TS3USB221/A/E High Speed USB 2.0 (480 Mbps) 1:2 Multiplexer/Demultiplexer Switch Evaluation Module

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1 Preface

1.1 About This Manual

This user's guide describes the TS3USB221/A/E Evaluation Module (EVM). This guide contains the EVM schematics, bill of materials, assembly drawings, and top and bottom board layouts.

1.2 How to Use This Manual

This document contains the following chapters:

- Chapter 1 – Preface
- Chapter 2 – Introduction and Quick Start
- Chapter 2 – EVM Configuration and Description
- Chapter 3 – Related Documents

1.2.1 Information about Cautions and Warnings

CAUTION

This EVM contains components that can potentially be damaged by electrostatic discharge. Always transport and store the EVM in its supplied ESD bag when not in use. Handle using an antistatic wristband. Operate on an antistatic work surface. For more information on proper handling, see the *Electrostatic Discharge (ESD)* application note (SSYA008).

The information in a caution or a warning is provided for your protection. Please read each caution and warning carefully.

1.2.2 FCC Warning

This equipment is intended for use in a laboratory test environment only. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to subpart J of part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case the user at his/her own expense will be required to take whatever measures may be required to correct this interference.

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2 Introduction

The TS3USB221/A/E EVM is an evaluation module for the Texas Instruments (TI) 1:2 multiplexer/demultiplexer high-bandwidth USB switches. It is specially designed for high-speed USB 2.0 signals, supports bidirectional signaling, and offers high-bandwidth (1.1 GHz). When interfacing other USB devices with this EVM, the switch allows signals to pass with minimum edge and phase distortion as well as little or no signal attenuation.

This evaluation module is designed to demonstrate the small printed circuit board (PCB) areas that can be achieved when designing with the TS3USB221/A/E USB switches. It is powered from the 5-V rail of the USB input. Additionally, the TS3USB221/A/E provides an output enable input and an output select input for flexible configuration of the USB. See Figure 1 for the EVM block diagram.

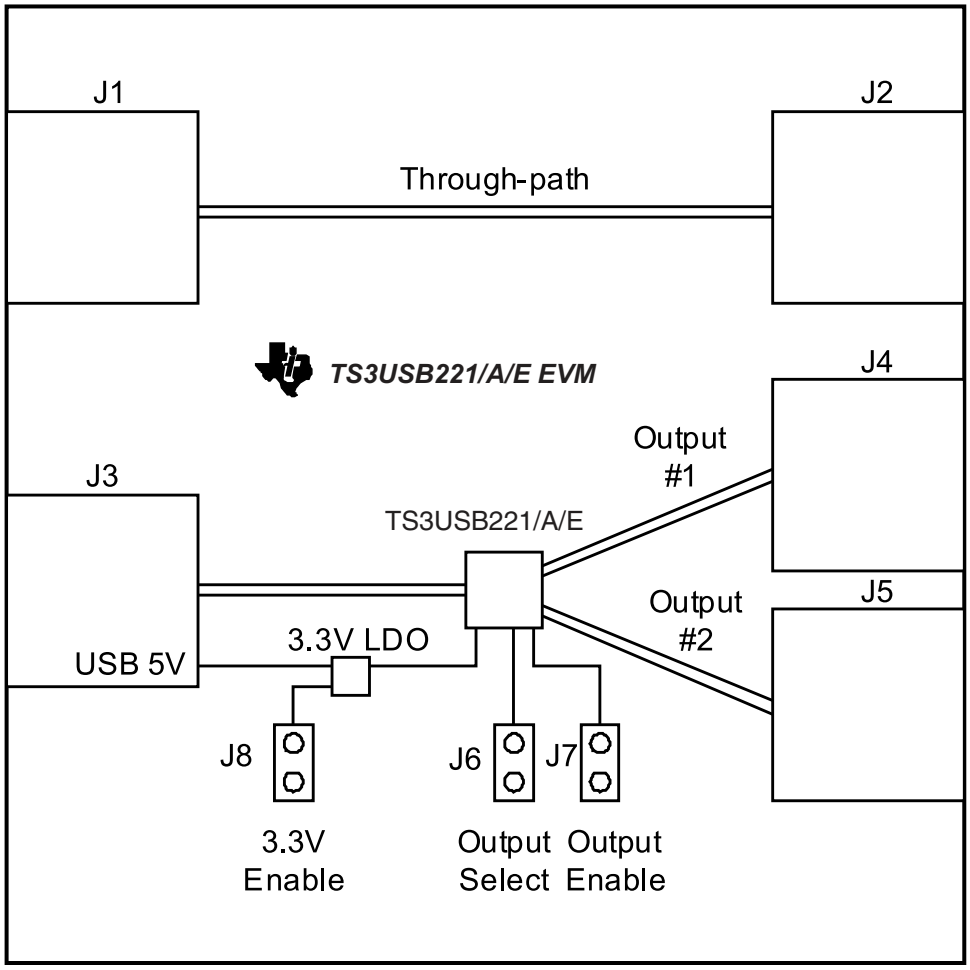

Figure 1. TS3USB221/A/E EVM Block Diagram

2.1 List of Hardware Items for Operation

The following items are required for EVM evaluation:

