bq24765 EVM (HPA349)

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1 Introduction

1.1 EVM Features

- Evaluation Module For BQ24765
- High Efficiency Integrated Power MOSFET Synchronous Buck Charger
- User-selectable 1-cell, 2-cell, 3-cell or 4-cell Li-ion Battery Voltage

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- Programmable Battery Voltage, Charge Current, and AC Adapter Current via SBS-Like SMBus Interface
- AC Adapter Operating Range 18 V–22 V
- LED Indication for Control and Status Signals.
- Test Points for Key Signals Available for Testing Purpose. Easy Probe Hook-up
- Jumpers Available. Easy to Change Connections.

1.2 General Description

The bq24765 evaluation module is a complete charger module for evaluating a multi cell integrated power MOSFETs synchronous notebook charge using the bq24765 devices. It is designed to deliver up to 8A of charge current to Li-Ion or Li-Pol applications. The charge current is programmable by SBS-like SMBus interface. The bq24765's frequency is 700 kHz for small inductor The bq24765 has a highly integrated battery charge controller designed to work with external host commands. The charge voltage, charge current, and input current are programmable via SBS-like SMBus interface.

The dynamic power management (DPM) function modifies the charge current depending on system load conditions, avoiding ac adapter overload.

High accuracy current sense amplifiers enable accurate measurement of the ac adapter current, allowing monitoring of overall system power.

For details, see bq24765 data sheet (SLUS999).

1.3 I/O Description

Jack		Description
J1–ACPWR		AC adapter, positive output
J1–GND		AC adapter, negative output
J2–CE		CE pin output
J2–SDA		SDA pin output, SMBus data line
J2–SCL		SCL pin output, SMBus clock line
J3–VEXT		External power supply, positive output
J3–GND		External power supply, negative output
J4–ACOK		ACOK pin
J4–ICOUT		ICOUT pin
J4–VICM		VICM pin
J4–VREF		IC reference voltage VREF
J5–1	} ACDRV	ACDRV signal
J5–2		LED drive
J6–1	} BATDRV	BATDRV signal
J6–2		LED drive
J7–1	} DIS CHG	CE pin
J7–2		GND
J8–HI		Pull-up voltage source
J8–LEDPWR		LED Pull-up power line
J9–VREF		IC reference voltage VREF
J9–VDDSMB		VDDSMB pin
J9–EXT		External voltage supply from J3
J10–GND		Ground
J10–BAT		Connected to battery pack
J10–SYS		Connected to system
J11–1	} BYPASS	BYPASS signal
J11–2		LED drive

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1.4 Controls and Key Parameters Setting

Jack	Description	Factory Setting
J5	The conduction of the AC MOSFET is indicated by LED when on	Jumper On
J6	The conduction of the battery MOSFET is indicated by LED when on	Jumper On
J7	Disable charge process when on	Jumper On
J8	The pull-up power source supplies the LEDs when on. LED has no power source when off.	Jumper On
J9	VDDSMB voltage source setting 1-2 : Connect VREF to VDDSMB 2-3 : Connect external voltage source to VDDSMB	Jumper On 2-3 (EXT and VDDSMB)
J11	The conduction of the BYPASS MOSFET is indicated by LED when on	Jumper On

1.5 Recommended Operating Conditions

Symbol	Description	Min	Typ	Max	Unit	Notes
Supply voltage, V_{IN}	Input voltage from ac adapter input	18	19	22	V	
Battery voltage, V_{BAT}	Voltage applied at VBAT terminal of J8	0	3–16.8	20	V	
Supply current, I_{AC}	Maximum input current from ac adapter input	0		4.5	A	
Charge current, I_{chrg}	Battery charge current	2	3 or 4	8	A	
Operating junction temperature range, T_J		0		125	°C	

2 Test Summary

2.1 Definitions

This procedure details how to configure the HPA349 evaluation board. On the test procedure the following naming conventions are followed. Refer to the HPA349 schematic for details.

VXXX :	External voltage supply name (VADP, VBT, VSBT)
LOADW:	External load name (LOADR, LOADI)
V(TPyyy):	Voltage at internal test point TPyyy. For example, V(TP12) means the voltage at TP12.
V(Jxx):	Voltage at jack terminal Jxx.
V(TP(XXX)):	Voltage at test point "XXX". For example, V(ACDET) means the voltage at the test point which is marked as "ACDET".
V(XXX, YYY):	Voltage across point XXX and YYY.
I(JXX(YYY)):	Current going out from the YYY terminal of jack XX.
Jxx(BBB):	Terminal or pin BBB of jack xx
Jxx ON :	Internal jumper Jxx terminals are shorted
Jxx OFF:	Internal jumper Jxx terminals are open
Jxx (-YY-) ON:	Internal jumper Jxx adjacent terminals marked as "YY" are shorted
Measure:→ A,B	Check specified parameters A, B. If measured values are not within specified limits the unit under test has failed.
Observe → A,B	Observe if A, B occur. If they do not occur, the unit under test has failed.

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2.2 Equipment

2.2.1 POWER SUPPLIES

Power Supply #1 (PS#1): a power supply capable of supplying 20-V at 5-A is required.

Power Supply #2 (PS#2): a power supply capable of supplying 5-V at 1-A is required.

Power Supply #3 (PS#3): a power supply capable of supplying 20-V at 1-A is required.

2.2.2 LOAD #1

A 30V (or above), 5A (or above) electronic load that can operate at constant current mode

2.2.3 LOAD #2

A HP 6060B 3-60V/0-60A, 300W system DC electronic load
Or: equivalent

2.2.4 METERS

Seven Fluke 75 multimeters, (equivalent or better)
Or: Four equivalent voltage meters and three equivalent current meters.
The current meters must be capable of measuring 5A+ current.

2.2.5 COMPUTER

A computer with at least one USB port and a USB cable. The EV2300 USB driver and the bq24765 SMB evaluation software must be properly installed.

2.2.6 EV2300 SMBUS COMMUNICATION KIT

An EV2300 SMBUS communication kit is required to interface this EVM with the PC and can be purchased separately.

2.2.7 SOFTWARE

(a) "Driver(USB EV2300) Installer XP2K-Last updated Jan28-04.zip": This is the EV2300 USB driver. Save and unzip to c:\temp (or other directory). Double click on the "setup.exe" file. Follow the installation steps.

(b) "bq24765_v101.zip": This is the bq24765 SMB evaluation software. Save and unzip to c:\temp (or other directory). Double click on the "setup.exe" file. Follow the installation steps. This software needs to be installed after the EV2300 USB driver.

2.3 Equipment Setup

(a) Set the power supply #1 for 0V ± 100mVDC, 5.0 ± 0.1A current limit and then turn off supply.

(b) Connect the output of power supply #1 in series with a current meter (multimeter) to J1 (ACPWR, GND).

(c) Connect a voltage meter across J1 (ACPWR, GND).

(d) Set the power supply #2 for 3.3V ± 100mVDC, 1.0 ± 0.1A current limit and then turn off supply.

(e) Connect the output of the power supply #2 to J3 (VEXT, GND).

(f) Turn off Load #1.

(g) Turn off Load #2.

(h) Connect a voltage meter across J10 (BAT, GND).

(i) Connect a voltage meter across J10 (SYS, GND).

(j) Connect J2 (SDA, SCL) and J3 (GND) to the EV2300 kit "SMB" port. Connect the USB port of the EV2300 kit to the USB port of the computer. The connections are shown in Figure 1.

