

# TPS61371 Boost Converter With I2C Interface Evaluation Module



## Description

The TPS61371EVM-155 is designed to demonstrate the features and functionality of the TPS61371 device, which is a high-performance, high-efficiency, synchronous boost converter with I<sup>2</sup>C interface. The factory default settings of the TPS61371EVM allow the operation with an input voltage range from 2.7V to 5.5V.

## Get Started

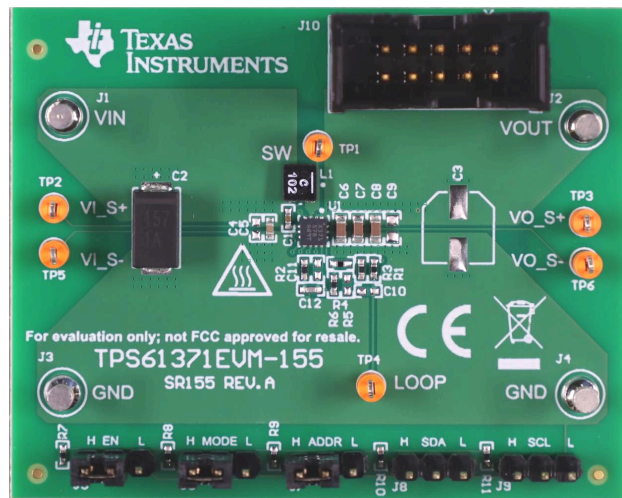
1. Order the EVM on [ti.com](https://www.ti.com).
2. Read the user's guide carefully.
3. Prepare the bench setup per instructions. Take precautions to prevent damage by ESD when handling the EVM.
4. Power up the EVM by following the recommended steps.
5. Run tests and measurements. Take cautions of high voltage and hot temperature produced by the EVM during test.

## Features

- V<sub>IN</sub> range from 2.7V to 5.5V
- Programmable reference voltage (0.324V to 0.959V) through I<sup>2</sup>C, default 0.594V
- Output discharge selectable
- Load disconnect during shutdown
- Pin selectable PFM/FPWM mode
- Output short and overvoltage protection with latch type

## Applications

- [NAND flash](#)
- [Optical sensor driver](#)
- RF power amplifier



TPS61371EVM

# 1 Evaluation Module Overview

## 1.1 Introduction

This EVM is designed for 2.7V to 5.5V input voltage and 11V output voltage applications. The EN jumper (J5) controls the ON and OFF of the device. The MODE jumper (J6) controls PFM or FPWM mode at light load. The ADDR jumper (J7) controls I2C address. This EVM has test points of TP1 and TP4 for SW voltage and loop measurement, respectively. The feedback divider can be modified for other application conditions as per the data sheet.

This user's guide describes the characteristics and operation of the evaluation module TPS61371EVM-155. This document provides instructions on how to use the evaluation module. Throughout this document, the terms of evaluation board, evaluation module, and EVM are synonymous with the TPS61371EVM-155. This document also includes a schematic, reference printed circuit board (PCB) layout, and a complete bill of materials (BOM).



## 1.2 Kit Contents

Table 1-1 details the contents of the EVM kit.

**Table 1-1. EVM Kit Contents**

ITEM	QUANTITY
TPS61371EVM-155	1

## 1.3 Specification

Table 1-2 provides a summary of the TPS61371EVM performance specifications. All specifications are given for an ambient temperature of 25°C.

**Table 1-2. Performance Specification Summary**

Parameter	Test Condition	Value	Unit
Input voltage		2.7 – 5.5	V
Output voltage		11	V
Maximum output current	$V_{IN} \geq 3.3V, V_{OUT} = 11V$	0.6	A

## 1.4 Device Information

The TPS61371 is a fully-integrated, synchronous boost converter with the load disconnect built-in. The device supports output voltage up to 16V with a 3.8A current limit. The output voltage can be changed either by the feedback resistors or by the I<sup>2</sup>C controlled reference voltage  $V_{REF}$ . The input voltage ranges from 2.7V to 5.5V supporting applications powered by a single-cell Lithium-ion battery or 3.3V/5V bus.

## 2 Hardware

This section describes how to properly connect, set up, and use the TPS61371EVM-155.

### 2.1 Connector and Test Point Descriptions

This EVM includes I/O connectors and test points as shown in [Table 2-1](#). Connect the power supply must be connected to input connectors, J1 and J3. Connect the load must be connected to output connectors, J2 and J4.

