

bq25120AEVM and bq25122EVM Evaluation Modules

This user's guide describes the characteristics, operation, and use of the bq25120A and bq25122 evaluation modules (EVM). A complete schematic diagram, printed-circuit board layouts, and bill of materials are included in this document.

Throughout this document, EVM refers to *evaluation module* and TI refers to Texas Instruments.

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Trademarks

LaunchPad is a trademark of Texas Instruments.
All other trademarks are the property of their respective owners.

1 Introduction

The BQ25120A EVM is an evaluation kit for the BQ25120A integrated battery charge management IC. The bq25120A is a highly-integrated battery charge management IC that integrates the most common functions for wearable devices: Linear charger, regulated output, load switch, manual reset with timer, and battery voltage monitor.

NOTE: Except where noted, for the remainder of this user's guide, all references to the bq25120A device or bq25120A EVM also apply to the bq25122 device or bq25122 EVM.

Table 1. PCB Configurations

EVM	Value
bq25120A EVM	BMS001 (001)
bq25122A EVM	BMS001 (002)

1.1 Evaluation Kit Contents

The EVM kit contains:

- bq25120A EVM
- Micro-USB cable

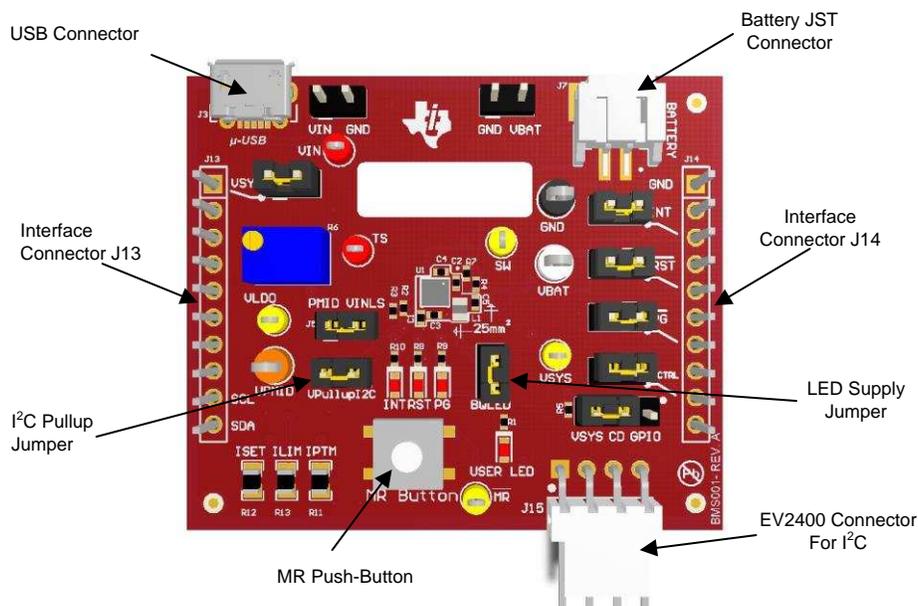


Figure 1. EVM Board Components

CAUTION

Do not connect the BQ25120A EVM to the LaunchPad™ boards. Ensure you have the proper jumper settings before doing so. The power from J13 will back-feed into the LaunchPad.

1.2 bq25120A IC Features

The bq25120A is a highly-integrated battery charge management IC that integrates the most common functions for wearable devices: linear charger, regulated output, load switch, manual reset with timer, and battery voltage monitor. The low quiescent current during operation and shutdown enables maximum battery life. The device supports charge currents from 5 mA to 300 mA. The input current limit, charge current, PWM output voltage, LDO output voltage, and other parameters are programmable through the I²C interface. The battery is charged using a standard Li-Ion charge profile with three phases: precharge, constant current, and constant voltage.

