



ABSTRACT

This document is the user's guide for the TPS25750 Evaluation Module (TPS25750EVM). The TPS25750EVM allows for evaluation of the TPS25750 IC as part of a stand-alone testing kit and for development and testing of USB Type-C™ and Power Delivery (PD) end products. The TPS25750EVM uses the TPS25750D version of the TPS25750 and can also verify the performance of the TPS25750S. The TPS25750D features a high-voltage integrated source path packaged in a 4 x 6 mm QFN package. The TPS25750S uses an external NFET power path and is packaged in a 4 x 4mm QFN package.

Out of the box, the TPS25750EVM is configured to source or sink power. When different configurations are required to test your system, use the [TPS25750 Application Configuration](#) software tool to create a configuration or load a different configuration template.

The TPS25750EVM has an integrated solution with the BQ25731 battery charger to allow users to source or sink high power. The TPS25750 can configure the battery charger using I2C.

The TPS25750EVM has the following functionality:

- Supply 15-W contracts using the integrated 5-V/3 A-Source-Only Power Path
- Negotiate 5-V to 20-V PD contracts at 3 A acting as a source or a sink using the integrated high-voltage bi-directional power path
- Test the bi-directional power path by swapping power roles dynamically
- Communicate with a battery charger for an integrated battery charging solution

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Trademarks

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1 Items Required for Operation

The following items are required to use the TPS25750EVM:

- TPS25750D data sheet
- TPS25750EVM
- TPS25750 Application Customization Tool
- 20-V barrel jack adapter or DC power supply
- USB Type-C cables
- USB Type-A to USB Micro-B cable
- Notebook with a USB port

2 TPS25750EVM System Description

The TPS25750EVM is an evaluation board used to evaluate the TPS25750 which is a single-port USB Type-C PD controller with integrated power paths. The TPS25750EVM is powered by a 20-V DC barrel jack. If this type of barrel jack is not available, the board can also be powered from an external bench supply connected to the SYS_PWR test point (TP4), with the bench supply providing 20 V. The TPS51225 provides the 3.3 V needed for powering the TPS25750 as well as the TM4C123GH, or the Tiva, and the 5-V supply is connected to the internal 5-V source power path for the TPS25750.

The TPS25750D incorporates two internal power paths; one 5-V source only power path and one high voltage bi-directional power path. The TPS51225 connects to PP5V, and the BQ25731 connects to PPHV, the internal high voltage bi-directional power path. Configuring this power path to act as a source or sink is explained in further detail later in this user's guide. The TM4C123GH is used to program the external flash connected to the TPS25750. The TM4C123GH converts the USB2.0 data sent over the micro-b connector to I²C, programming the external flash, which the TPS25750 will load during the next power cycle. Programming the TPS25750 is explained in further detail later in this user's guide.

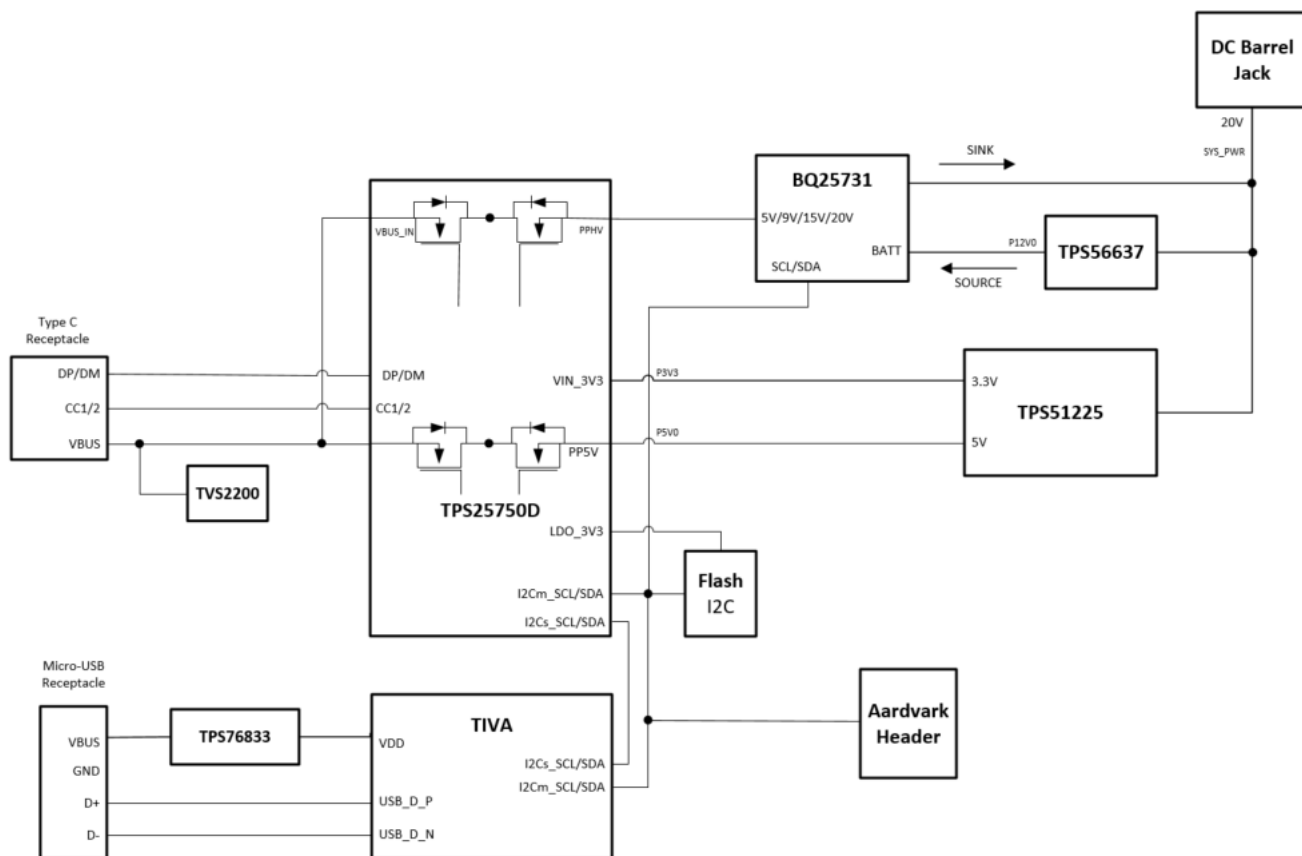


Figure 2-1. TPS25750EVM Block Diagram

2.1 Battery Charger (BQ25731)

The TPS25750EVM comes with an integrated battery charging solution using a BQ25731 buck/boost charger. The charger allows the EVM to operate as a source or sink from 5 to 20 volts at up to 3 amps. When acting as a sink, the TPS25750 negotiated the appropriate PD contract and enables the PPHV power path supplying power to the BQ. The BQ will then buck or boost the voltage to ensure the output is 12 volts (charging a 3S battery). When acting as a source, the BQ is powered by the barrel jack through the TPS56637 buck converter which simulates a 3S battery connection. The BQ will then buck or boost the 12 volts supplied from the TPS56637 to the desired output voltage which was negotiated in the PD contract.

2.2 Simulated Battery Connection (TPS56637)

Because the TPS25750EVM does not ship with a battery, a 12-V buck converter is used to simulate a 3S battery pack connected to the BQ25731RSN. This allows the customer to evaluate the performance of this EVM without having to supply their own 3S battery. The 12 V is generated by the TPS56637 buck converter which is powered from the 20-V DC barrel jack. When configured to use the on board buck converter, the EVM's source capabilities are limited to 60 watts. An external battery/power supply can be connected to the EVM if more sourcing power is required (up to 100 watts) or if the customer needs to test the charging capabilities of the BQ device. To connect an external battery, remove the jumper J5 first and then connect the battery + terminal to the TP3 test point. It is important to note that in order to charge an external battery, the diodes D2 and D3 will need to be removed or shorted, so that current will not back flow the battery.

