User's Guide

BQ25960EVM (BMS041) Evaluation Module User's Guide

ABSTRACT

This user's guide describes the characteristics, operation, and functionality of the BQ25960 Evaluation Module (EVM). It also describes the equipment, test setup, and software required to operate the EVM. A complete schematic diagram, printed-circuit board (PCB) layouts, and bill of materials (BOM) are also included in this document.

Throughout this user guide, the abbreviations and terms *EVM, BQ25960EVM, BMS041,* and *evaluation module* are synonymous with the BQ25960 EVM.

WARNING

Hot surface! Contact may cause burns. Do not touch!

Some components may reach high temperatures >55°C when the board is powered on. The user must not touch the board at any point during operation or immediately after operating, as high temperatures may be present.

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Trademarks

All trademarks are the property of their respective owners.

1 Introduction

1.1 EVM Features

The BQ25960 evaluation module (EVM) is a complete charger module for evaluating the highly-integrated BQ25960 switched cap battery charger in WCSP package for 1-cell Li-Ion and Li-polymer batteries in a wide range of smartphones and tablets.

The BQ25960EVM presents a complete fast charging solution. A typical use case is for the BQ25611D buck charger (U4) to perform pre-charge and charge termination, while one or both of the BQ25960 switched cap chargers (U1 and U2) perform fast charging in order to achieve the highest possible efficiency.

Users can configure the EVM for either single BQ25960 operation or dual BQ25960 operation based on the jumper settings described in the next section. In single BQ25960 operation, only U1 charges the battery. In dual BQ25960 operation, U1 acts as the primary charger, and U2 acts as the secondary charger.

This EVM does not include the EV2400 interface board. To evaluate the EVM, an EV2400 interface board must be ordered separately.

The device data sheet listed in Table 1-1 provides detailed features and operation.

Table 1-1. Device Data Sheet

Device	Data Sheet
BQ25960	SLUSE08

1.2 I/O Descriptions

Table 1-2 lists the BQ25960EVM board connections and ports.

Table 1-2. EVM Connections

Jack		Description
J1	VIN1	Positive rail of the priority input adapter or power supply
	GND	Ground
J2	VOUT	Positive rail of the charger battery input
	BATP	Input connected to the positive terminal of the battery for remote battery voltage sensing
	BATN	Input connected to the negative terminal of the battery for remote battery voltage sensing
	PACK-	Negative rail of the charger battery input
J3	VIN2	Positive rail of the secondary input adapter or power supply
	GND	Ground
J4	VBUS	Positive rail of the VBUS input to the charger ICs
	GND	Ground
J5	Communication port	I^2C communication port for use with the USB2ANY interface adapter
J6	Communication port	I^2C communication port for use with the EV2400 interface board
J7	VSYS	Positive rail of the BQ25611D charger's system output voltage
	GND	Ground
J8	USB-C connector	Provides power to VIN2 and has D+/D- lines for input source detection

Table 1-3 below lists the jumper connections available on this EVM.

Table 1-3. EVM Jumper Settings

Jumper	Description	Single BQ25960 Setting	Dual BQ25960 Setting
JP1	BATP to VOUT connection.	Installed	Installed
JP2	ACDRV1 to GND connection. Connect this jumper if powering directly from VBUS, or if ACFET1/RBFET1 are removed.	Not installed	Not installed
JP3	U1 TSBAT or SYNCOUT connection. Connect to SYNCOUT if operating in primary/secondary mode.	Installed between left pin and middle pin (connect to TSBAT)	Installed between middle pin and right pin (connect to SYNCOUT)
JP4	ACDRV2 to GND connection. Connect this jumper if ACFET2/RBFET2 are removed.	Not installed	Not installed
JP5	U1 /INT pin connection to 3.3V pull-up rail.	Installed	Installed
JP6	U1 REGN pin connection to U1 TSBUS resistor network.	Installed	Installed
JP7	Different resistor connection for U1 TSBUS resistor network.	Installed	Installed
JP8	U2 I^2C address and mode selection.	Installed	Installed
JP9	U1 I^2C address and mode selection.	Not installed	Installed between top pin and middle pin (connect to R16)
JP10	U1 TSBUS pin connection to U1 TSBUS resistor network.	Installed	Installed
JP11	U2 TSBAT connection to TSBAT resistor network.	Installed	Installed
JP12	U2 REGN pin connection to U2 TSBUS resistor network.	Installed	Installed
JP13	SDA and SCL connection to 3.3V I^2C pull-up rail.	Installed	Installed
JP14	Different resistor connection for U2 TSBUS resistor network.	Installed	Installed
JP15	U2 /INT pin connection to 3.3V pull-up rail.	Installed	Installed
JP16	U2 TSBUS pin connection to U2 TSBUS resistor network.	Installed	Installed
JP17	Connection from TSBAT resistor network to either U1 REGN pin or U2 REGN pin.	Installed between top pin and middle pin (connect to REGN_M)	Installed between top pin and middle pin (connect to REGN_M)
JP18	Input selection for 3.3V LDO	Installed between top pin and middle pin (connect to VOUT)	Installed between top pin and middle pin (connect to VOUT)
JP19	Different resistor connection for TSBAT resistor network.	Installed	Installed
JP20	D- connection for USB-C connector.	Installed	Installed
JP21	Charge enable connection for U4.	Installed	Installed
JP22	D+ connection for USB-C connector.	Installed	Installed
JP23	U4 thermistor NORMAL temperature setting. Install this jumper to simulate entering normal temperature region.	Installed	Installed

Out of the box, the BQ25960EVM is configured to evaluate the performance of the BQ25960 only. If the BQ25611D must also be evaluated, then the user should populate R29 and R32, as shown in the schematic in Figure 4-11.

Table 1-4 lists the recommended operating conditions for this EVM.

Table 1-4. Recommended Operating Conditions

	Description	MIN	MAX	UNIT
VIN1, VIN2, VBUS	Input voltage at J1, J3, and J4	0	13	V
I_{VIN1}, I_{VIN2}, I_{VBUS}	Input current into J1, J3, and J4		5	A
VOUT	Battery voltage at J2	0	5	V
I_{VOUT}	Battery charge current out of J2		8	A
T_A	Operating free-air temperature range	–40	85	°C

2 Test Summary

2.1 Equipment

This section includes a list of equipment required to perform tests on the BQ25960EVM.

1. **Power supply:** PS1. A power supply capable of supplying up to 20 V at 3 A is required.
2. **Battery simulator:** Load #1 (4-quadrant supply). A "Kepco" load, BOP, 20-5M, DC 0 to ±10 V, 0 to ±5 A (or higher)
3. **Meters:** (6x) "Fluke 75" multimeters, equivalent or better.
   Alternative Option: (4x) equivalent voltage meters and (2x) equivalent current meters. The current meters must be capable of measuring at least 5 A.
4. **Computer:** A computer with at least one USB port and a USB cable. Must have Battery Management Studio installed. The download link is provided in Section 2.3 of this User's Guide.
5. **PC communication interface:** EV2400 USB-based PC interface board.

