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Certified Evaluation Board for the ADM2795E-EP Robust 5 kV RMS Isolated RS-485 Transceiver with Level 4 DO-160G EMC and Full ±42 V Protection

FEATURES

- 5 kV rms signal isolated RS-485 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
- DO-160G Section 25 ESD protection: ±15 kV air discharge
- Fully certified DO-160G EMC protection on RS-485 bus pins
  - Section 22 Lightning Protection Waveform 3, Waveform 4/ Waveform 1, Waveform 5A pin injection, Level 4 protection
- RS-485 A pin and RS-485 B pin human body model (HBM) ESD protection: >±30 kV
- Evaluation board passes EN 55022 Class B radiated emissions with 6 dB µV margin
- Provides A and B bus pin fault protection to ±42 V ac/dc peak

EVALUATION KIT CONTENTS

EVAL-ADM2795EEPBZ

GENERAL DESCRIPTION

Use the EVAL-ADM2795EEPBZ evaluation board to easily evaluate the ADM2795E-EP 5 kV rms signal isolated RS-485 transceiver with Level 4 DO-160G EMC and 24 V supply fault protection. The EVAL-ADM2795EEPBZ evaluation board is easily configured through jumper connections and screw terminal blocks for signal and power connections. The EVAL-ADM2795EEPBZ 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.

Full specifications for the ADM2795E-EP are listed in the ADM2795E-EP data sheet available from Analog Devices, Inc. and should be consulted in conjunction with this user guide when using the evaluation boards.

Datasheet.Directory

EVALUATION BOARD PHOTOGRAPH

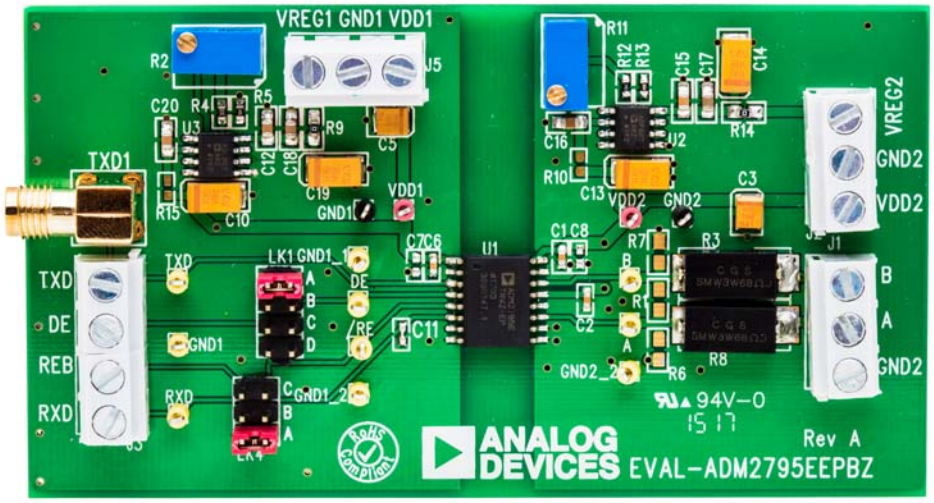

Figure 1.

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REVISION HISTORY

7/2017—Revision 0: Initial Version

CERTIFIED DO-160G EMC RS-485 EVALUATION BOARD

The EVAL-ADM2795EEPBZ evaluation board has been lab tested and certified to provide RS-485 A, B bus pin protection against DO-160G Lighting Section 22 Waveform 3, Waveform 4/ Waveform 1, and Waveform 5A to Level 4 using 33 Ω or 47 Ω current limiting resistors to GND_2, or to Level 4 across the isolation barrier to GND_1. The ADM2795E-EP was also tested and certified to provide robust protection against DO-160G Section 25 ESD, with ±15 kV ESD air discharge protection. The EVAL-ADM2795EEPBZ can withstand high voltage faults to ±42 V ac/dc peak on RS-485 A, B bus pins.

EVALUATION BOARD HARDWARE

TEST SETUP

The EVAL-ADM2795EEPBZ 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-ADM2795EEPBZ evaluation board to configure the inputs on the ADM2795E-EP (see Table 1). Do not place multiple jumper blocks on LK1 and LK4, because when placed together, the input sources can short. For each link, move a single jumper block from one position to another, as specified in Table 1.