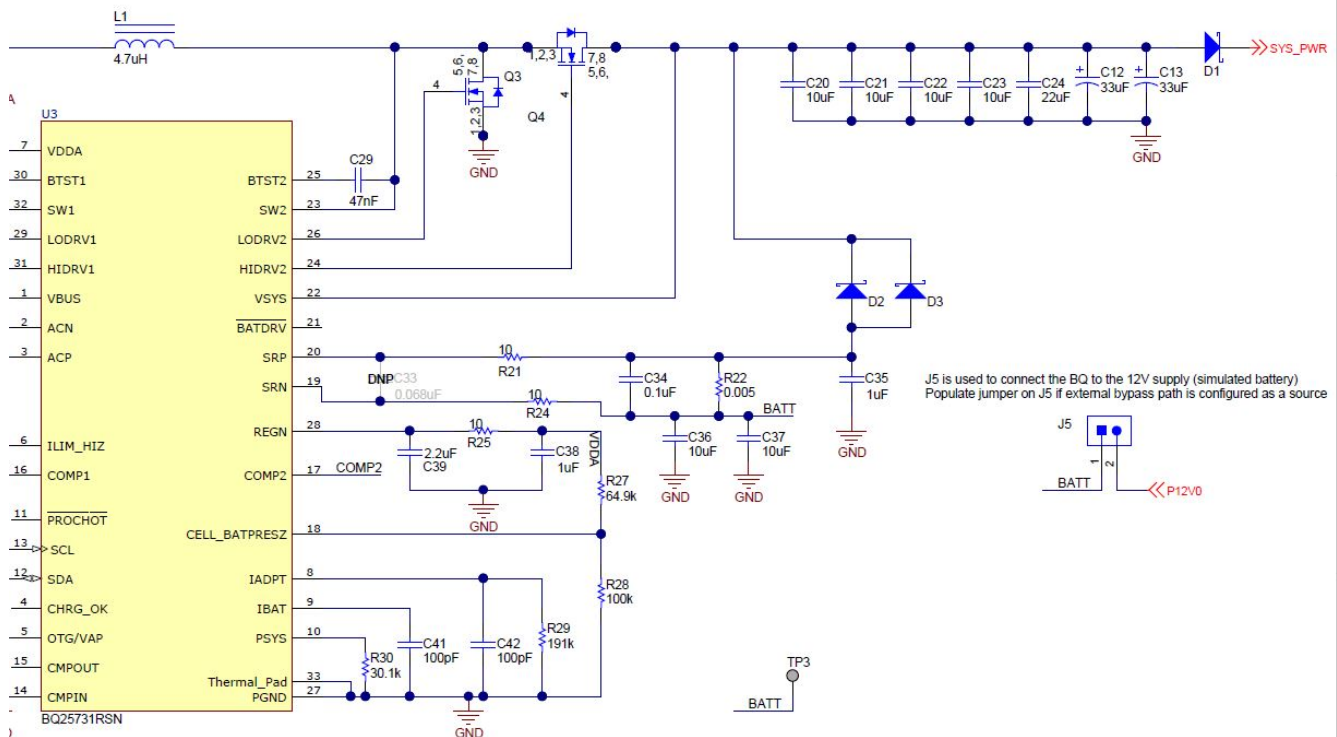


Figure 2-2. BQ Charger Partial Schematic

2.3 Power Paths on the TPS25750EVM

The TPS25750EVM features two internal power paths. The internal power path connected to PPHV is bi-directional capable of being a high voltage source as well as a sink. The high voltage path can source up to 60 W and sink up to 100 W in the out of box configuration. There is also a power path which is a dedicated 5 V 3 A source path.

2.4 Aardvark™ Connector (J8)

This connector (J9) matches the Total Phase® Aardvark that allows the user to access the I2C pins on the TPS25750EVM.

3 Powering the TPS25750EVM

The main power supply for the EVM is the barrel jack (J9), which accepts 19 V to 20 V via a barrel jack adapter. Alternatively, the EVM can also be powered with an external power supply on SYS_PWR (TP4). The input voltage can range from 12 V to 20 V. The EVM can also run in dead battery mode and be powered from the USB Type-C™ connector. Connect a USB Type-C™ source to the USB Type-C™ port. This will cause for the TPS25750 to be powered solely by VBUS from the USB Type-C™ source connected, allowing for users to test the behavior of the TPS25750 in a dead battery scenario.

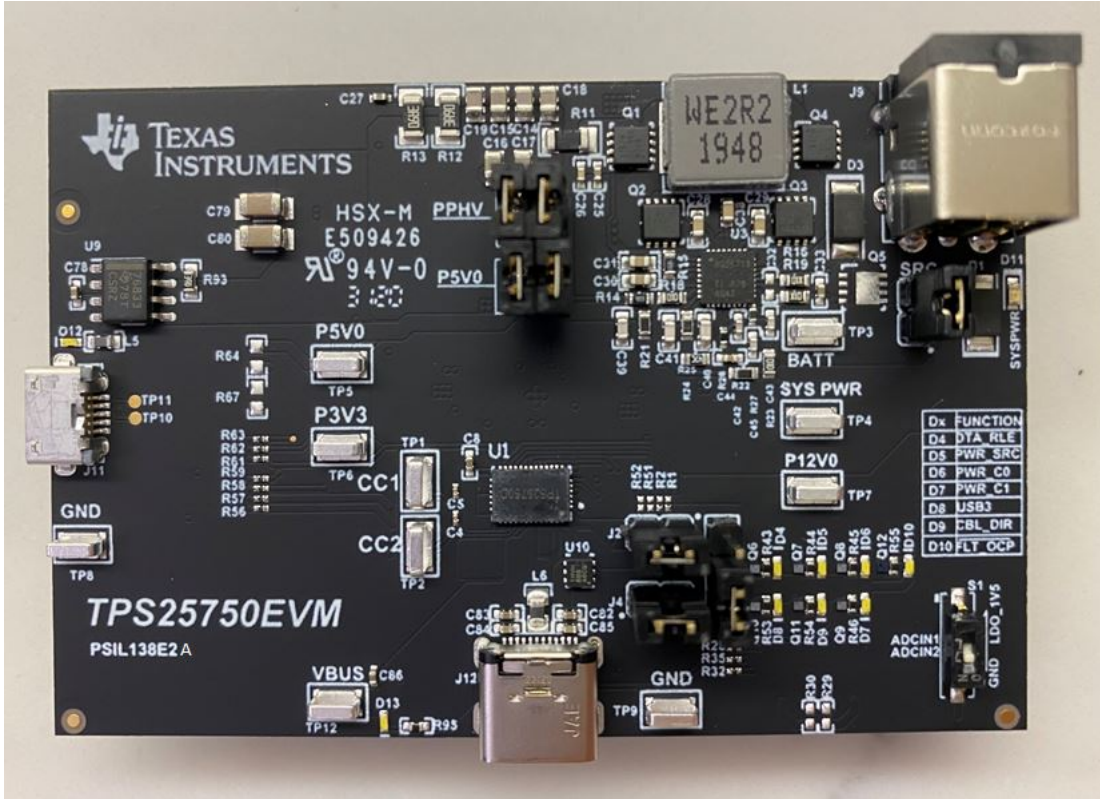


Figure 3-1. TPS25750EVM Power Connections

3.1 ADCin Setting (S1)

During the boot procedure, the TPS25750 will read the ADCINx pins and set the dead battery configuration and the I2C slave address for the PD controller based off of the pin inputs. The switch bank S1 can be switched to enable different dead battery conditions and I2C slave addresses. Keep in mind that S1A and S2A should never be turned on at the same time. The only safe switch configurations are listed below. A switch condition of 0 refers to the switch being open and a switch condition of 1 refers to a closed switch. These are also labeled on the EVM.

The two dead battery configurations offered are Safe Mode and Always Enable Sink. Their functions are listed below.

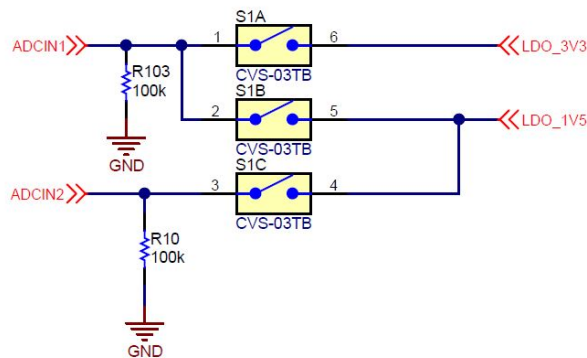
- Always Enable Sink: The device always enables the sink path regardless of the amount of current the attached source is offering. USB PD is disabled until configuration is loaded.
- Safe Mode: The device does not enable the sink path. USB PD is disabled until configuration is loaded. Note that the configuration could put the device into a source-only mode.

