

bq77905 3-5S Low Power Protector Evaluation Module

This evaluation module (EVM) is a complete evaluation system for the bq77905 3-5S low power protector for lithium-ion cells. The EVM includes one bq77905 and FETs to control current in a configuration typical for switching current in a lithium-ion battery pack. The circuit module includes one bq77905 integrated circuit (IC), a sense resistor, thermistor, two CSD18534Q5A FETs, and all other onboard components necessary to switch charge and discharge current. The circuit module connects between a "battery" source and a "pack" load. In addition to the current and voltage applied to the module the user can remove on-board jumpers to simulate over- or under-temperature conditions to observe FET control under different charge and discharge conditions.

1 Features

- Complete evaluation system for the bq77905 3-5S Low Power Protector IC
- Populated circuit module for quick setup

1.1 Kit Contents

- bq77905 circuit module

1.2 Ordering Information

The EVM orderable part number is bq77905EVM-707. For complete ordering information, see the product page at www.ti.com.

1.3 Documentation

See the device data sheet for bq77905 (SLUSCM3) on www.ti.com for information on device hardware.

1.4 bq77905 Circuit Module Performance Specification Summary

This section summarizes the performance specifications of the bq77905EVM.

Table 1. Performance Specification Summary

Specification	Minimum	Typical	Maximum	Unit
Input voltage BATT+ to BATT-	3	18	25	V
Output voltage PACK+ to PACK-	0	18	25	V
Charge and discharge current	0	2	3	A
Operating temperature	20	25	30	°C

While the board is rated at 3A, this is the nominal over current limit of the installed bq77905 configuration. Other components may have a higher rating.

2 bq77905EVM Quick Start Guide

This section provides the step-by-step procedures required to use a new EVM and configure it for operation in a laboratory environment.

2.1 Before You Begin

The following warnings and cautions are noted for the safety of anyone using or working close to the bq77905 EVM. Observe all safety precautions.

CAUTION

The circuit module has signal traces and component leads on the bottom of the board. This may result in exposed voltages, hot surfaces, or sharp edges. Do not reach under the board during operation. Do not operate the EVM on a conductive surface.

CAUTION

The circuit module may be damaged by overtemperature. To avoid damage, monitor the temperature during evaluation and provide cooling, as needed, for your system environment.

CAUTION

Some power supplies can be damaged by application of external voltages. If using more than one power supply, check your equipment requirements and use blocking diodes or other isolation techniques, as needed, to prevent damage to your equipment.

CAUTION

The circuit module is not a finished product or electrical appliance. It must be used by qualified personnel with additional equipment for evaluation only. Do not leave EVM powered when unattended.

2.2 Items Needed for EVM Quick Start Evaluation

- A bq77905 circuit module
- An adjustable DC power supply that can provide 10 V to 23 V and 1 A minimum (a voltage range, bipolar operation, and constant current – constant voltage capability is desirable)
- Five resistors for cell voltage simulation such as 200 Ω 1% 1/4-W or other suitable value
- A load such as a 5-k Ω , 1/4-W or other suitable resistor
- A DC meter or measurement instrument
- Some suitable cables for connection

2.3 EVM Connections

This section covers the hardware connections for the EVM (see [Figure 1](#)).