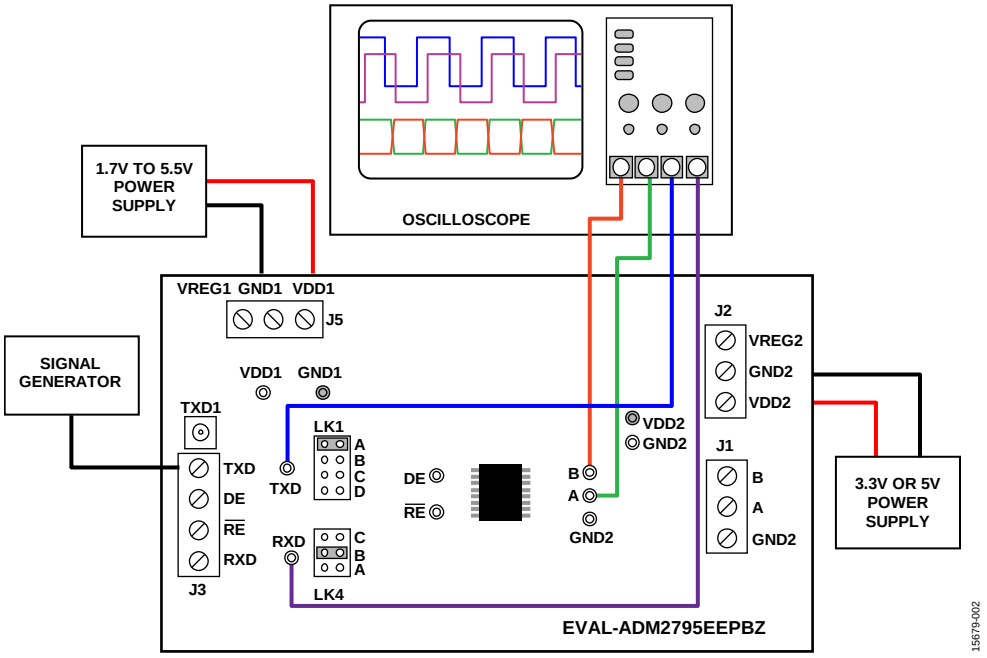

Figure 2. Basic Operation of the EVAL-ADM2795EEPBZ Evaluation Board for the ADM2795E-EP Robust 5 kV rms Isolated RS-485 Transceiver with Level 4 DO-160G and Full ±42 V Protection

Table 1. Jumper Configuration

Link	Connection	Description
LK1	A	Connects the driver enable input (DE) of the ADM2795E-EP to VDD1. This setting enables the driver.
	B	Connects the driver enable input (DE) of the ADM2795E-EP to GND1. This setting disables the driver.
	C	Connects the driver enable input (DE) of the ADM2795E-EP to the J3-2 terminal block connector.
	D	Connects the driver enable input (DE) of the ADM2795E-EP to the receiver enable input ($\overline{RE}$); that is, LK1 sets the input for both $\overline{RE}$ 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 ($\overline{RE}$) of the ADM2795E-EP to VDD1. This setting disables the receiver.
	B	Connects the receiver enable input ($\overline{RE}$) of the ADM2795E-EP to GND1. This setting disables the driver. This setting enables the receiver.
	C	Connects the receiver enable input ($\overline{RE}$) of the ADM2795E-EP to the J3-3 terminal block connector.

TERMINATION AND PULL-UP/PULL-DOWN RESISTORS

The EVAL-ADM2795EEPBZ evaluation board includes an R1 footprint for fitting a termination resistor between the A driver and the B driver outputs/receiver inputs. By default, the EVAL-ADM2795EEPBZ is not fitted with a 120 Ω resistor (R1) between the A pin and the B pin. If the EVAL-ADM2795EEPBZ 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-EP has a built-in receiver fail-safe for the bus idle condition, there are footprints on the EVAL-ADM2795EEPBZ 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-ADM2795EEPBZ uses the following decoupling and reservoir capacitors:

- On the logic side of the EVAL-ADM2795EEPBZ, the C5 and C6 capacitors must be 10 µF tantalum and 100 nF ceramic capacitors, respectively, and the C7 capacitor must not be fitted.
- On the bus side of the EVAL-ADM2795EEPBZ, the C3 and C1 capacitors must be 10 µF 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 µF tantalum capacitors must be added to the VDD1 power regulation circuit.
- The C17 and C18 10 µF 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-ADM2795EEPBZ evaluation board consists of two layers. The spacing between the top layer and the bottom layer is 1.6 mm. The EVAL-ADM2795EEPBZ 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 i*Coupler *Devices.*

ROBUST DO-160G EMC RS-485 EVALUATION BOARD

The EVAL-ADM2795EEPBZ evaluation board has been lab tested and certified to provide RS-485 A and RS-485 B bus pin protection for the following DO-160G standards and test levels. For more information see Table 2, Table 3, and Table 4.

