TPD12S520RMN EVM

This user's guide describes the characteristics, operation, and use of the TPD12S520RMNEVM Evaluation Module (EVM). This EVM includes 5 TPD12S520RMN's in various configurations for testing. Three TPD12S520 RMN's are configured for IEC61000-4-2 compliance testing, one TPD12S520RMN is configured for throughput on HDMI 1.4a Type A connectors for throughput analysis, and one is configured to allow 4-port analysis using a vector network analyzer. This user's guide includes setup instructions, schematic diagrams, a bill of materials, and printed-circuit board layout drawings for the EVM.

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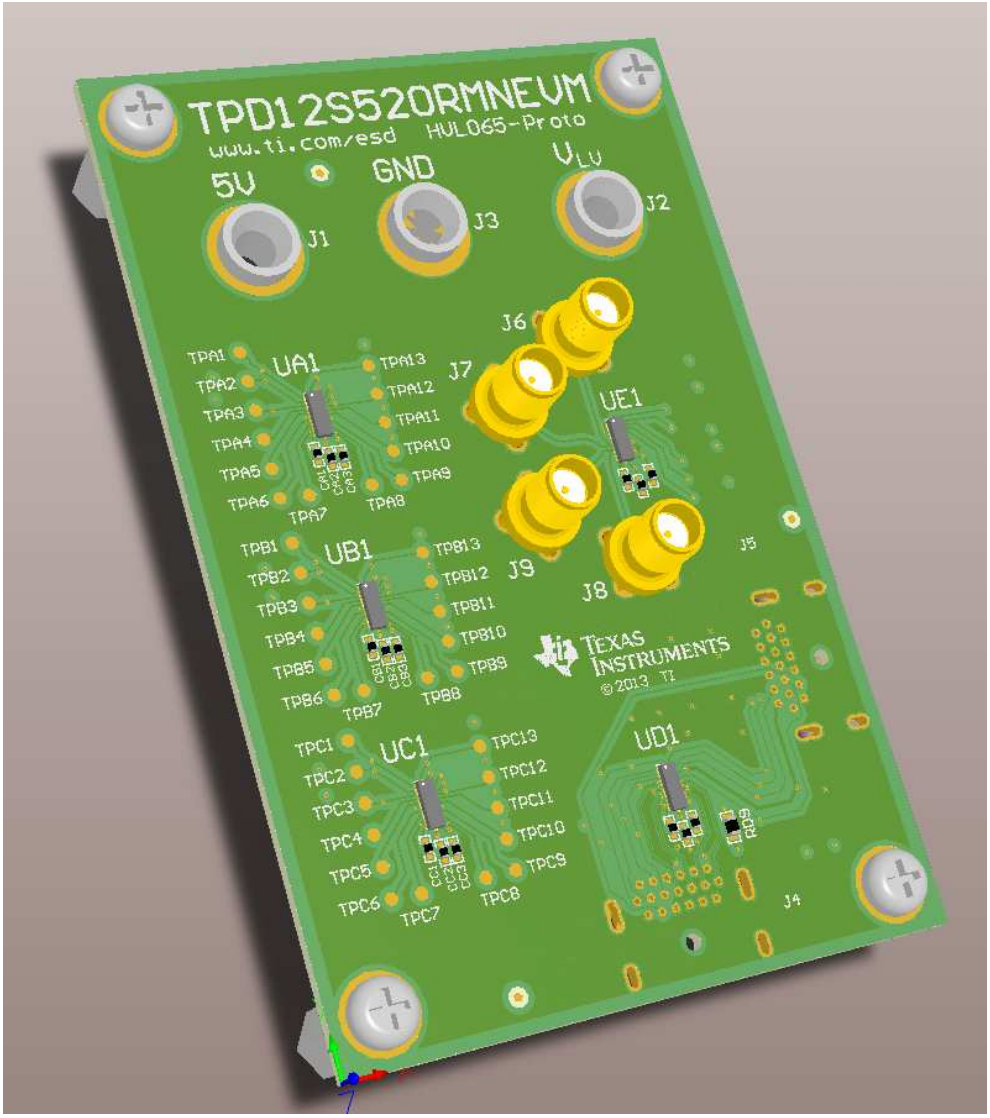

1 Introduction

Texas Instrument's TPD12S520RMNEVM evaluation module helps designers evaluate the operation and performance of the TPD12S520RMNEVM device. TheTPD12S520 is a single-chip electrostatic discharge (ESD) solution for the high-definition multi-media interface (HDMI) receiver port. The low-speed control lines offer voltage level-shifting to eliminate the need for an external voltage-level shifter IC. Control-line ESD clamps add 3.5-pF capacitance to the control lines.

