EVM User's Guide: TPS371KEVM

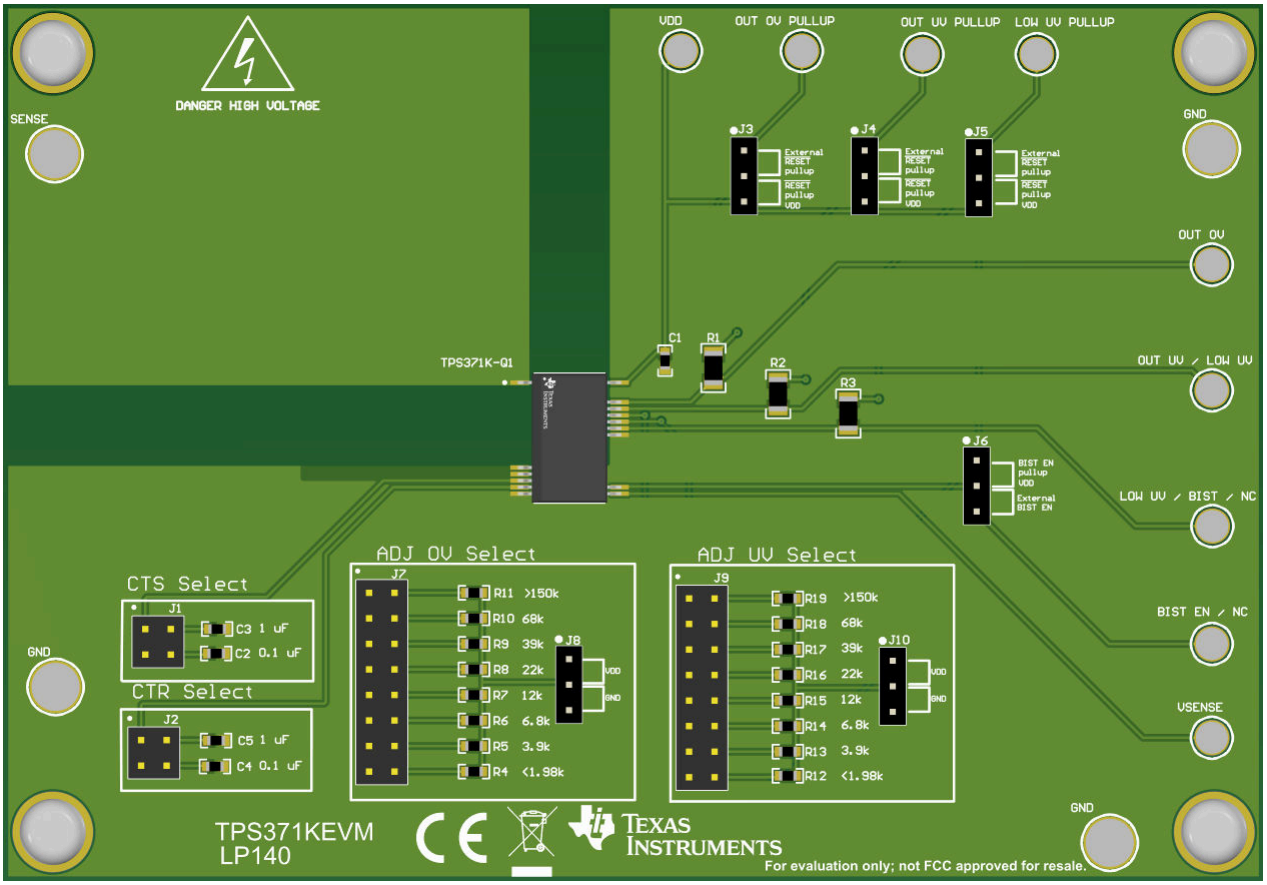
TPS371K Evaluation Module

Description

The TPS371KEVM is an evaluation module (EVM) for the TPS371K-Q1 family of voltage supervisors. The purpose of the this EVM is to provide a sample design and test point for all input and output pins of the TPS371K-Q1 device to capture measurements and gain familiarity with the device.

Features

- Wide input voltage range of 0V to 1500V
  - Overvoltage, undervoltage, and low undervoltage fault outputs
- Built-in self-test
- Output latching
- Integrated buffer for Analog-to-Digital Converter (ADC) monitoring
  - VSENSE pin can directly drive high-speed ADC inputs
  - High accuracy scaled down voltage of sense pin



TPS371KEVM

1 Evaluation Module Overview

1.1 Introduction

The TPS371KEVM is an evaluation module (EVM) for the TPS371K-Q1 voltage supervisor. This family is an automotive-grade device with support for undervoltage and overvoltage supervisor and Built-In Self-Test functionality. The TPS371KEVM offers connections to all input and output pins. Test points are provided to give the user access to an extra connection if needed for oscilloscope or multimeter measurements.

This user's guide describes the characteristics, operation, and use of the TPS371KEVM. Included in this user's guide are setup and operating instructions, printed-circuit board (PCB) layout, schematic diagram, and bill of materials (BOM). Throughout this document, the terms evaluation board, evaluation module, and EVM are synonymous with the TPS371KEVM.

