



## ABSTRACT

This user's guide describes the TPS25869-Q1 evaluation module (TPS25869Q1EVM-163). This document contains the EVM schematics, EVM configuration, bill of materials (BOM), board layout drawing, and assembly drawing.

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## 1 Introduction

The TPS25869Q1EVM-163 is an evaluation module (EVM) for TI's TPS25869-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. It's also integrated with Fault indicator and separate on and off control.

### 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
- 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 TPS25869Q1EVM-163 schematic.

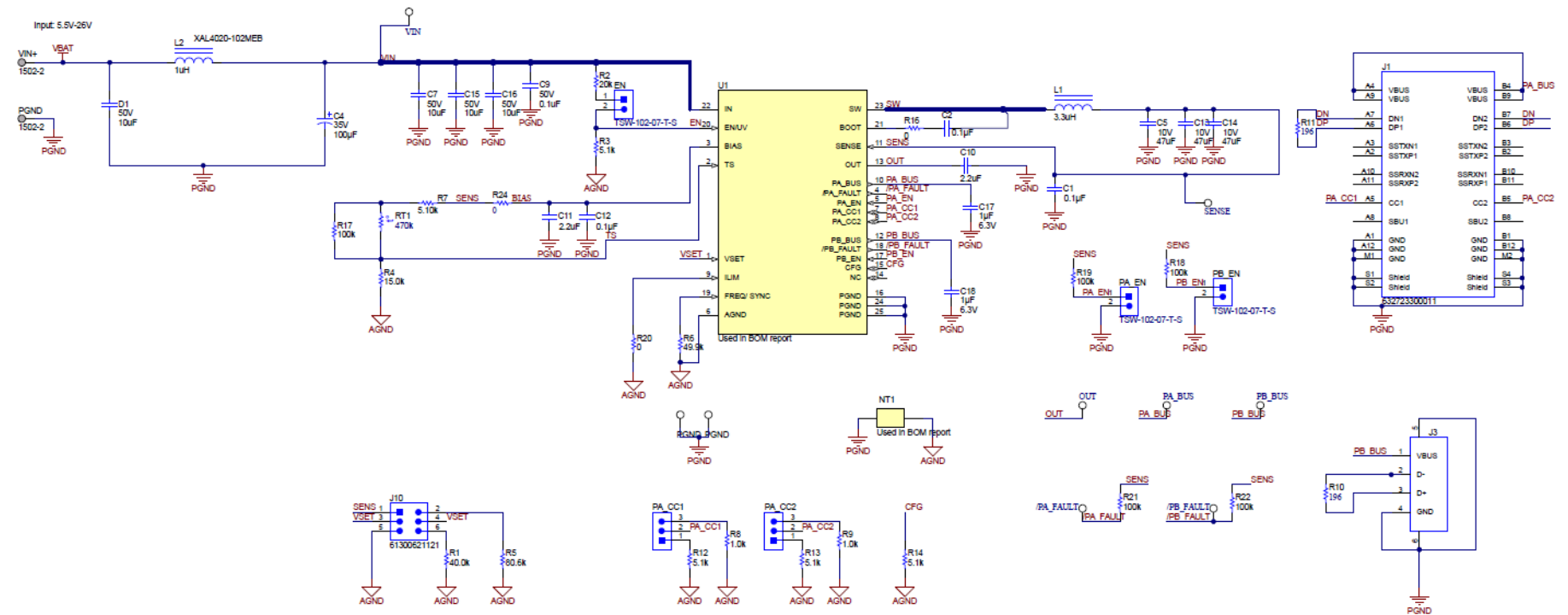


Figure 2-1. TPS25869Q1EVM-163 Schematic

### 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 TPS25869Q1EVM-163.

#### 3.1 Physical Access

[Table 3-1](#) lists the TPS25869Q1EVM-163 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 TPS25869-Q1 device.
VIN+, PGND	Terminal block	Power input connector for TPS25869-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.
PA/B_FAULT	PA/B_FAULT	Test Point
PA/B_EN	PA/B_EN	2 × 1 header. Install shunt to enable port A and port B.
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 jumper to enable Buck
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 800 KHz, 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 TPS25869EVMQ1-163 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 TPS25869-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 to the EN connector. Connect PA\_EN and PB\_EN to enable VBUS.

