



ABSTRACT

This user's guide describes the TPS25868-Q1 evaluation module (TPS25868Q1EVM-162). This document contains the EVM schematics, EVM configuration, bill of materials (BOM), board layout drawing, and assembly drawing.

Table of Contents

1 Introduction	2
1.1 Features.....	2
1.2 Applications.....	2
2 Schematic	3
3 General Configuration and Description	4
3.1 Physical Access.....	4
3.2 Adjusting the Switching Frequency.....	4
3.3 Adjusting the Current Limit Value.....	4
3.4 Adjusting the Cable Compensation Value.....	4
3.5 Thermal Management.....	5
3.6 Test Setup.....	5
4 Board Layout	6
5 Bill of Materials	10

List of Figures

Figure 2-1. TPS25868Q1EVM-162 Schematic.....	3
Figure 3-1. EVM Setup for Charging USB Type-C® Device.....	5
Figure 4-1. Top Side Assembly.....	6
Figure 4-2. Bottom Side Assembly.....	6
Figure 4-3. Top Side 3D View.....	7
Figure 4-4. Bottom Side 3D View.....	7
Figure 4-5. Top Layer Layout.....	8
Figure 4-6. Mid-1 Layer Layout.....	8
Figure 4-7. Mid-2 Layer Layout.....	9
Figure 4-8. Bottom Layer Layout.....	9

List of Tables

Table 3-1. Connectors.....	4
Table 3-2. Jumper.....	4
Table 3-3. Test Points.....	4
Table 5-1. TPS25868Q1EVM-162 Bill of Materials.....	10

Trademarks

USB Type-C® is a registered trademark of USB Implementers Forum.
All trademarks are the property of their respective owners.

1 Introduction

The TPS25868Q1EVM-162 is an evaluation module (EVM) for TI's TPS25868-Q1 USB Type-C® and type-A ports, which is capable of providing up to 5.6-A output current, 2.4 A for Type-A port, and 3 A for Type-C port, plus 200 mA for output. The EVM operates over a range from 5.5 V to 26 V and withstands 40-V transient voltage. The switching frequency can be adjusted by resistors on the EVM.

1.1 Features

The following features are available on this EVM:

- 5.5-V to 26-V input range, 2.4-A continuous output current buck converter for Type-A port and 3 A for Type-C port.
- 200-mA capability for OUT pin, 200-mA capability for VCONN power meeting for USB3.1 power requirement
- Forced PWM operation with Spread-Spectrum Dithering at 200 kHz–800kHz
- Fully AEC-Q100 qualified
- Smart thermal management
- USB battery charging specification Rev. 1.2 DCP mode, divider3 mode, Samsung 1.2-V mode, and USB Type-C Rev. 1.3 compliant
- User-programmable VBUS current limit and internal VCONN current limiting

1.2 Applications

The EVM is used in the following applications:

- Automotive: USB media hubs, USB charging ports, aftermarket Dual USB chargers

2 Schematic

Figure 2-1 illustrates the TPS25868Q1EVM-162 schematic.

