bq24076 and bq24078 1.5-A Single-Chip Li-Ion and Li-Polymer Charge Management IC EVM

This user's guide describes the bq24076 and bq24078 (hereafter, bq24076/8) evaluation module (EVM). The EVM provides a convenient method for evaluating the performance of a charge management and system power solution for portable applications using the bq24076/8 product families. A completely designed and tested module is presented. The charger is designed to deliver up to 1.5 A of continuous current to the system or charger for one-cell Li-ion or Li-polymer applications (see the data sheet for correct device) using a DC power supply. The charger is programmed from the factory to deliver 0.9 A of charging current. This EVM was designed as a stand-alone evaluation module, but it also can be interfaced with the system and host via the connectors and headers.

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Trademarks

1 Introduction

The bq24076/8 powers the system while independently charging the battery. This feature reduces the charge and discharge cycles on the battery, allows for proper charge termination, and allows the system to run with an absent or defective battery pack. This feature also allows for the system to instantaneously turn on from an external power source even when using a deeply discharged battery pack.

This charger has one input and can be programmed to be used with an adapter or USB port as the power source for the system. In the USB configuration, the host can select from the two preset input maximum rates of 100 mA and 500 mA. The charger dynamically adjusts the charge rate based on the system load to stay within the 100-mA or 500-mA maximum limits. An external resistor, RSET1, sets the magnitude of the charge current. If the charge current exceeds the available input current, the voltage on the OUT pin drops to the DPPM threshold or the battery voltage, whichever is higher. The charging current is reduced to what current is available ($I_{BAT} = I_{IN} – I_{OUT}$).

The integrated circuit (IC) charges the battery in three phases: conditioning, constant current, and constant voltage. Charge is terminated based on minimum current. A resistor-programmable charge timer provides a backup safety for charge termination. The charge automatically re-starts if the battery voltage falls below an internal threshold. Sleep mode is entered when the supply is removed (V_{IN} drops to the battery voltage).

2 Considerations When Testing and Using bq24076/8 ICs

The bq24076/8 series targets current above a nominal 500 mA (> 350 mA) and the differences are listed in Table 1.

Table 1. Ordering Information

Part Number	V_{OVP}	V_{BAT}	$V_{OUT(REG)}$	V_{DPM}	Marking
bq24076RGTR	6.6 V	4.4 V	V_{BAT} + 210 mV	V_{BAT} + 100 mV	CDU
bq24078RGTR	6.6 V	4.35 V	V_{BAT} + 210 mV	V_{BAT} + 100 mV	ODI

The bq24076/8 are suited for headset designs. The pinout of each IC is the same.

The two potential sources to power the system (V_{OUT}) are the input source and the battery (adapter or USB port). The IC is designed to power the system continuously. The battery, in most cases, is the last line of backup. If the adapter or USB input is not available (or disabled), the battery connects to the system.

In thermal regulation condition (T_J = 125°C not a first-choice design mode of operation), the charge current is reduced to the battery, and the system still gets its power from the input. The battery supplement is available in thermal regulation if the V_{OUT} falls to V_{BAT}. In thermal cutoff (approximately 155°C), the input sources are disconnected, but the internal battery FET connects the battery to V_{OUT}.

3 Performance Specification Summary

Table 2 summarizes the performance specifications of the EVM.

Table 2. Performance Specification Summary for bq24076/8 EVMs

Specification	Test Conditions	MIN	TYP	MAX	Units
Input DC Voltage, $V_{I(AC)}$		4.75	5	6.5	Volts
Battery Charge Current, $I_{O(CHG)}$			1	1.5	Amperes
Power Dissipation, bq24076/8 IC, 1 Cell	Pdiss = $(V_{IN} – V_{OUT})I_{OUT} + (V_{IN} – V_{BAT})I_{BAT}$			See (1)	Watts

(1) The BMS015 (bq24076/8) thermal design is optimized (8^+ vias, 0.031-inch PCB, 2-oz. copper) to give θ_{JA} approximately 27°C/W.

