bq25970 PWR893 Evaluation Module

User's Guide

Literature Number: SLUUBR4A
February 2018–Revised December 2018

bq25970 PWR893 Evaluation Module

This user's guide provides detailed testing instructions for the bq25970 evaluation modules (EVM). Also included are descriptions of the necessary equipment, equipment setup, and procedures. The reference documentation contains the printed-circuit board layouts, schematics, and the bill of materials (BOM).

1 Introduction

1.1 EVM Features

For detailed features and operation, refer to the device data sheet as listed in Table 1.

Table 1. Device Data Sheet

Device	Datasheet	EVM Label	Variant
bq25970	SLUSD72A	BQ25970EVM-893	001

The bq2597x evaluation module (EVM) is a complete charger module for evaluating the highly-integrated battery switch in WCSP package for 1 cell Li-Ion and Li-polymer battery in a wide range of smartphones and tablets.

This EVM does not include the EV2300 or EV2400 (EV2x00) interface board. To evaluate the EVM, a EV2x00 interface board must be ordered separately.

There are two bq25970 on the EVM, users can configure the EVM either as a single bq25970 or a parallel bq25970 operation based on the jumper setting described in next section.

1.2 I/O Descriptions

Table 2 lists the jumper connections available on this EVM.

Table 2. PWR893 EVM Header Jx Connections

Jack	Description	Single Setting	Parallel Setting
J1 – VBUS	Input Terminal	Installed	Installed
J2 – VOUT/PACK-	Output terminal	To battery	To battery
J3 – I^2C	EV2x00 I^2C 4-pin connector	To host	To host

Table 3 lists the EVM jumper connections.

Table 3. EVM Jumper JPx Shunt Installation

Jack	Description	Single Setting	Parallel Setting
JP1	VAC pin connection selection	(2) short to (3) VAC	(2) short to (1) VBUS
JP2	OVPGATE pin connection selection	(2) short to (3) OVPGATES	(2) short to (1) OVPGATEM
JP3	BATP connection selection	(2) short to (1) VOUT	(2) short to (1) SYNCOUT
JP4	SRP sense resistor selection	(2) short to (1) SRP	(2) short to (3) GND
JP5	SRN sense resistor selection	(2) short to (1) SRN	(2) short to (3) GND
JP6	VAC_M pin connection	not installed	installed
JP7	LDO input pin selection	(2) short to (3) VOUT	(2) short to (3) VOUT
JP8	ADDRMS pin selection for ADDR 0x66	installed	not installed
JP9	ADDRMS pin selection for ADDR 0x65	not installed	not installed
JP10	ADDRMS pin selection for parallel configuration	not installed	installed
JP11	I2C pull up selection	installed	installed
JP12	SDA and SCL pull up selection	installed	installed
JP13	TSBUS_M connection to charger	not installed	installed
JP14	TSBUS_M voltage adjustment	not installed	installed
JP15	TSBUS_M pull up to VOUT	not installed	installed
JP16	TSBUS_S connection to charger	installed	installed
JP17	TSBUS_S voltage adjustment	installed	installed
JP18	TSBUS_S pull up to VOUT	installed	installed
JP19	TSBAT_S connection to charger	installed	installed
JP20	TSBAT_S voltage adjustment	installed	installed
JP21	TSBAT_S pull up to VOUT	installed	installed

Table 4 lists the recommended operating conditions for this EVM.

Table 4. Recommended Operating Conditions(1)

		MIN	MAX	UNIT
Voltage	VAC		12	V
	VBUS		12	V
	VOUT	3	6	V
	CFH1-VOUT, CFL1, CFH2-VOUT,CFL2	0	6	V
	BATP_SYNCIN, BATN	0	6	V
	SRP-SRN	-0.05	0.05	V
	TS_BAT_SUNCOUT, TSBUS	0	3	V
	SDA, SCL, CDRVL_ADDRMS, INT	0	5	V
I_{VOUT}	Max current from VBUS to VOUT	0	8	A
T_A	Operating free-air temperature range	–40	85	°C

(1) Over operating free-air temperature range (unless otherwise noted)

2 Test Summary

2.1 Equipment

2.1.1 Specify Equipment Needed to Perform Tests

1. **Power Supplies (PS)**

   One power supply capable of supplying 12 V at 4 A (or above) is required. While this part can handle larger voltage and current, it is not necessary for this procedure.

   NOTE: If there is no display of current and voltage in this power supply, a separate current meter and a separate voltage meter are required to measure the input current and input voltage, respectively.

2. **Battery Simulator** (4-quadrant supply, constant voltage < 4.5 V)

   A Kepco load: BOP 20–12 M, DC 0 to ±20 V, 0 to ±8 A (or higher), or equivalent.

   NOTE: If there is no display of current and voltage in this electronic load, a separate current meter and a separate voltage meter are required to measure the output current and output voltage, respectively.

3. **Meters**

   Six Fluke 75 multimeters, (equivalent or better)

   or:

   Four equivalent voltage meters and two equivalent current meters. The current meters must be capable of measuring 8 A+ current.

   NOTE: Only needed if required as described in Power Supplies (PS) and Battery Simulator.

4. **Computer**

   A computer with at least one USB port and a USB cable. The bq25970EVM evaluation software must be properly installed (bqStudio).

5. **EV2x00 Communication Kit**

   The EV2x00 USB-based PC interface board.

2.1.2 Specify Software Needed for Testing

Download bqstudio from http://www.ti.com/tool/bqstudio. Follow the installation steps to install the tool. The software supports the Microsoft® Windows® XP and Windows 7 operating systems.

2.2 Equipment Setup

Set up the equipment using the following steps:

1. Set PS for 7.5-V DC output, 3A or above current limit and then turn off the supply.
2. Connect the output of PS to J1 (VAC and GND) as shown in Figure 1.
3. Turn on the battery simulator, set to constant voltage mode and output to 3.6 V. Turn off (disable) the load. Connect load to J2 (VOUT and GND) as shown in Figure 1.

