42 V ac ≤ V _B ≤ +42 V ac |

¹ This is the ac/dc peak miswire voltage between Pin A and GND₂, or Pin B and GND₂, or between Pin A and Pin B.
² V_A refers to the voltage on Pin A, and V_B refers to the voltage on Pin B.

RS-485 NETWORK BIASING AND TERMINATION

For a high voltage miswire on the RS-485 A, B bus pins with biasing and termination resistors installed, there is a current path through the biasing network to the ADM2795E power supply V_{DD2} pin. To protect the ADM2795E in this scenario, the device has an integrated V_{DD2} protection circuit. The ADM2795E is the only fault protected RS-485 device on the market that also features protection for its power supply pin. This protection means that the current path through the R1 pull-up resistor does not cause damage to the V_{DD2} pin, although the pull-up resistor itself can be damaged if it is not appropriately power rated (see Figure 9). The R1 pull-up resistor, power rating depends on the miswire voltage and the resistance value.

If there is a miswire between the A and the B pins in the Figure 9 bus setup, the ADM2795E is protected, but the RT bus termination resistor can be damaged if not appropriately power rated. The RT termination resistor, power rating depends on the miswire voltage and the resistance value.

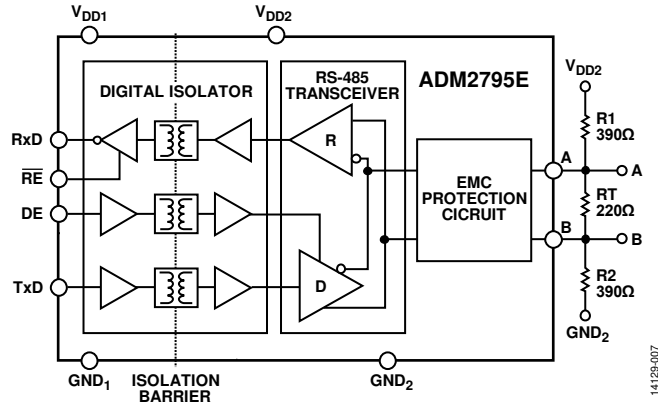


Figure 9. High Voltage Miswiring Protection for the ADM2795E with Bus Termination and Biasing Resistors

PASSING EN 55022 CLASS B RADIATED EMISSIONS

The EVAL-ADM2795EEBZ passed the EN 55022 Class B radiated emissions standard. The EVAL-ADM2795EEBZ was configured and tested with 1.7 V VDD1 and 3.0 V VDD2 power supplies, and it was also tested with 5.0 V VDD1 and 5.0 V VDD2 power supplies. Testing was performed at a 2.5 Mbps clock data on the TxD input. The RS-485 A, B bus pins were loaded with a 120 Ω termination resistor. Testing was also performed without a 120 Ω termination resistor.

Measurements were done in a semianechoic chamber at 10 meters within the 30 MHz to 2 GHz frequency range. Table 9 shows the list of test equipment used. Figure 10 and Figure 11 show the results of the worst case horizontal and vertical scans with 5.0 V VDD1 and 5.0 V VDD2 power supplied to the ADM2795E, using 9 V batteries and on-board regulator circuitry, with data switching at the 2.5 Mbps clock on TxD, and a 120 Ω termination resistor installed at R1 on the EVAL-ADM2795EEBZ. Table 10 details the certified results. The EVAL-ADM2795EEBZ evaluation board meets the EN 55022 Class B emission standard with more than a 6 dB μV margin. To obtain a 6 dB μV margin, it is recommended that a 120 pF, 0603 body size capacitor be added on the PCB trace connected to the RxD pin. EN 55022 Class B certification documents for the EVAL-ADM2795EEBZ evaluation board are available upon request from Analog Devices, Inc.

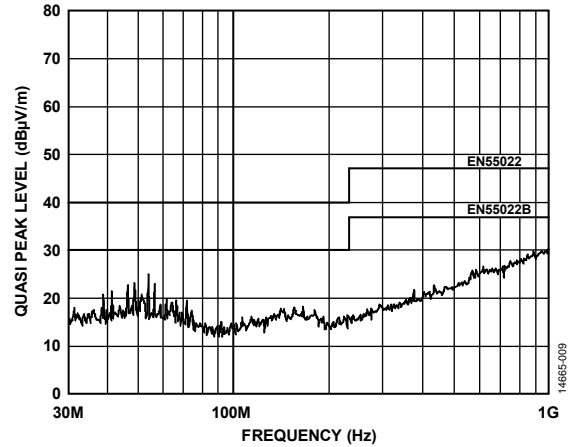


Figure 11. Worst Case Vertical Emissions, VDD1 = VDD2 = 5 V

Table 9. Radiated Emissions Test Equipment

| Instrument | Manufacturer | Model |
|--------------------|-----------------|----------------|
| Measuring Receiver | Rohde & Schwarz | ESVS30 |
| Bilog Antenna | Chase | Not applicable |
| Spectrum Analyzer | Agilent | E4408B |
| Horn Antenna | EMCO | EMCO 3115 |