- The TS3USB221/A/E EVM
- USB cables with connector type depending on the surrounding system

The following items are optional for EVM evaluation:

- USB type A or type B connectors to change connectors J1 through J5 for optimal system interface configuration
- IBM compatible PC with USB 2.0 ports for quick start evaluation

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2.2 Quick Start

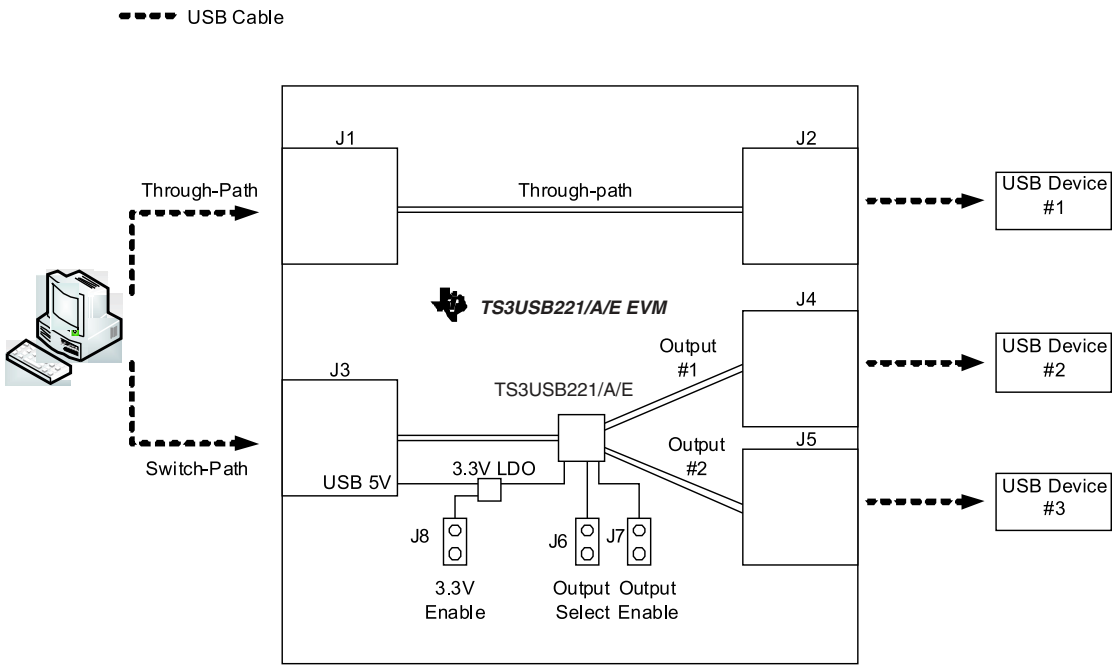

Figure 2. Quick Start Evaluation

1. Connect the PC to the USB connector J3 through a USB cable.
2. Make sure the 3.3-V LDO output is enabled by opening J8 without a jumper.
3. Make sure the TS3USB221/A/E IC is enabled by shunting J7 with a jumper.
4. Connect two USB downstream devices (for example, mouse, keyboard, USB memory stick, etc) to J4 and J5 on the EVM.
5. To select USB downstream device 1 connected to J4, make sure J6 is shunted with a jumper. To select USB downstream device 2 connected to J5, make sure J6 is open without a jumper.
6. Connector J1 and J2 are connected together without a USB switch. This through-path can serve as a reference to compare with the TS3USB221/A/E path.

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3 EVM Configuration and Description

3.1 EVM Description

To conform to the USB 2.0 specification, the differential traces D+ and D- lines on the board are impedance matched to 90-Ω differential. The trace length of the through-path and the trace length through the TS3USB221/A/E switch are also matched for comparison purpose. The PCB is a simple four-layer top-side populated board (see the schematic and PCB layout in Section 3.4 and Section 3.5). The major features of the hardware design are detailed in the following sections.

3.2 Jumper Configuration (J6 to J8)

The EVM has jumper J6 through J8 (see Figure 3) to provide configuration to the TS3USB221/A/E and the 3.3-V LDO. J6 allows switch output channel select, J7 provides switch enable control, and J8 provides 3.3-V LDO enable control. Table 1 lists all of the jumpers in the EVM and their respective functionality (all default settings are in bold).

