

**ABSTRACT**

This is the user guide for the TPS25814 Evaluation Module (TPS25814EVM). The TPS25814EVM allows for evaluation of the TPS25814 IC as part of a stand-alone testing kit and for development and testing of USB Type-C end products.

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1 Introduction

This user's guide describes the TPS25814EVM. The guide consists of an introduction, setup instructions, the EVM schematic, board layouts, component views, internal power (PWR) and ground (GND) plane layouts, and a bill of materials (BOM).

The TPS25814 is a stand-alone USB Type-C port controller providing cable plug and orientation detection at the USB Type-C connector. When cable detection is complete, the TPS25814 enables the internal 5 V power path and configures external multiplexers and alternate mode settings. This user guide describes how the TPS25814EVM can be used to test USB Type-C functionality, including USB 3.0 Data. [Figure 1-1](#) is the block diagram for the TPS25814EVM.

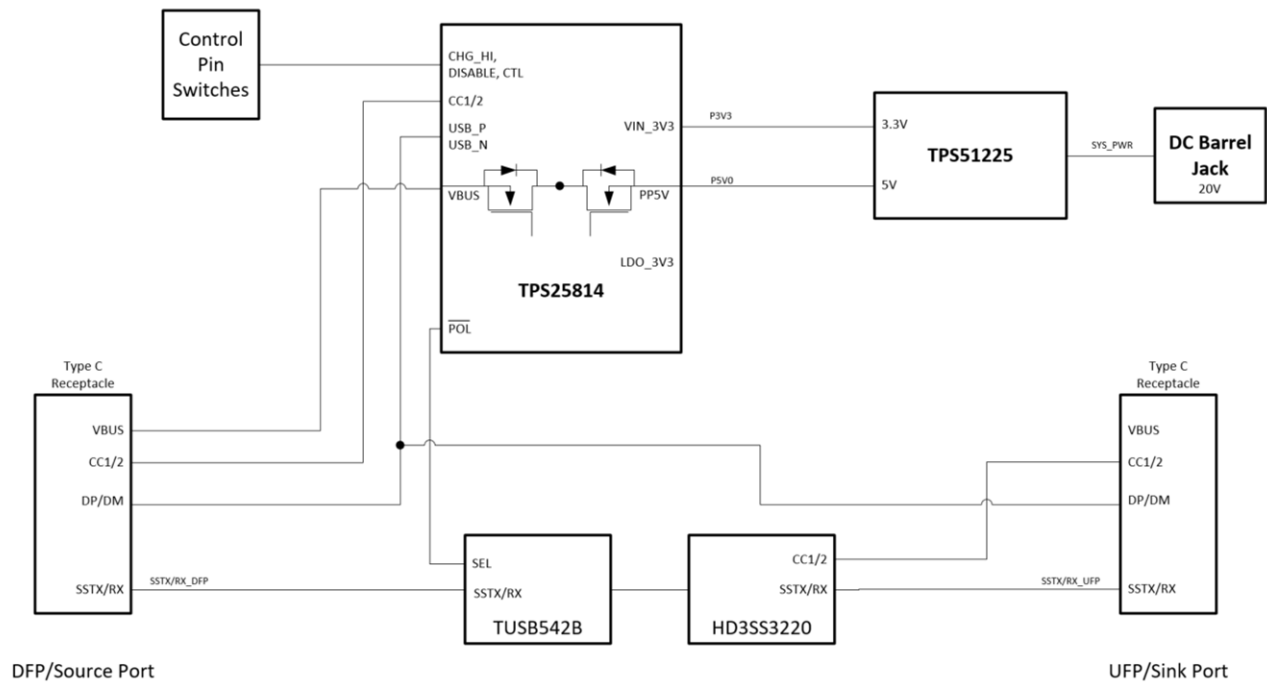


Figure 1-1. TPS25814EVM Block Diagram

The TPS25814EVM is powered by a 20-V DC barrel jack connection, or 20-V bench supply. This 20-V input supply is regulated to 5 V and 3.3 V using the TPS51220. The TUSB542 and HD3SS3220 route the USB SS lanes from the DFP pin to the UFP port, allowing for users to evaluate a USB 3.0 data solution.

1.1 Description

The TPS25814 is a stand-alone USB Type-C® controller providing cable plug and orientation detection for one USB Type-C connector. Upon cable attachment, the TPS25814 performs cable detection according to the USB Type-C specification. When cable detection is complete, the TPS25814 enables the internal power path. Status indicator pins may be used to control an external multiplexer. The TPS25814EVM allows for the evaluation of the TPS25814 in a system.

1.2 Features

This TPS25814 and the TPS25814EVM have the following features:

- USB Type-C specification compliant
 - Cable attach and orientation detection
 - Integrated VCONN switch
 - 26-V tolerant CC pins
 - Configurable current advertisement
- Integrated VBUS sourcing port power switch
 - 5-V, 3-A, 36-mΩ Sourcing switch
 - UL recognized component (E169910)
 - Undervoltage and overvoltage protection
 - Configurable current limit up to 3 A
- USB type-C connector system software interface (USCI) support
- Supports industrial temperature range
- Optional simple power management for multi-port systems

1.3 Applications

- Notebook and desktop computers
- 15-W USB-C chargers
- Docking stations and hubs

2 EVM Setup

The following items are required to use the TPS25814EVM:

- TPS25814 data sheet
- TPS25814EVM
- 20-V barrel jack adapter or DC power supply
- Passive USB Type-C cables
- USB Type-C Flash drive
- Notebook with USB 2.0 and USB 3.0 capabilities

To power the EVM, connect either the 20 V barrel jack adapter to J1 or a 20 V bench supply to TP4.

3 EVM Connectors, Test Points, and Devices

3.1 Power: 5 V and 3.3 V Supply

The TPS51220 is a dual channel buck controller that regulates the 20-V input supply to 5 V and 3.3 V. The 5-V supply connects to the internal 5-V power path for the TPS25814, which is used to supply power to VBUS as well as VCONN. The 3.3-V supply is used to power VIN_3V3 on the TPS25814 as well as the HD3SS3220. The 5-V supply has a 8-A current limit and the 3.3-V supply has a 3-A current limit.

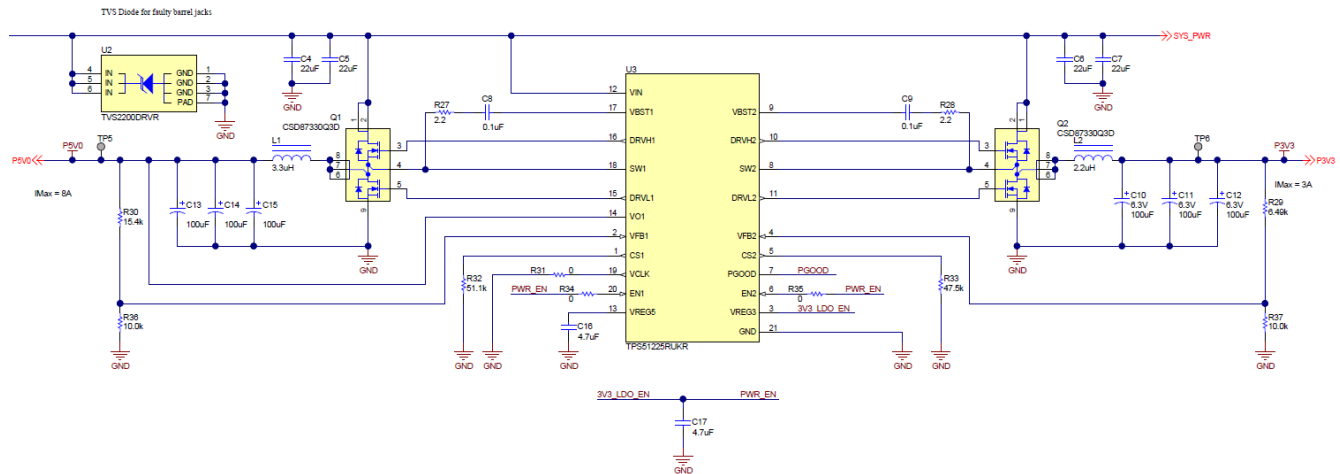


Figure 3-1. TPS51220 Schematic

3.2 Power: 1.8 V Supply

The LP5907 is used to generate 1.8 V, which is then supplied to the TUSB542 device.