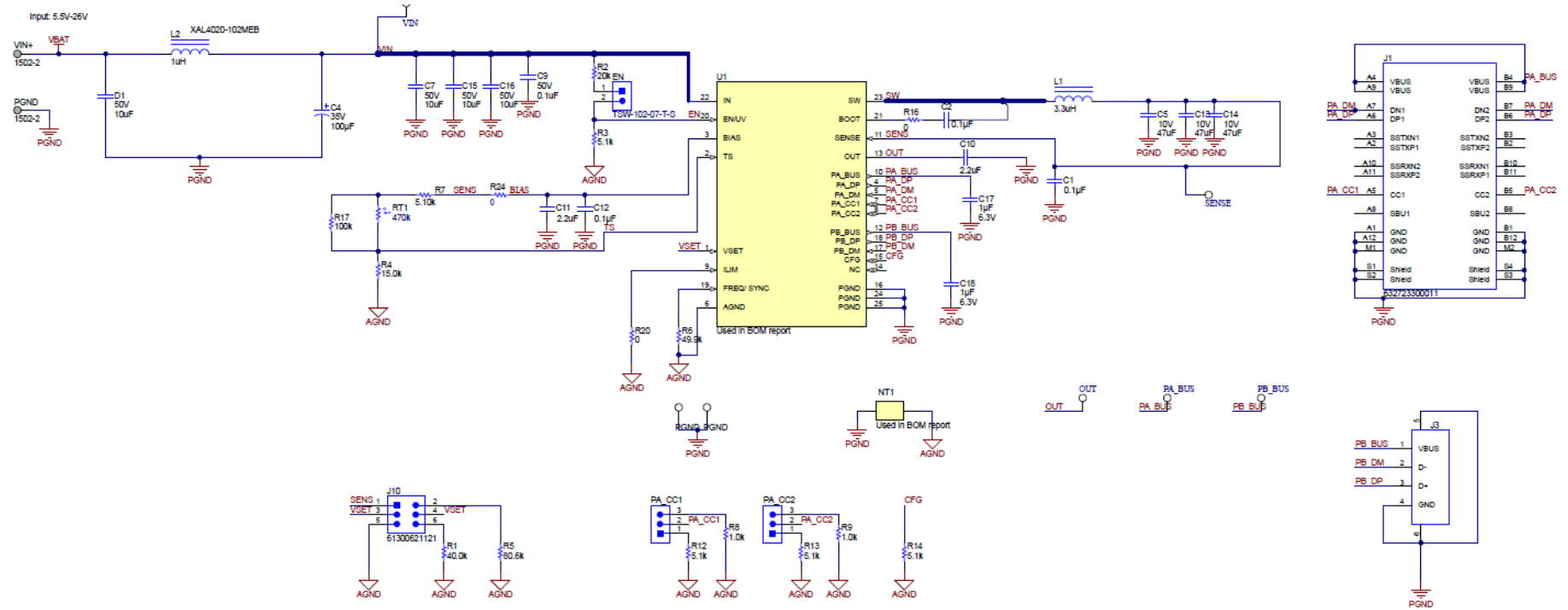


Figure 2-1. TPS25868Q1EVM-162 Schematic

3 General Configuration and Description

This section describes the connectors, jumpers, and test points on the EVM and how to properly connect, set up, and use the TPS25868Q1EVM-162.

3.1 Physical Access

[Table 3-1](#) lists the TPS25868Q1EVM-162 connector functionality, [Table 3-2](#) describes the jumper configuration, and [Table 3-3](#) describes the test point availability.

Table 3-1. Connectors

Connector	Component Type	Description
J1	USB Type-C connector, receptacle	Downstream facing USB Type-C connector. Connect to the USB Type-C slave for data pass through from PA_CC1/2 and BC1.2 or USB Type-C identification. USB output power is provided to the slave from the buck converter of the TPS25868-Q1 device.
VIN+, PGND	Terminal block	Power input connector for TPS25868-Q1. Connect to a 5.5-V to 26-V power supply.

Table 3-2. Jumper

Jumper	Label	Description
PA_CC1	PA_CC1	3 × 1 header. Install shunt to connect Ra or Rd on CC1 of port-A. Remove shunt to float CC1.
PA_CC2	PA_CC2	3 × 1 header. Install shunt to connect Ra or Rd on CC2 of port-A. Remove shunt to float CC2.
J10	Buck output voltage selection	3 × 2 header. Install shunt to pin 1 and pin 3 for 5.1 V, to pin 3 and pin 5 for 5.17 V, to pin 2 and pin 4 for 5.4 V, to pin 4 and pin 6 for 5.3 V.

Table 3-3. Test Points

Test Point	Label	Description
VIN	VIN	VIN pin test point
EN	EN	EN pin test point
OUT	OUT	OUT pin test point
SENSE	SENSE	SENSE pin test point
PA_BUS	PA_BUS	BUS pin of Port A test point
PB_BUS	PB_BUS	BUS pin of Port B test point
PGND	PGND	Power ground pin test point

3.2 Adjusting the Switching Frequency

If other frequencies are desired, within the frequency range of 200 kHz to 800kHz, the RFREQ (R6) resistor value can be changed. Consult the data sheet for proper selection of the RFREQ resistor. Change the inductor (L1) and the total output capacitance for proper control-loop operation. The FREQ/SYNC pin can also be used to synchronize the internal oscillator to an external clock. The TPS25868EVMQ1-162 allows users to synchronize the internal oscillator to both Lo-Z clock source and Hi-Z clock source. See the data sheet for detailed information.