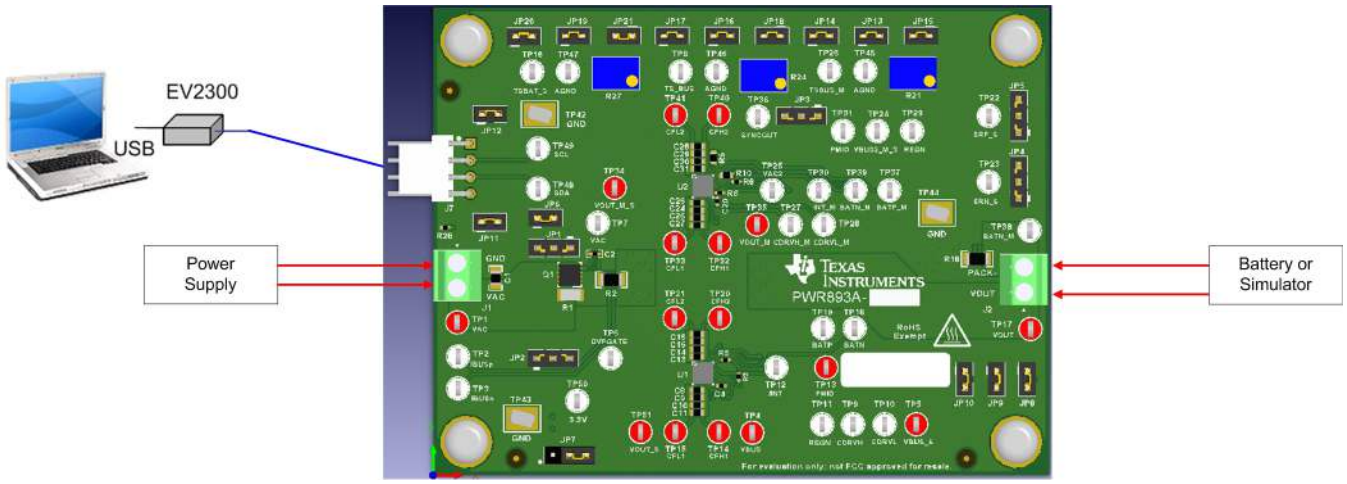


Figure 1. Test Setup for BQ25970

4. Connect the EV2x00 USB interface board to the computer with a USB cable and from I^2C port to J3 with the 4-pin cable. The connections are shown in Figure 2.

Figure 2. Connections of the EV2300 Kit

5. Turn on the computer. Launch *Battery Management Studio* (bqStudio). Select *Charger* and bq25970 evaluation software. The main window of the software is shown in Figure 3.

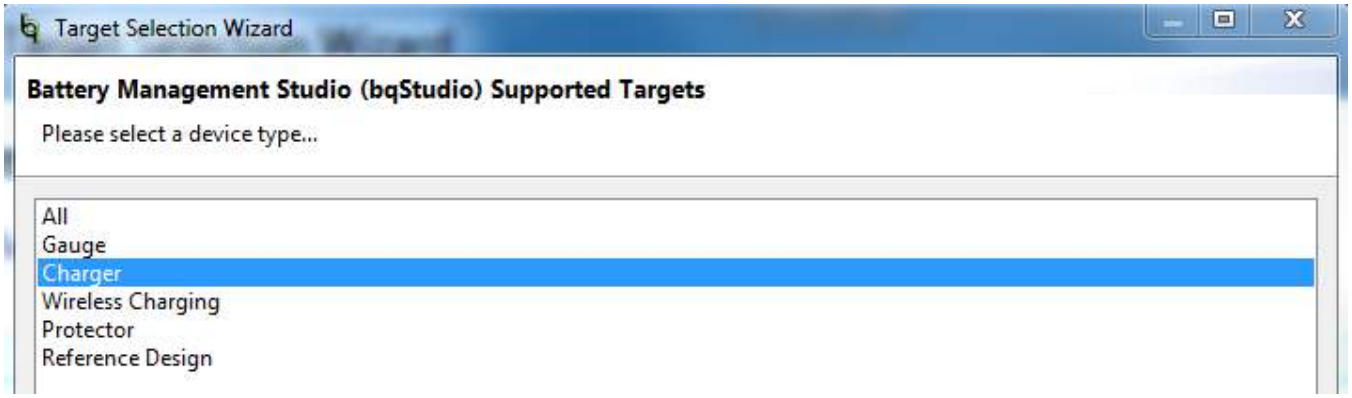


Figure 3. Select "Charger" in bqStudio Window

2.3 Test Procedure

The steps for the test procedure follow:

1. Ensure equipment setup steps are followed.
2. Launch the bq258970 EVM GUI software, if not already done.
3. Turn on PS and battery simulator.
4. Measure Input.

   VAC(TP1) = 7.5 V ±0.2 V

   VBUS(TP4) = 0 V, I_VBUS = 0 A

   Measure → Output:

   VOUT(TP17) = 3.6V ±0.2 V

2.4 Communication Verification

Use the following steps for communication verification:

1. Click the **Read** button, *Device ACK OK* should appear.
2. In the EVM software, select *Field View*, specify correct device "I2C Address" as defined in the datasheet, such as CC(66), and so forth.