1.3 bq25120A EVM Features

The bq25120A EVM is a complete battery power management module for evaluating compact, highly-integrated, flexible, high efficiency, linear charging solution for single cell, Li-Ion and Li-Polymer battery-powered systems used in wearables and low-power portable applications. Key EVM features include:

- Configurable 300-mA buck regulator (1.8-V default)
- 700-nA typical I_Q with PWM enabled
- 0.5% accurate battery voltage regulation (configurable from 3.6 V to 4.65 V in 10-mV steps)
- Configurable termination current down to 500 μ A
- 2.5 mm \times 2.5 mm WCSP package and 6 external components for minimum solution
- Power path management for powering the system and charging the battery
- Power path management enables < 150-nA ship-mode battery quiescent current for longest shelf life
- Push-button wake-up and reset with adjustable timers
- Battery charger operates from 3.4 V – 5.5 V V_{IN} (5.5-V OVP, 20-V tolerant)
- I²C control of key parameters

1.4 Setup Procedure

1.4.1 Power Supplies

Only use power supplies with the following features:

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

1.4.2 Meters

The following meters are required when using this EVM:

- One oscilloscope
- Four scope probes
- One digital multimeter

1.4.3 Tool and Software GUI (Optional)

The following tool and software can be used with this EVM. See www.ti.com for details:

- [EV2400 Interface Board](#)
- [BqStudio](#) software

1.6.2 Charge Disabled

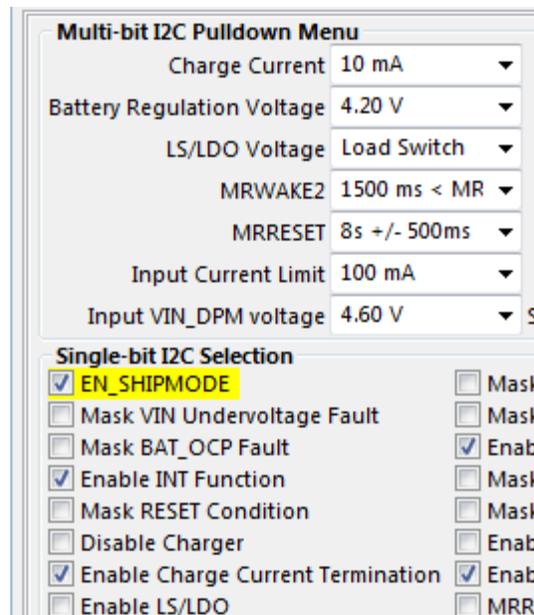
Power down the power supplies using the following steps:

1. Install the jumper – connect CD to VSYS
2. Enable PS#1 and PS#2
3. Observe USER LED is off
4. Measure on SC#1 → VIN (GND) = 5 V ± 100 mV
5. Measure on SC#2 → VBAT (GND) = 3.8 V ± 50 mV
6. Measure on SC#3 → VPMID (GND) = 5 V ± 200 mV
7. Measure on SC#4 → SYS (GND) = 1.8 V ± 50 mV
8. Disable PS#1 and PS#2.

1.6.3 Ship Mode

Complete the following for ship mode operation:

1. Connect the EV2400 interface board to the EVM (as shown in [Figure 3](#)).
2. Install the BqStudio software GUI from www.ti.com. Download the latest BqStudio release from the [Battery Management Studio \(bqStudio\) Software](#) folder (should be a zip file named SLUC525.zip).
3. Enable PS#1 and PS#2.
4. Open the software GUI.
5. Go to *Field View* of the GUI and then read all the registers. All the default register values should be shown in the register map (as shown in [Figure 4](#)).
6. Install the jumper – connect CD to SYS.
7. Disable PS#1.
8. Check the box in front of “EN_SHIPMODE” in the software GUI (as shown in the following image).