3.3 Adjusting the Current Limit Value

If other current limit values are desired, the RILIM resistor value can be changed. Modifying the value of R20 can change current limit threshold. Consult the data sheet for proper selection of RILIM.

3.4 Adjusting the Cable Compensation Value

The TPS25868-Q1 needs to short the VSET pin to ground to enable the cable compensation. With that setting, the buck regulator will increase its output voltage linearly as the load current increases, and the voltage compensation at currents of the USB ports greater than 2.4 A is 90 mV.

3.5 Thermal Management

The TS input pin allows for user programmable thermal protection. See Electrical Characteristics for TS pin thresholds. The TS input pin threshold is ratio metric with VSENSE. The external resistor divider setting VTS (R4, R7, and R17) must be connected to the TPS2585x-Q1 SENSE pin to achieve accurate results. See the data sheet for detailed information.

3.6 Test Setup

Figure 3-1 shows a typical test setup for charging the USB Type-C device. Connect VIN+ to the power supply. Connect the USB Type-C device to the J1 and J3 connector. Connect PA_CC1 to R12 5.1Kohm side. Connect the jumper EN.

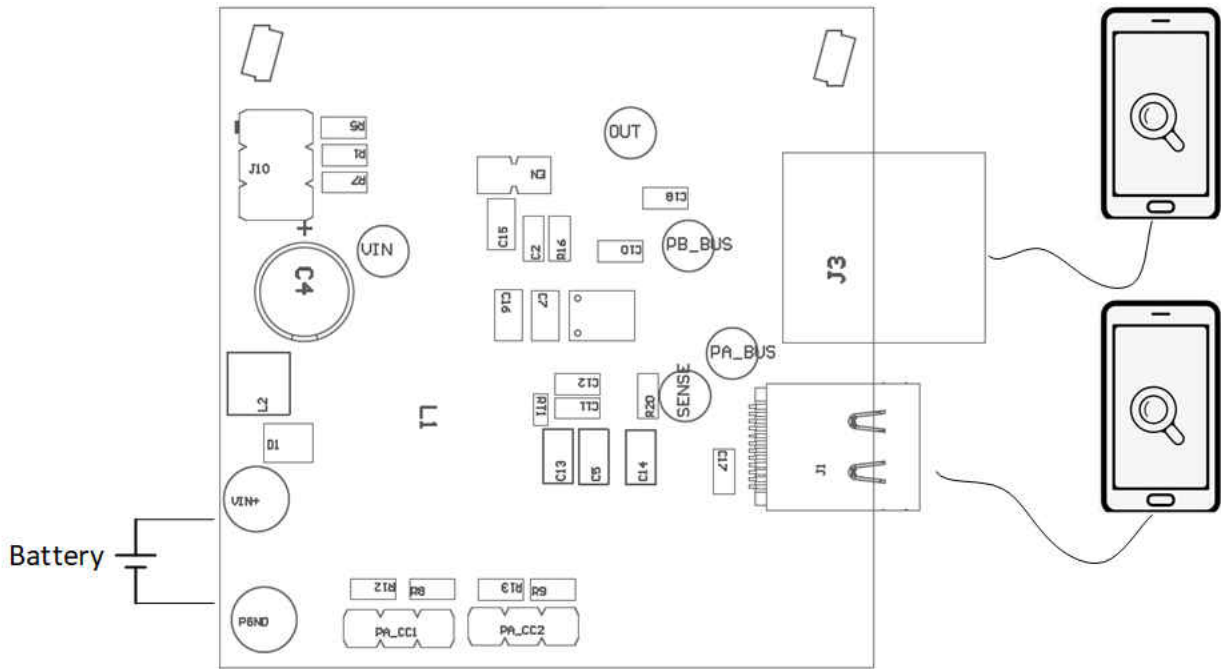


Figure 3-1. EVM Setup for Charging USB Type-C® Device

4 Board Layout

Figure 4-1 and Figure 4-2 show the top and bottom assembly. Figure 4-3 and Figure 4-4 show the top side and bottom side 3D view. Figure 4-5 through Figure 4-8 show the layout images of the EVM.

