

TPS22968EVM-007 Dual 4A Load Switch

The TPS22968EVM-007 evaluation module contains a dual channel, ultra low ON resistance, 4-A load switch with controlled turn and adjustable rise time.

Contents

1	Description	2
	1.1 Typical Applications	2
	1.2 Features	2
2	Electrical Performance Specifications	3
3	Schematic	3
4	Layout	4
5	Setup	6
	5.1 J1 VIN1/J2 VIN2 – Input Connections	6
	5.2 J3 VOUT1/J4 VOUT2 – Output Connections	6
	5.3 JP1 – VBIAS	6
	5.4 JP2/JP3 - Input Capacitors	7
	5.5 JP4/JP5 - Output Capacitors	7
	5.6 JP6/JP7/JP8/JP9 – Output Resistors	7
	5.7 JP10/JP11/JP12/JP13 – Output Parallel Connections	7
	5.8 TP1/TP2 – VIN1-VIN2	7
	5.9 TP3/TP4 - VIN Sense, TP7/TP8 - VOUT Sense	7
	5.10 TP5/TP6 – VOUT1-VOUT2	7
	5.11 TP10 – VBIAS	7
	5.12 TP9/TP11 – ON1-ON2	7
	5.13 TP12 – VOUT1 // VOUT2	7
	5.14 TP13 – TP16 GND	7
	5.15 List of Test Points	8
	5.16 Test Procedure	8
	5.17 R _{ON} Test Procedure	9
	5.18 t _R , t _{ON} , t _F , t _{OFF} Test Procedure	9
6	Test Setup	10
7	Performance Data and Typical Characteristic Curves	12
	7.1 t _R and t _{ON} Scope Capture	12
	7.2 t _F and t _{OFF} Scope Capture	13
	7.3 Parallel Switch Operation	13
8	Bill of Materials	14

1 Description

The TPS22968 device contains two N-channel MOSFETs that can operate over an input voltage range of 0.8V to 5.5 V and can support a maximum continuous current of up to 4-A per channel. Each switch is independently controlled by an on/off input (ON1, ON2), which is capable of interfacing directly with low-voltage GPIO control signals. In the TPS22968, a 260- Ω on-chip load resistor is added for quick output discharge (QOD) when the switch is turned off. The rise time of the device is internally controlled in order to avoid in-rush current and can be adjusted using a ceramic capacitor on the CTx pins. The TPS22968 is available in a small, space-saving 2mm x 3mm 14-pin SON package with integrated thermal pad allowing for high power dissipation.

The TPS22968 device is demonstrated using the TPS22968EVM-007 module. The TPS22968 Dual Load Switch device can be configured in either a dual switch configuration or a parallel switch configuration using the TPS22968EVM-007.

1.1 Typical Applications

- Ultrabooks™
- Notebooks/Netbooks
- Tablet PC
- Consumer Electronics
- Set-top Boxes
- Industrial Systems
- Telecom Systems

1.2 Features

- External capacitors for configurable rise time
- EVM configurable for single or parallel switch configurations
- Connection points to VIN, VOUT, VBIAS, ON pins as well as SENSE connections for accurate measurement of VIN and VOUT voltages
- High current connection terminals available for 4A maximum continuous switch current operation
- VIN input voltage range: 0.8V to 5.5V
- VBIAS voltage range: 2.5V to 5.5V

2 Electrical Performance Specifications

Reference Datasheet [SLVSCG3](#)