S1A	S1B	S1C	Dead Battery Configuration	I2C Slave Address
0	0	0	Safe Mode	#2

S1A	S1B	S1C	Dead Battery Configuration	I2C Slave Address
0	1	1	Always Enable Sink	#2
1	0	0	Safe Mode	#1
1	0	1	Always Enable Sink	#1

These two options are set with S1. The schematic for the ADCIN setting is shown below.

Please note that S1A and S2A should never be turned on at the same time. The only safe switch configurations are listed below. Here, 0 refers to the switch being open, and 1 refers to the switch being closed.



S1A	S1B	S1C	Dead Battery Condition	I2C Slave Address
0	0	0	SafeMode	#2
0	1	1	AlwaysEnableSink	#2
1	0	0	SafeMode	#1
1	0	1	AlwaysEnableSink	#1

Figure 3-2. ADCIN S1 Connections

4 Default Firmware Configurations

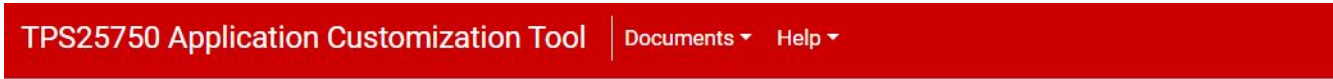
Out of the box, the TPS25750EVM is configured to emulate a single-port power bank. The EVM will be configured as a 60-watt source and a 100-watt sink. This configuration can be customized using the provided web based GUI tool. The following configurations are supported:

Source/Sink:

- 15 W (5 V)
- 27 W (9 V)
- 45 W (15 V)
- 60 W (20 V)
- 100 W (20 V) - sink only

5 Configuring the TPS25750EVM

The TPS25750EVM can be programmed using the [TPS25750 Application Customization Tool](#), which is a web based GUI. The configuration of the TPS25750 is controlled via this GUI, and programming the EVM is also done using this GUI. Once the web GUI is opened, follow the questions to match the EVM configuration. The first option asks to select the power path configuration, select the figure labeled "EVM", shown below.



1. Select your configuration:

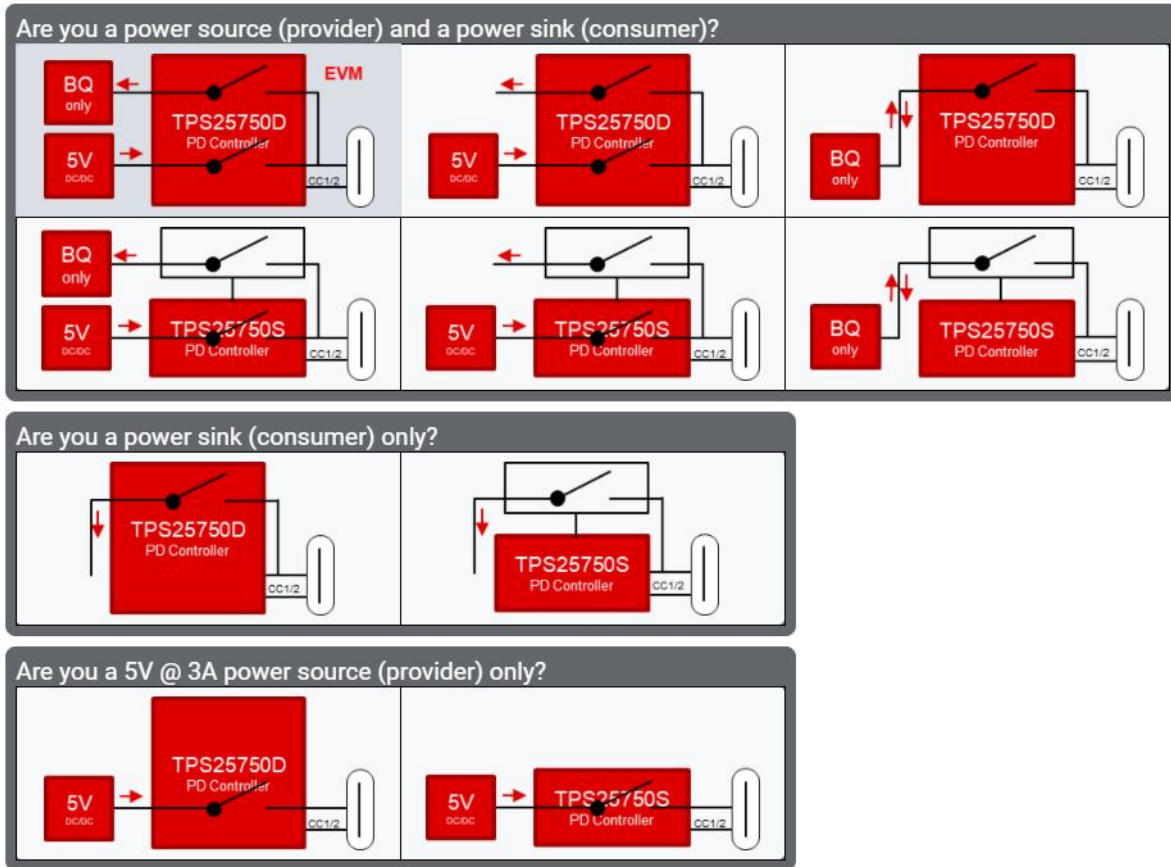


Figure 5-1. Application Customization Tool - Configuration Option

Questions 2 through 4 go through source and sink power and power role. Here the default source and sink power were chosen to match . The EVM's out of box power role is a source.

TPS25750 Application Customization Tool

Documents ▾ Help ▾

2. What is the maximum power that can be sourced?

- 15W (5V)
- 27W (9V)
- 45W (15V)
- 60W (20V)
- 100W (20V)

3. What is the required sink power or power consumed?

- 15W (5V)
- 27W (9V)
- 45W (15V)
- 60W (20V)
- 100W (20V)

4. What is the preferred power role?

- Power source (provider)
- Power sink (consumer)

Figure 5-2. Application Customization Tool - Power and Role Options

Question 5 through 8 go through additional questions. There is not a preferred data role on the EVM. There is no USB data on this EVM, the Vendor ID will be TI's Vendor ID, and the desired Product ID may be left as "0x000".

TPS25750 Application Customization Tool

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5. Do you have a preferred data role?

- No
- Host (PC, hub, etc.) to which devices are connected - Downstream Facing Port (DFP)
- Device (USB flash drive, USB monitor, USB mouse, etc.) that connects to another USB Host - Upstream Facing Port (UFP)
- Host & Device - Dual Role Port (DRP)

6. What is the supported USB Highest Speed?

- No USB data is being used
- USB 2
- USB 3.2 Gen 1
- USB 3.2 Gen 2

7. Do you have a Vendor ID provided by the USB-IF?

- Yes, enter here as a 4-digit hexadecimal number:
- No, use the TI Vendor ID in the Vendor Information File (VIF)

8. Do you have a desired Product ID?

- Yes, enter here as a 4-digit hexadecimal number:
- No, use "0x0000" as the Product ID

Figure 5-3. Application Customization Tool - USB and Miscellaneous Options

The battery charger section must have the BQ25731 selected with the correct voltage and current. The BQ25731 has its charging current set in 0.128 A steps due to bit resolution. For a 12 V 3 A application, the 3.072 A will be an appropriate charging current.

TPS25750 Application Customization Tool

Documents ▾ Help ▾

Battery Charger Configuration

9. Select the battery charger component to integrate:

- BQ25790 or BQ25792
 BQ25713
 BQ25731

10. What is the battery charging voltage?

 V

Valid values: 1.024V - 23.000V

11. What is the battery charging current?

 A

Valid values: 0.000A - 16.256A

12. What is the charge termination current?

 A

13. What is the pre-charge current?

 A**Figure 5-4. Application Customization Tool - Battery Charger Options**

Once the configuration has loaded, connect a Type-A cable to the Micro-B connector, J11 and your laptop. Make sure that the entire EVM is powered by connecting 20 V to either the barrel jack or the SYS_PWR test point. Once the Type-A cable has been connected, and power is provided to the EVM, you may flash the configuration from the GUI onto the EVM. Navigate to the right side of the page, which has the different file generation and flash options. Select "Flash To Device From Current Configuration" to load the settings onto the EVM.