3.1 Performance Recommendations

This IC is a linear battery charger and also powers the system from the input via the linear regulator output. The key here is that this is a linear device that is most efficient when the input voltage is not too far above the battery voltage (V_{IN} = 4.75 V to 5.5 V). Input voltage that is too low (less than the OUT voltage plus the dropout voltage) results in degraded performance. Excessive input voltage (> 5.5 V) results in excess power dissipation and reduced performance via thermal regulation. The IC is rated to 28 V, and will not be damaged with V_{IN} voltages less than this, but any V_{IN} voltage over the overvoltage protection (OVP) threshold disables the IC. Thus, the recommended operating range for maximum performance is between 4.75 V and 5.5 V, with a preference toward the lower values.

4 Test Summary

This section covers the setup and tests performed in evaluating the EVM.

4.1 Equipment

- Power supply (PS) (+5.25 ±0.25 V_{DC}), current limit set to 2 A ±0.2 A
- Three Fluke 75 DMMs (equivalent or better)
- Oscilloscope, Model TDS220 (equivalent or better)

4.2 Equipment and EVM Setup

- Preset power supply #1 to 5.25 V ±0.25 V, 2 A ±0.25-A current limit, turn off and connect to J1, IN and GND (+ to IN and – to GND)
- Connect a 10-Ω, 10-W resistor to J2, OUT and VSS
- Connect a fully discharged (V_{BAT} < 2.8 V) battery to J3, BAT+ and VSS (+ to BAT+ and – to VSS).
- Apply the jumpers as per Table 3.
- For the bq24076/8 EVM, adjust the potentiometers as follows (measure resistance from TP# to VSS):
  - R8 (ILIM-TP12) = 750 Ω (743 to 757); R11 (ISET-TP16) = 1 kΩ (0.98 kΩ to 1.02 kΩ) and R16 (TS-TP1) = 7.5 kΩ (7.3 kΩ to 7.7 kΩ).