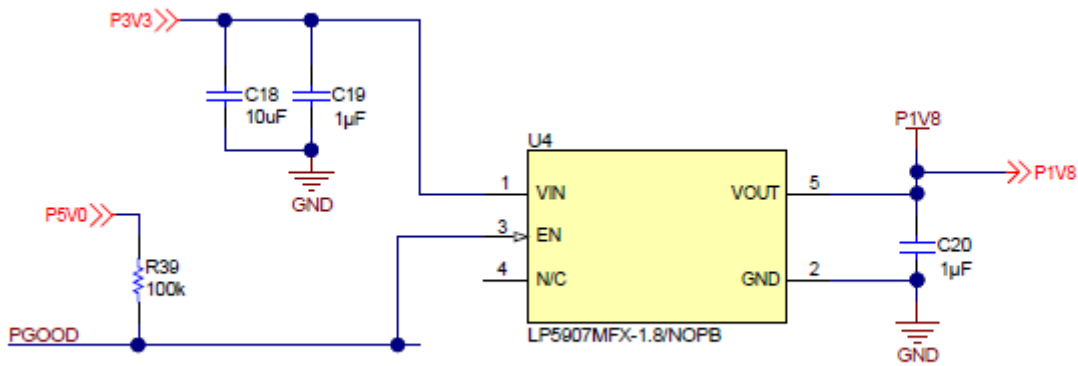


Figure 3-2. LP5907 Schematic

3.3 Power: Barrel Jack Power Connector

The barrel jack power connector accepts a 19-V to 20-V DC supply. A standard Dell notebook adapter (or similar adapter) provides the required power.

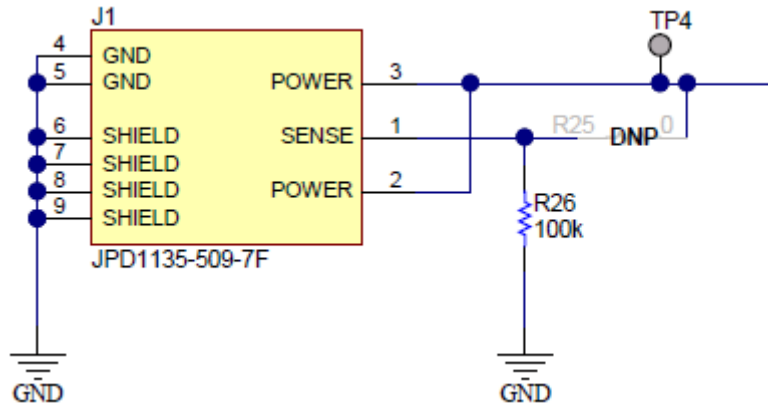


Figure 3-3. Barrel Jack Connector

3.4 Switches: ADCIN1 and ADCIN2

The TPS25814EVM has 3 switches (S2, S3, and S4) that can be used to configure the BusPowerZ setting of the device. As shown within the TPS25814 data sheet, there are eight different ADCINx decoded values ranging from 0 to 7. These three switches allow for control of these decoded values presented on both ADCIN1 and ADCIN2. Figure 3-4 shows these three switches.

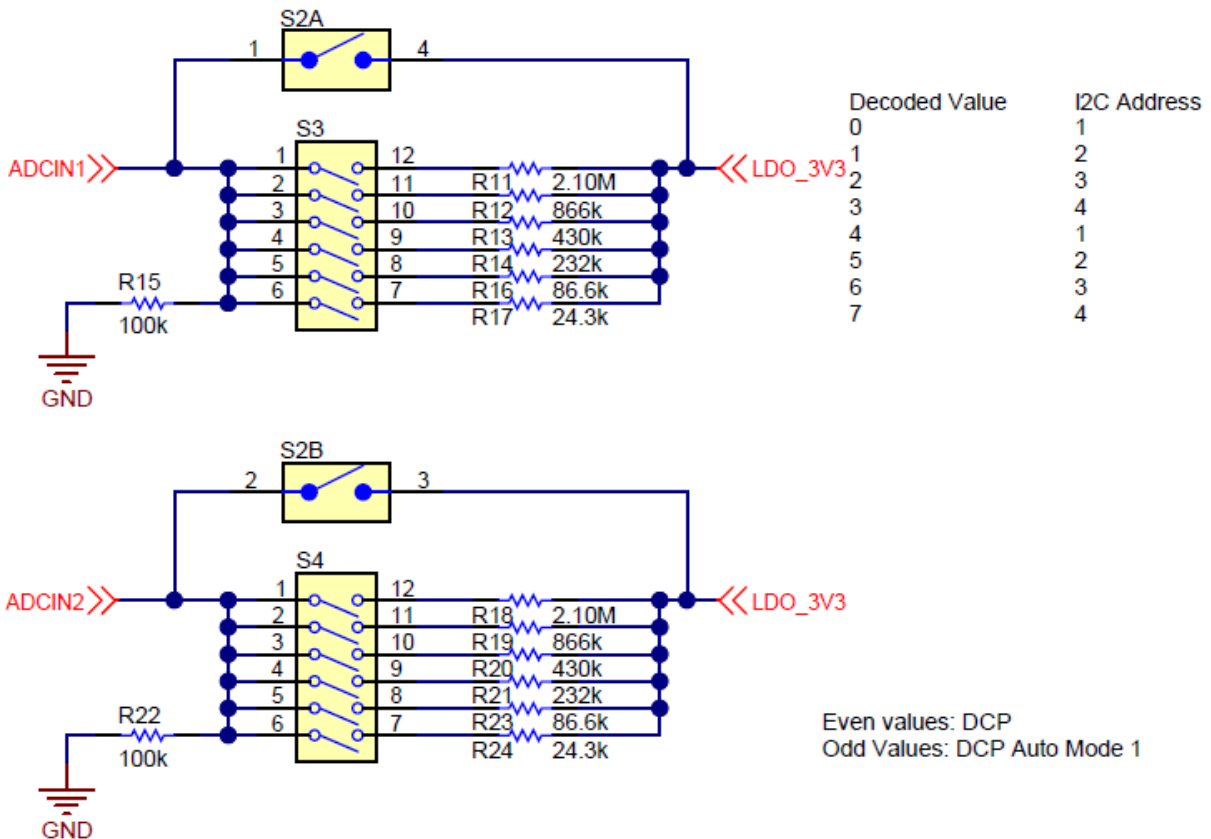


Figure 3-4. ADCINx Switches

Switches S2A and S3 are connected to ADCIN1, and switches S2B and S4 are connected to ADCIN2. When S2A or S2B are enabled, a decoded value of 7 will be presented on ADCIN1 and ADCIN2 respectively. For decoded value 0, disable all switches on S3 or S4, as well as S2. For a decoded value of 1 through 6, enable the wanted decoded value on switches S3 or S4. For example, for a decoded value of 3 for ADCIN1, enable position 3 on S3, having all other positions disabled on S3 as well as disabling S2A. For a decoded value of 7,

enable S2A or S2B, with all all positions on S3 or S4 disabled. It is important to note that only one switch can be enabled at a time for normal operation.

3.5 Switches: CTL, CHG_HI, EN

There are three switches used to control the TPS25814, which are connected to the CTL, CHG_HI, and EN pins of the TPS25814. S1A is connected to the CTL pin and when disabled the TPS25814 is configured to BC1.2 DCP charging mode. When S1A is enabled, the TPS25814 is configured to BC1.2 CDP charging mode. S1B is connected to the CHG_HI pin and when disabled, the TPS25814 presents a 3.0 A source current capability on the CC pins via a R_d . When S1B is enabled, the TPS25814 presents a 1.5 A source current capability. Finally, S1C is connected to the EN pin of the TPS25814 and when disabled, the TPS25814 is enabled and put into normal operation. When S1C is enabled, the TPS25814 will be disabled and remain in the Type-C Error Recovery state.

