

Certified Evaluation Board for the **ADM3095E-EP** RS-485 Transceiver with Level 4 DO-160G EMC and Full ± 42 V Fault Protection

FEATURES

DO-160G Section 25 ESD protection: ± 15 kV air discharge
Fully certified RS-485 bus pin protection for DO-160G EMC standards and test levels

Section 22 Lightning Waveform 3, Waveform 4/Waveform 1, Waveform 5A pin injection, Level 4 protection

RS-485 A pin and RS-485 B pin HBM ESD protection: $> \pm 30$ kV
Provides A and B bus pin fault protection to ± 42 V ac/dc peak
Convenient connections for power supplies and signals through screw terminal blocks

1.62 V to 5.5 V operating voltage range on V_{IO} logic supply

3.0 V to 5.5 V operating voltage range on V_{CC}

Configurable through jumper connections

Test points for measuring all signals

EVALUATION KIT CONTENTS

EVAL-ADM3095EEPBZ evaluation board

GENERAL DESCRIPTION

The EVAL-ADM3095EEPBZ can be used for evaluation of the **ADM3095E-EP** RS-485 transceiver with Level 4 DO-160G electromagnetic compatibility (EMC) and ± 42 V fault protection for ± 24 V supplies. Screw terminal blocks provide convenient connections for the power and signal connections.

The EVAL-ADM3095EEPBZ is configured through jumper connections. Jumper connections can enable or disable the RS-485 driver and receiver. Two power supplies, one supply for the V_{IO} logic supply and one V_{CC} supply for the RS-485 driver/receiver, can power the EVAL-ADM3095EEPBZ. When powering with only one power supply, the **ADM3095E-EP** V_{IO} and V_{CC} pins can connect with a convenient on-board jumper. In addition, test points are included for all power and signal lines.

For full details on the **ADM3095E-EP**, see the **ADM3095E-EP** data sheet, which must be consulted in conjunction with this user guide when using this evaluation board.

CERTIFIED DO-160G EMC RS-485 EVALUATION BOARD

The EVAL-ADM3095EEPBZ evaluation board has been lab tested and certified to provide RS-485 A and RS-485 B bus pin protection against DO-160G standards and test levels for Section 22, Lightning Waveform 3, Waveform 4/Waveform 1, and Waveform 5A to Level 4, using $33\ \Omega$ or $47\ \Omega$ current limiting resistors to GND. The **ADM3095E-EP** was also tested and confirmed to provide robust protection against DO-160G, Section 25 electrostatic discharge (ESD), with ± 15 kV ESD air discharge protection. The EVAL-ADM3095EEPBZ can withstand high voltage faults to ± 42 V ac/dc peak on the RS-485 A and RS-485 B bus pins.