2.2 Equipment Setup

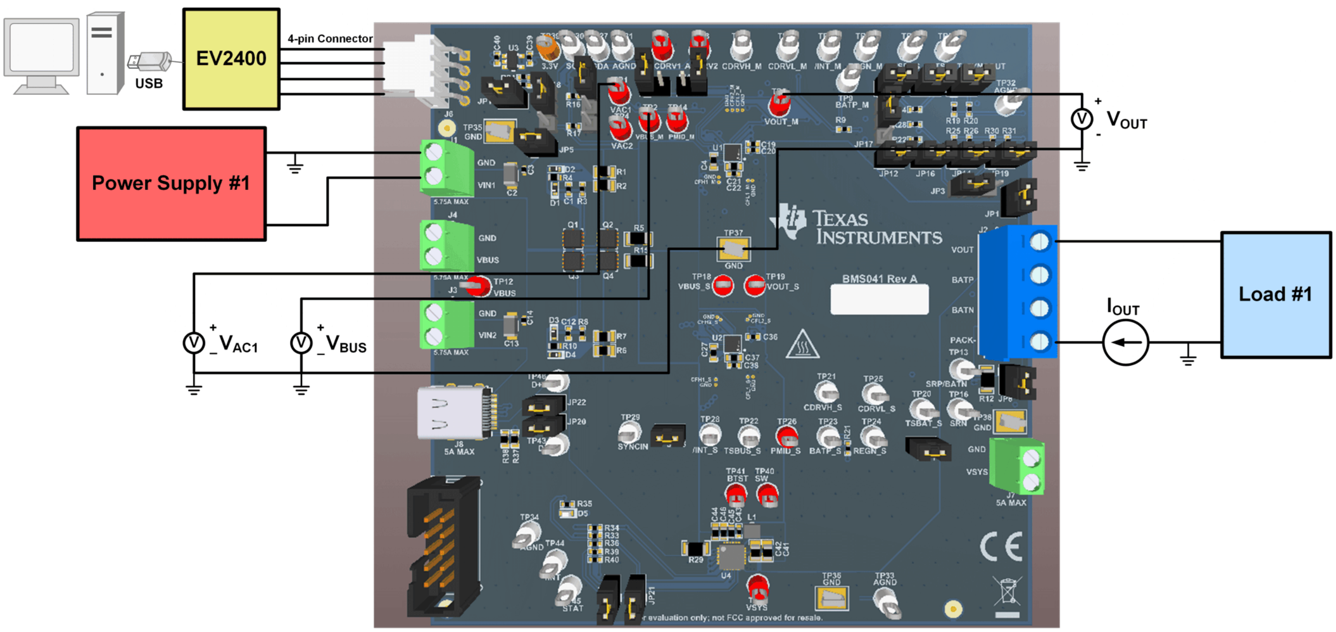


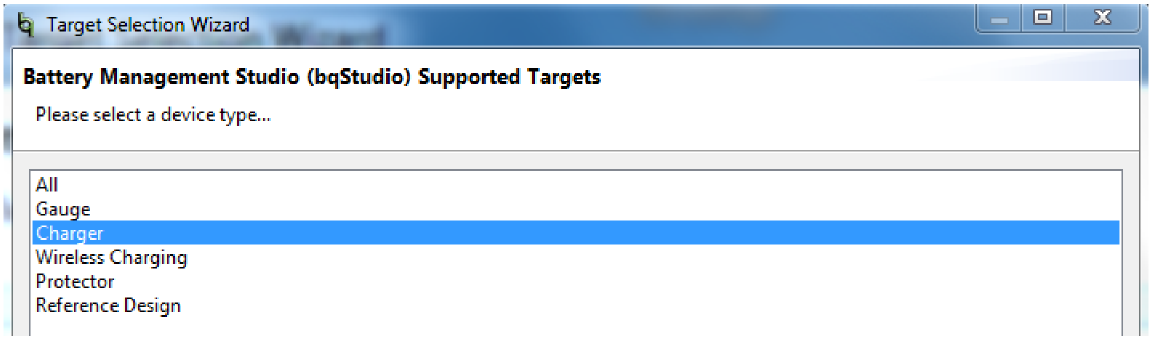
Figure 2-1. Equipment Test Setup

Use the following list to set up the EVM testing equipment. Refer to Figure 2-1 for the test setup connections to the EVM.

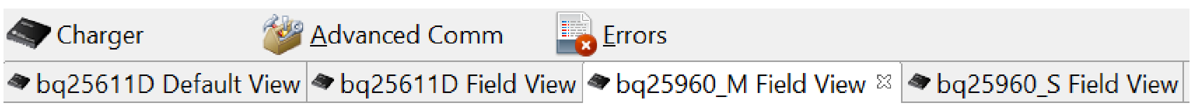
1. Review the EVM connections in Table 1-2.
2. Install jumpers as shown in Table 1-3.
3. Set PS1 for 8.3 V_{DC}, 1 A current limit, and then turn off the supply.
4. Connect PS1 to J1 (VIN1 and GND).
5. Connect a voltage meter across TP1 (VAC1) and TP37 (GND) to measure the input voltage as seen from the VAC1 bump of the U1 charger.
6. Connect a voltage meter across TP2 (VBUS_M) and TP37 (GND) to measure the input voltage as seen from the VBUS bumps of the U1 charger.
7. Set Load #1 to constant voltage mode with an output of 4.0 V, and then disable the load.
8. Connect Load #1 to J2 (VOUT and PACK-). Connect a current meter in series to measure the output current, as shown in Figure 2-1.
9. Connect a voltage meter across TP5 (VOUT_M) and TP37 (GND) to measure the output voltage as seen from the VOUT bumps of the charger.

2.3 Software Setup

Download the latest version of BQStudio. Double click the Battery Management Studio installation file and follow the installation steps. The software supports Microsoft® Windows® XP, 7, and 10 operating systems. Launch BQStudio and select "Charger", as shown below.



Next, select the BQ25960 configuration file, and BQStudio will open. If only the BQ25960 is being evaluated, then the user can select the more streamlined "Charger_2_00-bq25960.bqz" file. If the BQ25960 and the BQ25611D must be evaluated alongside each other, then the user should select the "Charger_2_00-bq25960_EVM.bqz" file instead, which contains separate tabs to communicate with U1, U2, and U4, as shown below.



If you do not have the BQ25960 configuration files, then please request the files through E2E. The .bqz configuration files must be saved into C:\XXX\BatteryManagementStudio\config, where XXX is the directory you selected to install BQStudio.

2.4 Test Procedure

2.4.1 Initial Settings

Use the following steps to enable the EVM test setup.

1. Make sure the steps in Section 2.2 and Section 2.3 have been followed.
2. Turn on PS1 and Load #1:
   - **Measure** → $V_{VAC1\text{-}GND}$(TP1 and TP37) = 8.3 ± 0.2 V
   - **Measure** → $V_{VBUS\_M\text{-}GND}$(TP2 and TP37) = 0 ± 0.5 V
   - **Measure** → $V_{VOUT\_M\text{-}GND}$(TP5 and TP37) = 4 ± 0.2 V

2.4.2 Communication Verification

Use the following steps for I²C communication verification. Assuming the jumper settings in Table 1-3 have been followed, the I²C address for U1 is 0x65, and the I²C address for U2 is 0x67. If R29 and R32 have been populated, then the I²C address for U4 is 0x6B.

1. In BQStudio, click "Field View" and select the I²C address for U1 (0x65).
2. Click "Read Register" at the top of the page. "Device ACK OK" should appear at the top right.
3. Verify that VAC1 and VOUT are reported as "Present".

Status

VBUS Present Status	Not present	VOUT Present Status	Present
VAC1 Present Status	Present	VAC2 Present Status	Not present

4. Change the following register settings:
   - Disable the watchdog timer

     ☑ Disable Watchdog Timer

   - Set VAC1 OVP to 10.5 V or higher

     VAC1 OVP Setting | 10.5 V

5. Click "Read Register" again. In addition to VAC1 and VOUT, VBUS should now also be reported as "Present".

Status

VBUS Present Status	Present	VOUT Present Status	Present
VAC1 Present Status	Present	VAC2 Present Status	Not present

   - Measure → $V_{VBUS\_M\text{-}GND}$(TP2 and TP37) = 8.3 ± 0.2 V

2.4.3 Switched Cap Mode Charge Verification

Use the following steps to verify battery charging in switched cap mode.

1. Make sure the steps in Section 2.4.1 and Section 2.4.2 have been followed.
2. Check the "CHG_CONFIG_1" box, and then click "Enable Charge". After enabling charge, the output current flowing into Load #1 should be about 2x the input current flowing out of PS1.