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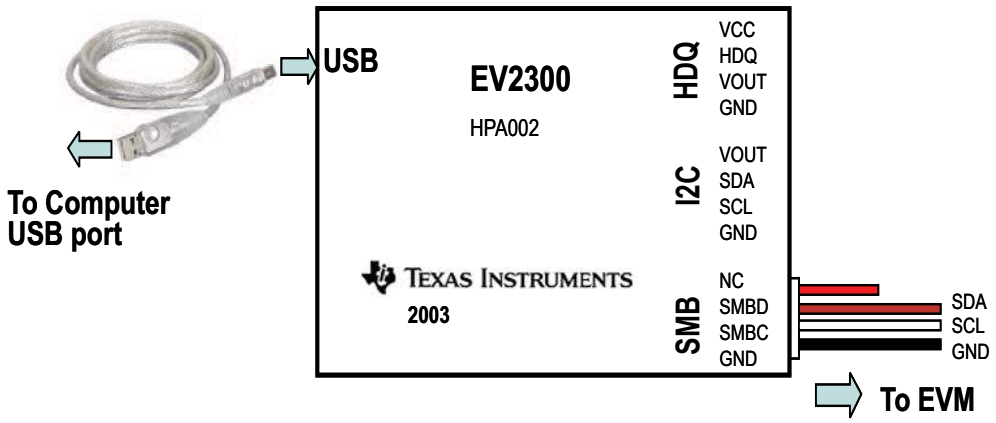

Figure 1. Connections of the EV2300 Kit

(k) J5: ON, J6: ON, J7: ON, J8: ON, J9(VDDSMB, EXT): ON, J11: ON.
After the steps above, the test setup for HPA349 is shown in Figure 2.

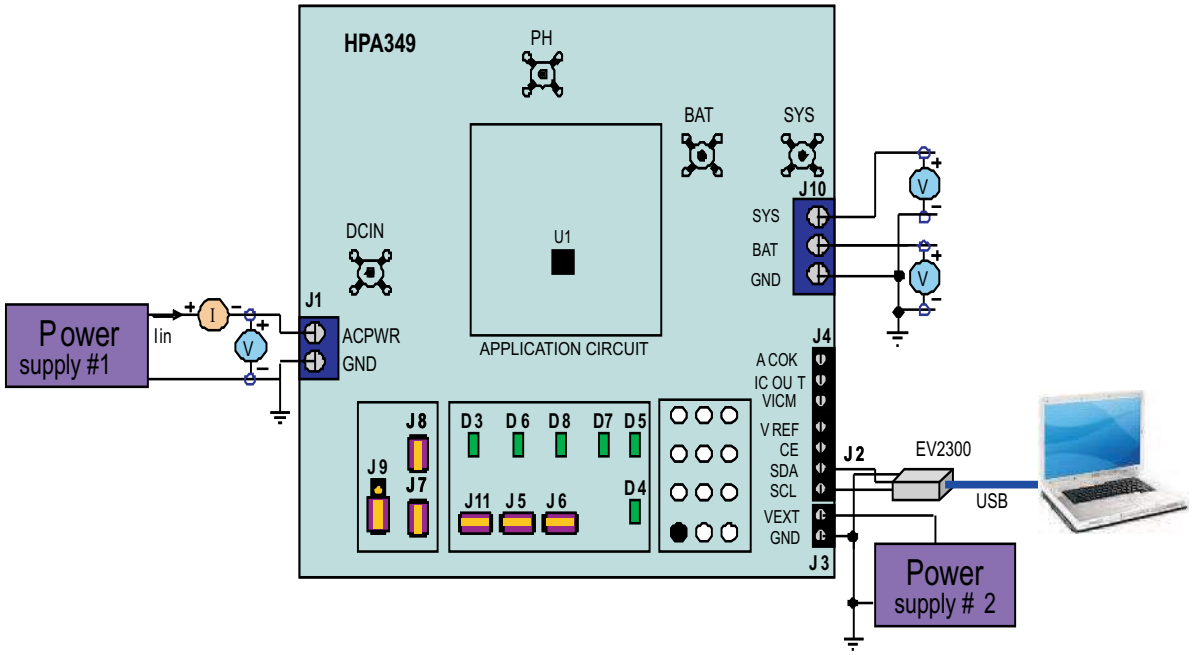

Figure 2. Original test setup for HPA349 (bq24765 EVM)

(l) Turn on the computer. Open the bq24765 SMB evaluation software. The main window of the software is shown in Figure 3.

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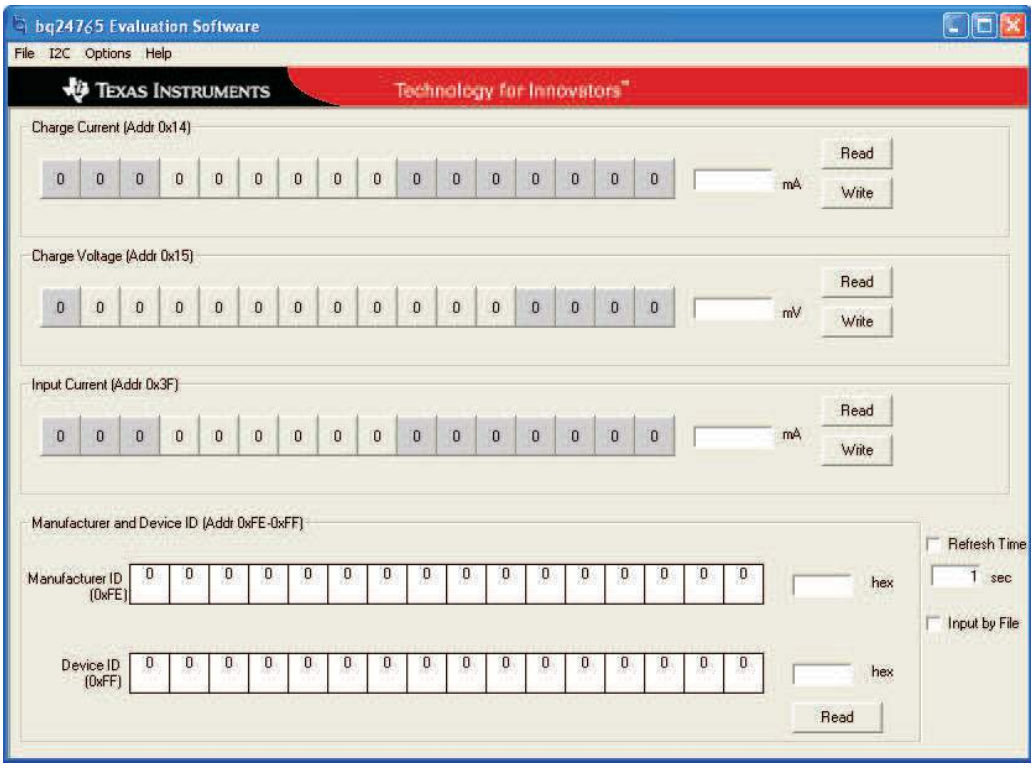

Figure 3. The Main Window of the bq24765 SMB Evaluation Software

2.4 Procedure

2.4.1 AC ADAPTER DETECTION THRESHOLD

2.4.1.1 Make sure EQUIPMENT SETUP steps are followed. Turn on PS#2.

2.4.1.2 Turn on PS#1.
Measure → V(J10(SYS)) = 0 ± 500mV
Measure → V(TP(VREF)) = 0V ± 1000mV
Measure → V(TP(VDDP)) = 0V ± 500mV

2.4.1.3 Increase the output voltage of PS#1 until D5 (ACOK) on but do not exceed 20V.
Measure → V(TP(ACIN)) = 2.4V ± 200mV
Measure → V(J1(ACPWR)) = 17.9V ± 1V
Measure → V(J10(SYS)) = 17.9V ± 1V
Measure → V(TP(VREF)) = 3.3V ± 200mV
Measure → V(TP(VDDP)) = 0V ± 500mV
Observe → D3 (BYPASS) on, D6 (ACDRV) on.

2.4.2 CHARGER Voltage Regulation

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2.4.2.1 Increase the voltage of PS#1 until V(J1(ACPWR)) = 19V ± 0.1V.

Measure → V(J10(BAT, GND)) = 0V ± 1V

2.4.2.2 In the software main window, click all the "Read" buttons. Make sure there is no error information generated.

Type in "512" (mA) in the Charge Current DAC and click "Write". This sets the battery charge current regulation threshold.