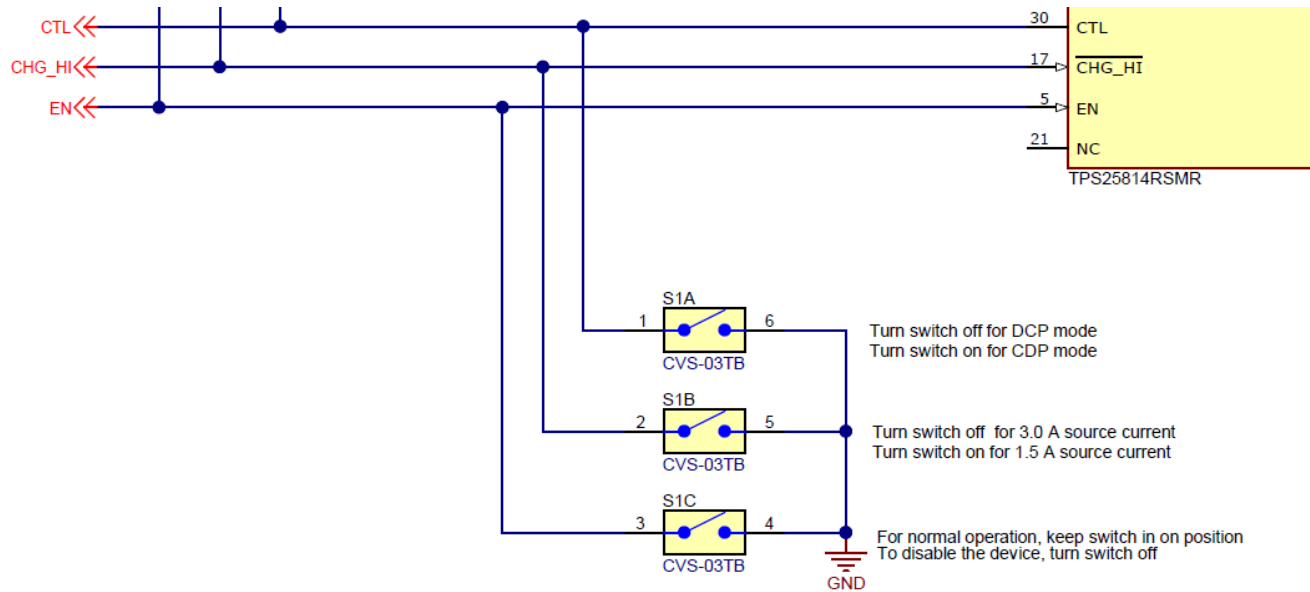


Figure 3-5. CTL, CHG_HI, and EN Switches

3.6 USB Type-C Connector: DFP and UFP

The DFP and UFP USB Type-C® connectors share a similar design. Both use a TVS2200 to help protect against transient voltage events, ESD diodes, and capacitors to bias the SS signals. From an evaluation perspective, the DFP port should be used to evaluate the TPS25814 as a port controller, and the UFP port should be used when evaluating the data capabilities of the EVM.

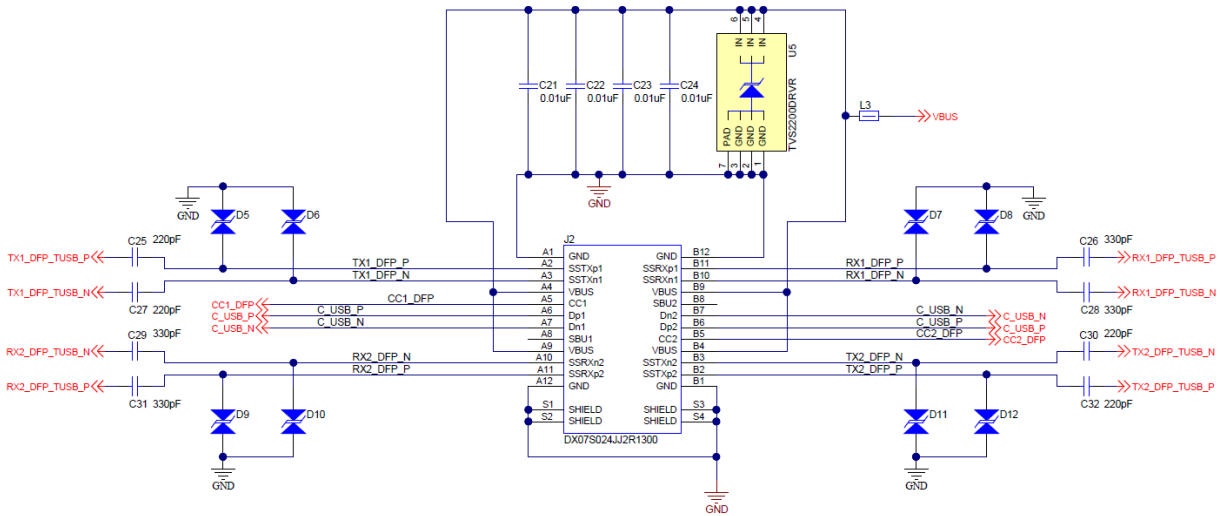


Figure 3-6. USB Type-C Connector

3.7 Device: TPS25814

The TPS25814 is powered from VIN_3V3 which is supplied by the TPS51220. LDO_3V3 is used to pullup the I2C communication channels as well as the status and control signals. PP5V is the system connection to the internal 5 V power path which is supplied by the TPS51220. VBUS connects directly to the USB Type-C DFP port.

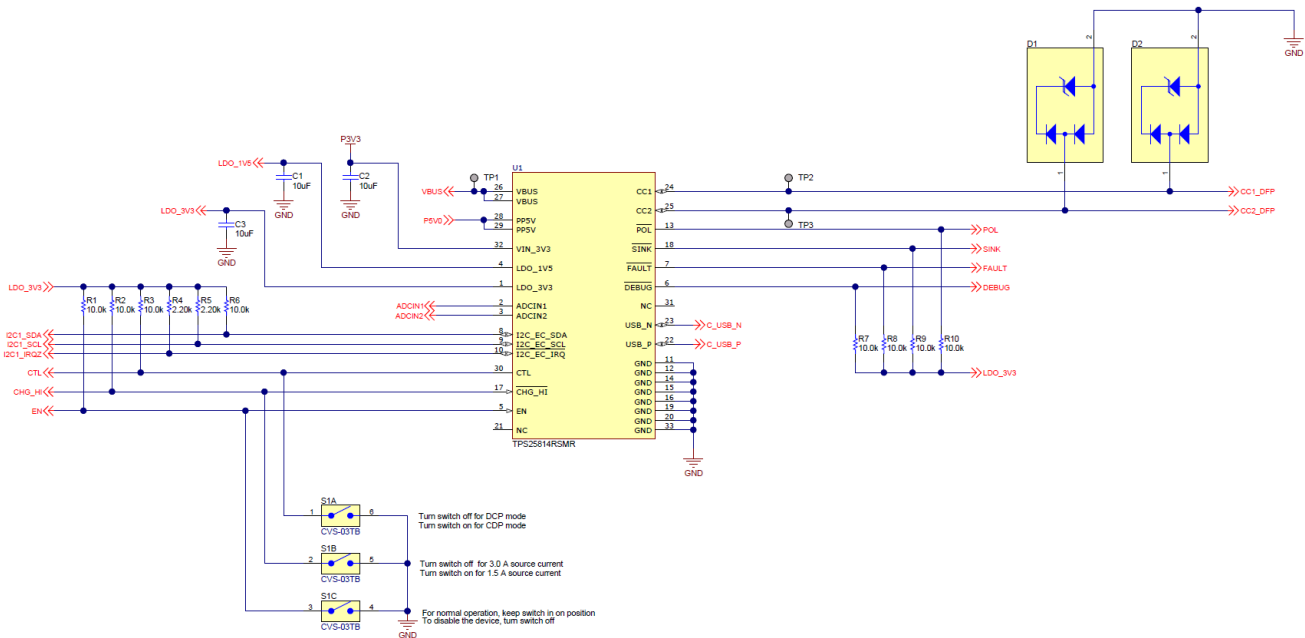


Figure 3-7. TPS25814

3.8 Device: HD3SS3220

The HD3SS3220 is connected to the USB Type-C UFP port, and is used as the UFP port controller as well as the MUX for the SS data lanes. The CC pins from the USB Type-C UFP port connect to the HD3SS3220 so that it may present an Rd, indicating a device connection to the attached DFP. RX_P, RX_N, TX_P, and TX_N connect to the TUSB542. TX1_UFP_HD_P, TX1_UFP_HD_N and other similar signal names connect to the SS pins from the USB Type-C UFP port.