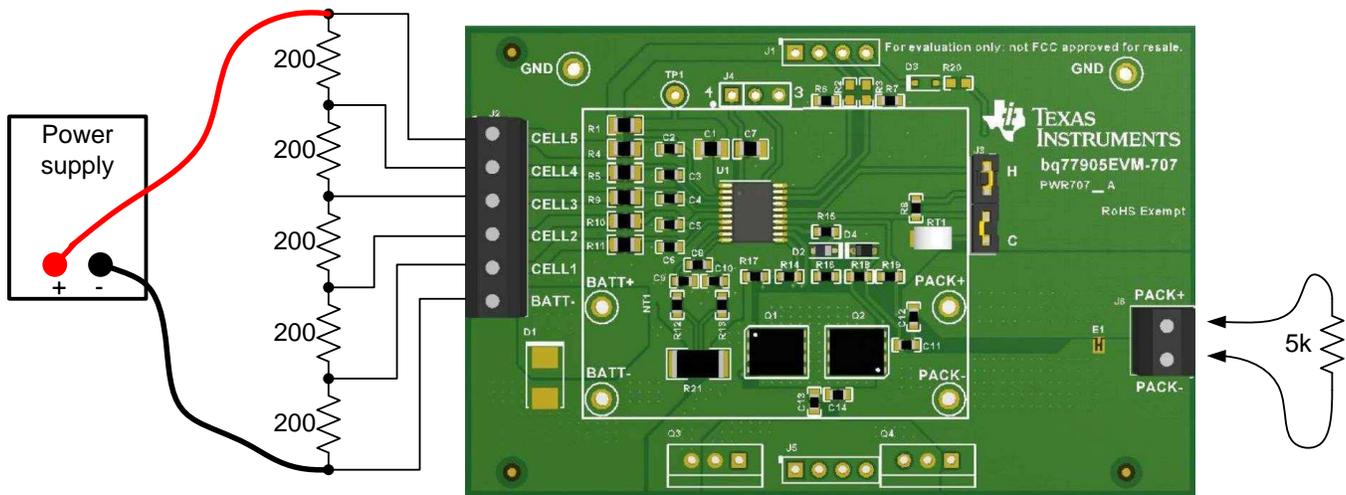


Figure 1. bq77905 Circuit Module Connection for Simple Demonstration

- Supply terminal block (J2)
These are the supply terminals for the board. BATT+ or CELL5 is the positive terminal of the power supply and BATT– is the negative terminal of the power supply. The inputs CELL1 through CELL4 are divided between the BATT+ and BATT- voltages. When using a power supply for evaluation, be sure the power supply can accept or is protected from any reverse current such as with a blocking diode if another supply is used in the system.
- Pack terminals (J6)
PACK+ and PACK– terminals are for attachment for the load or charger. If using a power supply to simulate a charger, be sure it can accept or is protected from any reverse current.
- "H" shunt (J3)
This shunt shorts J3 pins 1 and 2 connecting the IC VTB pin to the temperature measurement path. A hot temperature is simulated when the shunt is removed.
- "L" shunt (J3)
This shunt shorts J3 pins 3 and 4 connecting the IC TS pin to the thermistor. A cold temperature is simulated when the shunt is removed.

2.4 Quick Start Sequence

These steps describe a simple demonstration or check of the operation of the bq77905EVM in a 5S configuration with a typical 18-V stack voltage.

1. Connect 5 200-Ω resistors between the cell terminals of J2.
2. Confirm the "H" and "L" shunts are in place on J3.
3. Connect an 18-V adjustable DC power supply across the BATT+ and BATT– terminals of J2.
4. Enable the supply.
5. Measure the voltage on the pack terminals. Observe that this is the same voltage as the supply because both charge and discharge FETs are on, approximately 18 V.
6. Connect a load such as a 5-kΩ resistor across the PACK terminals
7. Adjust the supply voltage to 23 V to simulate an overvoltage condition. Observe that the voltage on the PACK terminals is approximately 600 mV below the supply voltage because the charge FET is off.
8. Adjust the supply voltage to 18 V to cause recovery from the overvoltage condition. Observe that the voltage on the PACK terminals is the supply voltage.
9. Remove the shunt at the J3 H position to simulate a hot condition. Observe that the pack voltage drops to approximately 0 V, and returns to normal when the shunt is re-installed.

10. Remove the shunt at the J3 C position to simulate a cold condition. Observe that the pack voltage drops to approximately 0 V and returns to normal when the shunt is re-installed.
11. Adjust the supply voltage to 12 V to simulate an undervoltage condition. Observe that the pack voltage drops to approximately 0 V.
12. Adjust the supply voltage to 18 V to allow recovery from the undervoltage condition. Observe that the pack voltage remains at approximately 0 V with the load resistor in place.
13. Remove the load resistor on the PACK terminals. Observe that the pack voltage returns to the supply voltage because undervoltage recovers on the installed part configuration with both voltage and load removal.
14. Disable the power supply and disconnect, if complete.

3 Additional Evaluation Setups

CAUTION

The bq77905 EVM does not contain capacitors on the input or output current paths to dampen transients. Be sure to use appropriate transient suppression to avoid damage to the board from cable or equipment transient responses during evaluation.

3.1 Operation With Charge and Discharge Currents

If bipolar power supplies are available, current control can be demonstrated through the board in both directions, see Figure 2. A battery voltage in range must be applied to the BATT side of the EVM for operation. The instrument on the PACK side can be used as a load if it is set to a lower voltage than the battery side or as a charger if set to a higher voltage. Additional equipment can be used to adjust the voltage across the individual input resistors to simulate different cell voltages.

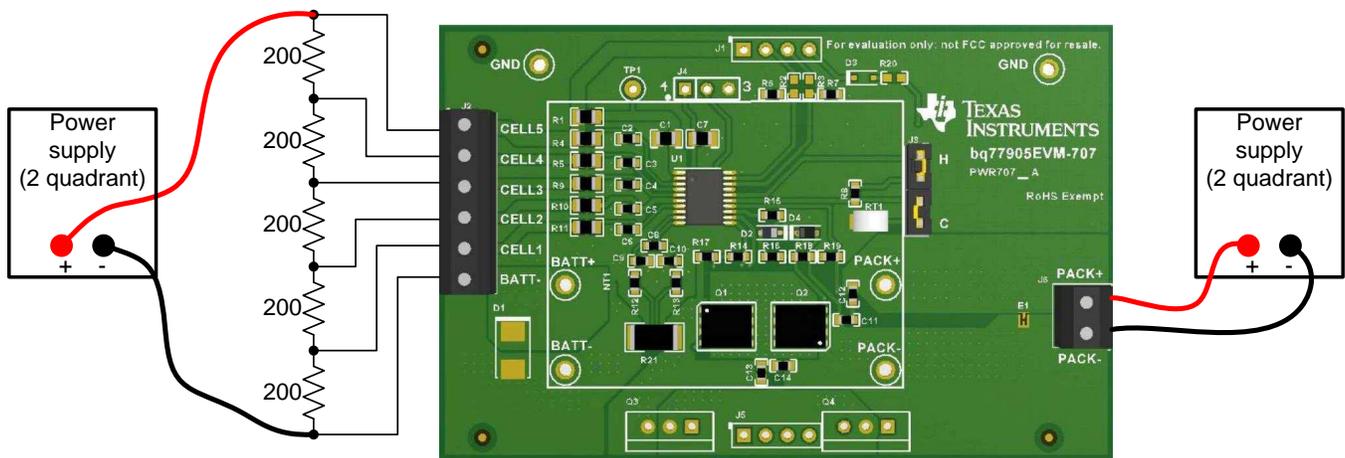


Figure 2. Bipolar Operation

Operation can also be demonstrated with conventional supplies and loads. Connect and operate the equipment within its performance limits.

