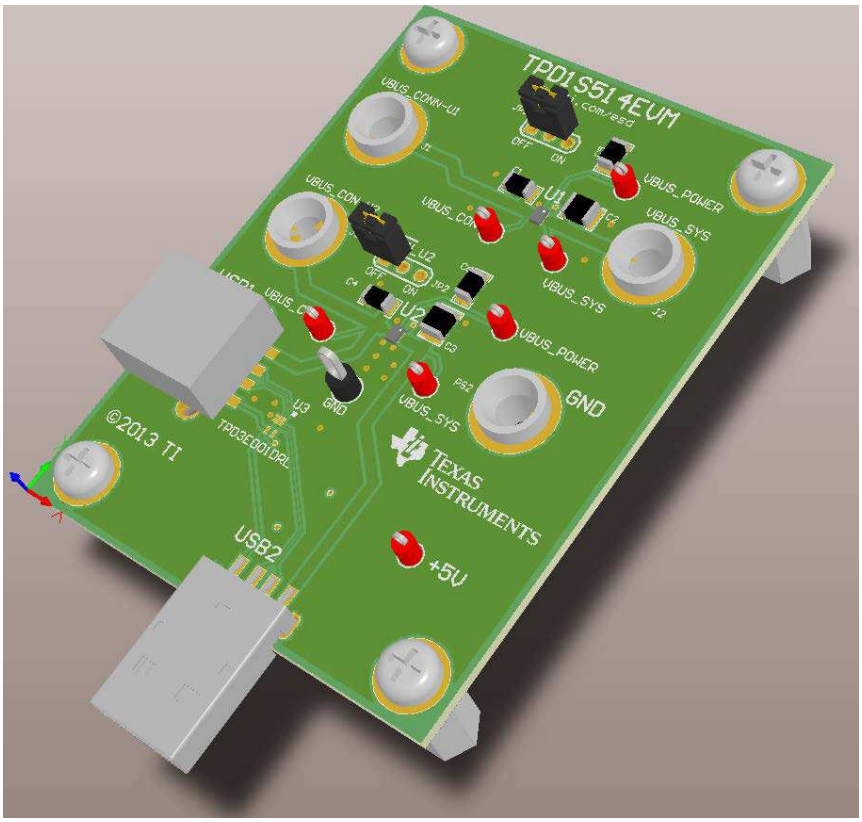
TPD1S514-1EVM

This user's guide describes the characteristics, operation, and use of the TPD1S514-1EVM evaluation module (EVM). This EVM includes 4 TPD1S514-1's in various configurations for testing. One TPD1S514-1 is configured with pin-outs and one TPD1S514-1 is configured with USB 2.0 Type A connectors for throughput analysis. 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 TPD1S514-1 evaluation module helps designers evaluate the operation and performance of the TPD1S514-1 device. The TPD1S514-1 is a single-chip solution for USB connector's VBUS line protection. The bi-directional nFET switch ensures safe current flow in both charging and host mode while protecting the internal system circuits from any over-voltage conditions at the V_{BUS_CON} pin. On the V_{BUS_CON} pin, this device can handle over-voltage protection up to 30 V. After the $\overline{EN}$ pin toggles low, the TPD1S514-1 waits 21 ms before turning ON the nFET through a startup delay. VBUS_POWER pin indicates the nFET is completely turned ON.

Table 1. EVM Configuration

Reference Designator	TI Part Number	Configuration
U1	TPD1S514-1	Surge
U2 and U3	TPD1S514-1 and TPD3E001	Surge and ESD

2 Board Setup

This section describes the intended use of the TPD1S514-1EVM. A generalized outline of the procedure given in IEC-61000-4-5 is described here. IEC-61000-4-5 should be referred to for a more specific testing outline. Connect +5V and GND during any tests.

2.1 U1

TPD1S514-1 (U1) is pinned out to allow evaluating device performance during normal operating conditions as well as during surge events. V_{BUS_CON} is J1 and V_{BUS_SYS} is J2. A 3-pin header (JP2) allows shunting the $\overline{EN}$ pin on or off. Test points allow monitoring of VBUS_CON, VBUS_SYS, and VBUS_POWER. TPD1S514-1 can pass up to 3.5 A continuous current from VBUS_CON to VBUS_SYS. RDYN can be measured under these conditions using the test points VBUS_CON and VBUS_SYS, where $R_{DYN} = I_{VBUS}/(V_{VBUS_CON} - V_{VBUS_SYS})$.