3. Click the **Read** button, *Device ACK OK* should appear.
4. In the EVM software, make the following changes as necessary Figure 4:
   - Select *Disable* for the *Watchdog Timer*
   - Change *VAC OVP* for to 14V or higher and make sure *VAC OVP Status* is *Normal*
   - Make Sure *VBUS too low for converter to start* and *VBUS too high for converter to start* are both *Normal*

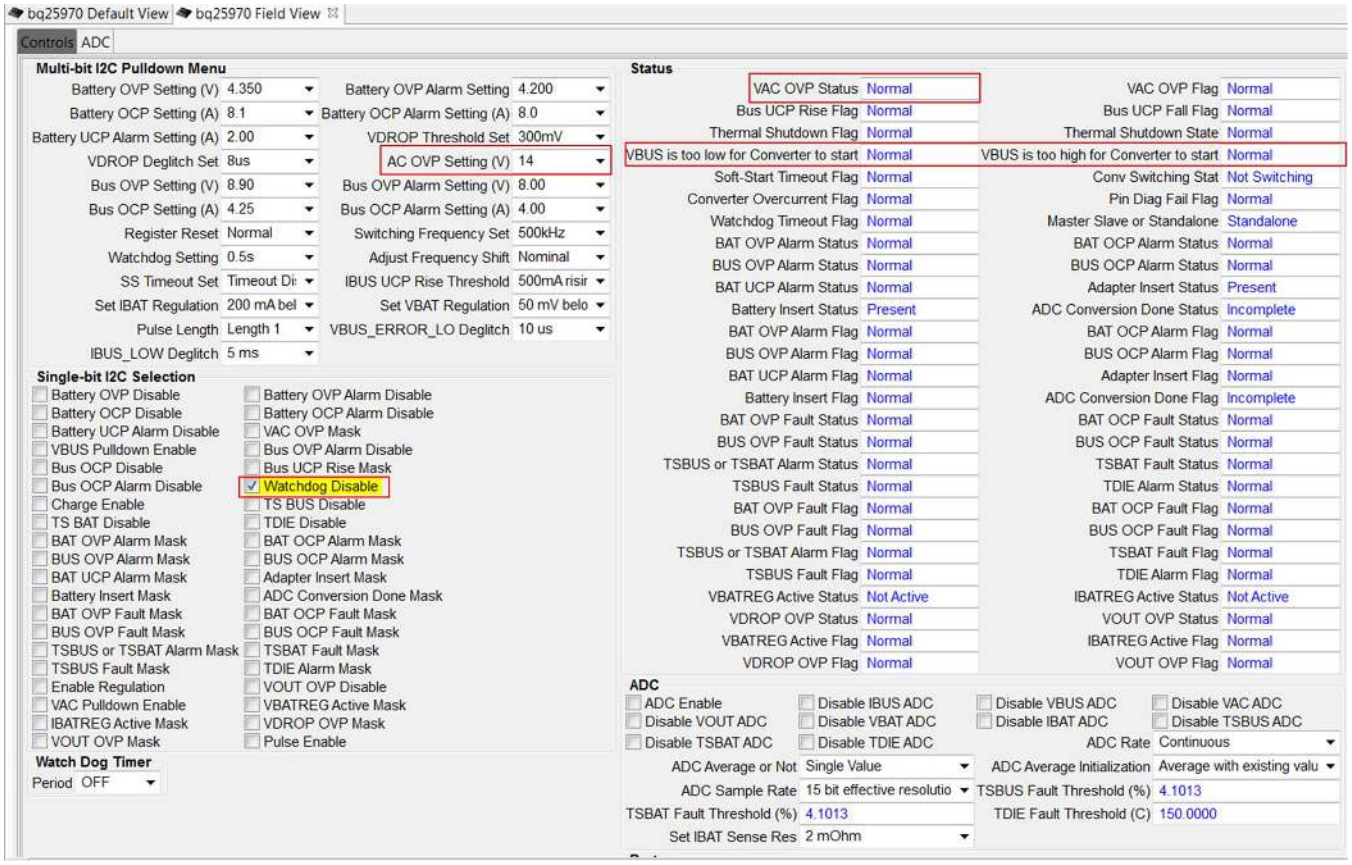


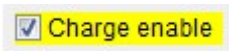
Figure 4. Sample of Register Map

5. Click the **Read** button.
   Observe → Everything *normal* at Fault box

2.5 Charger Mode Verification

Use the following steps for charger mode verification:

1. Select *Charge Enable*



2. Input and output voltage/current:
   After enabling charge, the output current should be two times of the input current.
3. Change charge current:
   By increasing the input voltage, the input current should increase together with the output current. The output current should always be two times of the input current.
4. Unselect *Charge Enable* (→ disable charge)
5. Measure the current at J3 and J5, both should go to zero amps.
6. Turn off and disconnect load
7. Turn off and disconnect PS

3 Board Layout, Schematic, and Bill of Materials

3.1 Board Layout

Figure 5 through Figure 10 illustrate the board layouts for this EVM.