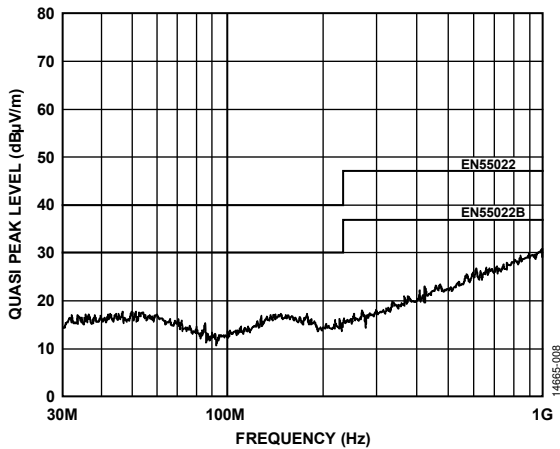


Figure 10. Worst Case Horizontal Emissions, VDD1 = VDD2 = 5.0 V

Table 10. EVAL-ADM2795EEBZ 5.0 V VDD1/VDD2 EN 55022 Certified Test Results

| Frequency (MHz) | Quasipeak Level dB (μV/m) | EN55022 Class B dB (μV/m) | Antenna Position | Pass/Fail |
|-----------------|---------------------------|---------------------------|------------------|----------------------------------|
| 46.272 | 23.9 | 30 | Vertical | Pass, with 6.1 dB (μV/m) margin |
| 48.776 | 23.7 | 30 | Vertical | Pass, with 6.3 dB (μV/m) margin |
| 48.772 | 16.8 | 30 | Horizontal | Pass, with 13.2 dB (μV/m) margin |
| 65.132 | 16 | 30 | Horizontal | Pass, with 14.0 dB (μV/m) margin |

Table 11 summarizes the EVAL-ADM2795EEBZ performance and classification achieved for the noted IEC system level EMC standards.

The performance that corresponds to each classification follows:

- Class A means normal operation.
- Class B means a temporary loss of performance (bit errors).
- Class C means that the system needs a reset.
- Class D means a permanent loss of function.

Table 11. EVAL-ADM2795EEBZ Performance and Classification Achieved

| Test | Ground Connection | Classification | Highest Pass Level |
|---|-------------------|----------------|-------------------------------|
| IEC 61000-4-5 Surge | GND1 | Class A | ±4 kV |
| | GND2 | Class B | ±4 kV |
| IEC 61000-4-4 Electrical Fast Transient (EFT) | GND1 | Class B | ±2 kV |
| | GND2 | Class B | ±2 kV |
| IEC 61000-4-2 Electrostatic Discharge (ESD) | GND1 | Class B | ±8 kV (air), ±9 kV (contact) |
| | GND2 | Class B | ±15 kV (air), ±8 kV (contact) |
| IEC 61000-4-6 Conducted RF Immunity | GND1 | Class A | 10 V/m |
| | GND2 | Class A | 10 V/m |
| IEC 61000-4-3 Radiated RF Immunity | GND2 | Class A | 30 V/m |
| IEC 61000-4-8 Magnetic Immunity | GND2 | Class A | 100 A/m |