1.2 Kit Contents

The TPS371KEVM circuit board comes pre-installed with a TPS371KA8C89DFXRQ1 device for functionality testing of the TPS371K-Q1 family of devices. The TPS371KEVM circuit board comes packaged in a moisture barrier bag inside of an antistatic foam layered cardboard box.

- 1 - TPS371KEVM

1.3 Specification

Table 1-1. Recommended Operating Conditions

		MIN	MAX	UNIT
Voltage	V_{SENSE}	0	1500	V
Voltage	V_{DD}, V_{OUTOV}, V_{OUTUV}, V_{LOWUV}, V_{VSENSE}, V_{ADJOV}, V_{ADJUV}, V_{CTS}, V_{CTR}, V_{BIST}, V_{BIST_EN}	0	5.5	V
Current	$I_{OUT\ OV}$, $I_{OUT\ UV}$, I_{LOWUV}, I_{BIST}	0	5	mA
Temperature	Operating junction temperature, T_J	–40	125	°C

1.4 Device Information

The TPS371KEVM circuit board comes pre-installed with a TPS371KA8C89DFXRQ1 device for functionality testing of the TPS371K-Q1 family of devices. The TPS371K-Q1 family has built-in self-test functionality and supports voltages up to 1500V. The device also includes an optional output latching feature.

1.5 General Texas Instruments High Voltage Evaluation (TI HV EVM) User Safety Guidelines

Always follow TI's set-up and application instructions, including use of all interface components within the recommended electrical rated voltage and power limits. Always use electrical safety precautions to help verify your personal safety and those working around you. For further information, contact TI's Customer support center.

Save all warnings and instructions for future reference.

WARNING

Failure to follow warnings and instructions can result in personal injury, property damage or death due to electrical shock and burn hazards.

The term TI HV EVM refers to an electronic device typically provided as an open framed, unenclosed printed circuit board assembly. This is *intended strictly for use in development laboratory environments, solely for qualified professional users having training, expertise and knowledge of electrical safety risks in development and application of high voltage electrical circuits. Any other use and/or application are strictly prohibited by Texas Instruments.* If you are not suitably qualified, you must immediately stop from further use of the HV EVM.

1. Work Area Safety:
   a. Keep work area clean and orderly.
   b. Qualified observers must be present anytime circuits are energized.
   c. Effective barriers and signage must be present in the area where the TI HV EVM and the interface electronics are energized, indicating operation of accessible high voltages can be present, for the purpose of protecting inadvertent access.
   d. All interface circuits, power supplies, evaluation modules, instruments, meters, scopes, and other related apparatus used in a development environment exceeding 50Vrms/75VDC must be electrically located within a protected Emergency Power Off EPO protected power strip.
   e. Use stable and non-conductive work surface.
   f. Use adequately insulated clamps and wires to attach measurement probes and instruments. No freehand testing whenever possible.
2. Electrical Safety:
   a. As a precautionary measure, a good engineering practice is to assume that the entire EVM can have fully accessible and active high voltages.
   b. De-energize the TI HV EVM and all the inputs, outputs and electrical loads before performing any electrical or other diagnostic measurements. Revalidate that TI HV EVM power has been safely de-energized.
   c. With the EVM confirmed de-energized, proceed with required electrical circuit configurations, wiring, measurement equipment hook-ups and other application needs, while still assuming the EVM circuit and measuring instruments are electrically live.
   d. Once EVM readiness is complete, energize the EVM as intended.

> **WARNING**
> While the EVM is energized, never touch the EVM or the electrical circuits, as the EVM or the electrical circuits can be at high voltages capable of causing electrical shock hazard.

3. Personal Safety
   a. Wear personal protective equipment, for example, latex gloves or safety glasses with side shields or protect EVM in an adequate lucent plastic box with interlocks from accidental touch.

Limitation for safe use:

EVMs are not to be used as all or part of a production unit. Do not leave EVM powered when unattended.

2 Hardware

2.1 EVM Connectors

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

2.1.1 EVM Jumpers

Table 2-1 lists the default jumper connections and functional description for the device configuration.

Table 2-1. Pinout and Onboard Jumpers

PIN NUMBER or PIN NAME	JUMPER CONNECTION	DEFAULT CONNECTION	DESCRIPTION
Pin 4, CTS	J1	Open	Jumper J1 configures the CTS pin. Connect a shunt jumper to: pins 1 and 2 to connect to C3, pins 3 and 4 to connect to C2. Refer to **TPS371K-Q1 data sheet** for adjustable capacitor values and sense delay timings.
Pin 5, CTR	J2	Open	Jumper J2 configures the CTR pin. Connect a shunt jumper to: pins 1 and 2 to connect to C5, pins 3 and 4 to connect to C4. Refer to **TPS371K-Q1 data sheet** for adjustable capacitor values and reset delay timings.
Pin 14, OUT OV	J3	Open	Jumper J3 configures the OUT OV pin. Connect a shunt jumper to: pins 1 and 2 to connect to the OUT OV PULLUP test point, pins 2 and 3 to connect to VDD.