Table 1. EVM Configuration

Reference Designator	TI Part Number	Configuration
UA1 – UC1	TPD12S520RMN	IEC61000-4-2 ESD Tests
UD1	TPD12S520RMN	HDMI 1.4 Eye Diagrams
UE1	TPD12S520RMN	S-parameters

2 Definitions

1. Contact Discharge – a method of testing in which the electrode of the ESD simulator is held in contact with the device-under-test (DUT).

2. Air Discharge – a method of testing in which the charged electrode of the ESD simulator approaches the DUT, and a spark to the DUT actuates the discharge.
3. ESD simulator – a device that outputs IEC61000-4-2 compliance ESD waveforms shown in Figure 1 with adjustable ranges shown in Table 2 and Table 3.

IEC61000-4-2 has 4 classes of protection levels. Classes 1 – 4 are shown in Table 2. Stress tests should be incrementally tested to level 4 as shown in Table 3 until the point of failure. If the DUT does not fail at 8kV, testing can continue in 2 kV increments until failure.

Table 2. IEC61000-4-2 Test Levels

Contact Discharge Class	Test Voltage [± kV]	Air Discharge Class	Test Voltage [± kV]
1	2	1	2
2	4	2	4
3	6	3	8
4	8	4	15

Table 3. Waveform Parameters in Contact Discharge Mode

Stress Level Step	Simulator Voltage [kV]	Ipeak ±15% [A]	Rise Time ±25% [nS]	Current at 30ns ±30% [A]	Current at 60ns ±30% [A]
1	2	7.5	0.8	4	2
2	4	15	0.8	8	4
3	6	22.5	0.8	12	6
4	8	30	0.8	16	8

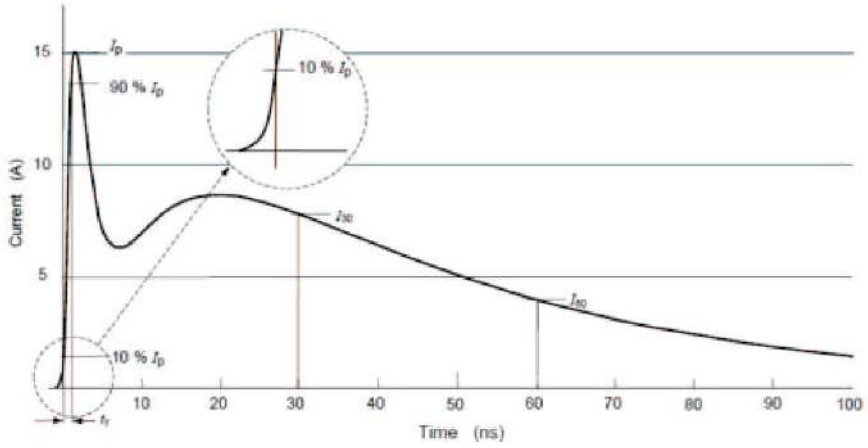

Figure 1. Ideal Contact Discharge Waveform of the Output Current of the ESD Simulator at 4 kV

3 Board Setup

This section describes the intended use of the TPD12S520RMNEVM. A generalized outline of the procedure given in IEC-61000-4-2 is described here. IEC-61000-4-2 should be referred to for a more specific testing outline.

3.1 UA1—UC1

Three separate and identical test setups for TPD12S520RMN (UA1–UC1) are pinned out to allow evaluating device performance during ESD events. The devices can be powered up (or not) so that all operating conditions can be evaluated.