EVAL-ADM3095EEPBZ PHOTOGRAPH

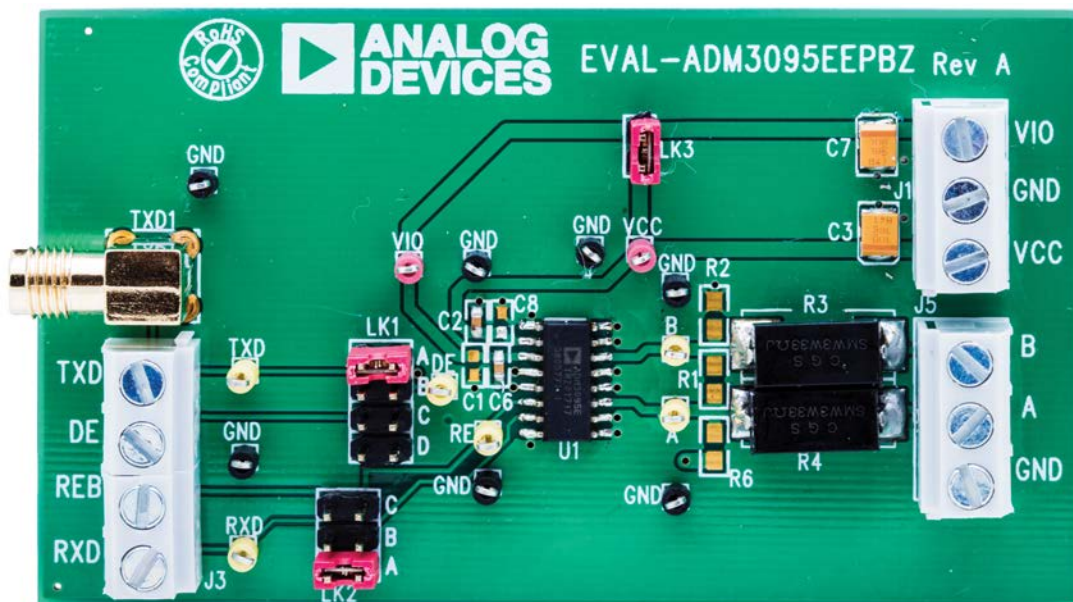


Figure 1.

15649-001

TABLE OF CONTENTS

Features	1	Termination and Pull-Up/Pull-Down Resistors	4
Evaluation Kit Contents.....	1	Decoupling and Reservoir Capacitors.....	4
General Description	1	Robust DO-160G EMC RS-485 Evaluation Board	4
Certified DO-160G EMC RS-485 Evaluation Board	1	Certified DO-160G EMC Protection	4
EVAL-ADM3095EEPZ Photograph	1	DO-160G ADM3095E-EP Test Details	4
Revision History	2	Evaluation Board Schematics and Artwork.....	6
Evaluation Board Hardware.....	3	Ordering Information.....	8
Test Setup.....	3	Bill of Materials.....	8
Jumper Settings.....	3		

REVISION HISTORY

8/2017—Revision 0: Initial Version

EVALUATION BOARD HARDWARE

TEST SETUP

The EVAL-ADM3095EEPBZ is shown in Figure 2 with the default jumper settings on LK1 and LK2 (driver and receiver enabled), power connections on J1, input signal connection on J3, and probes attached to RXD, TXD, A, and B for a loopback test.

JUMPER SETTINGS

Use jumpers on the evaluation board to configure the inputs to the [ADM3095E-EP](#) (see Table 1). Do not place multiple jumper blocks on LK1 and LK2 because the input sources can be shorted together. For each link, a single jumper block can move from one position to another, as specified in Table 1.

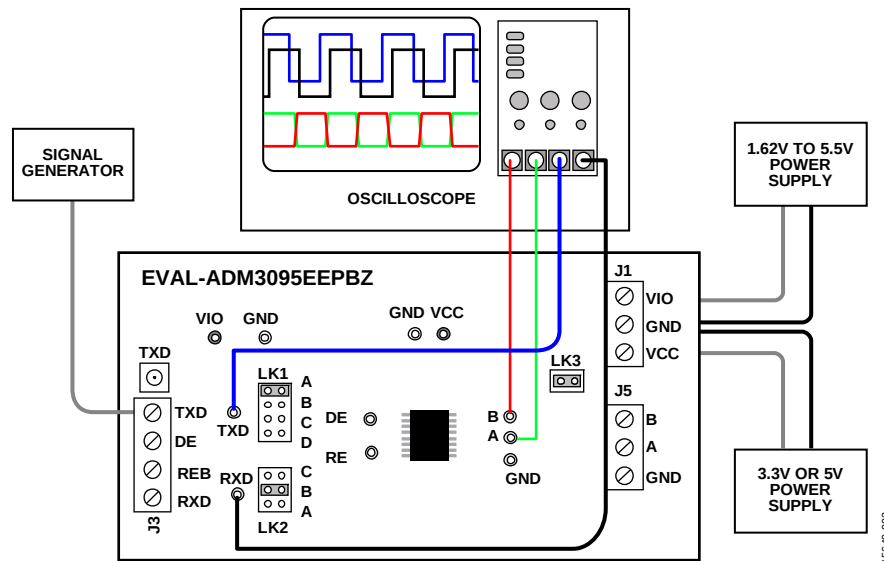


Figure 2. Basic Operation of the Evaluation Board for the [ADM3095E-EP](#) Level 4 DO-160G EMC and ± 42 V Peak AC/DC Supply Fault Protected RS-485 Transceiver

