

# EVM User's Guide: TPSI2240-Q1

## TPSI2240-Q1 Evaluation Module



### Description

The TPSI2240Q1EVM is a hardware evaluation module (EVM) containing multiple test points and jumpers to fully evaluate the performance and functionality of TPSI2240-Q1. The evaluation module contains the materials needed to test and assess the TPSI2240-Q1 device to seamlessly design the device into a larger applications, such as Battery Management Systems. Use the TPSI2240Q1EVM standalone or paired with an external microcontroller to drive the enable signal of the device. Evaluate application requirements, such as dielectric withstand testing (also known as High Potential [HiPot] Testing) and DC fast charger surge currents, using the EVM without requiring any external protection components. The EVM is populated with TPSI2240-Q1 in a SOIC package.

### Features

This EVM has the following features:

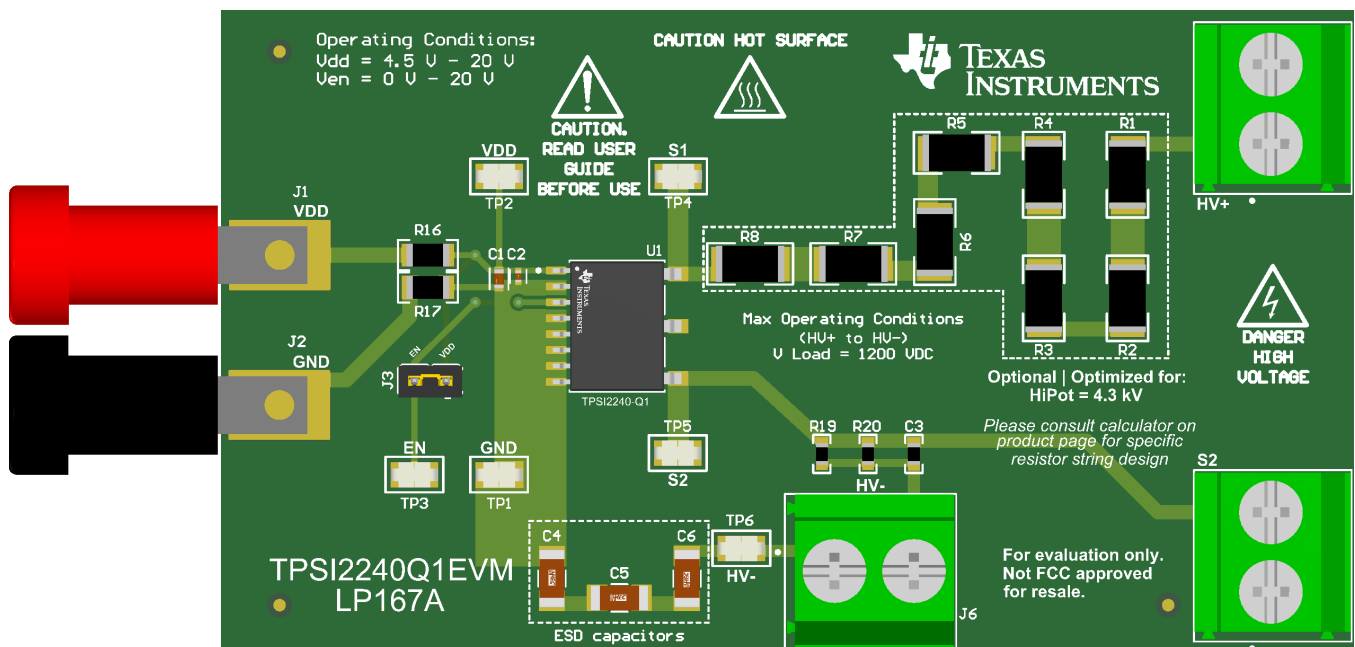
- Primary side operating voltage: 4.5V – 20V
- High potential (HiPot) withstand testing capability: up to 4.3kV
- Terminal blocks connectors for easily wired connections
- Test points available for every pin and voltage supply to provide correct functionality

### Applications

- [HEV/EV insulation resistance monitoring](#)
- [Hybrid, electric, and power train systems](#)
- [Battery management systems \(BMS\)](#)
- [Solar energy](#)
- [Onboard charger](#)
- [EV charging infrastructure](#)