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Surge can be injected onto V_{BUS_CON} using J1. Over Voltage Protection (OVP) and Under Voltage Lockout (UVLO) can be measured by sweeping 0 V - 30 V on VBUS_CONN and measuring at the three test points. VBUS_SYS should have a load typical to the expected operational condition.

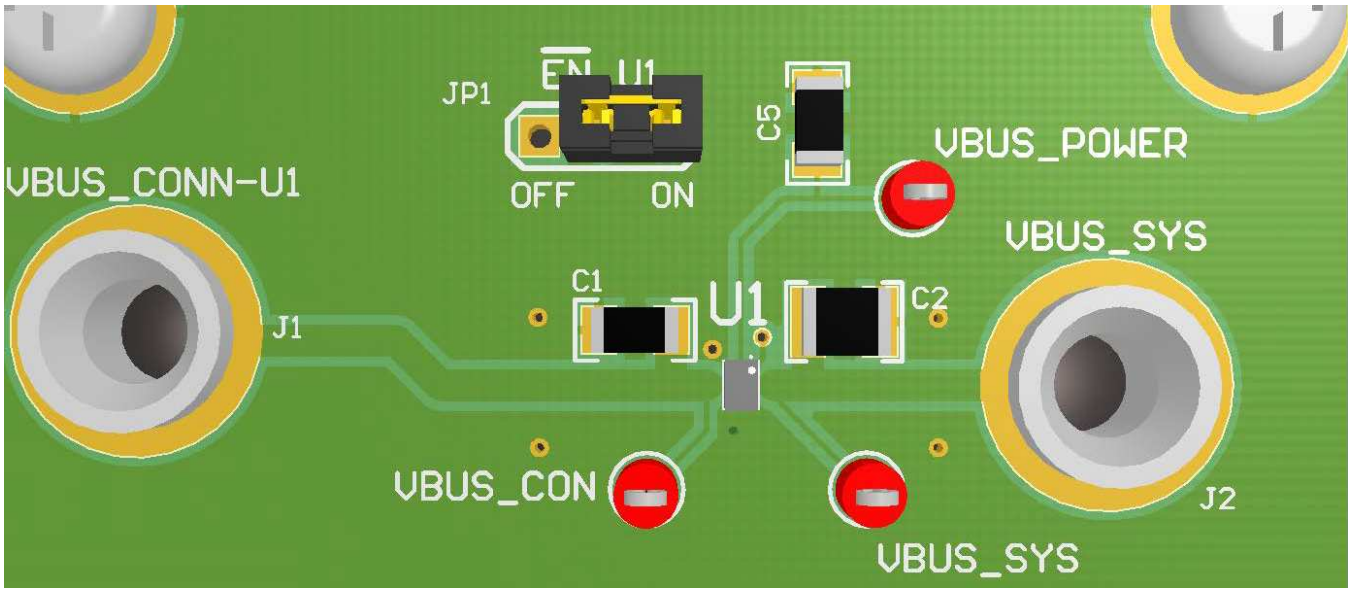


Figure 1. TPD1S514-1 Board Configuration for U1

Timing measurements should be performed after removal of C1, C2, and C3.