Single-bit I2C Selection

☑ CHG_CONFIG_1	☑ Disable Watchdog Timer
☑ Enable Charge	☐ Enable OTG Mode

3. Change the charge current:
   By increasing the input voltage, the output current should increase together with the input current. The output current should always be about 2x the input current.
4. To stop charging, deselect the "Enable Charge" box. The input current and the output current should both fall to zero.

2.4.4 Bypass Mode Charge Verification

Use the following steps to verify battery charging in bypass mode.

1. Make sure the steps in Section 2.4.1 and Section 2.4.2 have been followed.
2. Set PS1 to 4.1 V. Load #1 can be kept at 4.0 V.
3. Make sure the "Enable Charge" box is not selected. Then, click "Enable Bypass Mode".

Single-bit I2C Selection

☑ CHG_CONFIG_1	☑ Disable Watchdog Timer
☐ Enable Charge	☐ Enable OTG Mode
☐ Enable HIZ Mode	☑ Enable Bypass Mode

4. Click "Enable Charge". After enabling charge, the output current flowing into Load #1 should be approximately equal to the input current flowing out of PS1.
5. Change the charge current:
   By increasing the input voltage, the output current should increase together with the input current. The output current should always be approximately equal to the input current.
6. To stop charging, deselect the "Enable Charge" box. The input current and the output current should both fall to zero.

2.4.5 Dual BQ25960 Operation

The BQ25960 EVM also supports dual BQ25960 operation, with U1 operating as the primary charger, and U2 operating as the secondary charger. This allows each BQ25960 to operate at a lower charging current with higher efficiency compared with a single BQ25960 operating at the same total charging current. As a reminder, if the jumper settings in Table 1-3 have been followed, then the I^2C address for U1 is 0x65, and the I^2C address for U2 is 0x67. Note that the jumper settings for JP3 and JP9 are different for single BQ25960 and dual BQ25960 operation.

1. For U1, follow the previous steps in order to enable charge in either switched cap mode or bypass mode. U1 should now begin charging.
2. Select I^2C address 0x67 in order to communicate with U2.
3. Follow the same steps to enable charge for U2. The two BQ25960 devices should now be charging in parallel.

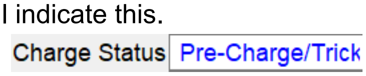
2.4.6 BQ25611D Charge Verification

Out of the box, the BQ25960EVM is configured to evaluate the performance of the BQ25960 only. If the BQ25611D must also be evaluated, then the user should populate R29 and R32, as shown in the schematic in Figure 4-11

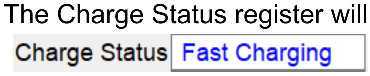
A typical use case is for the BQ25611D buck charger (U4) to perform low current pre-charge and charge termination, while one or both of the BQ25960 switched cap chargers (U1 and U2) perform high current fast charging in order to achieve the highest possible efficiency.

Use the following steps to charge with the BQ25611D. The I^2C address for U4 is 0x6B.

1. Turn PS1 and Load #1 off. Make any required hardware changes, such as populating R29 and R32 and configuring the jumpers.
2. Decrease the output of Load #1 to 2.5 V. This voltage is low enough for the BQ25611D to pre-charge.
3. Turn on PS1 and Load #1. The BQ25611D should automatically begin to apply the default 0.18 A pre-charge current. The Charge Status register will indicate this.



4. Increase the output of Load #1 above $V_{BATLOWV}$ (typical value of 3.12 V). The BQ25611D will begin applying the default 1.02 A fast charge current. The Charge Status register will indicate this.



3 PCB Layout Guidelines

The PCB layout is very important to maximize the electrical and thermal performance of the total system. General guidelines are provided, but the form factor, board stack-up, and proximity of other components also need to be considered to maximize the performance.

1. VBUS and VOUT copper pours should be as short and wide as possible to accommodate high current.
2. VBUS and VOUT copper pours should run at least 150 mil (3.81 mm) straight (perpendicular to the WCSP ball array) before making turns.
3. CFLY caps should be placed as close as possible to the device, and the CFLY copper pours should be as wide as possible until close to the IC.
4. CFLY pours should be as symmetrical as possible between CFH pads and CFL pads.
5. Place low ESR bypass capacitors to ground for VBUS, PMID, and VOUT. These capacitors should be placed as close to the device pins as possible.
6. The CFLY pads should be as small as possible, and the CFLY caps placed as close as possible to the device, as these are switching pins and this will help reduce EMI.
7. Do not route so the power planes are interrupted by signal traces.

4 Board Layout, Schematic, and Bill of Materials

4.1 Board Layout

Figure 4-1 through Figure 4-8 illustrate the PCB layout.