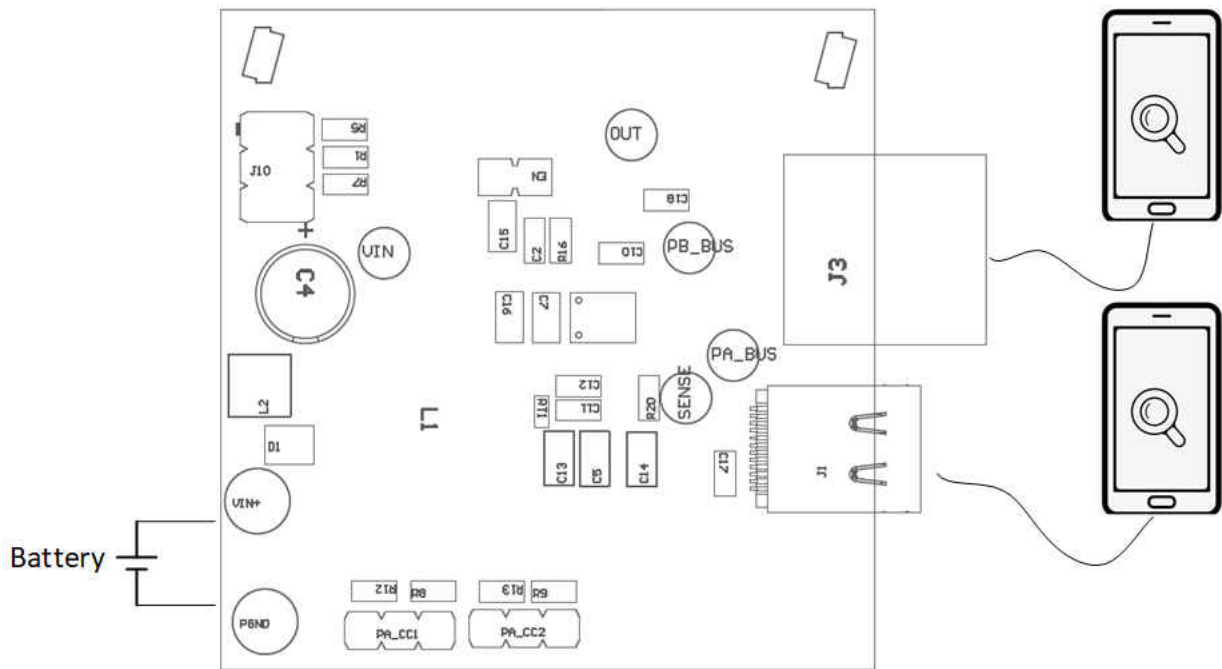
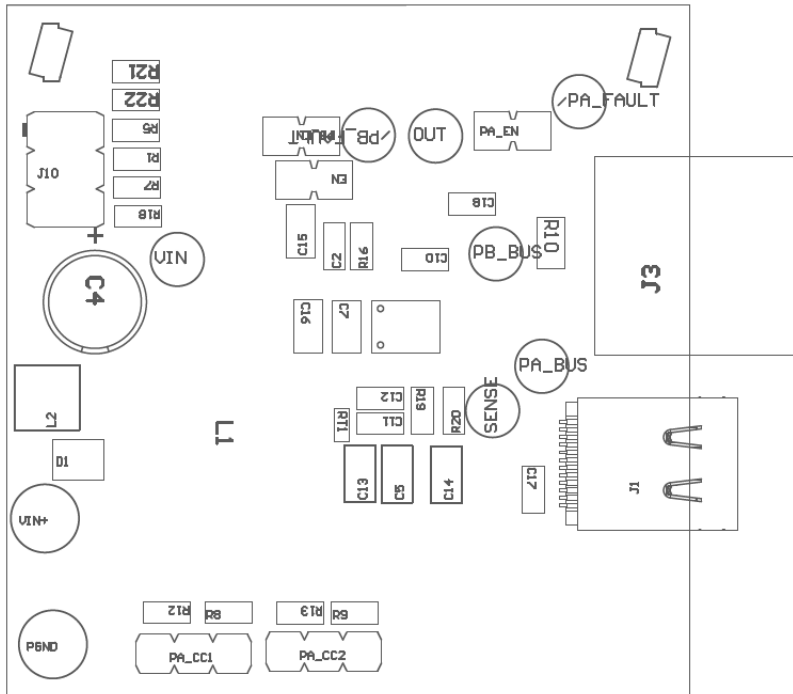