9. Disable PS#2.
10. Remove the jumper that connects CD to VSYS.

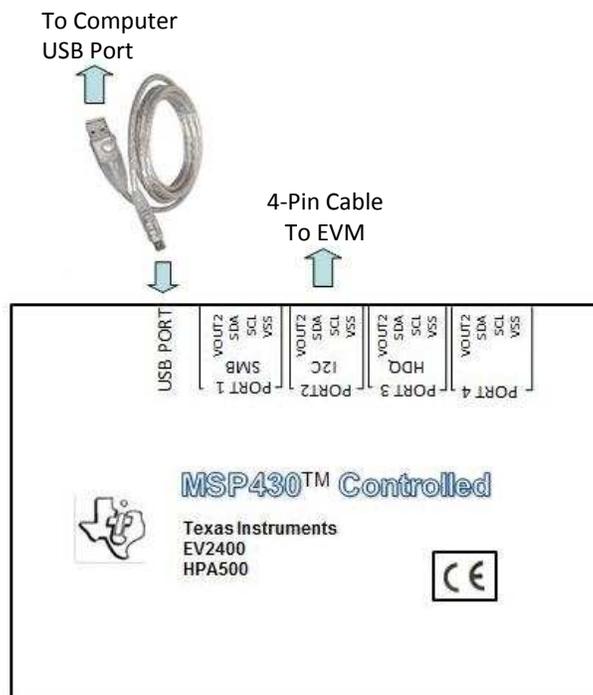


Figure 3. Connection of the EV2400 Interface Board

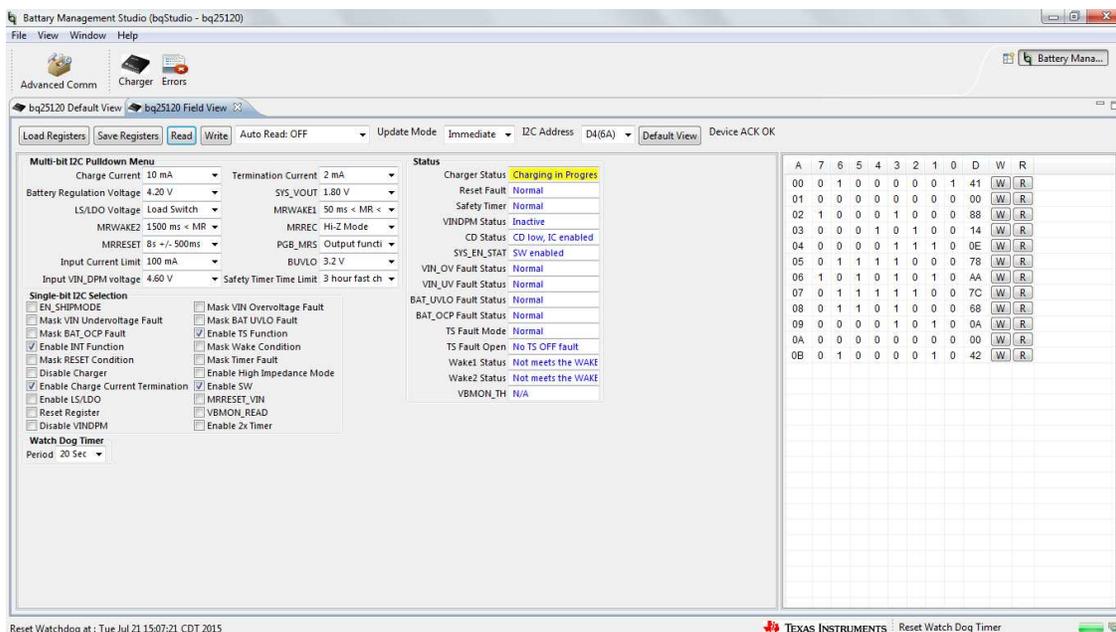


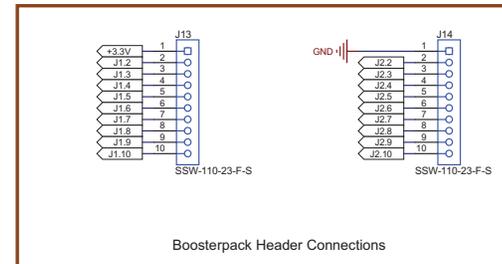
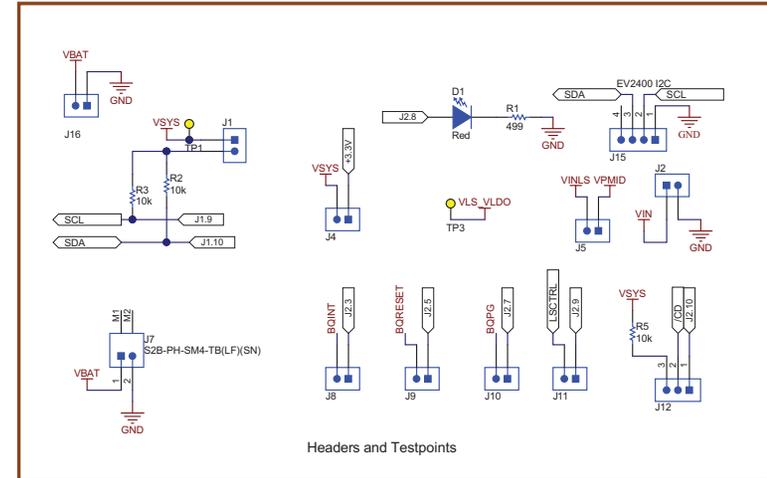
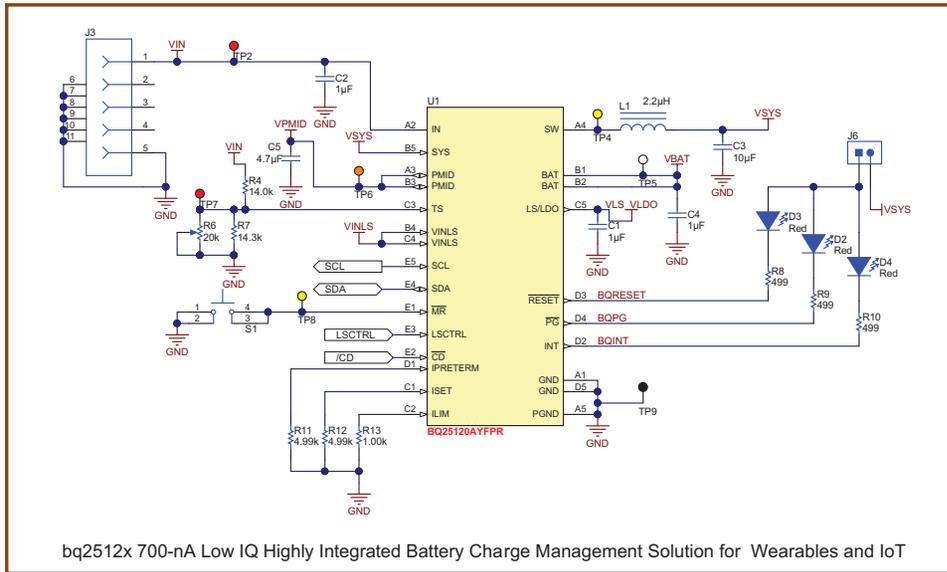
Figure 4. bq25120 Software GUI

1.6.4 Equipment Shutdown

Disable all power supplies and remove all connections being careful not to disturb the potentiometer settings.

1.7 Schematic

Figure 5 illustrates the EVM schematic.



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Figure 5. bq25120AEVM Schematic (bq25120 Represented)

1.8 Default Settings

The bq25120AEVM module has provided the capability of changing key parameters using I²C and the EV2400 communication interface. However, I²C communication is not required for this device to operate. The module is programmed to the default settings as described in [Table 2](#).

Table 2. Default Settings

Parameter	Options	bq25120A	bq25122
BAT_UVLO	2.2 V to 3.0 V (200-mV step)	3.0 V	3.0 V
VSYS	1.1 V to 3.3 V (100-mV step)	1.8 V	1.2 V
LS, LDO	LS, 0.8 V to 3.3 V (100-mV step)	LS	LS