3.2 Reducing the Cell Count

The bq77905 EVM may be modified to provide monitoring of three or four cells. A concept of simple three-cell evaluation is shown in Figure 3. Cells are connected from the bottom up with unused top cell inputs connected to the top cell at J2. While this is not the direct IC pin connection shown in the datasheet, it will work for general evaluation. The CCFG pin must also be connected to AVDD or GND to select monitoring of three or four cells. This can be done by adding a jumper at the J4 pattern between pins 1 and 2 or 2 and 3 as desired. The board is marked with "4" next to pin 1 and "3" next to pin 3. If the board will be used for further evaluation be sure to remove the jumper at J4 after the reduced cell test.

CAUTION

With a jumper installed at the J4 pattern the bq77905 will not evaluate the top one or two cells depending on the jumper installation. Remove any jumper to monitor all cell inputs.

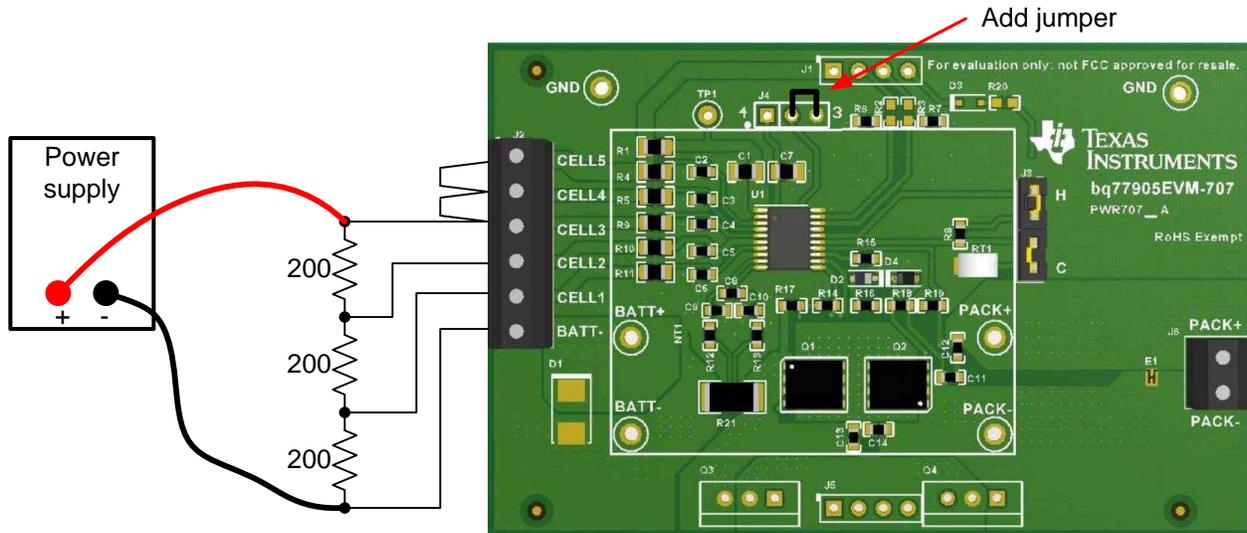


Figure 3. Operation with Reduced Cell Count

3.3 Connecting to Cells

It is recommended that the user operate the bq77905 EVM with power supplies to become familiar with the operation and features of module and bq77905 before connecting cells. The bq77905 EVM may be connected to cells so that the cells can provide the power for the bq77905, a concept is shown in Figure 4. The cells should be connected together before connecting to the board. The BATT- connection should be made first, then other cell connections can be made in any sequence.

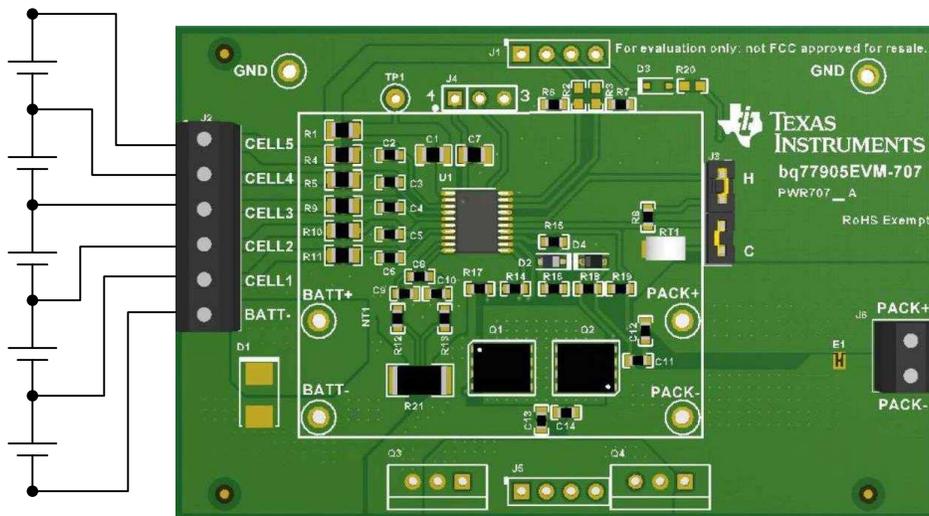


Figure 4. Connecting to cells

3.4 Stacking Modules

While the bq77905 EVM modules do not stack as delivered, they can be modified for a basic demonstration of stacking by adding additional components. The resulting circuit is not ideal because the ESD capacitors will remain across each module rather than across the pack terminals. The charge and discharge FETs installed are 60-V rated and will normally accommodate connection of two EVMs. Connection of more than two EVMs is not supported by the patterns on the board and is not recommended. Before connecting the modules, the bottom module must have component additions and changes shown in Table 2 to enable the stacking inputs and support the UV load removal recovery detection for the upper device. A connection example of the two modules is shown in Figure 5.