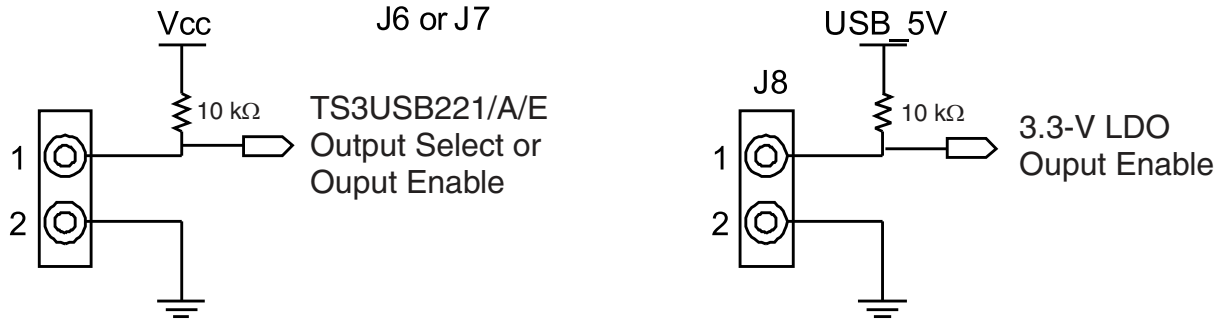

Figure 3. Jumpers J6, J7, and J8 Configuration

Table 1. EVM Jumper Description

Jumper	Functionality	Configuration
J6	TS3USB221/A/E Select	**Shunt J6 to select output 1** Open J6 to select output 2
J7	TS3USB221/A/E Enable	**Shunt J7 to enable the switch** Open J7 to disable the switch
J8	3.3V LDO Enable	**Shunt J8 to disable the LDO** Open J8 to enable the LDO

The EVM provides USB connectors J1 through J5 to interface with other USB devices. Depending on the application need, the connectors can be de-soldered and changed to either type A or type B connector. See Table 2 for the default connectors on the EVM.

Table 2. EVM Connector Description

Connector	Functionality	Configuration
J1	USB Connector	**Default as type B connector** Can be replaced with type A connector
J2	USB Connector	**Default as type A connector** Can be replaced with type B connector
J3	USB Connector	**Default as type B connector** Can be replaced with type A connector
J4	USB Connector	**Default as type B connector** Can be replaced with type A connector
J5	USB Connector	**Default as type B connector** Can be replaced with type A connector

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3.3 Board Stack-Up

Table 3 shows the board stack-up.

Table 3. Board Stack-Up

	Subclass Name	Type	Thickness (mils)	Dielectric Constant	Loss Tangent	Shield	Width (mils)	Impedance (Ω)	Coupling Type	Spacing (mils)	Diff Z_o (Ω)
1		SURFACE									
2	TOP	CONDUCTOR	2.4	1	0		7.5	47.72	EDGE	7.5	85.004
3		DIELECTRIC	4	4.1	0.035						
4	GND	PLANE	1.2	1	0	YES					
5		DIELECTRIC	48	4.1	0.035						
6	VCC	PLANE	1.2	1	0	YES					
7		DIELECTRIC	4	4.1	0.035		7.5	47.72	EDGE	7.5	85.004
8	BOTTOM	CONDUCTOR	2.4	1	0						
9		SURFACE									