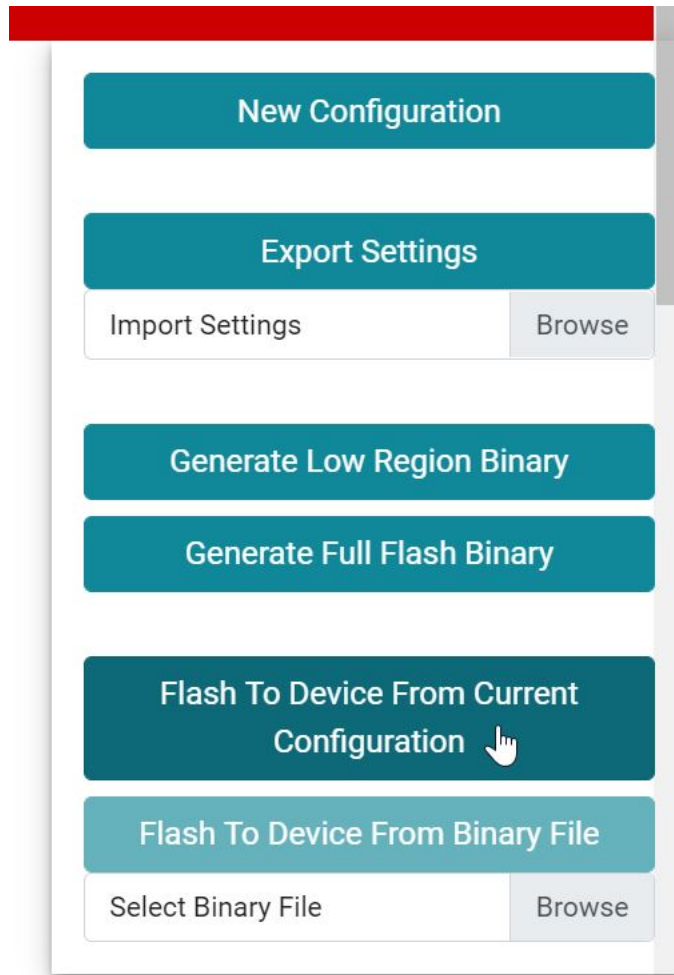


Figure 5-5. Application Customization Tool - Flash to Device

5.1 Other Configurations

Other systems may be simulated and tested on this EVM. For a dedicated 5 V at 3 A source only system, select question 1 to match the below image. Question 2 and 3 will then be disabled. Question 4, the preferred power role, will be a power source. Question 5-8 will match the default configuration answers shown in the previous section. The battery charger section will be disabled.

1. Select your configuration:

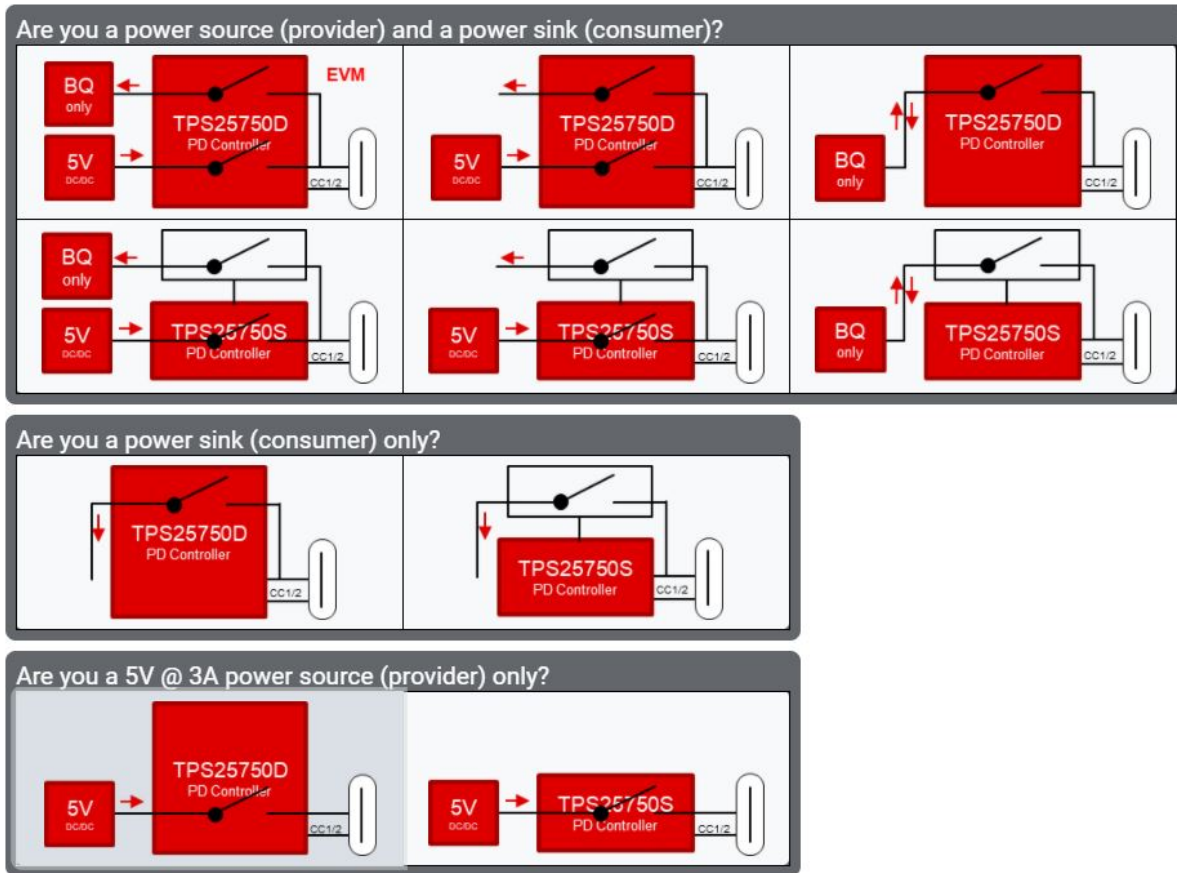


Figure 5-6. Provider Only - 5 V at 3 A

For a sink only application, select question 1 to match the below image. Question 2 will be disabled. Question 3, the required sink power, can be answered with the sink power the system is capable of. 100 W would be a 20 V at 5 A system. Question 4, the preferred power role, will be a power sink. Question 5-8 will match the default configuration answers shown in the previous section. The battery charger section will be disabled.

1. Select your configuration:

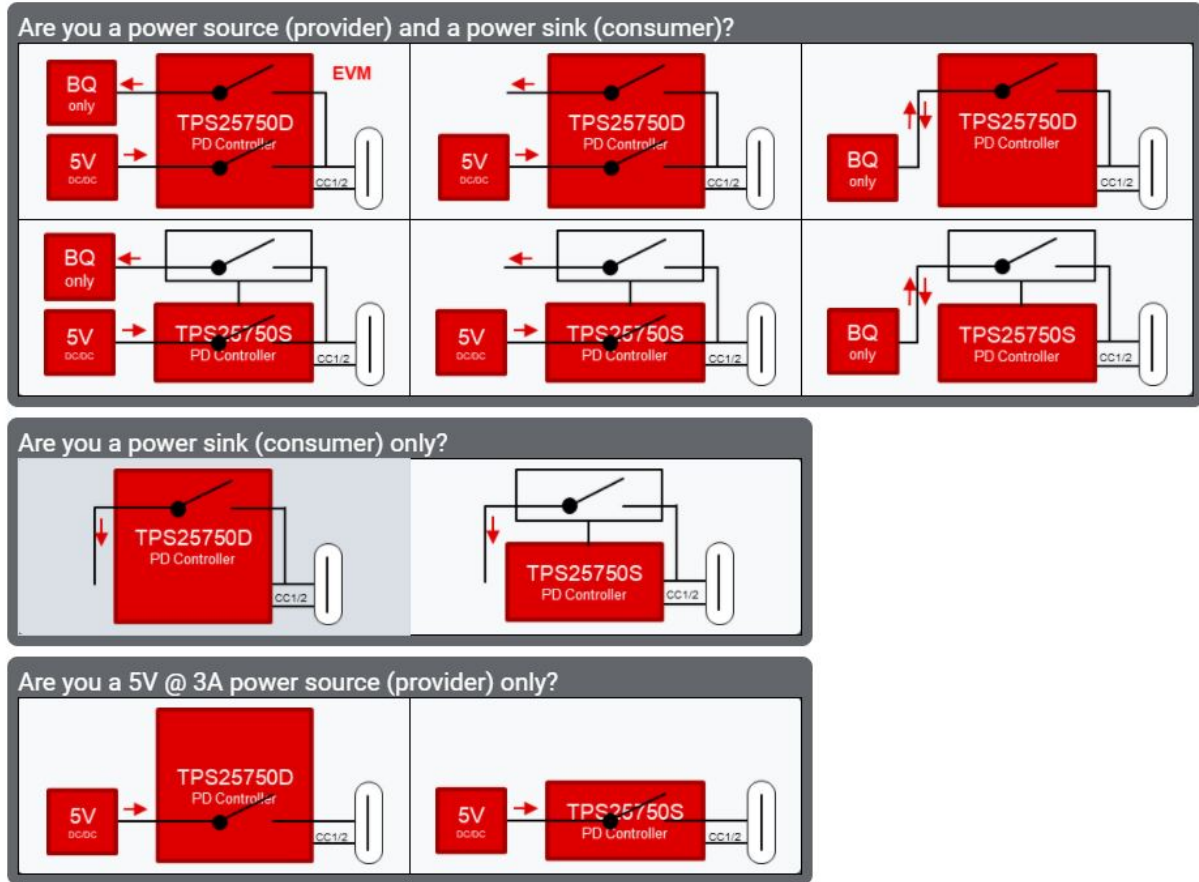


Figure 5-7. Sink Only Application

6 Schematic

The TPS25750 schematics are shown below.

