TEXAS INSTRUMENTS

User's Guide for QFN Packaged bq24265, bq24266, and bq24267 3-A Battery Charger Evaluation Module

The bq24265, bq24266, and bq24267 evaluation module (EVM) on PWR609 PCB is a complete charger module for evaluating a compact, flexible, high-efficiency, USB-friendly, switch-mode charge management solution for single-cell, Li-ion and Li-polymer batteries used in a wide range of portable applications.

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1 Introduction

1.1 *bq24265, bq24266, and bq24267 Features*

The bq24265, bq24266, and bq24267 integrates a synchronous PWM controller, power MOSFETs, input current sensing, high-accuracy current and voltage regulation, charge termination, and power path management into a chipscale package. Key integrated circuit (IC) features include:

- High-efficiency, fully integrated, NMOS-NMOS, synchronous buck charger with 1.5-MHz frequency
- Integrated power FETs for up to 2.5-A charge rate
- Power path management between battery and system voltages

For details, see the bq24265, bq24266, bq24267 data sheet (SLUSBY5).

1.2 *bq24265/6/7 EVM - 609 Features*

The bq24265, bq24266, and bq24267 EVM on PWR609 PCB is a complete charger module for evaluating compact, flexible, high-efficiency, USB-friendly, switch-mode battery charge and power path management solution for single-cell, Li-ion and Li-polymer battery-powered systems used in a wide range of portable applications. Key EVM features include:

- Programmable charge current, input current on, and V_{INDPM} threshold using jumpers
- Input power connectors for both USB input and AC adapter
- IN operating range of 4.2 to 13.5 V
- LED indication for status signals
- Test points for key signals available for testing purposes; easy probe hook-up
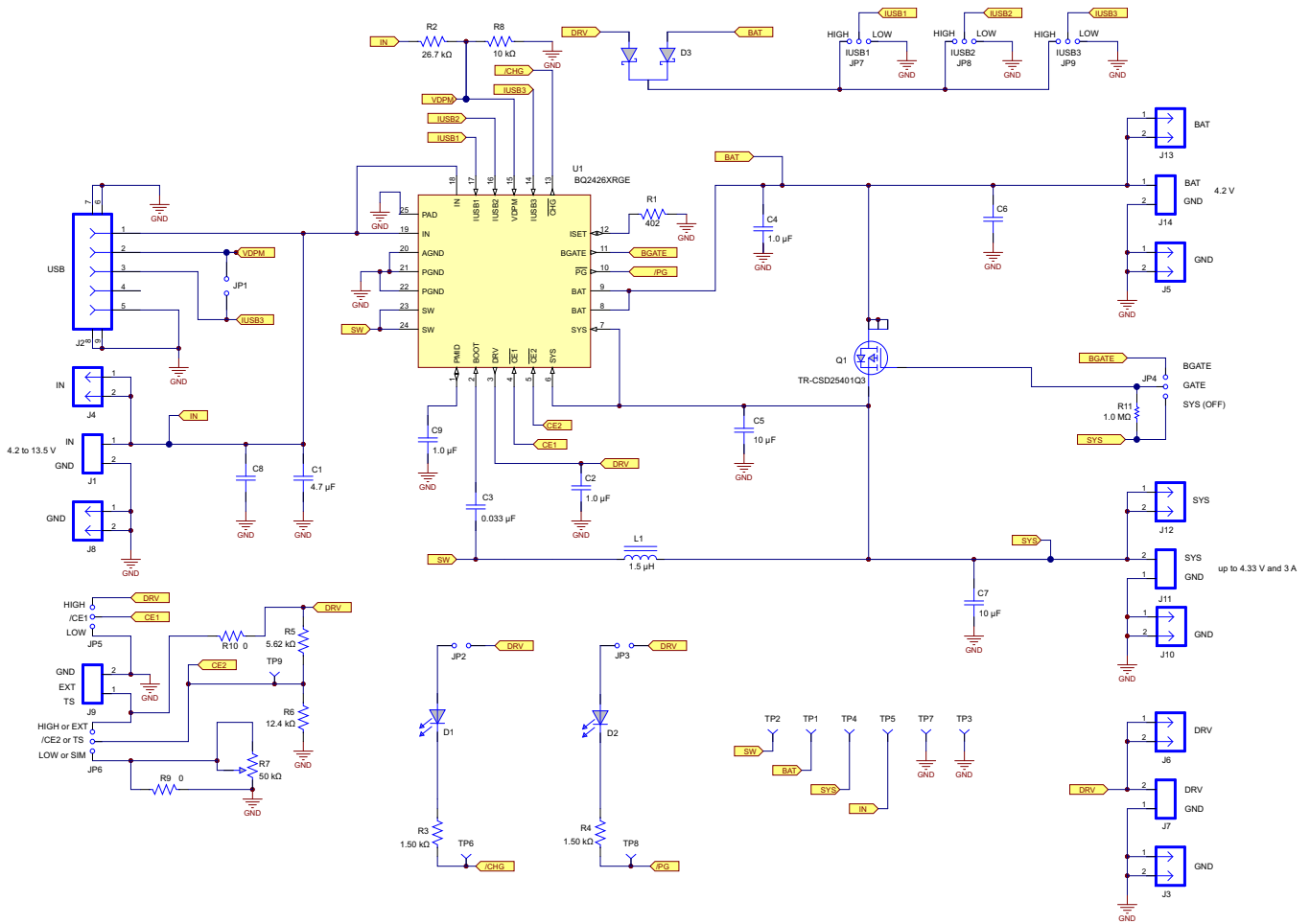
1.3 *Schematic*

