bq294502 Voltage Protector for 2-Series or 3-Series Cell Li-Ion Batteries EVM

The bq294502 EVM is a complete evaluation system for the bq2945xy family of second-level protectors. The EVM includes one bq294502-based circuit module.

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1 Features

- bq294502-based circuit module
- Link to support documentation

1.1 Ordering Information

Table 1. Ordering Information

EVM Part Number	Chemistry	Configuration	Capacity
bq294502EVM-001	Li-Ion	2-Series or 3-Series Cell	Any

2 bq294502-Based Circuit Module

The bq294502-based circuit module is a complete and compact example solution of a bq294502 second-level voltage protector. The circuit module includes one bq294502 IC, fuse blow circuitry, a fuse blow delay capacitor, and all other onboard components necessary to use and interface with the protector. The circuit module connects directly across the cells in a battery.

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2.1 Circuit Module Connections

Contacts on the circuit module provide the following connections:

- Direct connection to the cells: VSS, VC1, VC2, VC3
- The system load and charger connect across PACK+ and PACK–

2.2 Pin Descriptions

PIN NAME	DESCRIPTION
VSS	–ve connection of first (bottom) cell
VC1	+ve connection of first (bottom) cell
VC2	+ve connection of second cell
VC3	+ve connection of third cell
PACK–	Pack negative terminal
PACK+	Pack positive terminal

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3 bq294502 Circuit Module Schematic

This section contains information on the schematic for the bq294502 implementation.

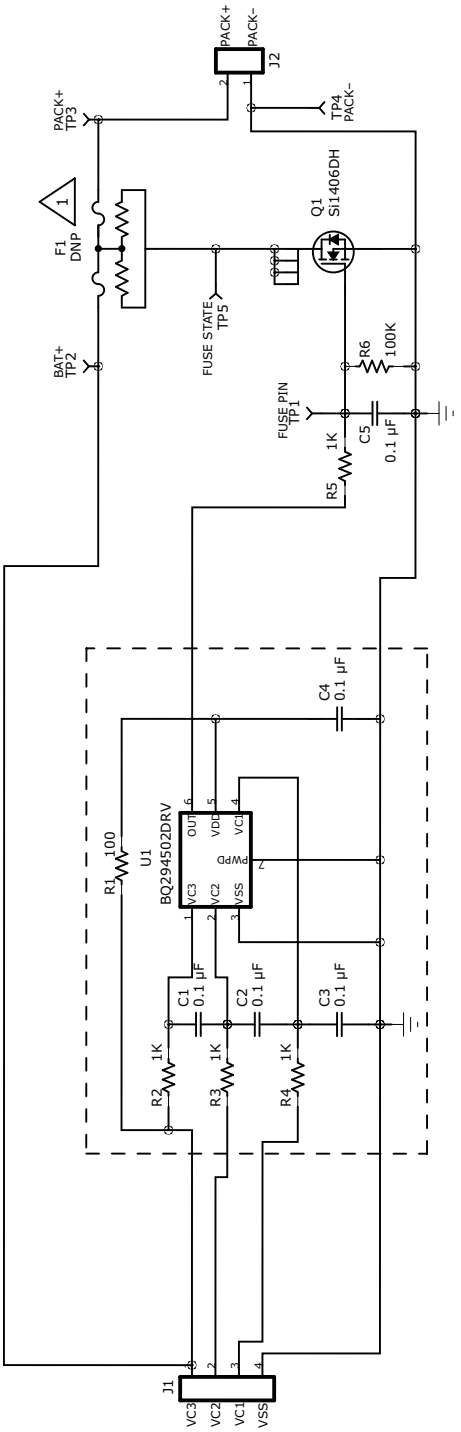


Figure 1. bq294502 Schematic

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3.1 Testing Fuse-Blowing Circuit

To prevent the loss of board functionality during the fuse-blowing test, the actual chemical fuse is not provided in the circuit. The OUT pin of the bq294502 drives TP1 high if a fuse-blow condition occurs; therefore, monitoring TP1 can be used to test this condition. There is a footprint for the fuse on the board in case fuse-blow testing is desired.

4 Circuit Module Physical Layouts and Bill of Materials

This section contains the board layout, bill of materials, and assembly drawings for the bq294502 circuit module.