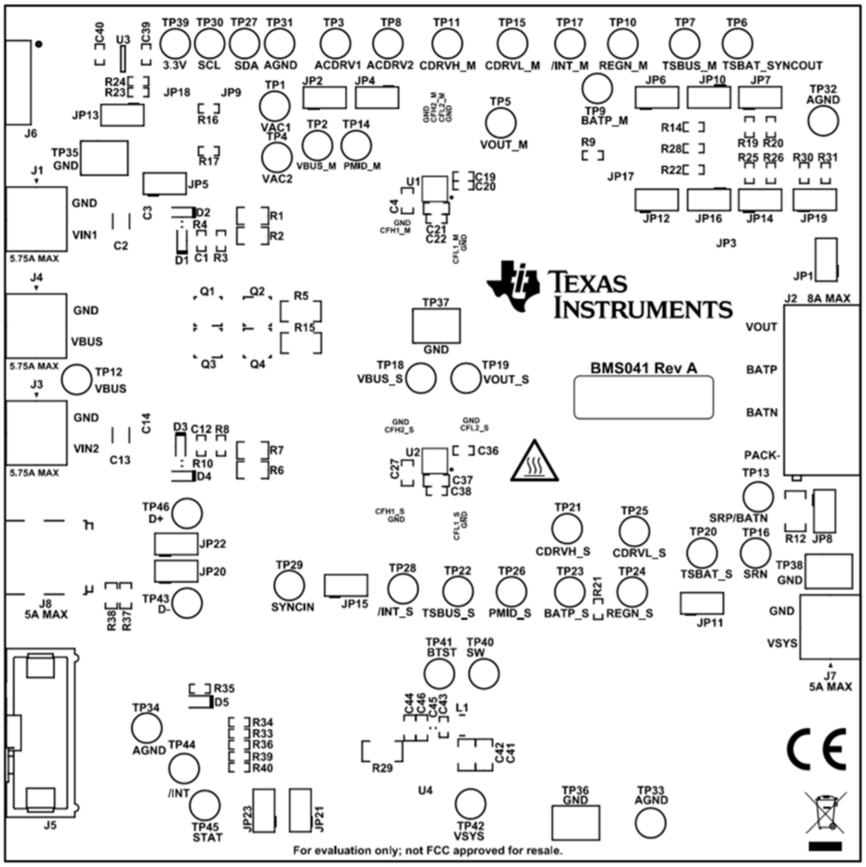


Figure 4-1. BMS041 Top Overlay

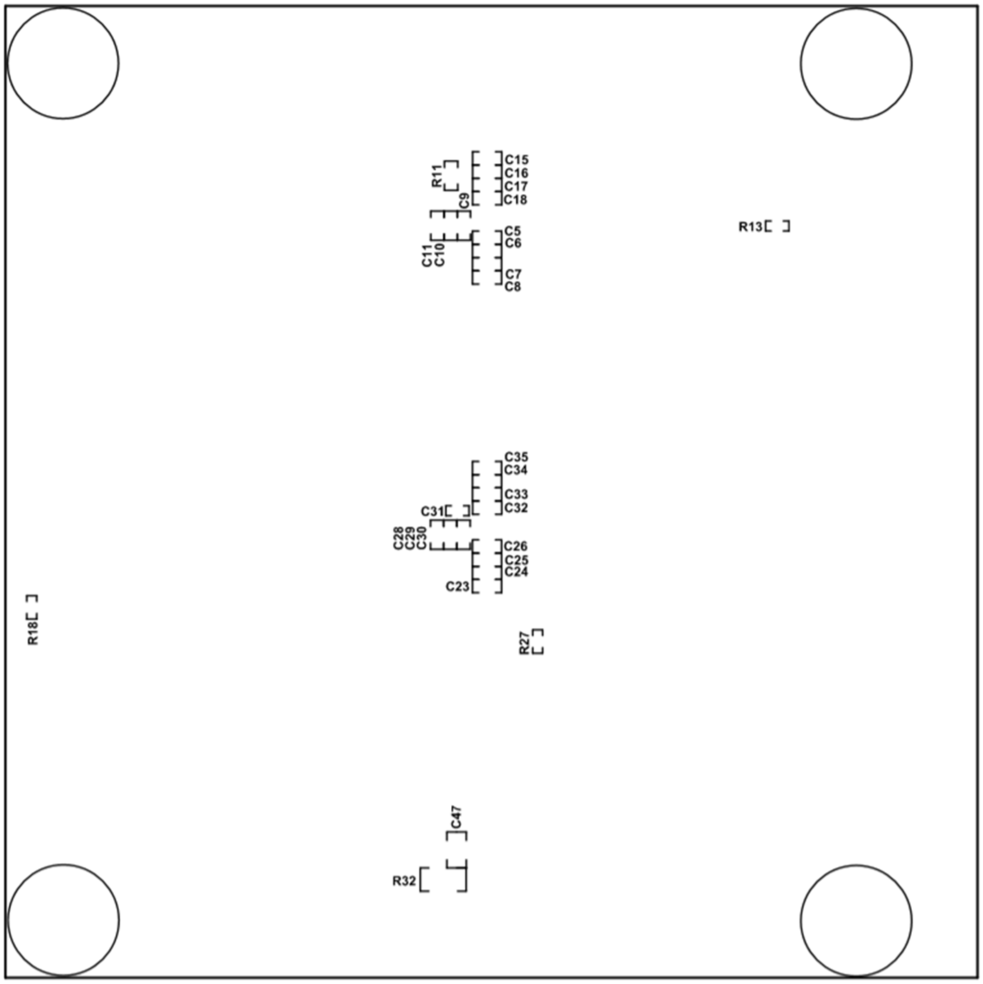


Figure 4-2. BMS041 Bottom Overlay

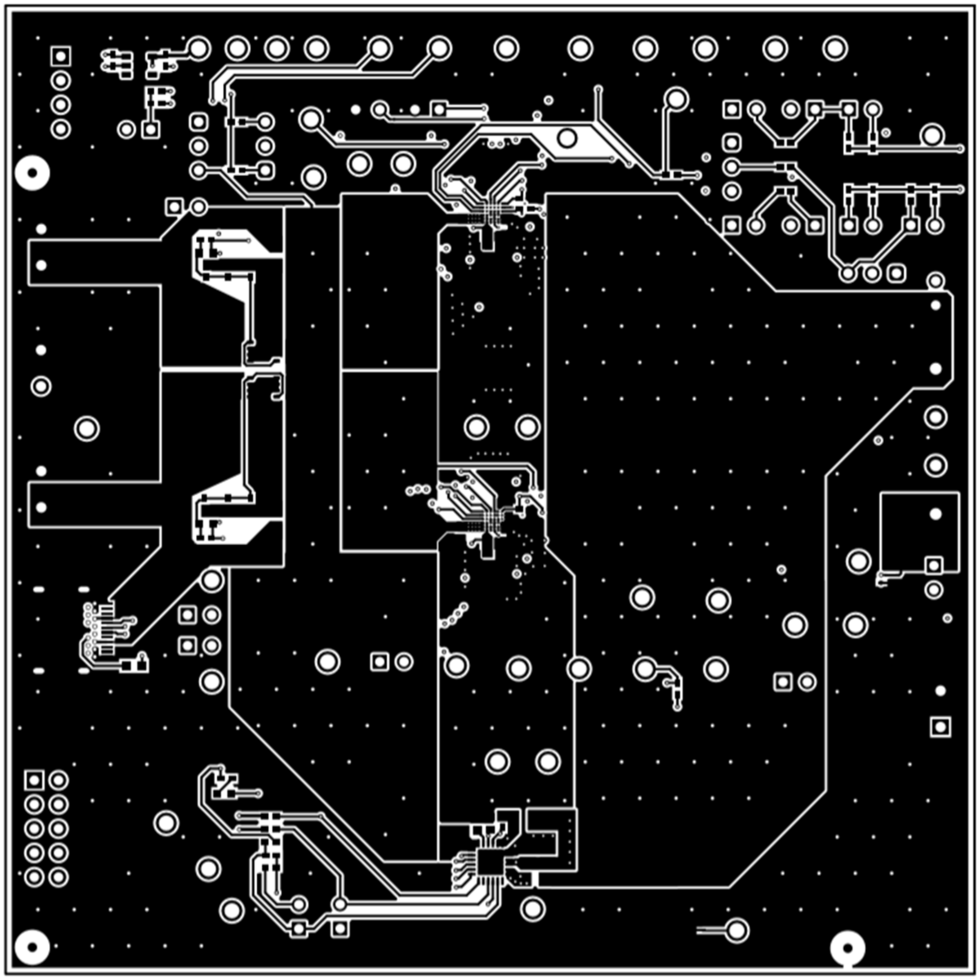


Figure 4-3. BMS041 Top Layer

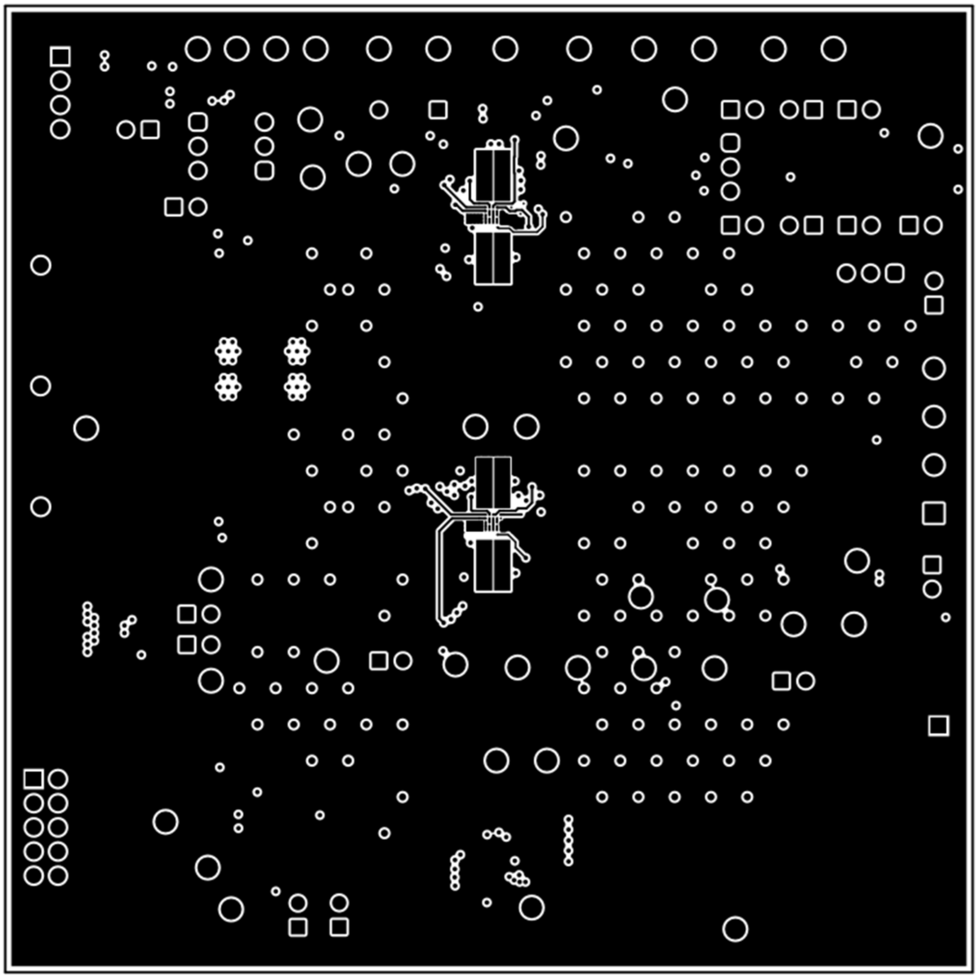