Table 2. Bottom Module Modifications for Stacking

Reference Designator	Action	Function
R2	Install 10-M Ω resistor	Stacking interface
R3	Install 10-M Ω resistor	
R6	Remove	
R7	Remove	
R20	Install 470-k Ω resistor	UV Load Detect Recovery
D3	Install BAS16J switching diode	

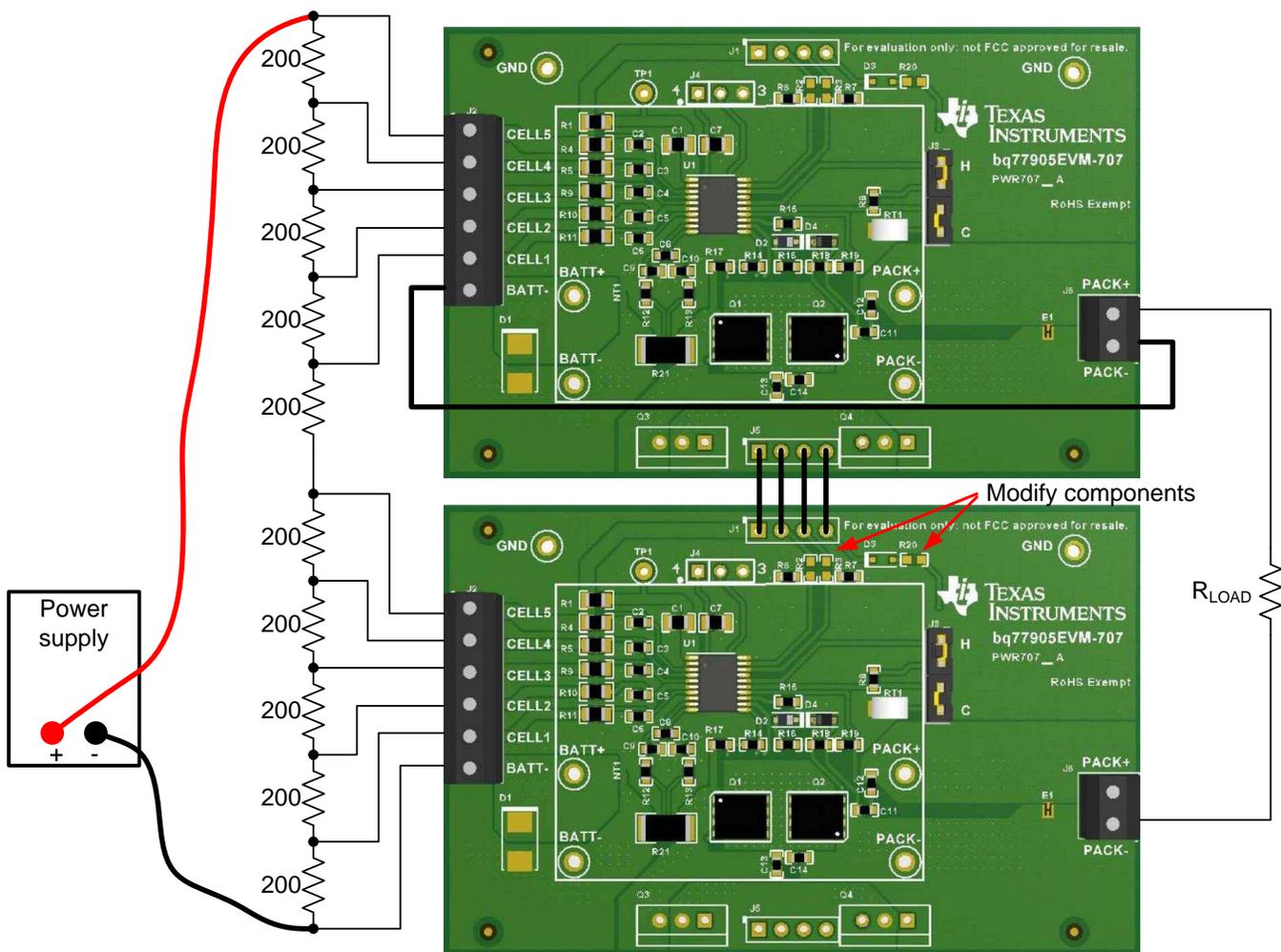


Figure 5. Stacking Circuit Modules

CAUTION

The bottom bq77905 module will not receive fault conditions from the top module unless properly modified and connected. Confirm operation of your modified evaluation setup.

Once modified, the bottom module will not enable FETs when disconnected from the top module.

3.5 Troubleshooting

If the bq77905 does not appear to be operating, check the VDD voltage at TP1 as this should be the same as the BATT+ voltage. Check the AVDD voltage at J4 pin 1, this should be approximately 2.5 V. Check that the shunts are installed at the H and L positions on J3 shorting pins 1 to 2 and pins 3 to 4. Check that the cell input voltages are within the operating range of the part. If a fault has been induced, check that the recovery condition has been met. The configuration of the supplied IC requires load removal for recovery from undervoltage, therefore remove any load from the PACK terminals or supply a charge voltage to recover from UV after the cell voltages have returned to normal. The [Quick Start Sequence](#) section is a good procedure to check the basic operation of the board. If the board has been used for stacking evaluation be sure the R6 and R7 resistors have been replaced.