Type in "12592" (mV) in the Charge Voltage DAC and click "Write". This sets the battery voltage regulation threshold.

Type in "4608" (mA) in the Input Current DAC and click "Write". This sets the input current regulation threshold.

2.4.2.3 Uninstall J7 (Enable the charging).

Observe → D4 (CHG EN) on.

Measure → V(J10(BAT)) = 12.6V ± 200mV

Measure → V(J4(ICOUT)) = 3.3V ± 300mV

Measure → V(TP(VDDP)) = 6V ± 500mV

2.4.3 CHARGE CURRENT AND AC CURRENT REGULATION (DPM)

2.4.3.1 Install J7 (Disable the charging).

2.4.3.2 Connect the Load #2 in series with a current meter (multimeter) to J10 (BAT, GND). Make sure a voltage meter is connected across J10 (BAT, GND). Turn on the Load #2. Use the constant voltage mode. Set the output voltage to 10.5V.

2.4.3.3 Connect the output of the Load #1 in series with a current meter (multimeter) to J10 (SYS, GND). Make sure a voltage meter is connected across J10 (SYS, GND). Turn on the power of the Load #1. Set the load current to 4.0A± 50mA but disable the output. The setup is now like Figure 4 for HPA349. Make sure Ibat = 0A± 10mA and Isys = 0A± 10mA.

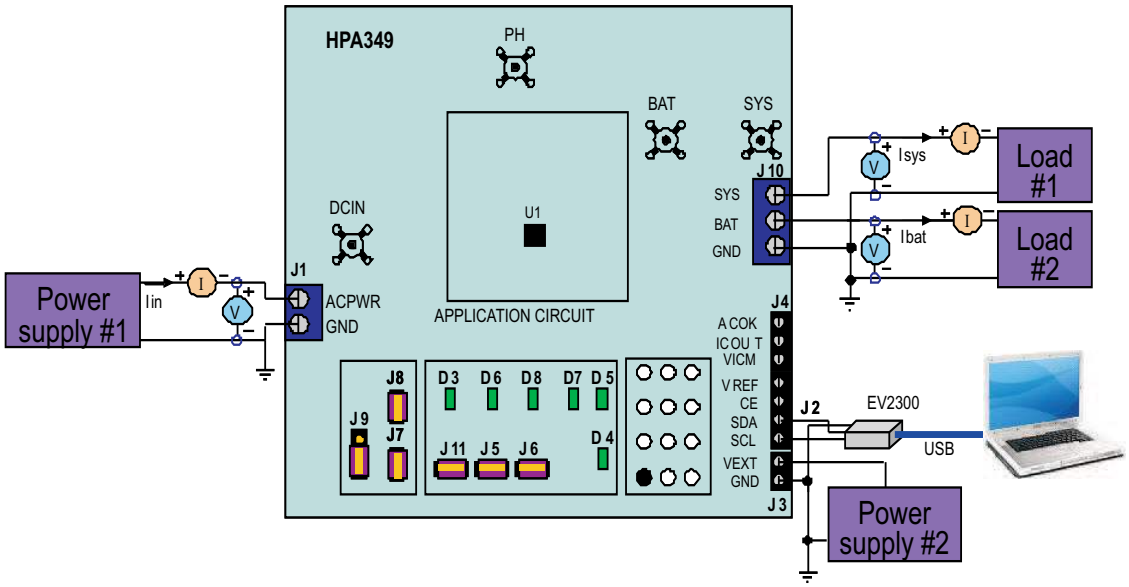

Figure 4. Test Setup for HPA349

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2.4.3.4 Uninstall J7 (Enable the charging).
Observe → D4 (CHG EN) on

2.4.3.5 *Measure* → Ibat = 500mA ± 200mA

2.4.3.6 Type in "2944" (mA) in the Charge Current DAC and click "Write". This sets the battery charge current regulation threshold to 2.944A.
Measure → Ibat = 3000mA ± 300mA
Measure → V(TP(VICM)):= 350mV ± 100mV
Measure → V(J4(ICOUT)) = 3.3V ± 300mV
Observe → D7 (LO PWR MODE) on

2.4.3.7 Enable the output of the Load #1.
Measure → Isys = 4000mA ± 200mA, Ibat = 1000mA ± 500mA, Iin = 4600mA ± 500mA
Measure → V(TP(VICM)) = 920mV ± 100mV
Measure → V(J4(ICOUT)) = 0V ± 300mV
Observe → D7 (LO PWR MODE) off

2.4.3.8 Turn off the Load #1.
Measure → Isys = 0 ± 100mA, Ibat = 3000mA ± 300mA.

2.4.4 POWER PATH SELECTION

2.4.4.1 Install J7 (Disable the charging)
Observe → D4 (CHG EN) off

2.4.4.2 Replace Load #2 and current meter with PS#3. Make sure a voltage meter is connected across J10 (BAT, GND). Enable the output of the PS #3. Make sure the output voltage is 10.5V ± 500mV.

2.4.4.3 *Measure* → V(J10(SYS)) = 19V ± 1V (adapter connected to system)
Observe → D3 (BYPASS) on, D6 (ACDRV) on, D8 (BATDRV) off.

2.4.4.4 Turn off PS#1.
Measure → V(J10(SYS)) = 10.5V ± 1V (battery connected to system)

2.4.4.5 *Observe* → D3 (BYPASS) off, D6 (ACDRV) off, D8 (BATDRV) on.

3 PCB Layout Guideline

1. It is critical that the exposed power pad on the backside of the bq24765 package be soldered to the PCB ground. Make sure there are sufficient thermal vias right underneath the IC, connecting to the ground plane on the other layers.
2. The control stage and the power stage should be routed separately. At each layer, the signal ground and the power ground are connected only at the power pad.
3. AC current sense resistor must be connected to CSSP and CSSN with a Kelvin contact. The area of this loop must be minimized. The decoupling capacitors for these pins should be placed as close to the IC as possible.
4. Charge current sense resistor must be connected to CSOP, CSON with a Kelvin contact. The area of this loop must be minimized. The decoupling capacitors for these pins should be placed as close to the IC as possible.
5. Decoupling capacitors for DCIN, VREF, VDDP should be placed underneath the IC (on the bottom layer) and make the interconnections to the IC as short as possible.
6. Decoupling capacitors for BAT, VICM must be placed close to the corresponding IC pins and make the interconnections to the IC as short as possible.

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4 Bill of Materials, Board Layout and Schematics