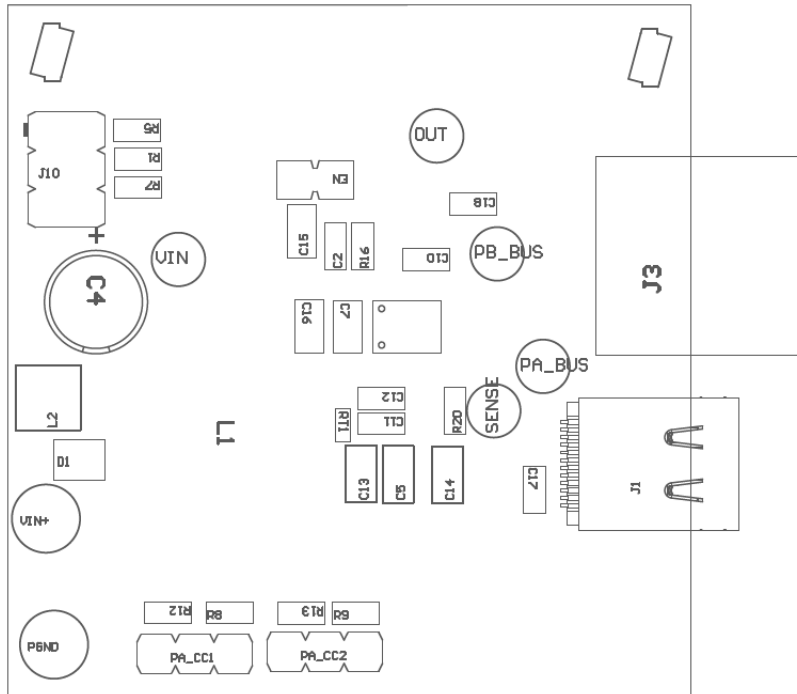


Figure 4-1. Top Side Assembly

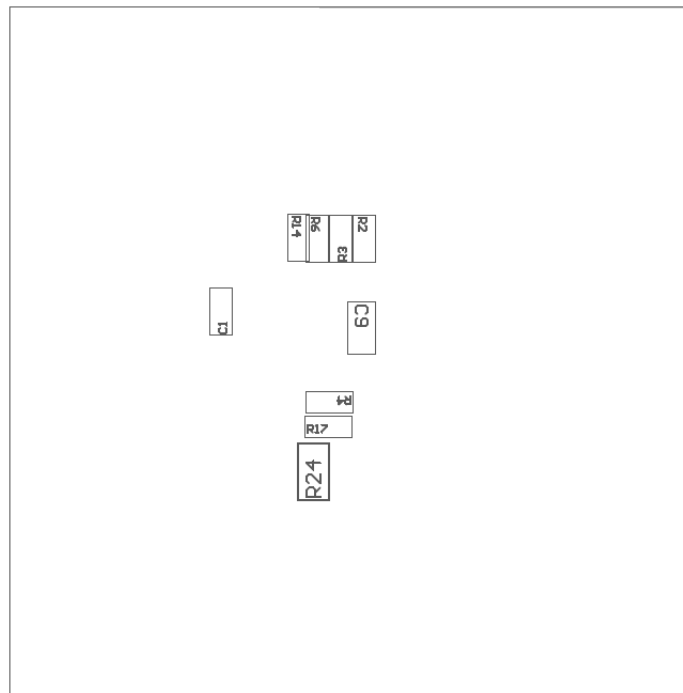


Figure 4-2. Bottom Side Assembly

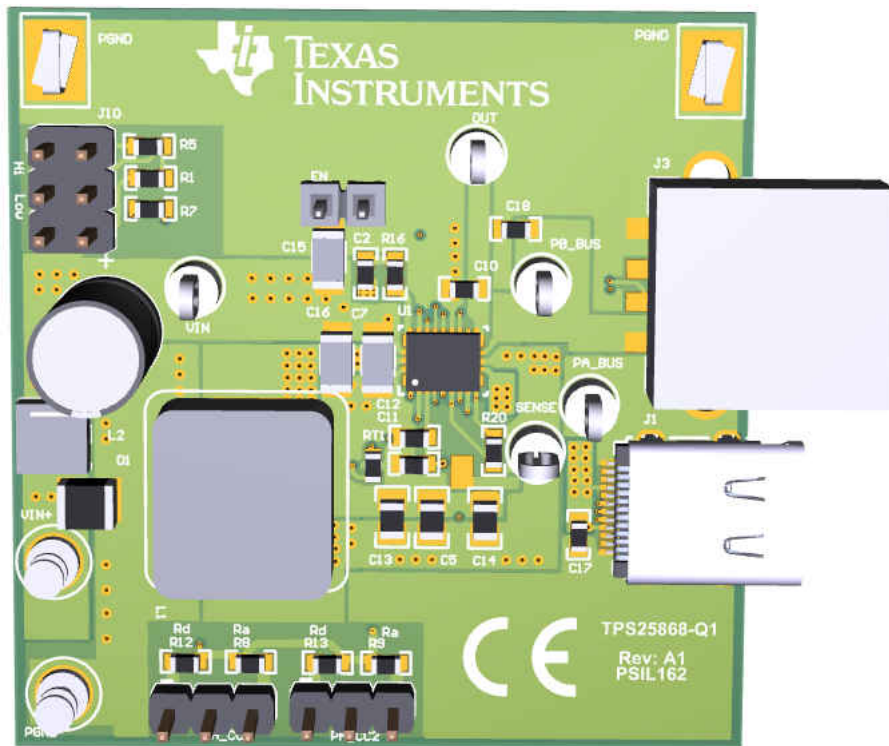


Figure 4-3. Top Side 3D View

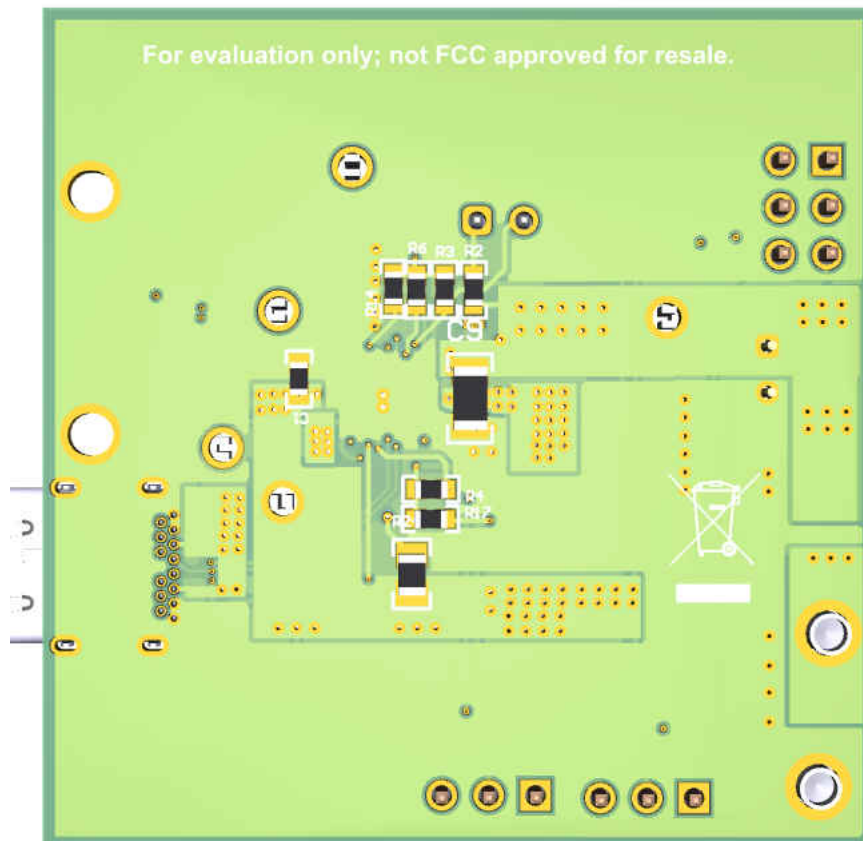


Figure 4-4. Bottom Side 3D View

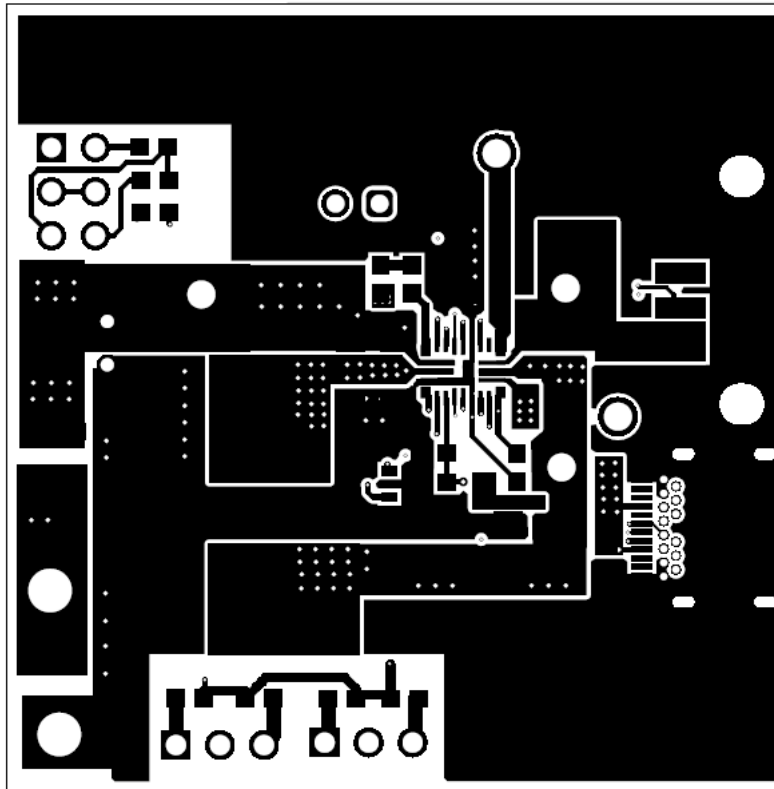


Figure 4-5. Top Layer Layout

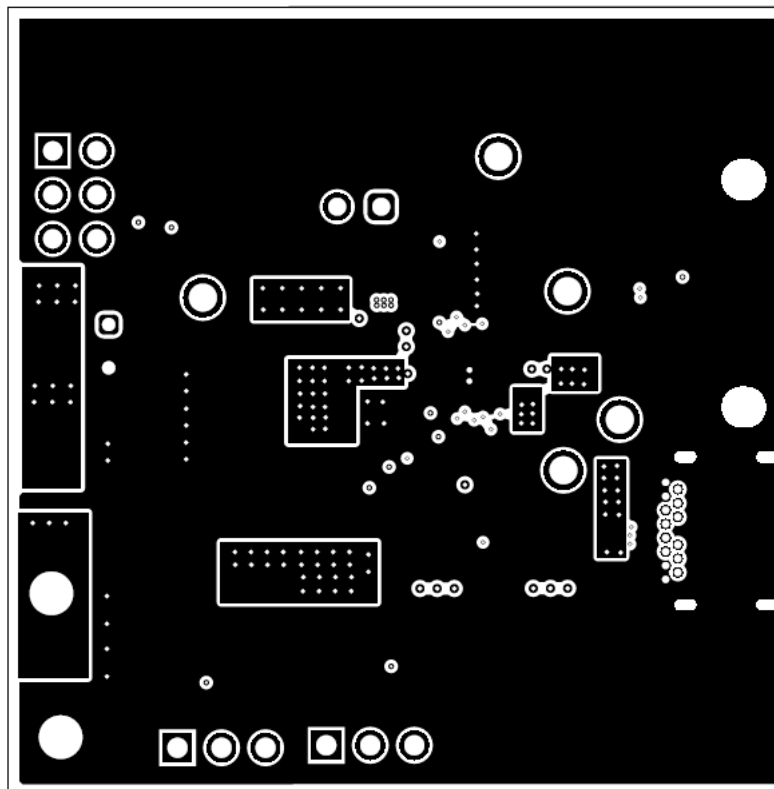


Figure 4-6. Mid-1 Layer Layout

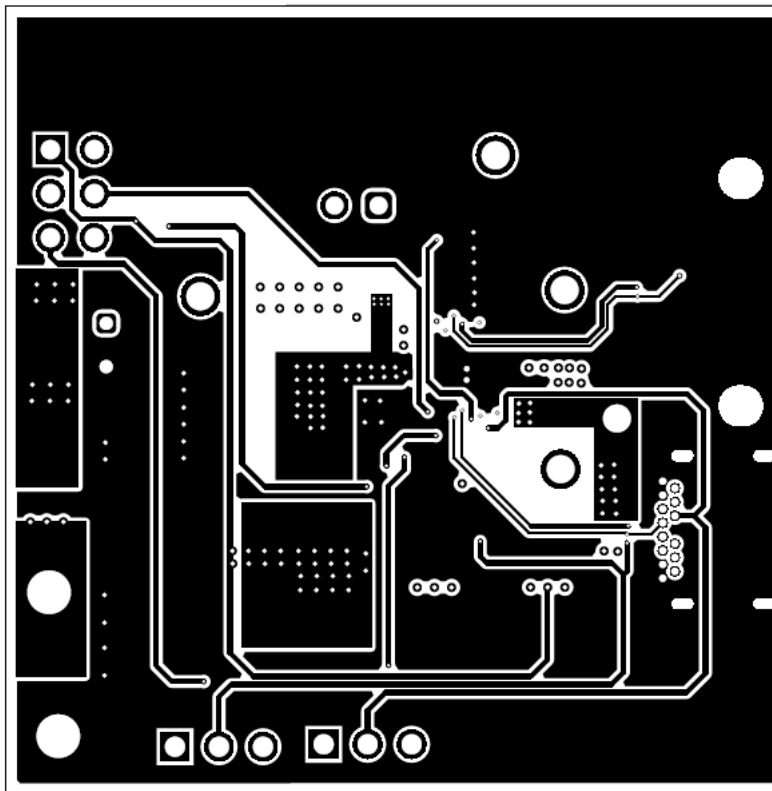


Figure 4-7. Mid-2 Layer Layout

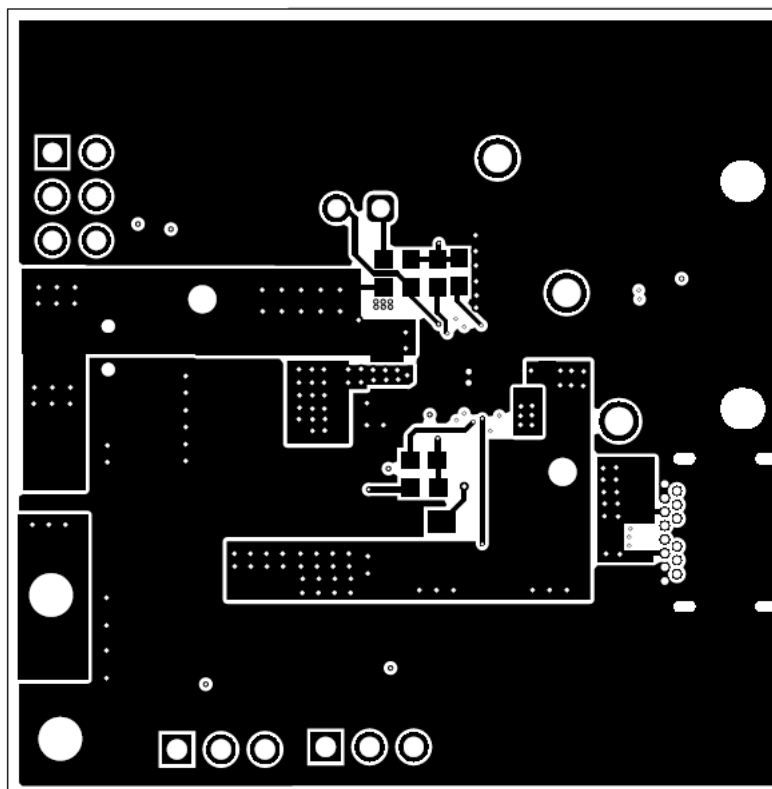


Figure 4-8. Bottom Layer Layout

5 Bill of Materials

Table 5-1 lists the EVM bill of materials

Table 5-1. TPS25868Q1EVM-162 Bill of Materials

Item #	Designator	Quantity	Value	Part Number	Manufacturer	Description	Package Reference