VBREG	3.6 V to 4.65 V (10-mV step)	4.2 V	4.2 V
ICHG	5 mA to 300 mA	10 mA	11 mA
IPRETERM	500 μ A to 50 mA	2 mA	0.5 mA
Input ILIM	50 mA to 400 mA (50-mA step)	100 mA	50 mA
VIN_DPM_ON	On or Off	On	On
VIN_DPM Threshold	4.2 V to 4.9 V	4.6 V	4.6 V
Auto Charge	On or Off	On	On
Safety Timer	30 min, 3 hr, 9 hr, Disabled	3 hr	3 hr

1.9 Recommended Operating Conditions

The recommended operating conditions are shown in [Table 3](#).

Table 3. Recommended Operating Conditions⁽¹⁾⁽²⁾

		MIN	NOM	MAX	Unit
V _{IN}	IN voltage range	3.4	5	20	V
	IN operating voltage range, recommended	3.4	5	5.5	
V _{BAT}	VBAT operating voltage range			5.5 ⁽¹⁾	V
V _{VINLS}	VINLS voltage range for Load Switch	0.8		5.5 ⁽²⁾	V
V _{VINLS}	VINLS voltage range for LDO	2.2		5.5	V
I _{IN}	Input Current, IN input			400	mA
I _{SW}	Output Current from SW, DC			300	mA
I _{PMID}	Output Current from PMID, DC			300	mA
I _{LS/LDO}	Output Current from LS/LDO			100	mA
I _{BAT} , I _{SYS}	Charging and discharging using internal battery FET			300	mA
T _J	Operating junction temperature range	-40		125	°C

⁽¹⁾ Any voltage greater than shown should be a transient event.

