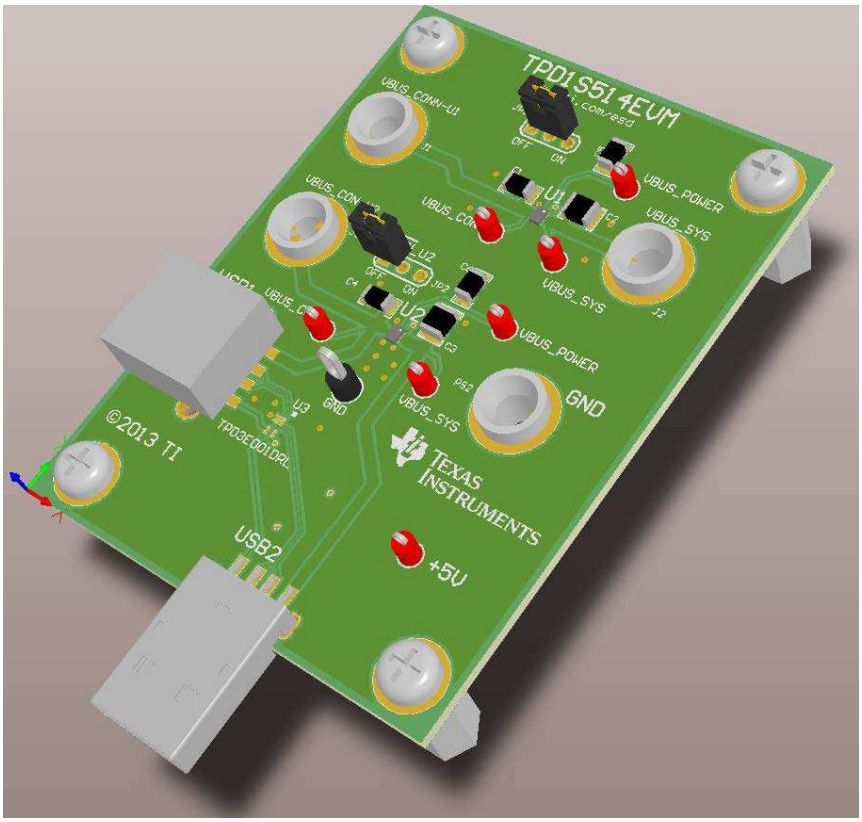
TPD1S514-3EVM

This user's guide describes the characteristics, operation, and use of the TPD1S514-3EVM evaluation module (EVM). This EVM includes 4 TPD1S514-3's in various configurations for testing. One TPD1S514-3 is configured with pin-outs and one TPD1S514-3 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.



Contents

List of Figures

List of Tables

1 Introduction

Texas Instrument's TPD1S514-3 evaluation module helps designers evaluate the operation and performance of the TPD1S514-3 device. The TPD1S514-3 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 TPD1S514-3 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	TPD1S514-3	Surge
U2 and U3	TPD1S514-3 and TPD3E001	Surge and ESD

2 Board Setup

This section describes the intended use of the TPD1S514-3EVM. 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

TPD1S514-3 (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. TPD1S514-3 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 $R_{DYN} = (V_{VBUS\_CON} – V_{VBUS\_SYS})/I_{VBUS}$.

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.