4.1 Bill of Materials

Table 1. Bill of Materials

bq24765	RefDes	Value	Description	Size	Part Number	Mfr
1	C1	2.2 µF	Capacitor, Ceramic, 25V, X5R, 10%	1210	Std	Std
3	C13, C27, C29	0.1 µF	Capacitor, Ceramic, 50V, X7R, 10%	0603	STD	STD
1	C14	100 pF	Capacitor, Ceramic, 50V, C0G, 5%	0603	STD	STD
3	C15, C19, C21	1 µF	Capacitor, Ceramic, 25V, X5R, 10%	0805	Std	Std
4	C16, C18, C23, C26	10 µF	Capacitor, Ceramic, 25V, X5R, 10%	1210	Std	Std
2	C2, C10	Open	Capacitor, Ceramic, 25V, X5R, 10%	1210	Std	Std
2	C24, C30	10 µF	Capacitor, Ceramic, 25V, X5R, 10%	1206	STD	STD
1	C25	Open	Capacitor, Ceramic, 50V, X7R, 10%	0603	STD	STD
1	C3	Open	Capacitor, Ceramic, 25V, X5R, 10%	0805	Std	Std
1	C31	OPEN	Capacitor, Ceramic, 50V, X7R, 10%	0805	STD	STD
2	C4, C11	10 nF	Capacitor, Ceramic, 50V, X7R, 10%	0603	Std	Std
1	C5	2000 pF	Capacitor, Ceramic, 50-V, C0G, 5%	0603	Std	Std
1	C6	51 pF	Capacitor, Ceramic, 50-V, C0G, 5%	0603	Std	Std
6	C7, C12, C17, C20, C22, C28	0.1 µF	Capacitor, Ceramic, 50V, X7R, 10%	0805	Std	Std
1	C8	130 pF	Capacitor, Ceramic, 50-V, C0G, 5%	0603	Std	Std
1	C9	1 µF	Capacitor, Ceramic, 25V, X5R, 10%	0603	Std	Std
1	D1	BAT54	Diode, Schottky, 200-mA, 30-V	SOT23	BAT54	Vishay-Liteon
1	D2	BAT54C	Diode, Dual Schottky, 200-mA, 30-V	SOT23	BAT54C	Vishay-Liteon
6	D3–D8	Green	Diode, LED, Green, 2.1-V, 20-mA, 6-mcd	0603	LTST-C190GKT	Lite On
1	D9	OPEN	Diode, Schottky, 2A, 40V	SMB	SS24	IR
1	J1	D120/2DS	Terminal Block, 2-pin, 15-A, 5.1mm	0.40 x 0.35 inch	D120/2DS	OST
1	J10	D120/3DS	Terminal Block, 3-pin, 15-A, 5.1mm	0.60 x 0.35 inch	D120/3DS	OST
1	J2	ED555/3DS	Terminal Block, 3-pin, 6-A, 3.5mm	0.41 x 0.25 inch	ED555/3DS	OST
1	J3	ED555/2DS	Terminal Block, 2-pin, 6-A, 3.5mm	0.27 x 0.25 inch	ED555/2DS	OST
1	J4	ED555/4DS	Terminal Block, 4-pin, 6-A, 3.5mm	0.55 x 0.25	ED555/4DS	OST
5	J5–J8, J11	PTC36SAAN	Header, 2-pin, 100mil spacing, (36-pin strip)	0.100 inch x 2	PTC36SAAN	Sullins
1	J9	PTC36SAAN	Header, 3-pin, 100mil spacing, (36-pin strip)	0.100 inch x 3	PTC36SAAN	Sullins
1	L1	3.3 µH	Inductor, SMT, 6A, 28milliohm	0.255 x 0.270 inch	IHLP2525CZER3R3M01	Vishay
3	Q1, Q2, Q3	Si4435DY	MOSFET, P-ch, 30-V, 8.0-A, 20-milliohm	SO8	Si4435DY	Siliconix
1	Q13	NDS0605	MOSFET,P-ch, -60 V, 180-mA, 5 Ohms	SOT-23	NDS0605	Vishay
3	Q14–Q16	TP0610K	Mosfet, P-Ch, 60V, Rds 6 ohms, Id 185 mA	SOT-23	TP0610K	Vishay-Siliconix
9	Q4–Q12	2N7002DICT	MOSFET, N-ch, 60-V, 115-mA, 1.2-Ohms	SOT23	2N7002DICT	Vishay-Liteon
2	R1, R40	4.02	Resistor, Chip, 0.5W, 1%	1210	Std	Std
1	R12	7.5k	Resistor, Chip, 1/16W, 1%	0603	STD	STD
1	R13	4.7k	Resistor, Chip, 1/16W, 1%	0603	STD	STD
1	R15	1400k	Resistor, Chip, 1/10W, 5%	0805	Std	Std
1	R17	0	Resistor, Chip, 1/16W, 5%	0402	Std	Std
2	R18, R26	0.01	Resistor, Chip, 1/2W, 1%	2010	Std	Std
1	R2	430k	Resistor, Chip, 1/16W, 1%	0603	STD	STD
1	R21	3.9	Resistor, Chip, 1/16W, 1%	0402	Std	Std
1	R22	1Meg	Resistor, Chip, 1/16W, 5%	0402	Std	Std
8	R25, R27, R28, R29, R32, R33, R37, R38	100k	Resistor, Chip, 1/16W, 5%	0402	Std	Std
1	R3	66.5k	Resistor, Chip, 1/16W, 1%	0603	STD	STD
6	R30, R31, R34, R35, R36, R39	2.2k	Resistor, Chip, 1/16W, 5%	0603	STD	STD

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Table 1. Bill of Materials (continued)

bq24765	RefDes	Value	Description	Size	Part Number	Mfr
11	R4, R5, R8, R10, R11, R14, R16, R19, R20, R23, R24	10k	Resistor, Chip, 1/16W, 5%	0402	Std	Std
1	R41	OPEN	Resistor, Chip, 1/16W, 5%	0402	Std	Std
1	R42	100	Resistor, Chip, 1/16W, 1%	0402	Std	Std
1	R43	OPEN	Resistor, Chip, 0.5W, 1%	1210	STD	STD
1	R44	10	Resistor, Chip, 0.25W, 1%	1206	STD	STD
1	R6	200k	Resistor, Chip, 1/16W, 1%	0402	Std	Std
1	R7	49.9k	Resistor, Chip, 1/16W, 1%	0402	Std	Std
1	R9	200k	Resistor, Chip, 1/16W, 1%	0603	STD	STD
1	TP1	5001	Test Point, Black, Thru Hole Color Keyed	0.100 x 0.100 inch	5001	Keystone
4	TP2, TP18–TP20	131-4244-00	Adaptor, 3.5-mm probe clip (or 131-5031-00)	0.200 inch	131-4244-00	Tektronix
12	TP21–TP32	5002	Test Point, White, Thru Hole Color Keyed	0.100 x 0.100 inch	5002	Keystone
1	U1	bq24765RUV	IC, SMBus-Controlled Level 2 Multi-chemistry Battery Charger with Integrated Power MOSFETs, CE, and Input Current Comparator	QFN-34	bq24765RUV	TI
6	SJ5–SJ9,SJ11	929950-00	Shorting jumpers, 2-pin, 100mil spacing,		929950-00	3M/ESD
4			Bumpons, cylindrical, black		SJ5514-0	3M
1	PCB	HPA349	4.5 x 4.5 inch 4 layer 2oz. PCB	4.5x4.5 inch	PCB	