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2.2 U2

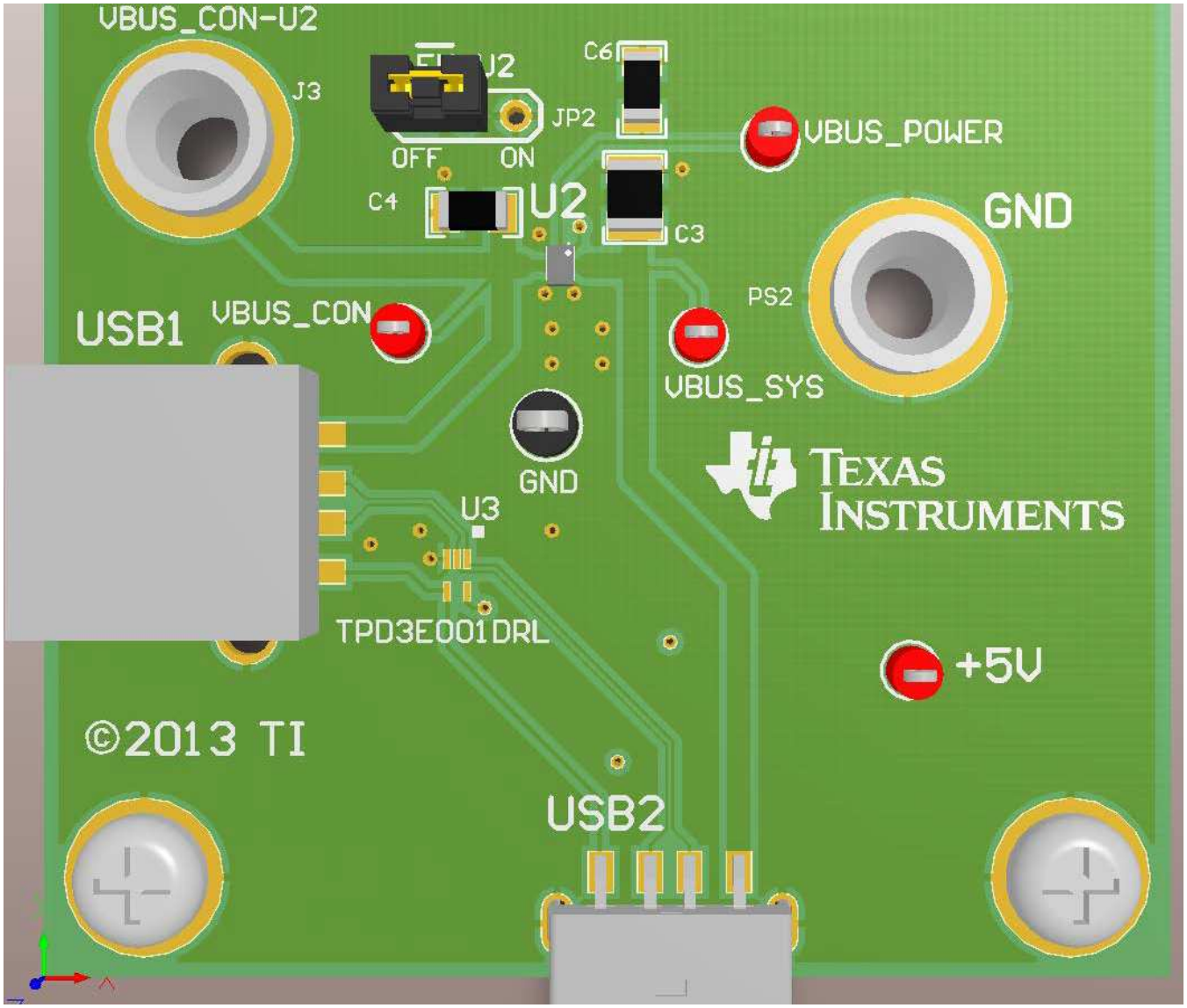


Figure 2. TPD1S514 Board Configuration for U2

A pass through USB2.0 port is included for system level testing. The female USB connector (USB1) is the “Connector” side of TPD1S514-1 and a male USB connector (USB2) is the “System” side. ESD protection has been added to the Hi-Speed data lines and ID pin in the form of TPD3E001DRL to complete the port protection example scheme.

Surge can be injected into V_{BUS_CON} using J3.

A 3-pin header (JP2) allows shunting the $\overline{EN}$ pin on or off. Test points allow monitoring of VBUS_CON, VBUS_SYS, and VBUS_POWER.