### Note

*Disclaimer: Refer to the data sheet and design resources on the TPSI2240-Q1 product page to optimize component selections for the HiPot voltage and avalanche current requirements of the desired application.*



ADVANCE INFORMATION

# 1 Evaluation Module Overview

## 1.1 Introduction

The TPSI2240-Q1 is an isolated solid-state relay, designed for high-voltage automotive and industrial applications. The TPSI2240-Q1 seamlessly replaces mechanical and photo relays by integrating TI's capacitive isolation technology. The capacitive isolation technology does not suffer from common failure modes such as mechanical wear out or photo degradation. The entire primary side of the device requires only 5mA of input current, incorporating a fail-safe EN pin preventing any possibility of back powering the VDD supply. The secondary side consists of back-to-back MOSFETs with a standoff voltage of 1200V from S1 to S2. The avalanche robust MOSFETs and the thermal benefits of the widened pins on the 11 DWQ package enable the TPSI2240-Q1 to withstand High Potential (HiPot) screening and DC fast charger surge currents, assuming appropriate component selection for the application. The TPSI2240Q1EVM helps users evaluate the operation and performance of the TPSI2240-Q1 isolated switch with reinforced isolation rating up to 5kVrms. The inputs and output connections to the board are terminal blocks, which allow for easily wired connections. This EVM user's guide provides the connectors, test point descriptions, operational modes, schematic, bill of materials, and board layout of the EVM.

## 1.2 Kit Contents

**Table 1-1. Kit Contents**

Item	Quantity
TPSI2240Q1EVM	1

## 1.3 Specification

This section summarizes the performance specifications of the TPSI2240Q1EVM in the default configuration. Refer to [Section 3.1.1](#) for recommended typical voltages during testing.

**Table 1-2. TPSI2240Q1EVM Input Voltage Limits**

PARAMETER		MIN	Typ	MAX	UNIT
V <sub>VDD</sub>	Primary side supply voltage	4.5	-	20	V
V <sub>EN</sub>	Enable Voltage	0	-	20	V
V <sub>HV*</sub>	Secondary side nominal high voltage input	0	-	800	V
V <sub>HiPot</sub>	Secondary side High Potential withstand voltage (60s pulse)	0	-	4300	V

## 1.4 Device Information

**Table 1-3. TPSI2240-Q1 Device Specifications**

Device Specifications	Values
Primary side supply current	9mA ON state, 1uA OFF state
Standoff voltage of integrated avalanche rated MOSFETs	1200V
Isolation barrier rating	5000V <sub>RMS</sub>
Automotive qualification	AEC-Q100
Package	DWQ (SOIC, 11) 10.3mm × 7.5mm (nom)

## 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 maintain the safety of you and those working around you. Contact TI's Product Information Center <http://ti.com/customer support> for further information.

**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. It 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 should immediately stop from further use of the HV EVM.

1. Work Area Safety:
  - a. Keep work area clean and orderly.
  - b. Verify that qualified observers are present anytime circuits are energized.
  - c. Verify that effective barriers and signage are 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. Electrically load all interface circuits, power supplies, evaluation modules, instruments, meters, scopes, and other related apparatus used in a development environment exceeding 50Vrms/75VDC 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. Whenever possible, do not freehand test.
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. Re-validate 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:* Do not use EVMs as all or part of a production unit.

## ADVANCE INFORMATION

## 2 Hardware

### 2.1 Recommended Test Equipment

The following list includes the recommended equipment to test the TPSI2240Q1EVM:

- Adjustable power supplies for the input
- Oscilloscope
- Digital multimeter
- *Optional:* function generator or microcontroller to toggle the enable (EN) pin of the TPSI2240-Q1

### 2.2 Jumper Information

**Table 2-1. Input and Output Connector Descriptions**

Connector	Label	Description
J1	VDD	Primary side supply
J2	GND	Primary side GND
J3	SH-1	Jumper connecting EN pin to VDD when closed
J4	HV+	Secondary side positive input
J5	S2	Voltage sense output
J6	HV-	Secondary side negative input