Table 2-1. Pinout and Onboard Jumpers (continued)

PIN NUMBER or PIN NAME	JUMPER CONNECTION	DEFAULT CONNECTION	DESCRIPTION
Pin 13, OUT UV	J4	Open	Jumper J4 configures the OUT UV pin. Connect a shunt jumper to: pins 1 and 2 to connect to the OUT UV PULLUP test point, pins 2 and 3 to connect to VDD.
Pin 10, LOW UV	J5	Open	Jumper J5 configures the LOW UV pin. Connect a shunt jumper to: pins 1 and 2 to connect to the LOW UV PULLUP test point, pins 2 and 3 to connect to VDD.
Pin 8, BIST EN	J6	Open	Jumper J6 configures the BIST EN pin. Connect a shunt jumper to: pins 1 and 2 to connect to VDD, pins 2 and 3 to connect to BIST EN / NC test point.
Pin 12, ADJ OV	J7	Open	Jumper J7 configures the ADJ OV pin. Connect a shunt jumper to configure the desired resistor value.
Pin 12, ADJ OV	J8	Open	Jumper J8 configures the ADJ OV pin. Connect a shunt jumper to configure the either a pullup to VDD or pulldown to GND.
Pin 11, ADJ UV	J9	Open	Jumper J9 configures the ADJ UV pin. Connect a shunt jumper to configure the desired resistor value.
Pin 11, ADJ UV	J10	Open	Jumper J10 configures the ADJ UV pin. Connect a shunt jumper to configure the either a pullup to VDD or pulldown to GND.

2.1.2 EVM Test Points

Table 2-2 lists the test point connections and functional description for the device configuration. Test points are placed throughout the board to verify pin functionality.

Table 2-2. Test Points

PIN NUMBER / NAME	Test Point	Description
Pin 1 / SENSE	SENSE	Connection to input pin SENSE.
Pin 7 / VSENSE	VSENSE	Connection to output pin VSENSE.
Pin 8 / BIST EN	BIST EN / NC	Connection to input pin BIST EN.
Pin 10 / LOW UV	LOW UV / BIST / NC	Connection to output pin LOW UV. This pin has a factory setting allowing for alternate function as BIST.
Pin 10 / LOW UV	LOW UV PULLUP	Connection for external pullup voltage on output pin LOW UV.
Pin 13 / OUT UV	OUT UV / LOW UV	Connection to output pin OUT UV. This pin has a factory setting allowing for alternate function as LOW UV.
Pin 13 / OUT UV	OUT UV PULLUP	Connection for external pullup voltage on output pin OUT UV.
Pin 14 / OUT OV	OUT OV	Connection to output pin OUT OV.
Pin 14 / OUT OV	OUT OV PULLUP	Connection for external pullup voltage on output pin OUT OV.
Pin 15 / VDD	VDD	Connection to input pin VDD.
Pin 6, Pin 9 / GND	GND	Connection to GND.

2.2 EVM Setup and Operation

This section describes the functionality and operation of the TPS371KEVM. This EVM comes with the TPS371KA8C89DFXRQ1 device installed.

2.2.1 Input Supply Voltage (V_{DD})

The input supply voltage (V_{DD}) is connected through VDD on the board. The input supply operating voltage range is 2.7V to 5.5V. A 0.1µF capacitor is placed between the VDD and GND to help with noise from the input supply.

2.2.2 SENSE

The SENSE is connected through SENSE on the board. The sense voltage range is 0V to 1500V.

2.2.3 VSENSE

The VSENSE is connected through VSENSE on the board. The VSENSE voltage is a scale down SENSE voltage as seen in the equation below:

$$\text{VSENSE} = \frac{\text{SENSE}}{\text{VSENSE Scaling}} \quad (1)$$

The VSENSE has an integrated 10Mhz buffer and can be directly connected to an ADC.

2.2.4 OUT OV

The OUT OV is connected through OUT OV on the board. The OUT OV output on the device asserts on SENSE going outside the supervisor overvoltage threshold. The device on the TPS371KEVM has an adjustable overvoltage threshold. See the datasheet voltage threshold table for selectable threshold options. The OUT OV is an active-low open-drain output topology.

2.2.5 OUT UV

The OUT UV is connected through OUT UV / LOW UV on the board. The OUT UV output on the device asserts on SENSE going outside the supervisor undervoltage threshold. The device on the TPS371KEVM has an adjustable undervoltage threshold. For selectable threshold options, see the device-specific data sheet voltage threshold table. The OUT UV is an active-low open-drain output topology.

2.2.6 LOW UV

The LOW UV is connected through the LOW UV / BIST / NC test point or OUT UV / LOW UV test point on the board. The LOW UV output on the device asserts on SENSE going outside the supervisor low undervoltage threshold. The default device on the TPS371KEVM has a fixed 60V low undervoltage threshold. For selectable threshold options, see the device-specific data sheet device comparison. The LOW UV is an active-low open-drain output topology.