- Protection against Section 22 Waveform 3 to Level 4 (1500 V, 60 A) using 47 Ω current limiting resistors on A and B bus pins.
- Protection against Section 22 Waveform 4/Waveform 1 to Level 4 (750 V, 150 A) using 33 Ω current limiting resistors on A and B bus pins.
- Protection against Section 22 Waveform 5A to Level 4 (750 V, 750 A) using 33 Ω current limiting resistors on A and B bus pins.
- Protection against Section 25 ESD to ±15 kV air discharge.
- HBM ESD to >±30 kV.

The EVAL-ADM2795EEPBZ evaluation board was lab tested and certified to the following DO-160G standards, showing the robust EMC immunity provided by the isolation barrier:

- Protection against Section 22 Waveform 3 to Level 4 (1500 V, 60 A).
- Protection against Section 22 Waveform 4/Waveform 1 to Level 4 (750 V, 150 A).
- Protection against Section 22 Waveform 5A to Level 4 (750 V, 750 A).

The EVAL-ADM2795EEPBZ evaluation board can withstand high voltage faults to ±42 V ac/dc peak on RS-485 A and RS-485 B bus pins.

CERTIFIED DO-160G EMC PROTECTION

Table 2 details the open-circuit voltage (V_{OC}) and short-circuit current (I_{SC}) as specified in the DO-160G Section 22 Lightning transient susceptibility standard for Waveform 3, Waveform 4/ Waveform 1, and Waveform 5A for pin injection testing. The peak currents for the DO-160G Level 4 tests are much greater than standard industrial surge IEC 61000-4-5 peak currents. The waveform shape and rise/decay times for the DO-160G standard are significantly longer than those specified by the IEC 61000-4-5 standard, as shown in Figure 3. Due to the high amounts of energy associated with the DO-160G Section 22 lightning standard, the ADM2795E-EP tested using external 33 Ω or 47 Ω A pin and B pin bus current limiting resistors for testing to GND2 .These resisters were required in addition to the ADM2795E-EP integrated EMC protection circuitry; however, when testing to GND1, no current limiting resistors are required. The ADM2795E-EP *i*Coupler isolation technology protects the device in the presence of these extreme transients.

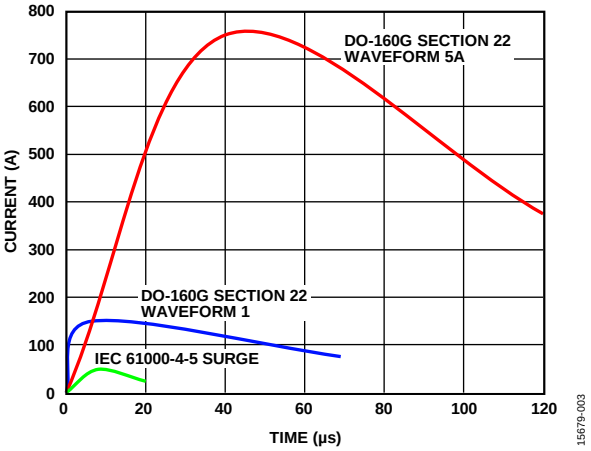

Figure 3. DO-160G Section 22 Waveform 1 and Waveform 5A, and IEC61000-4-5 Surge Waveform

DO-160G ADM2795E-EP TEST DETAILS

Figure 4 and Figure 5 show the Waveform 3 test setup coupling/decoupling network (CDN) and the Waveform 5A, Waveform 4/Waveform 1 CDN, respectively. For testing to the RS-485 bus side, GND2, an additional 33 Ω or 47 Ω current limiting resistance is added on both the A and B bus pins. DO-160G Section 22 testing is performed on one pin at a time. The test is not performed in common mode. Table 3 and Table 4 show a summary of the ADM2795E-EP certified test results.