4.1 Board Layout

This section shows the dimensions, PCB layers, and assembly drawing for the bq294502 module.

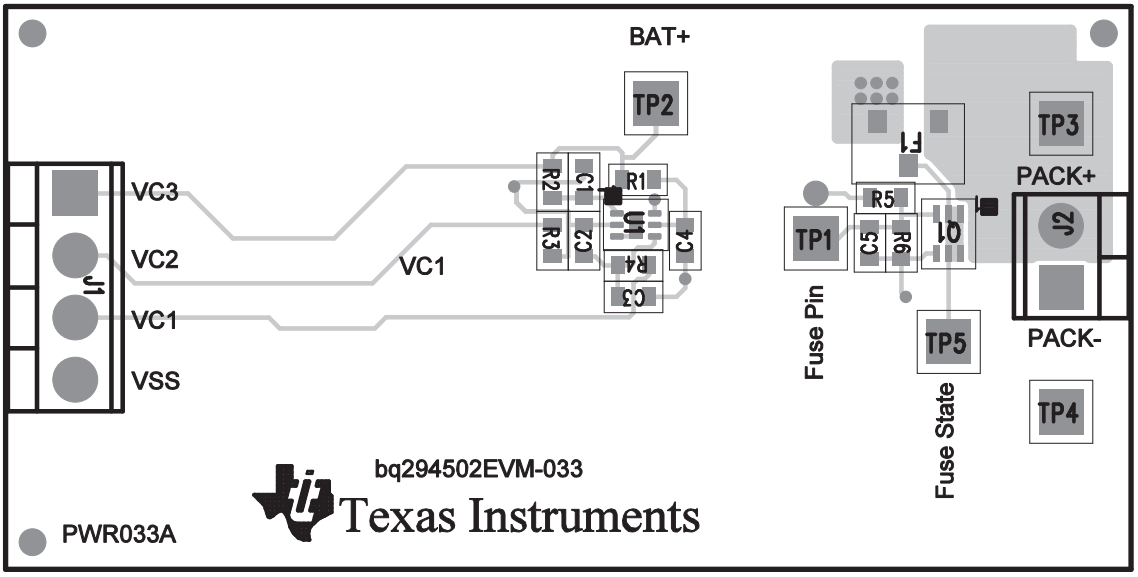


Figure 2. bq294502 Top Layer

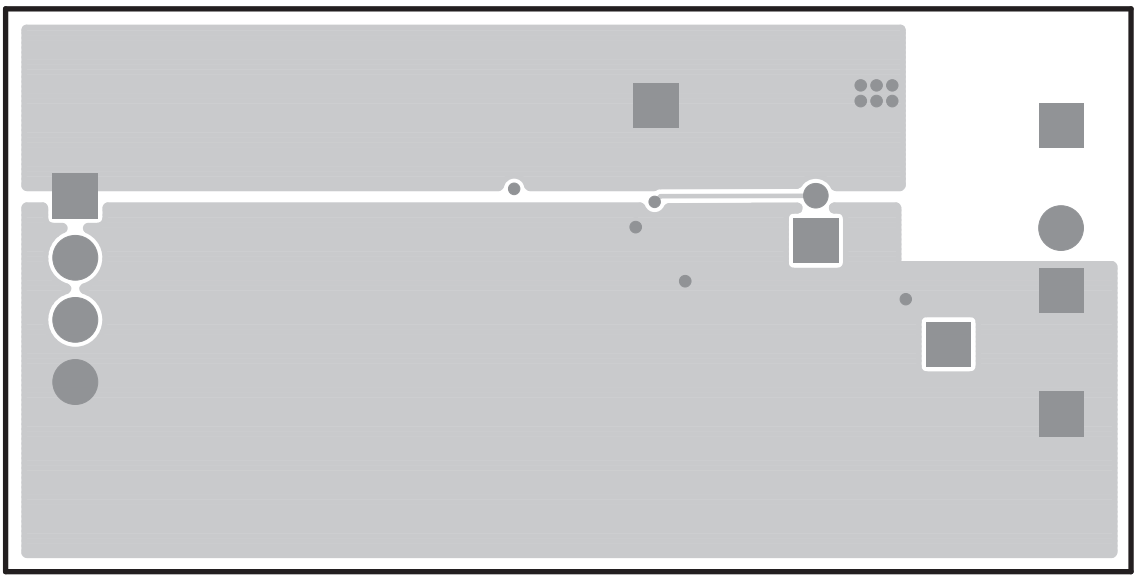


Figure 3. Bottom Layer

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4.2 Bill of Materials

Table 2. Bill of Materials

Count	Reference Design	Value	Description	Size	Part Number	Manufacturer
5	C1-5	0.1 µF	Capacitor, Ceramic, 50 V, X7R, 20%	0603	STD	Any
0	F1	DNP	Fuse, Slo-Blo Ceramic, xxA, yyyV	SFDxxx	SFDxxxx	Sony
1	J1	ED555/4DS	Terminal Block, 4-pin, 6-A, 3.5 mm	0.55 x 0.25 inch	ED555/4DS	OST
1	J2	ED555/2DS	Terminal Block, 2-pin, 6-A, 3.5 mm	0.27 x 0.25 inch	ED555/2DS	OST
1	Q1	Si1406DH	MOSFET, Nch, 20 V, 3.9 A, 65 mΩ	SC-70	Si1406DH	Vishay
1	R1	100	Resistor, Chip, 1/16 W, 1%	0603	STD	Any
4	R2-5	1K	Resistor, Chip, 1/16 W, 1%	0603	STD	Any
1	R6	100K	Resistor, Chip, 1/16 W, 1%	0603	STD	Any
5	TP1-5	5012	Test Point, White, Thru Hole	0.125 x 0.125 inch	5012	Keystone
1	U1	BQ294502DRV	IC, Overvoltage Protection Devices for 2-Series to 4-Series Cell Li-Ion Batteries	WSON	BQ294502DRV	TI
1		—	PCB		PWR033	Any

4.3 bq294502 Circuit Module Performance Specification Summary

This section summarizes the performance specifications of the bq294502 circuit module.

Table 3. Performance Specification Summary

Specification	Min	Typ	Max	Units
Input voltage Pack+ to Pack–	5	12	18	V
Charge and discharge current	0	2	5	A

5 EVM Hardware and Software Setup