Figure 1. bq24265, bq24266, and bq24267EVM (PWR609) Schematic

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1.4 I/O Description

Header or Terminal Block	Description
J1-IN/GND	Terminal block for connecting IN and GND pins to input supply positive and negative connections
J2-IN	USB micro connector for connecting IN and GND pins to USB micro cable
J3-GND	Header for connecting DRV pin reference voltage to external load or measurement device negative connection
J4-IN	Header for connecting IN pin to input supply or measurement device positive connection
J5-GND	Header for connecting GND pin to battery or measurement device negative connection
J6-DRV	Header for connecting DRV pin reference voltage to external load or measurement device positive connection
J7-DRV/GND	Terminal block for connecting DRV reference voltage and GND pins to external load positive and negative connections
J8-GND	Header for connecting GND pin to input supply or measurement device negative connection
J9-TS/GND	Terminal block for connecting TS and GND pins to battery NTC and ground connections
J10-GND	Header for connecting GND pin to system load or measurement device negative connection
J11-SYS/GND	Terminal block for connecting SYS and GND pins to external load positive and negative connections
J12-SYS	Header for connecting SYS pin to system load or measurement device positive connection
J13-BAT	Header for connecting BAT pin to battery or measurement device positive connection
J14-BAT/GND	Terminal block for connecting BAT and GND pins to battery positive and negative connections

1.5 Test Points

Test Point	Description
TP1	Test point connecting to BAT pin
TP2	Test point connecting to SW pin
TP3	Test point connecting to board GND plane
TP4	Test point connecting to SYS pin
TP5	Test point connecting to IN pin
TP6	Test point connecting to /CHG pin
TP7	Test point connecting to board GND plane
TP8	Test point connecting to /PG pin
TP9	Test point connecting to TS pin ('266/7) or /CE2 pin ('265)

1.6 Control and Key Parameters Setting

IC	Jumper	Description	Default Factory Setting
All	JP1	Not used.	N/A
All	JP2	Connects /CHG to DRV through LED D1 and pull up resistor.	Installed
All	JP3	Connects /PG to DRV through LED D2 and pull up resistor.	Installed
All	JP4	1-2: FET GATE = BGATE: External PFET's gate tied to BGATE pin and therefore controlled by IC. 2-3: FET GATE = SYS: External PFET's gate tied to SYS and therefore disabled.	1-2 (FET GATE = BGATE)
bq24265	JP5	1-2 ($\overline{CE1}$ = HIGH): Active-low enable for reduced VBATREG (if $\overline{CE2}$ = LOW) or suspended charging (if $\overline{CE2}$ = HIGH) 2-3 ($\overline{CE1}$ = LOW): Active-low enable for full current charging (if $\overline{CE2}$ = LOW) or reduced VBAT voltage (if $\overline{CE2}$ = HIGH)	2-3 ($\overline{CE1}$ = LOW)
bq24266 bq24267	JP6	1-2 (TS = EXT): Connects the TS pin to an external thermistor. The resistor divider formed by R5 and R6 has been sized to accommodate a 10-kΩ thermistor. If a different thermistor is used, R4 and R5 need to be resized. 2-3 (TS = SIM): Connects a potentiometer to the TS pin so the potentiometer simulates a thermistor. The potentiometer has been preset to approximately 10 kΩ so that the TS voltage is approximately 0.5 x V(DRV).	2-3 (TS = SIM)
All	JP7	1-2: IUSB1 = HIGH 2-3: IUSB1 = LOW See the USB1, USB2, and USB3 Input Table in the data sheet for a description of USB input current limit and VINDPM threshold setting. Default setting is for 2500-mA input current limit and VDPM pin external resistors set the VINDPM threshold voltage to 4.4 V typical.	1-2 (IUSB1 = LOW)
All	JP8	1-2: IUSB2 = HIGH 2-3: IUSB2 = LOW See the USB1, USB2, and USB3 Input Table in the data sheet for a description of USB input current limit and VINDPM threshold setting. Default setting is for 2500-mA input current limit and VDPM pin external resistors set the VINDPM threshold voltage to 4.4 V typical.	2-3 (IUSB2 = HIGH)
All	JP9	1-2: IUSB3 = HIGH 2-3: IUSB3 = LOW See the USB1, USB2, and USB3 Input Table in the data sheet for a description of USB input current limit and VINDPM threshold setting. Default setting is for 2500-mA input current limit and VDPM pin external resistors set the VINDPM threshold voltage to 4.4 V typical.	2-3 (IUSB3 = HIGH)

1.7 Recommended Operating Conditions

			MIN	TYP	MAX	UNIT
V_{IN}	Supply voltage	Operating input voltage from AC adapter (No charging for V_{IN} < VINDPM threshold = 4.4V)	4.2		13	V
V_{BAT}	Fully charged Battery voltage	Maximum voltage allowed at VBAT terminal (depends on status of $\overline{CE1}$ and $\overline{CE2}$ for bq24265)	4.03	4.2	4.23	V
V_{SYS}	System voltage	Maximum voltage output at SYS terminal (depends on VBAT voltage)	3.4		4.32	V
$I_{IN(MAX)}$	Supply current	Maximum input current limit for AC adapter input (set by IUSBx pins)	0.100		2.5	A
$I_{CHRG(MAX)}$	Max fast charge current	Battery charge current in constant current (CC) mode set by ISET resistor (reduced by VINDPM, ILIM, DPPM, IC thermal and/or TS control loops or $\overline{CEx}$ pin settings)	0.500		3.0	A
T_J	Operating junction temperature range		–40		125	°C

2 Test Summary

This procedure describes one test configuration of the bq24265, bq24266, and bq24267EVM-609 evaluation board for bench evaluation.