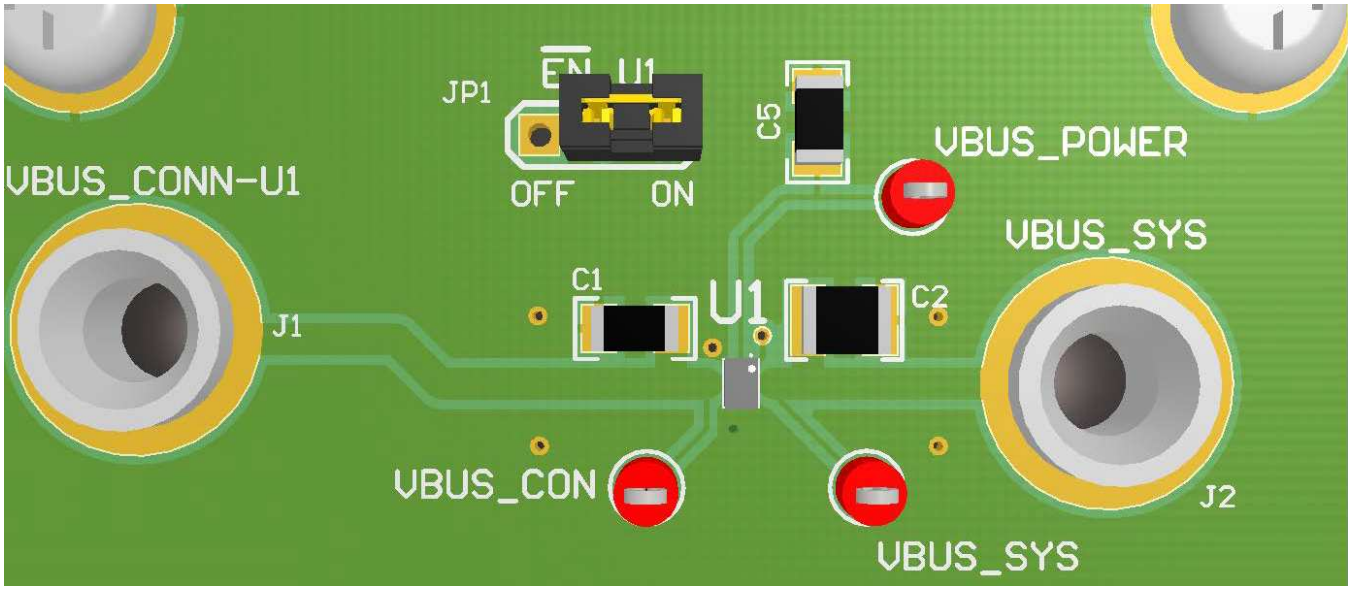


Figure 1. TPD1S514-3 Board Configuration for U1

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

2.2 U2

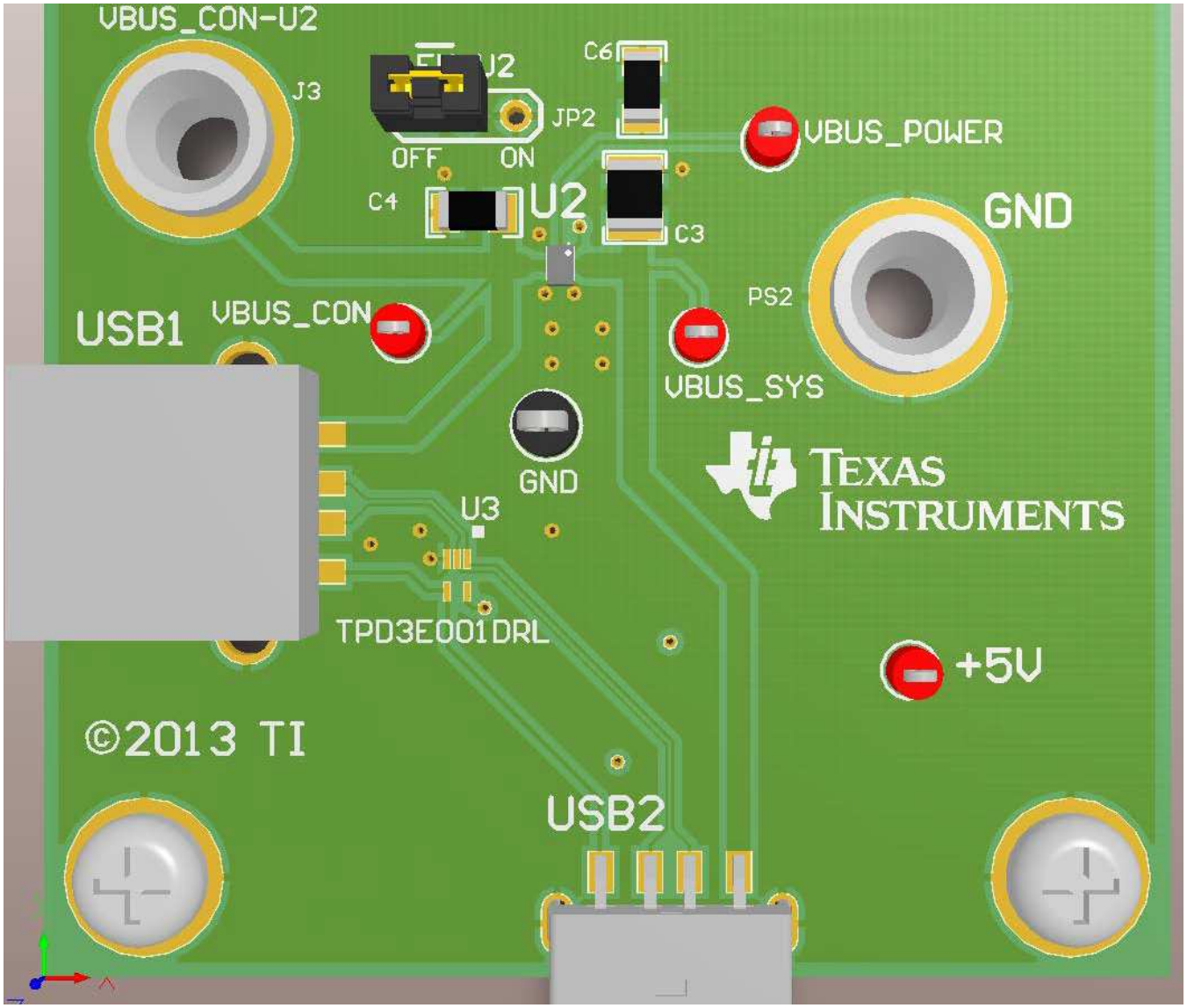


Figure 2. TPD1S514 Board Configuration for U2

A pass through USB2.0 port is included for system level testing. The female USB connector (USB1) is the “Connector” side of TPD1S514-3 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.