**Table 2-1. Connectors and Test Points**

Reference Designator	Description
J1	Input voltage positive connection
J3	Input voltage negative connection
TP2	Input voltage positive sense connection
TP5	Input voltage negative sense connection
J2	Output voltage positive connection
J4	Output voltage negative connection
TP3	Output voltage positive sense connection
TP6	Output voltage negative sense connection
J10	I <sup>2</sup> C USB2ANY connector

### 2.2 Jumper Configuration

#### 2.2.1 J5 (ENABLE)

The J5 jumper enables the device. By default, this jumper is set to the L position. Put this jumper in the H position to enable the device.

#### 2.2.2 J6 (MODE)

The J6 jumper selects the light load operation mode of TPS61371. Put this jumper in the H position to set the device in FPWM mode. Put this jumper in the L position to set the device in PFM mode in default, but in this case, the device can also be set to FPWM mode by setting the FPWM bit in the register.

#### 2.2.3 J7 (I<sup>2</sup>C Target Address Selection)

The J7 jumper is for the I<sup>2</sup>C target address selection. By default, this jumper is set to the L position and the device I<sup>2</sup>C target address is 74H. Place a jumper across GPIO and H to set the I<sup>2</sup>C target address to 72H. Leave a jumper floating to set the I<sup>2</sup>C target address to 73H.

### 2.3 Test Procedure

1. Set the power supply current limit to 4A. Set the power supply to approximately 3.3V. Turn off the power supply. Connect the positive output of the power supply to J1 and the negative output to J3.
2. Connect the load to J2 for the positive connection and connect the load J4 for the negative connection.
3. Turn on the power supply.
4. Set the J5 jumper across EN and H. The default output voltage is 11V.
5. Set the output voltage to the target value on the GUI user interface page.
6. Slowly increase the load while monitoring the output voltage between J2 and J4. Allow the output voltage to remain in regulation when the load current is lower than 0.6A.
7. Slowly sweep the input voltage from 2.7V to 5.5V. Allow the output voltage to remain in regulation when the load current is lower than the maximum load current specified in [Table 1-2](#).
8. Turn off the load and power supply.

## 3 Software

### 3.1 Software User Interface

#### 3.1.1 Install USB2ANY Explorer

Download and install the USB2ANY explorer from [USB2ANY](#). Upgrade the firmware version to 2.8.2.0.

#### 3.1.2 GUI Installation

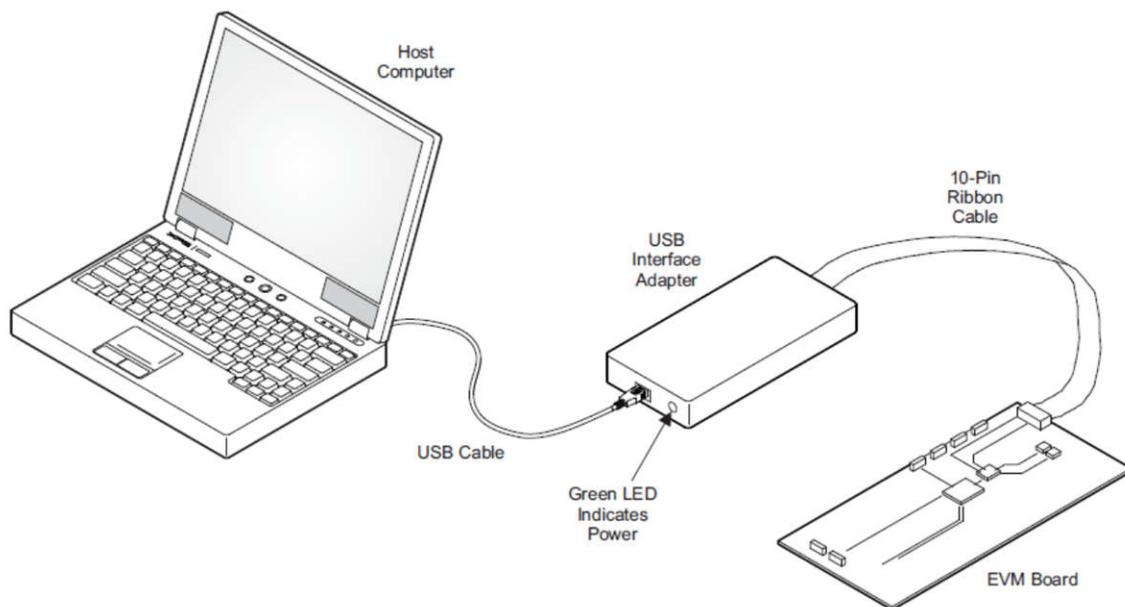
A graphical user interface (GUI) is available [here](#). The GUI allows simple and convenient programming of the device through the TI USB2ANY device.