2.2.7 ADJ OV

The TPS371K-Q1 family of devices contain an adjustable overvoltage threshold pin that controls the threshold with which the OUT OV pin assert. The user can adjust the configuration of this pin via the jumper located at J7 & J8. For threshold information, see the device-specific data sheet adjustable threshold tables.

2.2.8 ADJ UV

The TPS371K-Q1 family of devices contain an adjustable undervoltage threshold pin that controls the threshold with which the OUT UV pin assert. The user can adjust the configuration of this pin via jumper J9 & 10. for threshold information, see the device-specific data sheet adjustable threshold tables.

2.2.9 BIST EN

The TPS371K-Q1 family of devices contain an optional Built-In Self-Test Enable pin that is used to initiate a Built-In Self-Test (BIST). BIST is an internal diagnositcs of the device. Please refer to the device data sheet for additional details. The user can adjust the configuration of this pin via the jumper J6.

2.2.10 Reset Time Delay (CTR)

The TPS371K-Q1 family of devices contain an adjustable reset time delay pin that controls the time that pin 13 either OUT UV or LOW UV pin de-asserts after reaching the valid condition. The user can adjust the configuration of this pin via the jumper J2. Refer to Section 2.1.1 for jumper connections.

2.2.11 Sense Time Delay (CTS)

The TPS371K-Q1 family of devices contain an adjustable sense time delay pin that controls the time that pin 13 either OUT UV or LOW UV pin asserts after reaching the invalid condition. The user can adjust the configuration of this pin via the jumper J1. Refer to Section 2.1.1 for jumper connections.

3 Implementation Results

3.1 EVM Performance Results

The following measurements are taken using the default TPS371KEVM with a custom TPS371K-Q1 device.

