PMICLOADBOARDEVM Evaluation Module User's Guide

This user's guide describes the operation of the PMICLOADBOARDEVM which is a load transient board for Texas Instruments (TI) evaluation modules (EVM). Supported PMIC evaluation modules can be found in Section 1.1. This user's guide also provides design information including the schematic and bill of materials (BOM).

⚠	Caution	Caution Hot surface. Contact may cause burns. Do not touch!

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Trademarks

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1 Introduction

The PMICLOADBOARDEVM is an active load which is designed to support PMIC evaluation module measurements. Minimum load current rise and fall times can be as low as 80 ns thus providing high slew rate for evaluating transient performance. Example current waveforms with 80 ns rise and fall time is in Section 5. The main use case of the PMICLOADBOARDEVM is to provide an convenient way to evaluate transient performance with various Texas Instruments™ power management integrated circuit evaluation modules. However, the device can also be used to provide a DC load to the EVM. The PMICLOADBOARDEVM is equipped with two load channels which can be driven individually or by using the same signal source.
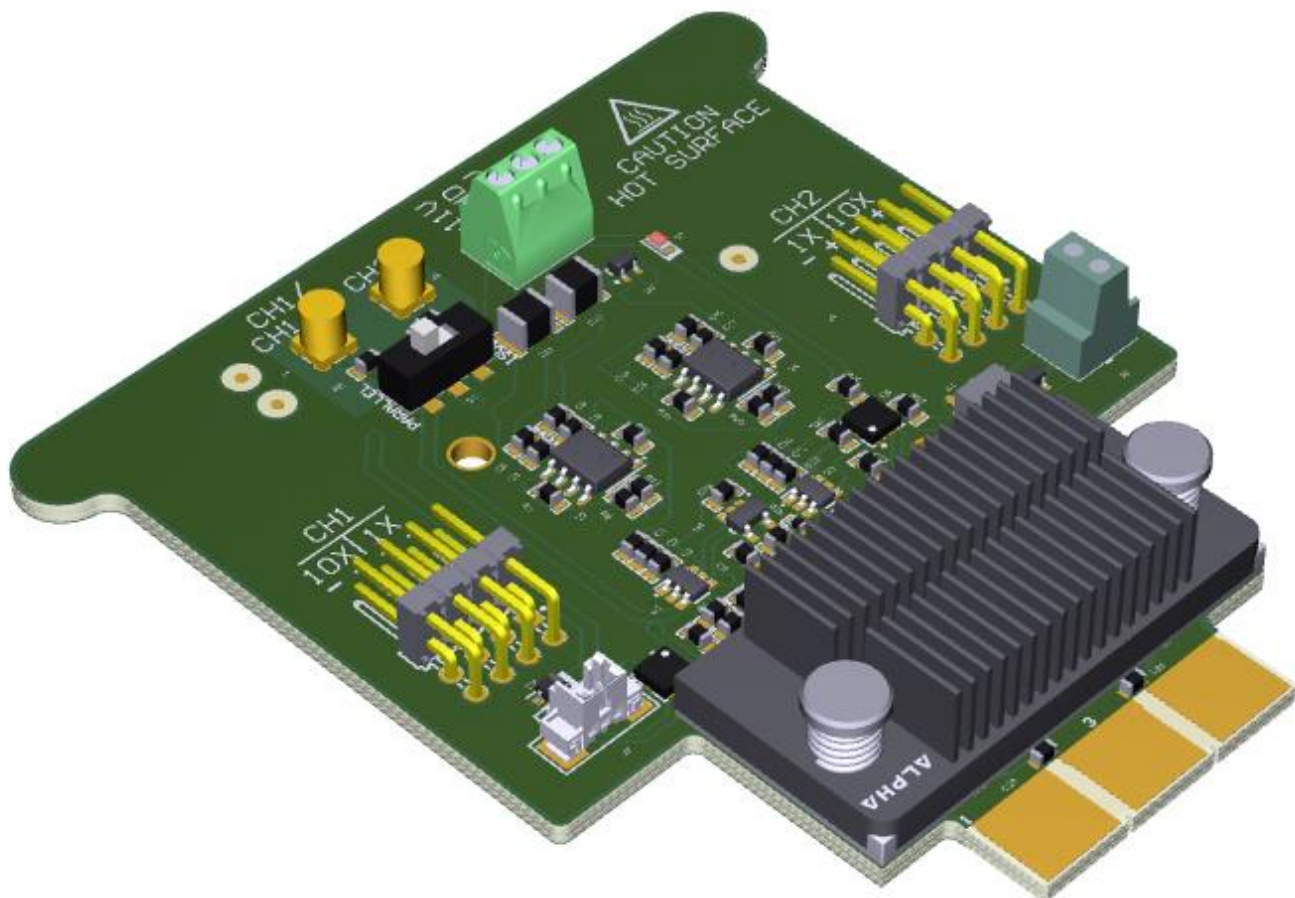

Figure 1. 3D Model of the PMICLOADBOARDEVM

1.1 Applications

The PMICLOADBOARDEVM can be used with EVMs that have the load module connector support. Supported evaluation modules are listed below.

- TPS659411EVM, TPS659413EVM
- LP87561Q1EVM, LP87562Q1EVM, LP87563Q1EVM, LP87564Q1EVM, and LP87565Q1EVM
- LP875701Q1EVM
- LP8770Q1EVM

The device ships with the correct load module connector that can be soldered on the tested EVM.

The device includes automated overtemperature protections. After the device reaches 80 °C, an optional fan turns on. The fan is not included and must be purchased separately if needed. After the PMICLOADBOARDEVM reaches 90 °C, the device shuts down.

2 Test Setup and Results

This section describes how to properly connect, set up, and use the PMICLOADBOARDEVM. The input voltage range for the device is ±6 volts to ±11 volts. However, the recommended power supply input voltage is ±11 V for the best performance. The device should be connected to an EVM for proper operation.