3 Schematics

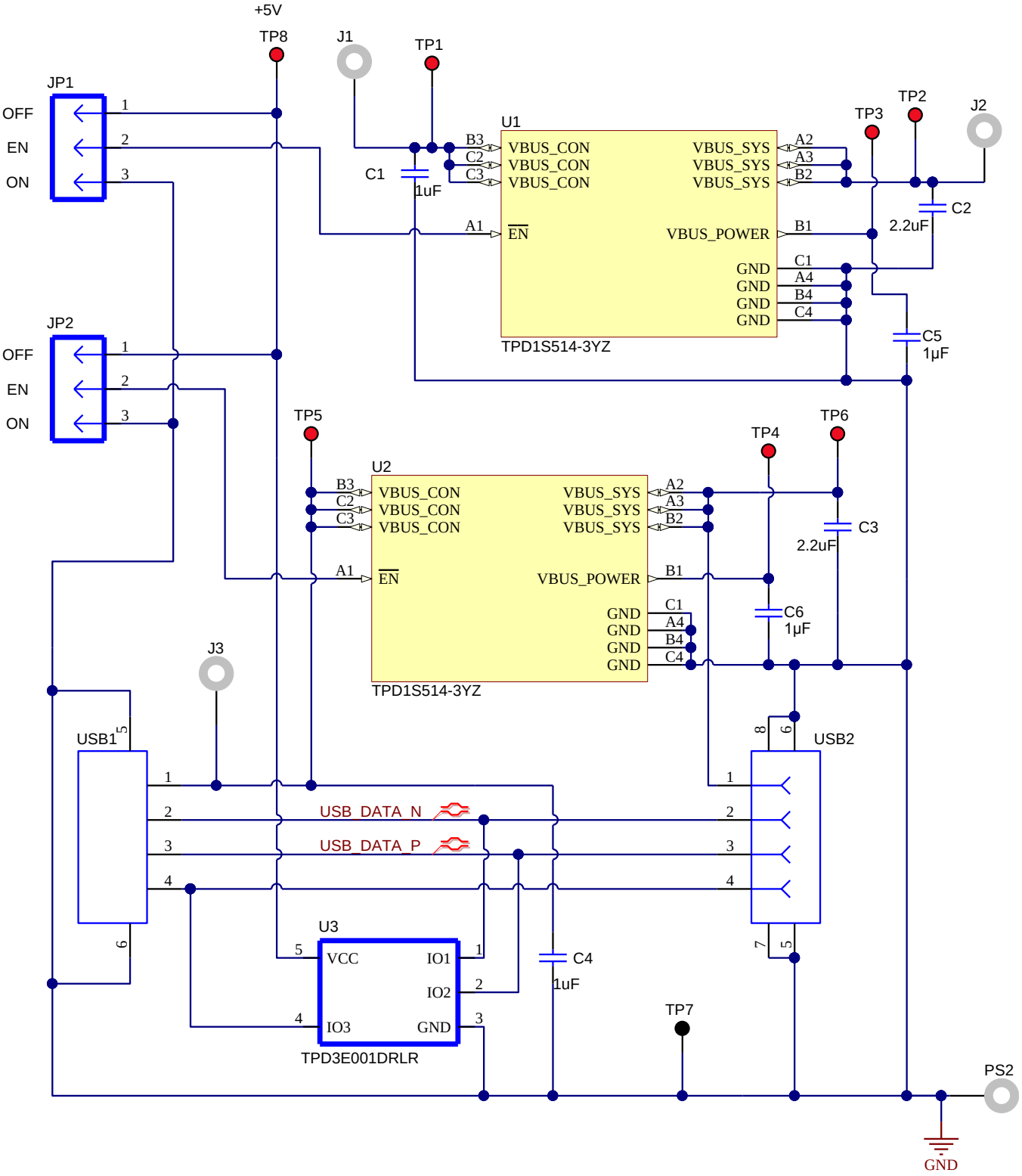


Figure 3. TPD1S514-3EVM Schematic

4 Board Layout

This section provides the TPD1S514-3EVM board layout. TPD1S514-3EVM is a 4-layer board of FR-4 at 0.062" thickness, with ½ oz. copper outer layers and 1 oz. copper inner layers.