1. Download the zip file for the desired platform.
2. Download GUI Composer Runtime.
3. Extract the zip folder and install the GUI.
4. Run through the installation steps. The installation wizard shows a prompt for GUI Composer Runtime, which is done automatically.
5. Open the GUI.

#### 3.1.3 Interface Hardware Setup

Connect the USB2ANY adapter to a PC using the supplied USB cable. Connect the TPS61371EVM-155 connector J10 to the USB2ANY adapter using the supplied 10-pin ribbon cable. The connectors on the ribbon cable are keyed to prevent incorrect installation.

[Figure 3-1](#) shows a quick connection overview.



**Figure 3-1. Quick Connection Overview**

#### 3.1.4 User Interface Operation

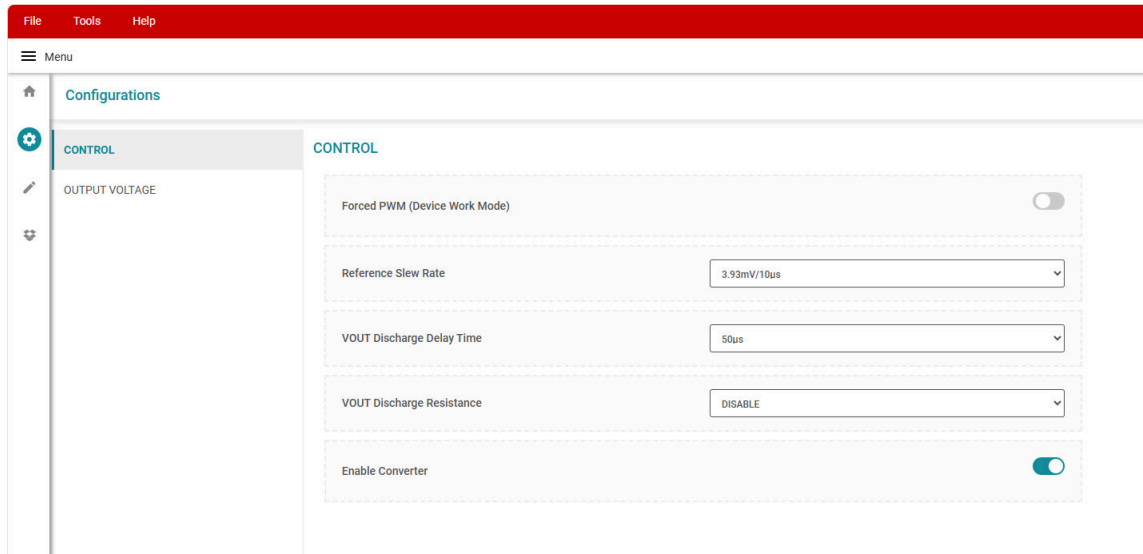
Enable the TPS61371EVM board for operation by the following steps:

1. Set J5 to the ON position. Turn on the power supply.
2. Open the GUI.
3. Select the *Auto Connect* button on the bottom left corner of the page on the target address widget ([Figure 3-2](#)). The button automatically checks for target addresses (0x72, 0x73, 0x74) and connects the GUI with the device.