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3 Schematics

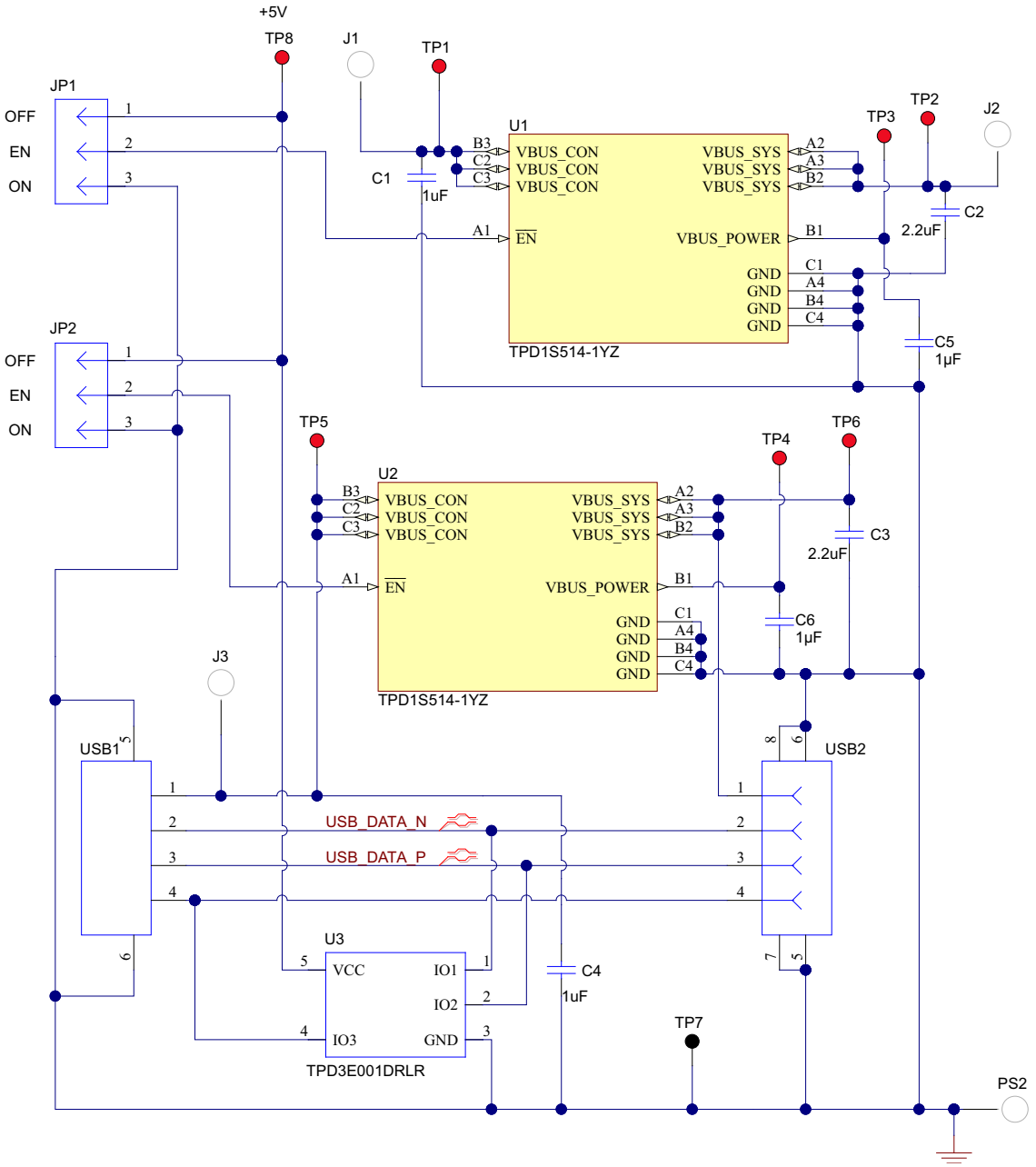


Figure 3. TPD1S514-1EVM Schematic

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4 Board Layout

This section provides the TPD1S514-1EVM board layout. TPD1S514-1EVM is a 4-layer board of FR-4 at 0.062" thickness, with ½ oz. copper outer layers and 1 oz. copper inner layers.