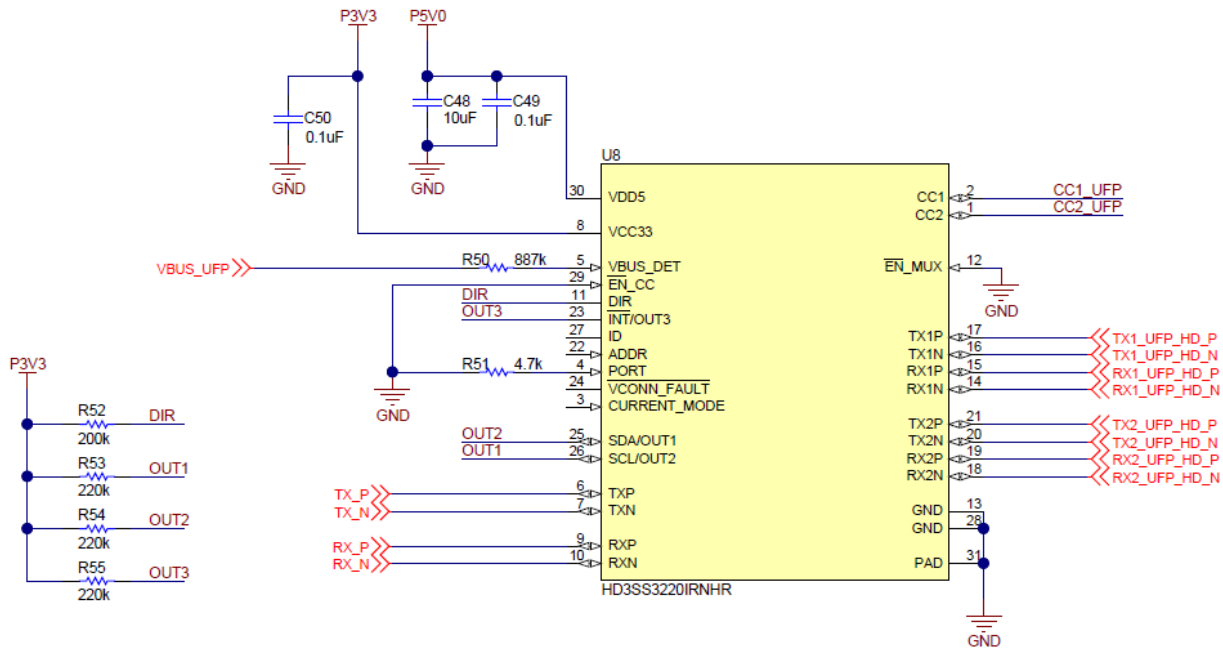


Figure 3-8. HD3SS3220

3.9 Device: TUSB542

The TUSB542 connects to the USB Type-C DFP port, and is used as a MUX the SS signals depending on the orientation of the device attached to the USB Type-C DFP port. The polarity of the MUX is controlled by the SEL pin, which is controller by the POL signal from the TPS25814. TX2_DFP_TUSB_P, TX2_DFP_TUSB_N and other similar signal names connect to the SS pins from the USB Type-C DFP port. RX_P, RX_N, TX_P, and TX_N connect to the HD3SS3220.

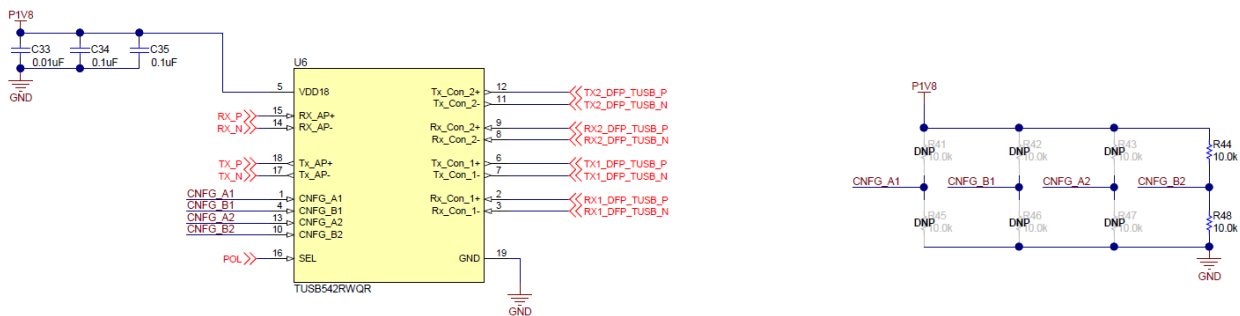


Figure 3-9. TUSB542

4 Testing Procedures

Evaluating USB3 Data Capabilities

The TPS25814EVM has the capabilities of passing USB3 signals from a connected UFP to a downstream DFP. This can be done by connecting a USB3 UFP device such as a Type-C flash drive to the USB Type-C DFP port on the TPS25814EVM. Next, connect a USB3 DFP such as a Type-C port on a laptop to the USB Type-C UFP port on the TPS25814EVM. [Figure 4-1](#) shows an example of this test setup.