**Figure 3-2. GUI Auto Connect Button**

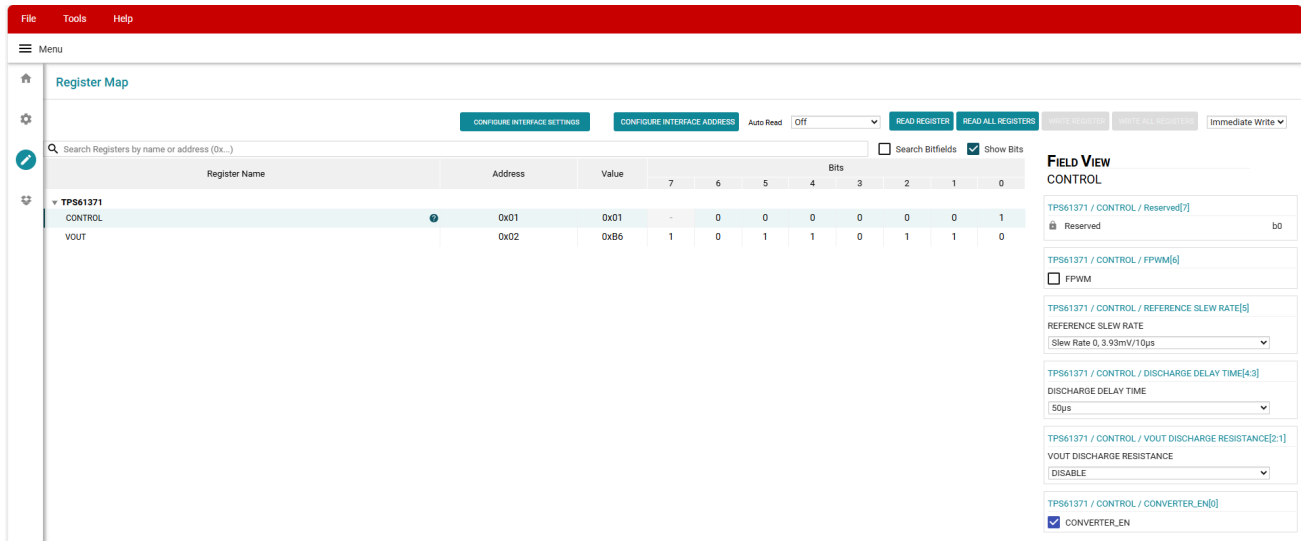
- Select the *Start* button. This button shows the GUI user interface of TPS61371EVM-155 (Figure 3-3).



**Figure 3-3. GUI User Interface of TPS61371EVM-155**

### 3.1.5 Register Map Screen

The *Register Map* screen shows a register-wise view of all parameters. Here, single registers are read or written to the device (if applicable). See also the [TPS61371 16V, 3.8A Synchronous Boost With Load Disconnect datasheet](#) for a detailed description of the TPS61371 registers.