1	C1, C2, C12	3	0.1uF	C0603C104K5RACAUTO	Kemet	CAP, CERM, 0.1 μ F, 50 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603	0603
2	C4	1	100uF	35ZLJ100M6.3X11	Rubycon	CAP, AL, 100 μ F, 35 V, +/- 20%, TH	D6.3xL11mm
3	C5, C13, C14	3	47uF	C2012X5R1A476M125AC	TDK	CAP, CERM, 47 uF, 10 V, +/- 20%, X5R, 0805	0805
4	C7, C15, C16	3	10uF	GRT31CR61H106KE01L	MuRata	CAP, CERM, 10 uF, 50 V, +/- 10%, X5R, AEC-Q200 Grade 1, 1206	1206
5	C9	1	0.1uF	12065C104KAT2A	AVX	CAP, CERM, 0.1 uF, 50 V, +/- 10%, X7R, 1206	1206
6	C10, C11	2	2.2uF	885012106018	Würth Elektronik	CAP, CERM, 2.2 uF, 16 V, +/- 20%, X5R, 0603	0603
7	C17, C18	2	1uF	CL10B105KQ8NNNC	Samsung Electro-Mechanics	CAP, CERM, 1 uF, 6.3 V, +/- 10%, X7R, 0603	0603
8	D1	1	10uF	GRM32ER71H106MA12	MuRata	CAP, CERM, 10 uF, 50 V, +/- 20%, X7R, 1210	1210