EVALUATION BOARD SCHEMATICS

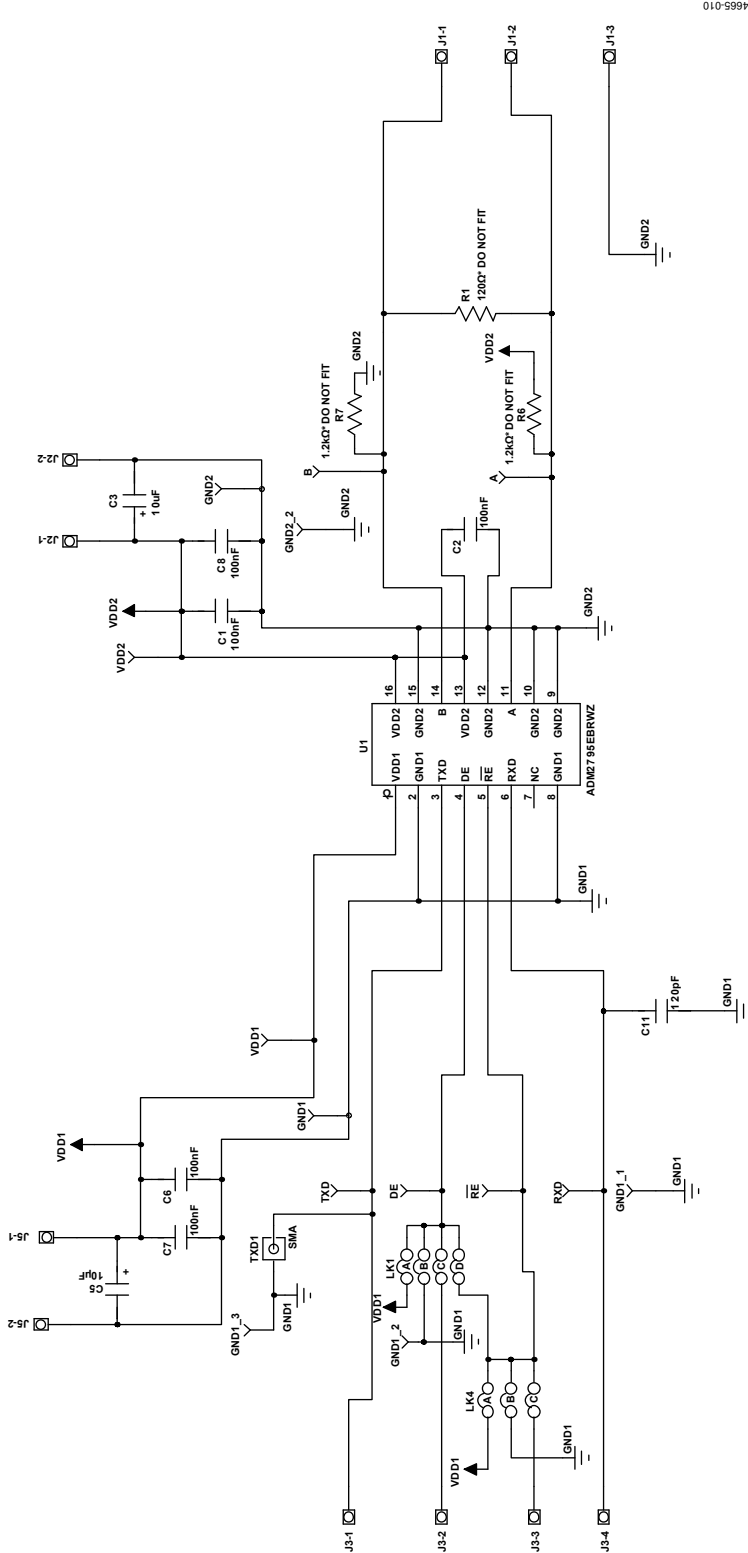


Figure 12. Schematics of the EVAL-ADM2795EEBZ Evaluation Board, Page 1

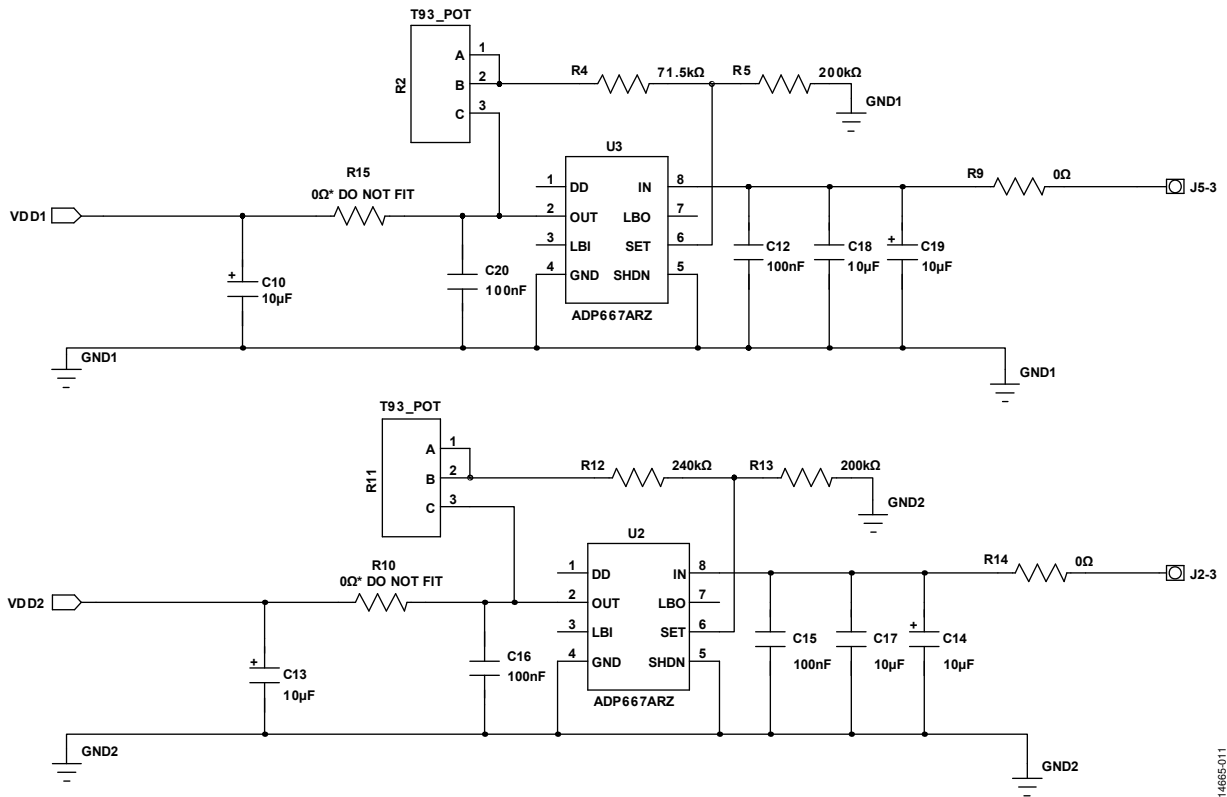


Figure 13. Schematics of the EVAL-ADM2795EEBZ Evaluation Board, Page 2