**Figure 3-4. GUI Register Map Screen**



## 4.2 PCB Layouts

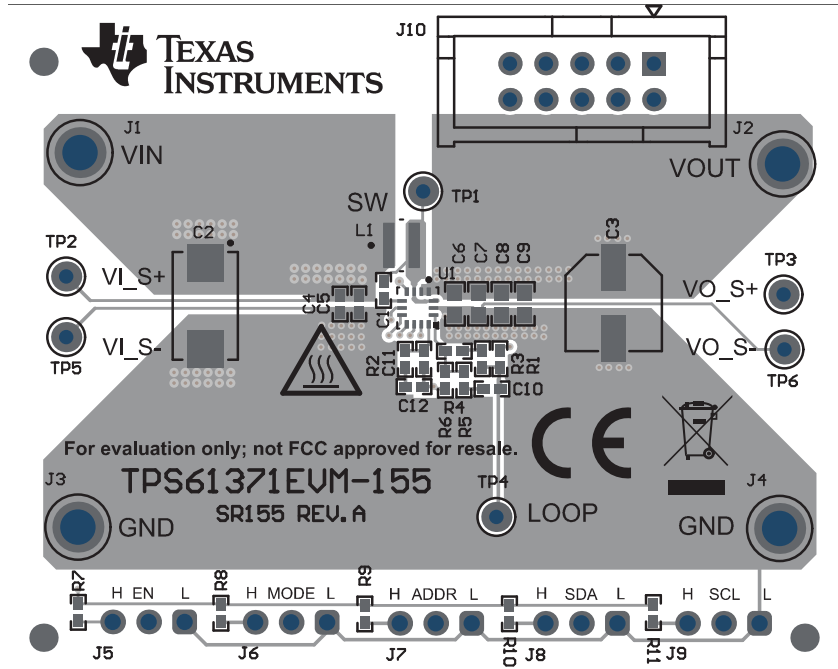


Figure 4-2. TPS61371EVM-155 Top-Side Layout

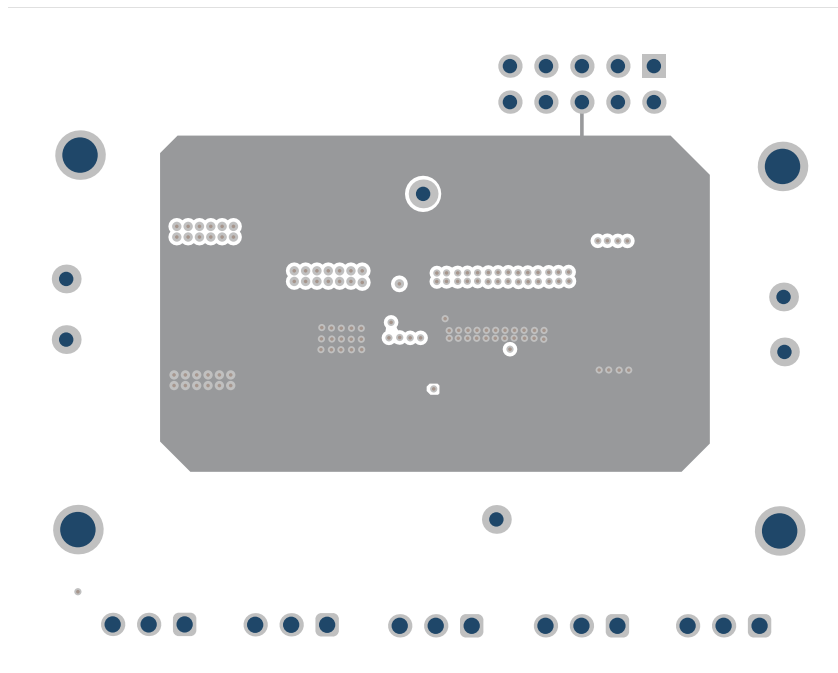
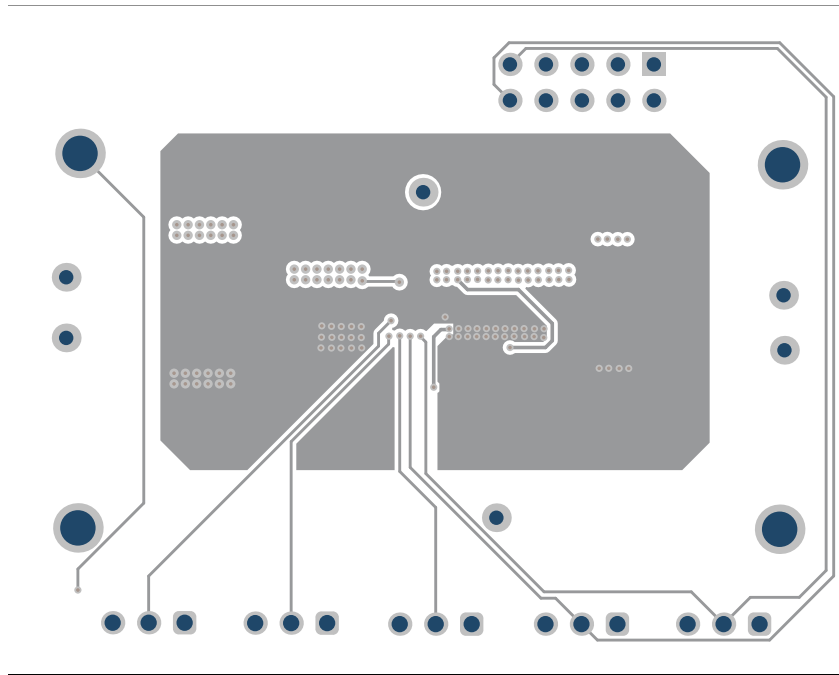
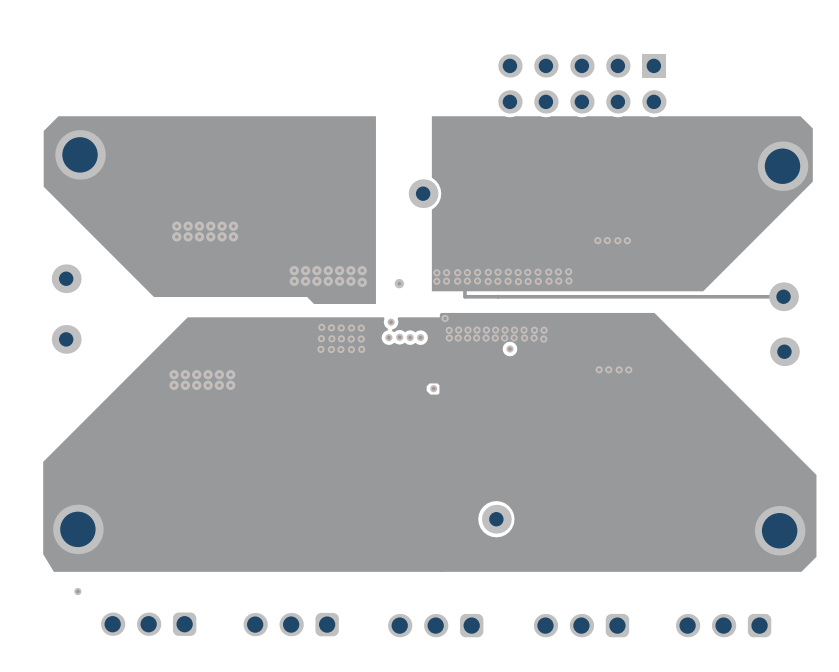