3 Schematic

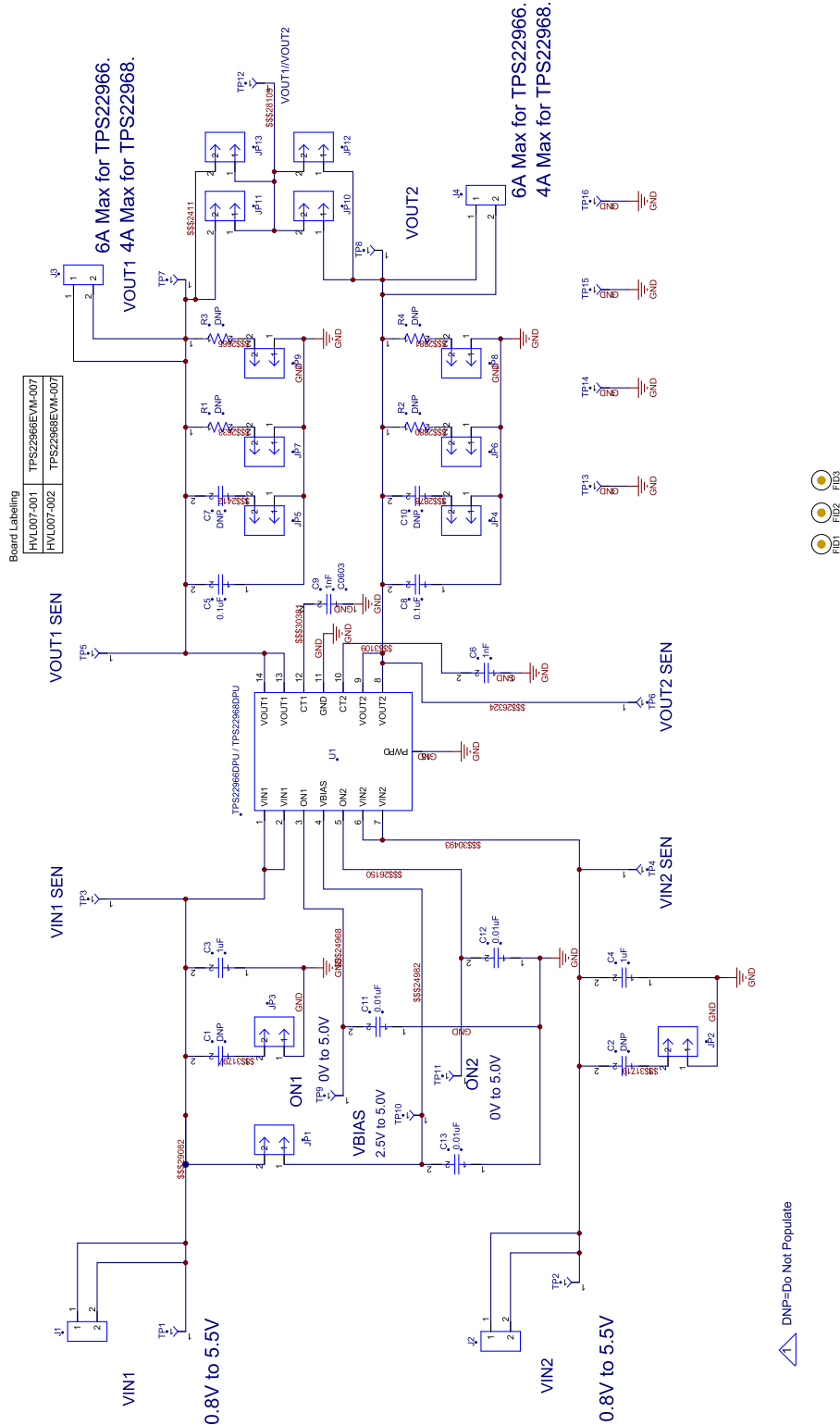


Figure 1. TPS22968EVM-007 Schematic

4 Layout

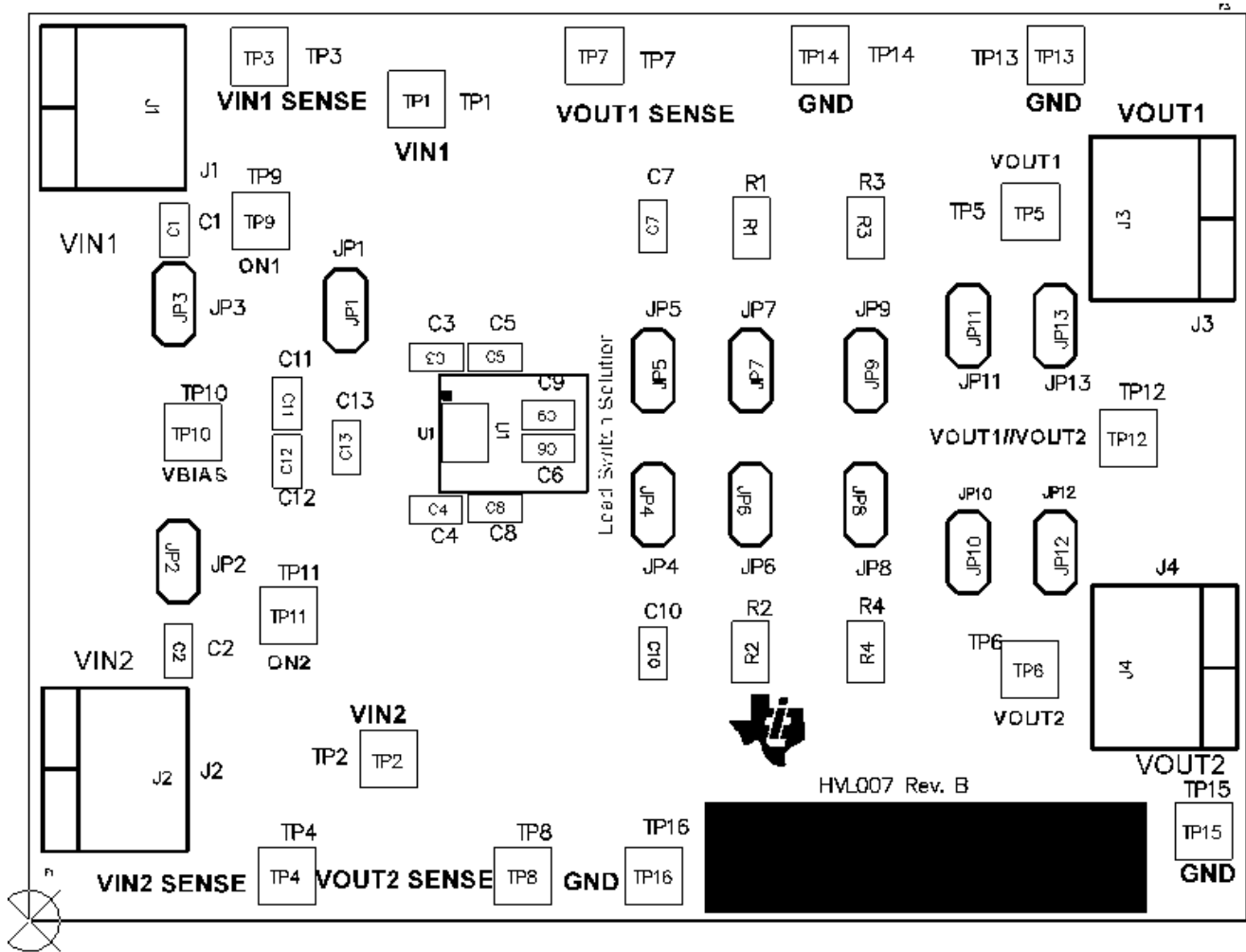


Figure 2. TPS22968EVM-007 Top Assembly

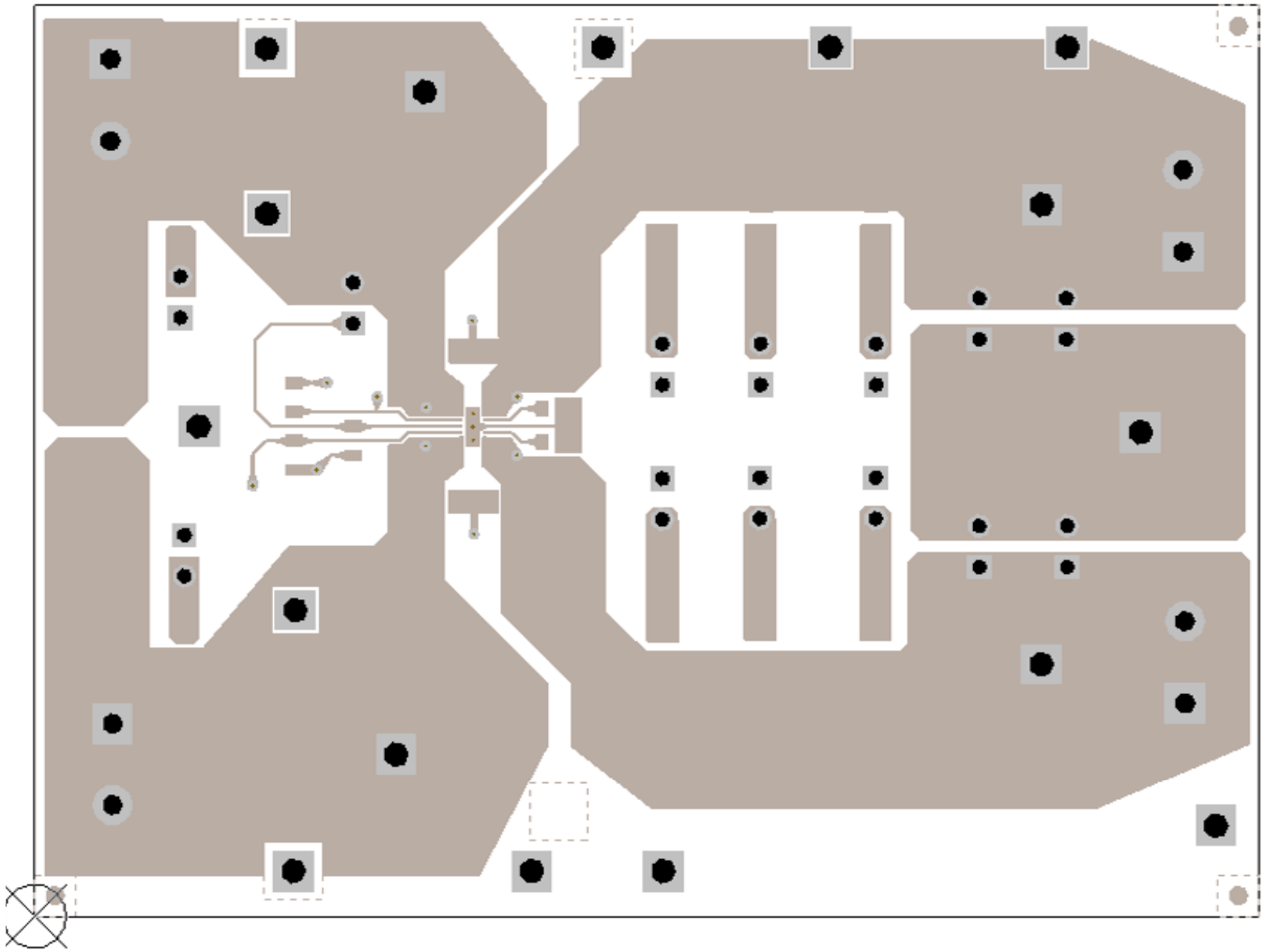


Figure 3. TPS22968EVM-007 Top

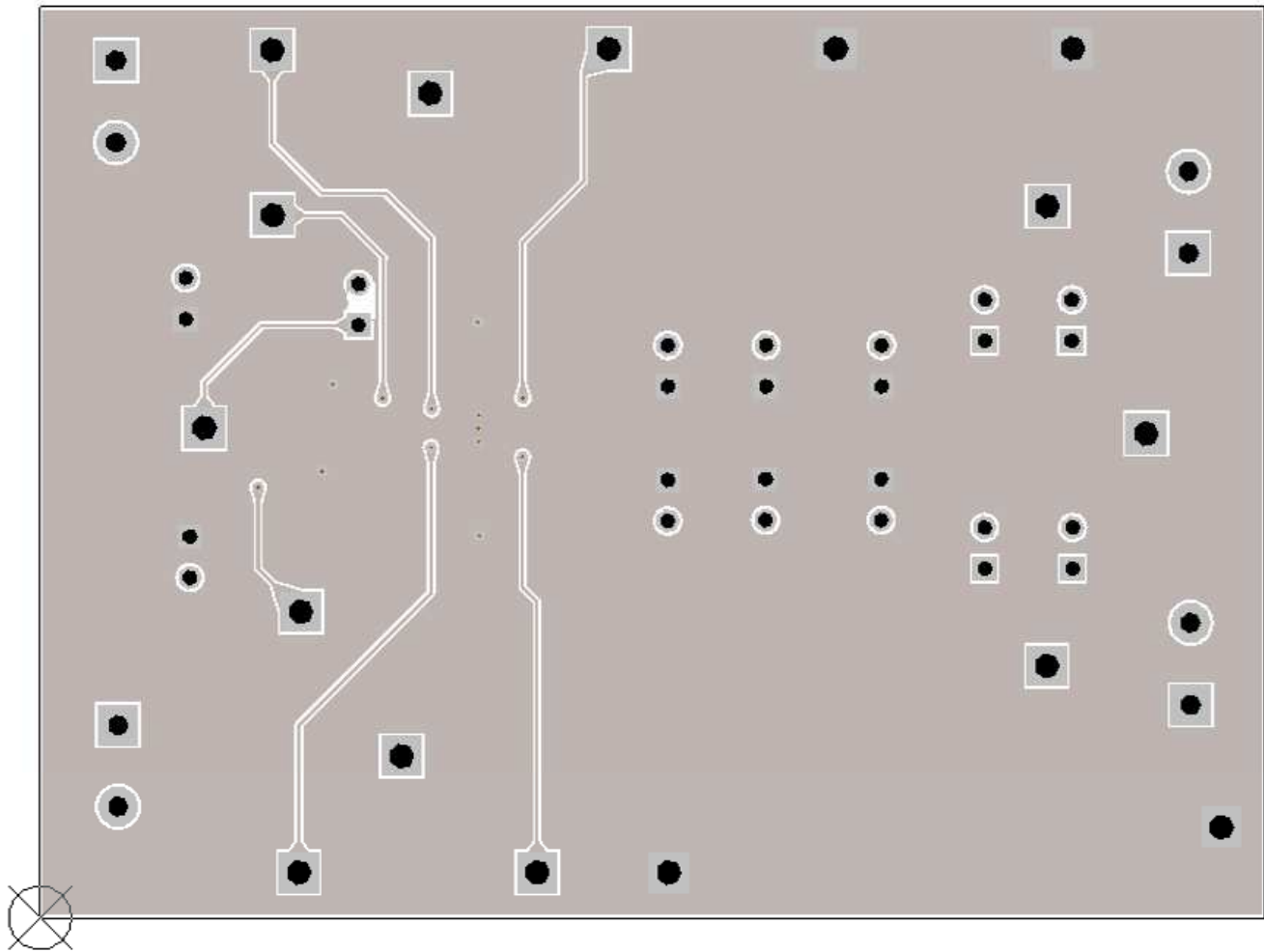


Figure 4. TPS22968EVM-007 Bottom

5 Setup

This section describes the jumpers and connectors on the EVM as well as how to properly connect, set up, and use the EVM.

5.1 J1 VIN1/J2 VIN2 – Input Connections

These are the high current input connections from the input source. Connect the positive lead to J1 and J2 terminal and the negative lead to a GND connection point.

5.2 J3 VOUT1/J4 VOUT2 – Output Connections

These are the high current connections for the outputs of the EVM. Connect the positive lead to J3 and J4 terminal and the negative lead to GND connection point.

5.3 JP1 – VBIAS

This jumper connects VBIAS to VIN1 voltage source. VBIAS must be maintained between 2.5V – 5.5V for proper operation on the TPS22968 device. If testing conditions involve taking VIN1 levels Below 2.5V, remove the shunt across JP1 and connect VBIAS voltage at TP10.

5.4 JP2/JP3 - Input Capacitors

During normal operation the shorting jumper is removed on JP2 and JP3. These jumpers connect C1 and C2 capacitors (unpopulated) from the input of the device to ground. Refer to the Applications Section of the Datasheet for additional information on selecting the input capacitor.

5.5 JP4/JP5 - Output Capacitors

During normal operation the shorting jumper is removed on JP4 and JP5. These jumpers connect C7 and C10 capacitors (unpopulated) from the output of the device to ground. Refer to the Applications Section of the Datasheet for additional information on selecting the output capacitor.