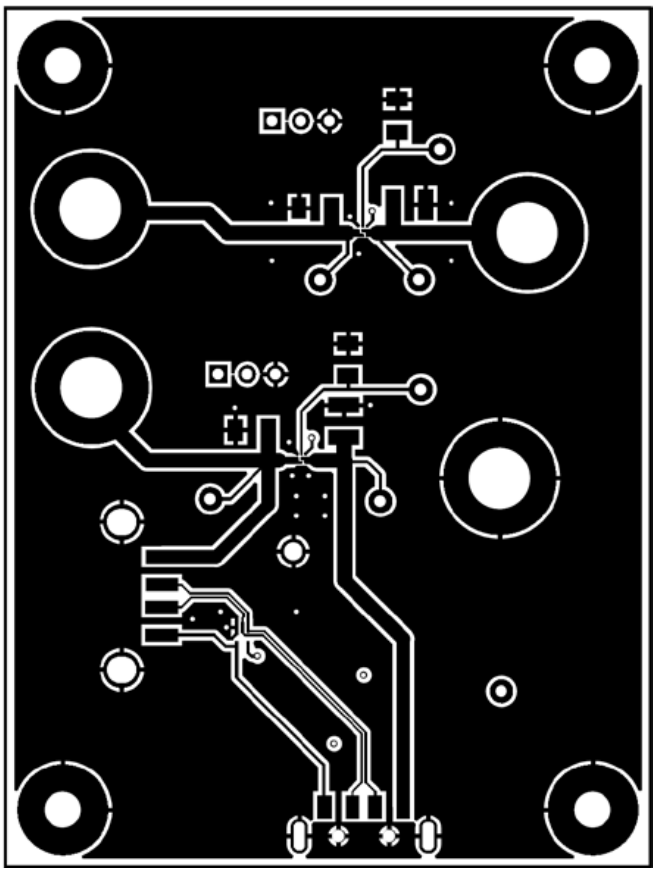


Figure 4. Top Layer Copper

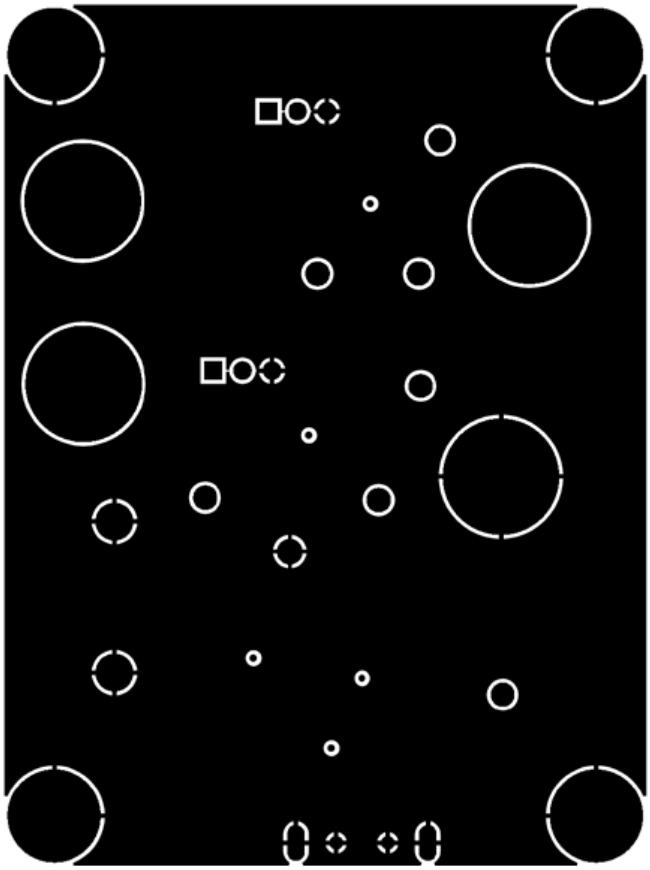


Figure 5. Second Layer Copper

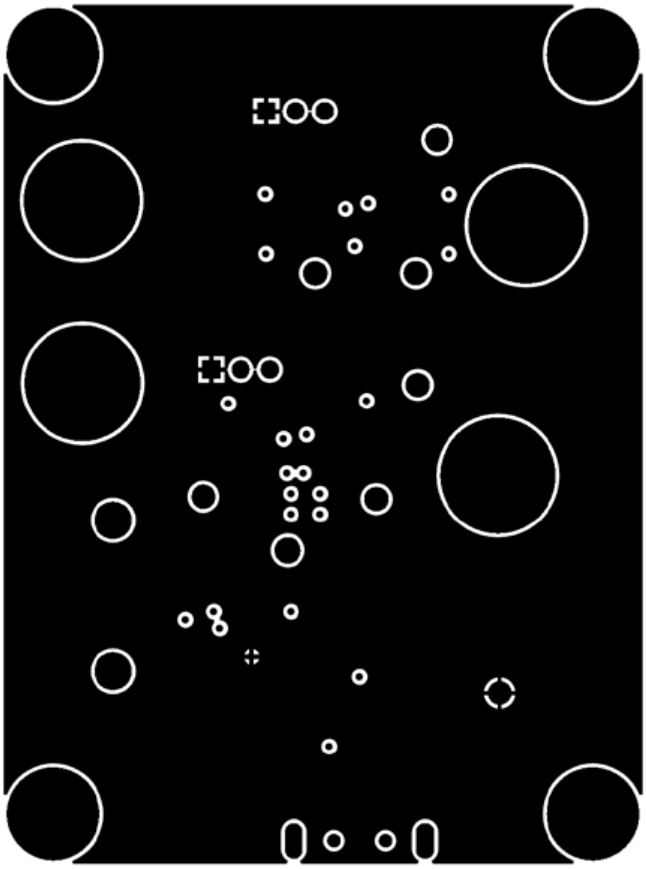


Figure 6. Layer 3 Copper

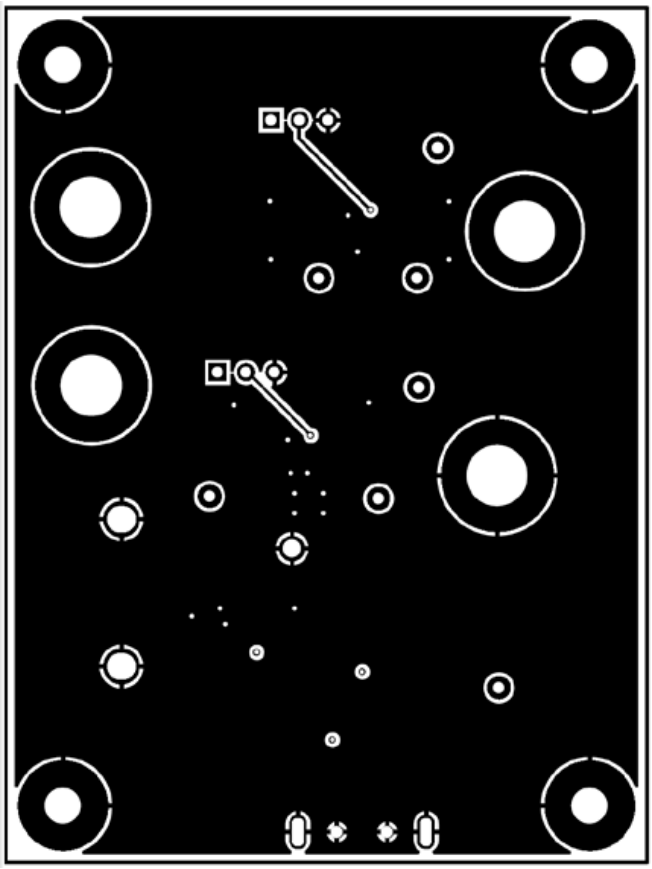


Figure 7. Bottom Layer Copper

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	TPD1S514-3YZ	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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This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

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- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

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Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

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Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

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Last updated 10/2025