3.6 Changing Configuration or Conditions

If the board is modified to change the IC or other components or is operated at an expanded temperature range, be sure to check component temperatures and other operating characteristics to be sure the board does not provide a hazard in evaluation. A sample IC device may allow more current flow with higher surface temperatures. Alternate FETs may require a change to the gate resistor to provide an appropriate switching time.

4 bq77905EVM Circuit Module Schematic

This section contains information on other EVM features.

4.1 Alternate FETs

The EVM has TO-220 footprints for use as test points or power FETs as options for evaluation.

4.2 BATT Transient Pattern

D1 is a pattern for a TVS on the battery input terminals, if desired.

4.3 Other Uninstalled Components

The bq77905 EVM contains patterns for cell count configuration and stacking interface. Refer to the schematic diagram and [Section 3](#) for additional information.

5 Circuit Module Physical Layouts

This section contains the printed-circuit board (PCB) layout, assembly drawings, and schematic for the bq77905 circuit module.

5.1 Board Layout

This section shows the PCB layers and assembly drawing for the bq77905 module (see Figure 6 through Figure 11). The board is a single sided assembly, no components are located on the bottom.

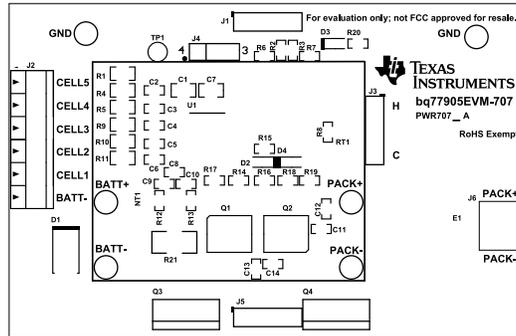


Figure 6. Top Silk Screen

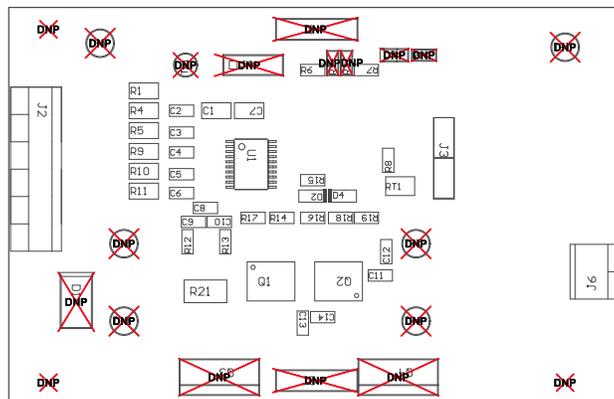


Figure 7. Top Assembly

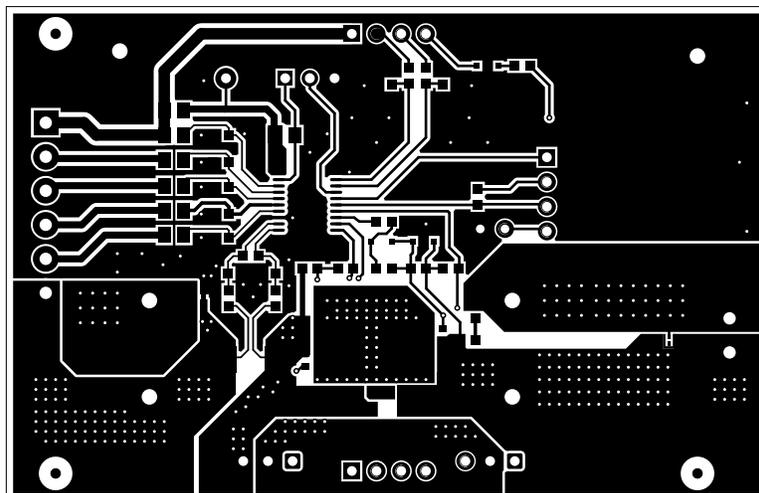


Figure 8. Top Layer

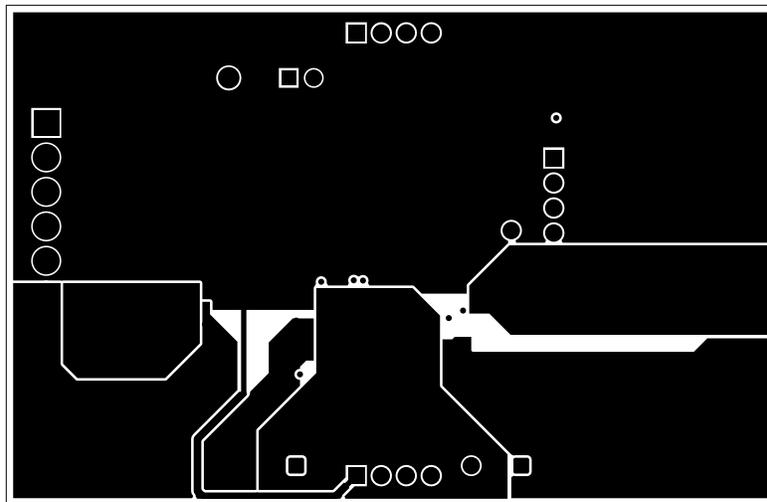


Figure 9. Internal Layer 1

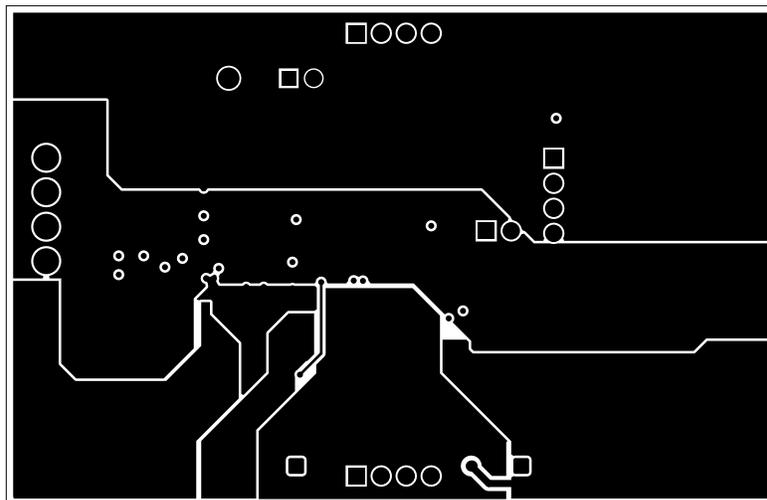


Figure 10. Internal Layer 2

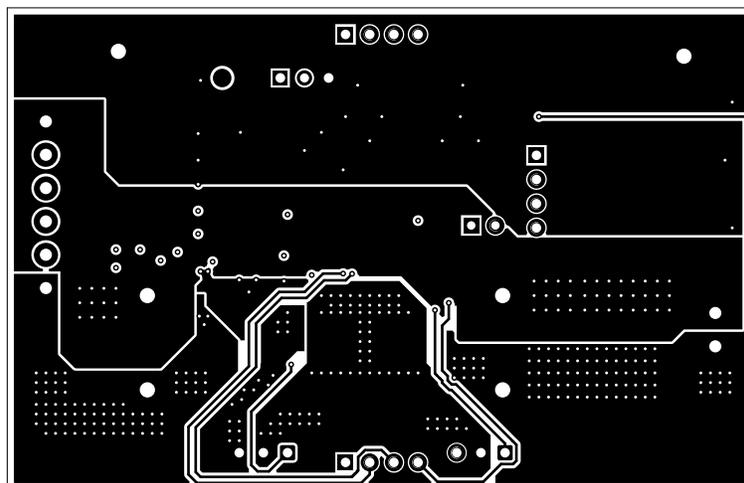


Figure 11. Bottom Layer

5.2 Schematic

Figure 12 shows the bq77905EVM schematic.