5.6 JP6/JP7/JP8/JP9 – Output Resistors

During normal operation no shorting jumper is placed on JP6-JP9. A shorting jumper may be used on JP6-JP9 to connect R1-R4 load resistors from the output of the device to ground. R1-R4 is for user selected values and are unpopulated.

5.7 JP10/JP11/JP12/JP13 – Output Parallel Connections

JP10-JP12 connects VOUT1 and VOUT2 together and is used when testing both device switches in parallel configuration.

5.8 TP1/TP2 – VIN1-VIN2

These are input connections to the device.

5.9 TP3/TP4 - VIN Sense, TP7/TP8 - VOUT Sense

These two connections are used when very accurate measurements of the input or output are required. RON measurements should be made using these sense connections when measuring the voltage drop from VIN to VOUT and then calculating the resistance.

5.10 TP5/TP6 – VOUT1-VOUT2

These are output connections to the device.

5.11 TP10 – VBIAS

This is the VBIAS connection point. VBIAS must be applied to the TPS22968 device at a voltage level of 2.5V to 5.5V level for proper operation. VBIAS may be applied direct at this connection point or applied using JP1.

5.12 TP9/TP11 – ON1-ON2

These are the enable inputs for the device. Apply an external enable/disable source to TP9 and TP11. The TPS22968 is active High. ON1 and ON2 must not be left floating. Refer to the datasheet for proper ON and OFF voltage level settings. A switching signal may also be used and connected at these points.

5.13 TP12 – VOUT1 // VOUT2