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3.4 Schematics

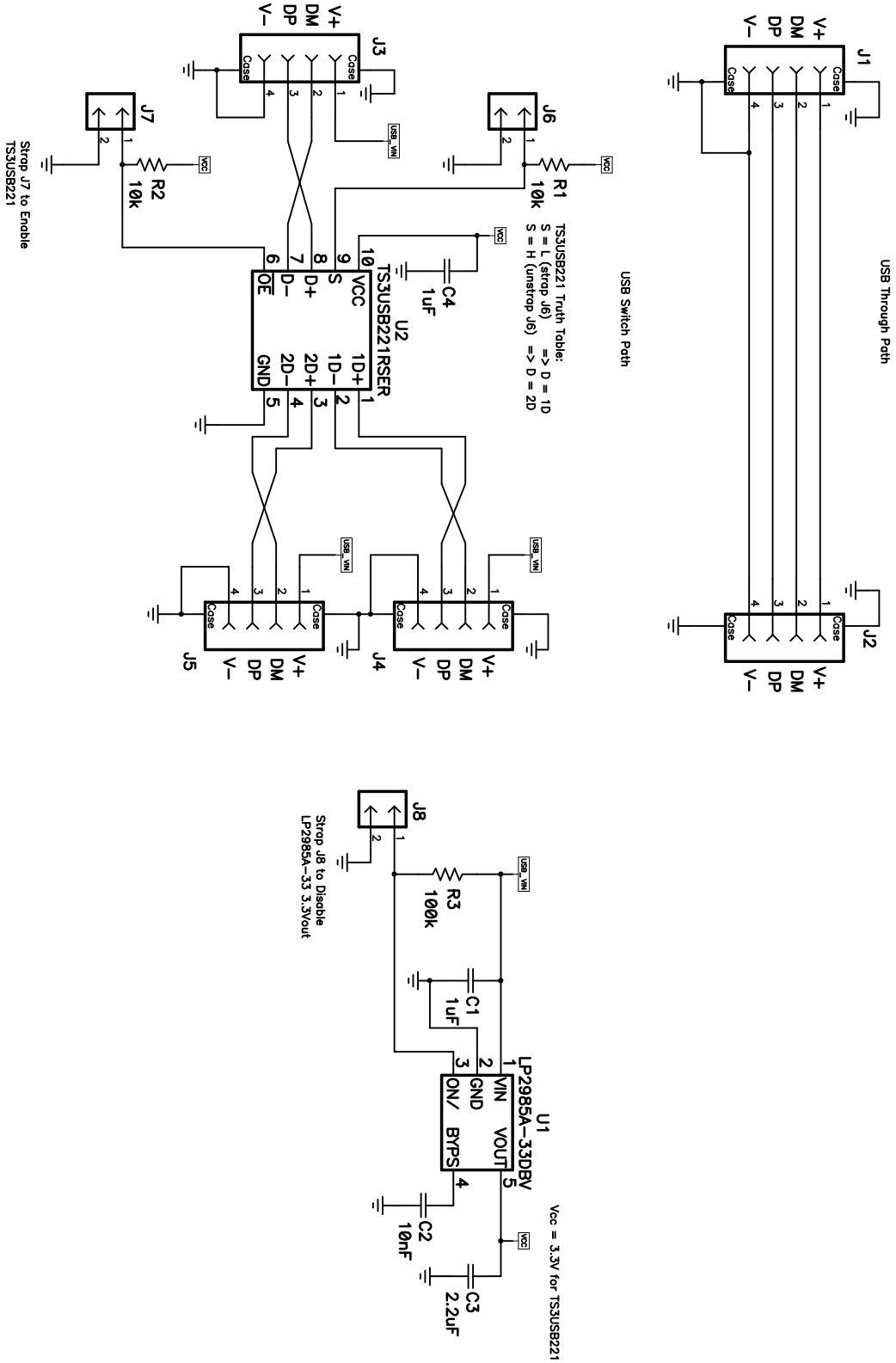

Figure 4. EVM Schematic

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3.5 PCB Layout