2.1 Definitions

The following naming conventions are followed.

VXXX :	External voltage supply name (VIN, VUSB)
LOAD#:	External load name
V(TPyyy):	Voltage at internal test point TPyyy. For example, V(TP12) means the voltage at TP12.
V(Jxx):	Voltage at header Jxx
V(XXX, YYY):	Voltage across point XXX and YYY.
I(JXX(YYY)):	Current going out from the YYY terminal of header XX.
Jxx(BBB):	Terminal or pin BBB of header xx
JPx ON :	Internal jumper Jxx terminals are shorted.
JPx OFF:	Internal jumper Jxx terminals are open.
JPx (-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.

Assembly drawings have location for jumpers, test points, and individual components.

2.2 Recommended Test Equipment

2.2.1 Power Supplies

1. Power supply number 1 (PS#1) capable of supplying 12 V and at least 2.0 A is required.
2. If battery as the load, then a second power supply (PS#2), capable of supplying up to 5 V at 5 A, as shown in Figure 2.

2.2.2 Load Number 1 Between BAT and GND

Testing with an actual battery is the best way to verify operation in the system. If a battery is unavailable, then sourcemeter like a Keithley 2420, capable of both sourcing and sinking current, or a circuit similar to the one shown in Figure 2 can simulate a battery when connected to PS#2.
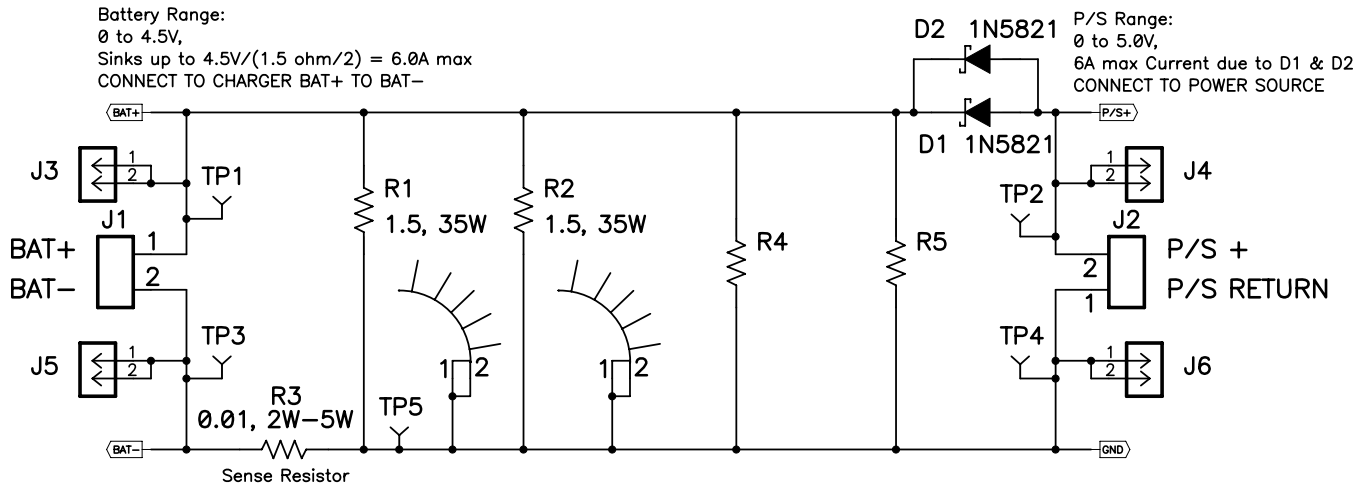
Figure 2. BAT Load (PR1010) Schematic

2.2.3 Load Number 2 Between SYS and GND

Although not required, a resistive load capable of sinking up to 3 A can be used.

2.2.4 Meters

Three equivalent voltage meters (VM#x) and two equivalent current meters (CM#x) are required. The current meters must be able to measure at least 3-A current.

2.3 Recommended Test Equipment Setup

1. For all power connections, use short, twisted-pair wires of appropriate gauge wire for the amount of the current.
2. Set PS#1 for 12 V ±100 mV, 2-A current limit, and then turn off supply. Connect the supply in to J1 or J4 and J8 (IN, GND) with a CM#1 in series with the positive connection to J1 or J4.
3. Connect VM#1 across J4 or TP5 and J8 or TP7 (IN, GND).
4. If BAT_Load (PR1010), as shown in Figure 2, is used, connect PS2 set to approximately 3.6 V to the input side (PS2±) of BAT_Load (PR1010), then turn off PS#2.

CAUTION
The heat sinks on PR1010 will be very hot.