This is the common connection point for VOUT when the switch output are connected in parallel configuration.

5.14 TP13 – TP16 GND

These are the GND connection points to the EVM.

5.15 List of Test Points

Table 1. The Functions of Each Test Points

Test Points	Name	Description
J1	VIN1	DC Input to VIN1
J2	VIN2	DC Input to VIN2
J3	VOUT1	DC Output from VOUT1
J4	VOUT2	DC Output from VOUT2
JP1	VBIAS	Connects VBIAS to VIN1
JP2	C2	Connects C2 from VIN2 to GND
JP3	C1	Connects C1 from VIN1 to GND
JP4	C10	Connects C10 from VOUT2 to GND
JP5	C7	Connects C7 from VOUT1 to GND
JP6	R2	Connects R2 from VOUT2 to GND
JP7	R1	Connects R1 from VOUT1 to GND
JP8	R4	Connects R4 from VOUT2 to GND
JP9	R3	Connects R3 from VOUT1 to GND
JP10, JP11, JP12, JP13	VOUT1 // VOUT2	Shorts VOUT1 and VOUT2 together used in parallel switch configuration
TP1	VIN1	VIN1 connection
TP2	VIN2	VIN2 connection
TP3	VIN1 SEN	Sense connect to VIN1
TP4	VIN2 SEN	Sense connect to VIN2
TP5	VOUT1	VOUT1 connection
TP6	VOUT2	VOUT2 connection
TP7	VOUT1 SEN	Sense connect to VOUT1
TP8	VOUT2 SEN	Sense connect to VOUT2
TP9	ON1	ON1 connection
TP10	VBIAS	VBIAS connection
TP11	VOUT1 VOUT2	ON2 connection
TP12	VOUT1 // VOUT2	VOUT1 VOUT2 connected in parallel configuration
TP13	AGND	Ground Connection
TP14	AGND	Ground Connection
TP15	AGND	Ground Connection
TP16	AGND	Ground Connection

5.16 Test Procedure

Figure 5 shows a typical setup for the R_{ON} test of the EVM. VBIAS voltage must be present for the device to function, keep this voltage level constant between 2.5V-5.25V. Adding a shunt across JP1 will connect the VBIAS pin to VIN1. When testing with VIN1 below 2.5V JP1 shunt must be removed and VBIAS tied to another voltage source.