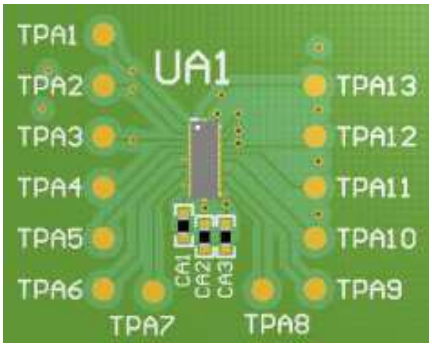

Figure 2. 1 of 3 TPD12S520RMN for IEC-61000-4-2 Tests

To test powered up: Connect 5V to 5V (J1), 3.3V to VLV (J2), and connect ground to GND (J3).

To test un-powered: Connect ground to 5V (J1), VLV (J2), and GND (J3).

3.1.1 Test Method and Set-Up

An example test setup is shown in Figure 3. Details of the testing table and ground planes can be found in the IEC 61000-4-2 test procedure. Ground the EVM using the banana connector labeled GND (J9). Discharge the ESD simulator on any of the Test Points TPA1–TPA13. Contact and air-gap discharge are tested using the same simulator with the same discharge waveform. While the simulator is in direct contact with the test point during contact, it is not during air-gap.

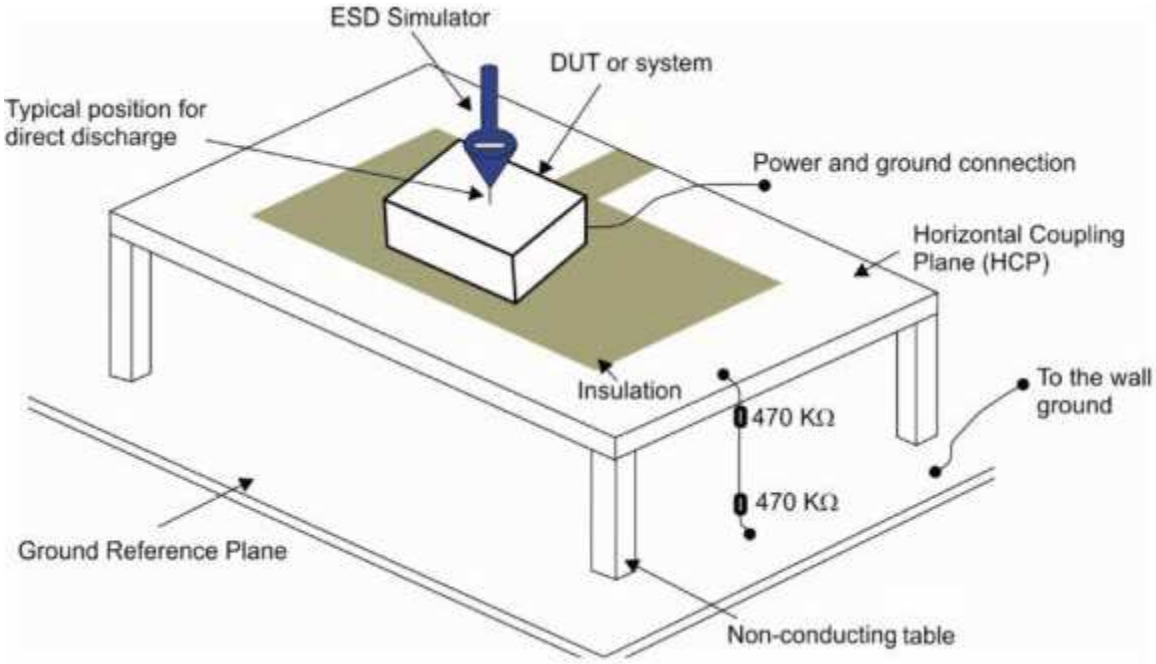

Figure 3. System Level ESD Test Setup

3.1.2 Evaluation of Test Results

Connect the tested device on the EVM to a curve tracer both before and after ESD testing. After each incremental level, if the IV curve of the ESD protection diode shifts ±0.1V, or leakage current increases by a factor of ten, then the device is permanently damaged by ESD.