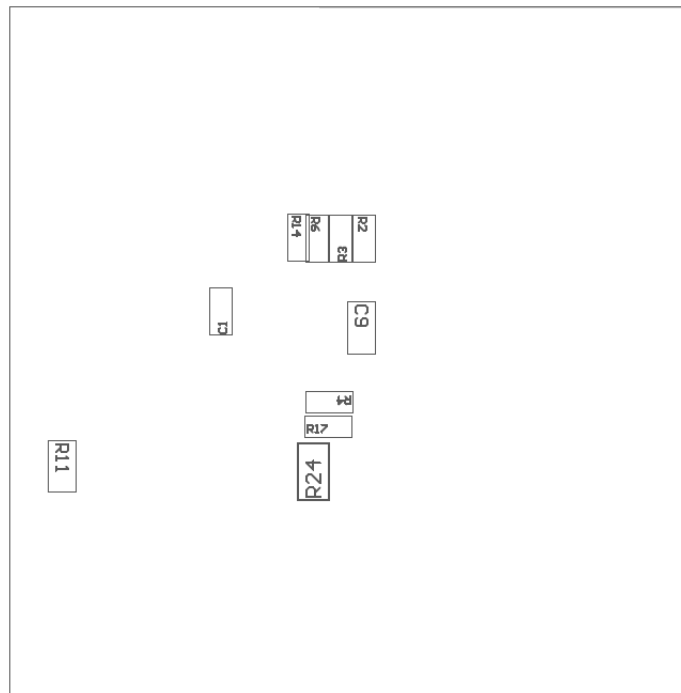
Figure 3-1. EVM Setup for Charging USB Type-C® Device