2.1 Input and Output Connector Descriptions

S1 – Switch is used to determine if the load channels are driven individually or in parallel with the same control signal. Channel 1 (CH1) is always controlled from J1 but channel 2 (CH2) control is switch (S1) dependent. When the S1 slider knob is on J3 (*isolated*), CH1 is controlled by input J1 and CH2 is controlled by input J3. When the S1 slider knob is on J1 side (*parallel*) both CH1 and CH2 are controlled by input J1. Figure 2 summarizes the switch functionality when selecting the conducting channels.

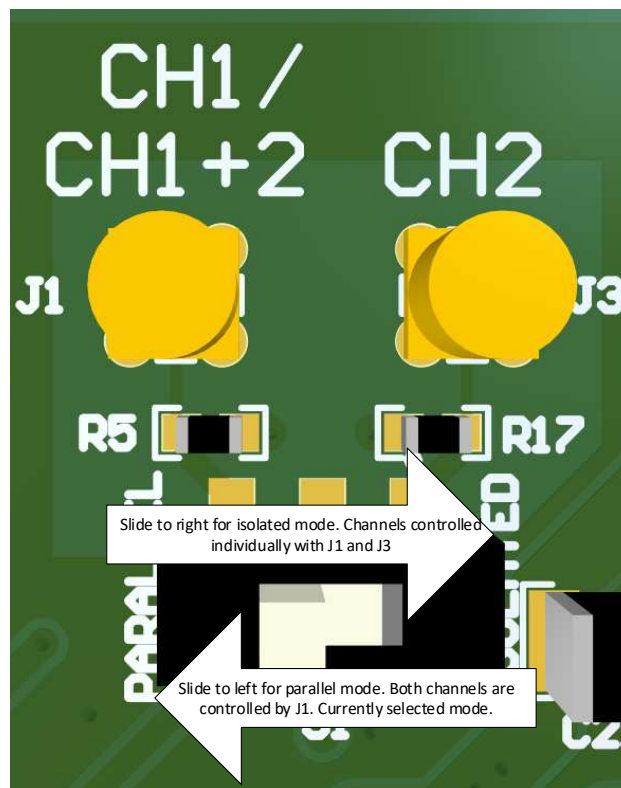**Figure 2. Switch S1 Control Selection**

J1 – Input is the control signal for CH1 or CH1+CH2 depending on the position of the S1. A signal generator is used to control the loading current and the connector type is MMCX. 1 V of control signal is equal of 20 A of load current for each channel.

J2 – Outputs are differential current monitoring signals (1X and 10X) for CH1. The 2.54 mm pinhead connectors provide:

a. Voltage over 50 mΩ load resistance: 1X

b. The same voltage differentially amplified by 10: 10X

J3 – Input is the control signal of CH2 if switch S1 is set to enable the input. A signal generator is used to control the loading current and the connector type is MMCX. 1 V of control signal is equal of 20 A of load current.

J4 – Outputs are differential current monitoring signals (1X and 10X) for CH2. The 2.54 mm pinhead connectors provide:

a. Voltage over 50 mΩ load resistance: 1X

b. The same voltage differentially amplified by 10: 10X

J5 – Input is power input terminal. Power supply is connected to this terminal block for providing positive supply power (+11 V), negative supply power (-11 V) and ground (GND) connection.

J6 – Output is a solid state relay output connector for passing information of an overtemperature situation. The relay output connection is normally open and it closes when an overtemperature mode is triggered. This output can be used as a failure flag to inform test equipment.

J7 – Output is a fan connector which can used to attach a fan to improve thermal management of the PMICLOADBOARDEVM. Fan is not included in the kit and must be purchased separately. The PCB of the PMICLOADBOARDEVM has mounting holes sized for BFB0312HA-A fan

EC-1 Input is a PCB edge connector which is used to connect the PMICLOADBOARDEVM to an EVM. The connector has six pads but there are only three connections because the facing top and bottom layer pads are connected together. CH1 load connections are on J2 side and CH2 load connections are on J4 side. The middle pad is connected to GND.

Figure 3 shows the PMICLOADBOARDEVM connected to an EVM and points out all the necessary connections for correct functionality.
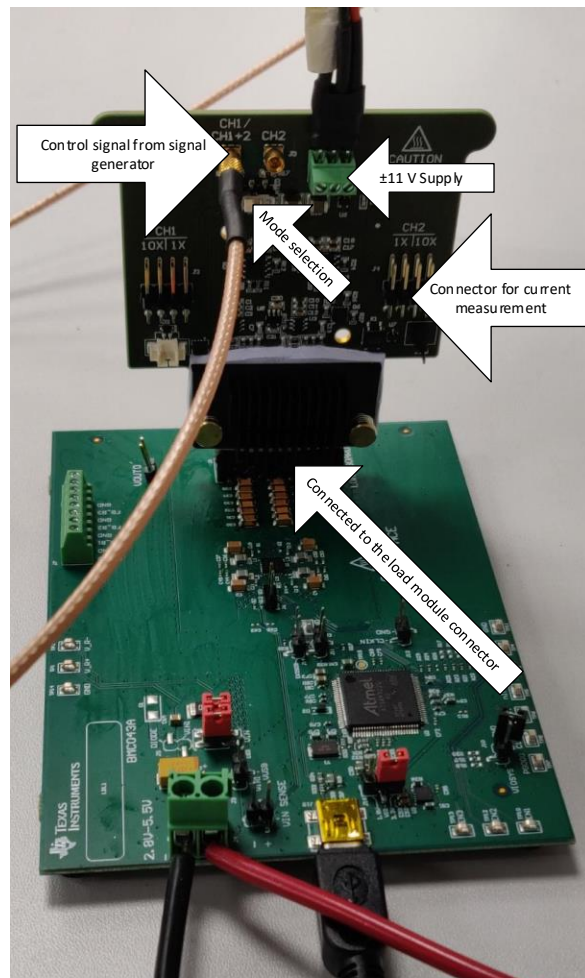
Figure 3. The PMICLOADBOARDEVM Connected to LP875701Q1EVM

2.2 Load Current

The resulting load current can be calculated with equation:

$I_{LOAD}=20 \times V_{CONTROL}$

If the PMICLOADBOARDEVM is in parallel mode then the resulting load current is doubled:

$I_{LOAD}=40 \times V_{CONTROL}$

However, in parallel mode the drawn current is drawn from both sides of the EC-1 connector. Current pulse should be short as possible but long as necessary to avoid thermal buildup. Some common values for the control signal and load current have been precalculated into Table 1.