5. Connect the output side of the battery or BAT_Load (PR1010) in series with CM#2 to J13 and J5 or J14 (BAT, GND). Ensure that VM#2 is connected across J13 or TP1 and J5 or TP3 (BAT, GND).
6. Connect VM3 across J12 or TP4 and J10 or TP3 (SYS, GND).
7. Ensure jumpers are at the default factory settings per Section 1.6.
8. After the preceding steps are accomplished, the test setup for bq24265, bq24266, and bq24267EVM-609 is as shown in Figure 3.
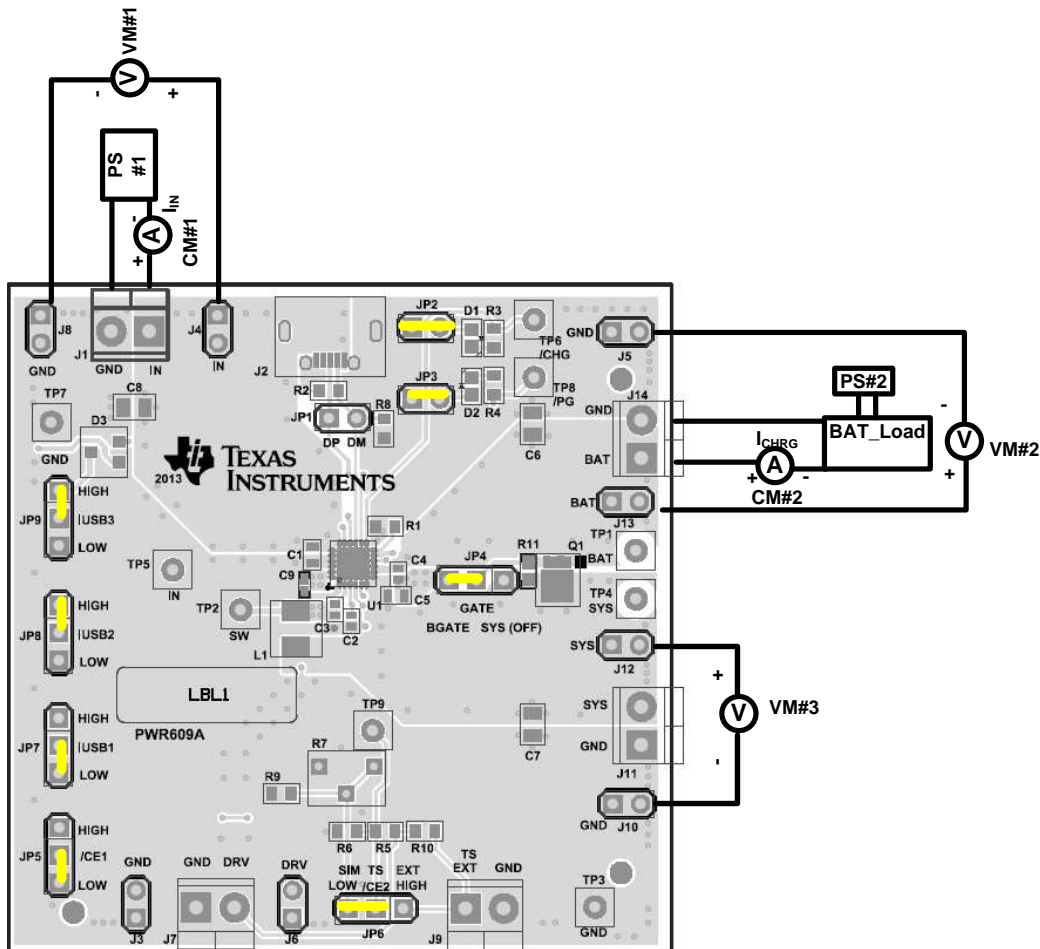
Figure 3. Test Setup for bq24265, bq24266, and bq24267 EVM (PWR609)

2.4 Recommended Test Procedure

The following test procedure may be useful for evaluating the charger IC outside of a real system, if no battery is available to connect to the output and a circuit similar to PR1010 is used to simulate a battery.

2.4.1 Charge Voltage and Current Regulation

1. Ensure that the *Section 2.3* steps are followed.
2. For bq24265EVM , move $\overline{CE1}$ (JP5) = $\overline{CE2}$ (JP6) = High. For -bq24266/7EVM, move $\overline{CE}$ (JP5) =High.
3. Turn on and adjust the PS#1 so that VM#1 reads 12.0V +/- 100mV.

   Measure on CM#1 → I(IN) < 15 mA

   Measure on CM#2 → I(BAT) = 0 mA

   Measure on VM#3 → V(SYS) = 4.28 V - 4.32 V

   Observe D1 ($\overline{CHG}$) is off

   Observe D2 ($\overline{PG}$) is on

4. Return $\overline{CE1}$ or $\overline{CE}$(JP5) to Low.
5. Adjust PS#2 so that the voltage measured by VM#2, across BAT and GND, measures 3.7V-3.8V.
6. Adjust the PS#1 so that VM#1 reads 12.0V +/- 100mV.

   Measure on CM#1 → I(IN) < 1.2 A

   Measure on CM#2 → I(BAT) = 2.85 A - 3.15 A

Measure on VM#3 → V(SYS) = 4.28 V - 4.32 V

Observe D1 ($\overline{CHG}$) is off

Observe D2 ($\overline{PG}$) is on

7. Take JP5 high, change IUSBx settings, return JP5 low then repeat steps 10 and 11 to observe operation with different input limit settings.

8. Turn off PS#1 and PS#2 when complete.

2.4.2   Helpful Hints

1. The leads and cables to the various power supplies have resistance. The current meters also have series resistance. Therefore, voltmeters must be used to measure the voltage as close to the IC pins as possible instead of relying on each supply's digital measurement.