Table 1. Jumper Configurations

Link	Connection	Description
LK1	A B C D	Connects the driver enable input (DE) of the ADM3095E-EP to VIO. This setting enables the driver. Connects the driver enable input (DE) of the ADM3095E-EP to GND. This setting disables the driver. Connects the driver enable input (DE) of the ADM3095E-EP to the J3-2 terminal block connector. Connects the driver enable input (DE) of the ADM3095E-EP to the receiver enable input ($\overline{\text{RE}}$); that is, the input for both $\overline{\text{RE}}$ and DE is set by LK1. This setting ensures that when the driver is enabled, the receiver is disabled; and when the driver is disabled, the receiver is enabled.
LK2	A B C	Connects the receiver enable input ($\overline{\text{RE}}$) of the ADM3095E-EP to VIO. This setting disables the receiver. Connects the receiver enable input ($\overline{\text{RE}}$) of the ADM3095E-EP to GND. This setting enables the receiver. Connects the receiver enable input ($\overline{\text{RE}}$) of the ADM3095E-EP to the J3-3 terminal block connector.
LK3	Connected Not connected	Connects the VIO trace to the VCC trace. The EVAL-ADM3095EEPZ can be powered from one power supply only. The VIO and VCC traces are not connected. The EVAL-ADM3095EEPZ must be powered from two power supplies: one for the VIO and one for the VCC.

TERMINATION AND PULL-UP/PULL-DOWN RESISTORS

The EVAL-ADM3095EEPZ includes the R1 footprint for fitting a termination resistor between the A and B driver outputs and receiver inputs. By default, the 120 Ω resistor (R1) between Pin A and Pin B, shown in Figure 6, is not on the EVAL-ADM3095EEPZ. Remove this resistor if the EVAL-ADM3095EEPZ connects to a bus that already terminates at both ends. For more information about proper termination, see the [AN-960 Application Note](#), *RS-485/RS-422 Circuit Implementation Guide*.

Although the [ADM3095E-EP](#) has a built-in receiver fail-safe for the bus idle condition, there are footprints on the EVAL-ADM3095EEPZ for fitting the R6 pull-up resistor to V_{CC} on Pin A, as well as the R2 pull-down resistor to GND on Pin B. When connecting to other devices that require such external biasing resistors on the bus, these resistors can be fitted. The exact value required for a 200 mV minimum differential voltage in the bus idle condition depends on the V_{CC} 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-ADM3095EEPZ uses the following decoupling and reservoir capacitors:

- C2 and C6 are 100 nF ceramic capacitors fitted between V_{CC} (Pin 2) and GND (Pin 1), and between V_{IO} (Pin 3) and GND (Pin 1), respectively. Pads for additional capacitors (C1 and C8) are unpopulated when the printed circuit board (PCB) is assembled.
- Additional 10 μ F tantalum capacitors (C3 and C7) are added for the power supply inputs at the J1 connector.

ROBUST DO-160G EMC RS-485 EVALUATION BOARD

The EVAL-ADM3095EEPZ 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 the 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 the 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 the A and B bus pins.

The EVAL-ADM3095EEPZ also provides protection against the following:

- Section 25 ESD to ± 15 kV air discharge.
- Human body model (HBM) ESD to $> \pm 30$ kV.

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 [ADM3095E-EP](#) was tested using external 33 Ω or 47 Ω A pin and B pin bus current limiting resistors for testing to GND. These resistors were required in addition to the [ADM3095E-EP](#) integrated EMC protection circuitry.