3.2 UD1

A single TPD12S520RMN (UD1) is configured with two HDMI 1.4***a*** Type A female connectors (J4 and J5) for capturing Eye Diagrams. Connect 5V to 5V (J1), 3.3V to V_{LV} (J2), and connect ground to GND (J3). Using either J4 or J5 as input or output attach to an HDMI compliant Eye Diagram test setup and follow the manufacturer's instructions for performing signal integrity tests.

3.3 UE1

A single TPD12S520RMN (UE1) is configured with 4 SMA (J1–J4) connectors to allow 4-port analysis with a vector network analyzer. Connect Port 1 to J6, Port 2 to J7, Port 3 to J8, and Port 4 to J9. Connect 5V to 5V (J1), 3.3V to VLV (J2), and connect ground to GND (J3). Follow the vector analyzer's manufacturer's instructions to obtain signal integrity parameters. This configuration allows for the following terminology in 4 port analysis:

- S_{11}: Return loss
- S_{21}: Insertion loss
- S_{31}: Near end cross talk
- S_{41}: Far end cross talk

4 Board Layout

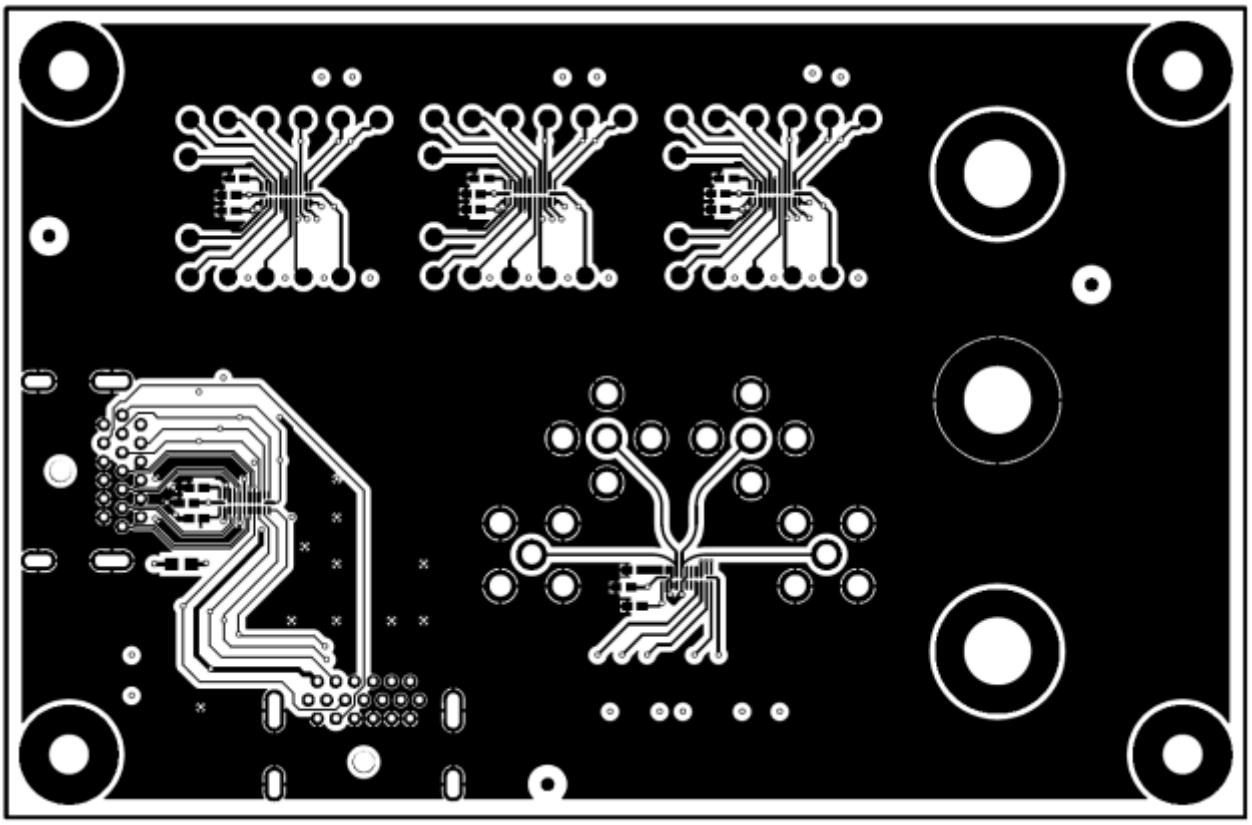