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ASSEMBLY DRAWINGS AND BOARD LAYOUT

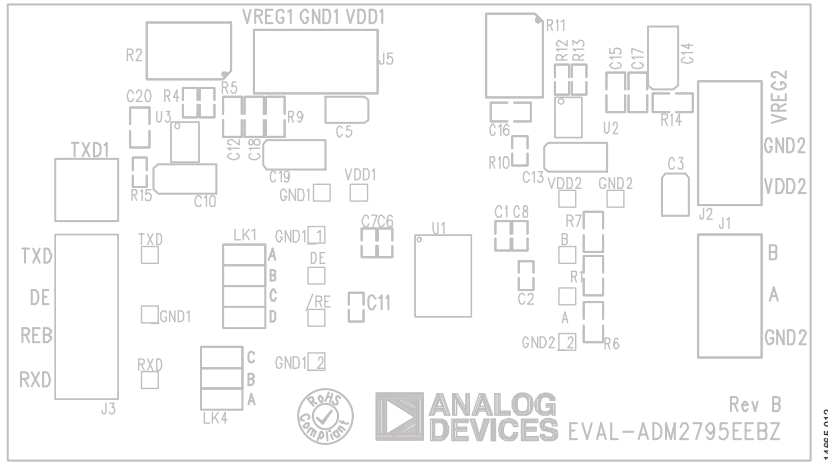


Figure 14. EVAL-ADM2795EEBZ Evaluation Board Silkscreen

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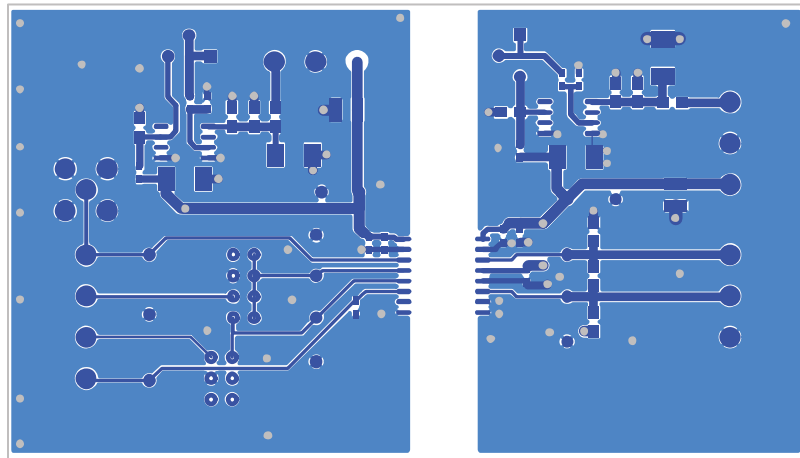