2. When using a sourcemeter as your battery simulator, it is highly recommended to add a large (1000 µF) capacitor at the EVM BAT and GND connectors in order to prevent oscillations at the BAT pin due to mismatched impedances of the charger output and sourcemeter input within their respective regulation loop bandwidths. Configuring the sourcemeter for 4-wire sensing eliminates the need for a separate voltmeter to measure the voltage at the BAT pin. When using 4-wire sensing, the 1000-µF capacitor across is required and the sensing leads must be connected before connecting the power leads in order to prevent accidental overvoltage by the power leads.

3. To observe the taper current as the battery voltage approaches the set regulation voltage, allow the battery to charge, or if using BAT_Load (PR1010), slowly increase the PS2 voltage powering BAT_Load (PR1010). Use VM#2 across BAT and GND to measure the battery voltage seen by the IC.

4. For precise measurements of charge current and battery regulation near termination, remove the current meter in series with the battery or battery simulator. An alternate method for measuring charge current is to either use an oscilloscope with hall effect current probe or place a 1% or better, thermally capable (for example, 0.010 Ω in 1210 or larger footprint) resistor in series between the BAT or GND pins and battery and measure the voltage across that resistor. PR1010 resistor R3 is such a resistor.

5. To observe the V_{INDPM} function, lower the current limit on PS#1 (with 3.1 V < VBAT < 4.2 V).

6. To observe the DPPM (power path) function, increase the load across SYS and GND until the charge current drops below the fast charge current level (with 3.1 V < VBAT < 4.2 V).

7. To observe battery supplement mode, increase the load across SYS and GND until the charge current drops below zero (with 3.1 V < VBAT < 4.2 V).

3   PCB Layout Guidelines

1. To minimize EMI, proper layout is critical. Placement of the PMID and IN caps as close as possible between their respective pins and power PGND are most critical, followed by the SYS capacitor.

2. Place all decoupling capacitors close to their respective IC pins and as close as possible to PGND (do not place components such that routing interrupts power stage currents). All small control signals must be routed away from the high-current paths.

3. The PCB must have a ground plane (return) connected directly to the return of all components through vias (two vias per capacitor for power-stage capacitors, one via per capacitor for small-signal components). TI also recommends to put vias inside the PGND pads for the IC, if possible. A star ground design approach is typically used to keep circuit block currents isolated (high-power/low-power small-signal), which reduces noise-coupling and ground-bounce issues. A single ground plane for this design gives good results. With this small layout and a single ground plane, no ground-bounce issue occurs, and having the components segregated minimizes coupling between signals.

4. The high-current charge paths into IN, BAT, SYS, and from the SW pins must be sized appropriately for the maximum charge current in order to avoid voltage drops in these traces. The PGND pins must be connected to the ground plane to return current through the internal low-side FET.

5. For high-current applications, the balls for the power paths must be connected to as much copper in the board as possible. This allows better thermal performance because the board conducts heat away from the IC.

4 Bill of Materials and Board Layout

This section contains the bill of materials (BOM) and the PCB board layout.

4.1 Bill of Materials

Table 1 lists the bq24265/6/7 BOM.

Table 1. Bill of Materials – PWR609[1]

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
PCB	1		Printed Circuit Board		PWR609	Any
C1	1	4.7uF	CAP CER 4.7UF 25V 20% X5R 0603	603	C1608X5R1E475M080AC	TDK
C2, C4	2	1.0uF	CAP CER 1UF 10V 10% X5R 0402	402	C1005X5R1A105K050BB	TDK
C3	1	0.033uF	CAP CER 0.033UF 10V 10% X5R 0402	402	GRM155R61A333KA01D	Murata
C5	1	10uF	Capacitor, Ceramic, 10V, X5R, 20%	603	C1608X5R1A106M080AC	TDK
C7	1	10uF	Capacitor, Ceramic, 10V, X5R, 20%	1210	LMK325BJ106MD-T	Taiyo Yuden
C9	1	1.0uF	Capacitor, Ceramic Chip, 25V, ±10%	402	C1005X5R1E105K050BC	TDK
D1	1	LTST-C190GKT	Diode, LED, Green, 2.1-V, 20-mA, 6-mcd	603	LTST-C190GKT	Lite On
D2	1	LTST-C190CKT	Diode, LED, Red, 2.1-V, 20-mA, 6-mcd	603	LTST-C190CKT	Lite On
D3	1	BAT54C	Diode, Dual Schottky, 200-mA, 30-V	SOT23	BAT54C	Vishay-Liteon
J1, J7, J9, J11, J14	5	ED555/2DS	Terminal Block, 2-pin, 6-A, 3.5mm	0.27 x 0.25 inch	ED555/2DS	OST
J2	1	ZX62D-AB-5P8	Connector, USB Micro, Type AB	0.315 X 0.200 inch	ZX62D-AB-5P8	Hirose
J3, J4, J5, J6, J8, J10, J12, J13, JP2, JP3	10	PEC02SAAN	Header, Male 2-pin, 100mil spacing,	0.100 inch x 2	PEC02SAAN	Sullins
JP4, JP5, JP6, JP7, JP8, JP9	6	PEC03SAAN	Header, Male 3-pin, 100mil spacing,	0.100 inch x 3	PEC03SAAN	Sullins
L1	1	1.5 uH	Inductor, I_R=3.1A, I_{SAT}=3.5A, 59 mΩ typ Inductor, I_R=3.3A, I_{SAT}=4.1A, 64 mΩ typ Inductor, I_R=3.0A, I_{SAT}=4.0A, 55 mΩ typ	.1mm x 4.40 mm x1.2mm 4.1mm x 4.40 mm x1.0mm 4.1mm x 4.45 mm x1.0mm	SPM4012T-1R5M/ Alt: FDSD0415-H-1R5M Alt:S13100073	TDK Toko Wurth Elektronik
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	PCB Label 0.650"H x 0.200"W	THT-14-423-10	Brady
Q1	1	CSD25401Q3	MOSFET, PChan, -20V, 60A, 8.7 milliOhm	QFN3.3X3.3mm	CSD25401Q3	TI
R1	1	402	RES 402 OHM 1/16W 1% 0402 SMD	402	CRCW0402402RFKED	Vishay
R2	1	26.7k	RES 26.7K OHM 1/16W 1% 0402 SMD	402	CRCW040226K7FKED	Vishay
R3, R4	2	1.50k	RES 1.50K OHM 1/10W 1% 0603 SMD	603	CRCW06031K50FKEA	Vishay
R5	1	5.62K	RES 5.62K OHM 1/16W 1% 0402 SMD	402	CRCW04025K62FKED	Vishay
R6	1	12.4K	RES 12.4K OHM 1/16W 1% 0402 SMD	402	CRCW040212K4FKED	Vishay
R7	1	50k	TRIMMER 50K OHM 0.25W PC PIN	0.264" L x 0.177"	3266W-1-503LF	Bourns
R8	1	10K	RES 10.0K OHM 1/16W 1% 0402 SMD	402	CRCW040210K0FKED	Vishay
R11	1	1.0Meg	RES, 1.0Meg ohm, 5%, 0.1W, 0603	0603	CRCW06031M00JNEA	Vishay-Dale