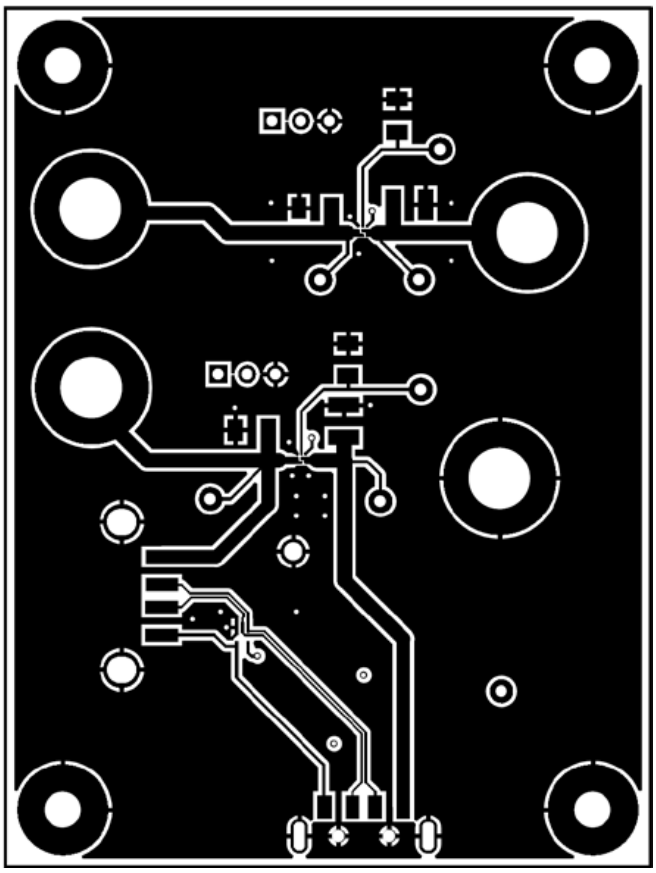


Figure 4. Top Layer Copper

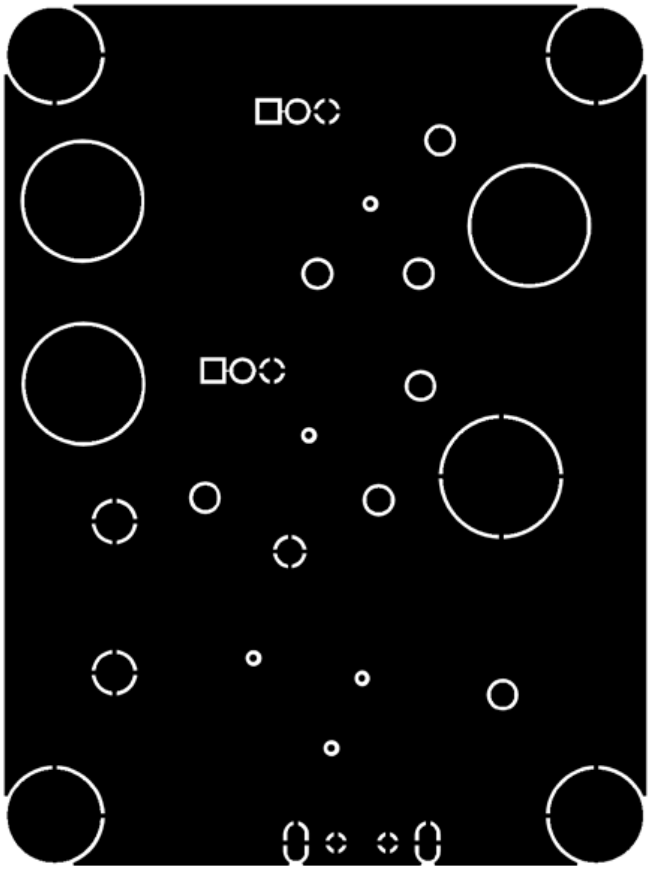


Figure 5. Second Layer Copper

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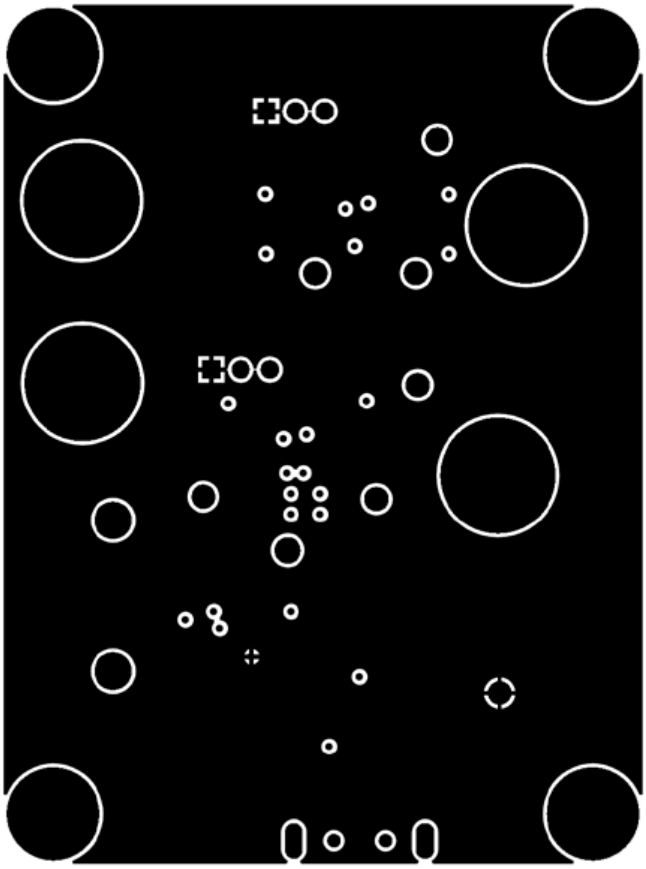