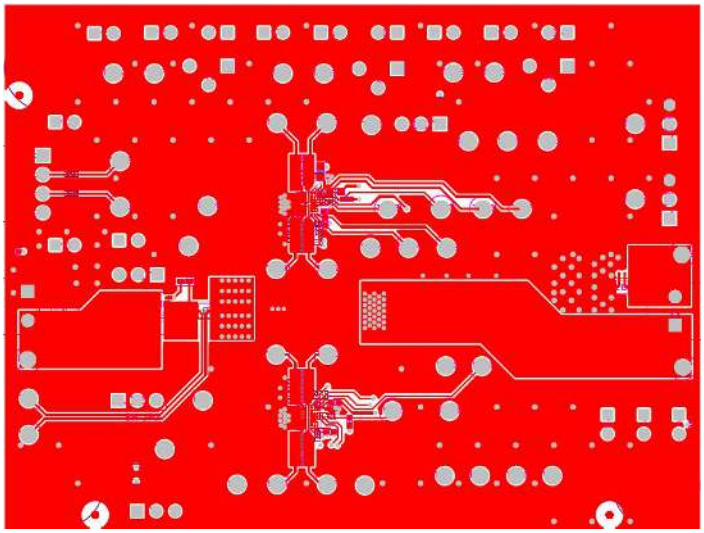


Figure 5. BQ25970EVM-893 top layer

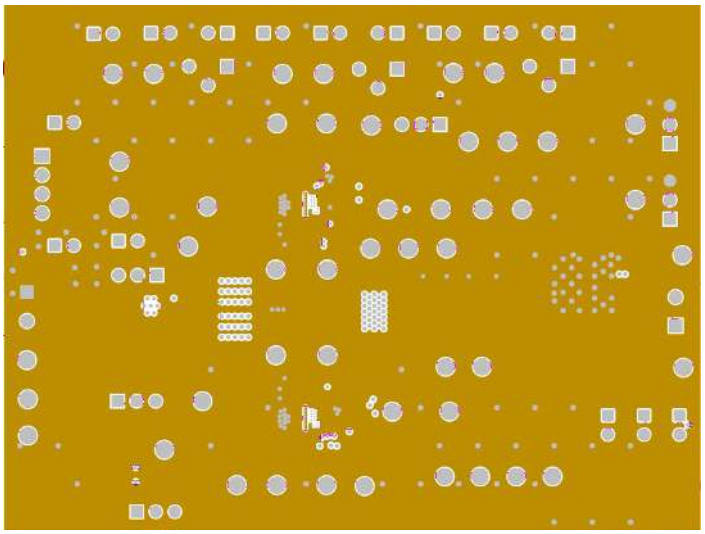


Figure 6. BQ25970EVM-893 Mid Layer 1

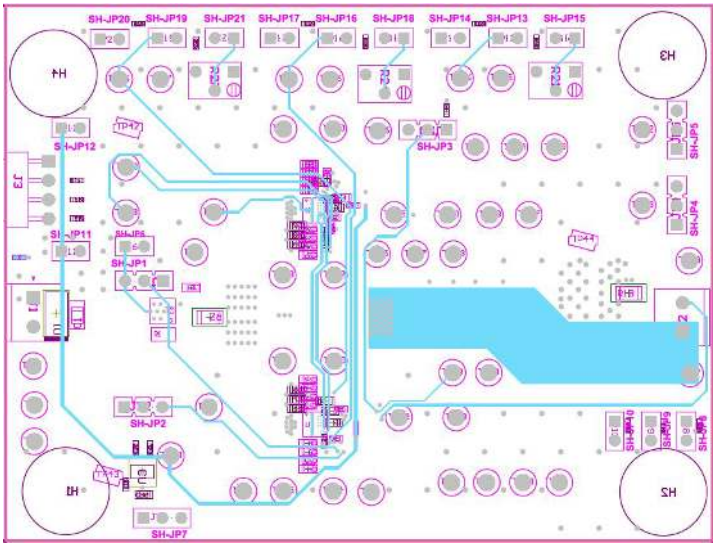


Figure 7. BQ25970EVM-893 Mid-Layer 2

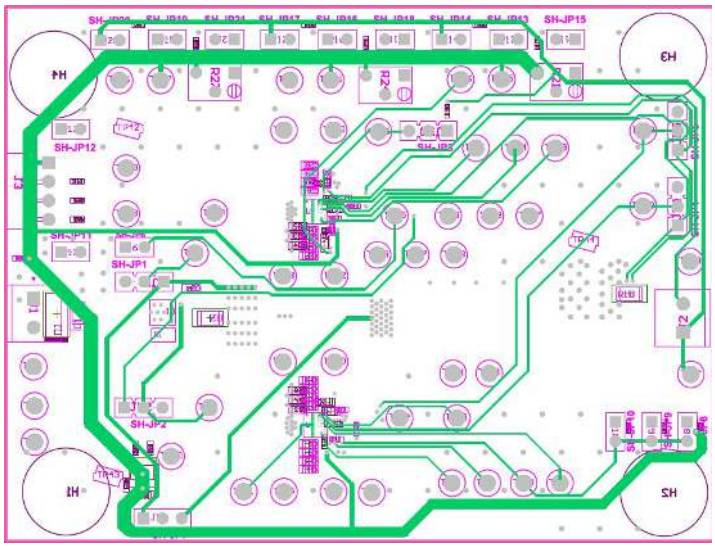


Figure 8. BQ25970EVM-893 Mid-Layer 3

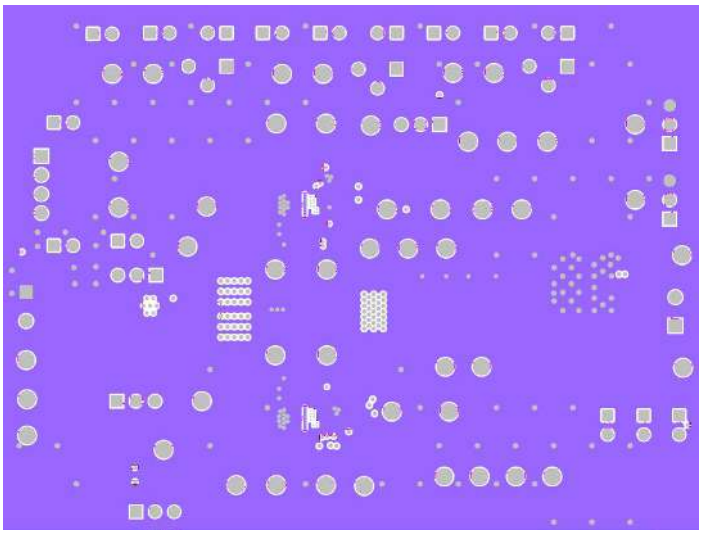


Figure 9. BQ25970EVM-893 Mid-Layer 4

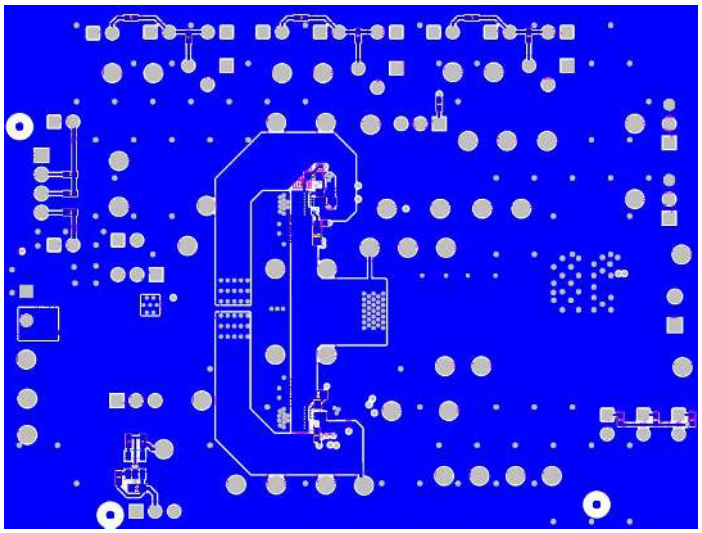


Figure 10. BQ25970EVM-893 Bottom Layer

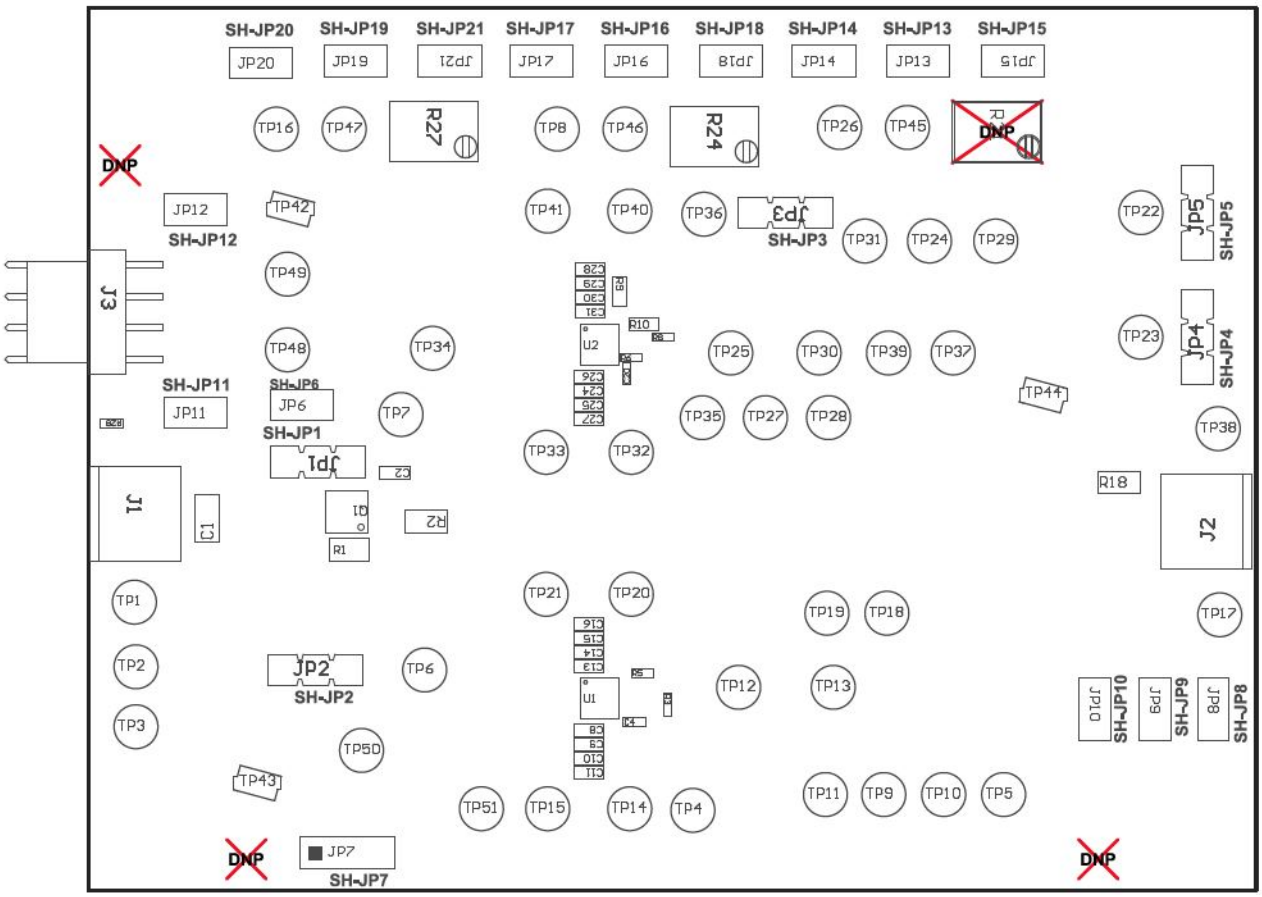


Figure 11. bq25970EVM-893 Top Layer Assembly

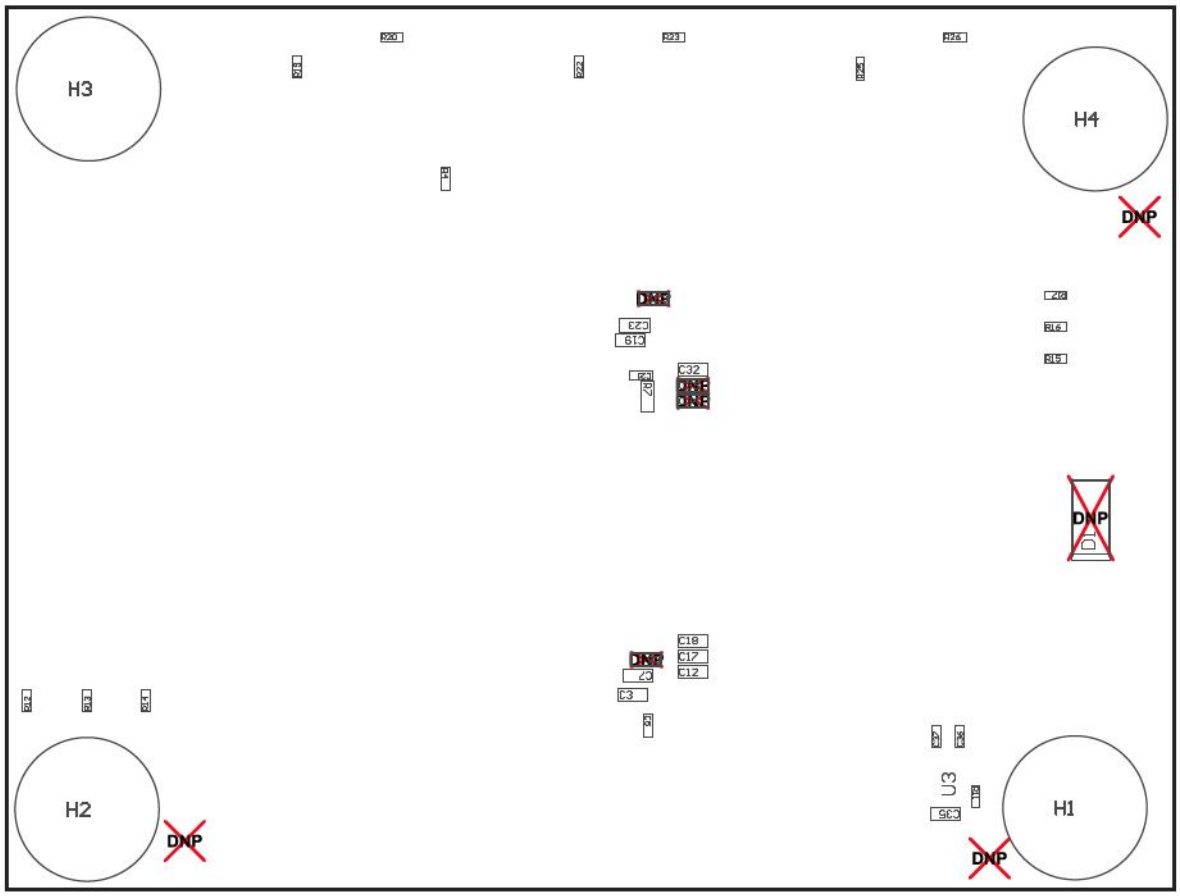