Table 1. Control Signal and Resulting Load Current

| Control signal voltage (mV)	Load current in isolated channels (A)	Load current in parallel channels (A)
25	0.5	1.0
50	1.0	2.0
100	2.0	4.0
150	3.0	6.0
200	4.0	8.0
250	5.0	10.0

Table 1. Control Signal and Resulting Load Current (continued)

Control signal voltage (mV)	Load current in isolated channels (A)	Load current in parallel channels (A)
300	6.0	12.0

Note: the current is drawn from the designated pad of the EC-1 connector as shown in Section 2.1. Therefore, when the device operates in parallel mode half of the current is drawn from J1 side of the EC-1 connecter and the other half is drawn from J2 sides of the EC-1 connector.

3 Board Layout

Figure 4, Figure 5, Figure 6, Figure 7 and Figure 8 show the board layout. The board is constructed on a 6-layer PCB. Routing is mostly done on top layer, third layer and bottom layer. The top layer contains the routing of the main components and empty areas are filled with copper to spread the heat. Second layer is ground plane and third layer contains current monitoring signals, feedbacks, gate drive routing and other necessary routing. Fourth and fifth layers are also signal ground planes. Bottom layer is mostly ground plane excluding the load area which is connected to top layer.
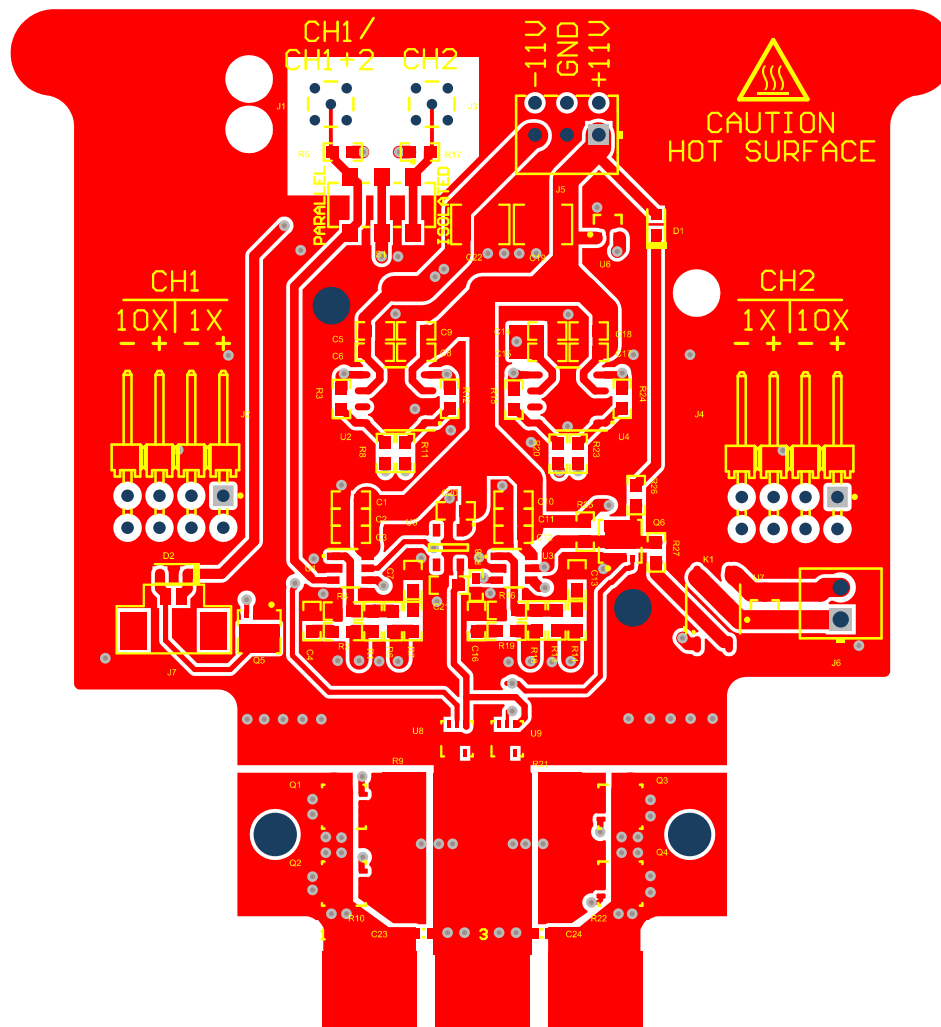
Figure 4. Top Assembly Layer
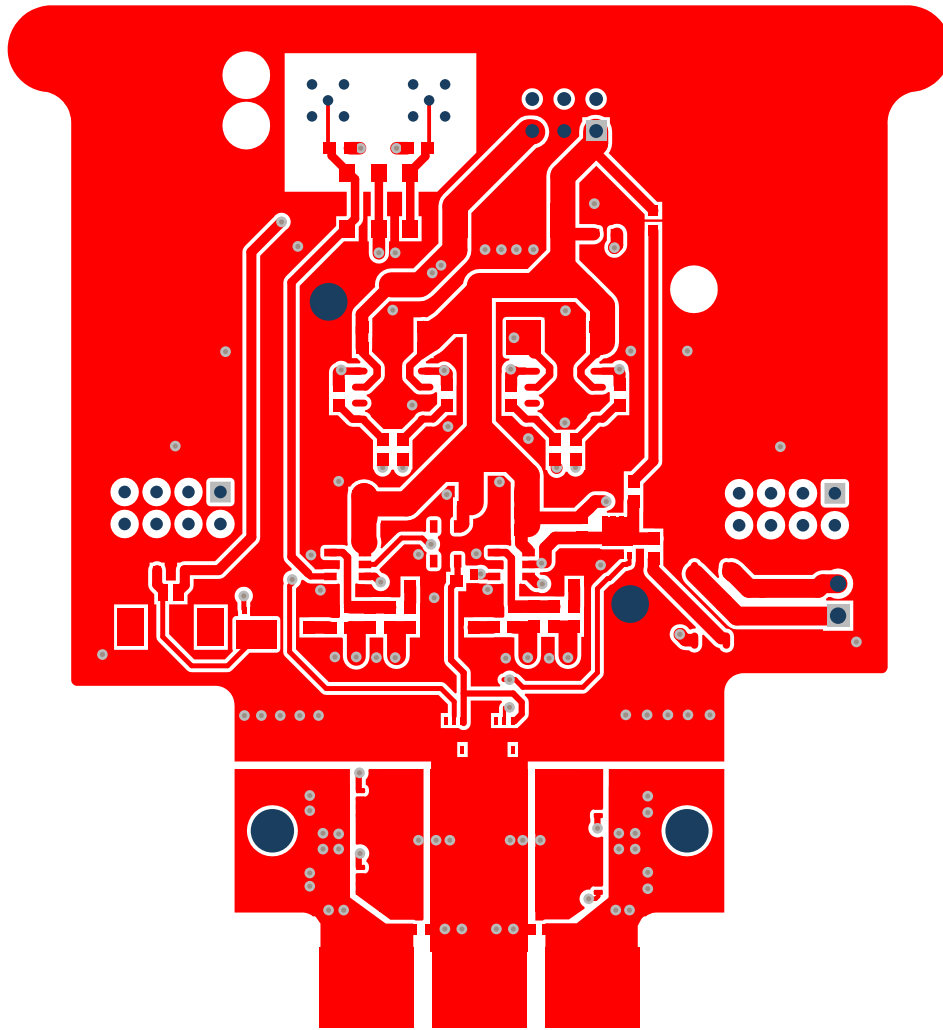
Figure 5. Top Layer Routing
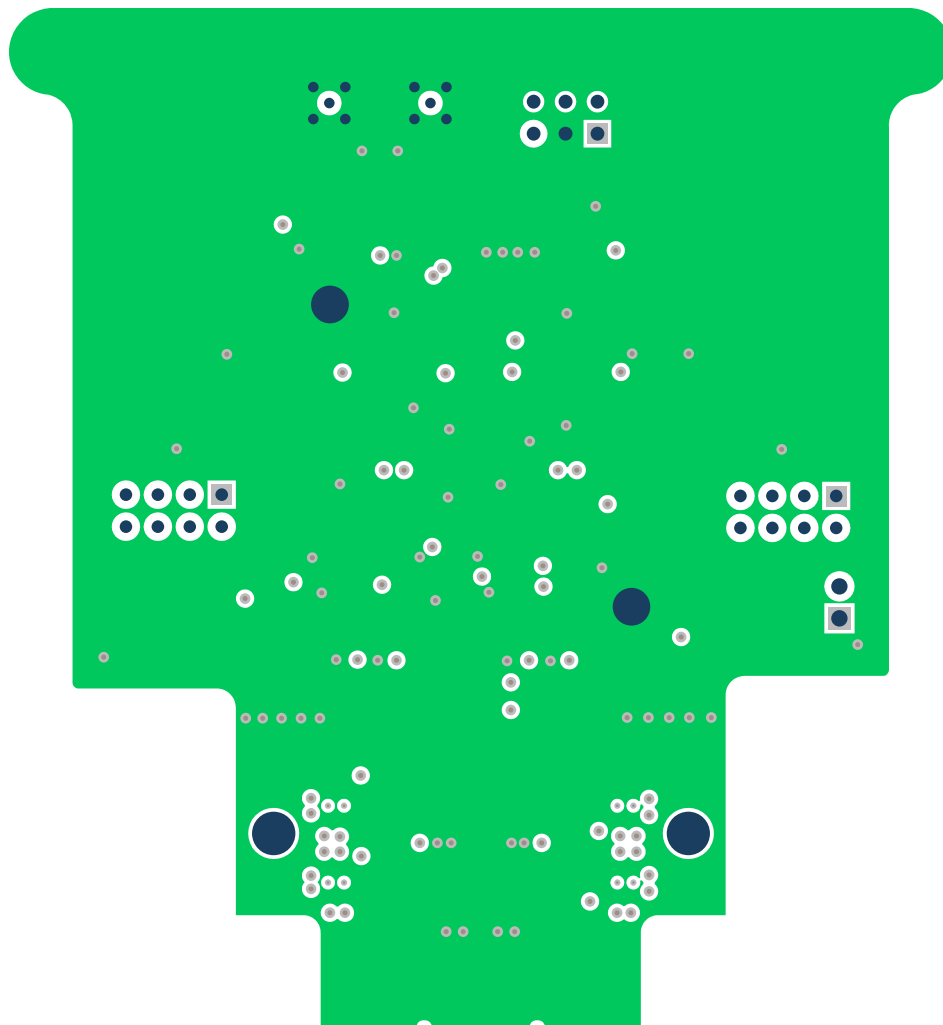
Figure 6. Signal Layers 1, 3, and 4 Routing