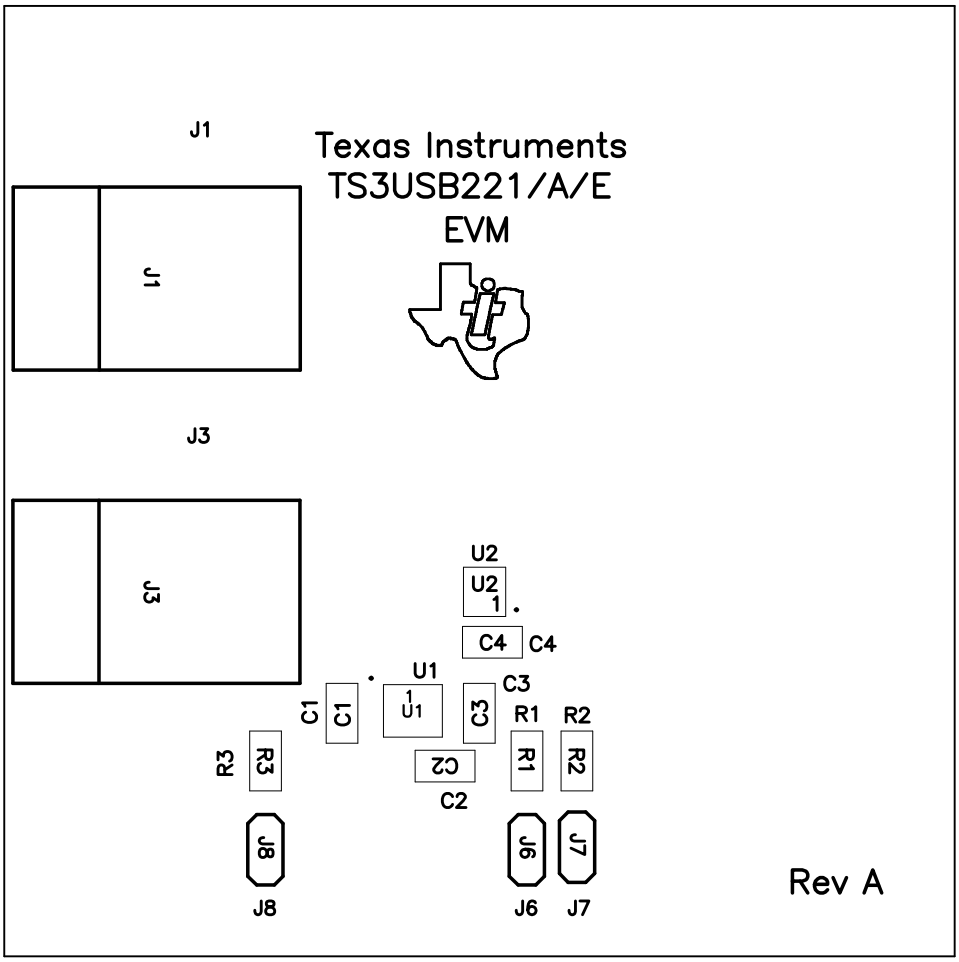

Figure 5. Top Silkscreen/Assembly

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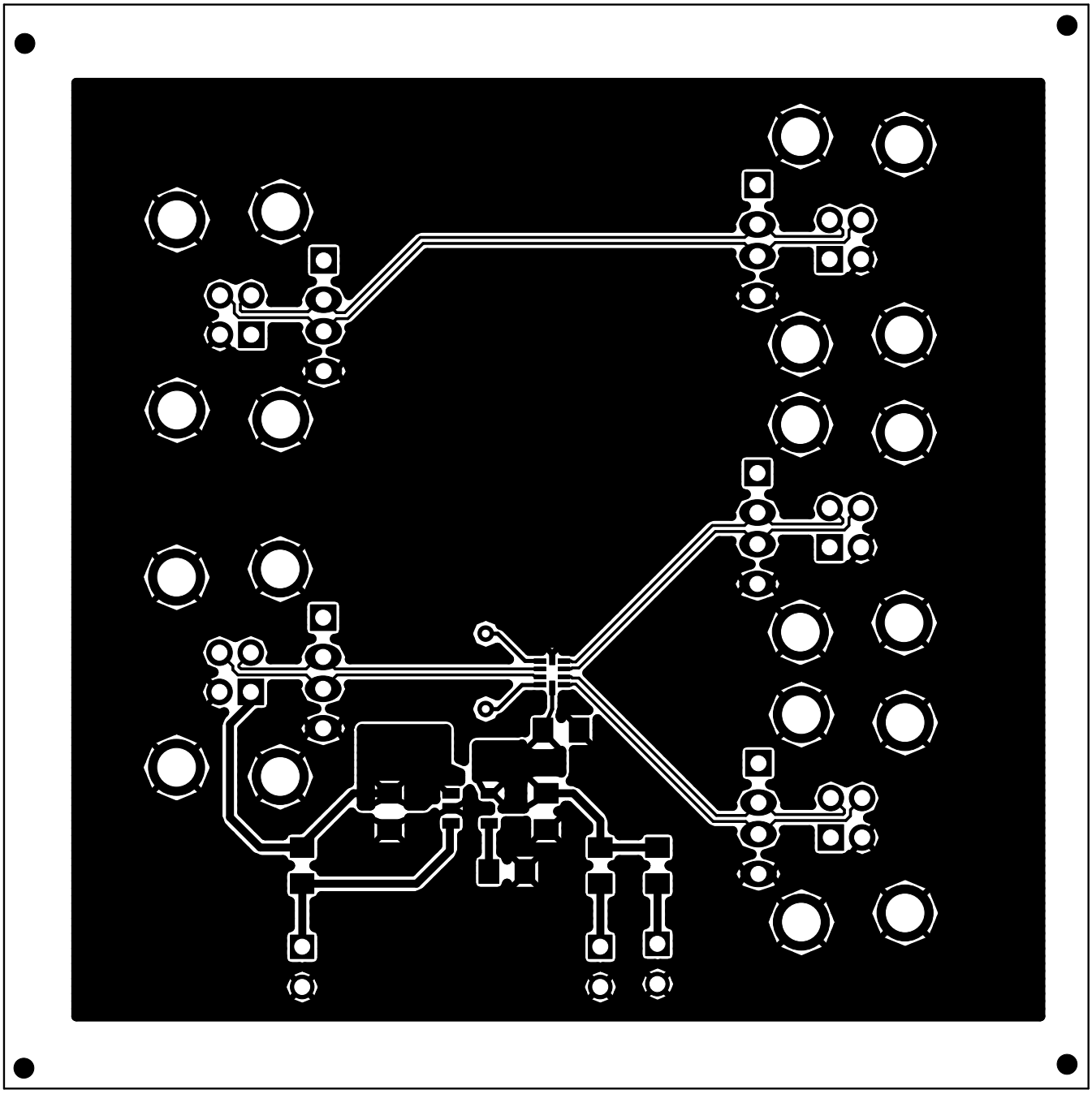

Figure 6. Top Metal (High-Speed Differential)