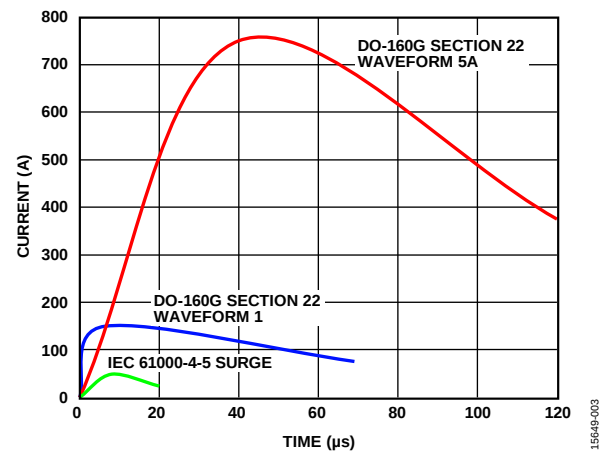


Figure 3. DO-160G Section 22 Waveform 1 and Waveform 5A, and IEC61000-4-5 Surge Waveform

DO-160G ADM3095E-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 RS-485 bus side, GND, 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 shows a summary of the [ADM3095E-EP](#) certified test results.

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 4 Certified Test Results

Testing to	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	47 Ω or 33 Ω	Pass with 47 Ω	Pass with 33 Ω	Pass with 33 Ω

Table 4. DO-160G, Section 22, Pin Injection, Level 3 Certified Test Results

Testing to	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	33 Ω	Pass	Pass	Pass

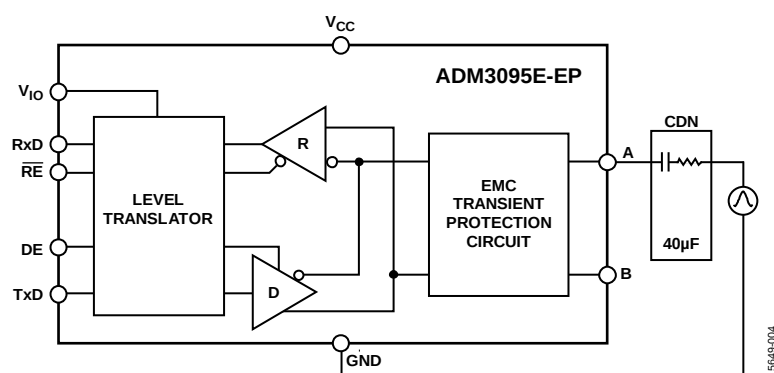


Figure 4. DO-160G, Section 22, Waveform 3 Test Setup and Coupling Network

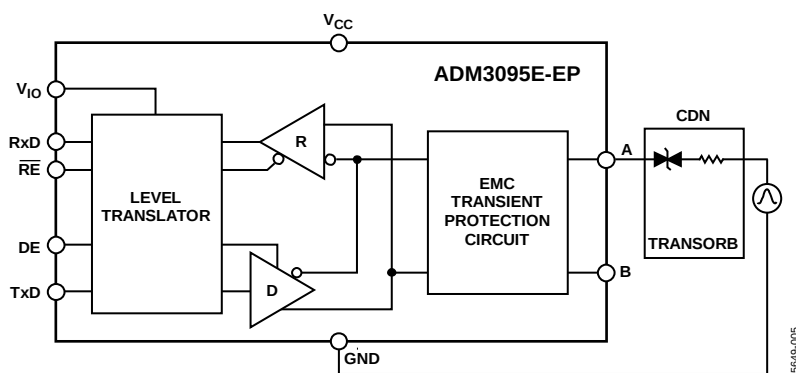


Figure 5. DO-160G, Section 22, Waveform 5A, Waveform 4/Waveform 1 Test Setup and Coupling Network