Figure 7. Signal Layer 2 Routing
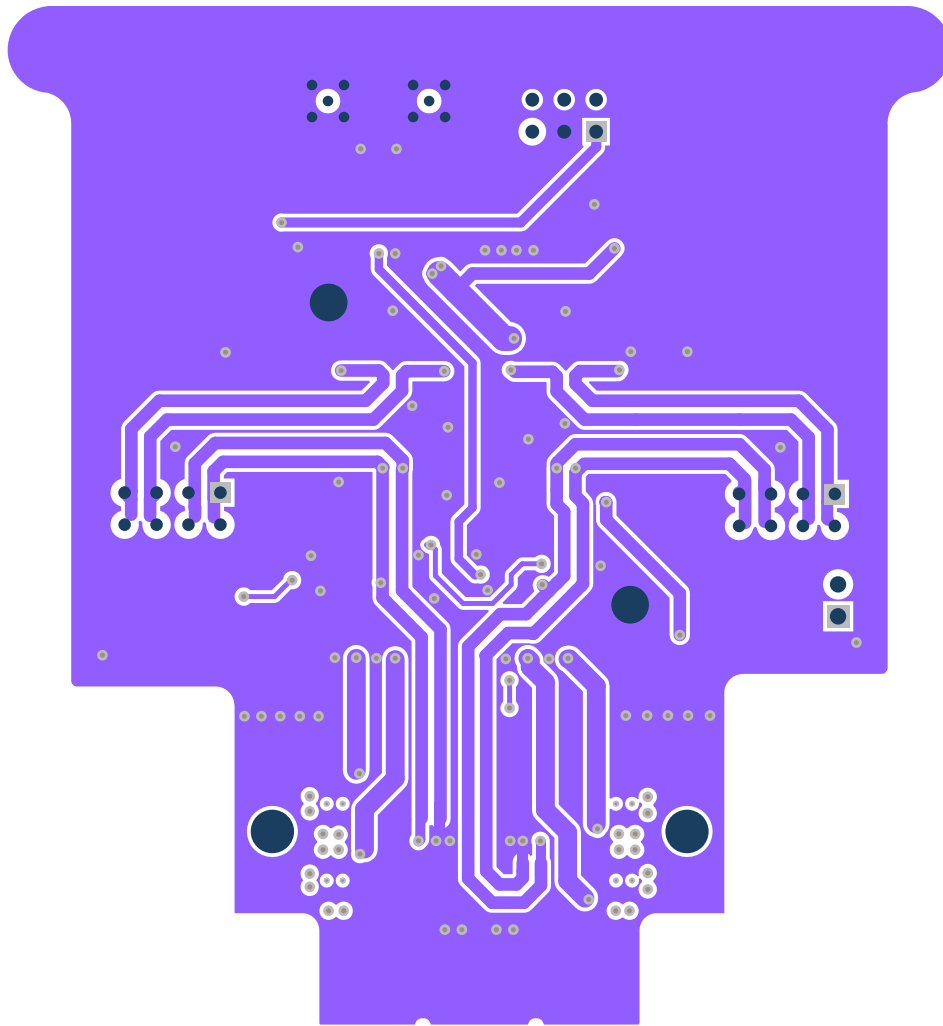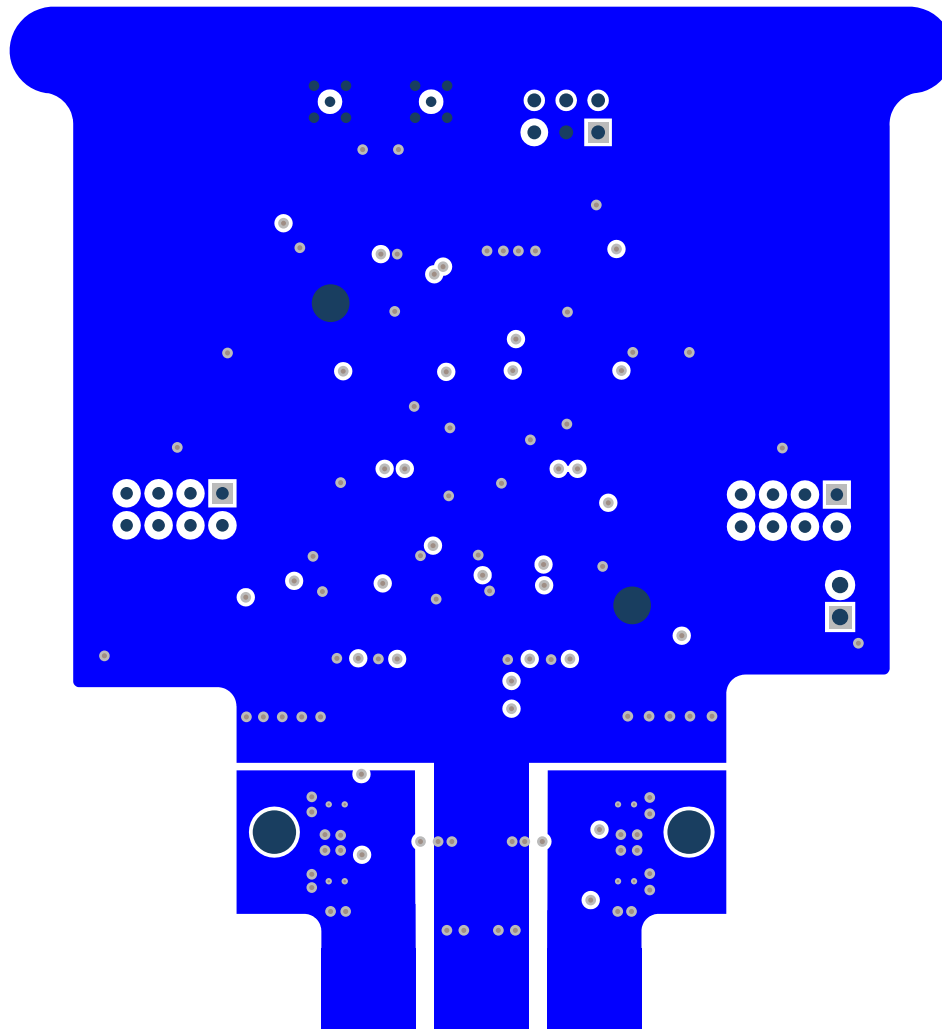
Figure 8. Bottom Layer Routing

4 Schematic and Bill of Materials

This chapter shows the device schematics and lists the bill of materials.