⁽²⁾ These inputs will support 6.6 V for less than 10% of the lifetime at V_(BAT) or V_{IN}, with a reduced current and/or performance.

2 Bill of Materials and Board Layout

This section provides the bq25120A EVM bill of materials (BOM) and the printed-circuit board (PCB) layout illustrations.

2.1 Bill of Materials

Table 4 lists the EVM BOM.

Table 4. bq25120AEVM Bill of Materials⁽¹⁾

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
!PCB1	1		Printed Circuit Board		BMS001	Any	-	-
C1, C2, C4	3	1uF	CAP, CERM, 1 μ F, 25 V, +/- 10%, X5R, 0402	0402	C1005X5R1E105K050BC	TDK		
C3	1	10uF	CAP, CERM, 10 μ F, 10 V, +/- 20%, X5R, 0402	0402	CL05A106MP5NUNC	Samsung Electro-Mechanics		
C5	1	4.7uF	CAP, CERM, 4.7 μ F, 10 V, +/- 20%, X5R, 0402	0402	GRM155R61A475MEAAD	Murata		
D1, D2, D3, D4	4	Red	LED, Red, SMD	Red LED, 1.6x0.8x0.8mm	LTST-C190CKT	Lite-On		
FID1, FID2, FID3	3		Fiducial mark. There is nothing to buy or mount.	Fiducial	N/A	N/A		
H1	1		USB A MALE TO MICRO B MALE 3'	Used in PnP output and some BOM reports	3025010-03	Used in BOM report	-	-
J1, J2, J4, J5, J6, J8, J9, J10, J11, J16	10		Header, 100mil, 2x1, Tin, TH	Header, 2 PIN, 100mil, Tin	PEC02SAAN	Sullins Connector Solutions		
J3	1		Receptacle, Micro-USB-B, Right Angle, SMD	Micro USB receptacle	105017-0001	Molex		
J7	1		Header (shrouded), 2mm, 2x1, R/A, SMT	Header, 2x1, 2mm, R/A	S2B-PH-SM4-TB(LF)(SN)	JST Manufacturing		
J12	1		Header, 100mil, 3x1, Tin, TH	Header, 3 PIN, 100mil, Tin	PEC03SAAN	Sullins Connector Solutions		
J13, J14	2		Connector, Receptacle, 100mil, 10x1, Gold plated, TH	10x1 Receptacle	SSW-110-23-F-S	Samtec		
J15	1		Header (friction lock), 100mil, 4x1, R/A, TH	4x1 R/A Header	22-05-3041	Molex		
L1	1	2.2uH	Inductor, Multilayer, Ferrite, 2.2 μ H, 0.7 A, 0.125 ohm, SMD	2.0x1.0x1.2mm	LQM21PN2R2MGH	Murata		
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	PCB Label 0.650 x 0.200 inch	THT-14-423-10	Brady		
R1, R8, R9, R10	4	499	RES, 499, 1%, 0.063 W, 0402	0402	CRCW0402499RFKED	Vishay-Dale		
R2, R3, R5	3	10k	RES, 10 k, 5%, 0.063 W, 0402	0402	CRCW040210K0JNED	Vishay-Dale		
R4	1	14.0k	RES, 14.0 k, 1%, 0.063 W, 0402	0402	CRCW040214K0FKED	Vishay-Dale		
R6	1	20k	Trimmer, 20k ohm, 0.25W, TH	4.5x8x6.7mm	3266W-1-203LF	Bourns		
R7	1	14.3k	RES, 14.3 k, 1%, 0.063 W, 0402	0402	CRCW040214K3FKED	Vishay-Dale		
R11, R12	2	4.99k	RES, 4.99 k, 1%, 0.125 W, 0805	0805	CRCW08054K99FKEA	Vishay-Dale		
R13	1	1.00k	RES, 1.00 k, 1%, 0.125 W, 0805	0805	CRCW08051K00FKEA	Vishay-Dale		
S1	1		Switch, Tactile, SPST-NO, SMT	Switch, 6.2X5X6.2 mm	KST221JLFS	C&K Components		
SH-JP1, SH-JP2, SH-JP3, SH-JP4, SH-JP5, SH-JP6, SH-JP7, SH-JP8, SH-JP9	9	1x2	Shunt, 100mil, Gold plated, Black	Shunt	969102-0000-DA	3M	SNT-100-BK-G	Samtec
TP1, TP3, TP4, TP8	4		Test Point, Miniature, Yellow, TH	Yellow Miniature Testpoint	5004	Keystone		
TP2, TP7	2		Test Point, Miniature, Red, TH	Red Miniature Testpoint	5000	Keystone		