Figure 6. Layer 3 Copper

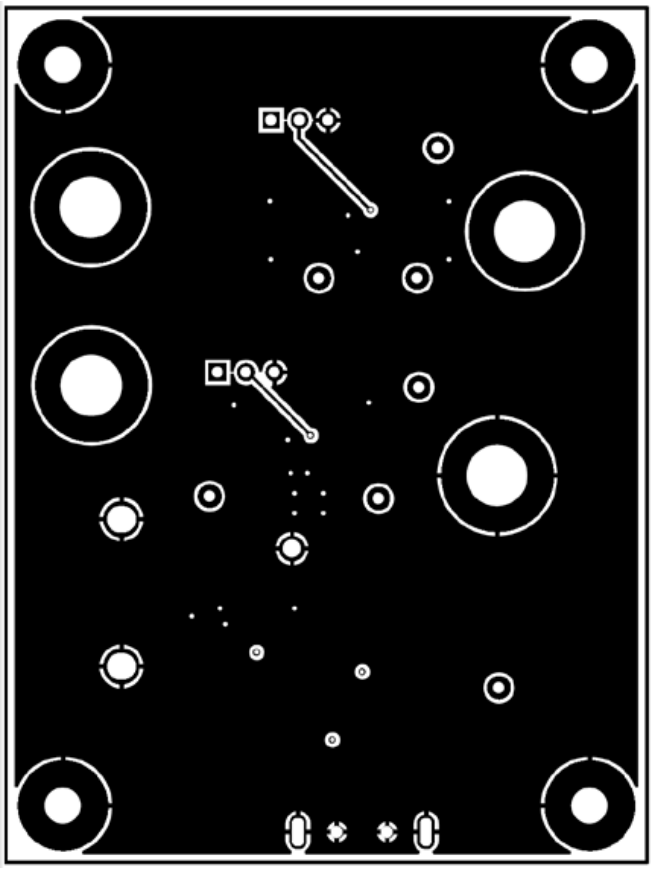


Figure 7. Bottom Layer Copper

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5 Bill of Materials

Table 2. Bill of Materials

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
C1, C4, C5, C6	4	1µF	CAP, CERM, 1µF, 25V, ±10%, X7R, 1206	1206	12063C105KAT2A	AVX
C2, C3	2	2.2µF	CAP, CERM, 2.2µF, 100V, ±10%, X7R, 1210	1210	GRM32ER72A225 KA35L	MuRata
H1, H2, H3, H4	4		Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	Screw	NY PMS 440 0025 PH	B&F Fastener Supply
H5, H6, H7, H8	4		Standoff, Hex, 0.5"L #4-40 Nylon	Standoff	1902C	Keystone
J1, J2, J3, PS2	4		Standard Banana Jack, Uninsulated, 5.5mm	Keystone_575-4	575-4	Keystone
JP1, JP2	2	PEC03SAAN	Header, Male 3-pin, 100mil spacing,	0.100 inch x 3	PEC03SAAN	Sullins
SH-J1A, SH-J2A	2	1x2	Shunt, 100mil, Gold plated, Black	Shunt	969102-0000-DA	3M
TP1, TP2, TP3, TP4, TP5, TP6, TP8	7	Red	Test Point, Miniature, Red, TH	Red Miniature Testpoint	5000	Keystone
TP7	1	Black	Test Point, Multipurpose, Black, TH	Black Multipurpose Testpoint	5011	Keystone
U1, U2	2		USB Charger Over Voltage, Surge and ESD Protection for VBUS_CON Pin, YZ0012AFAV	YZ0012AFAV	TPD1S514-1YZ	Texas Instruments
U3	1	TPD3E001DRLR	IC, LOW-CAPACITANCE 3-CHANNEL ±15-kV ESD-PROTECTION ARRAY FOR HIGH-SPEED DATA INTERFACES	SOP-5 (DRL)	TPD3E001DRL	Texas Instruments
USB1	1		Connector, Receptacle, USB TYPE A, 4POS SMD	USB TYPE A CONNECTOR RECEPTACLE 4POS SMD	896-43-004-00-000000	Mill-Max
USB2	1		Connector, USB Type A, 4POS R/A, SMD	USB Type A right angle	48037-1000	Molex

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