4.1 Schematic

Main schematic of the PMICLOADBOARDEVM is shown in Figure 9. The thermal protection circuitry included in the device is shown in Figure 10.

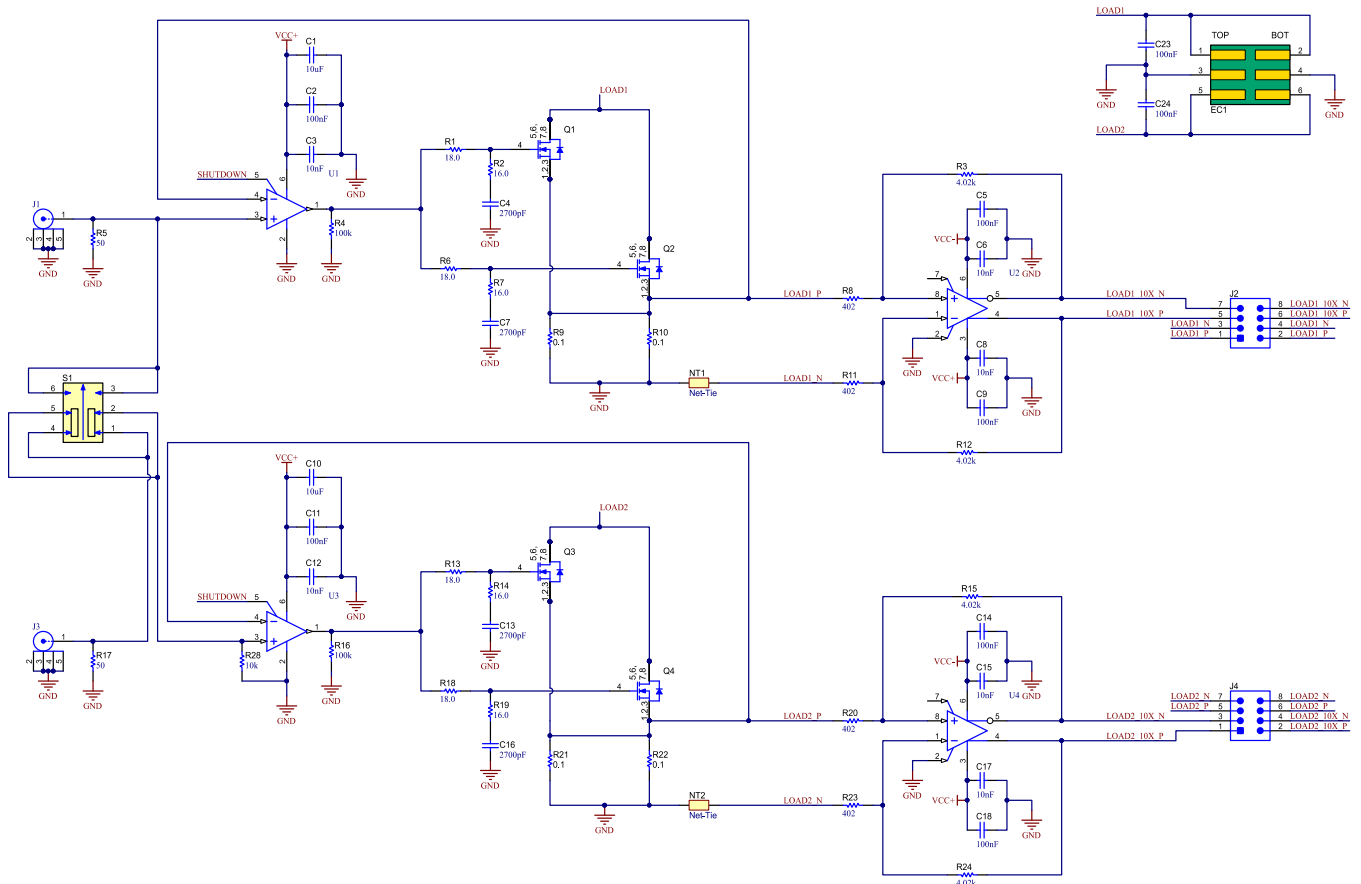**Figure 9. Main Schematic**

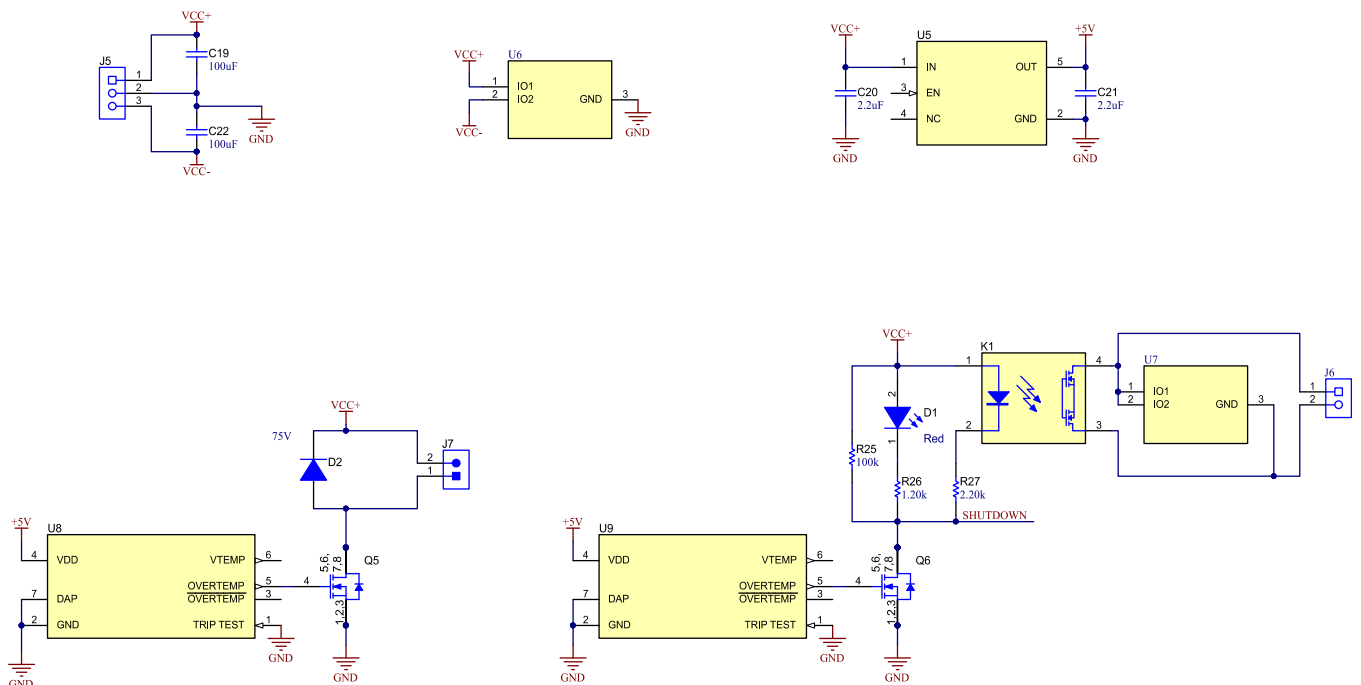**Figure 10. Thermal Protection Circuitry**

4.2   Bill of Materials

Table 2 lists EVM bill of materials.

Table 2. Bill of Materials

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer
PCB	1		Printed Circuit Board		BMC065	Any
C1, C10	2	10 µF	CAP, CERM, 10 µF, 16 V, ± 20%, X5R, 0603	0603	EMK107BBJ106MA-T	Taiyo Yuden
C2, C5, C9, C11, C14, C18	6	0.1 µF	CAP, CERM, 0.1 µF, 16 V, ± 20%, X7R, 0603	0603	C0603C104M4RACTU	Kemet
C3, C6, C8, C12, C15, C17	6	0.01 µF	CAP, CERM, 0.01 µF, 16 V, ± 10%, X7R, 0603	0603	885012206040	Wurth Elektronik
C4, C7, C13, C16	4	2700 pF	CAP, CERM, 2700 pF, 50 V, ± 5%, C0G/NP0, 0603	0603	GRM1885C1H272JA01D	MuRata
C19, C22	2	100 µF	CAP, CERM, 100 µF, 16 V, ± 20%, X5R, 1210	1210	C1210C107M4PAC7800	Kemet
C20, C21	2	2.2 µF	CAP, CERM, 2.2 µF, 16 V, ± 20%, X5R, 0603	0603	885012106018	Wurth Elektronik
C23, C24	2	0.1 µF	CAP, CERM, 0.1 µF, 16 V, ±10%, X7R, AEC-Q200 Grade 1, 0603	0603	GCM188R71C104KA37J	MuRata
D1	1	Red	LED, Red, SMD	LED_0603	150060RS75000	Wurth Elektronik
D2	1	75 V	Diode, Switching, 75 V, 0.25 A, SOD-323	SOD-323	1N4448WX-TP	Micro Commercial Components
J1, J3	2		MMCX JACK, 50 Ω, Gold, TH	MMCX JACK, Gold, TH	0734151471	Molex
J2, J4	2		Header, 100 mil, 4 x 2, Gold, R/A, TH	Header, 100 mil, 4x2, R/A, TH	TSW-104-09-G-D-RA	Samtec
J5	1		Terminal Block, 3 x 1, 2.54 mm, TH	Terminal Block, 3 x 1, 2.54 mm, TH	1725669	Phoenix Contact