## 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**

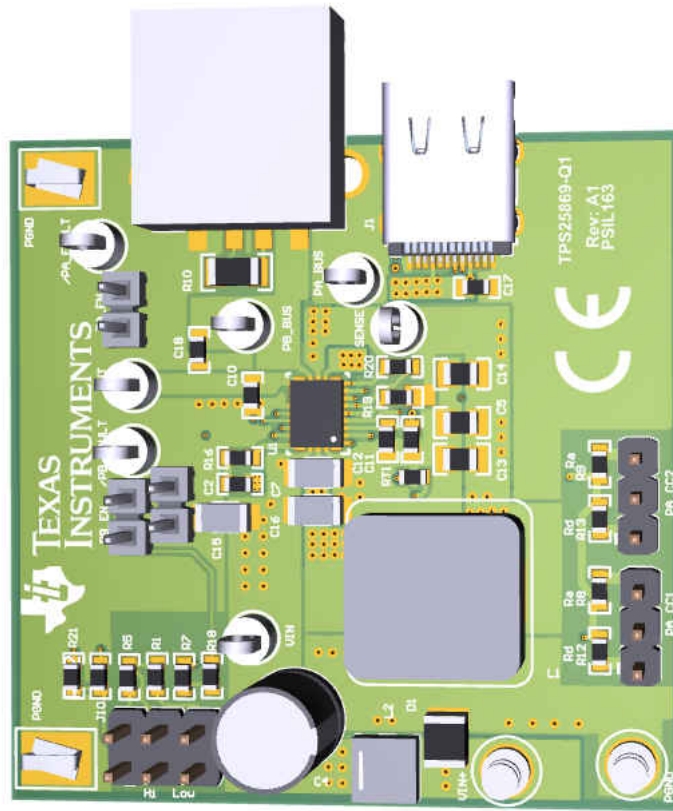


Figure 4-3. Top Side 3D View

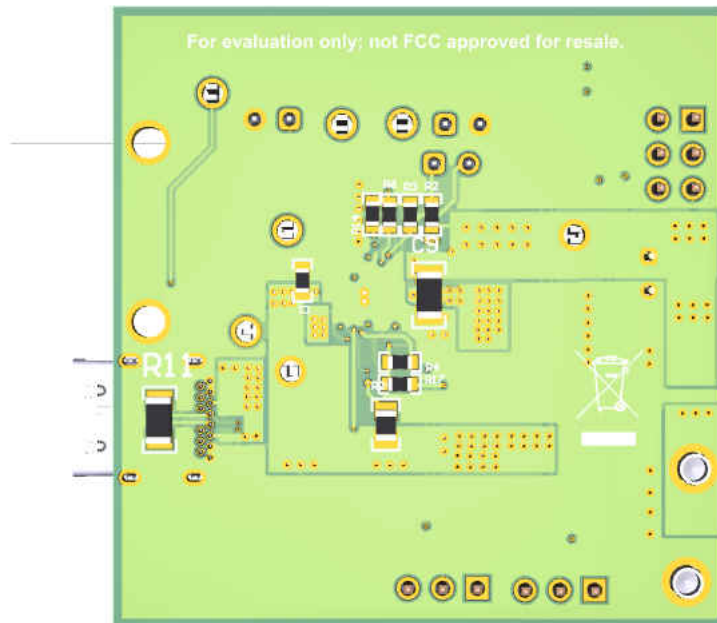


Figure 4-4. Bottom Side 3D View

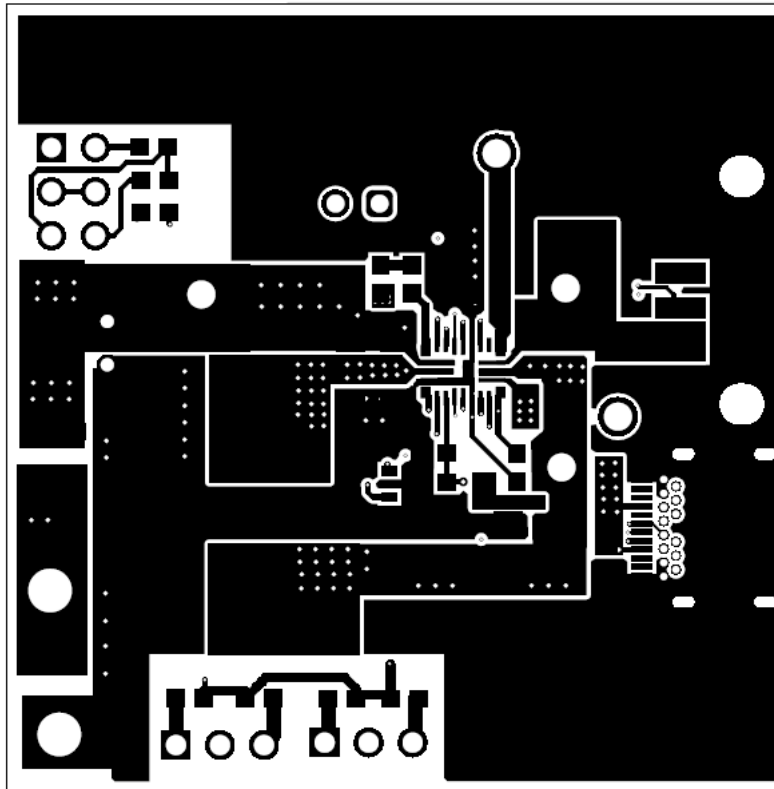


Figure 4-5. Top Layer Layout

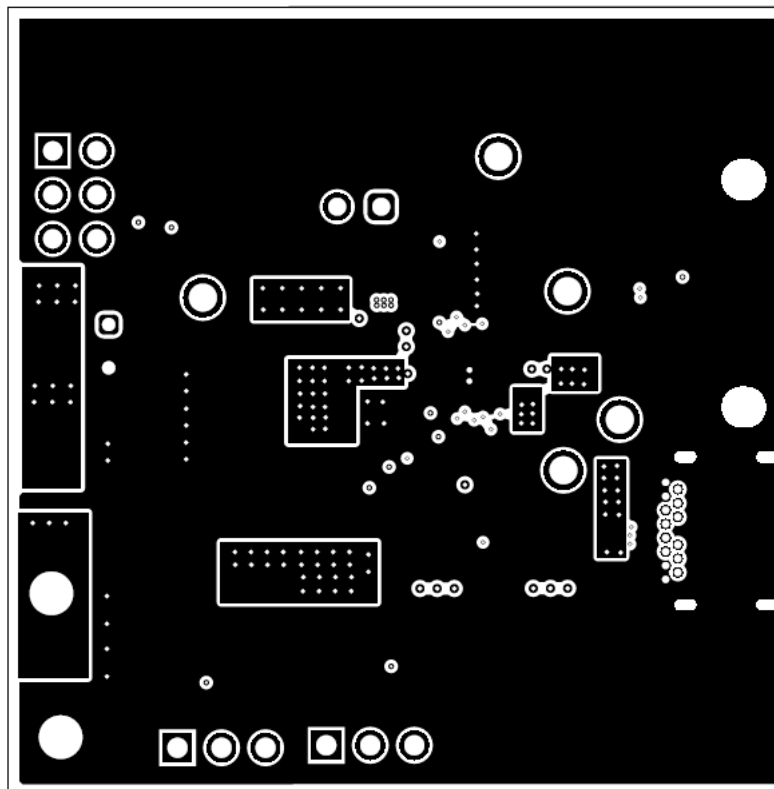


Figure 4-6. Mid-1 Layer Layout



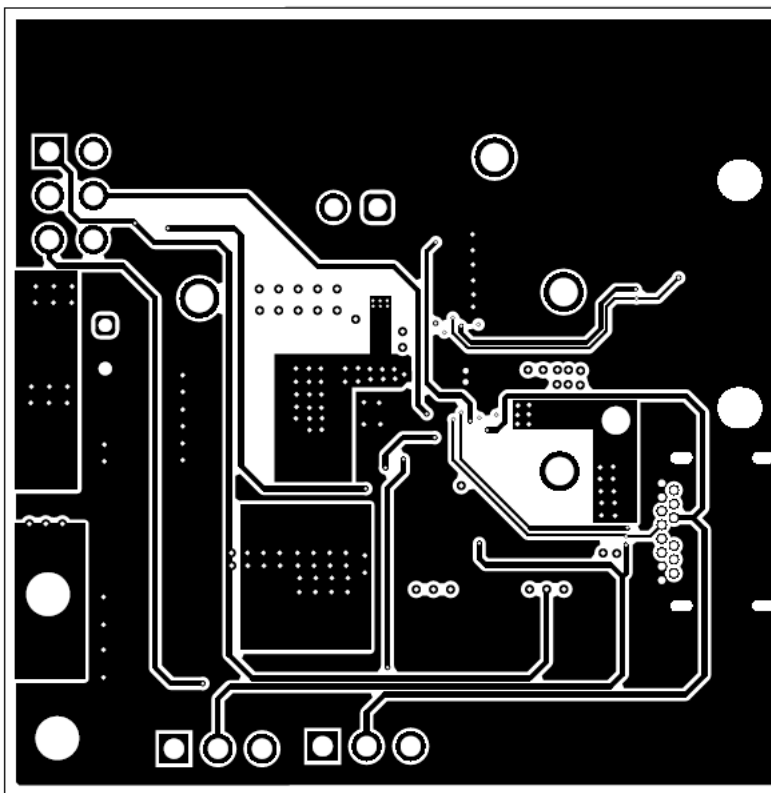


Figure 4-7. Mid-2 Layer Layout

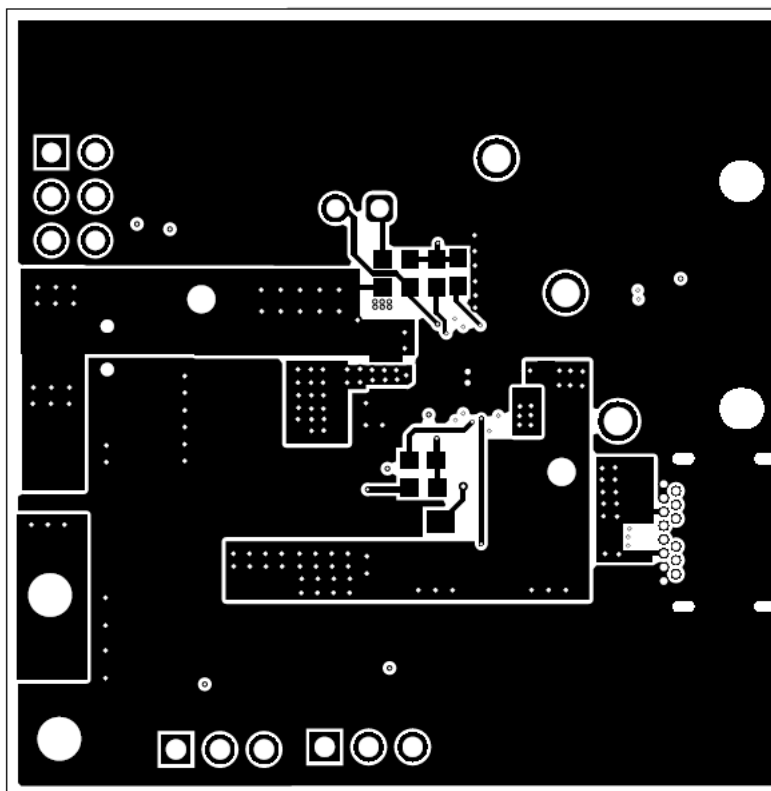


Figure 4-8. Bottom Layer Layout

## 5 Bill of Materials

Table 5-1 lists the EVM bill of materials

**Table 5-1. TPS25869Q1EVM-163 Bill of Materials**

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