Table 3. bq240xx

Jumper	'76, '78
JMP1 (J5)	RES–TMR
JMP2 (J6)	OFF–V_{SS}
JMP3	CE–V_{SS}
JMP4	EN2–HI
JMP5	EN1–V_{SS}

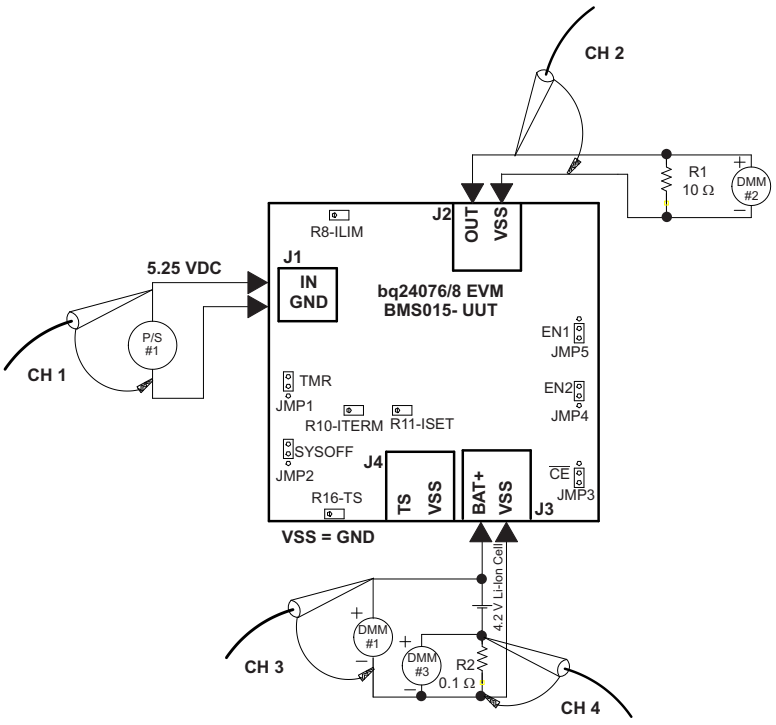


Figure 1. Test Diagram

4.3 Test Procedure

1. Verify that the equipment and EVM is set up according to the preceding section.
2. Verify that V_{OUT} is approximately equal to V_{BAT}
3. Turn on PS#1, +5.25-V_{DC} supply to the UUT.
4. Verify V_{BAT} is between 2.4 V_{DC} and 3 V_{DC}, and the charger is in precharge state: LEDs CHG (D1) and PGOOD (D2) are on. If V_{BAT} is above the low-voltage threshold ($V_{(LOWV)}$ approximately 3 V), then the IC is in fast-charge mode. If the IC is in fast charge, skip step 7.
5. Verify DMM#3, I_{BAT} is approximately 9 mV or approximately 0.09 A
6. Verify that V_{OUT} for bq24076/8 is approximately 210 mV above the battery voltage or a minimum of 3.4 V_{DC}.
7. Allow the battery to charge until V_{BAT} is between 3.3 V_{DC} and 4 V_{DC}. The charger delivers the programmed constant current to the battery unless the input cannot source the required current.
8. Verify I_{BAT} is approximately 88 mV or approximately 0.9 A (for a 1-kΩ resistor on *ISET*).
9. Verify V_{OUT}: bq24076/8 – approximately 210 mV above the battery voltage.
10. Set JMP5 (EN1) to HI, and verify that the chip has been disabled, D1 (CHG) has turned off, and the PS#1 current has dropped to zero. The internal battery FET must be on, connecting the BAT pin to the OUT pin. Verify that the voltage on the OUT pin is close to the battery voltage. See Figure 2 for EN1 and EN2 modes of operation.
11. SET JMP4 (EN2) to VSS. Verify that the input current is less than 500 mA (USB 500-mA mode). If the input current is restricted due to USB mode, or if the adapter is current limiting, the OUT pin drops in voltage and enters the DPM mode, if the system current is less than the restricted input current. This IC must be in DPM mode with the system voltage at the DPM
12. Set JMP5 (EN1) to VSS and verify USB 100-mA mode. The system load is more than the allowed 100 mA on the input, so the OUT voltage drops to the battery voltage, and the battery FET is switched on and supplements the input current. Verify that V_{OUT} has dropped just below the battery voltage and the battery is supplying I_{BAT}, approximately (V_{OUT} / 10 Ω – 100 mA).
13. Set JMP4 (EN2) to HI to return to the ISET mode where the programmed current is approximately 0.9 A.
14. Set JMP3 to HI, and verify that the charging is disabled and that the CHG LED (D1) turns off. Verify that the system is still powered by the input. See Figure 3.
15. Set JMP3 to VSS, and verify that charging continues and that D1 turns on.
16. Record the OUT voltage and battery charge current. Adjust R8 CCW until the input current starts to be reduced (approximately 2 turns). Note how the OUT voltage drops and the charge current is reduced as the input current limit loops activates and limits the input current. Adjust R8 to its original position
17. On the bq24076/8 IC, set JMP2 HI, and verify that the BAT FET turns off and allows no charging or discharging of the battery.
18. Adjust the R16 (TS-Pot) up or down until the TS threshold is reached. Verify that the charging current is disabled. Return the TS resistance within the normal range and verify the continued charging operation.
19. Allow the battery to continue to charge until the battery reaches voltage regulation, approximately 4.4 V ±40 mV for bq24076 and 4.35 V ±40 mV for bq24078. Verify that the voltage is regulated as the current tapers over the next one-to-two hours depending on the battery capacity. See Figure 4 for a charge profile (time in plot is not proportional to actual charge time).
20. Verify that the current tapers to around 90 mA (9 mV on DMM#3) when termination occurs.
21. Verify that the LED, D1, turns off and the current drops to zero.
22. Turn off PS#1, and allow the system load to discharge the battery until a refresh charge is initiated. Verify that the battery voltage dropped to approximately 4.3 V for bq24076 and to 4.25 V for bq24078 prior to refresh.
23. Verify that the LED, D1, did not turn on for the refresh cycle.

This concludes the procedure for demonstrating the features of this power path charger. See *bq2407x 1.5-A USB-Friendly Li-Ion Battery Charger and Power-Path Management IC Data* for more detailed explanations and instructive waveforms.