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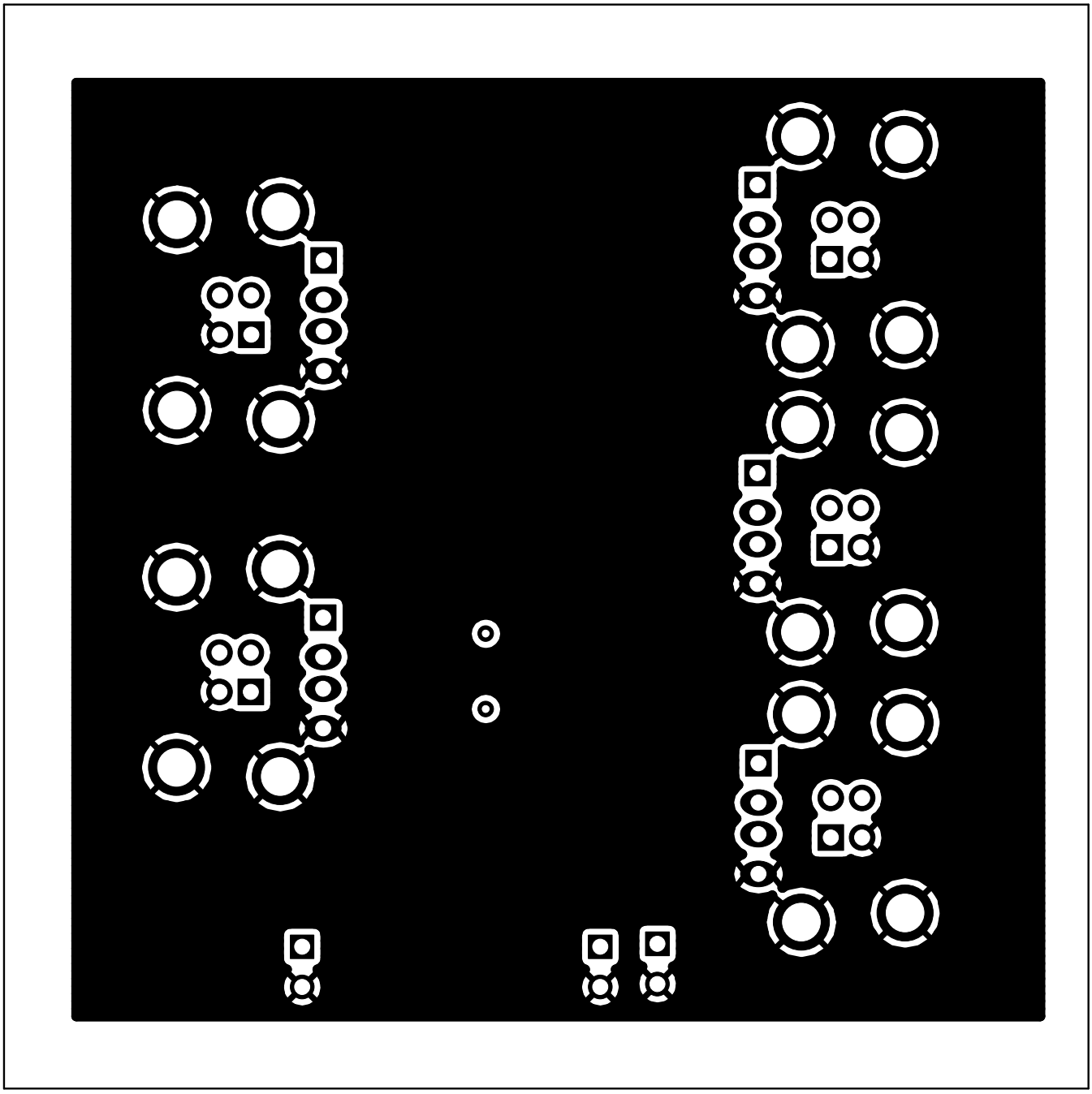

Figure 7. Internal Ground Plane

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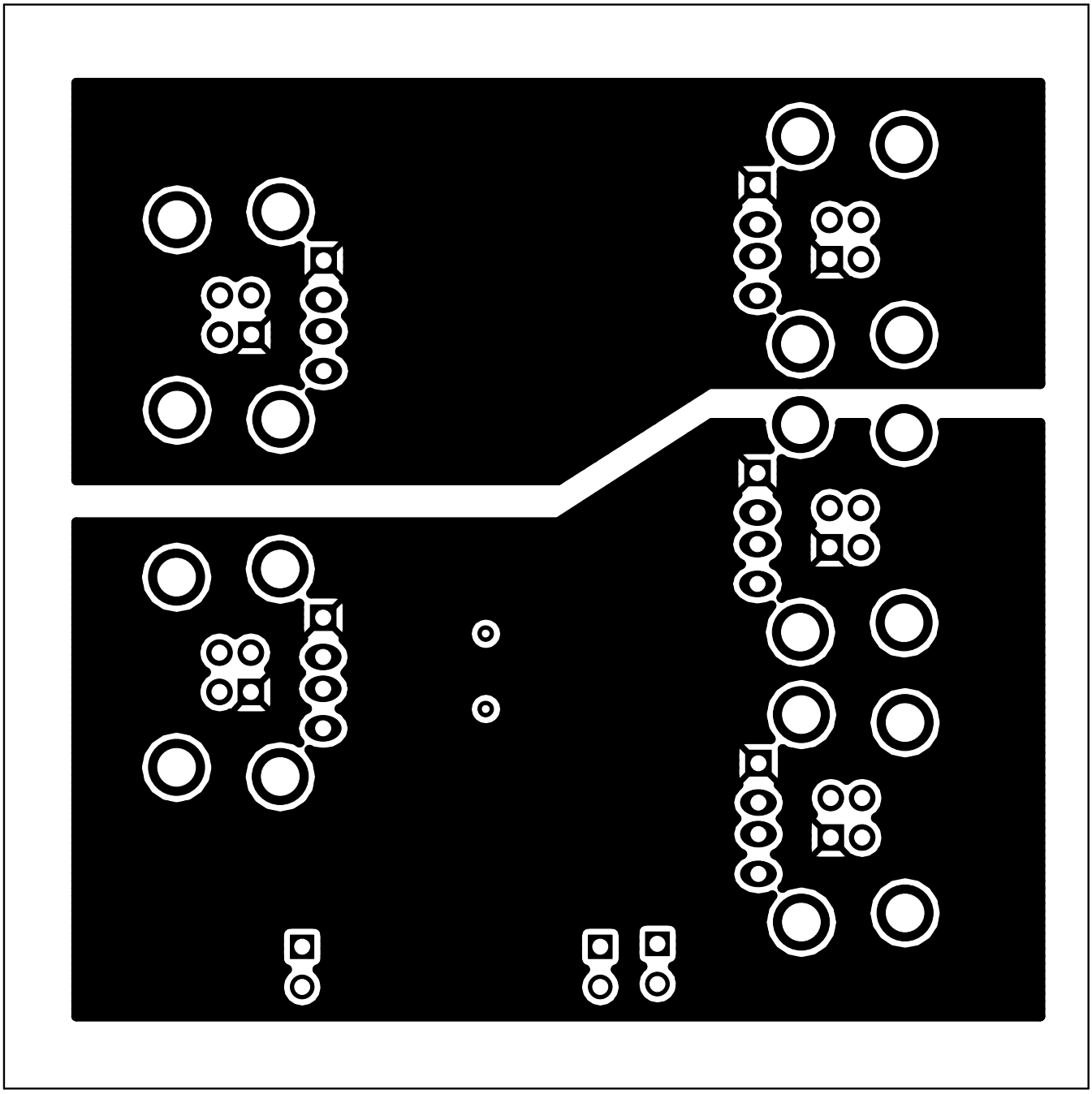