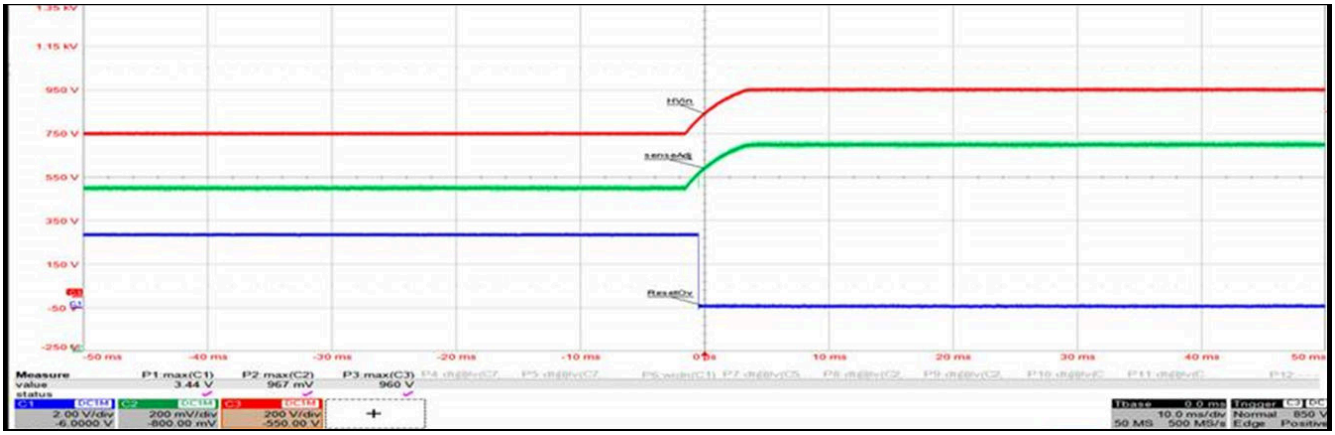


Figure 3-1. OUT OV Assertion waveform

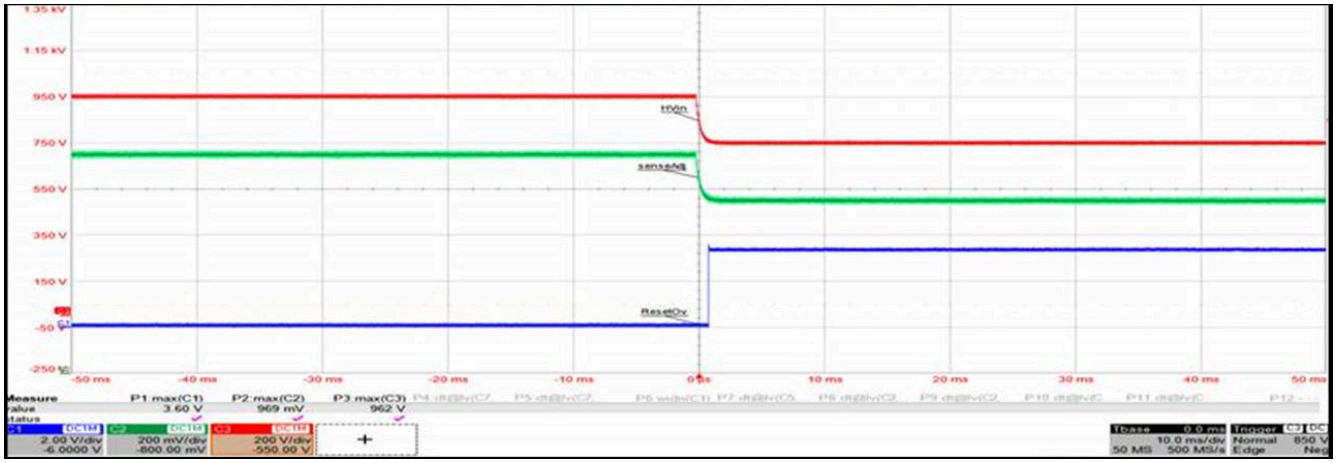


Figure 3-2. OUT OV Deassertion waveform

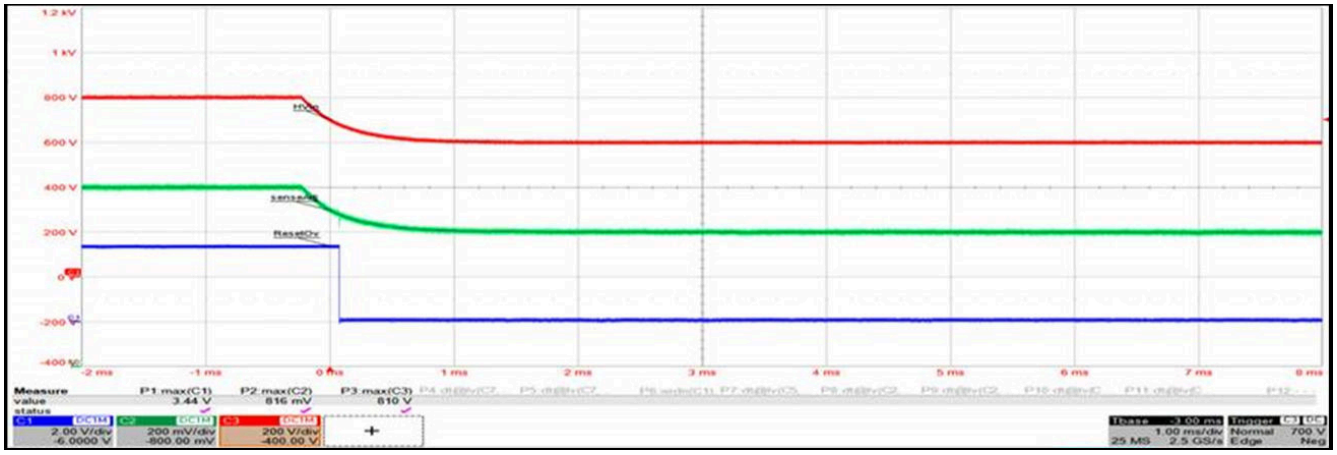


Figure 3-3. OUT UV Assertion waveform

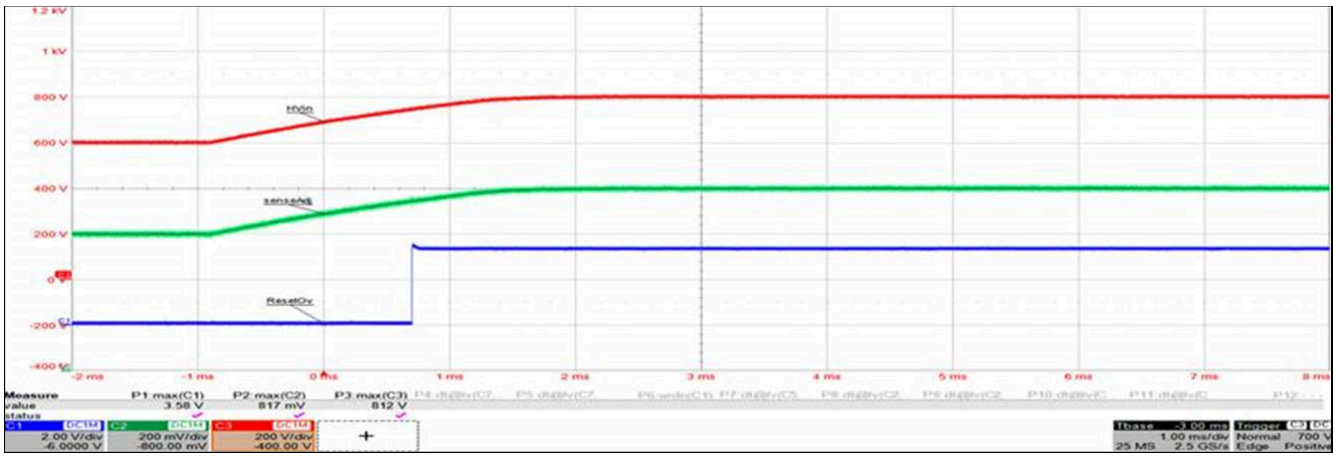


Figure 3-4. OUT UV Deassertion waveform

4 Hardware Design Files

4.1 Schematics