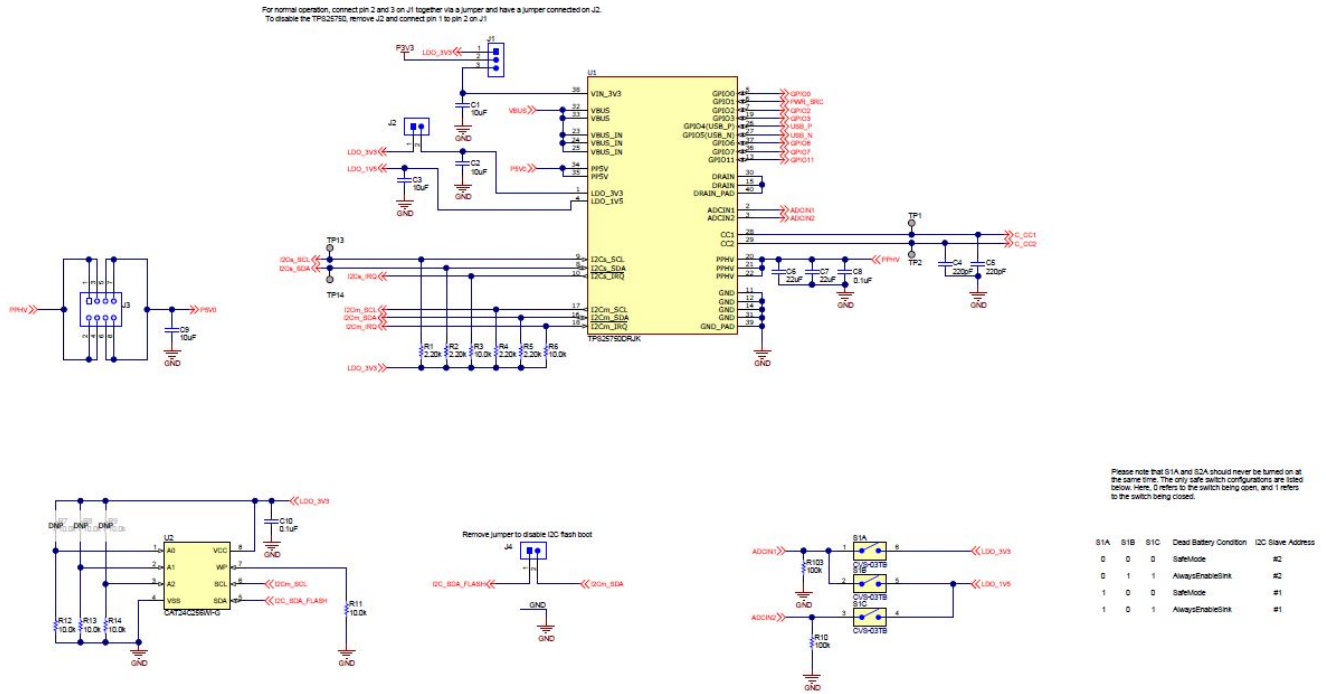


Figure 6-1. TPS25750

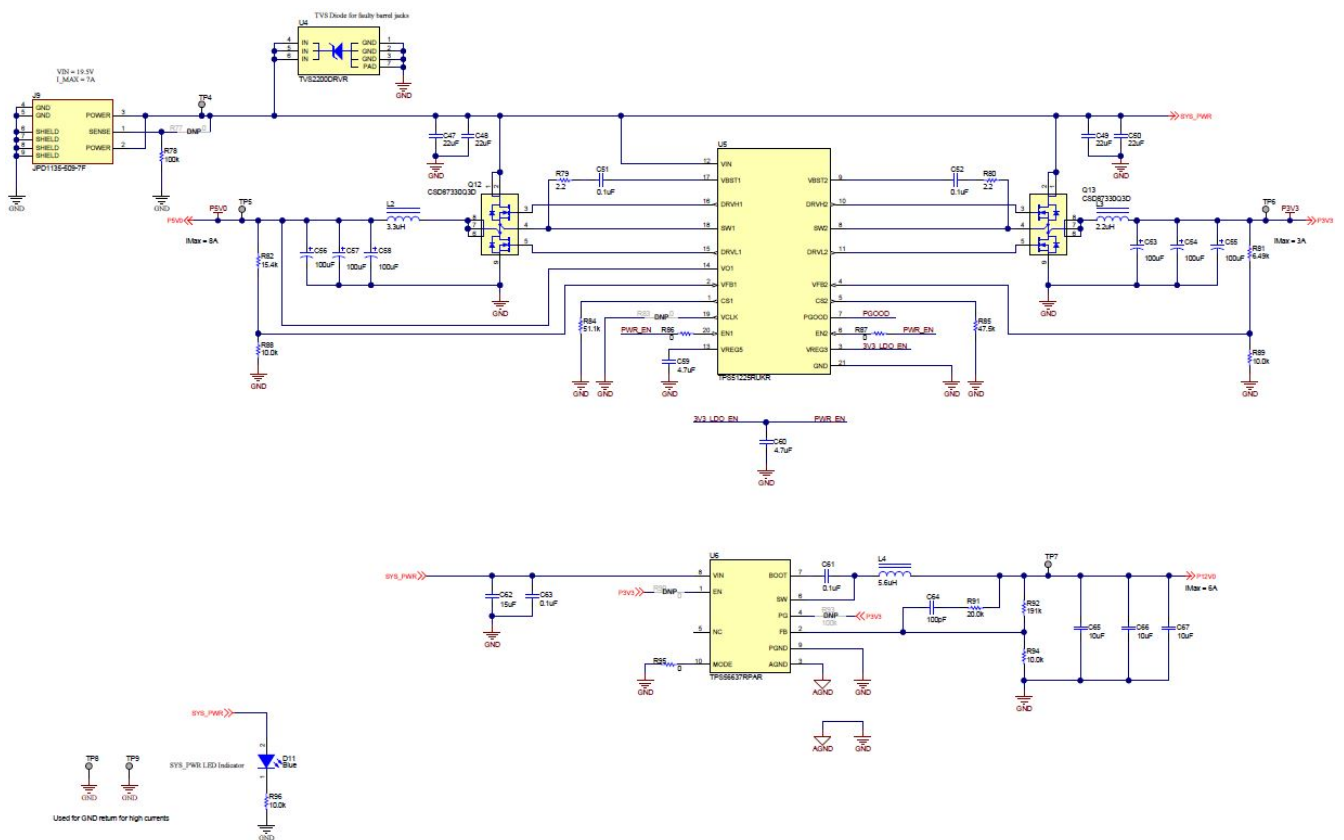


Figure 6-2. TPS51225 - 5 V, and 3.3-V Supply, TPS56637 - 12-V Supply

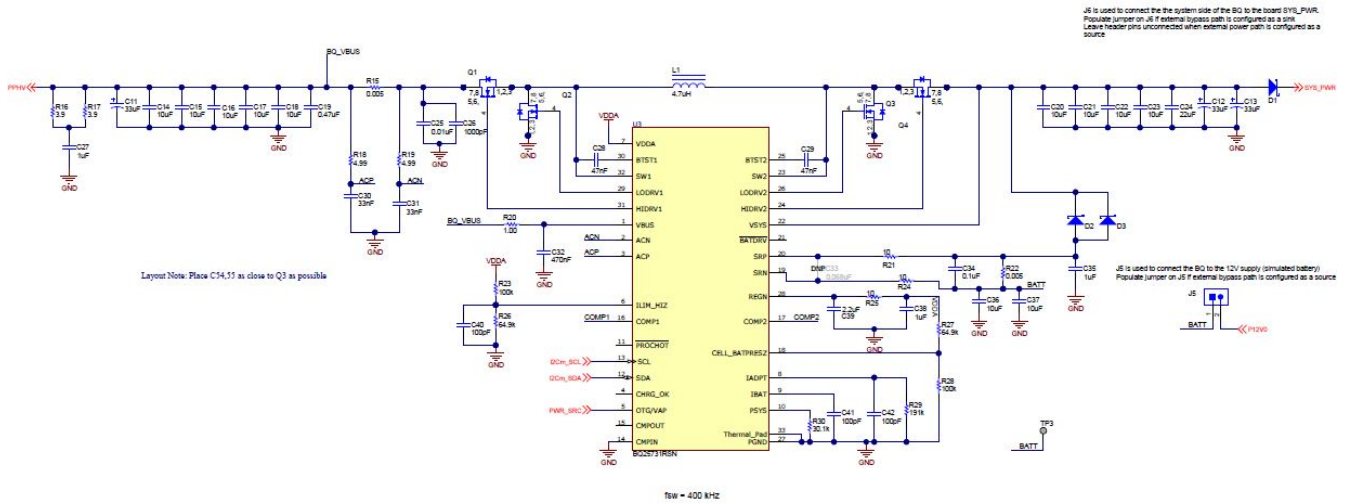


Figure 6-3. BQ25731 - Battery Charger

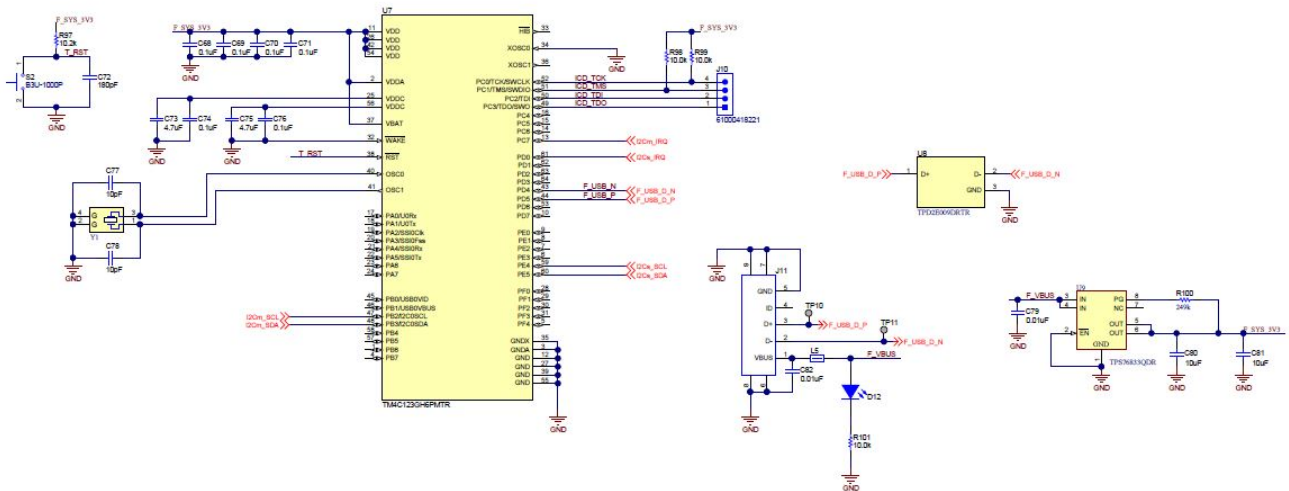