Figure 12. bq25970EVM-893 Bottom Layer Assembly

3.1.1 PCB Layout Guideline

The bq25970 supports up to a 8-A charge current. It is critical to maximize the BUS and VOUT Cu trace. TI recommends following the PCB layout guidelines:

1. VBUS traces should be as short and wide as possible to accommodate for high current.
2. Minimize losses through connectors wherever possible, as the losses in these connectors will contribute a significant amount to the total power loss.
3. Use vias under the exposed thermal pad for thermal relief.
4. Place low ESR bypass capacitors to ground for VBUS, PMID, and VOUT. The capacitor should be placed as close to the device pins as possible.
5. The CFLY pads should be as small as possible, and the CFLY caps placed as close as possible to the device, as these are switching pins and this will help reduce EMI.
6. Connect all quiet signals to the AGND pin(s).
7. Connect all power signals to the GND pin(s).
8. Do not route so the power planes are interrupted by signal traces.

3.2 Schematic

Figure 13 and Figure 14 illustrate the schematic for this EVM.

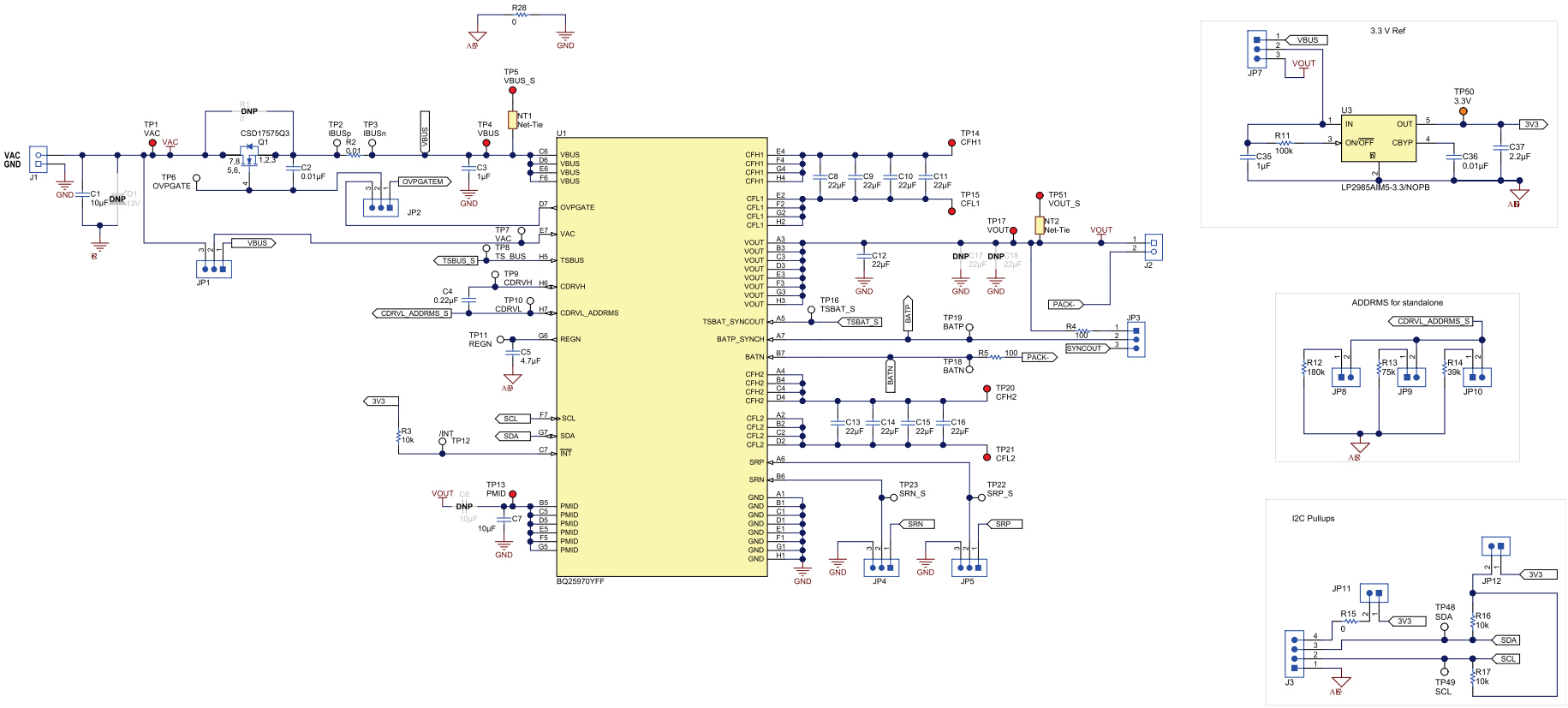


Figure 13. bq25970EVM-893 Schematic (page 1)