Figure 4. Top Layer

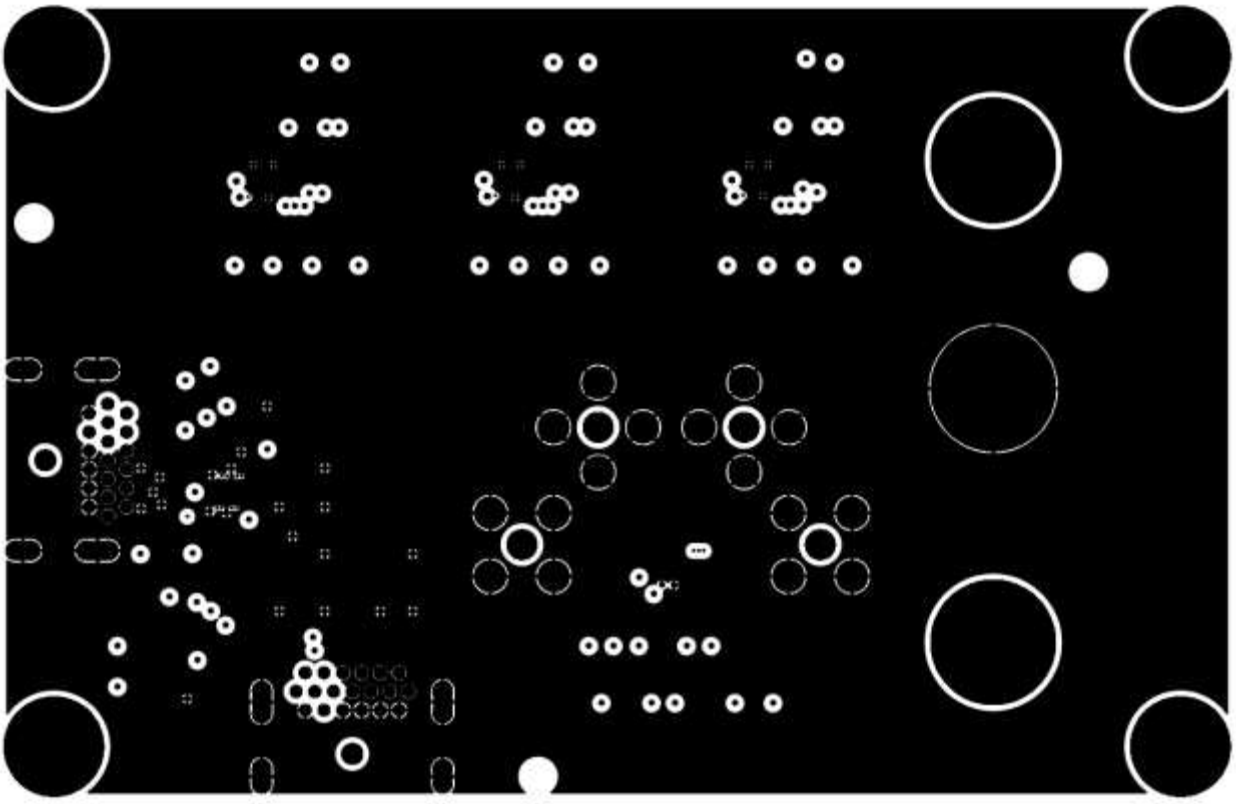

Figure 5. Layer 2

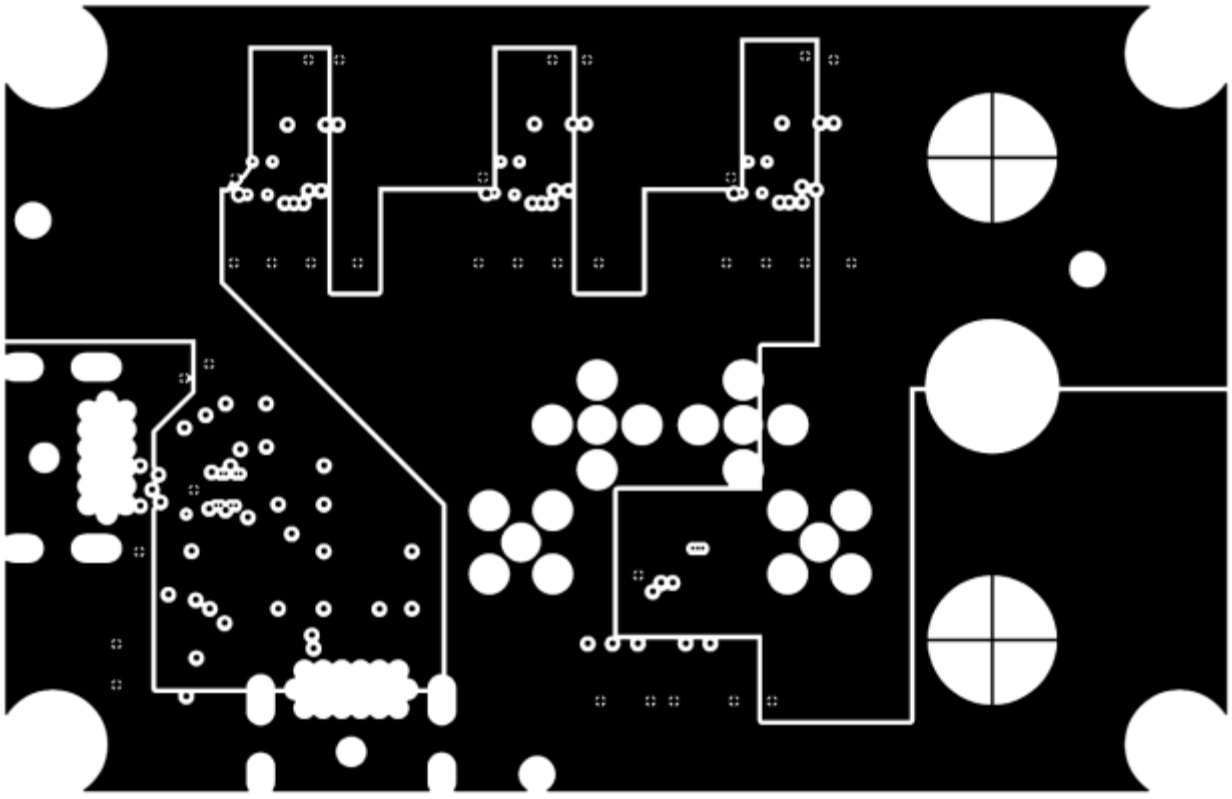

Figure 6. Layer 3

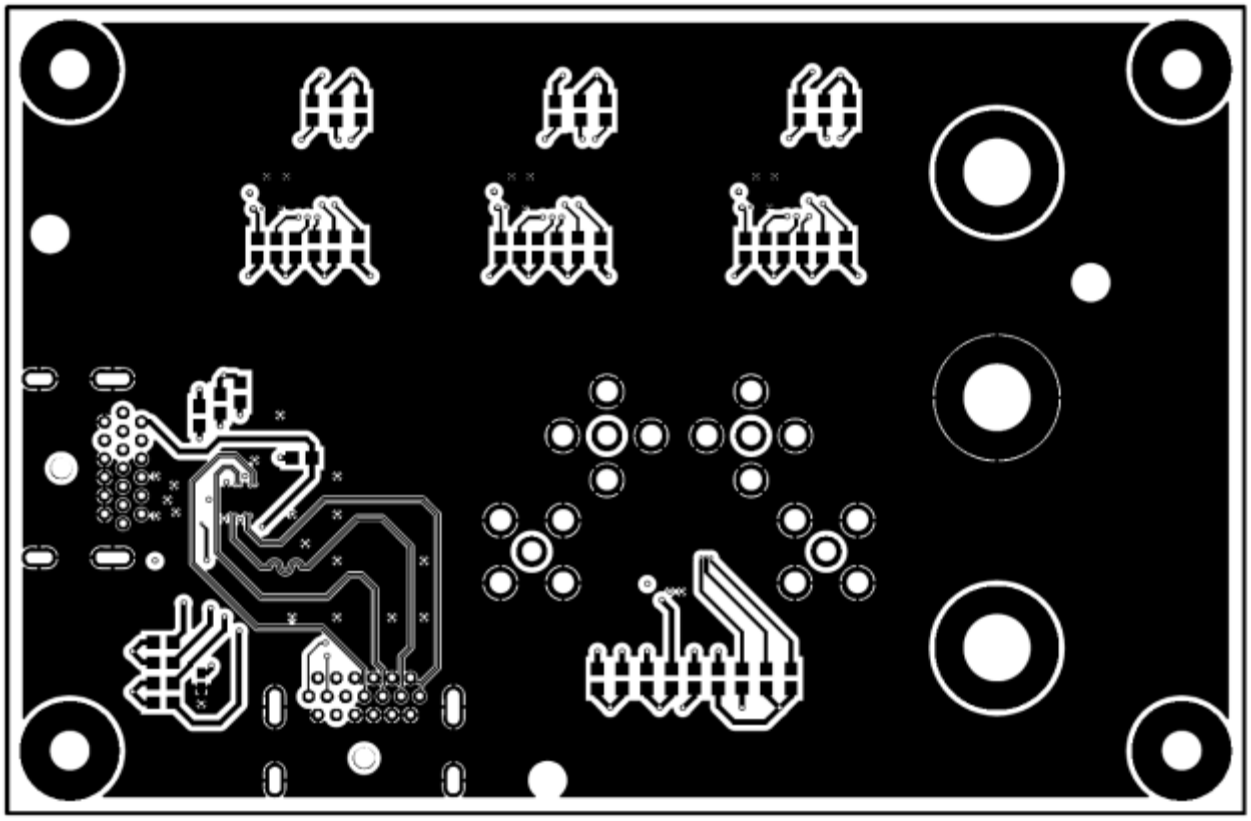

Figure 7. Bottom layer

5 Schematics

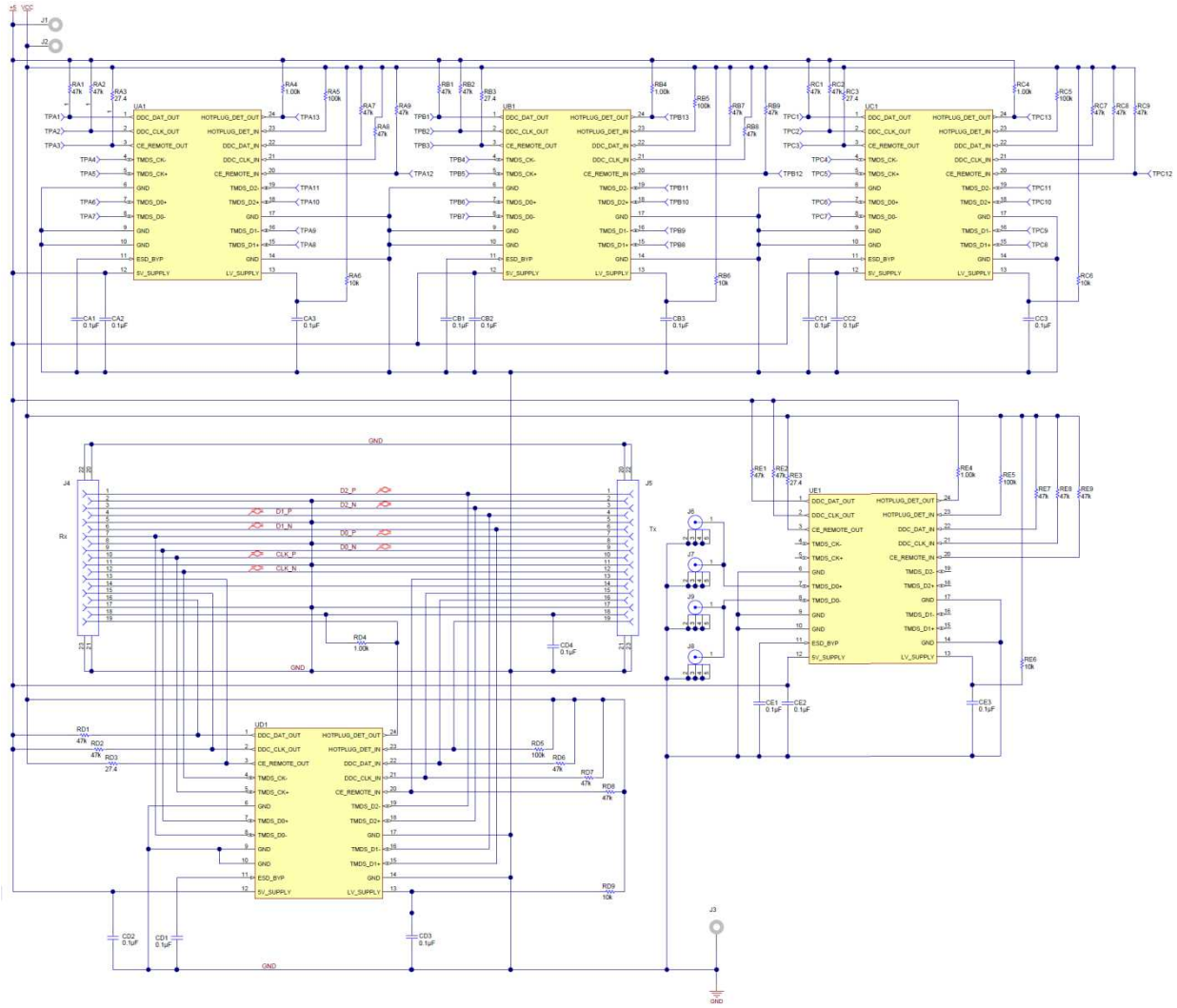

Figure 8. TPD12S520RMNEVM Schematics

6 Bill of Materials

Table 4. Bill of Materials

Qty.	Designator	Description	Part Number	Manufacturer
16	CA1, CA2, CA3, CB1, CB2, CB3, CC1, CC2, CC3, CD1, CD2, CD3, CD4, CE1, CE2, CE3	CAP, CERM, 0.1uF, 50V, +/-10%, C0G/NP0, 0402	C1005X7R1H104K	TDK