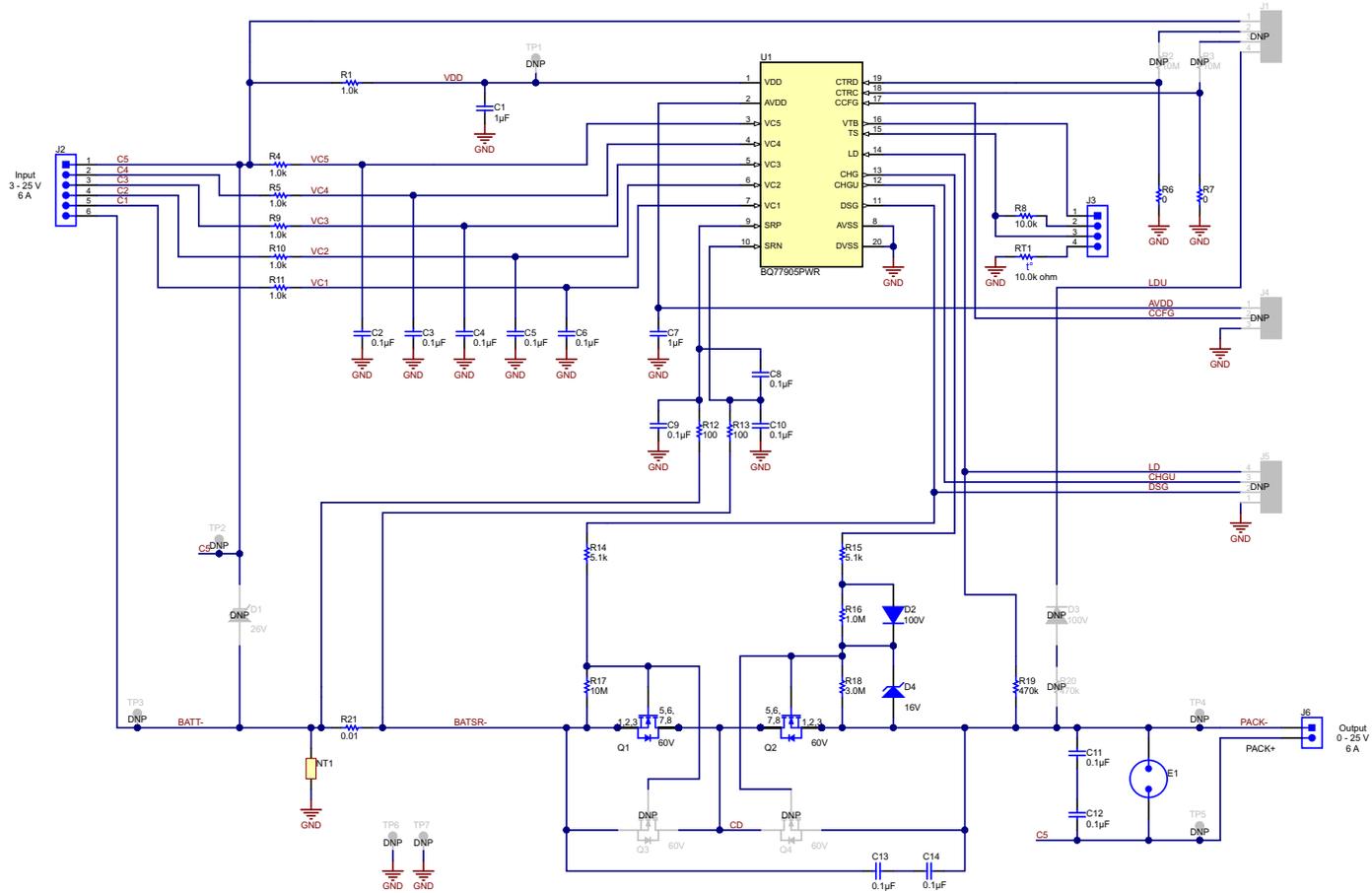


Figure 12. bq77905EVM Schematic

6 Bill of Materials

Table 3 lists the bq77905EVM Bill of Materials.

Table 3. bq77905EVM Bill of Materials⁽¹⁾

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
!PCB1	1		Printed Circuit Board		PWR707	Any		
C1, C7	2	1 uF	CAP, CERM, 1 μF, 50 V, +/- 10%, X7R, 0805	0805	GRM21BR71H105 KA12L	MuRata		
C2, C3, C4, C5, C6, C8, C9, C10, C11, C12, C13, C14	12	0.1 uF	CAP, CERM, 0.1 μF, 50 V, +/- 10%, X7R, 0603	0603	06035C104KAT2A	AVX		
D2	1	100 V	Diode, Switching, 100 V, 0.25 A, SOD-323F	SOD-323F	BAS16J,135	NXP Semiconductor		
D4	1	16 V	Diode, Zener, 16 V, 200 mW, SOD-323	SOD-323	MMSZ5246BS-7-F	Diodes Inc.	MM3Z16VST1G	ON Semiconductor
J2	1		Terminal Block, 6 A, 3.5 mm Pitch, 6-Pos, TH	20.5 × 8.2 × 6.5 mm	ED555/6DS	On-Shore Technology		
J3	1		Header, 100 mil, 4 × 1, Tin, TH	Header, 4 × 1, 100 mil, TH	PEC04SAAN	Sullins Connector Solutions		
J6	1		Terminal Block, 6 A, 3.5 mm Pitch, 2-Pos, TH	7.0 × 8.2 × 6.5 mm	ED555/2DS	On-Shore Technology		
Q1, Q2	2	60 V	MOSFET, N-CH, 60 V, 50 A, SON 5 × 6 mm	SON 5 × 6 mm	CSD18534Q5A	Texas Instruments		None
R1, R4, R5, R9, R10, R11	6	1.0 k	RES, 1.0 k, 5%, 0.125 W, 0805	0805	CRCW08051K00J NEA	Vishay-Dale		
R6, R7	2	0	RES, 0, 5%, 0.1 W, 0603	0603	CRCW06030000Z0 EA	Vishay-Dale		
R8	1	10.0 k	RES, 10.0 k, 1%, 0.1 W, 0603	0603	CRCW060310K0F KEA	Vishay-Dale		
R12, R13	2	100	RES, 100, 5%, 0.1 W, 0603	0603	CRCW0603100RJ NEA	Vishay-Dale		
R14, R15	2	5.1 k	RES, 5.1 k, 5%, 0.1 W, 0603	0603	CRCW06035K10J NEA	Vishay-Dale		

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