9	EN	1		TSW-102-07-T-S	Samtec	Header, 2.54 mm, 2x1, Tin, TH	Header, 2.54 mm, 2x1, TH
10	J1	1		632723300011	Würth Elektronik	Connector, Receptacle, USB Type C, R/A	Connector, Receptacle, USB Type C, R/A, THT/SMT
11	J3	1		896-43-004-00-000000	Mill-Max	Connector, Receptacle, USB TYPE A, R/A, Top Mount SMT	USB TYPE A CONNECTOR RECEPTACLE 4POS SMD
12	J10	1		61300621121	Würth Elektronik	Header, 2.54mm, 3x2, Gold, TH	Header, 2.54mm, 3x2, TH
13	L1	1	3.3uH	744325330	Würth Elektronik	Inductor, Shielded Drum Core, Superflux, 3.3 uH, 12 A, 0.0059 ohm, SMD	WE-HC6
14	L2	1	1uH	XAL4020-102MEB	Coilcraft	Inductor, Shielded, Composite, 1 uH, 8.75 A, 0.01 ohm, SMD	4x2.1x4mm
15	NT1, PGND, U1	4		Used in BOM report	Used in BOM report		eg: 0603, used in PnP report
16	OUT, PA_BUS, PB_BUS, SENSE, VIN	5		5012	Keystone	Test Point, Multipurpose, White, TH	White Multipurpose Testpoint