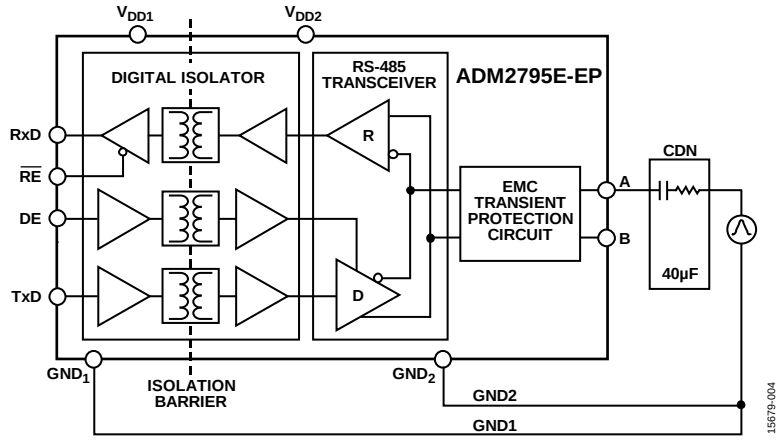

Figure 4. DO-160G Section 22 Waveform 3 Test Setup and Coupling/Decoupling Network

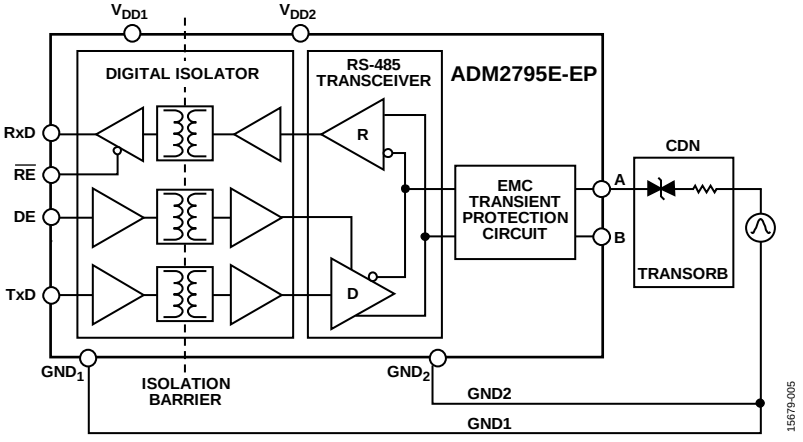

Figure 5. DO-160G Section 22 Waveform 5A, Waveform 4/Waveform 1 Test Setup and Coupling/Decoupling Network

Table 2. DO-160G Section 22 Pin Injection Level 4 Compared to IEC 61000-4-5 Lightning Level 4

Level	DO-160G Waveform 3	DO-160G Waveform 4/Waveform 1	DO-160G Waveform 5A	IEC 61000-4-5
4	1500 V, 60 A	750 V, 150 A	750 V, 750 A	4000 V, 49 A
3	600 V, 24 A	300 V, 60 A	300 V, 300 A	2000 V, 24.5 A

Table 3. DO-160G Section 22 Pin Injection Level 3 Certified Test Results

Testing to GND_x	Current Limiting Resistor	DO-160G Waveform 3; 600 V, 24 A	DO-160G Waveform 4/ Waveform 1; 300 V, 60 A	DO-160G Waveform 5A; 300 V ,300 A
GND_1	None	Pass	Pass	Pass
GND_2	33 Ω	Pass	Pass	Pass

Table 4. DO-160G Section 22 Pin Injection Level 4 Certified Test Results

Testing to GND_x	Current Limiting Resistor	DO-160G Waveform 3; 1500 V, 60 A	DO-160G Waveform 4/ Waveform 1; 750 V, 150 A	DO-160G Waveform 5A; 750 V ,750 A
GND_1	None	Pass	Pass	Pass
GND_2	47 Ω or 33 Ω	Pass with 47 Ω	Pass with 33 Ω	Pass with 33 Ω