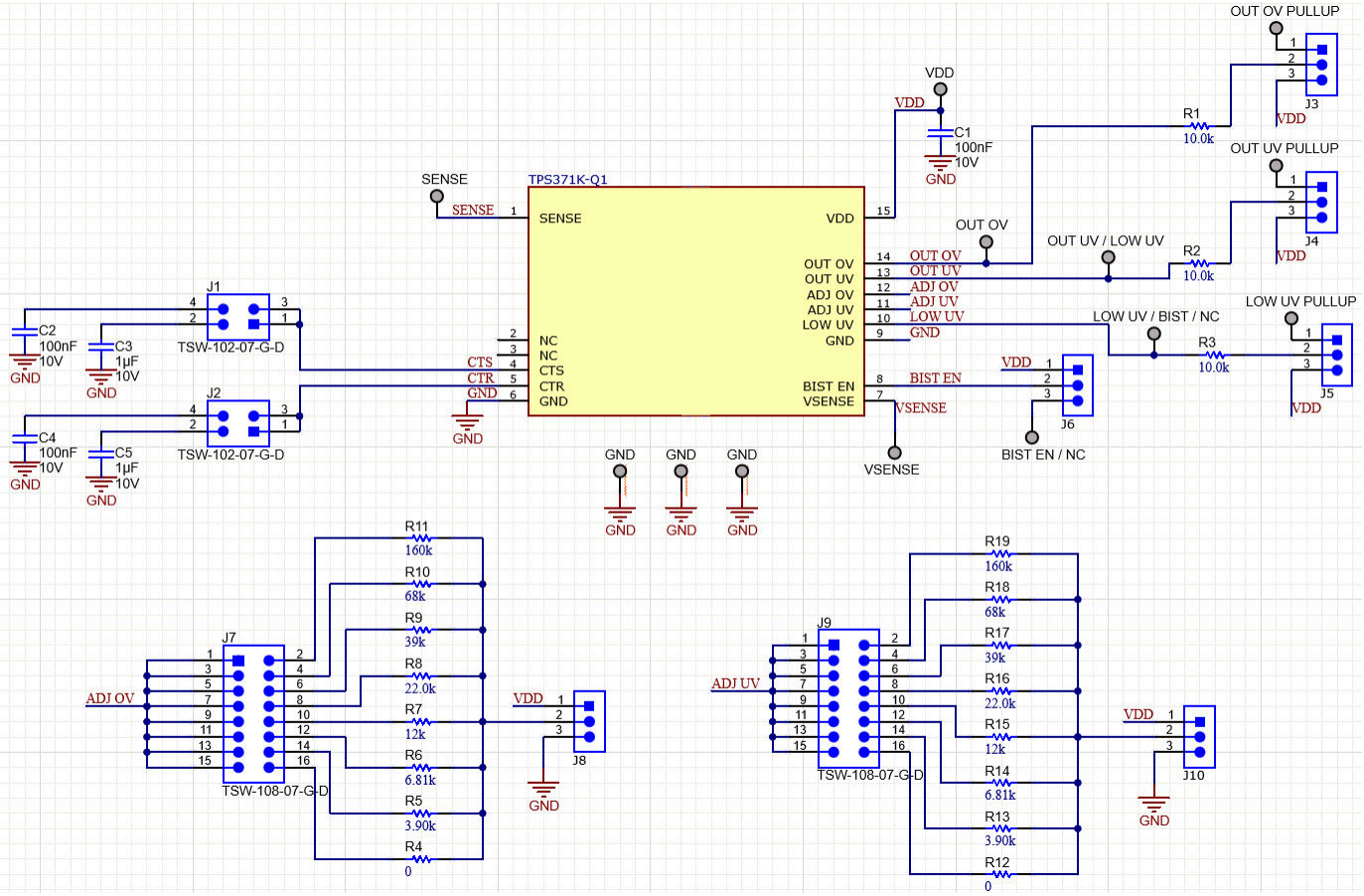


Figure 4-1. TPS371KEVM Schematic

4.2 PCB Layout

Figure 4-2 and Figure 4-3 show the top and bottom assemblies of the printed circuit board (PCB) to display the component placement of the EVM.

Figure 4-4 and Figure 4-5 show the top and bottom layouts, Figure 4-6 and Figure 4-7 show the top and bottom layers, and Figure 4-8 shows the top solder mask of the EVM.