### 2.3 Test Points

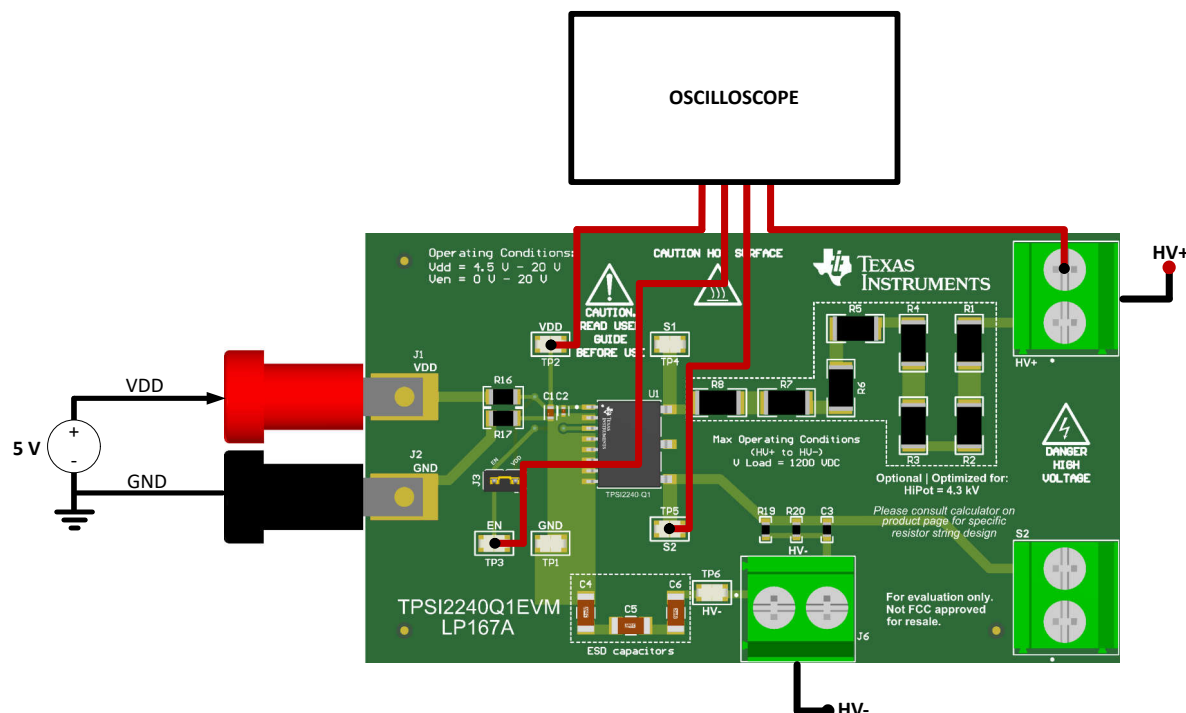
**Table 2-2. Test Point and Jumper Descriptions**

Test Point, Jumper	Label	Description
TP1	GND	Primary side GND test point
TP2	VDD	Primary side supply test point
TP3	EN	Enable pin test point
TP4	S1	Secondary side HV+ voltage after resistor chain
TP5	S2	Voltage sense output test point
TP6	HV-	HV– secondary side test point

## 3 Implementation Results

### 3.1 Evaluation Setup

#### 3.1.1 Recommended Test Setup



**Figure 3-1. TPSI2240Q1EVM Test Setup**

#### Note

**Important Note:** The setup shown in [Figure 3-1](#) assumes that high and low voltage grounds (GND & HV-) are shorted to allow for safe oscilloscope capture. In this configuration, the isolation barrier in the TPSI2240-Q1 device is bypassed. To evaluate the device with the isolation barrier, use differential oscilloscope probes and keep high and low voltage grounds separated.