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4.2 Board Layout

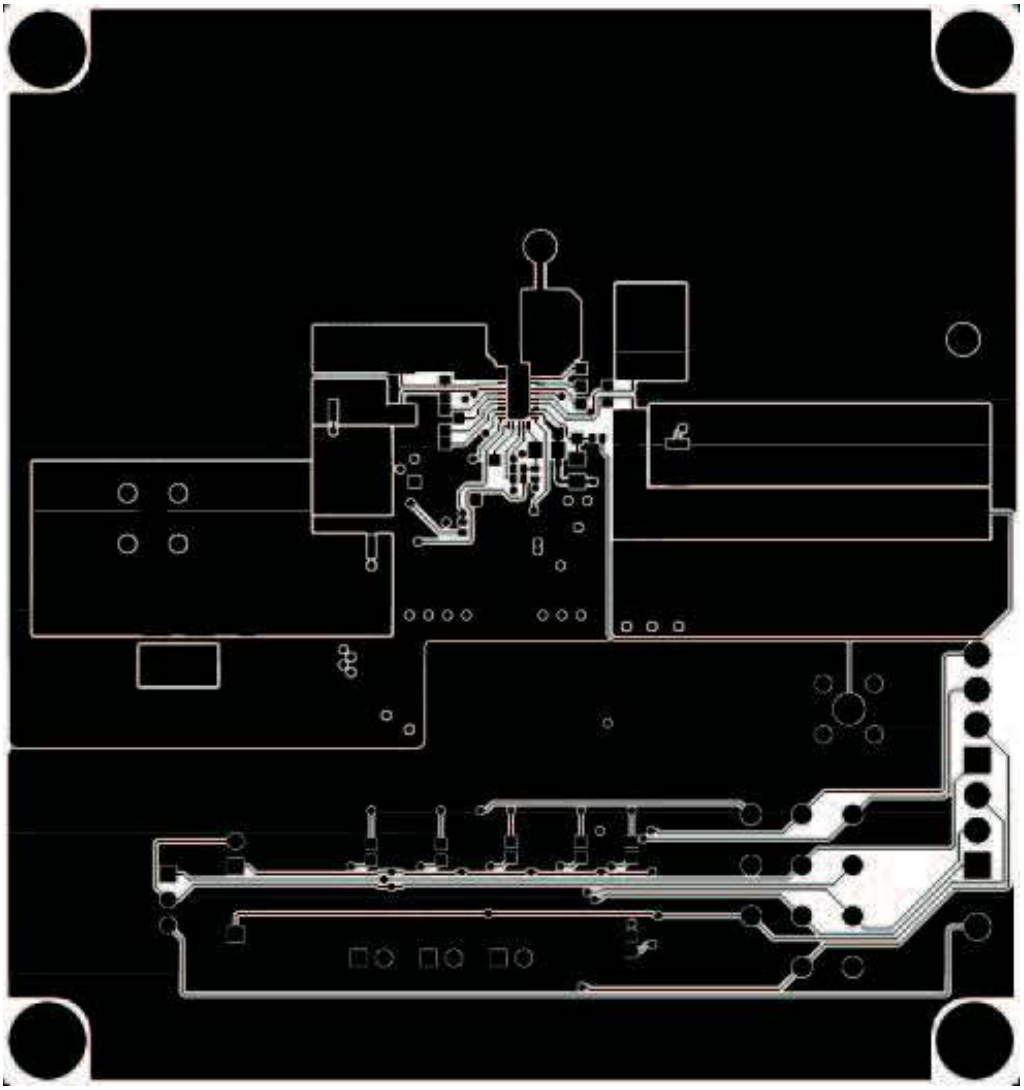

Figure 5. Top Layer

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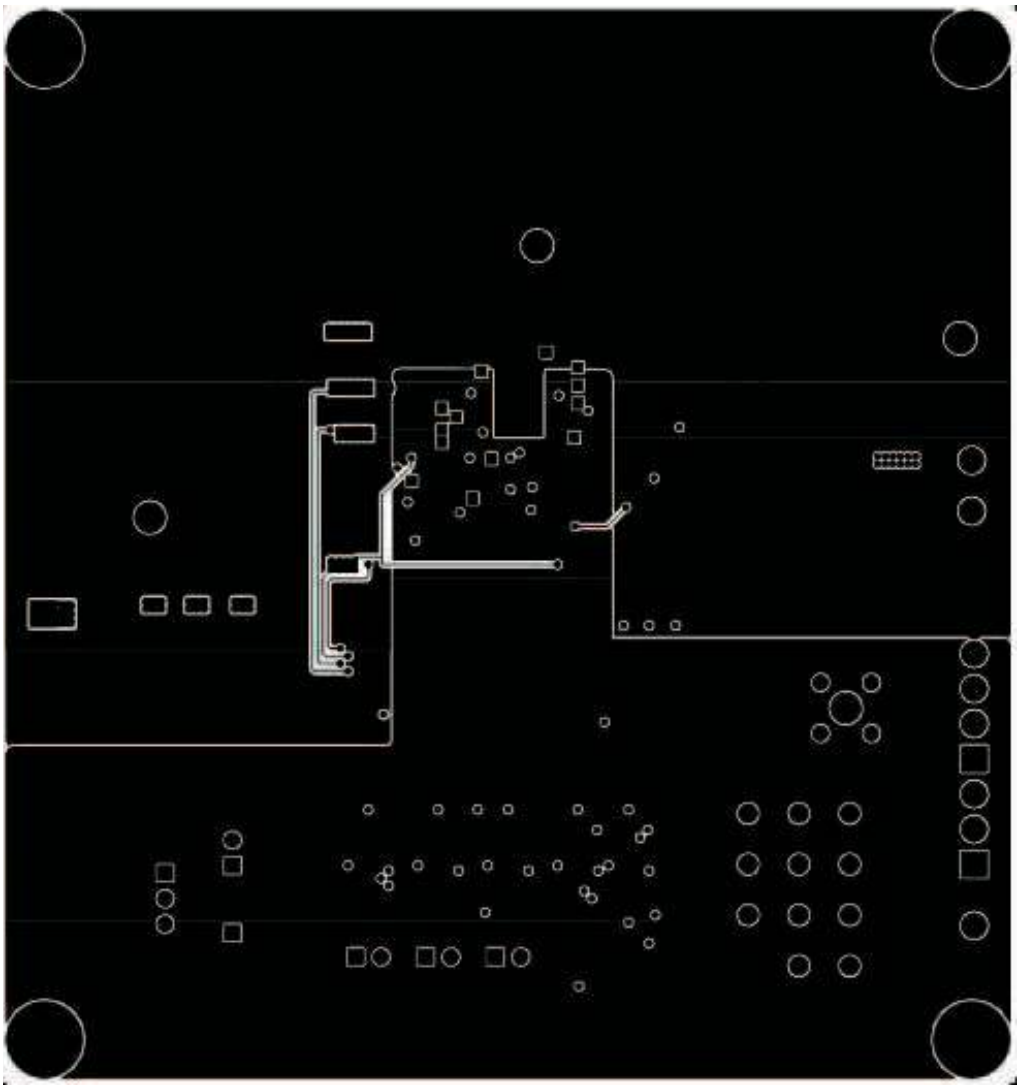

Figure 6. 2nd Layer

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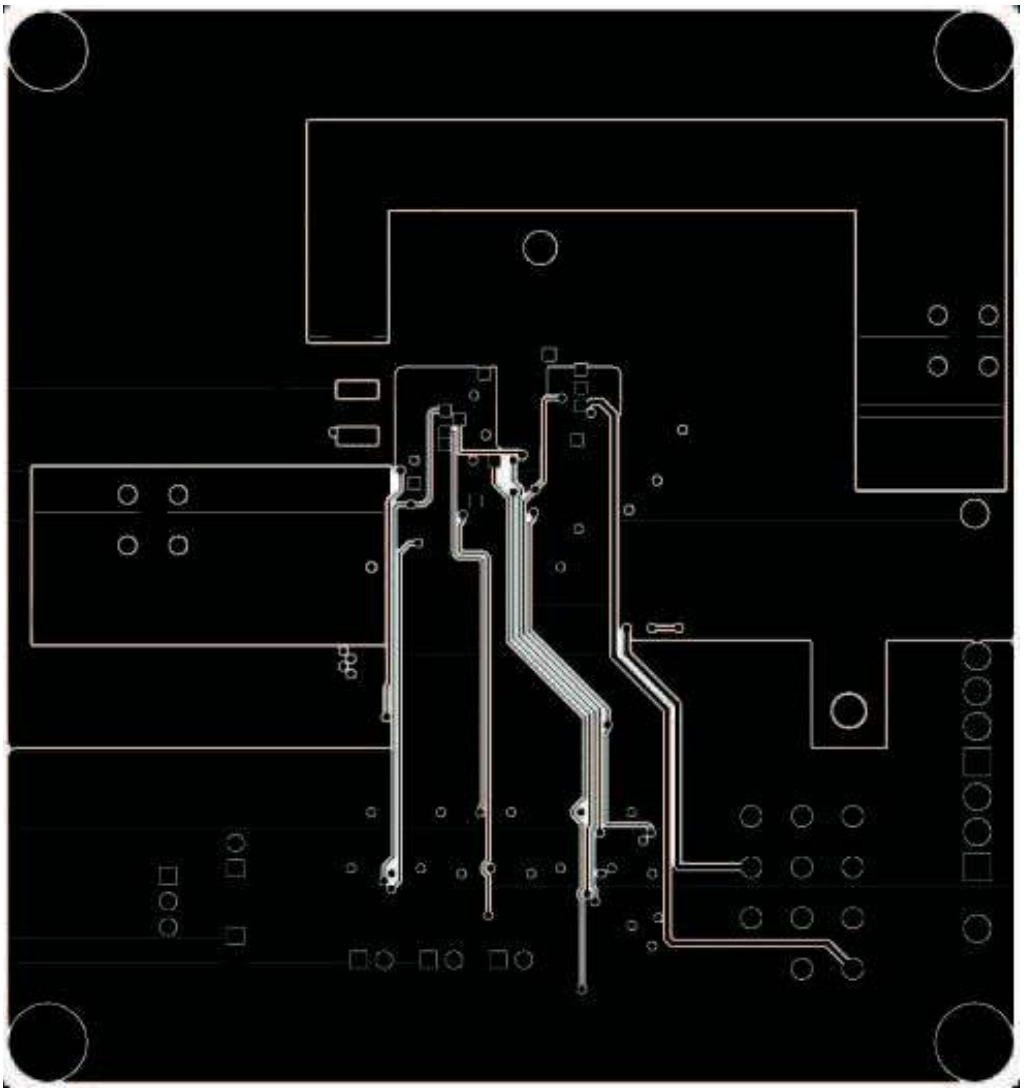