Figure 4-4. BMS041 Signal Layer 1

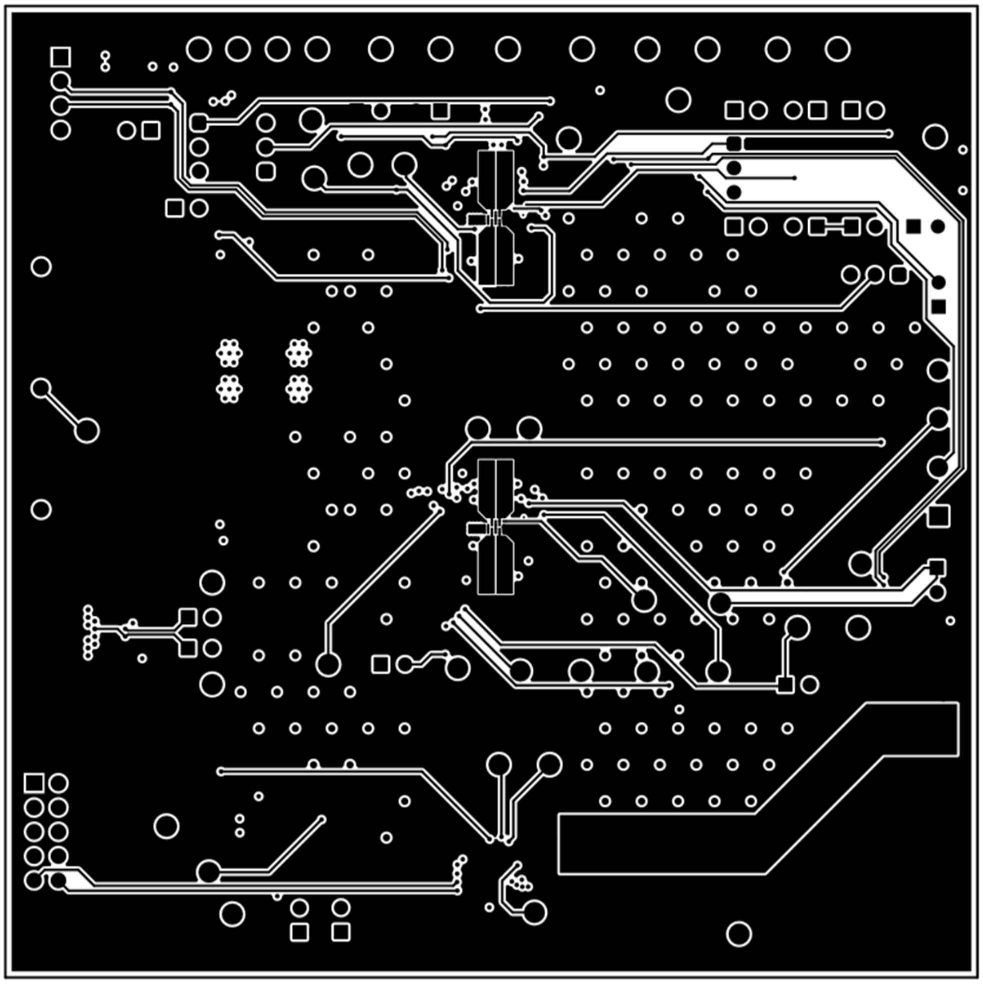


Figure 4-5. BMS041 Signal Layer 2

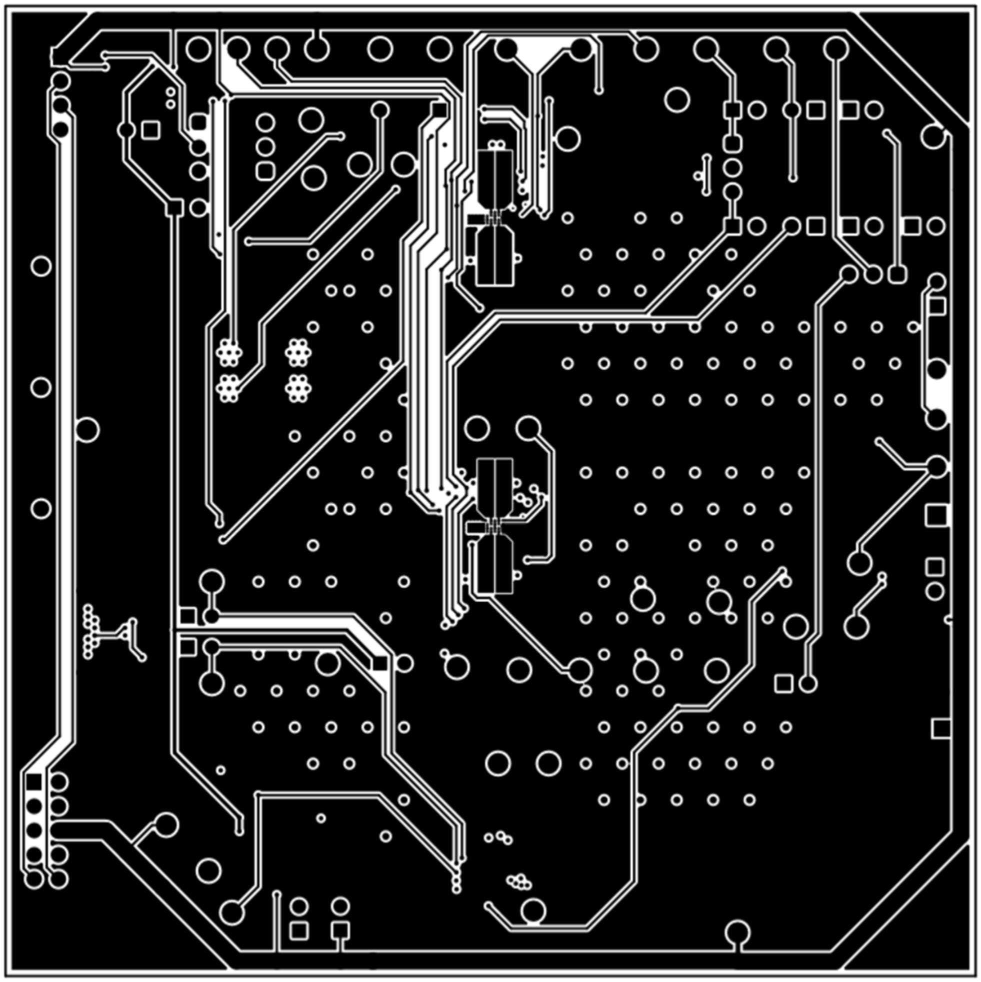


Figure 4-6. BMS041 Signal Layer 3

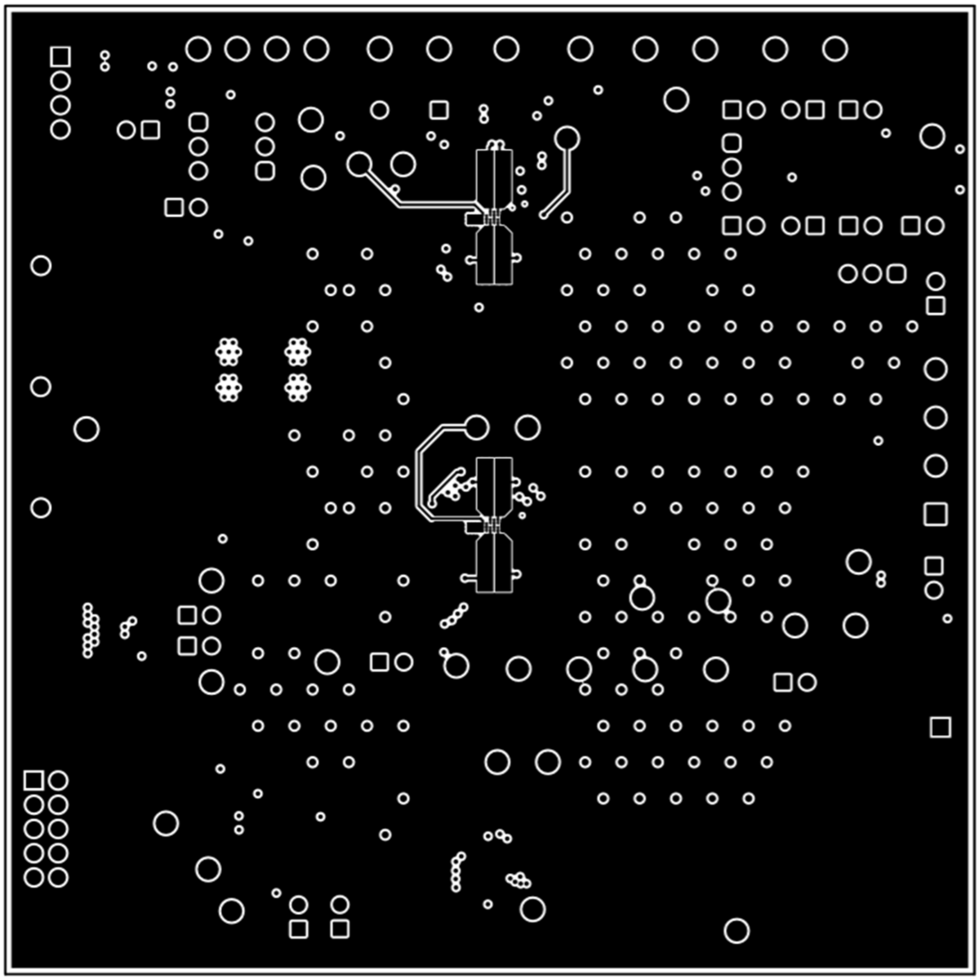


Figure 4-7. BMS041 Signal Layer 4