Figure 6-4. TM4C123GH6PMTR - USB2.0 to I²C Programmer

Schematic

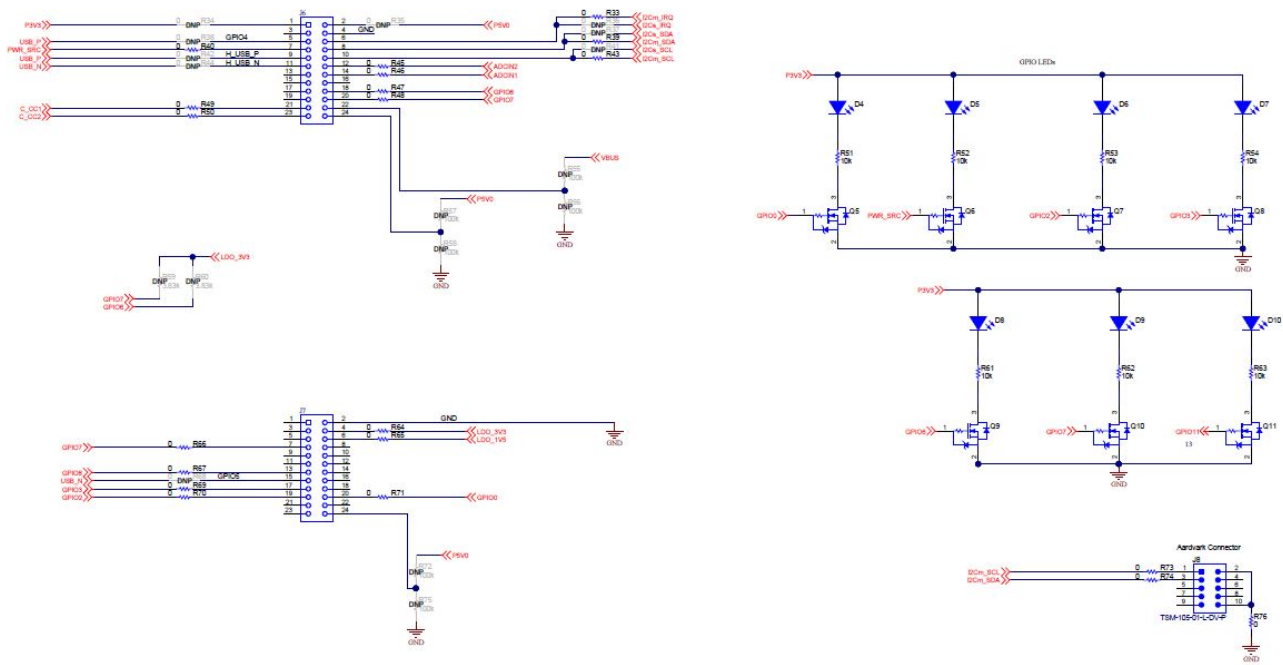


Figure 6-5. Debug Header and Status LED

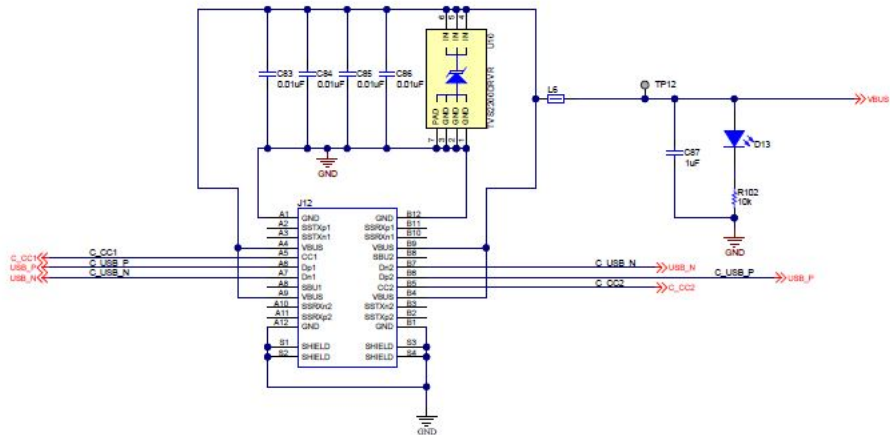


Figure 6-6. USB Type-C Port

7 Bill of Materials

The TPS25750EVM Bill of Materials (BOM) table is shown below:

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
!PCB1	1		Printed Circuit Board		PSIL138	Any
C1, C2, C3	3	10 uF	CAP, CERM, 10 uF, 10 V, +/- 20%, X5R, 0402	0402	CL05A106MP5NUNC	Samsung Electro-Mechanics
C4, C5	2	220 pF	CAP, CERM, 220 pF, 50 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0201	0201	CGA1A2X7R1H221K030BA	TDK
C6, C7, C24, C47, C48, C49, C50	7	22 uF	CAP, CERM, 22 uF, 35 V, +/- 20%, X5R, 0805	0805	C2012X5R1V226M125AC	TDK
C8, C10, C34, C51, C52, C63	6	0.1uF	CAP, CERM, 0.1 uF, 35 V, +/- 10%, X5R, 0402	0402	GMK105BJ104KV-F	Taiyo Yuden
C9	1	10 uF	CAP, CERM, 10 uF, 25 V, +/- 20%, X5R, 0603	0603	GRM188R61E106MA73D	MuRata
C11, C12, C13	3	33 uF	CAP, TA, 33 uF, 35 V, +/- 20%, 0.065 ohm, SMD	7343-31	T521D336M035ATE065	Kemet
C14, C15, C16, C17, C18, C20, C21, C22, C23, C36, C37	11	10 uF	CAP, CERM, 10 uF, 25 V, +/- 10%, X5R, 0805	0805	GRM21BR61E106KA73L	MuRata
C19	1	0.47 uF	CAP, CERM, 0.47 uF, 16 V, +/- 10%, X7R, 0805	0805	C0805C474K4RACTU	Kemet
C25, C79, C82, C83, C84, C85, C86	7	0.01 uF	CAP, CERM, 0.01 uF, 50 V, +/- 5%, X7R, 0402	0402	C0402C103J5RACTU	Kemet
C26	1	1000 pF	CAP, CERM, 1000 pF, 50 V, +/- 10%, X7R, 0402	0402	C0402C102K5RACTU	Kemet
C27, C35, C38, C87	4	1 uF	CAP, CERM, 1 uF, 35 V, +/- 10%, X5R, 0402	0402	GRM155R6YA105KE11D	MuRata
C28, C29	2	0.047 uF	CAP, CERM, 0.047 uF, 25 V, +/- 5%, X7R, 0603	0603	06033C473JAT2A	AVX
C30, C31	2	0.033 uF	CAP, CERM, 0.033 uF, 25 V, +/- 5%, X7R, 0603	0603	C0603C333J3RACTU	Kemet
C32	1	0.47 uF	CAP, CERM, 0.47 uF, 50 V, +/- 10%, X7R, 0603	0603	UMK107B7474KA-TR	Taiyo Yuden
C39	1	2.2 uF	CAP, CERM, 2.2 uF, 35 V, +/- 10%, X5R, 0603	0603	GRM188R6YA225KA12D	MuRata
C40, C41, C42	3	100 pF	CAP, CERM, 100 pF, 50 V, +/- 5%, C0G/NP0, 0603	0603	06035A101JAT2A	AVX
C43	1	33 pF	CAP, CERM, 33 pF, 50 V, +/- 5%, C0G/NP0, 0402	0402	C1005C0G1H330J050BA	TDK

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
C44	1	15 pF	CAP, CERM, 15 pF, 50 V, +/- 5%, C0G/NP0, 0402	0402	CC0402JRNPO9BN150	Yageo America
C45	1	4700 pF	CAP, CERM, 4700 pF, 50 V, +/- 5%, X7R, 0603	0603	C0603C472J5RACTU	Kemet
C46	1	680 pF	CAP, CERM, 680 pF, 50 V,+/- 1%, C0G/NP0, AEC-Q200 Grade 1, 0402	0402	GCM1555C1H681FA16D	MuRata
C53, C54, C55, C56, C57, C58	6	100 uF	CAP, TA, 100 uF, 6.3 V, +/- 20%, 0.015 ohm, SMD	3528-21	T520B107M006ATE015	Kemet
C59, C60	2	4.7 uF	CAP, CERM, 4.7 uF, 6.3 V, +/- 20%, X5R, 0402	0402	GRM155R60J475ME87D	MuRata
C61	1	0.1 uF	CAP, CERM, 0.1 uF, 16 V, +/- 10%, X7R, 0402	0402	885012205037	Wurth Elektronik
C62	1	15 uF	CAP, CERM, 15 uF, 35 V, +/- 20%, X5R, 0805	0805	C2012X5R1V156M125AC	TDK
C64	1	100 pF	CAP, CERM, 100 pF, 25 V, +/- 10%, X7R, 0201	0201	GRM033R71E101KA01D	MuRata
C65, C66, C67, C80, C81	5	10 uF	CAP, CERM, 10 uF, 25 V, +/- 10%, X7R, 1206	1206	GRM31CR71E106KA12L	MuRata
C68, C69, C70, C71, C74, C76	6	0.1 uF	CAP, CERM, 0.1 uF, 10 V, +/- 10%, X5R, 0201	0201	CL03A104KP3NNNC	Samsung Electro-Mechanics
C72	1	180 pF	CAP, CERM, 180 pF, 25 V, +/- 10%, X7R, 0201	0201	GRM033R71E181KA01D	MuRata
C73, C75	2	4.7 uF	CAP, CERM, 4.7 uF, 6.3 V, +/- 20%, X5R, 0201	0201	GRM035R60J475ME15D	MuRata
C77, C78	2	10 pF	CAP, CERM, 10 pF, 16 V,+/- 10%, C0G, 0402	0402	C0402C100K4GACTU	Kemet
D1, D2, D3	3	40 V	Diode, Schottky, 40 V, 5 A, AEC-Q101, SOD-128	SOD-128	PMEG4050EP,115	Nexperia
D4, D5, D6, D7, D8, D9, D10, D12, D13	9	White	LED, White, SMD	0402, White	LW QH8G-Q2S2-3K5L-1	OSRAM
D11	1	Blue	LED, Blue, SMD	LED_0603	150060BS75000	Wurth Elektronik
J1	1		Header, 100 mil, 3 x 1, Tin, TH	Header, 3 PIN, 100mil, Tin	PEC03SAAN	Sullins Connector Solutions
J2, J4, J5	3		Header, 100 mil, 2 x 1, Gold, TH	Sullins 100 mil, 1 x 2, 230 mil above insulator	PBC02SAAN	Sullins Connector Solutions
J3	1		Receptacle, 2.54 mm, 4 x 2, Gold, TH	Receptacle, 2.54 mm, 4 x 2, TH	SSQ-104-03-G-D	Samtec

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
J6, J7	2		Receptacle, 12 x 2, 2.54 mm, Gold, SMT	Receptacle, 12 x 2, 2.54 mm, SMT	SSW-112-22-G-D-VS	Samtec
J8	1		Header, 2.54 mm, 5 x 2, Gold, SMT	Header, 2.54 mm, 5 x 2, SMT	TSM-105-01-L-DV-P	Samtec
J9	1		Connector, DC Power Jack, R/A, 3 Pos, TH	Power connector	JPD1135-509-7F	Foxconn
J10	1		Header, 2.54 mm, 4 x 1, Gold, SMT	Header, 2.54 mm, 4 x 1, SMT	61000418221	Wurth Elektronik
J11	1		Connector, Receptacle, Micro-USB Type AB, R/A, Bottom Mount SMT	Connector, USB Micro AB	DX4R205JJAR1800	JAE Electronics
J12	1		Receptacle, USB 3.1 Type C, R/A, Gold, SMT	Receptacle, USB 3.1 Type C, R/A, SMT	DX07S024JJ2R1300	JAE Electronics
L1	1	4.7 uH	Inductor, Shielded, Composite, 4.7 uH, 13.6 A, 0.01 ohm, SMD	7.2 x 7 x 7.5 mm	XAL7070-472MEB	Coilcraft
L2	1	3.3 uH	Inductor, Shielded Drum Core, Superflux, 3.3 uH, 8 A, 0.0096 ohm, SMD	6.9 x 4.8 x 6.9 mm	744314330	Wurth Elektronik
L3	1	2.2 uH	Inductor, Shielded Drum Core, Powdered Iron, 2.2 uH, 3.25 A, 0.051 ohm, SMD	4.45 x 1.8 x 4.06 mm	74437324022	Wurth Elektronik
L4	1	5.6 uH	Inductor, Shielded, Composite, 5.6 uH, 11.4 A, 0.01 ohm, SMD	7.2 x 7 x 7.5 mm	XAL7070-562MEB	Coilcraft
L5	1	26 ohm	Ferrite Bead, 26 ohm @ 100 MHz, 6 A, 0603	0603	BLM18SG260TN1D	MuRata
L6	1	21 ohm	Ferrite Bead, 21 ohm @ 100 MHz, 6 A, 0805	0805	FBMJ2125HM210NT	Taiyo Yuden
Q1, Q2, Q3, Q4	4	30 V	MOSFET, N-CH, 30 V, 14 A, DNH0008A (VSONP-8)	DNH0008A	CSD17578Q3A	Texas Instruments
Q5, Q6, Q7, Q8, Q9, Q10, Q11	7	20 V	MOSFET, N-CH, 20 V, 0.5 A, YJM0003A (PICOSTAR-3)	YJM0003A	CSD15380F3	Texas Instruments
Q12, Q13	2	30 V	MOSFET, 2-CH, N-CH, 30 V, 20 A, DQZ0008A (LSON-CLIP-8)	DQZ0008A	CSD87330Q3D	Texas Instruments
R1, R2, R4, R5	4	2.20 k	RES, 2.20 k, 1%, 0.05 W, 0201	0201	CRCW02012K20FKED	Vishay-Dale
R3, R6, R11, R12, R13, R14	6	10.0 k	RES, 10.0 k, 1%, 0.05 W, 0201	0201	CRCW020110K0FKED	Vishay-Dale