EVALUATION BOARD SCHEMATICS AND ARTWORK

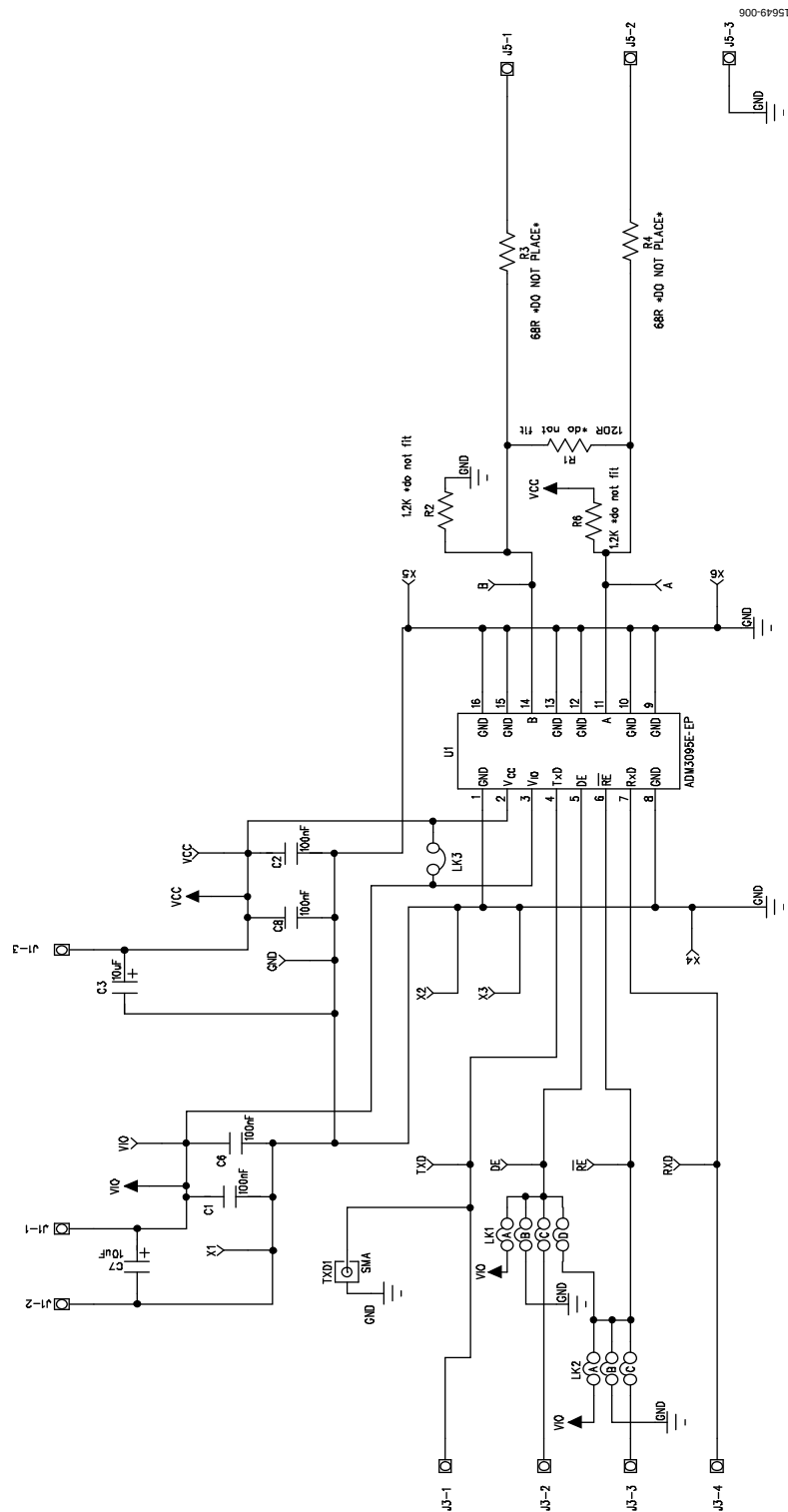


Figure 6. EVAL-ADM3095EEPBZ Evaluation Board Schematic

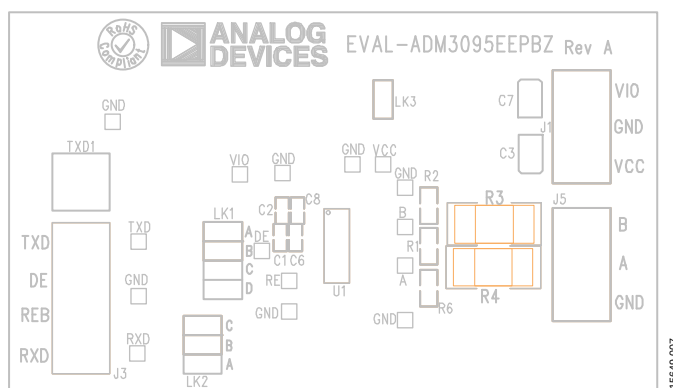


Figure 7. EVAL-ADM3095EEPZ Evaluation Board Silkscreen

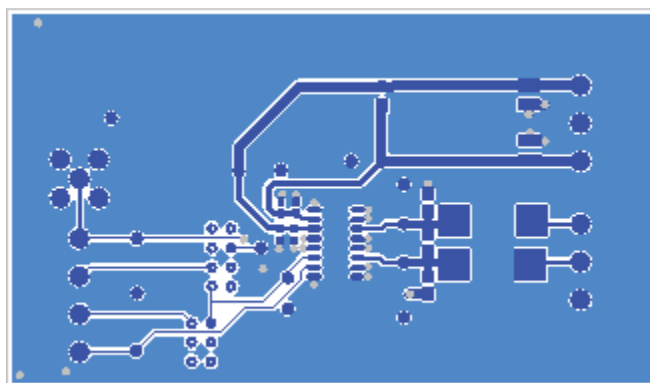


Figure 8. EVAL-ADM3095EEPZ Evaluation Board Top Layer

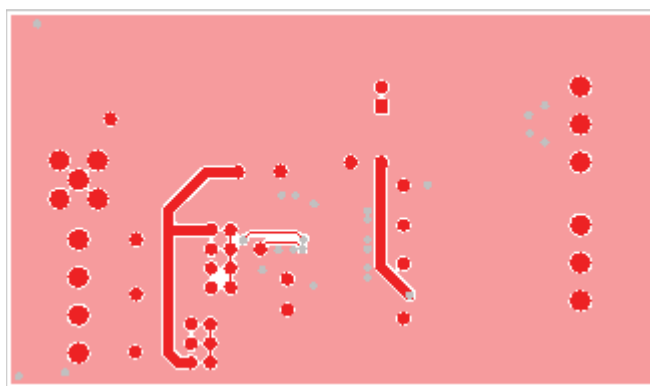


Figure 9. EVAL-ADM3095EEPZ Evaluation Board Bottom Layer

ORDERING INFORMATION

BILL OF MATERIALS

Table 5.

Quantity	Reference Designator	Description	Supplier	Part No.
4	C1, C2, C6, C8	Capacitors, 0603 size, 100 nF	AVX Corporation	06033C104JAT2A
2	C3, C7	Capacitors, tantalum, Case B, 10 μ F	KEMET	B45196H3106K209
1	R1	Resistor, 120 Ω , 0805 size (not inserted)	TT Electronics Welwyn Components	WCR0805-120RFI
2	R2, R6	Resistors, 1.2 k Ω , 0805 size (not inserted)	Panasonic	ERA6AEB122V
2	R3, R4	Resistors, 33 Ω , 4121 size	TE Connectivity	SMW333RJT
1	LK1	8-pin (4 $\times$ 2), 2.54 mm header and shorting block	Harwin	M20-9953646
1	LK2	6-pin (3 $\times$ 2), 2.54 mm header and shorting block	Harwin	M20-9983646
1	LK3	2-pin (1 $\times$ 1), 2.54 mm header and shorting block	Harwin	M20-9990246
3	J1	Connector, 3-way, 3-pin terminal blocks	CamdenBoss	CTB5000/3
1	J3	Connector, 4-way, 4-pin terminal block	Lumberg	KRM 04
2	J5	Connector, 3-way, 3-pin terminal blocks	Lumberg	KRM 03
7	GND	Test points, black	Vero Technologies	20-2137
6	A, B, DE, RE, RXD, TXD	Test points, yellow	Vero Technologies	20-313140
2	VCC, VIO	Test points, red	Vero Technologies	20-313137
1	TXD1	RH SMA connector	TE Connectivity	5-1814400-1
1	U1	Level 4 EMC and full $\pm$ 42 V fault protected RS-485 transceiver	Analog Devices, Inc.	ADM3095EBRZ

**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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