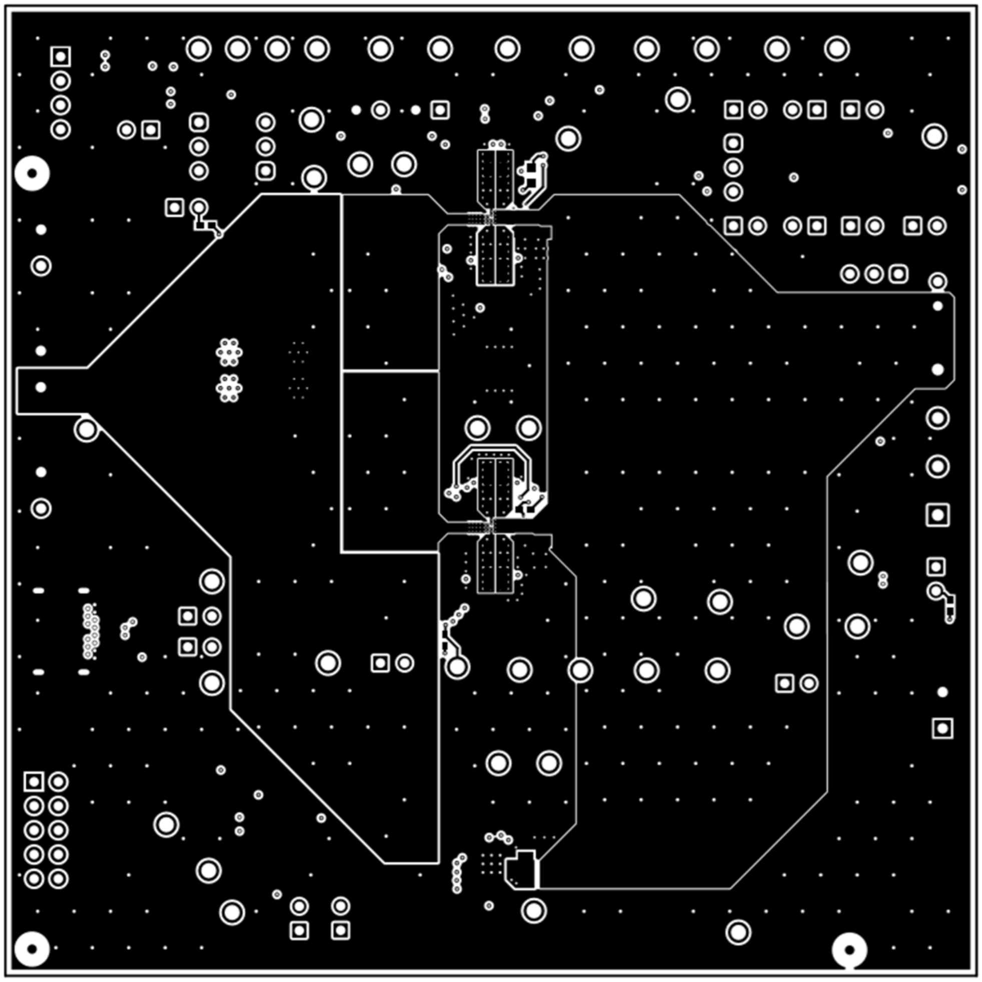


Figure 4-8. BMS041 Bottom Layer

4.2 Schematic

Figure 4-9 through Figure 4-11 illustrate the schematic for the BQ25960EVM.

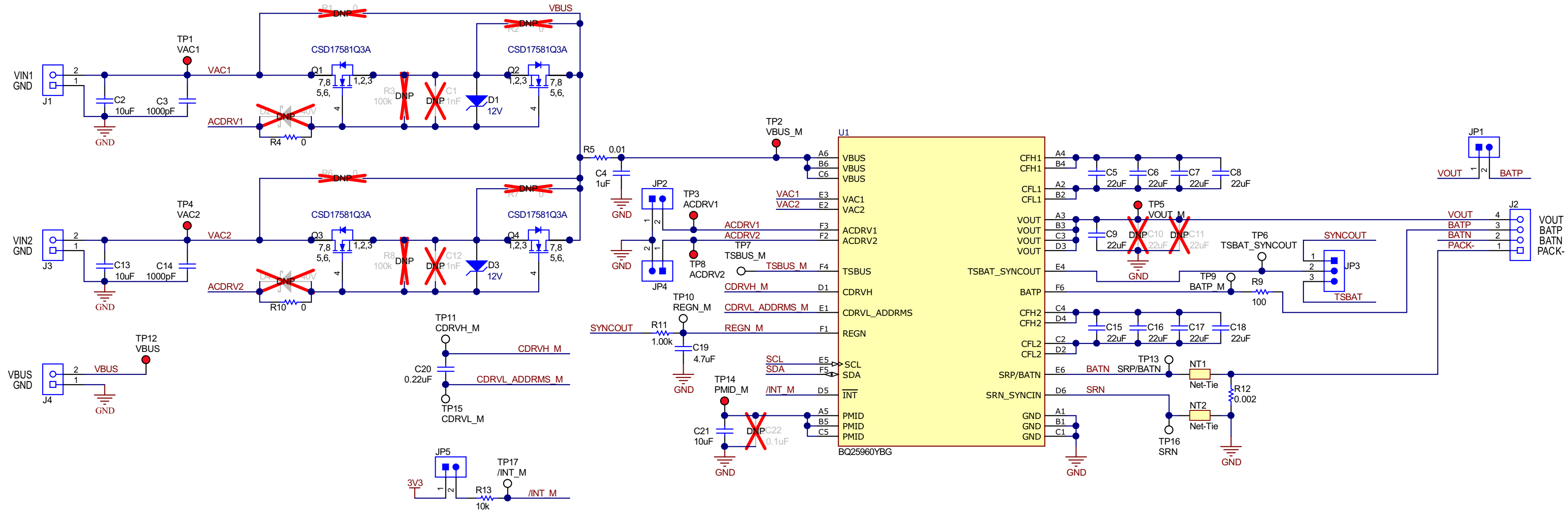


Figure 4-9. BQ25960EVM Schematic (Page 1)