17	PA_CC1, PA_CC2	2		61300311121	Würth Elektronik	Header, 2.54 mm, 3x1, Gold, TH	Header, 2.54mm, 3x1, TH
18	PGND, VIN+	2		1502-2	Keystone	Terminal, Turret, TH, Double	Keystone1502-2
19	R1	1	40.0k	PAT0603E4002BST1	Vishay Thin Film	RES, 40.0 k, 0.1%, 0.15 W, AEC-Q200 Grade 0, 0603	0603
20	R2	1	20k	CRCW060320K0JNEA	Vishay-Dale	RES, 20 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603
21	R3, R12, R13, R14	4	5.1k	CRCW06035K10JNEA	Vishay-Dale	RES, 5.1 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603
22	R4	1	15.0k	RT0603DRE0715KL	Yageo America	RES, 15.0 k, 0.5%, 0.1 W, 0603	0603
23	R5	1	80.6k	RT0603DRE0780K6L	Yageo America	RES, 80.6 k, 0.5%, 0.1 W, 0603	0603
24	R6	1	49.9k	ERJ-3EKF4992V	Panasonic	RES, 49.9 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603
25	R7	1	5.10k	RC0603FR-075K1L	Yageo America	RES, 5.10 k, 1%, 0.1 W, 0603	0603

Table 5-1. TPS25868Q1EVM-162 Bill of Materials (continued)

Item #	Designator	Quantity	Value	Part Number	Manufacturer	Description	Package Reference
26	R8, R9	2	1.0k	CRCW06031K00JNEA	Vishay-Dale	RES, 1.0 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603
27	R16, R20	2	0	RMCF0603ZT0R00	Stackpole Electronics Inc	RES, 0, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603
28	R17	1	100k	CRCW0603100KFKEA	Vishay-Dale	RES, 100 k, 1%, 0.1 W, 0603	0603
29	R24	1	0	MCR10EZPJ000	Rohm	RES, 0, 5%, 0.125 W, 0805	0805
30	RT1	1	470k	NCP18WM474E03RB	MuRata	Thermistor NTC, 470k ohm, 3%, 0603	0603

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#) or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2022, Texas Instruments Incorporated