Table 3. bq77905EVM Bill of Materials⁽¹⁾ (continued)

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
R16	1	1.0 Meg	RES, 1.0 M, 5%, 0.1 W, 0603	0603	CRCW06031M00J NEA	Vishay-Dale		
R17	1	10 Meg	RES, 10 M, 5%, 0.1 W, 0603	0603	CRCW060310M0J NEA	Vishay-Dale		
R18	1	3.0 Meg	RES, 3.0 M, 5%, 0.1 W, 0603	0603	CRCW06033M00J NEA	Vishay-Dale		
R19	1	470 k	RES, 470 k, 5%, 0.1 W, 0603	0603	CRCW0603470KJ NEA	Vishay-Dale		
R21	1	0.01	RES, 0.01, 1%, 1 W, 2010	2010	CSRN2010FK10L0	Stackpole Electronics Inc		
RT1	1	10.0 kΩ	Thermistor NTC, 10.0 kΩ, 1%, Disc, 5 x 8.4 mm	Disc, 5 x 8.4 mm	103AT-2	SEMITEC Corporation		
SH-J3_1, SH-J3_3	2	1 x 2	Shunt, 100 mil, Gold plated, Black	Shunt	969102-0000-DA	3M	SNT-100-BK-G	Samtec
U1	1		3-5S Low Power Protector, PW0020A	PW0020A	BQ77905PWR	Texas Instruments	BQ77905PW	Texas Instruments
D1	0	26 V	Diode, TVS, Uni, 26 V, 600 W, SMB	SMB	SMBJ26A-13-F	Diodes Inc.		
D3	0	100 V	Diode, Switching, 100 V, 0.25 A, SOD-323F	SOD-323F	BAS16J,135	NXP Semiconductor		
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A		
J1, J5	0		Header, 100 mil, 4 x 1, Tin, TH	Header, 4 x 1, 100 mil, TH	PEC04SAAN	Sullins Connector Solutions		
J4	0		Header, 100 mil, 3 x 1, Tin, TH	Header, 3 PIN, 100 mil, Tin	PEC03SAAN	Sullins Connector Solutions		
Q3, Q4	0	60 V	MOSFET, N-CH, 60 V, 73 A, KCS0003A	KCS0003A	CSD18534KCS	Texas Instruments		None
R2, R3	0	10 Meg	RES, 10 M, 5%, 0.1 W, 0603	0603	CRCW060310M0J NEA	Vishay-Dale		
R20	0	470 k	RES, 470 k, 5%, 0.1 W, 0603	0603	CRCW0603470KJ NEA	Vishay-Dale		
TP1	0	White	Test Point, Miniature, White, TH	White Miniature Testpoint	5002	Keystone		