/PA_FAULT, /PB_FAULT, OUT, PA_BUS, PB_BUS, SENSE, VIN	7		Test Point, Multipurpose, White, TH	White Multipurpose Testpoint	5012	Keystone
C1, C2, C12	3	0.1uF	CAP, CERM, 0.1 $\mu$ F, 50 V,+/- 10%, X7R, AEC-Q200 Grade 1, 0603	0603	C0603C104K5RACAUTO	Kemet
C4	1	100uF	CAP, AL, 100 $\mu$ F, 35 V, +/- 20%, TH	D6.3xL11mm	35ZLJ100M6.3X11	Rubycon
C5, C13, C14	3	47uF	CAP, CERM, 47 uF, 10 V, +/- 20%, X5R, 0805	0805	C2012X5R1A476M125A C	TDK
C7, C15, C16	3	10uF	CAP, CERM, 10 uF, 50 V, +/- 10%, X5R, AEC-Q200 Grade 1, 1206	1206	GRT31CR61H106KE01L	MuRata
C9	1	0.1uF	CAP, CERM, 0.1 uF, 50 V, +/- 10%, X7R, 1206	1206	12065C104KAT2A	AVX
C10, C11	2	2.2uF	CAP, CERM, 2.2 uF, 16 V, +/- 20%, X5R, 0603	0603	885012106018	Würth Elektronik
C17, C18	2	1uF	CAP, CERM, 1 uF, 6.3 V, +/- 10%, X7R, 0603	0603	CL10B105KQ8NNNC	Samsung Electro-Mechanics
D1	1	10uF	CAP, CERM, 10 uF, 50 V, +/- 20%, X7R, 1210	1210	GRM32ER71H106MA12	MuRata
EN, PA_EN, PB_EN	3		Header, 2.54 mm, 2x1, Tin, TH	Header, 2.54 mm, 2x1, TH	TSW-102-07-T-S	Samtec
J1	1		Connector, Receptacle, USB Type C, R/A	Connector, Receptacle, USB Type C, R/A, THT/SMT	632723300011	Würth Elektronik
J3	1		Connector, Receptacle, USB TYPE A, R/A, Top Mount SMT	USB TYPE A CONNECTOR RECEPTACLE 4POS SMD	896-43-004-00-000000	Mill-Max