[1] Unless otherwise noted in the Alternate Part Number and Alternate Manufacturer columns, all parts can be substituted with equivalents.

Table 1. Bill of Materials – PWR609[1] (continued)

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9	9	5002	Test Point, White, Thru Hole Color Keyed	0.100 x 0.100 inch	5002	Keystone
U1	1		3A, Standalone Single-Input, Single Cell Switchmode Li-Ion Battery Charger with Power Path Management, RGE0024H	RGE0024H	BQ24266RGE	Texas Instruments
C6, C8	0	Open	Capacitor, Ceramic,	805	STD	STD
JP1	0	PEC02SAAN	Header, Male 2-pin, 100mil spacing,	0.100 inch x 2	PEC02SAAN	Sullins
R9, R10	0	0	RES 0.0 OHM 1/10W JUMP 0603 SMD	603	CRCW06030000Z0EA	Vishay

4.2 Board Layout
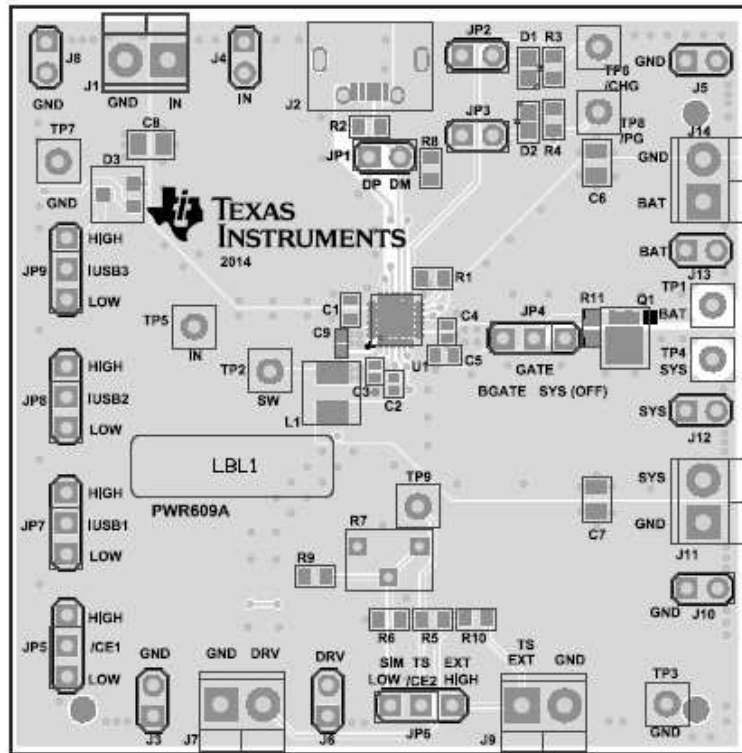
Figure 4. Top Assembly Layer

Figure 5. Top Layer

User's Guide for QFN Packaged bq24265, bq24266, and bq24267 3-A
Battery Charger Evaluation Module
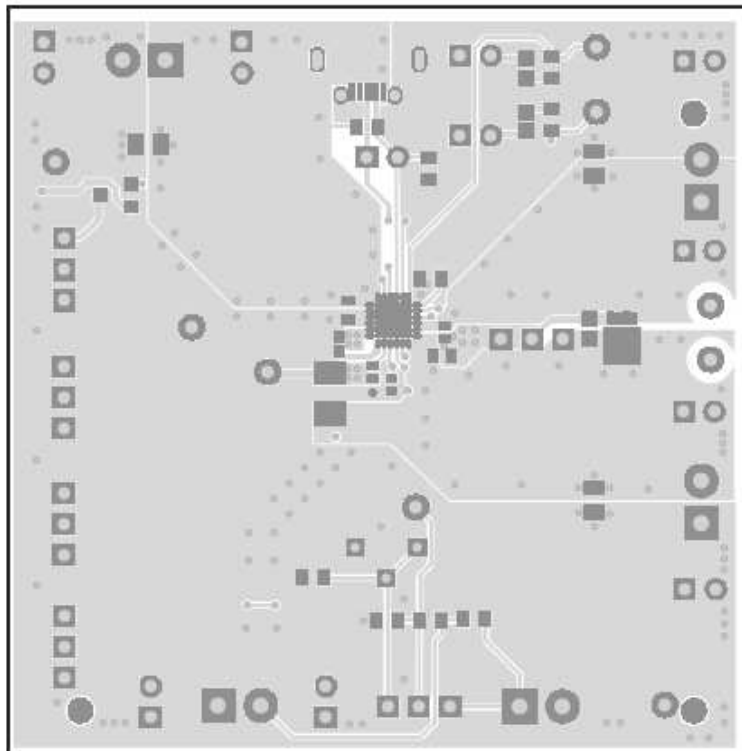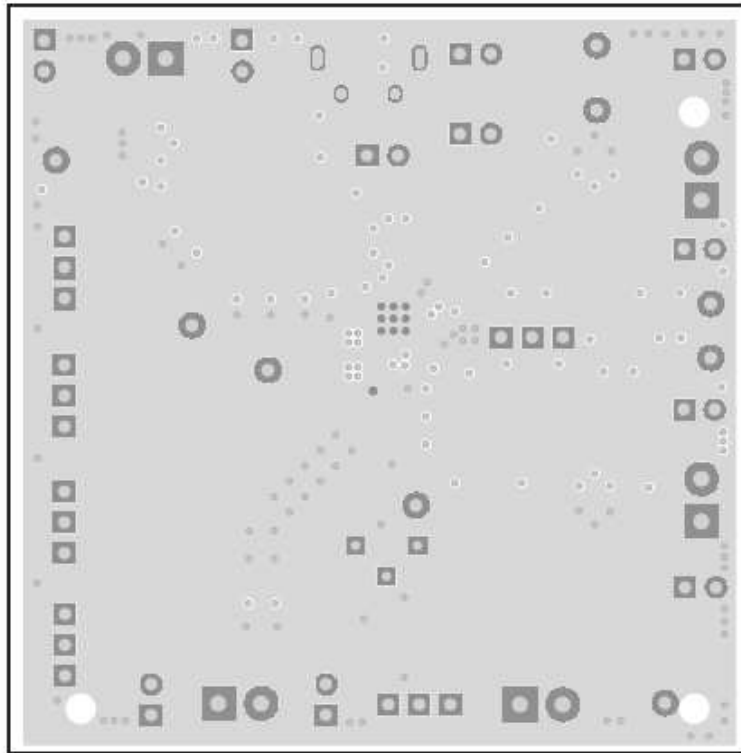
Figure 6. Bottom Layer
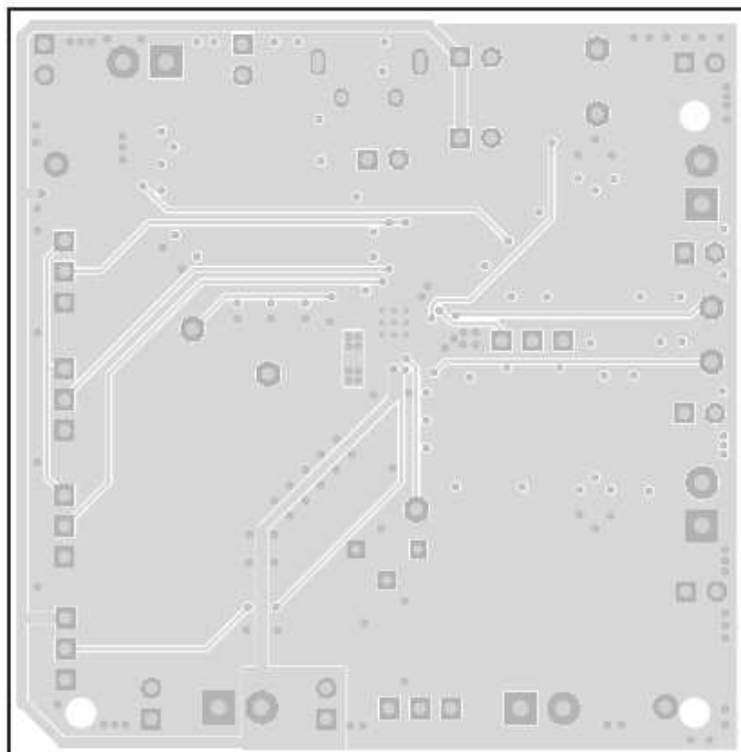
Figure 7. First Internal Layer