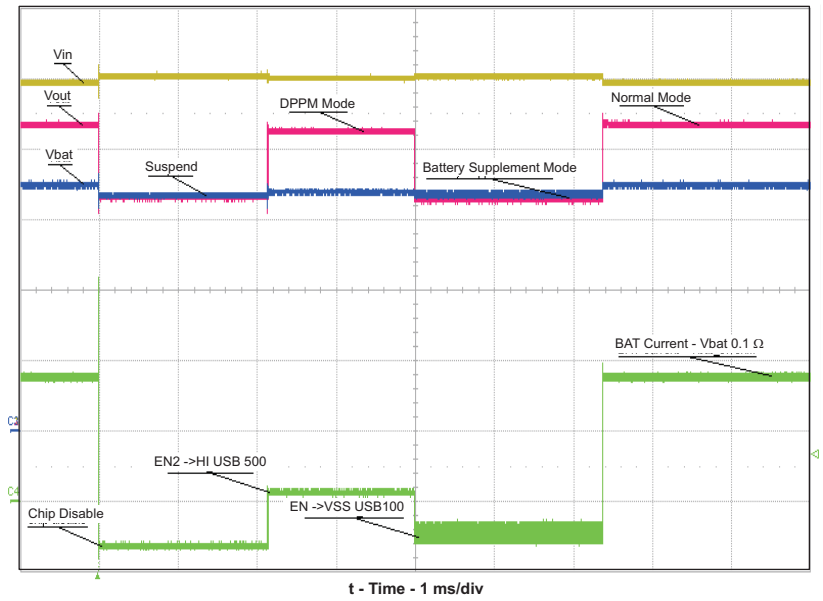


Figure 2. Modes of Operation Tested in Steps 11 Through 13

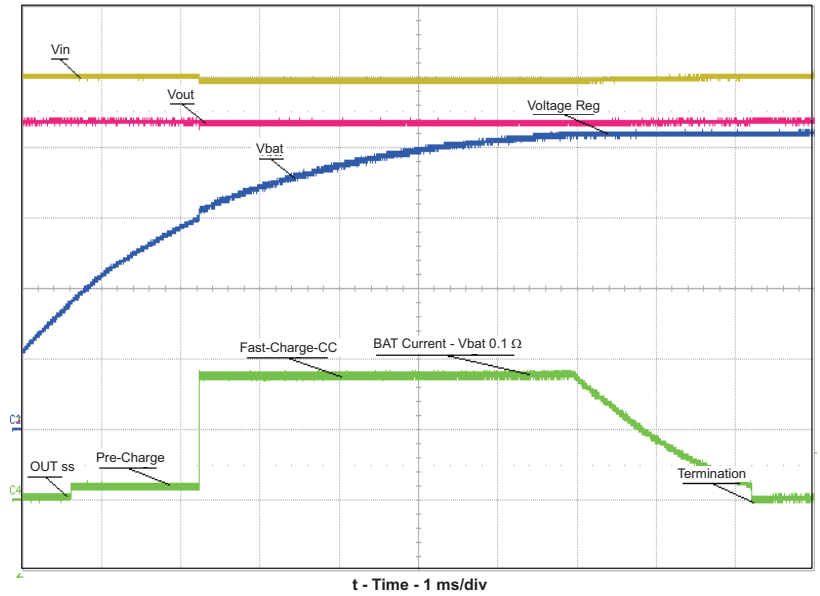