Figure 7. 3rd Layer

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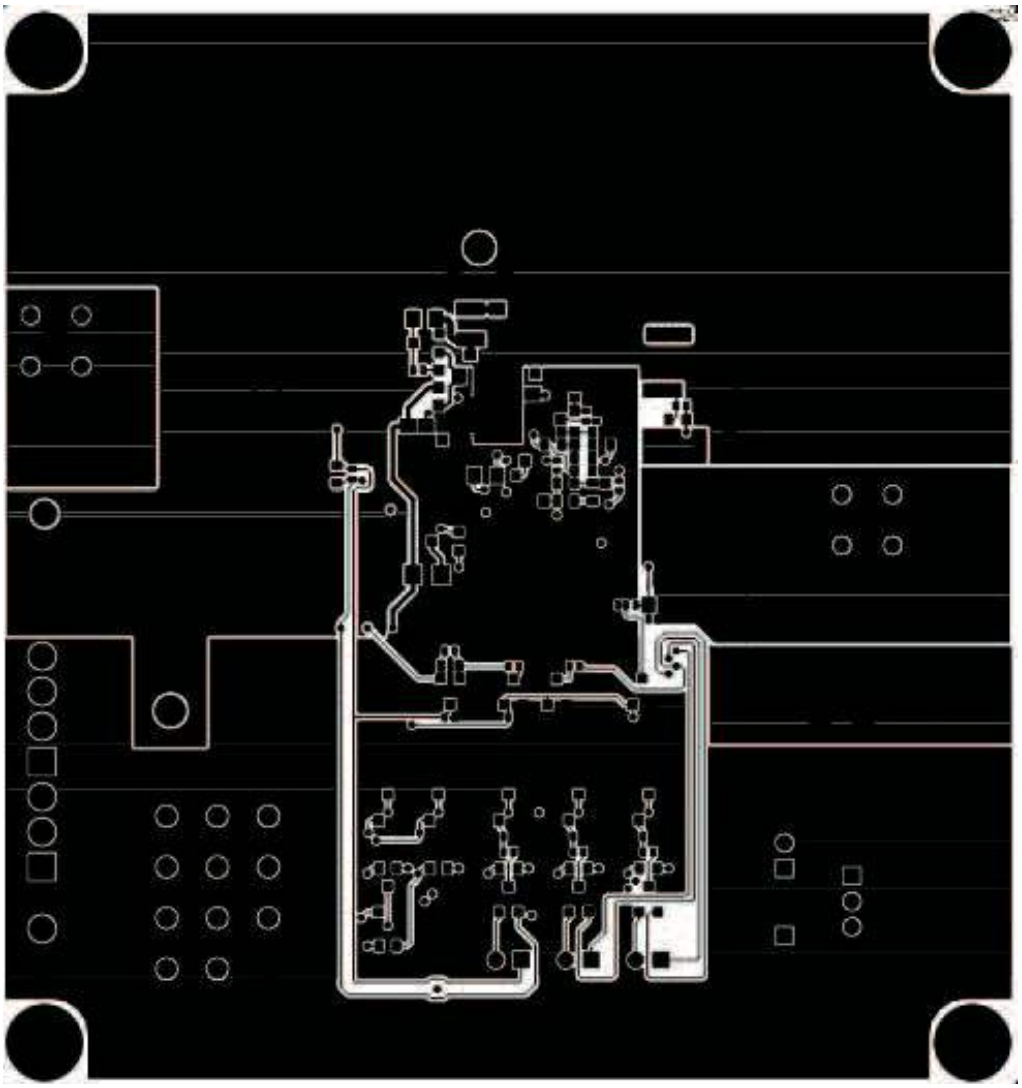

Figure 8. Bottom Layer

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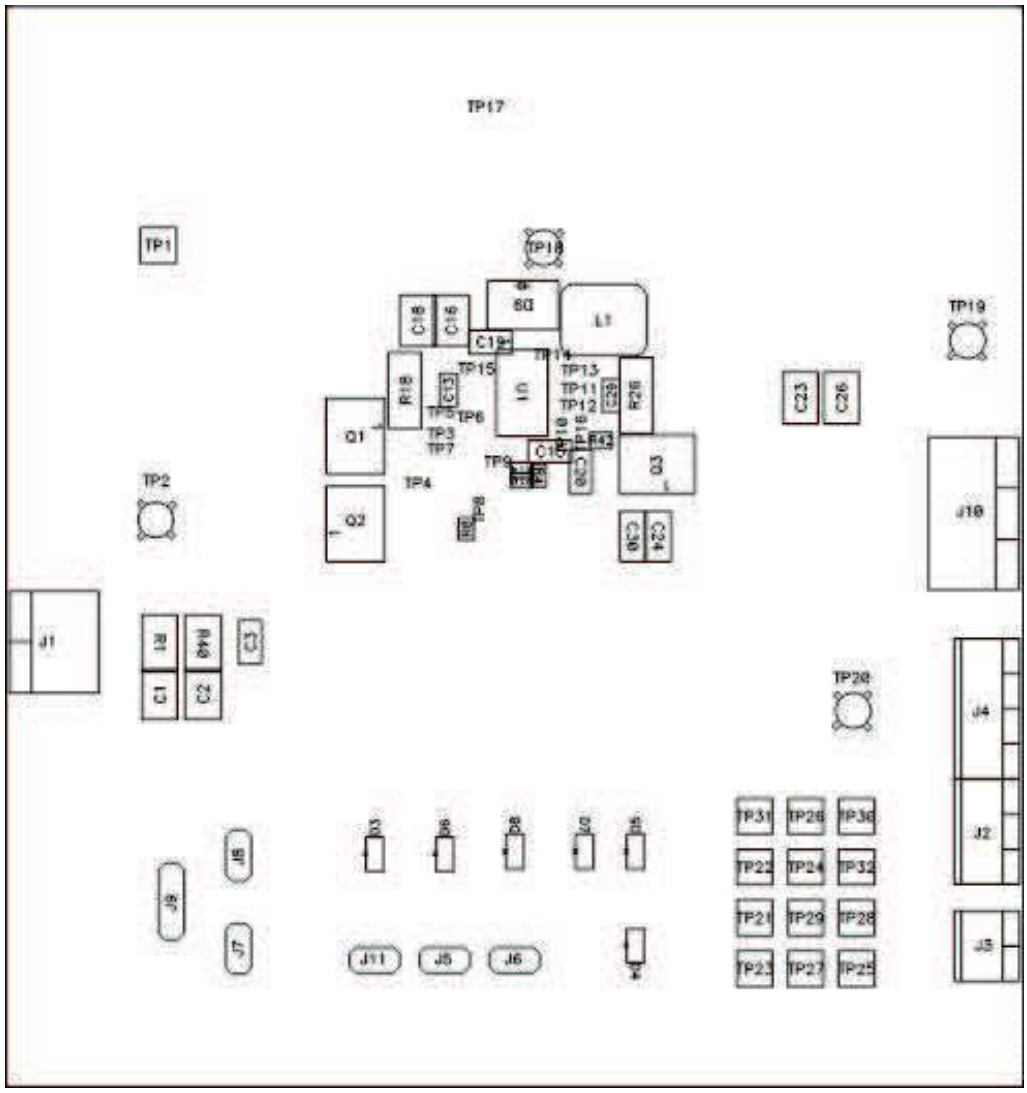