Verify that the TPSI2240Q1EVM has the following setting on the jumpers:

1. **J3** – Connecting EN pin to VDD Rail

To test the normal operation of TPSI2240-Q1, follow the steps outlined below:

1. Connect a 5V power supply to the banana jacks of **J1** with the negative lead connected to **J2** to power TPSI2240-Q1.
2. Before placing in the enclosure or connecting the High-Voltage (HV) power supply, verify all voltages on the primary side of TPSI2240-Q1 are as expected using **TP2** (VDD) and **TP3** (EN) referenced to **TP1** (GND).
3. Place the board in the enclosure. Attach the high-voltage power supply (800V) positive lead to **J4** and the negative to **J6**.
4. With oscilloscope probes connected to voltages of interest (VDD/EN, HV+, S2), turn on the high-voltage supply then subsequently toggle the 5V supply connected to EN. Observe that **TP3** (EN), **J4** (HV+), and **TP6** (S2) show the expected voltages.

To test the High Potential (HiPot) operation of TPSI2240-Q1, follow the steps below:

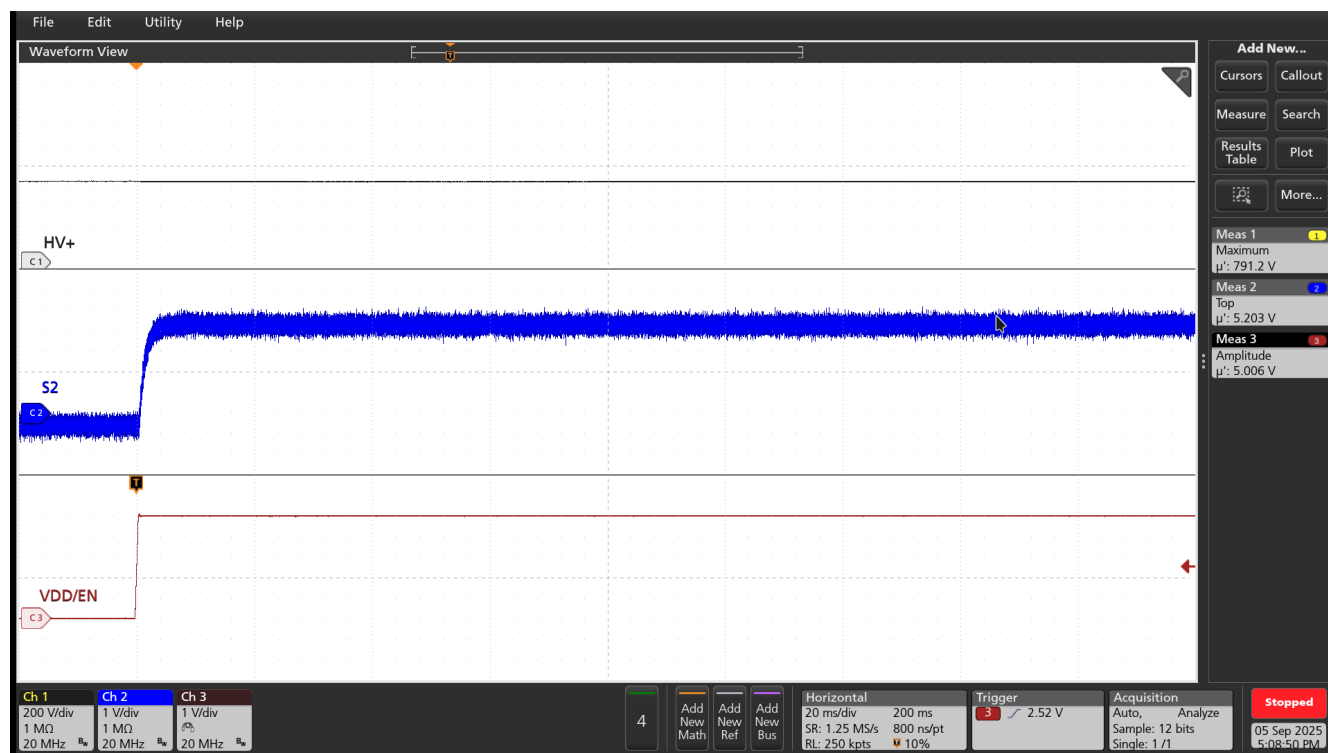
1. Verify that no power supply connects to the TPSI2240-Q1 **J1** and **J2** primary side connectors during HiPot testing.
2. Place the board in the enclosure and attach the high-voltage power supply (4300V) positive lead to **J4** and the negative lead to **J6**.
3. With oscilloscope probes connected to voltages of interest (HV+, S1-S2), turn on the high-voltage supply with a 60s pulse then observe that **J4** (HV+), **TP4-TP6** (S1-S2) show the expected voltages.