Table 3. bq77905EVM Bill of Materials⁽¹⁾ (continued)

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
TP2, TP3, TP4, TP5	0	White	Test Point, Multipurpose, White, TH	White Multipurpose Testpoint	5012	Keystone		
TP6, TP7	0	Black	Test Point, Multipurpose, Black, TH	Black Multipurpose Testpoint	5011	Keystone		

7 Related Documentation from Texas Instruments

- bq77905, 3-5S Low Power Protector data sheet, [SLUSCM3](#)

Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original (April 2016) to A Revision	Page
• Changed the data sheet literature number From: SLUSBZ7 To: SLUSCM3 in Section 1.3	1
• Changed the data sheet literature number From: SLUSBZ7 To: SLUSCM3 in Section 7	15

STANDARD TERMS AND CONDITIONS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, or documentation (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms and conditions set forth herein. Acceptance of the EVM is expressly subject to the following terms and conditions.
 - 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 semiconductor 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 and conditions 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 and conditions 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 any defects that are 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. Moreover, TI shall not be liable for any defects that result from User's design, specifications or instructions for such EVMs. Testing and other quality control techniques are used to the extent TI deems necessary or as mandated by government requirements. TI does not test all parameters of each EVM.
 - 2.3 If any EVM fails to conform to the warranty set forth above, TI's sole liability shall be at its option to repair or replace such EVM, 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:*

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

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-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.

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/lstds/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/lstds/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 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.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けていないものがあります。技術適合証明を受けていないものご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

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。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。日本テキサス・インスツルメンツ株式会社
東京都新宿区西新宿 6 丁目 2 4 番 1 号
西新宿三井ビル

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

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.

6. *Disclaimers:*
- 6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY WRITTEN DESIGN MATERIALS PROVIDED WITH THE EVM (AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.
- 6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS AND CONDITIONS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT MADE, CONCEIVED OR ACQUIRED PRIOR TO OR AFTER DELIVERY OF THE EVM.
7. *USER'S INDEMNITY OBLIGATIONS AND REPRESENTATIONS.* USER WILL DEFEND, INDEMNIFY AND HOLD TI, ITS 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 OR USE OF THE EVM THAT IS NOT IN ACCORDANCE WITH THESE TERMS AND CONDITIONS. THIS OBLIGATION SHALL APPLY WHETHER CLAIMS ARISE UNDER STATUTE, REGULATION, OR THE LAW OF TORT, CONTRACT OR ANY OTHER LEGAL THEORY, AND EVEN IF THE EVM FAILS TO PERFORM AS DESCRIBED OR EXPECTED.
8. *Limitations on Damages and Liability:*
- 8.1 *General Limitations.* IN NO EVENT SHALL TI BE LIABLE FOR ANY SPECIAL, COLLATERAL, INDIRECT, PUNITIVE, INCIDENTAL, CONSEQUENTIAL, OR EXEMPLARY DAMAGES IN CONNECTION WITH OR ARISING OUT OF THESE TERMS AND CONDITIONS OR THE USE OF THE EVMS PROVIDED HEREUNDER, REGARDLESS OF WHETHER TI HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES. EXCLUDED DAMAGES INCLUDE, BUT ARE NOT LIMITED TO, COST OF REMOVAL OR REINSTALLATION, ANCILLARY COSTS TO THE PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES, RETESTING, OUTSIDE COMPUTER TIME, LABOR COSTS, LOSS OF GOODWILL, LOSS OF PROFITS, LOSS OF SAVINGS, LOSS OF USE, LOSS OF DATA, OR BUSINESS INTERRUPTION. NO CLAIM, SUIT OR ACTION SHALL BE BROUGHT AGAINST TI MORE THAN ONE YEAR AFTER THE RELATED CAUSE OF ACTION HAS OCCURRED.
- 8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY WARRANTY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS AND CONDITIONS, OR ANY USE OF ANY TI EVM PROVIDED HEREUNDER, EXCEED THE TOTAL AMOUNT PAID TO TI FOR THE PARTICULAR UNITS SOLD UNDER THESE TERMS AND CONDITIONS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM AGAINST THE PARTICULAR UNITS SOLD TO USER UNDER THESE TERMS AND CONDITIONS SHALL NOT ENLARGE OR EXTEND THIS LIMIT.
9. *Return Policy.* Except as otherwise provided, TI does not offer any refunds, returns, or exchanges. Furthermore, no return of EVM(s) will be accepted if the package has been opened and no return of the EVM(s) will be accepted if they are damaged or otherwise not in a resalable condition. If User feels it has been incorrectly charged for the EVM(s) it ordered or that delivery violates the applicable order, User should contact TI. All refunds will be made in full within thirty (30) working days from the return of the components(s), excluding any postage or packaging costs.
10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2015, Texas Instruments Incorporated

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Applications Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community

e2e.ti.com