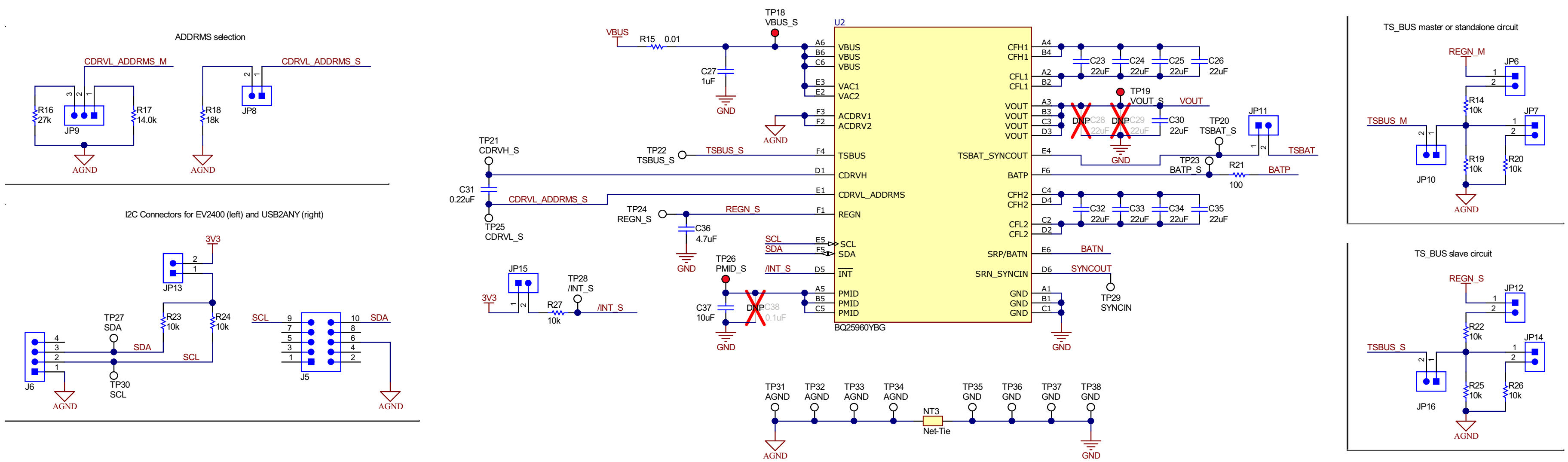


Figure 4-10. BQ25960EVM Schematic (Page 2)

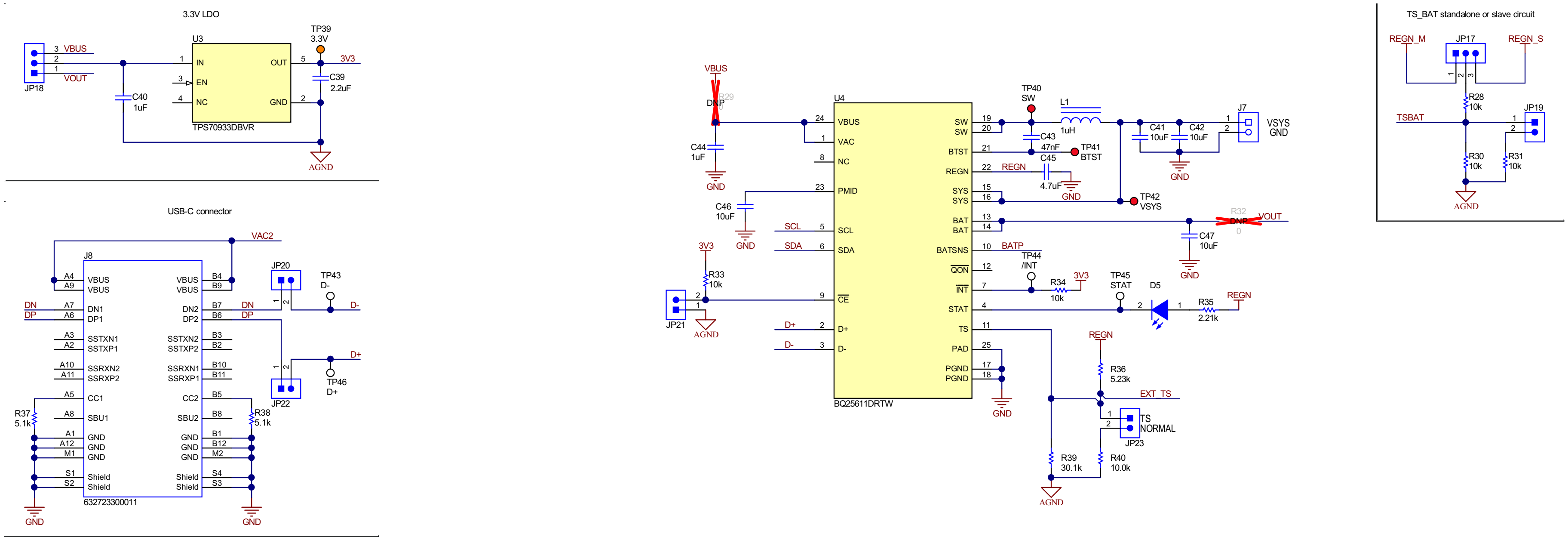


Figure 4-11. BQ25960EVM Schematic (Page 3)