Figure 4-1. USB3 Testing on TPS25814EVM

5 PCB Layouts

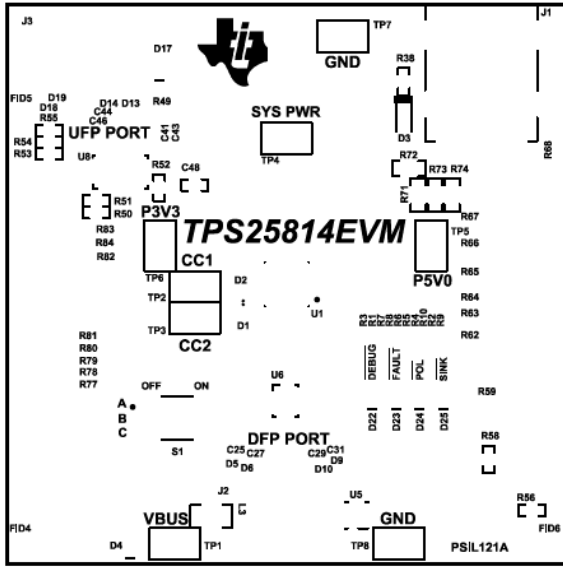


Figure 5-1. Top Overlay

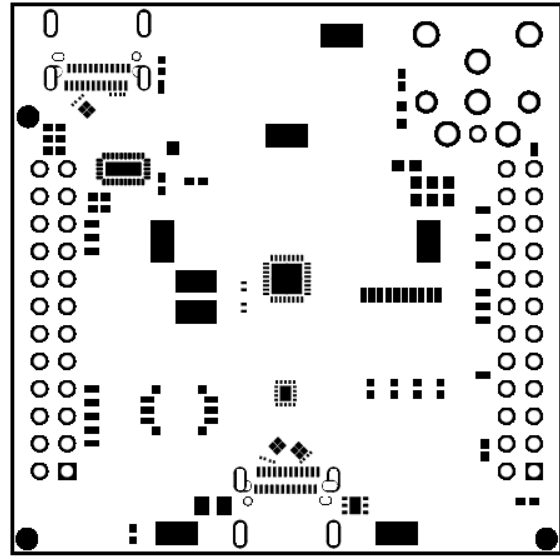


Figure 5-2. Top Solder

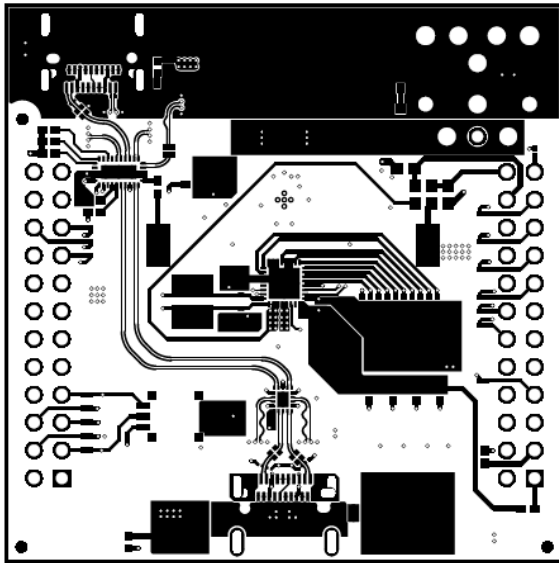


Figure 5-3. Top Layer

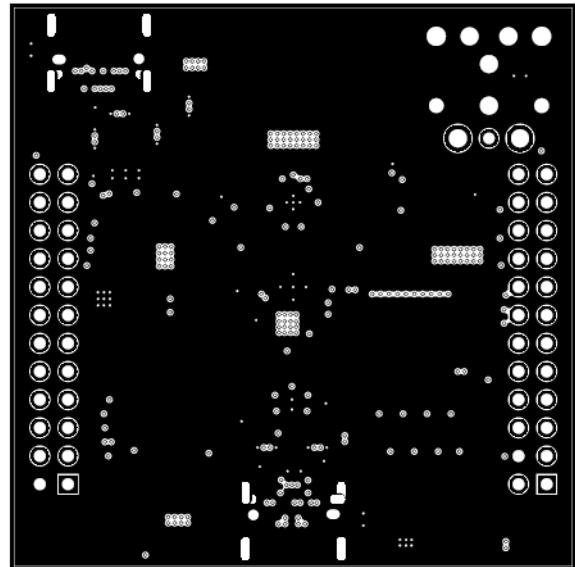


Figure 5-4. GND 1 Layer

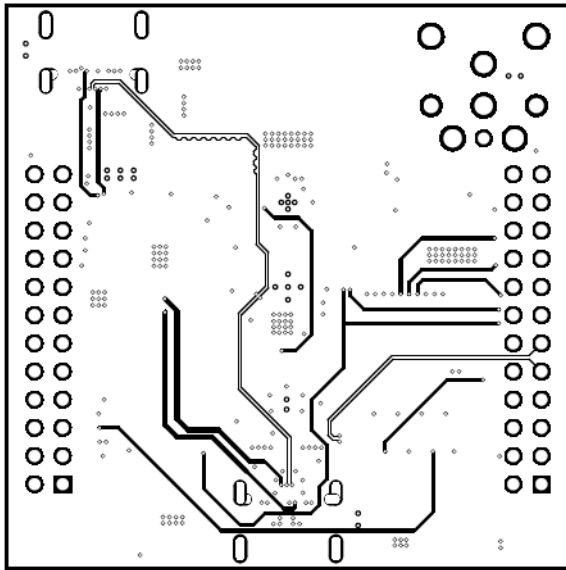


Figure 5-5. High Speed Layer

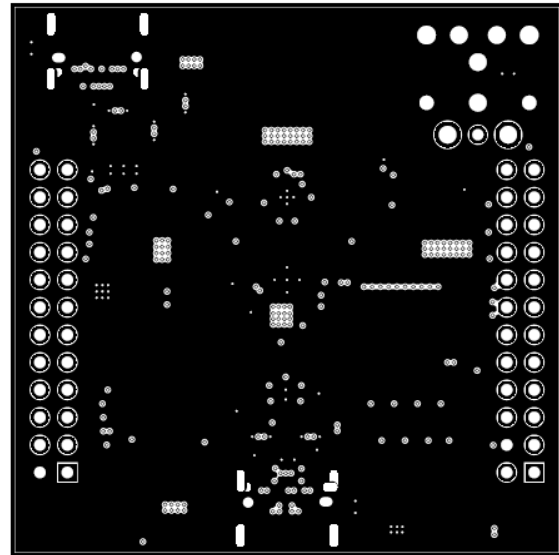


Figure 5-6. GND 2 Layer

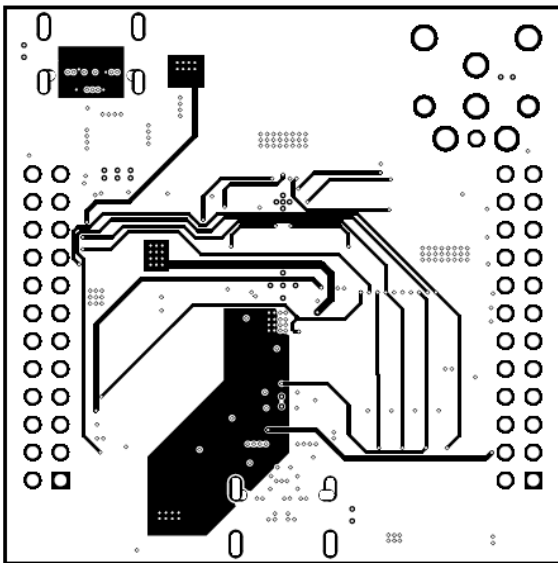


Figure 5-7. Power 1 Layer

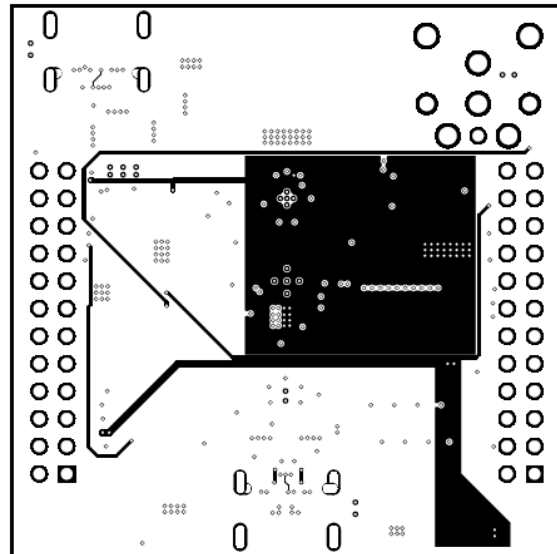


Figure 5-8. Power 2 Layer

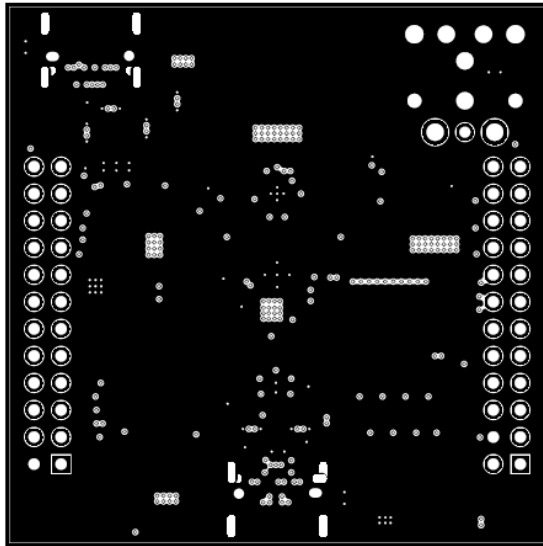


Figure 5-9. GND 3 Layer

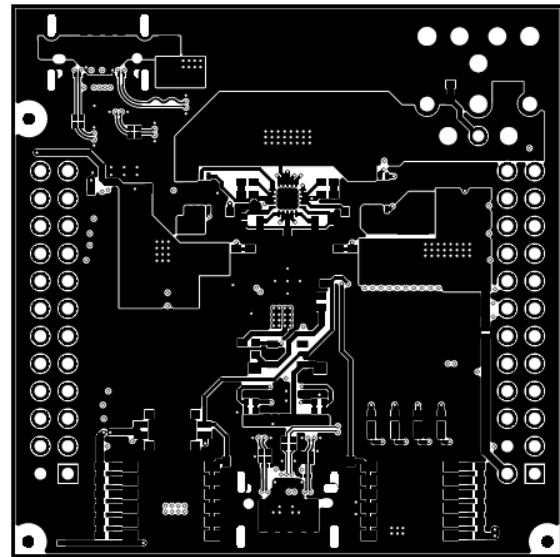


Figure 5-10. Bottom Layer

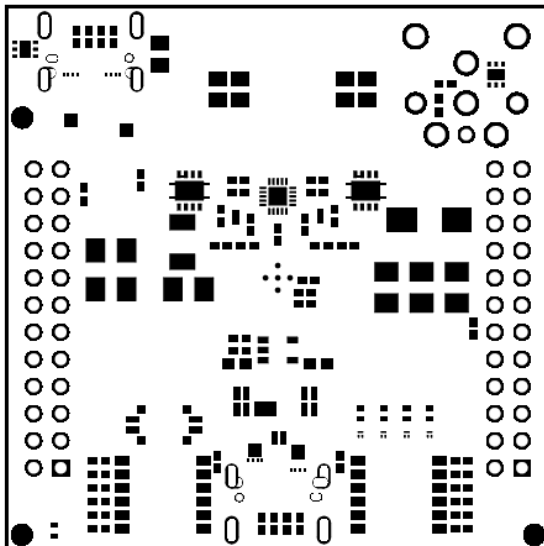


Figure 5-11. Bottom Solder

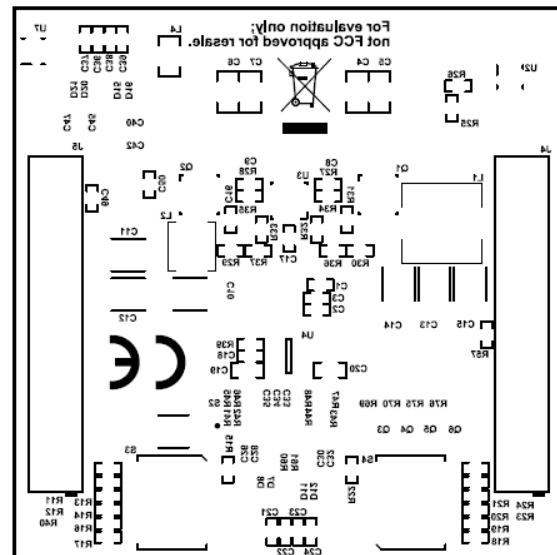


Figure 5-12. Bottom Overlay