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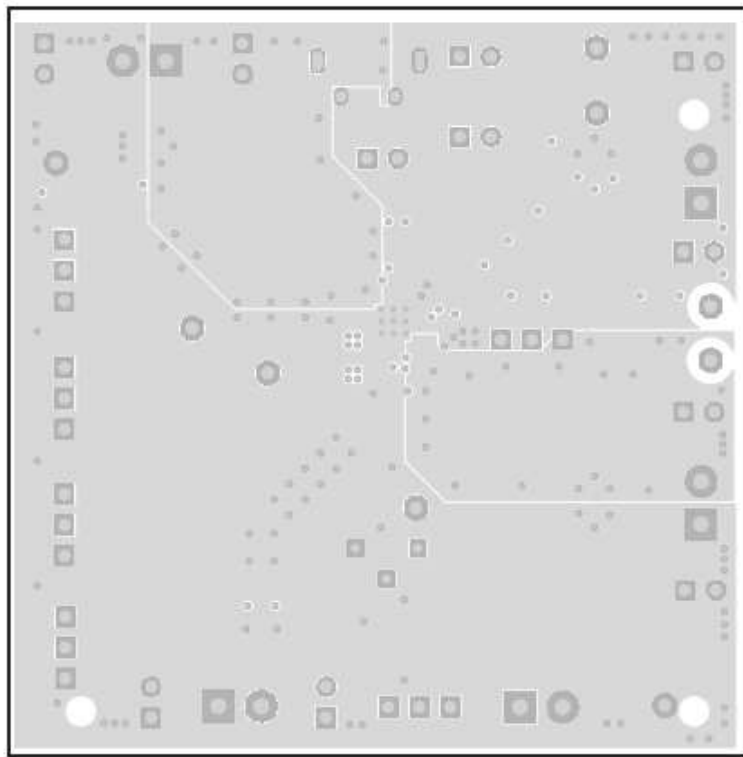
Figure 8. Second Internal Layer

Revision History

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9. User assumes sole responsibility to determine whether EVMs may be subject to any applicable federal, state, or local laws and regulatory requirements (including but not limited to U.S. Food and Drug Administration regulations, if applicable) related to its handling and use of EVMs and, if applicable, compliance in all respects with such laws and regulations.
10. User has sole responsibility to ensure the safety of any activities to be conducted by it and its employees, affiliates, contractors or designees, with respect to handling and using EVMs. Further, user is responsible to ensure that any interfaces (electronic and/or mechanical) between EVMs and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard.
11. User shall employ reasonable safeguards to ensure that user's use of EVMs will not result in any property damage, injury or death, even if EVMs should fail to perform as described or expected.
12. User shall be solely responsible for proper disposal and recycling of EVMs consistent with all applicable federal, state, and local requirements.

Certain Instructions. User shall operate EVMs within TI's recommended specifications and environmental considerations per the user's guide, accompanying documentation, and any other applicable requirements. Exceeding the specified ratings (including but not limited to input and output voltage, current, power, and environmental ranges) for EVMs may cause property damage, personal injury or death. If there are questions concerning these ratings, user should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the applicable EVM user's guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative. During normal operation, some circuit components may have case temperatures greater than 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using EVMs' schematics located in the applicable EVM user's guide. When placing measurement probes near EVMs during normal operation, please be aware that EVMs may become very warm. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use EVMs.

Agreement to Defend, Indemnify and Hold Harmless. User agrees to defend, indemnify, and hold TI, its directors, officers, employees, agents, representatives, affiliates, licensors and their representatives harmless from and against any and all claims, damages, losses, expenses, costs and liabilities (collectively, "Claims") arising out of, or in connection with, any handling and/or use of EVMs. User's indemnity shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if EVMs fail to perform as described or expected.

Safety-Critical or Life-Critical Applications. If user intends to use EVMs in evaluations of safety critical applications (such as life support), and a failure of a TI product considered for purchase by user for use in user's product would reasonably be expected to cause severe personal injury or death such as devices which are classified as FDA Class III or similar classification, then user must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

RADIO FREQUENCY REGULATORY COMPLIANCE INFORMATION FOR EVALUATION MODULES

Texas Instruments Incorporated (TI) evaluation boards, kits, and/or modules (EVMs) and/or accompanying hardware that is marketed, sold, or loaned to users may or may not be subject to radio frequency regulations in specific countries.

General Statement for EVMs Not Including a Radio

For EVMs not including a radio and not subject to the U.S. Federal Communications Commission (FCC) or Industry Canada (IC) regulations, TI intends EVMs to be used only for engineering development, demonstration, or evaluation purposes. EVMs are not finished products typically fit for general consumer use. EVMs may nonetheless generate, use, or radiate radio frequency energy, but have not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or the ICES-003 rules. Operation of such EVMs 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: For EVMs including a radio, the radio included in such EVMs is intended for development and/or professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability in such EVMs and their development application(s) must comply with local laws governing radio spectrum allocation and power limits for such EVMs. 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 TI unless user has obtained appropriate experimental and/or development licenses from local regulatory authorities, which is the sole responsibility of the user, including its acceptable authorization.

U.S. Federal Communications Commission Compliance

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 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 its 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.

Industry Canada Compliance (English)

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.

Canada Industry Canada Compliance (French)

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 Considered "Radio Frequency Products" in Japan

EVMs entering Japan are NOT certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If user uses EVMs in Japan, user is required by Radio Law of Japan to follow the instructions below with respect to EVMs:

1. Use EVMs 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 EVMs only after user obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after user obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless user gives the same notice above to the transferee. Please note that if user does not follow the instructions above, user will be subject to penalties of Radio Law of Japan.

http://www.tij.co.jp

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IMPORTANT NOTICE

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