4.3 Bill of Materials

Table 4-1. Bill of Materials

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
!PCB1	1		Printed Circuit Board		BMS041	Any
C2, C13	2	10uF	CAP, CERM, 10 uF, 50 V, +/- 10%, X5R, 1206	1206	C3216X5R1H106K160AB	TDK
C3, C14	2	1000pF	CAP, CERM, 1000 pF, 50 V, +/- 5%, C0G/NP0, 0402	0402	GRM1555C1H102JA01D	MuRata
C4, C27, C44	3	1uF	CAP, CERM, 1 uF, 35 V, +/- 10%, X5R, 0603	0603	GMK107BJ105KA-T	Taiyo Yuden
C5, C6, C9, C17, C18, C25, C26, C30, C32, C33	10	22uF	CAP, CERM, 22 uF, 16 V, +/- 20%, X5R, 0603	0603	GRM188R61C226ME01D	MuRata
C19, C36	2	4.7uF	CAP, CERM, 4.7 uF, 10 V, +/- 20%, X5R, 0402	0402	GRM155R61A475MEAAD	MuRata
C20, C31	2	0.22uF	CAP, CERM, 0.22 uF, 25 V, +/- 10%, X5R, AEC-Q200, 0402	0402	GRT155R61E224KE01D	MuRata
C21, C37, C46	3	10uF	CAP, CERM, 10 uF, 35 V, +/- 20%, X5R, 0603	0603	GRM188R6YA106MA73D	Murata
C39	1	2.2uF	CAP, CERM, 2.2 uF, 10 V, +/- 10%, X5R, 0402	0402	C1005X5R1A225K050BC	TDK
C40	1	1uF	CAP, CERM, 1 uF, 35 V, +/- 10%, X5R, 0402	0402	GRM155R6YA105KE11D	MuRata
C41, C42, C47	3	10uF	CAP, CERM, 10 uF, 25 V, +/- 10%, X5R, 0805	0805	C2012X5R1E106K125AB	TDK
C43	1	0.047uF	CAP, CERM, 0.047 uF, 25 V, +/- 10%, X7R, 0402	0402	GRM155R71E473KA88D	MuRata
C45	1	4.7uF	CAP, CERM, 4.7 uF, 16 V, +/- 10%, X5R, 0603	0603	GRM188R61C475KAAJD	MuRata
D1, D3	2	12V	Diode, Zener, 12 V, 300 mW, SOD-523	SOD-523	BZT52C12T-7	Diodes Inc.
D5	1	Green	LED, Green, SMD	1.6x0.8x0.8mm	LTST-C190GKT	Lite-On
FID1, FID2, FID3, FID4, FID5, FID6	6		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A
H1, H2, H3, H4	4		Bumpon, Hemisphere, 0.44 X 0.20, Clear	Transparent Bumpon	SJ-5303 (CLEAR)	3M
J1, J3, J4, J7	4		Conn Term Block, 2POS, 3.81mm, TH	2POS Terminal Block	1727010	Phoenix Contact
J2	1		Terminal Block, 5.08 mm, 4x1, Brass, TH	4x1 5.08 mm Terminal Block	ED120/4DS	On-Shore Technology
J5	1		Header (shrouded), 100mil, 5x2, High-Temperature, Gold, TH	5x2 Shrouded header	N2510-6002-RB	3M
J6	1		Header (friction lock), 100mil, 4x1, R/A, TH	4x1 R/A Header	22/05/3041	Molex
J8	1		Connector, Receptacle, USB Type C, R/A	Connector, Receptacle, USB Type C, R/A, THT/SMT	632723300011	Wurth Elektronik
JP1, JP2, JP4, JP5, JP6, JP7, JP8, JP10, JP11, JP12, JP13, JP14, JP15, JP16, JP19, JP20, JP21, JP22, JP23	19		Header, 100mil, 2x1, Tin, TH	Header, 2 PIN, 100mil, Tin	PEC02SAAN	Sullins Connector Solutions
JP3, JP9, JP17, JP18	4		Header, 2.54 mm, 3x1, Tin, TH	Header, 2.54 mm, 3x1, TH	TSW-103-07-T-S	Samtec
L1	1	1uH	Inductor, 1 uH, 3.2 A, 0.028 ohm, SMD	2.5x2mm	MPIM252010F1R0M-LF	Microgate
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	PCB Label 0.650 x 0.200 inch	THT-14-423-10	Brady
Q1, Q2, Q3, Q4	4	30V	MOSFET, N-CH, 30 V, 60 A, DNH0008A (VSONP-8)	DNH0008A	CSD17581Q3A	Texas Instruments
R4, R10	2	0	RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06030000Z0EA	Vishay-Dale
R5, R15	2	0.01	RES, 0.01, 1%, 1 W, 1206	1206	WSLP1206R0100FEA	Vishay-Dale
R9, R21	2	100	RES, 100, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW0402100RFKED	Vishay-Dale
R11	1	1.00k	RES, 1.00 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06031K00FKEA	Vishay-Dale
R12	1	0.002	RES, 0.002, 1%, 1 W, 1206	1206	CSNL1206FT2L00	Stackpole Electronics Inc

Table 4-1. Bill of Materials (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
R13, R14, R19, R20, R22, R23, R24, R25, R26, R27, R28, R30, R31, R33, R34	15	10k	RES, 10 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040210K0JNED	Vishay-Dale
R16	1	27k	RES, 27 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040227K0JNED	Vishay-Dale
R17	1	14.0k	RES, 14.0 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040214K0FKED	Vishay-Dale
R18	1	18k	RES, 18 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040218K0JNED	Vishay-Dale
R35	1	2.21k	RES, 2.21 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04022K21FKED	Vishay-Dale
R36	1	5.23k	RES, 5.23 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04025K23FKED	Vishay-Dale
R37, R38	2	5.1k	RES, 5.1 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06035K10JNEA	Vishay-Dale
R39	1	30.1k	RES, 30.1 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040230K1FKED	Vishay-Dale
R40	1	10.0k	RES, 10.0 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040210K0FKED	Vishay-Dale
SH-JP1, SH-JP2, SH-JP3, SH-JP4, SH-JP5, SH-JP6, SH-JP7, SH-JP8, SH-JP9, SH-JP10, SH-JP11, SH-JP12, SH-JP13, SH-JP14, SH-JP15, SH-JP16, SH-JP17, SH-JP18, SH-JP19, SH-JP20, SH-JP21, SH-JP22, SH-JP23	23	1x2	Shunt, 100mil, Gold plated, Black	Shunt	SNT-100-BK-G	Samtec
TP1, TP2, TP3, TP4, TP5, TP8, TP12, TP14, TP18, TP19, TP26, TP40, TP41, TP42	14		Test Point, Multipurpose, Red, TH	Red Multipurpose Testpoint	5010	Keystone
TP6, TP7, TP9, TP10, TP11, TP13, TP15, TP16, TP17, TP20, TP21, TP22, TP23, TP24, TP25, TP27, TP28, TP29, TP30, TP31, TP32, TP33, TP34, TP43, TP44, TP45, TP46	27		Test Point, Multipurpose, White, TH	White Multipurpose Testpoint	5012	Keystone
TP35, TP36, TP37, TP38	4		Test Point, Compact, SMT	Testpoint_Keystone_Compact	5016	Keystone
TP39	1		Test Point, Compact, Orange, TH	Orange Compact Testpoint	5008	Keystone
U1, U2	2		6A Switched Cap Battery Charger with Integrated Protection, I2C Programmability and ADC	DSBGA36	BQ25960YBG	Texas Instruments
U3	1		150-mA, 30-V, Ultra-Low IQ, Wide Input Low-Dropout Regulator with Reverse Current Protection, DBV0005A (SOT-23-5)	DBV0005A	TPS70933DBVR	Texas Instruments
U4	1		3A I2C Controlled 1-Cell Buck Battery Charger with USB Detection and 1.2A Boost Operation	RTW0024P	BQ25611DRTW	Texas Instruments
C1, C12	0	1000pF	CAP, CERM, 1000 pF, 50 V, +/- 1%, C0G/NP0, 0402	0402	GRM1555C1H102FA01D	MuRata
C7, C8, C10, C11, C15, C16, C23, C24, C28, C29, C34, C35	0	22uF	CAP, CERM, 22 uF, 16 V, +/- 20%, X5R, 0603	0603	GRM188R61C226ME01D	MuRata
C22, C38	0	0.1uF	CAP, CERM, 0.1 uF, 35 V, +/- 10%, X5R, 0402	0402	GMK105BJ104KV-F	Taiyo Yuden
D2, D4	0	40V	Diode, Schottky, 40 V, 0.38 A, SOD-523	SOD-523	ZLLS350TA	Diodes Inc.
R1, R2, R6, R7	0	0	RES, 0, 5%, 0.333 W, AEC-Q200 Grade 0, 0805	0805	CRCW08050000Z0EAHP	Vishay-Dale
R3, R8	0	100k	RES, 100 k, 1%, 0.0625 W, 0402	0402	RC0402FR-07100KL	Yageo America

Table 4-1. Bill of Materials (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
R29, R32	0	0	RES, 0, 5%, 0.25 W, AEC-Q200 Grade 0, 1206	1206	CRCW12060000Z0EA	Vishay-Dale