6 Schematics

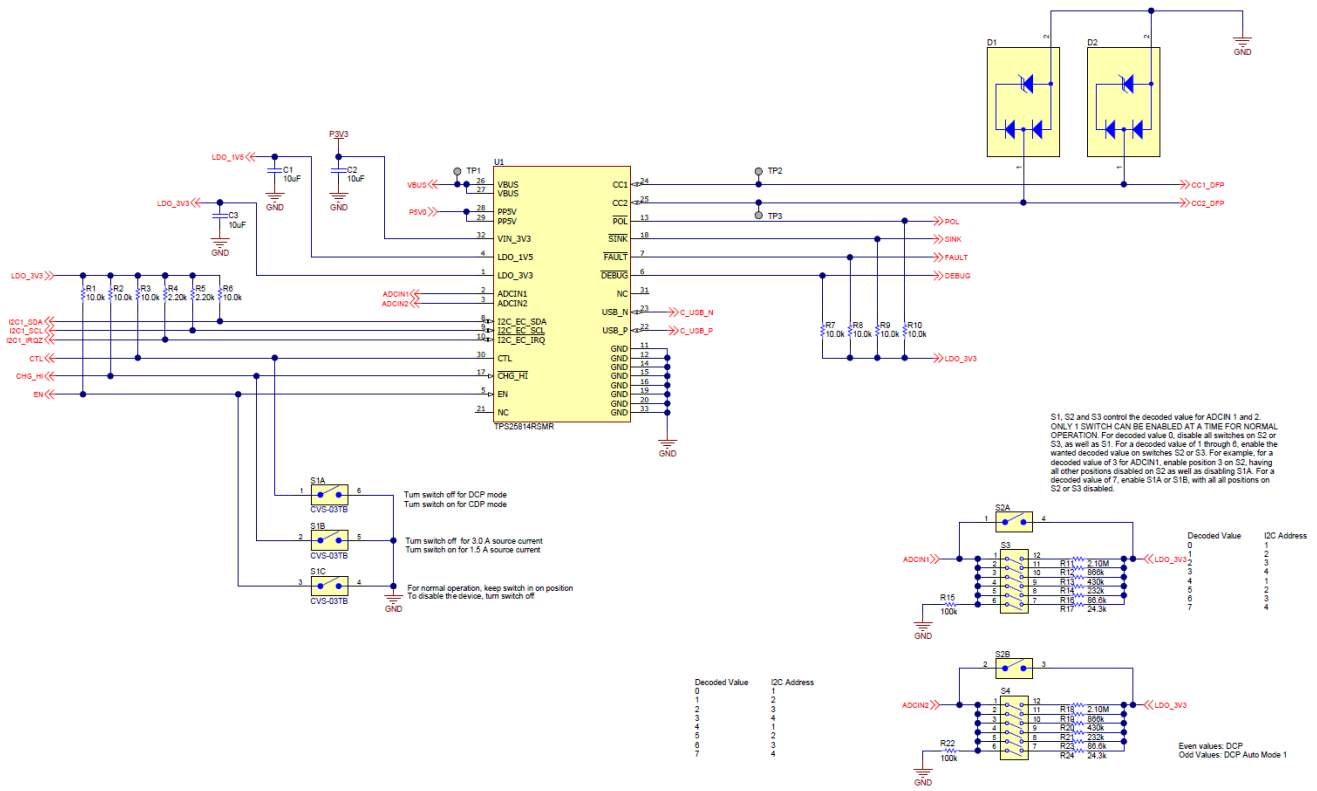


Figure 6-1. TPS25814 Schematic

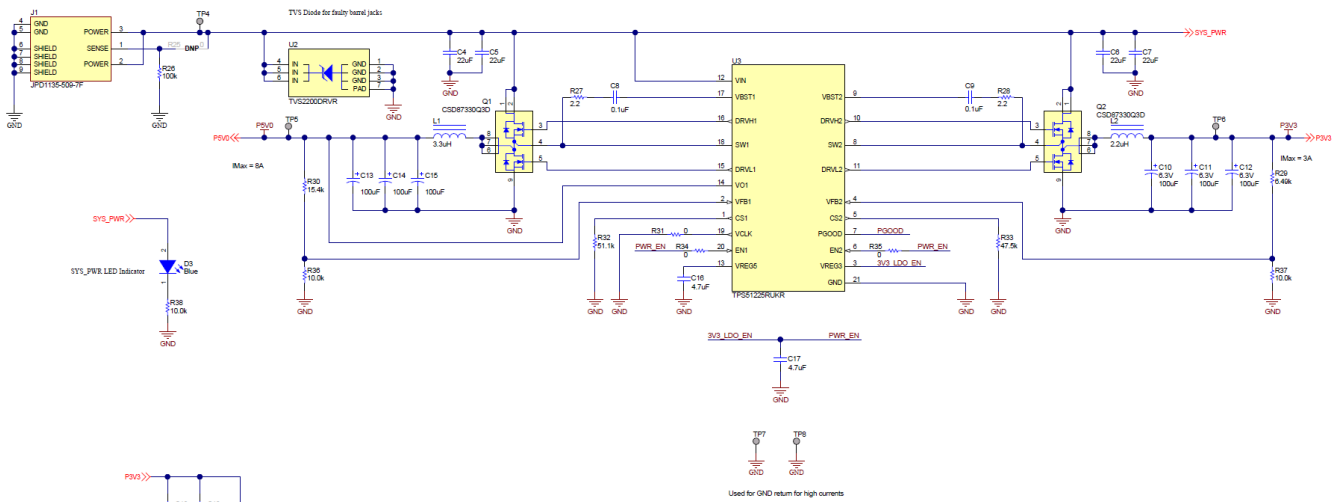


Figure 6-2. Power Schematic

USB Type-C DFP Port

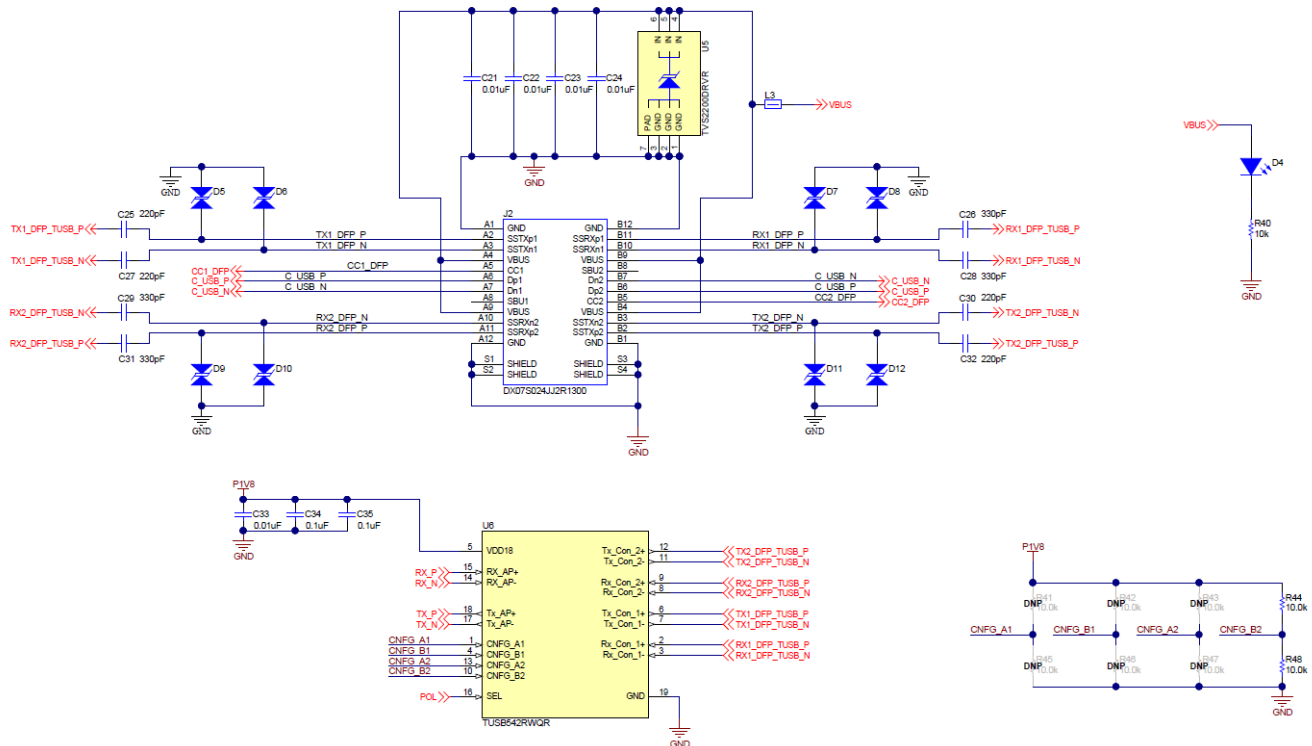


Figure 6-3. USB Type-C DFP Port Schematic

USB Type-C UFP Port

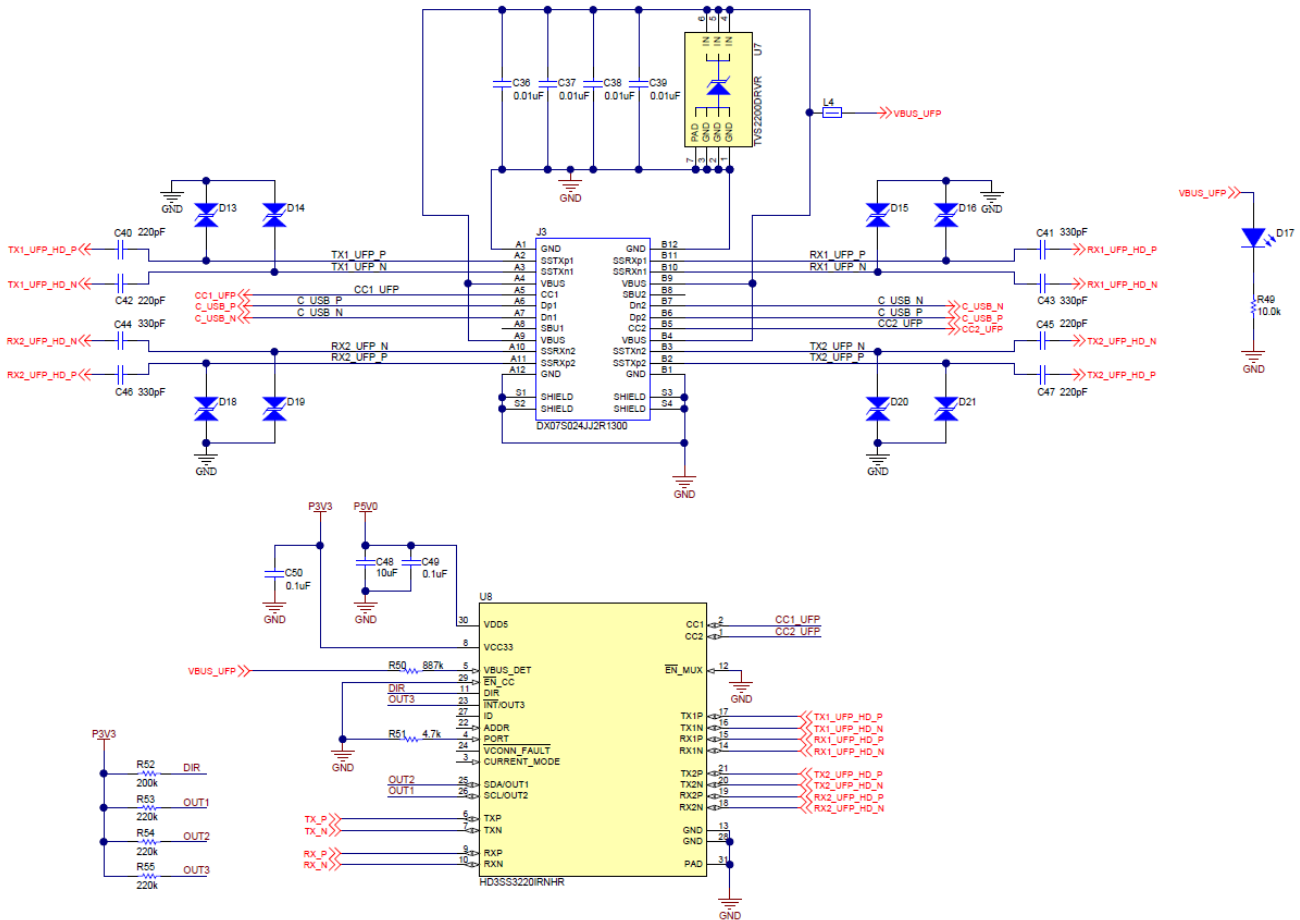


Figure 6-4. USB Type-C UFP Port Schematic

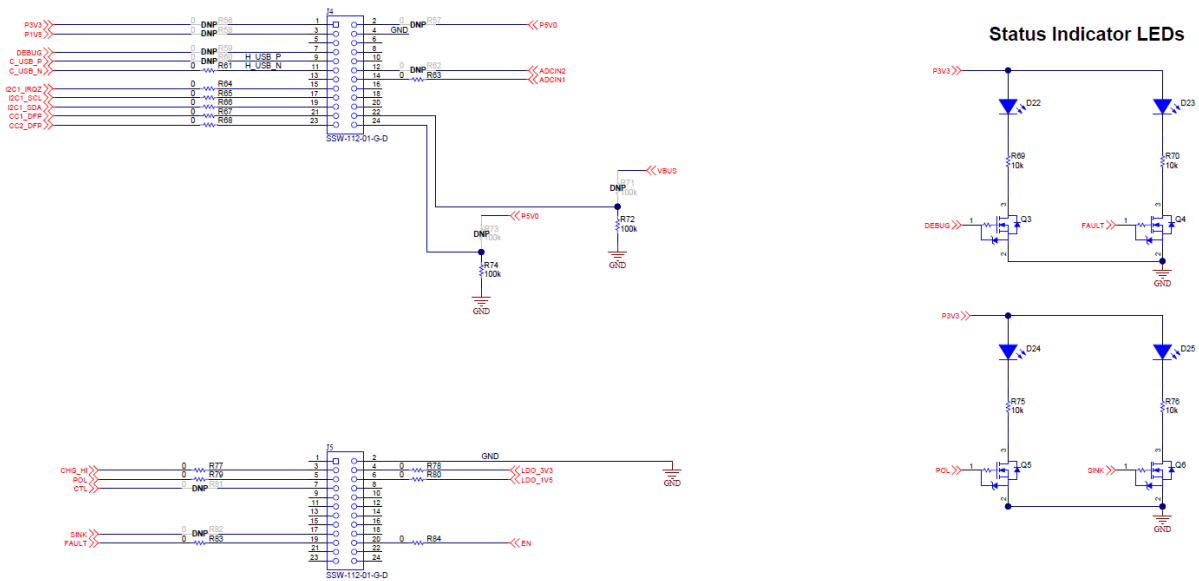


Figure 6-5. Debug Headers and Status LEDs

7 Bill of Materials

Table 7-1. TPS25814EVM BOM

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
!PCB1	1		Printed Circuit Board		PSIL121	Any		
C1, C2, C3, C18, C48	5	10uF	CAP, CERM, 10 uF, 10 V, +/- 20%, X5R, 0402	0402	CL05A106MP5NUNC	Samsung Electro-Mechanics		
C4, C5, C6, C7	4	22uF	CAP, CERM, 22 uF, 35 V, +/- 20%, X5R, 0805	0805	C2012X5R1V226M125AC	TDK		