Figure 9. Top Assembly

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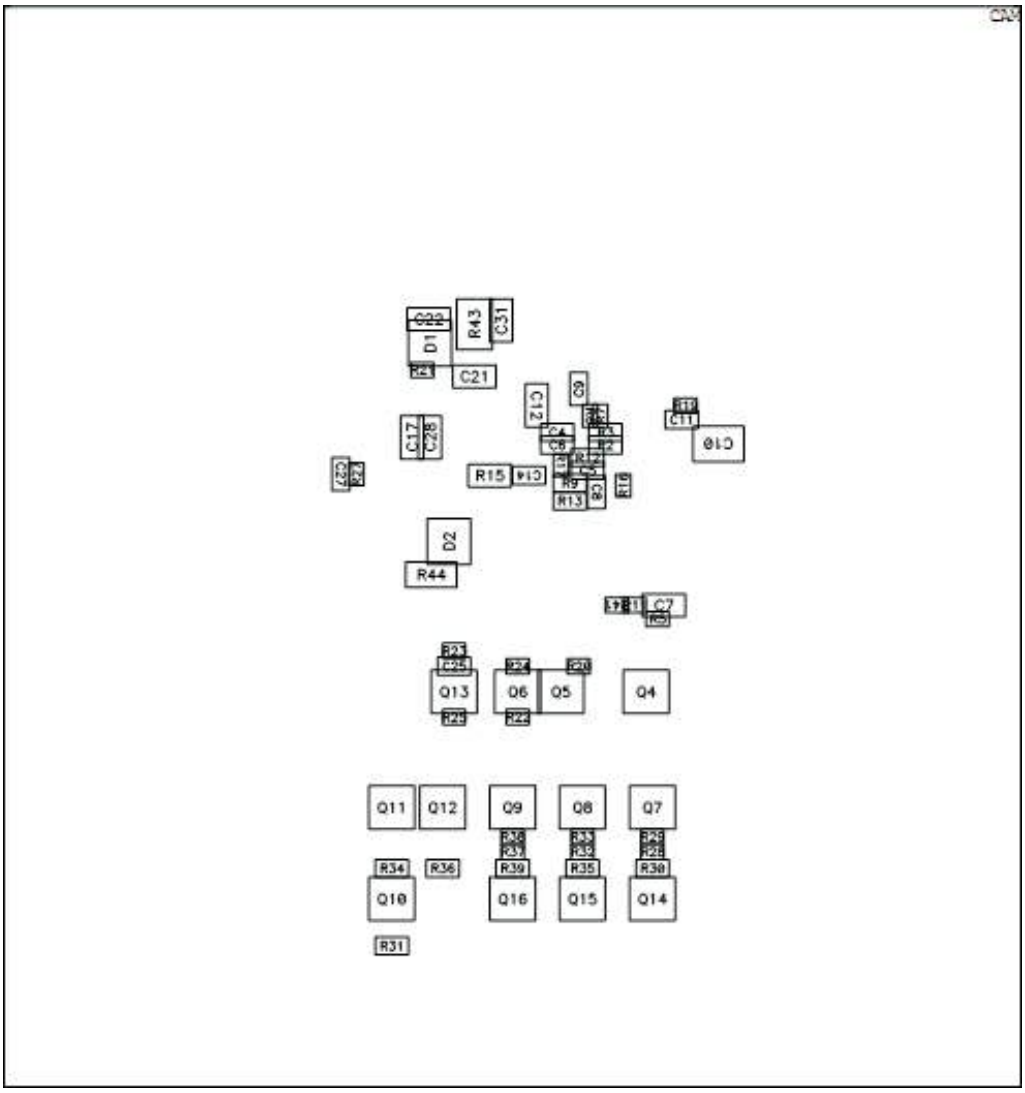

Figure 10. Bottom Assembly

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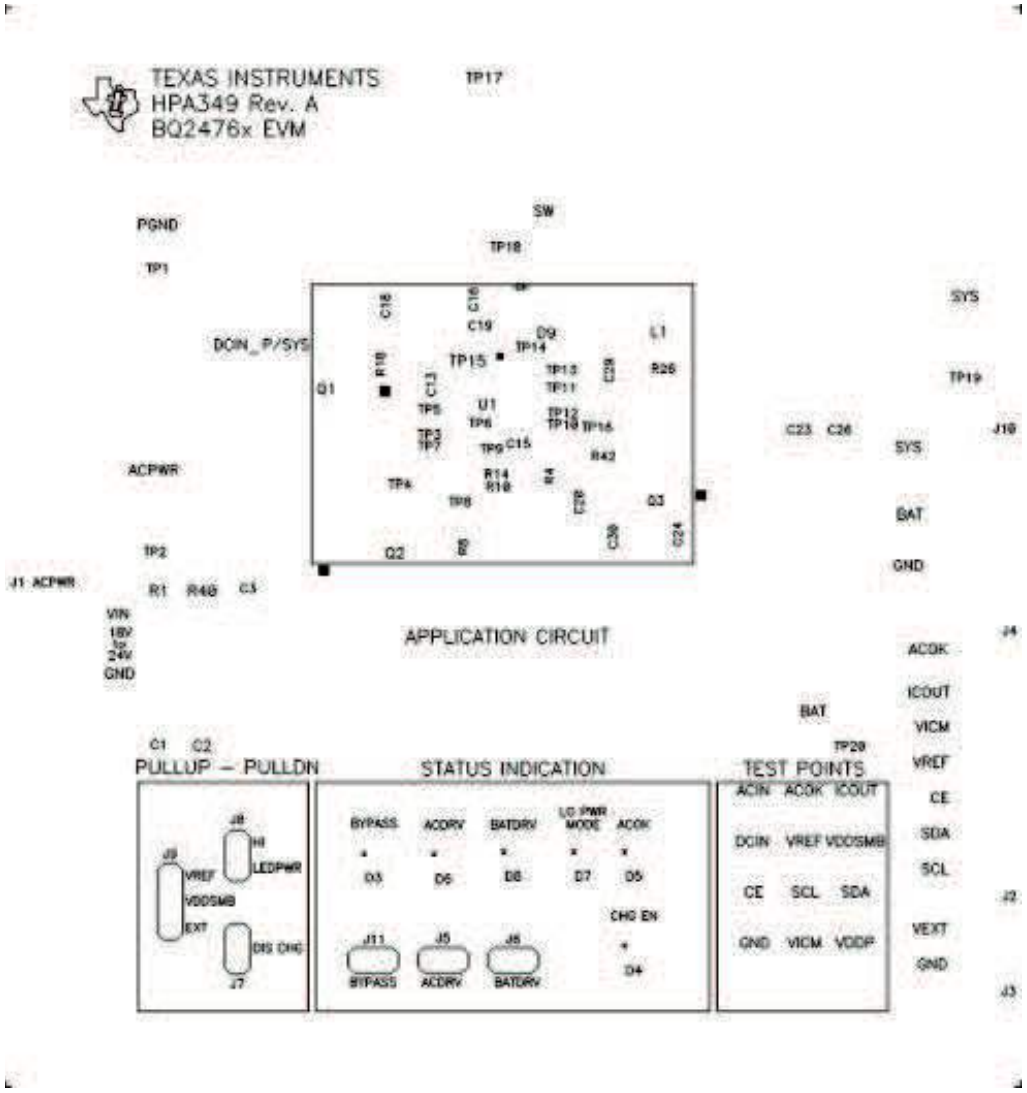