## 3.2 Performance Data and Results

### 3.2.1 Waveforms

After completing the [recommended test setup](#), verify that the following channels are displayed in the waveforms in [Figure 3-2](#)

- **CH 1** = HV+
- **CH 2** = S2
- **CH 3** = VDD/EN



**Figure 3-2. Voltage Sense Output (S2) Test Point at HV = 800V (EN = 5V)**

[Figure 3-3](#) shows two test points using the following channels settings.

- **CH 1** = VHipot (HV+)
- **CH 2** = S1-S2



Figure 3-3. Secondary Sense (S1) and Voltage Sense (S2) Test Points at HV = 4300V

### 3.2.2 S2 Voltage Divider

The voltage sense output test point, S2 (TP6), is the voltage divider measurement. The voltage measured is dependent on parallel resistors R19 and R20, and the resistor network R1-R8. Calculate the voltage measurement using the following equation:

$$V_{S2} = \frac{R19 \parallel R20}{(R1 + R2 + \dots + R8) + (R19 \parallel R20)} \times V_{HV} \quad (1)$$



## 4 Hardware Design Files

### 4.1 Schematics

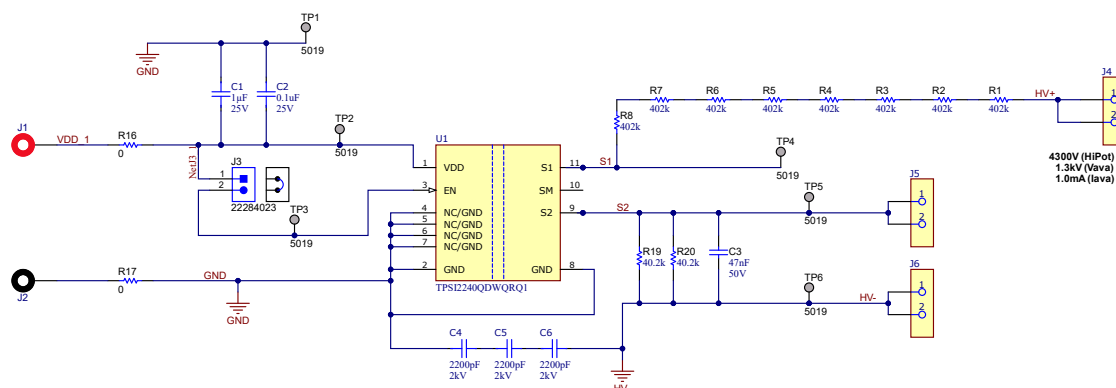


Figure 4-1. TPSI2240Q1EVM Schematic

### 4.2 PCB Layouts

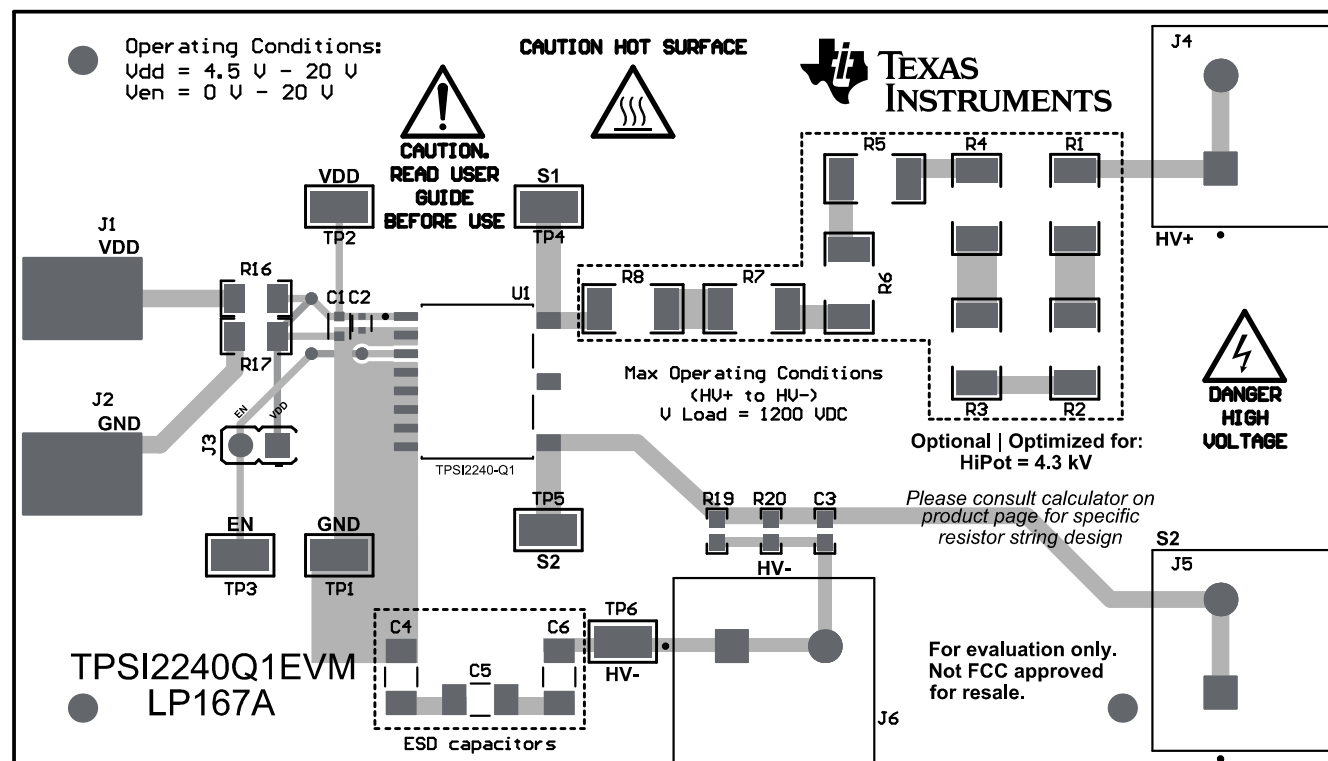