C8, C9	2	0.1uF	CAP, CERM, 0.1 uF, 35 V, +/- 10%, X5R, 0402	0402	GMK105BJ104KV-F	Taiyo Yuden		
C10, C11, C12, C13, C14, C15	6	100uF	CAP, TA, 100 uF, 6.3 V, +/- 20%, 0.015 ohm, SMD	3528-21	T520B107M006ATE015	Kemet		
C16, C17	2	4.7uF	CAP, CERM, 4.7 uF, 6.3 V, +/- 20%, X5R, 0402	0402	GRM155R60J475ME87D	MuRata		
C19, C20	2	1uF	CAP, CERM, 1 uF, 10 V, +/- 10%, X7R, 0603	0603	0603ZC105KAT4A	AVX		
C21, C22, C23, C24, C36, C37, C38, C39	8	0.01uF	CAP, CERM, 0.01 uF, 50 V, +/- 5%, X7R, 0402	0402	C0402C103J5RACTU	Kemet		
C25, C27, C30, C32, C40, C42, C45, C47	8	220pF	CAP, CERM, 220 pF, 50 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0201	0201	CGA1A2X7R1H221K030BA	TDK		
C26, C28, C29, C31, C41, C43, C44, C46	8	330pF	CAP, CERM, 330 pF, 50 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0201	0201	CGA1A2X7R1H331K030BA	TDK		
C33	1	0.01uF	CAP, CERM, 0.01 uF, 10 V, +/- 10%, X7R, 0201	0201	GRM033R71A103KA01D	MuRata		