J6	1		Terminal Block, 2.54 mm, 2 x 1, Brass, TH	Terminal Block, 2.54 mm, 2-pole, Brass, TH	OSTVN02A150	On-Shore Technology
J7	1		Plug, SMT, Vertical, 1.25 mm, 1 x 2	533980271	53398-0271	Molex
J8	1		Receptacle, 2.5 mm, 3 x 2, Gold, SMT	Receptacle, 2.5 mm, 3 x 2, SMT	6651712-1	TE Connectivity
K1	1		Relay, SPST-NO (1 Form A), 0.1 A, 1.2 V, SMD	4.089 mm x 3.81 mm	CPC1017N	IXYS
LBL1	1		Thermal Transfer Printable Labels, 0.650 in W x 0.200 in H - 10,000 per roll	PCB Label 0.650 in x 0.200 in	THT-14-423-10	Brady
MP1	1		Thermal Interface Products Tflex 6100 9 in x 9 in 3.0W/mK gap filler	THERMAL_GAP_40MM_20MM	A12624-01	Laird
MP2	1		Heatsink, Through-hole	PTH_HS_40MM0_20MM0	S08DYP03	Alpha
Q1, Q2, Q3, Q4	4	30 V	MOSFET, N-CH, 30 V, 8.7 A, PowerPAK 1212	PowerPAK 1212	SIS412DN-T1-GE3	Vishay-Siliconix
Q5, Q6	2	30 V	MOSFET, N-CH, 30 V, 30 A, FET, 3 mm x 0.8 mm x 3 mm	FET, 3 mm x 0.8 mm x 3 mm	AON7534	AOS
R1, R6, R13, R18	4	18.0 Ω	RES, 18.0, 1%, 0.1 W, 0603	0603	RC0603FR-0718RL	Yageo
R2, R7, R14, R19	4	16.0 Ω	RES, 16.0, 1%, 0.1 W, 0603	0603	RC0603FR-0716RL	Yageo
R3, R12, R15, R24	4	4.02 kΩ	RES, 4.02 k, 1%, 0.1 W, 0603	0603	RC0603FR-074K02L	Yageo
R4, R16, R25	3	100 kΩ	RES, 100 k, 1%, 0.1 W, 0603	0603	RC0603FR-07100KL	Yageo
R5, R17	2	50 Ω	RES, 50, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW060350R0FKEA	Vishay-Dale
R8, R11, R20, R23	4	402 Ω	RES, 402, 1%, 0.1 W, 0603	0603	RC0603FR-07402RL	Yageo
R9, R10, R21, R22	4	0.1 Ω	RES, 0.1, 1%, 7 W, AEC-Q200 Grade 0, 7.1 mm x 4.6 mm	7.1 mm x 4.6 mm	WSHM2818R1000FEA	Vishay-Dale
R26	1	1.20 kΩ	RES, 1.20 k, 1%, 0.1 W, 0603	0603	RC0603FR-071K2L	Yageo
R27	1	2.20 kΩ	RES, 2.20 k, 1%, 0.1 W, 0603	0603	RC0603FR-072K2L	Yageo