Figure 3. Charger Profile With EN1 = VSS and EN2 = HI, Programmed by ISET

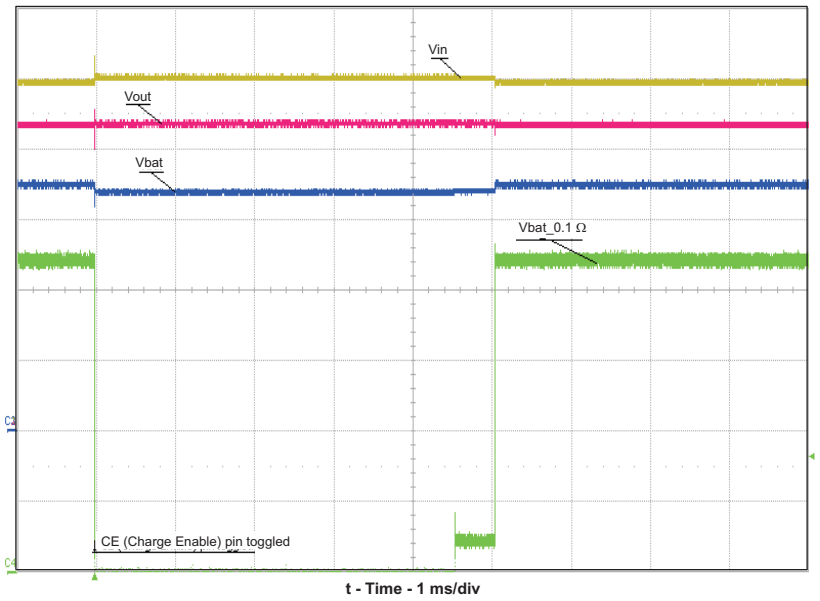
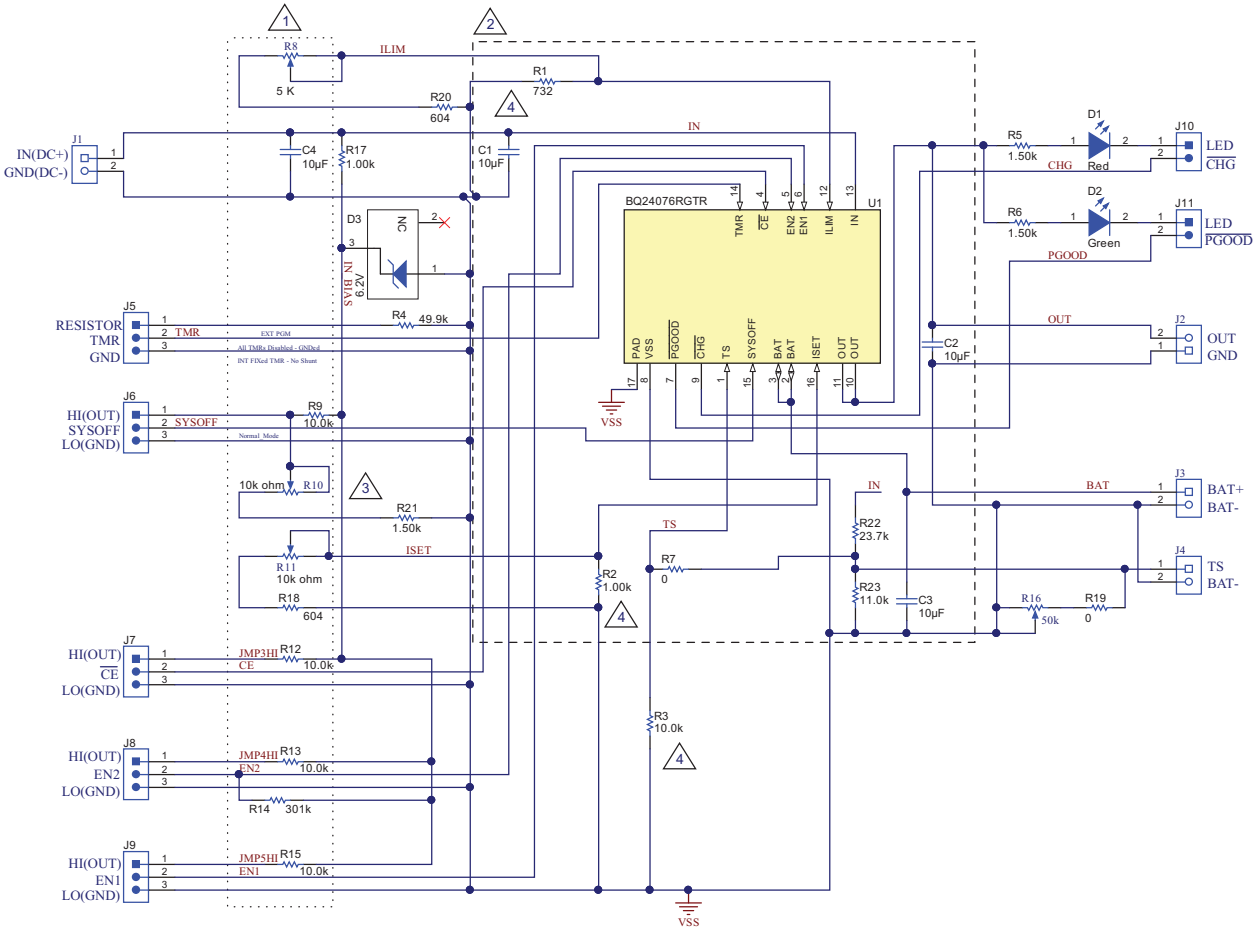