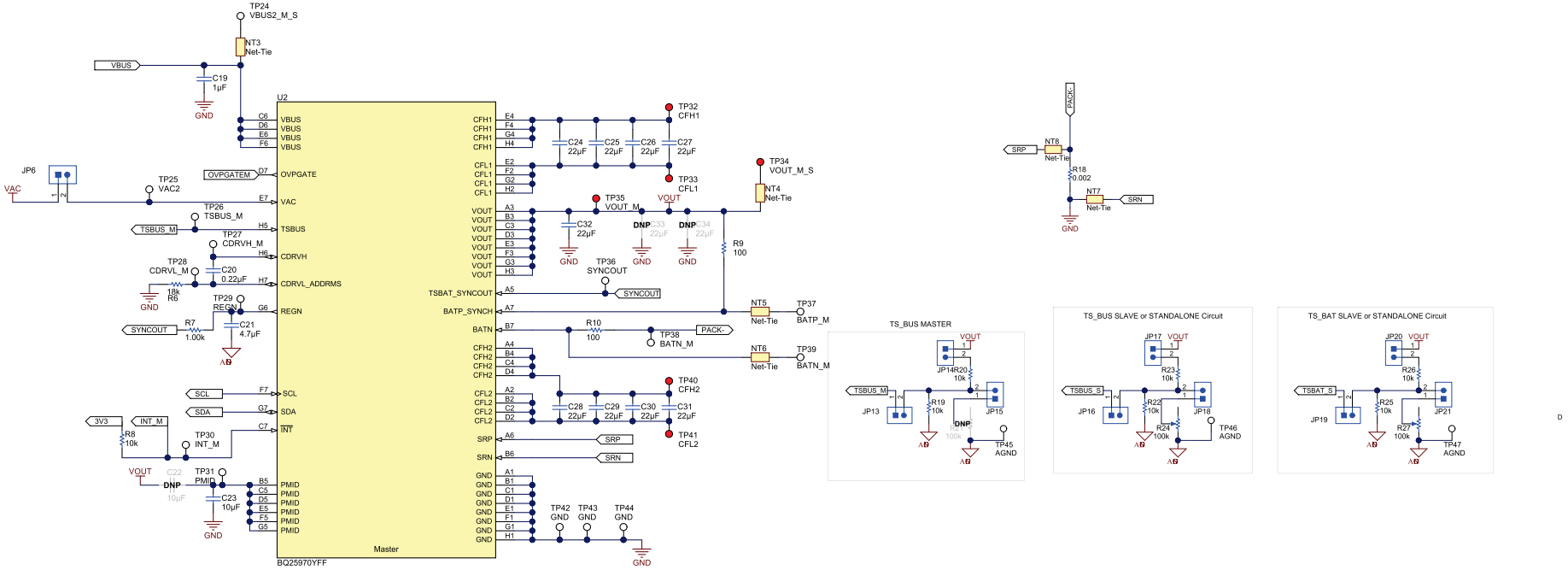


Figure 14. bq25970EVM-893 Schematic (page 2)

4 List of Materials

Table 5. List of Materials for BQ25970EVM-893

DESIGNATOR	QTY	VALUE	DESCRIPTION	PART NUMBER (1)	MANUFACTURER
!PCB1	1		Printed Circuit Board	PWR893	Any
C1	1	10uF	Capacitor ceramic, 10 µF, 25 V, ±10%, X5R, 0805	C2012X5R1E106K125AB	TDK
C2, C36	2	0.01uF	Capacitor ceramic, 0.01 µF, 25 V, ± 10%, X7R, 0402	GRM155R71E103KA01D	MuRata
C3, C19	2	1uF	Capacitor ceramic, 1 µF, 25 V, ± 10%, X5R, 0603	GRM188R61E105KA12D	MuRata
C4, C20	2	0.22uF	Capacitor ceramic, 0.22 µF, 16 V, ± 10%, X7R, 0402	GRM155R71C224KA12D	MuRata
C5, C21	2	4.7uF	Capacitor ceramic, 4.7 µF, 10 V, ± 20%, X5R, 0402	GRM155R61A475MEAAD	MuRata
C7, C23	2	10uF	Capacitor ceramic, 10 µF, 10 V, ±20%, X7T, 0603	GRM188D71A106MA73D	MuRata
C8, C9, C10, C11, C12, C13, C14, C15, C16, C24, C25, C26, C27, C28, C29, C30, C31, C32	18	22uF	Capacitor ceramic, 22 µF, 10 V, ±20%, X5R, 0603	GRM188R61A226ME15D	MuRata
C35	1	1uF	Capacitor ceramic, 1 µF, 25 V, +±10%, X7R, 0603	GRM188R71E105KA12D	MuRata
C37	1	2.2uF	Capacitor ceramic, 2.2 µF, 10V, ±10%, X5R, 0402	C1005X5R1A225K050BC	TDK
H1, H2, H3, H4	4		Bumpon, hemisphere, 0.44 X 0.20, Clear	SJ-5303 (CLEAR)	3M
J1	1	2x1	Conn term block, 2POS, 3.81 mm, TH	1727010	Phoenix Contact
J2	1		Conn term block, 2POS, 3.81 mm, TH	1727010	Phoenix Contact
J3	1		Header, 100 mil, 4x1, R/A, TH	22-05-3041	Molex
JP1, JP2, JP3, JP4, JP5	5		Header, 2.54 mm, 3x1, Tin, TH	TSW-103-07-T-S	Samtec
JP6, JP8, JP9, JP10, JP11, JP12, JP13, JP14, JP15, JP16, JP17, JP18, JP19, JP20, JP21	15		Header, 100 mil, 2x1, Tin, TH	PEC02SAAN	Sullins Connector Solutions
JP7	1		Header, 100 mil, 3x1, Tin, TH	PEC03SAAN	Sullins Connector Solutions
Q1	1	30V	MOSFET, N-CH, 30 V, 60 A, DQG0008A (VSON-CLIP-8)	CSD17575Q3	Texas Instruments
R2	2	0.01	Resistor, 0.01 Ω, 1%, 1 W, 1206	WSLP1206R0100FEA	Vishay-Dale
R3, R8, R16, R17, R19, R20, R22, R23, R25, R26	10	10k	Resistor, 10 kΩ, 5%, 0.063 W, 0402	CRCW040210K0JNED	Vishay-Dale
R4, R5	2	100	Resistor, 100 Ω, 1%, 0.1 W, 0402	ERJ-2RKF1000X	Panasonic
R6	1	18k	Resistor, 18 kΩ, 5%, 0.063 W, 0402	CRCW040218K0JNED	Vishay-Dale
R7	1	1.00k	Resistor, 1.00 kΩk, 1%, 0.1 W, 0603	RC0603FR-071KL	Yageo America
R9, R10	2	100	Resistor, 100 Ω, 5%, 0.1 W, 0603	CRCW0603100RJNEA	Vishay-Dale
R11	1	100k	Resistor, 100 kΩ, 1%, 0.063 W, 0402	CRCW0402100KFKED	Vishay-Dale
R12	1	180k	Resistor, 180 kΩ, 5%, 0.063 W, 0402	CRCW0402180KJNED	Vishay-Dale
R13	1	75k	Resistor, 75 kΩk, 5%, 0.063 W, 0402	CRCW040275K0JNED	Vishay-Dale
R14	1	39k	Resistor, 39 kΩ, 5%, 0.063 W, 0402	CRCW040239K0JNED	Vishay-Dale
R15, R28	2	0	Resistor, 0 Ω, 5%, 0.063 W, 0402	CRCW040200000Z0ED	Vishay-Dale
R18	1	0.002	Resistor, 0.002 Ω, 1%, 1 W, 1206	CSNL1206FT2L00	Stackpole Electronics Inc
R24, R27	2	100k	Trimmer, 100 kΩ, 0.25 W, TH	3266W-1-104LF	Bourns
SH-JP1, SH-JP2, SH-JP3, SH-JP4, SH-JP5, SH-JP7, SH-JP8, SH-JP11, SH-JP12, SH-JP16, SH-JP17, SH-JP18, SH-JP19, SH-JP20, SH-JP21	15	1x2	Shunt, 100 mil, Gold plated, Black	969102-0000-DA or SNT-100-BK-G	3M or Samtec