**Table 5-1. TPS25869Q1EVM-163 Bill of Materials (continued)**

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
J10	1		Header, 2.54mm, 3x2, Gold, TH	Header, 2.54mm, 3x2, TH	61300621121	Würth Elektronik
L1	1	3.3uH	Inductor, Shielded Drum Core, Superflux, 3.3 uH, 12 A, 0.0059 ohm, SMD	WE-HC6	744325330	Würth Elektronik
L2	1	1uH	Inductor, Shielded, Composite, 1 uH, 8.75 A, 0.01 ohm, SMD	4x2.1x4mm	XAL4020-102MEB	Coilcraft
NT1, PGND, U1	4			eg: 0603, used in PnP report	Used in BOM report	Used in BOM report
PA_CC1, PA_CC2	2		Header, 2.54 mm, 3x1, Gold, TH	Header, 2.54mm, 3x1, TH	61300311121	Würth Elektronik
PGND, VIN+	2		Terminal, Turret, TH, Double	Keystone1502-2	1502-2	Keystone
R1	1	40.0k	RES, 40.0 k, 0.1%, 0.15 W, AEC-Q200 Grade 0, 0603	0603	PAT0603E4002BST1	Vishay Thin Film
R2	1	20k	RES, 20 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW060320K0JNEA	Vishay-Dale
R3, R12, R13, R14	4	5.1k	RES, 5.1 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06035K10JNEA	Vishay-Dale
R4	1	15.0k	RES, 15.0 k, 0.5%, 0.1 W, 0603	0603	RT0603DRE0715KL	Yageo America
R5	1	80.6k	RES, 80.6 k, 0.5%, 0.1 W, 0603	0603	RT0603DRE0780K6L	Yageo America
R6	1	49.9k	RES, 49.9 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	ERJ-3EKF4992V	Panasonic
R7	1	5.10k	RES, 5.10 k, 1%, 0.1 W, 0603	0603	RC0603FR-075K1L	Yageo America
R8, R9	2	1.0k	RES, 1.0 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06031K00JNEA	Vishay-Dale
R10	1	196	RES, 196, 1%, 0.25 W, 1206	1206	ERJ-8ENF1960V	Panasonic

**Table 5-1. TPS25869Q1EVM-163 Bill of Materials (continued)**

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
R16, R20	2	0	RES, 0, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	RMCF0603ZT0R00	Stackpole Electronics Inc
R17	1	100k	RES, 100 k, 1%, 0.1 W, 0603	0603	CRCW0603100KFKEA	Vishay-Dale
R18, R19, R21, R22	4	100k	RES, 100 k, 0.1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	ERA-3AEB104V	Panasonic
R24	1	0	RES, 0, 5%, 0.125 W, 0805	0805	MCR10EZPJ000	Rohm
RT1	1	470k	Thermistor NTC, 470k ohm, 3%, 0603	0603	NCP18WM474E03RB	MuRata

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