5.17 R_{ON} Test Procedure

1. Setup the EVM per [Figure 5](#).
2. Set SOURCE1 level to 5.0V.
3. Place a shunt across JP1.
4. Connect ON1 to a DC source between 1.05v and 5.5v, SOURCE1 supply can be used for this. (When testing R_{ON} it is desired to have the switch operating in the always ON condition.)
5. Connect ON2 to GND. This keeps switch 2 in the off state.
6. Place a load on VOUT1 and VOUT2.
7. Turn on SOURCE1.
8. Record the voltage reading from METER1, record the input current reading from SOURCE1. Calculate R_{ON} by dividing METER1 voltage level by the current reading from SOURCE1. The result will be the R_{ON} value for switch 1.
9. Turn SOURCE1 off.
10. Remove ON1 from SOURCE1 and connect to GND.
11. Remove ON2 from GND and connect to SOURCE1.
12. Turn SOURCE1 on.
13. Record the voltage reading from METER2, record the input current reading from SOURCE1. Calculate R_{ON} by dividing the voltage reading of METER2 by the current reading from SOURCE1. The results will be the R_{ON} value for switch 2.
14. Turn SOURCE1 off.

5.18 $t_R, t_{ON}, t_F, t_{OFF}$ Test Procedure

1. The rise time (t_R) is selected by the CT capacitor value on each switch channel. The EVM is shipped with a default CT value of 1nF.
2. Set up the EVM per [Figure 6](#)
3. Set SOURCE1 level to 5.0V.
4. Place a shunt across JP1.
5. Place a load on VOUT1 and VOUT2 (a 10 Ω , 3.25W resistor is recommended for this test).
6. Set Signal Generator output to 0-2Vpp, 10-100Hz, and 25% duty cycle.
7. Turn SOURCE1 on.
8. Enable the Signal Generator output.
9. Rise time (t_R) and turn-on time (t_{ON}) can be observed with a Oscilloscope sync the scope trigger on the rising edge of the on signal.. A detailed description of t_R, t_{ON}, t_F and t_{OFF} are listed in the TPS22968 Datasheet under the Switching Characteristics Section.
10. Fall time (t_F) and turn-of time (t_{OFF}) can be observed from the oscilloscope by changing the scope triggering to sync with the falling edge of the ON signal.
11. Turn SOURCE1 off and disable the signal Generator output.