Figure 11. Top Silkscreen

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4.3 Schematics

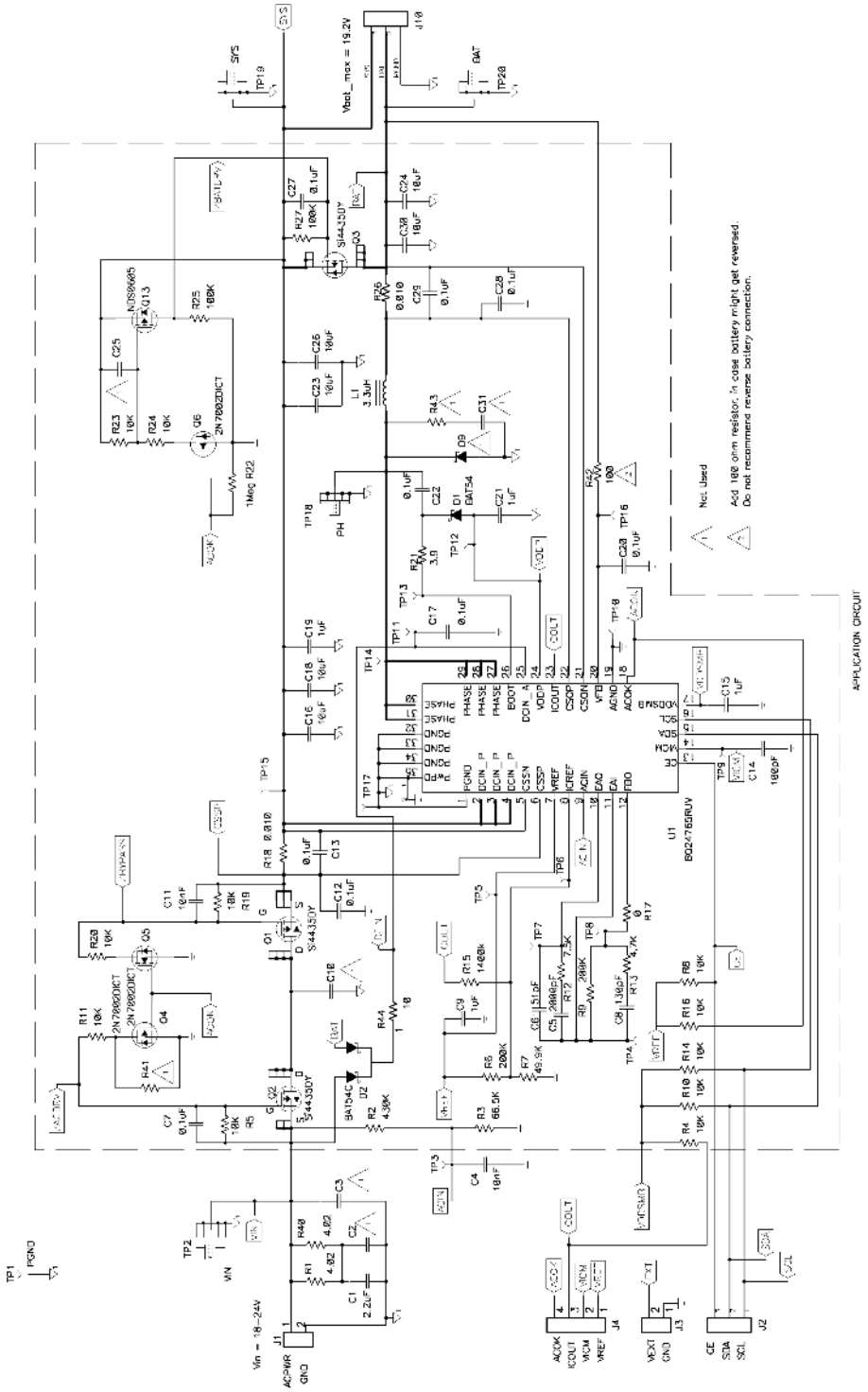

Figure 12. bq24765 EVM Schematic (Sheet 1 of 2)

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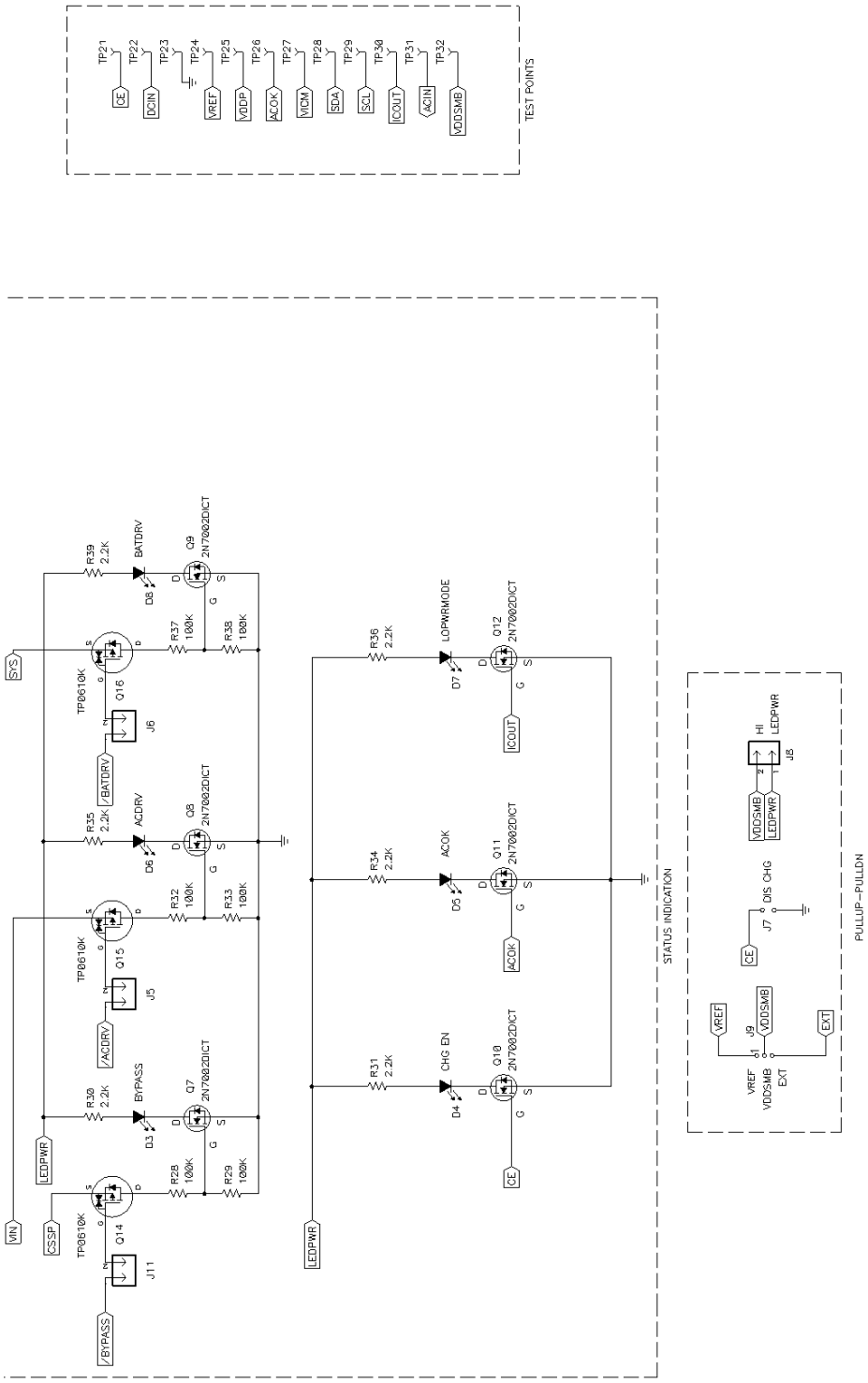

Figure 13. bq24745 EVM Schematic (Sheet 2 of 2)

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As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

For EVMs **not** subject to the above rules, this evaluation board/kit/module is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by TI to be a finished end product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant

Caution

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concerning EVMs including detachable antennas

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

Concernant les EVMs avec appareils radio

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

【Important Notice for Users of EVMs for RF Products in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

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Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

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