EVALUATION BOARD SCHEMATICS

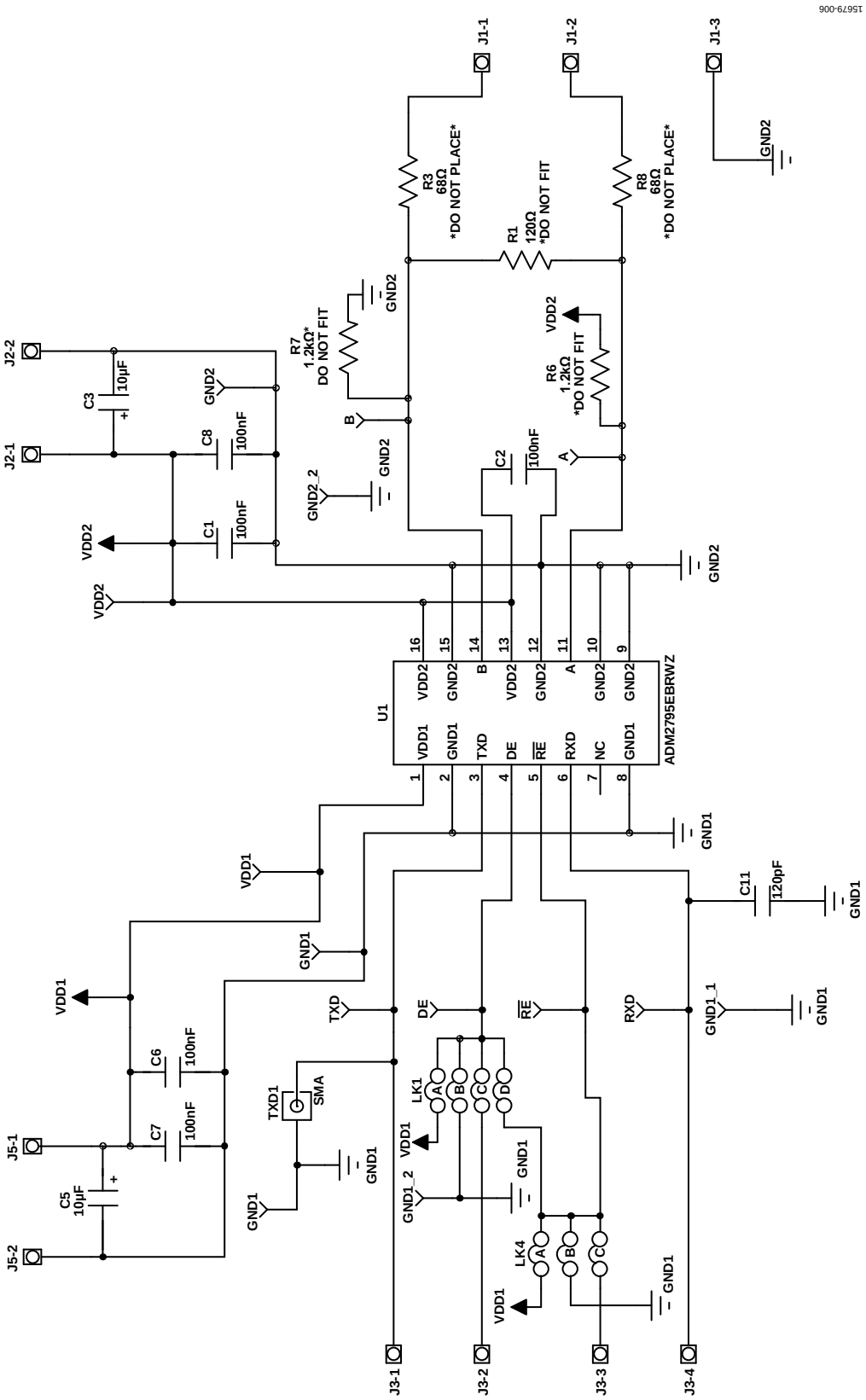

Figure 6. Schematics of the EVAL-ADM2795EEPBZ Evaluation Board, Page 1

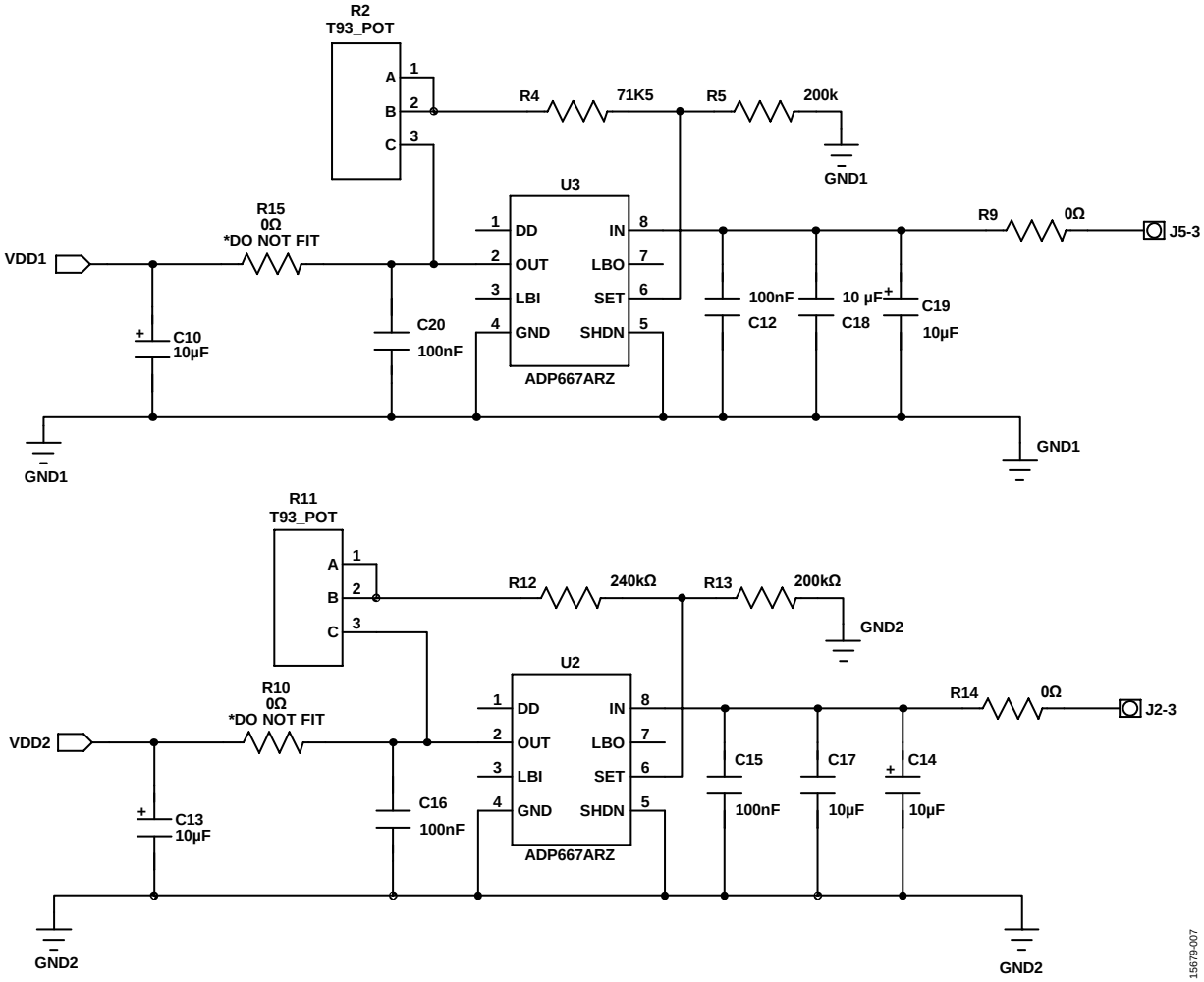

Figure 7. Schematics of the EVAL-ADM2795EEPBZ Evaluation Board, Page 2

ASSEMBLY DRAWINGS AND BOARD LAYOUT

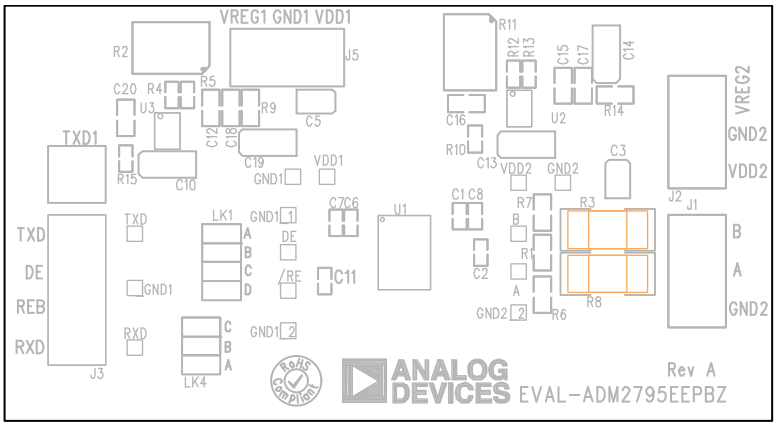

Figure 8. EVAL-ADM2795EEPBZ Evaluation Board Silkscreen

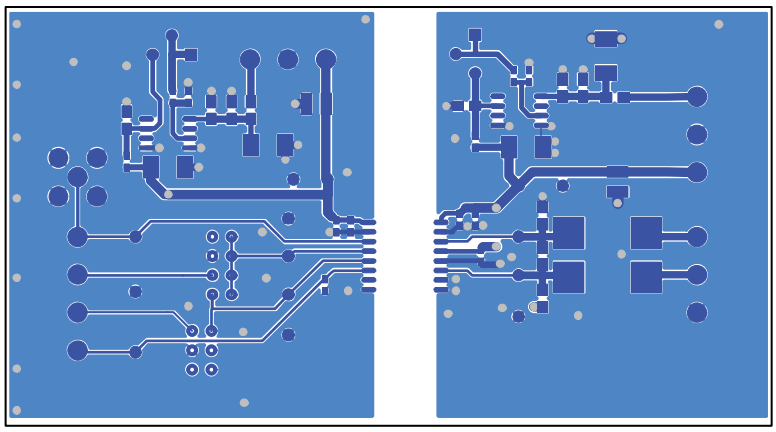

Figure 9. EVAL-ADM2795EEPBZ Evaluation Board Top Layer

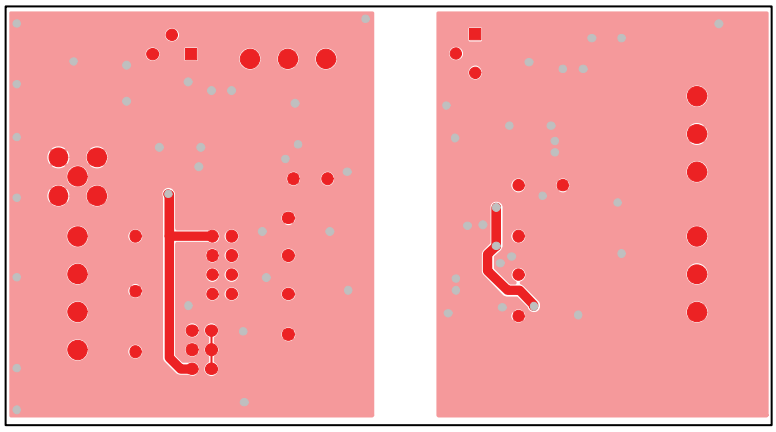

Figure 10. EVAL-ADM2795EEPBZ Evaluation Board Bottom Layer