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
R10, R103	2	100 k	RES, 100 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	RMCF0402FT100K	Stackpole Electronics Inc
R15, R22	2	0.005	RES, 0.005, 1%, 1 W, AEC-Q200 Grade 0, 1206	1206	CRF1206-FZ-R005ELF	Bourns
R16, R17	2	3.9	RES, 3.9, 5%, 0.25 W, AEC-Q200 Grade 0, 1206	1206	CRCW12063R90JNEA	Vishay-Dale
R18, R19	2	4.99	RES, 4.99, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06034R99FKEA	Vishay-Dale
R20	1	1.00	RES, 1.00, 1%, 0.1 W, 0603	0603	CRCW06031R00FKEA	Vishay-Dale
R21, R24, R25	3	10	RES, 10, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW060310R0JNEA	Vishay-Dale
R23, R28	2	100 k	RES, 100 k, 1%, 0.1 W, 0603	0603	RC0603FR-07100KL	Yageo America
R26, R27	2	64.9 k	RES, 64.9 k, 1%, 0.1 W, 0603	0603	RC0603FR-0764K9L	Yageo America
R29	1	191 k	RES, 191 k, 1%, 0.1 W, 0603	0603	CRCW0603191KFKEA	Vishay-Dale
R30	1	30.1 k	RES, 30.1 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW060330K1FKEA	Vishay-Dale
R31	1	15.0 k	RES, 15.0 k, 1%, 0.063 W, 0402	0402	CRCW040215K0FKED	Vishay-Dale
R32	1	40.2 k	RES, 40.2 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040240K2FKED	Vishay-Dale
R33, R39, R40, R43, R45, R46, R47, R48, R49, R50, R64, R65, R66, R67, R69, R70, R71, R73, R74, R76, R86, R87	22	0	RES, 0, 5%, 0.05 W, 0201	0201	CRCW02010000Z0ED	Vishay-Dale
R51, R52, R53, R54, R61, R62, R63, R102	8	10 k	RES, 10 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040210K0JNED	Vishay-Dale
R78	1	100 k	RES, 100 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW0402100KFKEA	Vishay-Dale
R79, R80	2	2.2	RES, 2.2, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04022R20JNED	Vishay-Dale
R81	1	6.49 k	RES, 6.49 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04026K49FKED	Vishay-Dale

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
R82	1	15.4 k	RES, 15.4 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040215K4FKED	Vishay-Dale
R84	1	51.1 k	RES, 51.1 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040251K1FKED	Vishay-Dale
R85	1	47.5 k	RES, 47.5 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040247K5FKED	Vishay-Dale
R88, R89, R96, R98, R99, R101	6	10.0 k	RES, 10.0 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040210K0FKED	Vishay-Dale
R91	1	20.0 k	RES, 20.0 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040220K0FKED	Vishay-Dale
R92	1	191 k	RES, 191 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW0402191KFKED	Vishay-Dale
R94	1	10.0 k	RES, 10.0 k, 1%, 0.05 W, 0201	0201	RC0201FR-0710KL	Yageo America
R95	1	0	RES, 0, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04020000Z0ED	Vishay-Dale
R97	1	10.2 k	RES, 10.2 k, 1%, 0.05 W, 0201	0201	RC0201FR-0710K2L	Yageo America
R100	1	249 k	RES, 249 k, 1%, 0.1 W, 0603	0603	RC0603FR-07249KL	Yageo
S1	1		DIP Switch, SPST, 3Pos, Slide, SMT	SW, 4.7 x 1.45 x 4 mm	CVS-03TB	Copal Electronics
S2	1		SWITCH TACTILE SPST-NO 0.05 A 12 V	3 x 1.6 x 2.5 mm	B3U-1000P	Omron Electronic Components
SH-J1, SH-J2, SH-J3, SH-J4, SH-J5, SH-J6, SH-J7	7		Shunt, 2.54 mm, Gold, Black	Shunt, 2.54 mm, Black	60900213421	Wurth Elektronik
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP12, TP13, TP14	12		Test Point, Miniature, SMT	Test Point, Miniature, SMT	5019	Keystone
U1	1		USB Type-C and USB PD Controller with Integrated Power Switches Optimized for Power Applications	VQFN32	TPS25750DRJK	Texas Instruments
U2	1		256 kb I2C CMOS Serial EEPROM, SOIC-8	SOIC-8	CAT24C256WI-G	ON Semiconductor

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
U3	1		No Description	WQFN32	BQ25731RSN	Texas Instruments
U4, U10	2		22-V Precision Surge Protection Clamp, DRV0006A (WSO-6)	DRV0006A	TVS2200DRVR	Texas Instruments
U5	1		Dual Synchronous Step-Down Controller with 5-V and 3.3-V LDOs, RUK0020B (WQFN-20)	RUK0020B	TPS51225RUKR	Texas Instruments
U6	1		4.5-V to 28-V Input, 6-A Synchronous Buck Converter with ULQ-mode, RPA0010A (VQFN-HR-10)	RPA0010A	TPS56637RPAR	Texas Instruments
U7	1		Tiva C Series Microcontroller, 256 KB Flash, 32 KB SRAM, 12 Bit, 12 Channels, -40 to 105 degC, 64-Pin LQFP (PM), Green (RoHS & no Sb/Br), Tape and Reel	PM0064A	TM4C123GH6PMTR	Texas Instruments
U8	1		ESD Protection Array for High-Speed Data Interfaces, 2 Channels, -40 to +85°C, 3-pin SOT (DRT), Green (RoHS & no Sb/Br)	DRT0003A	TPD2E009DRTR	Texas Instruments
U9	1		Single Output Fast Transient Response LDO, 1 A, Fixed 3.3 V Output, 2.7 to 10 V Input, with Low IQ, 8-pin SOIC (D), -40 to 125°C, Green (RoHS & no Sb/Br)	D0008A	TPS76833QDR	Texas Instruments
Y1	1		Crystal, 16 MHz, 8 pF, SMD	3.2 x 0.75 x 2.5 mm	NX3225GA-16.000M-STD-CRG-1	NDK
C33	0	0.068 uF	CAP, CERM, 0.068 uF, 16 V, +/-10%, X5R, 0402	0402	GRM155R61C683KA88D	MuRata
FID1, FID2, FID3, FID4, FID5, FID6	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A
R7, R8, R9	0	10.0 k	RES, 10.0 k, 1%, 0.05 W, 0201	0201	CRCW020110K0FKED	Vishay-Dale
R34, R35	0	0	RES, 0, 5%, 0.063 W, 0402	0402	CRCW04020000Z0ED	Vishay-Dale

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
R36, R37, R38, R41, R42, R44, R68	0	0	RES, 0, 5%, 0.05 W, 0201	0201	CRCW02010000Z0ED	Vishay-Dale
R55, R56, R57, R58, R72, R75	0	100 k	RES, 100 k, 1%, 0.1 W, 0603	0603	CRCW0603100KFKEA	Vishay-Dale
R59, R60	0	3.83 k	RES, 3.83 k, 1%, 0.05 W, 0201	0201	CRCW02013K83FKED	Vishay-Dale
R77, R83, R90	0	0	RES, 0, 5%, 0.063 W, AEC- Q200 Grade 0, 0402	0402	CRCW04020000Z0ED	Vishay-Dale
R93	0	100 k	RES, 100 k, 1%, 0.063 W, AEC- Q200 Grade 0, 0402	0402	CRCW0402100KFKED	Vishay-Dale

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