Table 2. Bill of Materials (continued)

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer
R28	1	10 kΩ	RES, 10 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040210K0JNED	Vishay-Dale
S1	1		Switch, Slide, DPDT, 0.2 A, GULL, 12 V, SMD	SMD, 6-Leads, Body 8.5 mm x 3.5 mm, Pitch 2.5 mm	CL-SB-22B-02T	Copal Electronics
U1, U3	2		Single Supply 345 MHz Rail-to-Rail Output Amplifier, 6-pin Tiny SOT23, Pb-Free		LMH6611MK/NOPB	Texas Instruments
U2, U4	2		Fully Differential Input / Output Low Noise Amplifier with Shutdown, 5 V to 30 V, -40 to 85 °C, 8-pin SOIC (D8), Green (RoHS & no Sb/Br)	D0008A	THS4130ID	Texas Instruments
U5	1		150-mA, 30-V, Ultra-Low IQ, Wide Input Low-Dropout Regulator with Reverse Current Protection, DBV0005A (SOT-23-5)	DBV0005A	TPS70950DBVR	Texas Instruments
U6, U7	2		ESD Protection Array for AC Signal Data Interface, 2 Channels, -40 to +85 °C, 3-pin SC70 (DCK), Green (RoHS & no Sb/Br)	DCK0003A	TPD2E007DCKR	Texas Instruments
U8	1		1.6 V-Capable Temperature Sensor Switch with Factory Programmed Trip Points, NGF0006A (WSON-6)	NGF0006A	LM26LVCISD-080/NOPB	Texas Instruments
U9	1		1.6 V-Capable Temperature Sensor Switch with Factory Programmed Trip Points, NGF0006A (WSON-6)	NGF0006A	LM26LVCISD-090/NOPB	Texas Instruments

5   Performance

Figure 11 and Figure 12 show the load current waveform during 0-8 A load transient with 80 ns rise and fall time. Tests were done on LP875701Q1EVM.
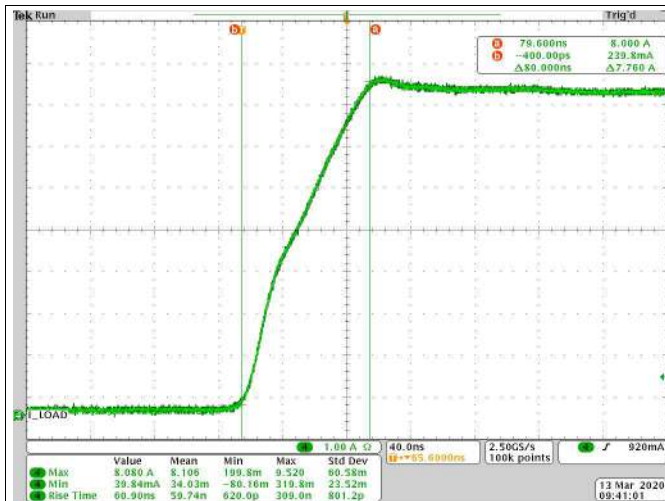

Figure 11. Current Waveform from 0 A to 8 A With 80 ns Rise Time
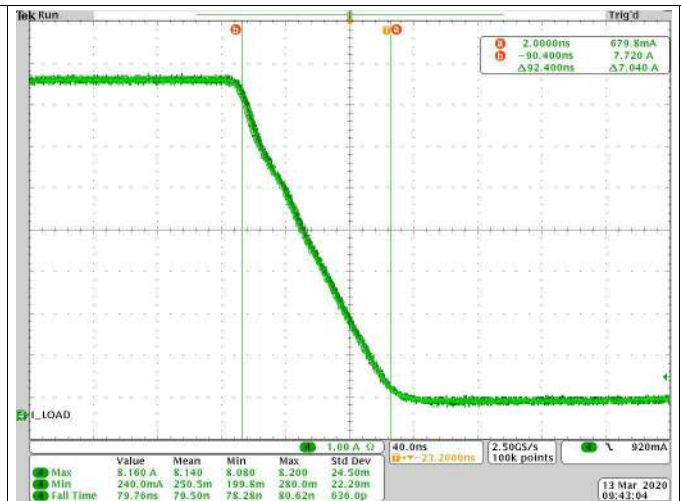
Figure 12. Current Waveform from 8 A to 0 A With 80 ns Fall Time

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.

<u>WARNING</u>

Evaluation Kits 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 shall operate the Evaluation Kit within TI's recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI's recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI's instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:
EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGREDATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

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.