3	J1, J2, J3	Standard Banana Jack, Un-insulated, 5.5mm	575-4	Keystone
2	J4, J5	Connector, HDMI, 19-Pos Receptacle, SMT	1746679-1	TE Connectivity
4	J6, J7, J8, J9	Connector, TH, SMA	142-0701-201	Emerson Network Power
25	RA1, RA2, RA7, RA8, RA9, RB1, RB2, RB7, RB8, RB9, RC1, RC2, RC7, RC8, RC9, RD1, RD2, RD6, RD7, RD8, RE1, RE2, RE7, RE8, RE9	RES, 47k ohm, 5%, 0.1W, 0603	CRCW060347K0JNEA	Vishay-Dale
5	RA3, RB3, RC3, RD3, RE3	RES, 27.4 ohm, 1%, 0.1W, 0603	CRCW060327R4FKEA	Vishay-Dale
5	RA4, RB4, RC4, RD4, RE4	RES, 1.00k ohm, 1%, 0.1W, 0603	CRCW06031K00FKEA	Vishay-Dale
5	RA5, RB5, RC5, RD5, RE5	RES, 100k ohm, 5%, 0.1W, 0603	CRCW0603100KJNEA	Vishay-Dale
5	RA6, RB6, RC6, RD9, RE6	RES, 10k ohm, 5%, 0.1W, 0604	CRCW060310K0JNEA	Vishay-Dale
5	UA1, UB1, UC1, UD1, UE1	SINGLE-CHIP HDMI RECEIVER PORT PROTECTION AND INTERFACE DEVICE, RMN0024A	TPD12S520RMN	Texas Instruments

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