Figure 4. Charge Enabled, Pulled High, Then Low – Disables Charge

5 Schematic

The bq24076/8 EVM schematic is shown in Figure 5



1 Resistors, in dotted box, typically not needed in a design but used here to assist in evaluation of the IC or to protect the EVM from incorrect input connections (R8 through R14). C4 may be used, if needed, for higher current appli cations.

2 Resistors, in the dashed box are the required components for a simplified design. Components outside the dashed box are optional components. See data sheet for more detail on desired features.

3 R10 is not need.

4 Not used See BOM for different Configurations.

Figure 5. Schematic

6 Physical Layouts

This section contains the board layout and assembly drawings for the EVM.

6.1 Board Layout

Figure 6 shows the top assembly view of the EVM. Figure 7 shows the top etch layer of the EVM and Figure 8 shows the bottom etch layer.

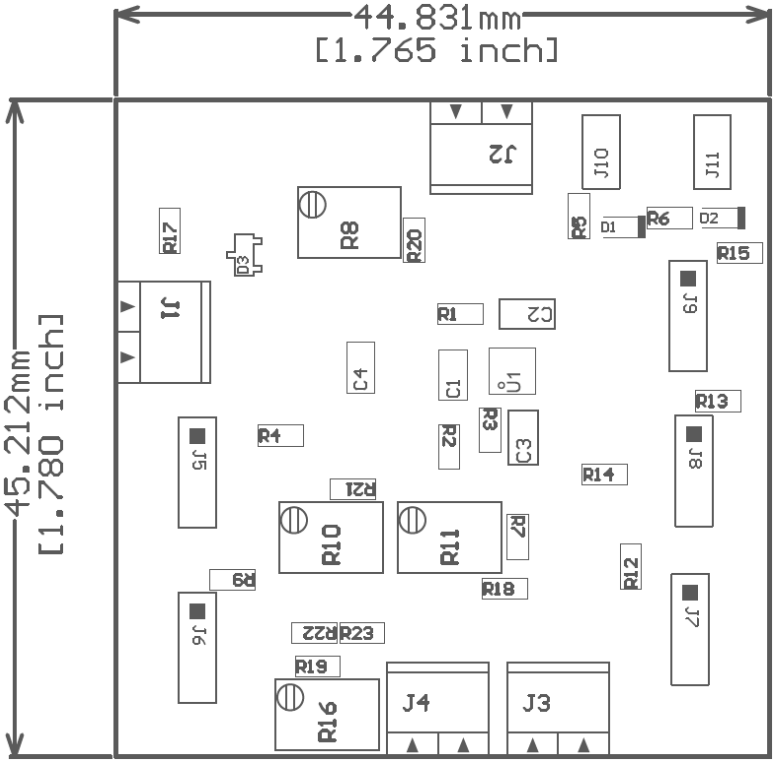


Figure 6. Top Assembly View

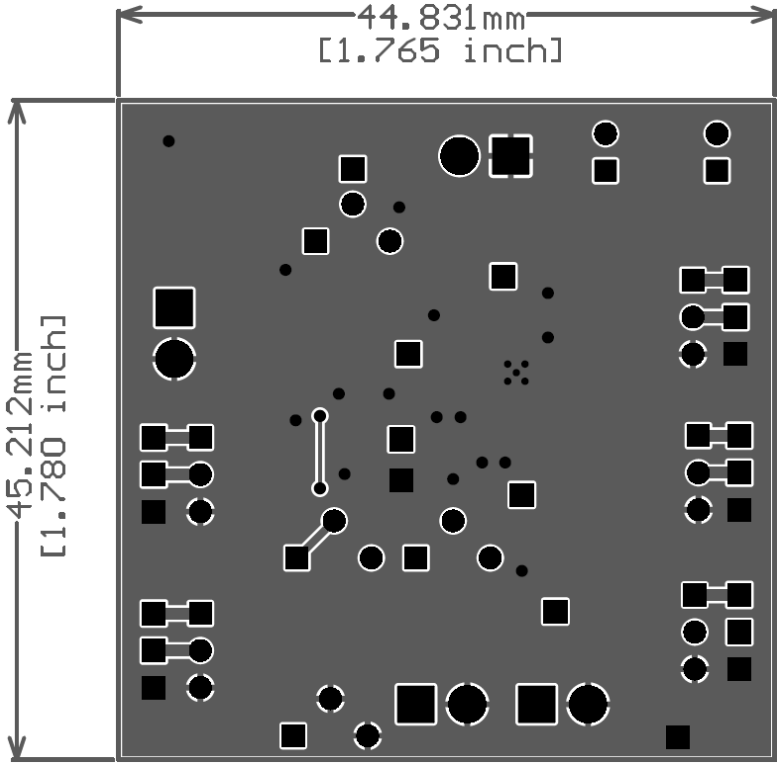


Figure 7. Board Layout – Top Etch Layer

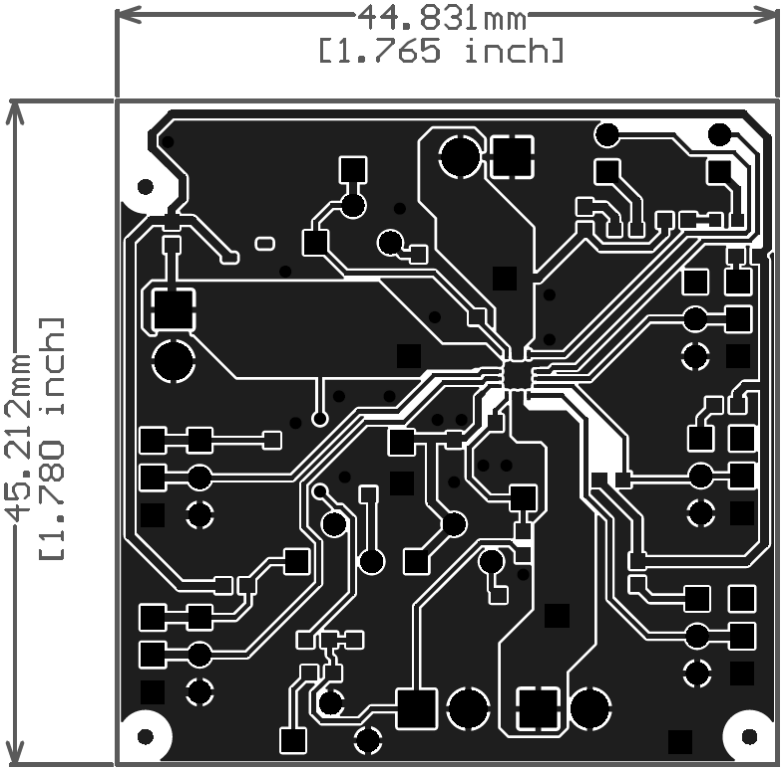


Figure 8. Board Layout – Bottom Etch Layer

7 Bill of Materials

Table 4 lists the EVM BOM.

Table 4. BMS015 Bill of Materials(1)