Figure 8. Internal Power Plane

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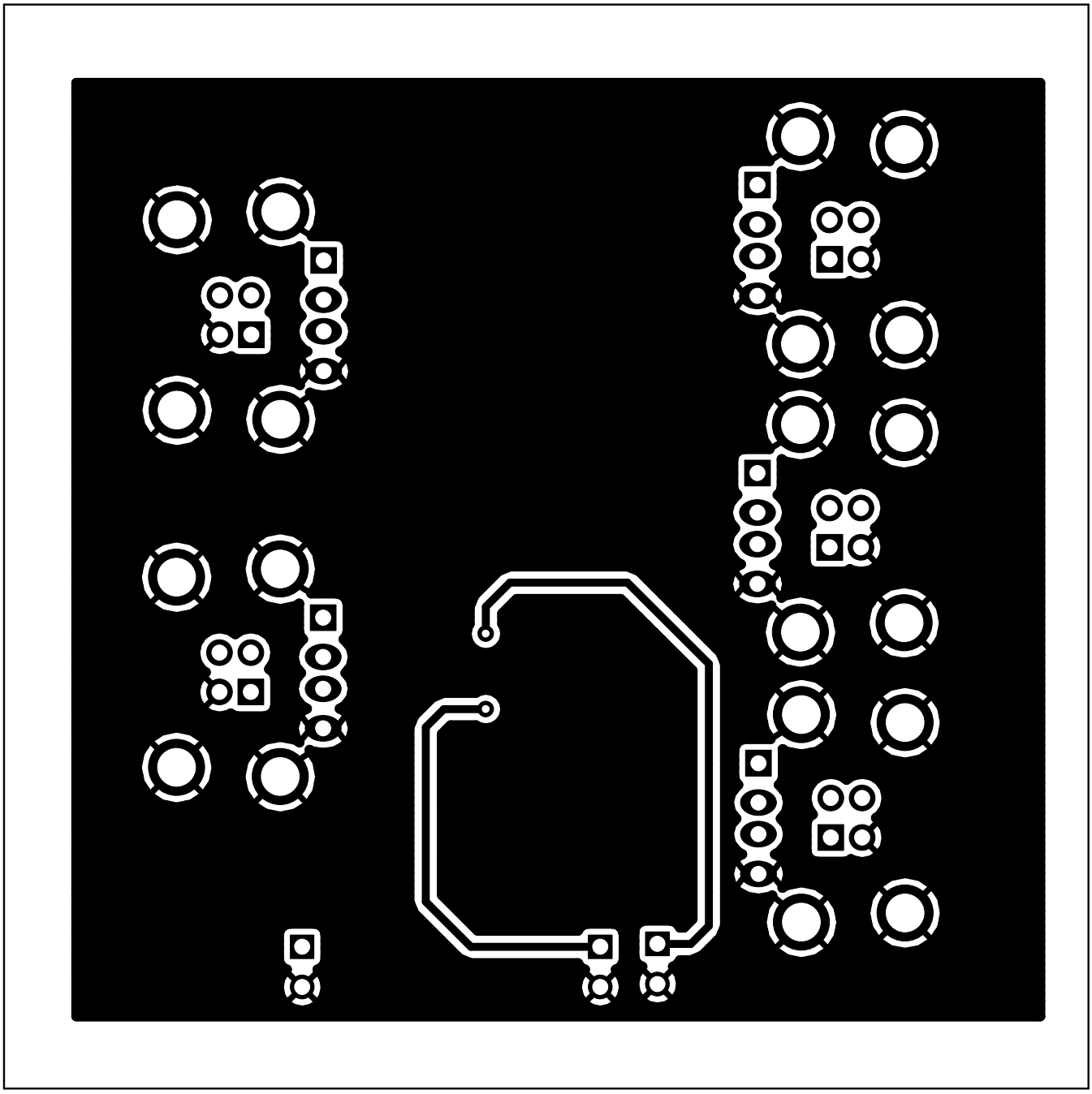