ORDERING INFORMATION

BILL OF MATERIALS

Table 5.

Qty	Reference Designator	Description	Supplier	Part Number
3	C1, C2, C6	Capacitors, size 0603, 100 nF	AVX	06033C104JAT2A
2	C3, C5	Capacitors, tantalum, Case B, 10 µF	KEMET	B45196H3106K209
2	C7, C8	Capacitors, size 0603, 100 nF	AVX	06033C104JAT2A
4	C10, C13, C14, C19	Capacitors, tantalum, Case C, 10 µF	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 µF	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 × 2), 2.54 mm header and shorting block	Harwin	M20-9953646
1	LK4	6-pin (3 × 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 kΩ, size 0805	Welwyn	MC0063W0603171K5
2	R5, R13	Resistors, 200 kΩ, size 0603	Bourns	CR0603-FX-2003ELF
2	R6, R7	Resistors, 1.2 kΩ, 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 kΩ, size 0603	Vishay	CRCW0603240KFKEA
2	R3, R8	Resistor, 33 Ω, size 4121	TE Connectivity	SMW368RJT
6	RXD, RE, DE, TXD, A, B	Test points, yellow	Vero	20-313140
5	GND1_1to GND1_3, GND2_1, GND2_2	Test points, yellow	Vero	20-313140
2	GND1, GND2	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	ADM2795ETRWZ-EP
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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