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

Table 4. bq25120AEVM Bill of Materials⁽¹⁾ (continued)

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
TP5	1		Test Point, Multipurpose, White, TH	White Multipurpose Testpoint	5012	Keystone		
TP6	1		Test Point, Multipurpose, Orange, TH	Orange Multipurpose Testpoint	5013	Keystone		
TP9	1		Test Point, Multipurpose, Black, TH	Black Multipurpose Testpoint	5011	Keystone		
U1	1		700-nA Low IQ Highly Integrated Battery Charge Management Solution for Wearables and IoT	YFP0025BABD	BQ25120AYFPR	Texas Instruments	BQ25120AYFPT	Texas Instruments

2.2 Board Layouts

2.2.1 BQ25120AEVM Layouts

Figure 6 through Figure 15 illustrate the BMS001 EVM PCB board layouts.

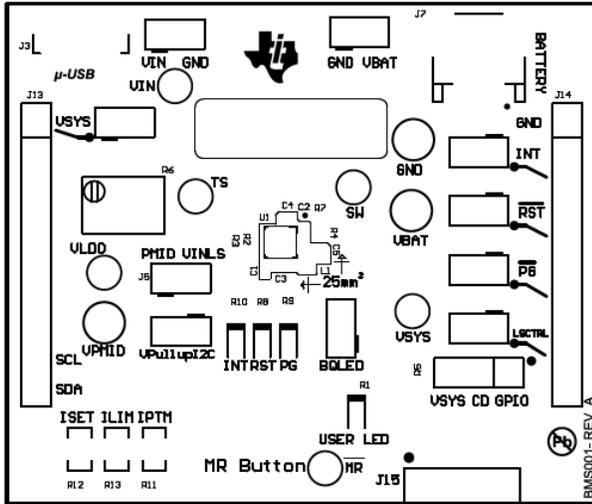


Figure 6. Top Overlay

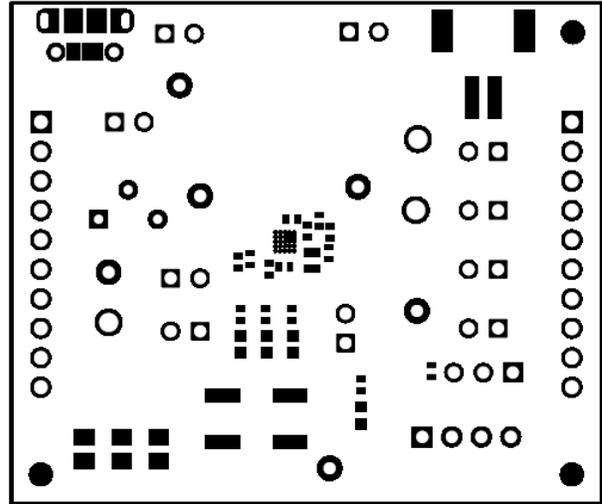


Figure 7. Top Solder Mask

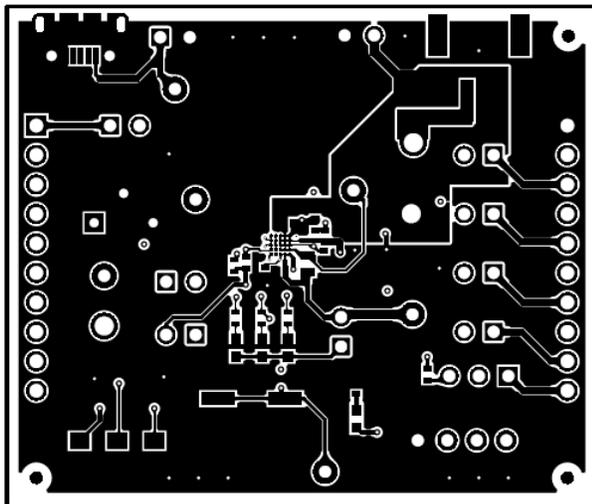


Figure 8. Top Layer