(1) Unless otherwise noted, all parts may be substituted with equivalents.

Table 5. List of Materials for BQ25970EVM-893 (continued)

DESIGNATOR	QTY	VALUE	DESCRIPTION	PART NUMBER (1)	MANUFACTURER
TP1, TP4, TP5, TP13, TP14, TP15, TP17, TP20, TP21, TP32, TP33, TP34, TP35, TP40, TP41, TP51	16	Red	Test Point, Multipurpose, Red, TH	5010	Keystone
TP2, TP3, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP16, TP18, TP19, TP22, TP23, TP24, TP25, TP26, TP27, TP28, TP29, TP30, TP31, TP36, TP37, TP38, TP39, TP45, TP46, TP47	29		Test Point, Multipurpose, White, TH	5012	Keystone
TP42, TP43, TP44	3		Test Point, Compact, SMT	5016	Keystone
TP48, TP49	2	White	Test Point, Multipurpose, White, TH	5012	Keystone
TP50	1		Test Point, Compact, Orange, TH	5008	Keystone
U1, U2	2		97% Efficient, 8A Switched Cap Battery Charger with Integrated Protection, I2C Programmability and ADC, YFF0056APAF (DSBGA-56)	BQ25970YFF	Texas Instruments
U3	1		Micropower 150 mA Low-Noise Ultra Low-Dropout Regulator, 5-pin SOT-23, Pb-Free	LP2985AIM5-3.3/NOPB	Texas Instruments
C6, C22	0	10uF	Capacitor, ceramic, 10 µF, 10 V, +/- 20%, X7T, 0603	GRM188D71A106MA73D	MuRata
C17, C18, C33, C34	0	22uF	Capacitor, ceramic, 22 µF, 10 V, +/- 20%, X5R, 0603	GRM188R61A226ME15D	MuRata
D1	0	13V	Diode, TVS, Uni, 13 V, SMA	SMAJ13A	Littelfuse
FID1, FID2, FID3, FID4, FID5, FID6	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A
R1	0	0	Resistor, 0, 1%, 0.5 W, 1206	5108	Keystone
R21	0	100k	Trimmer, 100k ohm, 0.25W, TH	3266W-1-104LF	Bourns
SH-JP6, SH-JP9, SH-JP10, SH-JP13, SH-JP14, SH-JP15	0	1x2	Shunt, 100mil, Gold plated, Black	969102-0000-DA or SNT-100-BK-G	3M or Samtec

Revision History

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

Changes from Original (February 2018) to A Revision	Page
• Changed the Schematic images	13

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.

【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２４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/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.

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.

   6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS 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, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.

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. 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 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.

   8.2 *Specific Limitations.* IN NO EVENT SHALL TI'S AGGREGATE LIABILITY FROM ANY USE OF AN EVM PROVIDED HEREUNDER, INCLUDING FROM ANY WARRANTY, INDEMITY OR OTHER OBLIGATION ARISING OUT OF OR IN CONNECTION WITH THESE TERMS, , EXCEED THE TOTAL AMOUNT PAID TO TI BY USER FOR THE PARTICULAR EVM(S) AT ISSUE DURING THE PRIOR TWELVE (12) MONTHS WITH RESPECT TO WHICH LOSSES OR DAMAGES ARE CLAIMED. THE EXISTENCE OF MORE THAN ONE CLAIM 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

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI’s products are provided subject to TI’s Terms of Sale (www.ti.com/legal/termsofsale.html) or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI’s provision of these resources does not expand or otherwise alter TI’s applicable warranties or warranty disclaimers for TI products.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265