Designator	QTY	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
!PCB	1		Printed Circuit Board		BMS015	Any	-	-
C1, C4	2	10uF	CAP, CERM, 10 µF, 25 V,+/- 10%, X7R, 1206	1206	C1206C106K3RACTU	Kemet		
C2, C3	2	10uF	CAP, CERM, 10 µF, 6.3 V,+/- 10%, X7R, 0805	0805	JMK212B7106KG-T	Taiyo Yuden		
D1	1	Red	LED, Red, SMD	Red LED, 1.6x0.8x0.8mm	LTST-C190CKT	Lite-On		
D2	1	Green	LED, Green, SMD	1.6x0.8x0.8mm	LTST-C190GKT	Lite-On		
D3	1	6.2V	Diode, Zener, 6.2 V, 225 mW, SOT-23	SOT-23	BZX84C6V2LT1G	ON Semiconductor		
J1, J2, J3, J4	4		Terminal Block, 3.5mm Pitch, 2x1, TH	7.0x8.2x6.5mm	ED555/2DS	On-Shore Technology		
J5, J6, J7, J8, J9	5		Header, 100mil, 3x1, Tin, TH	Header, 3 PIN, 100mil, Tin	PEC03SAAN	Sullins Connector Solutions		
J10, J11	2		Header, 100mil, 2x1, Tin, TH	Header, 2 PIN, 100mil, Tin	PEC02SAAN	Sullins Connector Solutions		
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	-	-
R1	1	732	RES, 732, 1%, 0.1 W, 0603	0603	RC0603FR-07732RL	Yageo America		
R2, R17	2	1.00k	RES, 1.00 k, 1%, 0.1 W, 0603	0603	RC0603FR-071KL	Yageo America		
R3, R9, R12, R13, R15	5	10.0k	RES, 10.0 k, 1%, 0.1 W, 0603	0603	RC0603FR-0710KL	Yageo America		
R4	1	49.9k	RES, 49.9 k, 1%, 0.1 W, 0603	0603	RC0603FR-0749K9L	Yageo America		
R5, R6, R21	3	1.50k	RES, 1.50 k, 0.5%, 0.1 W, 0603	0603	RT0603DRE071K5L	Yageo America		
R7, R19	2	0	RES, 0, 5%, 0.1 W, 0603	0603	RC0603JR-070RL	Yageo America		
R8	1	5 K	Trimmer, 5k ohm, 0.25W, TH	4.5x8x6.7mm	3266W-1-502LF	Bourns		
R11	1	10k ohm	Trimmer, 10k ohm, 0.25W, TH	4.5x8x6.7mm	3266W-1-103LF	Bourns		
R14	1	301k	RES, 301 k, 1%, 0.1 W, 0603	0603	CRCW0603301KFKEA	Vishay-Dale		
R16	1	50k	Trimmer, 50k ohm, 0.25W, TH	4.5x8x6.7mm	3266W-1-503LF	Bourns		
R18, R20	2	604	RES, 604, 1%, 0.1 W, 0603	0603	CRCW0603604RFKEA	Vishay-Dale		
U1	1	bq24076/8RGT	1.5-A USB-Friendly Li-Ion Battery Charger and Power-Path Management IC, RGT0016C (VQFN-16)	RGT0016C	BQ24076RGTR or BQ24078RGTR	Texas Instruments	BQ24076RGTT or BQ24078RGTT	Texas Instruments
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A		
R10	0	10k ohm	Trimmer, 10k ohm, 0.25W, TH	4.5x8x6.7mm	3266W-1-103LF	Bourns		
R22	0	23.7k	RES, 23.7 k, 1%, 0.1 W, 0603	0603	RC0603FR-0723K7L	Yageo America		
R23	0	11.0k	RES, 11.0 k, 1%, 0.1 W, 0603	0603	RC0603FR-0711KL	Yageo America		

(1) Unless otherwise noted in the *Alternate Part Number* or *Alternate Manufacturer* columns, all parts may be substituted with equivalents.

8 References

1. Texas Instruments, *bq2407x 1.5-A USB-Friendly Li-Ion Battery Charger and Power-Path Management IC Data Sheet*

STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an “EVM” or “EVMs”) to the User (“User”) in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.

   1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM (“Software”) shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software

   1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

2 *Limited Warranty and Related Remedies/Disclaimers*:

   2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

   2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

   2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

3 *Regulatory Notices:*

   3.1 *United States*

      3.1.1 *Notice applicable to EVMs not FCC-Approved:*

      FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

      3.1.2 *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

      NOTE: 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

NOTE: 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.*

3.2 *Canada*

3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. 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.

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.

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.

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

3.3 *Japan*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

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.

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1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
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西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

3.4 *European Union*

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive)*:

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, 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 also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user 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, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM 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. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

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