6 Test Setup

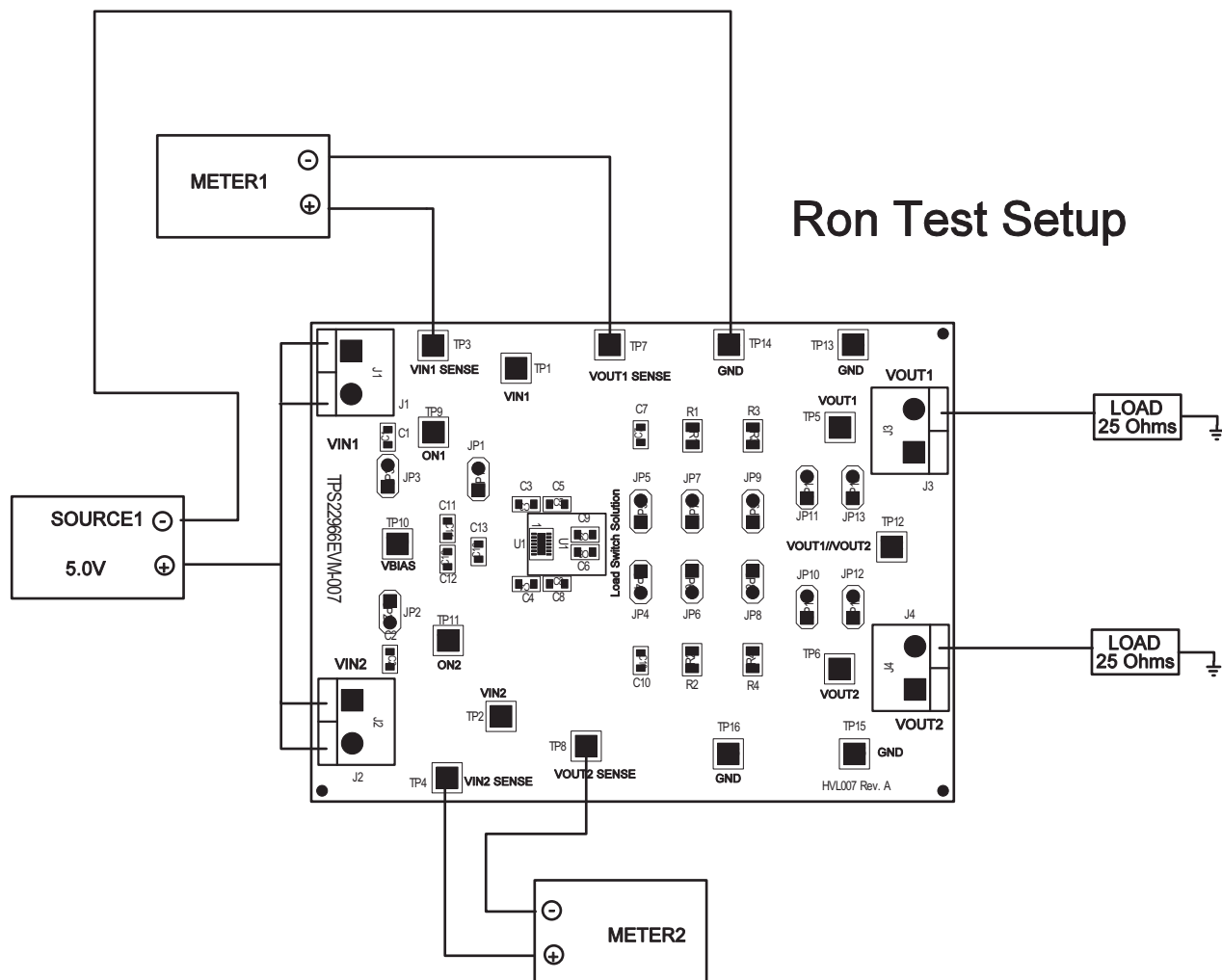


Figure 5. TPS22968EVM-007 Recommended Ron Test Set Up

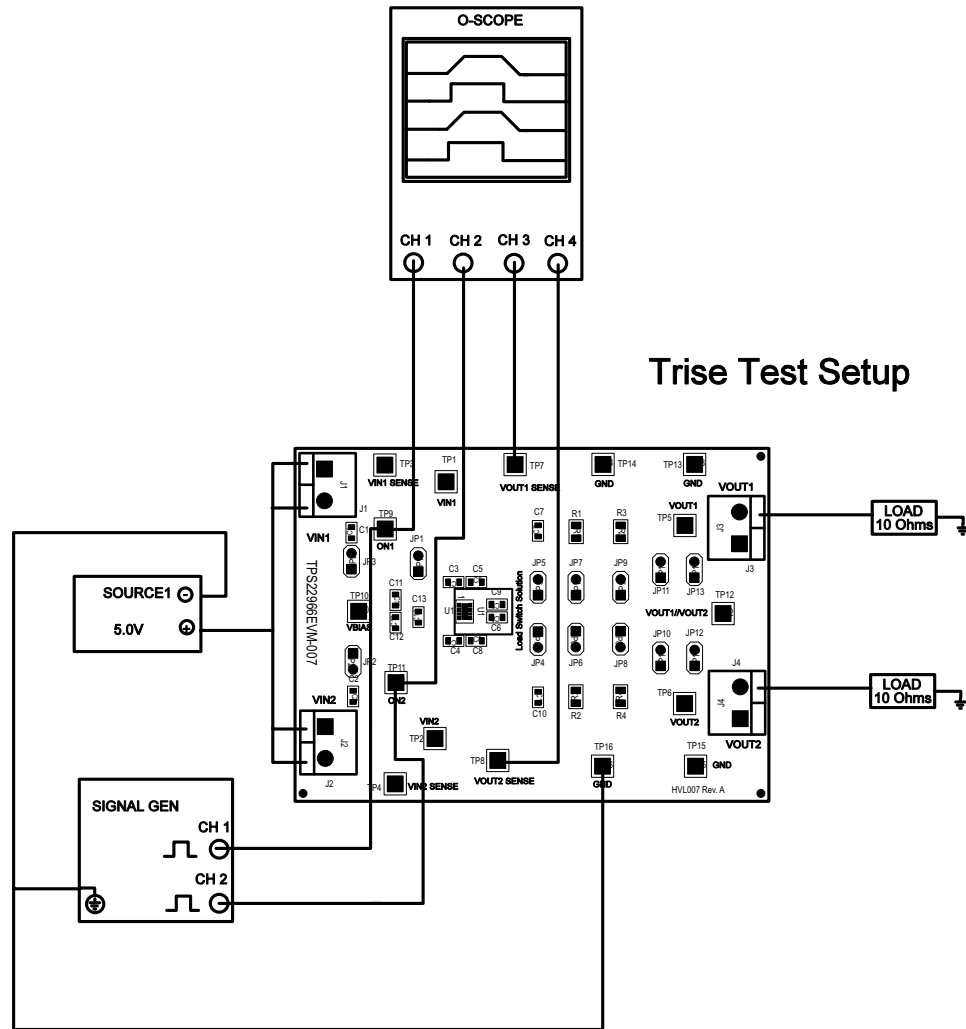


Figure 6. TPS22968EVM-007 Recommended Trise Test Set Up

7 Performance Data and Typical Characteristic Curves

Figure 7 through Figure 8 present typical performance curves for TPS22968EVM-007.