Figure 4-3. TPS61371EVM-155 Inner Layer1



**Figure 4-4. TPS61371EVM-155 Inner Layer2**



**Figure 4-5. TPS61371EVM-155 Bottom-Side Layout**

### 4.3 Bill of Materials

**Table 4-1. Bill of Materials**

Designator	Qty	Value	Description	Package	Part Number	Manufacturer
C1	1	0.1uF	CAP, CERM, 0.1 uF, 16 V, +/- 10%, X5R, 0402	0402	GRM155R61C104KA88D	MuRata
C2	1	150uF	150 µF 10 V Aluminum - Polymer Capacitors 2917 (7343 Metric) 10mOhm	2917	ECASD61A157M010KA0	MuRata
C5	1	10uF	CAP, CERM, 10 uF, 10 V, +/- 20%, X5R, 0402	0402	GRM155R61A106ME11D	MuRata
C6, C7, C8	3	10uF	CAP, CERM, 10 uF, 25V, +/- 20%, X5R, 0603	0603	GRM188R61E106MA73D	MuRata
C12	1	680pF	CAP, CERM, 680 pF, 50 V, +/- 5%, C0G/NP0, 0402	0402	GRM1555C1H681JA01D	MuRata
J1, J2, J3, J4	4		Terminal, Turret, TH, Double	Keystone1502-2	1502-2	Keystone
J5, J6, J7, J8, J9	5		Header, 2.54 mm, 3x1, Gold, TH	Header, 2.54mm, 3x1, TH	61300311121	Würth Elektronik
J10	1		Header (shrouded), 100mil, 5x2, Gold, TH	5x2 Shrouded header	5103308-1	TE Connectivity
L1	1	1uH	1 µH Shielded Molded Inductor 4.9 A 32.2mOhm Max Nonstandard	SMD2	XGL3512-102MEC	Coilcraft
R1	1	49.9	RES, 49.9, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040249R9FKED	Vishay-Dale
R2	1	61.9k	RES, 61.9 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040261K9FKED	Vishay-Dale
R3	1	453k	RES, 453 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW0402453KFKED	Vishay-Dale
R4	1	1.30Meg	RES, 1.30 M, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04021M30FKED	Vishay-Dale
R6, R7, R8, R9	4	100k	RES, 100 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW0402100KFKED	Vishay-Dale
R10, R11	2	1.00k	RES, 1.00 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04021K00FKED	Vishay-Dale
SH-J1, SH-J2, SH-J3	3		Shunt, 2.54mm, Gold, Black	Shunt, 2.54mm, Black	60900213421	Würth Elektronik
TP1, TP2, TP3, TP4, TP5, TP6	6		Test Point, Miniature, Orange, TH	Orange Miniature Testpoint	5003	Keystone Electronics
U1	1		16-V, 3.8-A Synchronous Boost With Load Disconnect	WQFN-HR14	TPS61371VARR	Texas Instruments

## **5 Additional Information**

### **5.1 Trademarks**

All trademarks are the property of their respective owners.

## 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/lstds/ti\\_ja/general/eStore/notice\\_01.page](http://www.tij.co.jp/lstds/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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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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3.3.3 *Notice for EVMs for Power Line Communication:* Please see [http://www.tij.co.jp/lstds/ti\\_ja/general/eStore/notice\\_02.page](http://www.tij.co.jp/lstds/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.
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