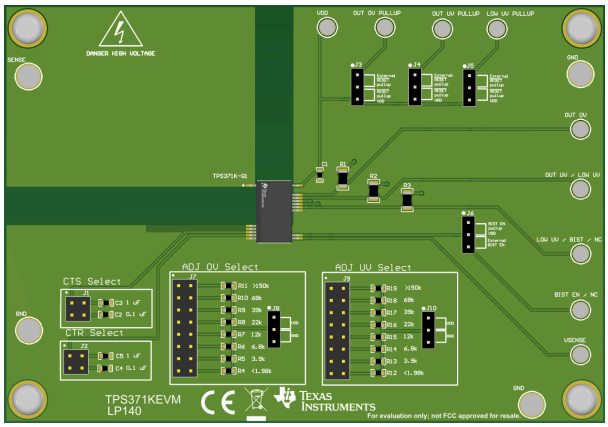


Figure 4-2. Component Placement - Top Assembly

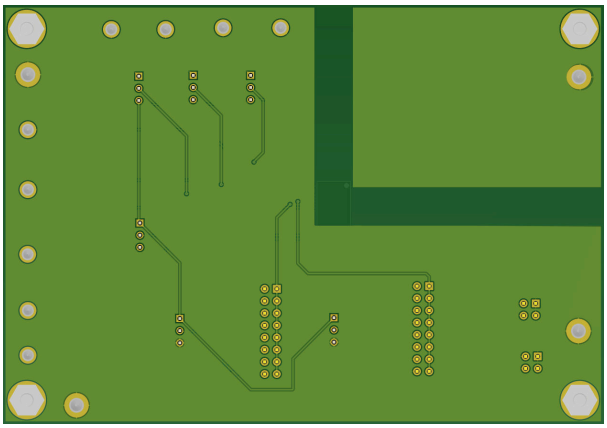


Figure 4-3. Component Placement - Bottom Assembly

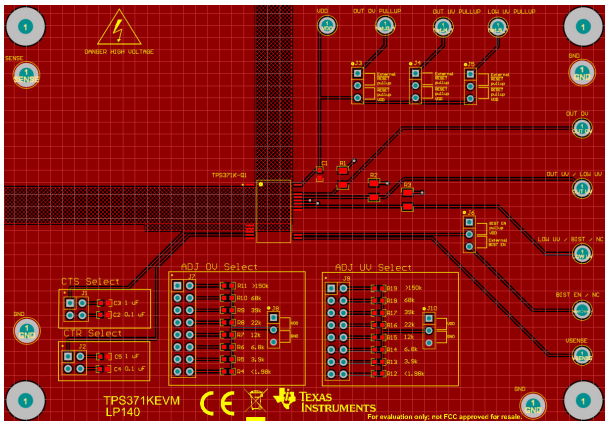


Figure 4-4. Layout - Top

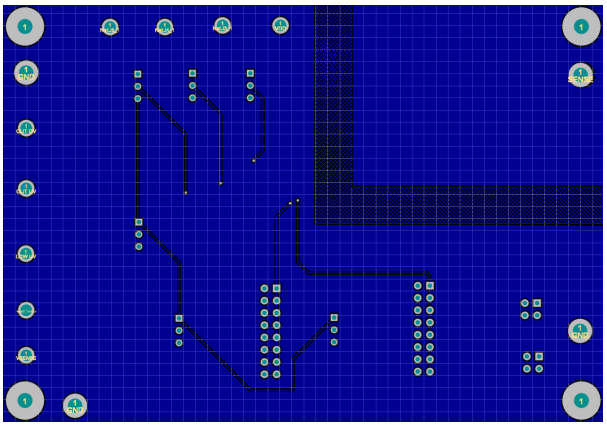


Figure 4-5. Layout - Bottom

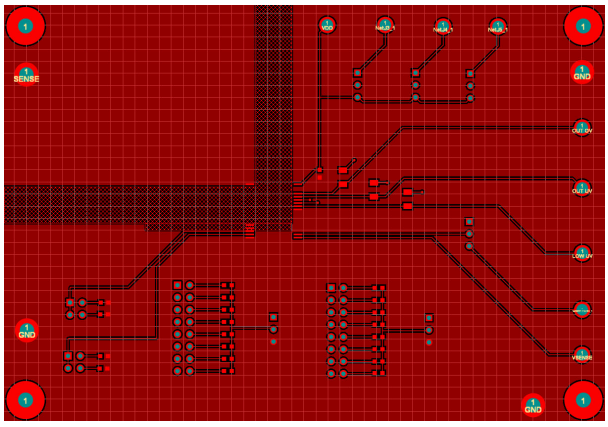


Figure 4-6. Top Layer

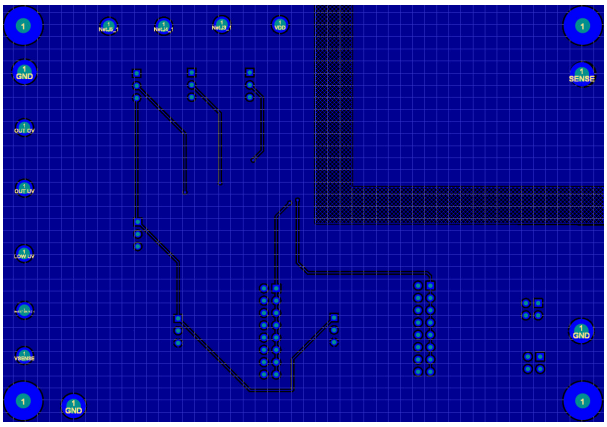


Figure 4-7. Bottom Layer

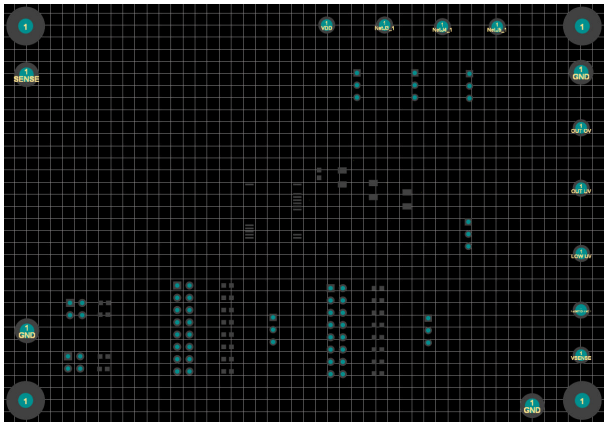


Figure 4-8. Top Solder Mask

4.3 Bill of Materials

Table 4-1. TPS371KEVM Bill of Materials

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer
!PCB	1		Printed Circuit Board		LP140	Any
C3, C5	2	1uF	CAP, CERM, 1uF, 10V, ±10%, X7R, 0603	0603	LMK107B7105KA-T	Taiyo Yuden
C1, C2, C4	3	0.1uF	CAP, CERM, 0.1uF, 10V, ±10%, X7R, 0603	0603	C0603C104K8RACTU	KEMET
H1, H2, H3, H4	4	33nF	Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	Screw	NY PMS 440 0025 PH	B&F Fastener Supply
H5, H6, H7, H8	4		Standoff, Hex, 0.5"L #4-40 Nylon	Standoff	1902C	Keystone Electronics
J1, J2	2		Header, 100mil, 2x2, Gold, TH	2x2 Header	TSW-102-07-G-D	Samtec Inc.
J3, J4, J5, J6, J8, J10	6		Header, 100mil, 3x1, Tin, TH	3x1 Header	PEC03SAAN	Sullins Connector Solutions
J7, J9	2		Header, 100mil, 8x2, Gold, TH	8x2 Header	TSW-108-07-G-D	Samtec Inc.
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H	PCB Label 0.650 x 0.200 inch	THT-14-423-10	Brady Corporation
R1, R2, R3	3	10k	RES, 10.0 k, 1%, 0.25W, 1206	1206	RC1206FR-0710KL	YAGEO
R4, R12	2	0	RES, 0, 5%, 0.1W, 0603	0603	ERJ-3GEY0R00V	Panasonic
R5, R13	2	3.9k	RES, 3.90 k, 0.1%, 0.1W, 0603	0603	RG1608P-392-B-T5	Susumu
R6, R14	2	6.81k	RES, 6.81 k, 0.1%, 0.1W, 0603	0603	RT0603BRD076K81L	YAGEO
R7, R15	2	12k	RES, 12 k, 5%, 0.1W, 0603	0603	CRCW060312K0JNEA	Vishay
R8, R16	2	22k	RES, 22.0 k, 1%, 0.1W, AEC-Q200 Grade 0, 0603	0603	ERJ-3EKF2202V	Panasonic