Figure 9. Bottom Metal (Low-Speed Single-Ended)

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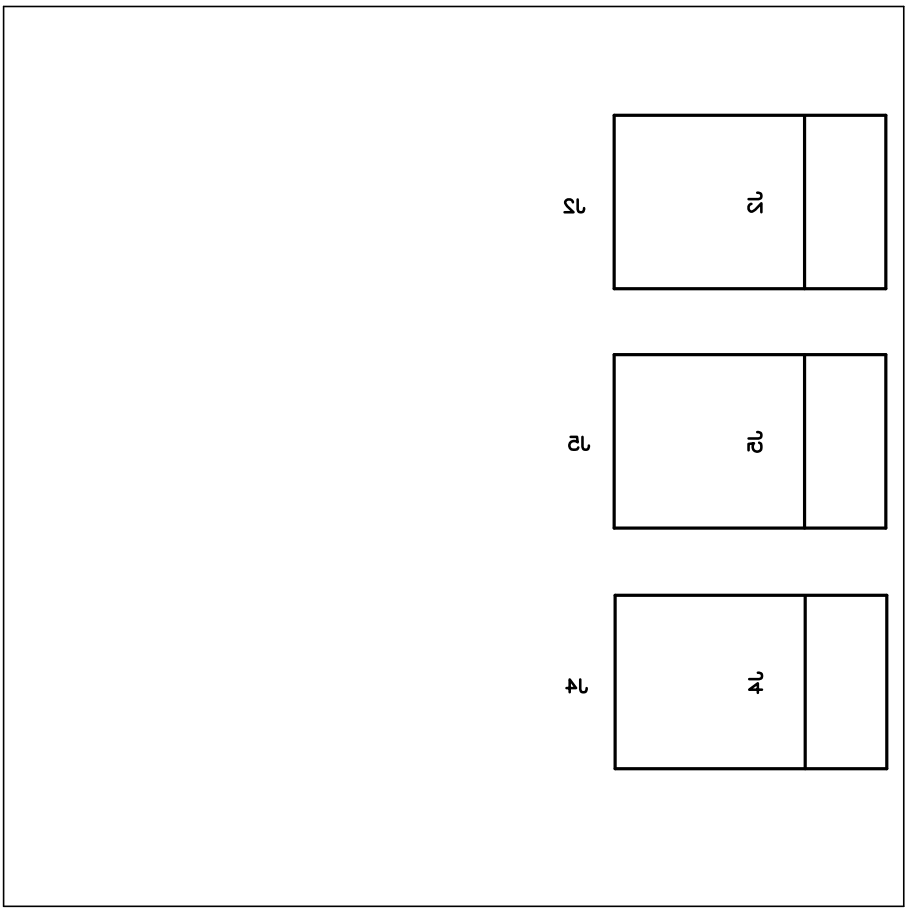

Figure 10. Bottom Silkscreen/Assembly

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3.6 Bill of Materials

Table 4. Bill of Materials

Count	RefDes	Value	Description	Size	Part Number	Manufacturer
2	J1, J3	–	USB Connector Type A	–	AU-Y1005	Assmann Electronics Inc
3	J2, J4, J5	–	USB Connector Type B	–	67068-9000	Molex / Waldom Electronics
3	J6, J7, J8	–	Header, 2x1pin, 100mil spacing	100 mil x 100 mil	PEC36SAAN	Sullins Connector Solutions
2	C1, C4	1.0 µF	Capacitor, Ceramic, 1.0uF, X7R, 10%	805	Std	Std
1	C2	10 nF	Capacitor, Ceramic, 10nF, X7R, 10%	805	Std	Std
1	C3	2.2 µF	Capacitor, Ceramic, 2.2uF, X7R, 10%	805	Std	Std
2	R1, R2	10 kΩ	Resistor, Chip, 10kΩ, 1/8W, 5%	805	Std	Std
1	R3	100 kΩ	Resistor, Chip, 100kΩ, 1/8W, 5%	805	Std	Std
1	U1	TS3USB221/A/E	IC, High Speed 1:2 USB Switch	RSE	TS3USB221RSER/ TS3USB221xRSER	TI
1	U2	LP2985-33	IC, 150mA LDO regulator	SOT23-5	LP2985-33DBV	TI

4 Related Documentation

TS3USB221 High-Speed USB 2.0 (480Mbps) 1:2 Multiplexer/Demultiplexer Switch with Single Enable data sheet (SCDS220F)

TS3USB221A ESD Protected, High-Speed USB 2.0 (480Mbps) 1:2 Multiplexer/Demultiplexer Switch with Single Enable data sheet (SCDS277)

TS3USB221E High-Speed USB 2.0 (480Mbps) 1:2 Multiplexer/Demultiplexer Switch with Single Enable and IEC Level 3 ESD Protection data sheet (SCDS263)

USB 2.0 Board Design and Layout Guidelines application report (SPRAAR7)

High Speed USB Platform Design Guidelines, Intel, 2000, http://www.intel.com/technology/usb/download/usb2dg_R1_0.pdf

USB 2.0 Specification, Intel, 2000, http://www.usb.org/developers/docs

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