7.1 t_R and t_{ON} Scope Capture

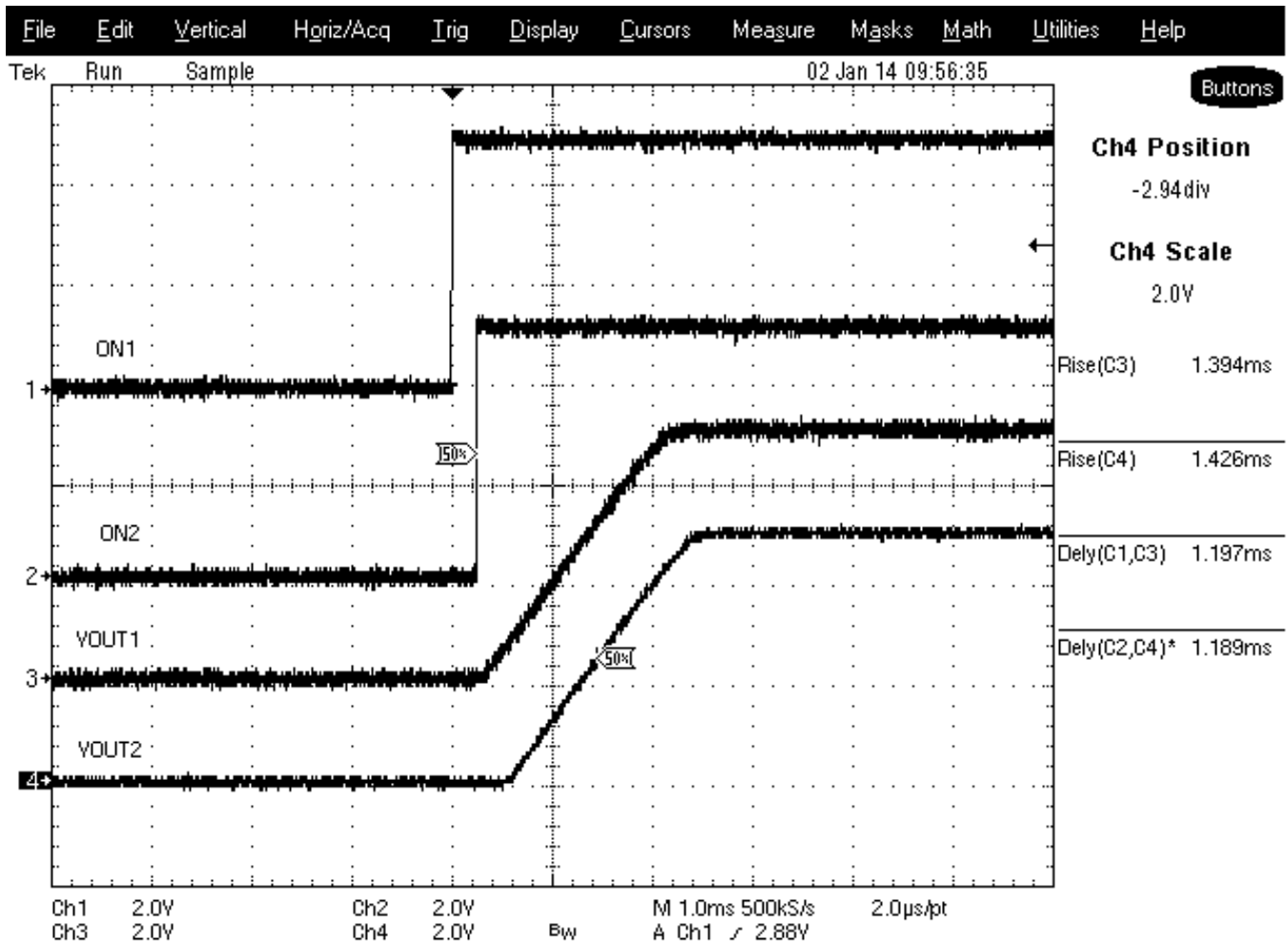


Figure 7. TPS22968EVM-007 t_R with $V_{IN}=5V$, $C_T=1nF$ and Load =10Ω.