R9, R17	2	39k	RES, 39 k, 5%, 0.1W, 0603	0603	RC0603JR-0739KL	YAGEO
R10, R18	2	68k	RES, 68 k, 5%, 0.1W, 0603	0603	CRCW060368K0JNEA	Vishay
R11, R19	2	160k	RES, 160 k, 1%, 0.1W, 0603	0603	RC0603FR-07160KL	YAGEO
SENSE, GND	4		Terminal, Turret, TH, Double	Keystone1503-2	1503-2	Keystone Electronics
BIST EN / NC, LOW UV / BIST / NC, LOW UV PULLUP, OUT OV, OUT OV PULLUP, OUT UV / LOW UV, OUT UV PULLUP, VDD, VSENSE	9		Terminal, Turret, TH, Triple	Keystone1598-2	1598-2	Keystone Electronics

Table 4-1. TPS371KEVM Bill of Materials (continued)

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer
TPS371K-Q1	1		Wide VIN 1500V Overvoltage and Undervoltage (OV and UV) Detector with Built-in Self-test for Automotive	DFX0015A	TPS371KA8C89DFXRQ1	Texas Instruments

5 Additional Information

5.1 Trademarks

All trademarks are the property of their respective owners.

6 Revision History

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

Changes from Revision * (February 2025) to Revision A (August 2025)	Page
• Updated the populated EVM IC	2
• Updated EVM layout images to match the latest EVM board	9

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.

WARNING

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。

https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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

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

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。 日本テキサス・インスツルメンツ株式会社

東京都新宿区西新宿 6 丁目 2 4 番 1 号

西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/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。https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-for-power-line-communication.html

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.

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