Figure 15. EVAL-ADM2795EEBZ Evaluation Board Top Layer

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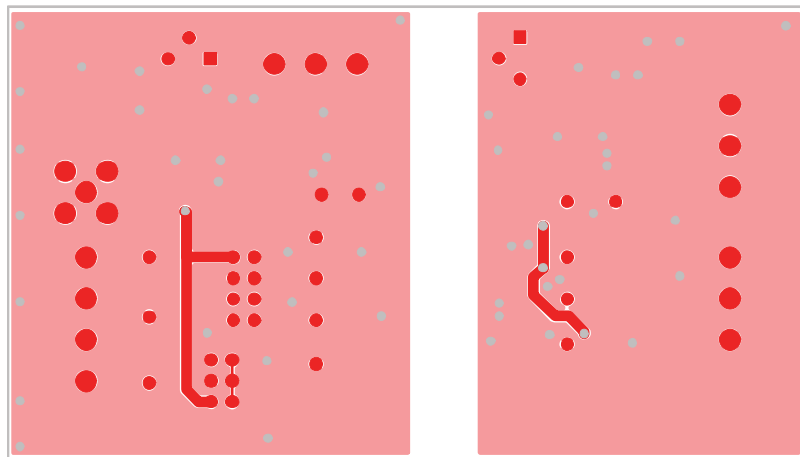


Figure 16. EVAL-ADM2795EEBZ Evaluation Board Bottom Layer

14665-014

ORDERING INFORMATION

BILL OF MATERIALS

Table 12.

| Quantity | Reference Designator | Description | Supplier | Device No. |
|----------|---|---|-----------------|-------------------|
| 3 | C1, C2, C6 | Capacitors, size 0603, 100 nF | AVX | 06033C104JAT2A |
| 2 | C3, C5 | Capacitors, tantalum, Case B, 10 μ F | KEMET | B45196H3106K209 |
| 2 | C7, C8 | Capacitors, size 0603, 100 nF | AVX | 06033C104JAT2A |
| 4 | C10, C13, C14, C19 | Capacitors, tantalum, Case C, 10 μ F | KEMET | B45196E3106K309 |
| 1 | C11 | Capacitor, size 0603, 120 pF | AVX | 0201YC121KAT2A |
| 4 | C12, C15, C16, C20 | Capacitors, size 0805, 100 nF | Multicomp | MC0805F104Z160CT |
| 2 | C17, C18 | Capacitors, size 0805, 10 μ F | AVX | 08056C106KAT2A |
| 3 | J1, J2, J5 | CON\POWER3, 3-pin terminal blocks | Camden | CTB5000/3 |
| 1 | J3 | CON\POWER4, 4-pin terminal block | Lumberg | KRM 04 |
| 2 | J4, J6 | CON\POWER2, 2-pin terminal blocks | Lumberg | KRM 02 |
| 1 | LK1 | 8-pin (4 \times 2), 2.54 mm header and shorting block | Harwin | M20-9953646 |
| 1 | LK4 | 6-pin (3 \times 2), 2.54 mm header and shorting block | Harwin | M20-9983646 |
| 1 | R1 | Resistor, 120 Ω , size 0805 (not inserted) | Welwyn | WCR0805-120RFI |
| 2 | R2, R11 | Trimmer potentiometers | Vishay | T93YB504KT20 |
| 1 | R4 | Resistor, 71.5 k Ω , size 0805 | Welwyn | MC0063W0603171K5 |
| 2 | R5, R13 | Resistors, 200 k Ω , size 0603 | Bourns | CR0603-FX-2003ELF |
| 2 | R6, R7 | Resistors, 1.2 k Ω , size 0805 (not inserted) | Panasonic | ERA6AEB122V |
| 2 | R9, R14 | Resistors, 0 Ω , size 0805 | Welwyn | WCR0805-R005JI |
| 2 | R10, R15 | Resistors, 0 Ω , size 0603 (not inserted) | Multicomp | MC0063W06030R |
| 1 | R12 | Resistor, 240 k Ω , size 0603 | Vishay | CRCW0603240KFKEA |
| 6 | RXD, RE, DE, TXD, A, B | Test points, yellow | Vero | 20-313140 |
| 5 | GND1_1, GND1_2, GND1_3, GND2_1, GND2_2, | Test points, yellow | Vero | 20-313140 |
| 2 | GND1, GND 2 | Test points, black | Vero | 20-2137 |
| 1 | TXD1 | RH SMA connector | TE Connectivity | 5-1814400-1 |
| 1 | U1 | Isolated Level 4 EMC and 24 V supply fault protected RS-485 transceiver | Analog Devices | ADM2795EBRWZ |
| 2 | U2 | 5 V fixed, adjustable voltage regulator | Analog Devices | ADP667ARZ |
| 2 | VDD1, VDD2 | Test points, red | Vero | 20-313137 |

NOTES

**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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