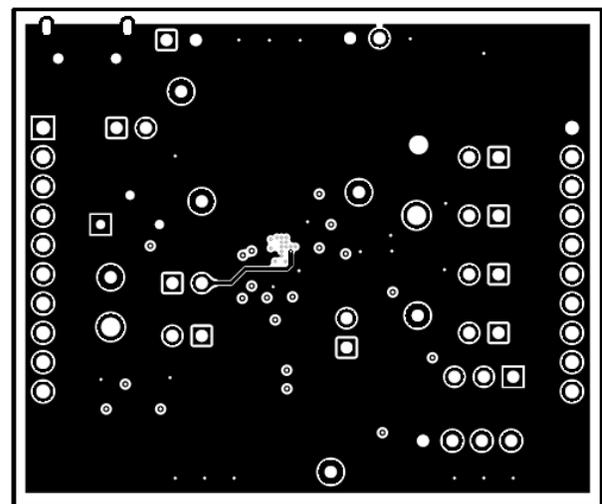


Figure 9. Signal Layer 1

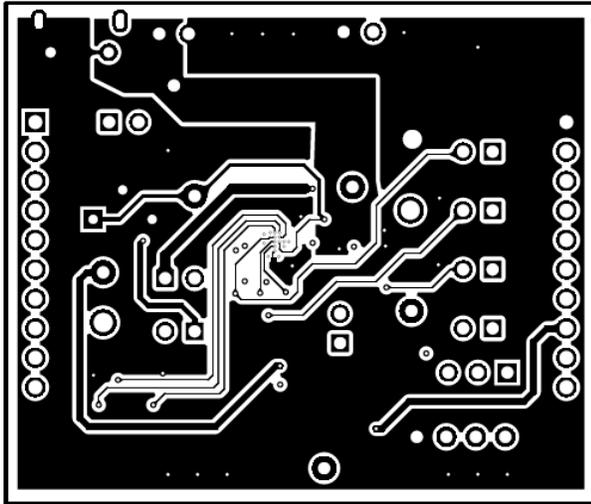


Figure 10. Signal Layer 2

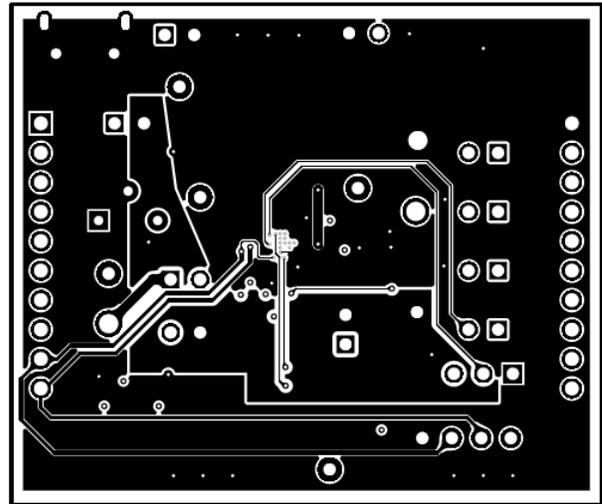


Figure 11. Bottom Layer

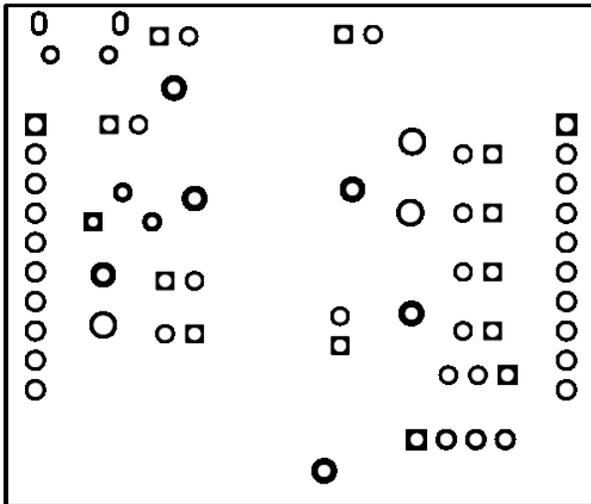


Figure 12. Bottom Solder Mask

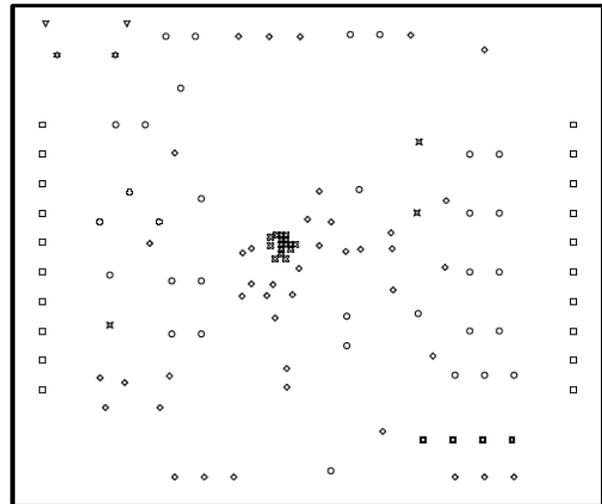


Figure 13. Drill Drawing

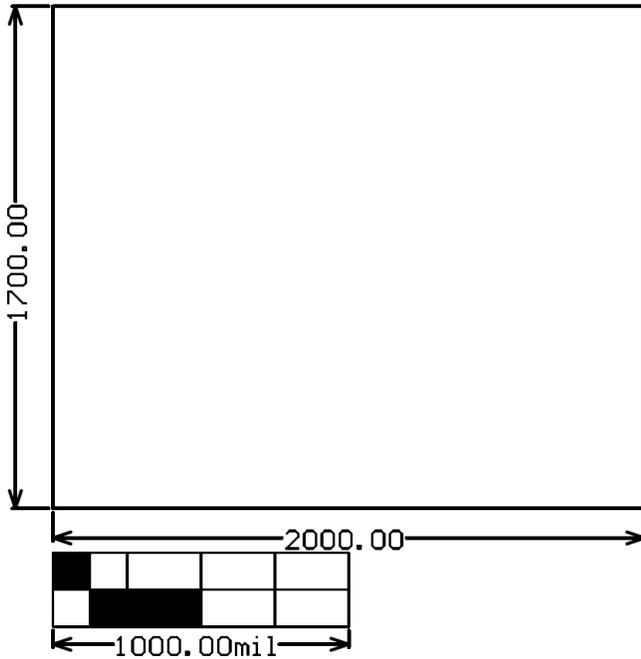


Figure 14. Board Dimensions (Image is not Actual Size)

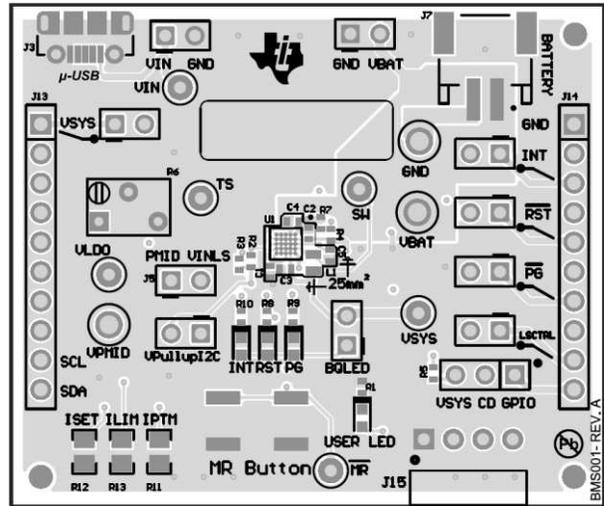


Figure 15. Component View Top

Revision History

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

Changes from Original (September 2017) to A Revision

Page

• Added bq25122EVM to the user's guide.	1
• Added <i>PCB Configurations</i> table.	2
• Added bq25122 default settings.	8

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 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 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/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 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。
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/lstds/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/lstds/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.

6. *Disclaimers:*

6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS 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 EPIDEMIC FAILURE WARRANTY OR 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.

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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 OR THE USE OF THE EVMS, 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 TWELVE (12) MONTHS AFTER THE EVENT THAT GAVE RISE TO THE CAUSE OF ACTION HAS OCCURRED.

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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.

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