Figure 4-2. TPSI2240-Q1 EVM - Composite View

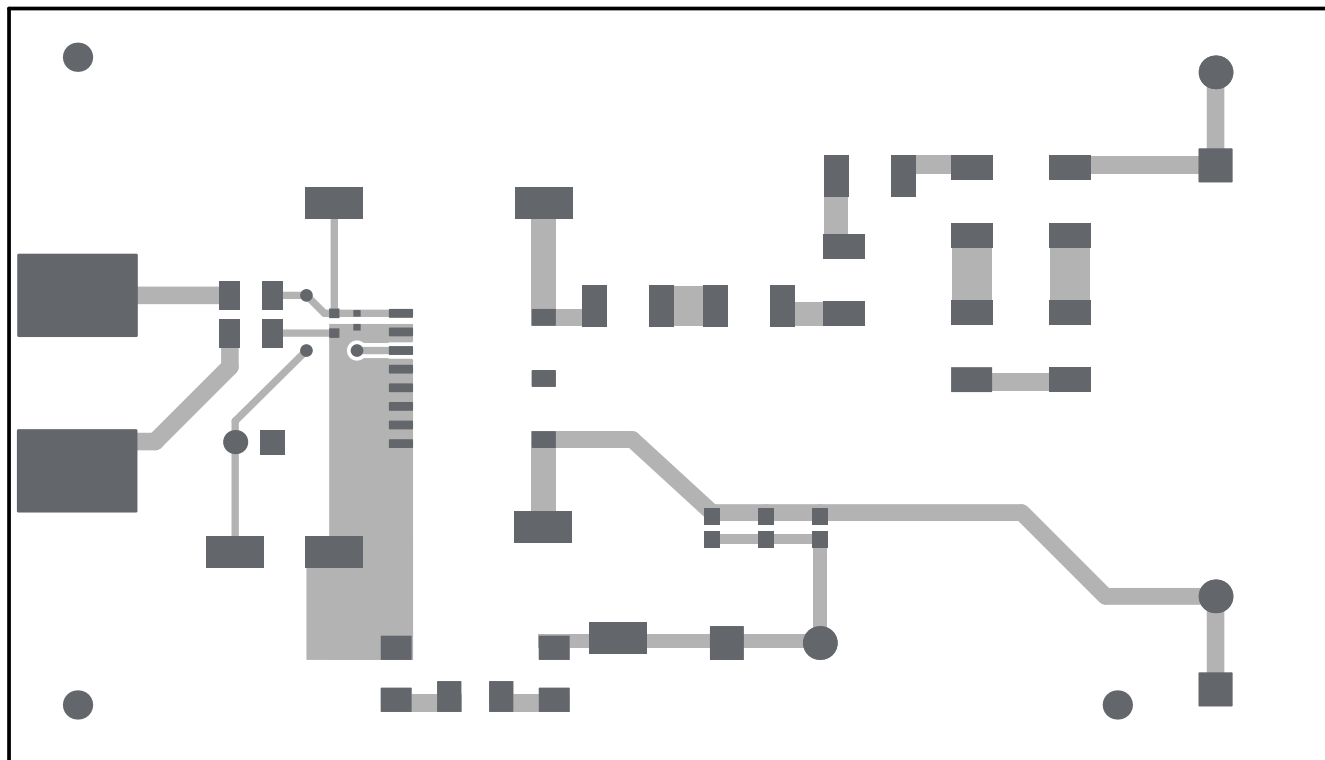


Figure 4-3. TPSI2240-Q1 EVM - Layer 1



Figure 4-4. TPSI2240-Q1 EVM - Layer 2

### 4.3 Bill of Materials (BOM)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
!PCB	1		Printed Circuit Board		LP167	Any
C1	1	1 $\mu$ F	Ceramic Capacitor for Automotive 1uF $\pm$ 10% 25VDC X7R 0603 Paper T/R	0603	GCM188R71E105KA64J	Murata
C2	1	100nF	Ceramic Capacitor Automotive 0.1uF $\pm$ 10% 25V X7R 0402	0402	TMK105B7104KVHF	Taiyo Yuden
C3	1	0.047uF	CAP, CERM, 0.047 uF, 50 V, +/- 10%, X7R, 0603	0603	C1608X7R1H473K080AA	TDK
C4, C5, C6	3	2.2nF	2200 pF $\pm$ 10% 2000V (2kV) Ceramic Capacitor X7R 1808 (4520 Metric)	1808	C1808X222K202T	Holy Stone
FID1, FID2, FID3	3		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A
H1, H2, H3, H4	4		Bumpon, Hemisphere, 0.44 X 0.20, Clear	Transparent Bumpon	SJ-5303 (CLEAR)	3M
J1	1		Banana Jack Insul Nylon Red, TH	Banana Jack Insul Nylon Red, TH	108-0902-001	Cinch Connectivity
J2	1		Banana Jack Insul Nylon Black, TH	Banana Jack Insul Nylon Black, TH	108-0903-001	Cinch Connectivity
J3	1		Header, 2.54mm, 2x1, Tin, TH	Header, 2.54mm, 2x1, TH	22284023	Molex
J4, J5, J6	3			CONN_TERM_BLOCK2	6.91251E+11	Wurth Electronics
R1, R2, R3, R4, R5, R6, R7, R8	8	402k	RES, 402 k, 1%, 0.75 W, AEC-Q200 Grade 0, 2010	2010	CRCW2010402KFKEF	Vishay-Dale
R16, R17	2	0	RES, 0, 5%, 0.25 W, 1206	1206	RC1206JR-070RL	Yageo America
R19, R20	2	40.2k	RES, 40.2 k, 0.1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	ERA-3AEB4022V	Panasonic
SH-1	1	1x2	Shunt, 100mil, Gold plated, Black	Shunt	SNT-100-BK-G	Samtec

TP1, TP2, TP3, TP4, TP5, TP6	6		Test Point, Miniature, SMT	Test Point, Miniature, SMT	5019	Keystone
U1	1		1200-V, 50-mA, Automotive Solid State Relay With Avalanche Protection	SOIC11	TPSI2240QDWQRQ1	Texas Instruments

## 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 DEGRADATION 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/sds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/sds/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。

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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:*

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