This section describes how to connect the different components of the bq294502 EVM. Figure 4 shows how to connect the bq294502 circuit module to the cells and system load/charger. The cells must be connected in the following order:

1. 3-Cell Pack: VSS (bottom of stack), VC1, VC2, then VC3 (see Section 2.2 for definitions).
2. 2-Cell Pack: VSS (bottom of stack), VC1, and then connect VC2 and VC3 together.

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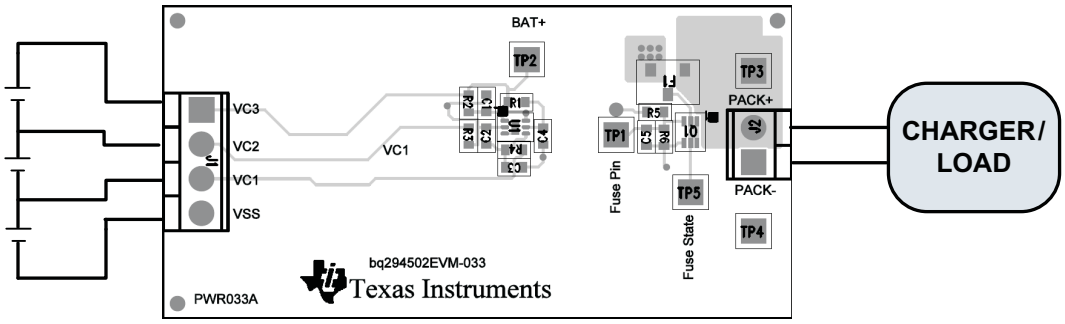


Figure 4. bq294502 Circuit Module Connection to Cells and System Load/Charger

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It is important to operate this EVM within the input voltage range of 0 V to 18 V and the output voltage range of (N/A).

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

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During normal operation, some circuit components may have case temperatures greater than 60°C. The EVM is designed to operate properly with certain components above 60°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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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.

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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.

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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
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