7.2 t_F and t_{OFF} Scope Capture

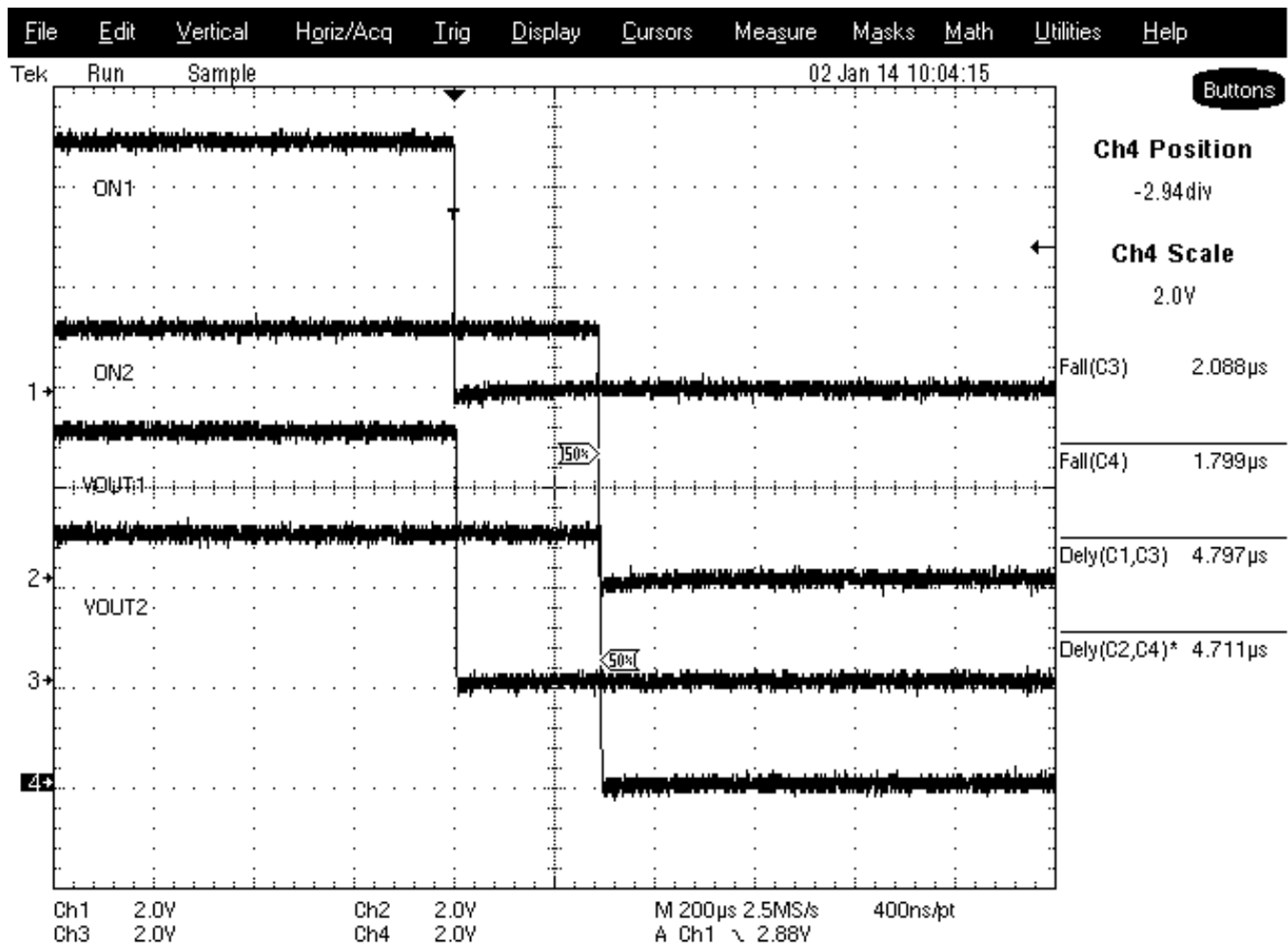


Figure 8. TPS22968EVM-007

7.3 Parallel Switch Operation

The TPS22968 device switches can be connected in parallel configuration by adding shorting shunts across JP10, JP11, JP12, and JP13. Parallel switch configuration lowers RON and raises maximum continuous current capability. Refer to Applications Note [SLVA585](#) for further details.

8 Bill of Materials

Table 2 is the EVM components list according to the schematic shown in Figure 1.

Table 2. EVM Components List

Count	RefDes	Value	Description	Size	Part Number	MFR
0	C1, C2, C7, C10	DNP	Capacitor, Ceramic, 25V, X7R, 20%	603	Std	Std
3	C11, C12, C13	0.01 μ F	Capacitor, Ceramic, 16V, X7R, 20%	603	Std	Std
2	C3, C4	1 μ F	Capacitor, Ceramic, 16V, X7R, 20%	603	Std	Std
2	C5, C8	0.1 μ F	Capacitor, Ceramic, 25V, X7R, 20%	603	Std	Std
2	C6, C9	1nF	Capacitor, Ceramic, 25V, X7R, 20%	603	Std	Std
1	JP1	PEC02SAAN	Header, Male 2-pin, 100mil spacing	0.100 inch x 2	PEC02SAAN	Sullins
12	JP2, JP3, JP4, JP5, JP6, JP7, JP8, JP9, JP10, JP11, JP12, JP13	PEC02SAAN	Header, Male 2-pin, 100mil spacing	0.100 inch x 2	PEC02SAAN	Sullins
0	R1, R2, R3, R4	DNP	Resistor, Chip, 1/16W, x%	805	Std	Std
12	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12	5010	Test Point, Red, Thru Hole Compact Style	0.125 x 0.125 inch	5010	Keystone
4	TP13, TP14, TP15, TP16	5011	Test Point, Black, Thru Hole Compact Style	0.125 x 0.125 inch	5011	Keystone
4	J1, J2, J3, J4	ED120/2DS	Terminal Block, 2-pin, 15-A, 5.1mm	0.512 inch	ED120/2DS	OST
1	U1	TPS22968DPU	IC, 6-A Dual Load Switch With Controlled Turn-On	PWSON	TPS22968DPU	TI
1	--		PCB, 2.98 In x 2.22 In x 0.062 In		HVL007	Any
1			Shunt, Black	100-mil	929950-00	3M

Notes: 1. These assemblies are ESD sensitive, ESD precautions shall be observed.
 2. These assemblies must be clean and free from flux and all contaminants. Use of no clean flux is not acceptable.
 3. These assemblies must comply with workmanship standards IPC-A-610 Class 2.
 4. Ref designators marked with an asterisk (***) cannot be substituted. All other components can be substituted with equivalent MFG's components.

EVALUATION BOARD/KIT/MODULE (EVM) ADDITIONAL TERMS

Texas Instruments (TI) provides the enclosed Evaluation Board/Kit/Module (EVM) under the following conditions:

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING LIMITED WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please visit www.ti.com/esh or contact TI.

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used. TI currently deals with a variety of customers for products, and therefore our arrangement with the user is not exclusive. TI assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein.

REGULATORY COMPLIANCE INFORMATION

As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

For EVMs **not** subject to the above rules, this evaluation board/kit/module is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by TI to be a finished end product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant

Caution

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concerning EVMs including detachable antennas

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

Concernant les EVMs avec appareils radio

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

【Important Notice for Users of EVMs for RF Products in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product 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 this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

Texas Instruments Japan Limited
(address) 24-1, Nishi-Shinjuku 6 chome, Shinjuku-ku, Tokyo, Japan

<http://www.tij.co.jp>

【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】

本開発キットは技術基準適合証明を受けておりません。

本製品のご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

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

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。

日本テキサス・インスツルメンツ株式会社

東京都新宿区西新宿 6 丁目 2 4 番 1 号

西新宿三井ビル

<http://www.tij.co.jp>

EVALUATION BOARD/KIT/MODULE (EVM) WARNINGS, RESTRICTIONS AND DISCLAIMERS

For Feasibility Evaluation Only, in Laboratory/Development Environments. Unless otherwise indicated, this EVM is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. It should not be used as all or part of a finished end product.

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure 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.
3. Since the EVM is not a completed product, it may not meet all applicable regulatory and safety compliance standards (such as UL, CSA, VDE, CE, RoHS and WEEE) which may normally be associated with similar items. You assume full responsibility to determine and/or assure compliance with any such standards and related certifications as may be applicable. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

Certain Instructions. It is important to operate this EVM within TI's recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please 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 result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM User's 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, some circuit components may have case temperatures greater than 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

Agreement to Defend, Indemnify and Hold Harmless. You agree to 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 use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

Safety-Critical or Life-Critical Applications. If you intend to evaluate the components for possible use in safety critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2014, Texas Instruments Incorporated

IMPORTANT NOTICE

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

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

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

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

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

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

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

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

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

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

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

Products

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

Applications

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

TI E2E Community

e2e.ti.com