Table 7-1. TPS25814EVM BOM (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
C34, C35	2	0.1uF	CAP, CERM, 0.1 uF, 10 V, +/- 10%, X5R, 0201	0201	CL03A104KP3NANC	Samsung Electro-Mechanics		
C49, C50	2	0.1uF	CAP, CERM, 0.1 uF, 16 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0402	0402	C0402C104K4RACAUTO	Kemet		
D1, D2	2		Automotive 1-Channel Ultra-Low-Capacitance IEC ESD Protection Diode, DPY0002A (X1SON-2)	DPY0002A	TPD1E05U06QDPYRQ1	Texas Instruments	TPD1E05U06QDPYTQ1	Texas Instruments
D3	1	Blue	LED, Blue, SMD	LED_0603	150060BS75000	Wurth Elektronik		
D4, D17, D22, D23, D24, D25	6	White	LED, White, SMD	0402, White	LW QH8G-Q2S2-3K5L-1	OSRAM	LW QH8G-Q200-3K5L-1	
D5, D6, D7, D8, D9, D10, D11, D12, D13, D14, D15, D16, D18, D19, D20, D21	16		1-Channel ESD Protection Diode for USB Type-C and Thunderbolt 3, DPL0002A (X2SON-2)	DPL0002A	TPD1E01B04DPLR	Texas Instruments	TPD1E01B04DPLT	Texas Instruments
J1	1		Connector, DC Power Jack, R/A, 3 Pos, TH	Power connector	JPD1135-509-7F	Foxconn		
J2, J3	2		Receptacle, USB 3.1 Type C, R/A, Gold, SMT	Receptacle, USB 3.1 Type C, R/A, SMT	DX07S024JJ2R1300	JAE Electronics		
J4, J5	2		Receptacle, 12x2, 2.54mm, Gold, TH	Receptacle, 12x2, 2.54mm, TH	SSW-112-01-G-D	Samtec		

Table 7-1. TPS25814EVM BOM (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
L1	1	3.3uH	Inductor, Shielded Drum Core, Superflux, 3.3 uH, 8 A, 0.0096 ohm, SMD	6.9x4.8x6.9mm	744314330	Wurth Elektronik		
L2	1	2.2uH	Inductor, Shielded Drum Core, Powdered Iron, 2.2 uH, 3.25 A, 0.051 ohm, SMD	4.45x1.8x4.06mm	74437324022	Wurth Elektronik		
L3, L4	2	21 ohm	Ferrite Bead, 21 ohm @ 100 MHz, 6 A, 0805	0805	FBMJ2125H M210NT	Taiyo Yuden		
Q1, Q2	2	30V	MOSFET, 2-CH, N-CH, 30 V, 20 A, DQZ0008A (LSON-CLIP-8)	DQZ0008A	CSD87330Q3 D	Texas Instruments		None
Q3, Q4, Q5, Q6	4	20V	MOSFET, N-CH, 20 V, 0.5 A, YJM0003A (PICOSTAR-3)	YJM0003A	CSD15380F3	Texas Instruments		None
R1, R2, R3, R6, R7, R8, R9, R10, R44, R48, R49	11	10.0k	RES, 10.0 k, 1%, 0.05 W, 0201	0201	CRCW020110 K0FKED	Vishay-Dale		
R4, R5	2	2.20k	RES, 2.20 k, 1%, 0.05 W, 0201	0201	CRCW02012 K20FKED	Vishay-Dale		
R11, R18	2	2.10Meg	RES, 2.10 M, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04022 M10FKED	Vishay-Dale		
R12, R19	2	866k	RES, 866 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04028 66KFKED	Vishay-Dale		
R13, R20	2	430k	RES, 430 k, 1%, 0.063 W, 0402	0402	RC0402FR-0 7430KL	Yageo America		

Table 7-1. TPS25814EVM BOM (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
R14, R21	2	232k	RES, 232 k, 1%, 0.063 W, 0402	0402	RC1005F232 3CS	Samsung Electro- Mechanics		
R15, R22	2	100k	RES, 100 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	RMCF0402FT 100K	Stackpole Electronics Inc		
R16, R23	2	86.6k	RES, 86.6 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04028 6K6FKED	Vishay-Dale		
R17, R24	2	24.3k	RES, 24.3 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04022 4K3FKED	Vishay-Dale		
R26, R39	2	100k	RES, 100 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04021 00KFKED	Vishay-Dale		
R27, R28	2	2.2	RES, 2.2, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04022 R20JNED	Vishay-Dale		
R29	1	6.49k	RES, 6.49 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04026 K49FKED	Vishay-Dale		
R30	1	15.4k	RES, 15.4 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04021 5K4FKED	Vishay-Dale		
R31	1	0	RES, 0, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04020 000Z0ED	Vishay-Dale		
R32	1	51.1k	RES, 51.1 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04025 1K1FKED	Vishay-Dale		

Table 7-1. TPS25814EVM BOM (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
R33	1	47.5k	RES, 47.5 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04024 7K5FKED	Vishay-Dale		
R34, R35, R61, R63, R64, R65, R66, R67, R68, R77, R78, R79, R80, R83, R84	15	0	RES, 0, 5%, 0.05 W, 0201	0201	CRCW02010 000Z0ED	Vishay-Dale		
R36, R37, R38	3	10.0k	RES, 10.0 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04021 0K0FKED	Vishay-Dale		
R40, R69, R70, R75, R76	5	10k	RES, 10 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04021 0K0JNED	Vishay-Dale		
R50	1	887k	RES, 887 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04028 87KFKED	Vishay-Dale		
R51	1	4.7k	RES, 4.7 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04024 K70JNED	Vishay-Dale		
R52	1	200k	RES, 200 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04022 00KFKED	Vishay-Dale		
R53, R54, R55	3	220k	RES, 220 k, 1%, 0.0625 W, 0402	0402	RC0402FR-0 7220KL	Yageo America		
R72, R74	2	100k	RES, 100 k, 1%, 0.1 W, 0603	0603	CRCW06031 00KFKEA	Vishay-Dale		
S1	1		DIP Switch, SPST, 3Pos, Slide, SMT	SW, 4.7x1.45x4m m	CVS-03TB	Copal Electronics		
S2	1		DIP Switch, SPST, 2Pos, Slide, SMT	SW, 4.7x1.45x3m m	CVS-02TB	Copal Electronics		

Table 7-1. TPS25814EVM BOM (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
S3, S4	2		DIP Switch, SPST, 6Pos, Slide, SMT	8.75x6.2mm	TDA06H0SB1	C&K Components		
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8	8		Test Point, Miniature, SMT	Test Point, Miniature, SMT	5019	Keystone		
U1	1		USB Type-C Controller with Integrated Source Power Switch	VQFN32	TPS25814RS MR	Texas Instruments		
U2, U5, U7	3		22-V Precision Surge Protection Clamp, DRV0006A (WSON-6)	DRV0006A	TVS2200DRVR	Texas Instruments		Texas Instruments
U3	1		Dual Synchronous Step-Down Controller with 5-V and 3.3-V LDOs, RUK0020B (WQFN-20)	RUK0020B	TPS51225RUKR	Texas Instruments	TPS51225RUKT	Texas Instruments
U4	1		250-mA Ultra-Low-Noise, Low-IQ LDO, DBV0005A (SOT-23-5)	DBV0005A	LP5907MFX-1.8/NOPB	Texas Instruments		Texas Instruments
U6	1		5Gbps USB 3.1 Gen1 Type-C 2:1 MUX and Redriver, RWQ0018A (X2QFN-18)	RWQ0018A	TUSB542RWQR	Texas Instruments		Texas Instruments
U8	1		USB Type-C DRP Port Controller with SuperSpeed 2:1 MUX, RNH0030A (WQFN-30)	RNH0030A	HD3SS3220I RNHR	Texas Instruments	HD3SS3220I RNHT	Texas Instruments

Table 7-1. TPS25814EVM BOM (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
FID1, FID2, FID3, FID4, FID5, FID6	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A		
R25	0	0	RES, 0, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04020 000Z0ED	Vishay-Dale		
R41, R42, R43, R45, R46, R47	0	10.0k	RES, 10.0 k, 1%, 0.05 W, 0201	0201	CRCW020110 K0FKED	Vishay-Dale		
R56, R57, R58	0	0	RES, 0, 5%, 0.063 W, 0402	0402	CRCW04020 000Z0ED	Vishay-Dale		
R59, R60, R62, R81, R82	0	0	RES, 0, 5%, 0.05 W, 0201	0201	CRCW02010 000Z0ED	Vishay-Dale		
R71, R73	0	100k	RES, 100 k, 1%, 0.1 W, 0603	0603	CRCW06031 00KFKEA	Vishay-Dale		

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