User's Guide

TPS6286x0EVM-109 Evaluation Module

Excel Regidor

ABSTRACT

TPS6286x0EVM-109 facilitates the evaluation of the TPS6286x0 family of 600-mA and 1.0-A, step-down converters with 2.3-µA I_Q in tiny 0.7-mm by 1.4-mm WCSP packages with 0.4-mm pitch. The EVM contains circuits to create output voltages between 0.4-V to 1.9875-V from higher input voltages between 1.8 V and 5.5 V. The TPS6286x0 is a highly-efficient and tiny solution for point-of-load (POL) converters for space-constrained applications, such as wearables and smart phones.

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Trademarks

All other trademarks are the property of their respective owners.

1 Introduction

The TPS6286x0 is a synchronous, step-down converter in a 0.7-mm × 1.4-mm wafer chip-scale package (WCSP) with a 0.4-mm pitch. The BSR109 EVMs support different IC version of TPS62860 and TPS62861 families.

1.1 Background

The TPS628600EVM-109 is with the TPS628600 integrated circuit (IC) and with a default output voltage of 1.1-V. The TPS628610EVM-109 uses the TPS628610 integrated circuit (IC) and the output voltage set at 1.1-V. The output voltage can be adjusted after the start-up phase with its graphic user interface via the I2C communication protocol. The EVM operates with an input voltage between 1.8-V and 5.5-V.

1.2 Performance Specification

Table 1-1 provides a summary of the TPS6286x0EVM-109 performance specifications. All specifications are given for an ambient temperature of 25°C.

Table 1-1. Performance Specification Summary

SPECIFICATION	EVM BOARD / TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input voltage		1.8	3.6	5.5	V
Output voltage		0.4		1.9875	V
Output current	TPS628600EVM-109; V_{IN} ≥ 1.8 V			0.6	A
	TPS628610EVM-109; V_{IN} ≥ 1.8V			1.0	A

1.3 Modifications

The EVM can support variance of the TPS6286x0 IC family. Additional input and output capacitors can be added.

1.3.1 IC U1 Operation

The EVM requires an I2C interface, such as the TI USB2ANY and the graphic user interface, to configure the TPS6286x0 functions. The output voltage can be changed in an instant using the preset value on the VOUT Register 1 and VOUT Register 2 using an onboard jumper.

2 Setup

This section describes how to properly use the TPS6286x0EVM-109.

2.1 Input and Output Connector Description

2.1.1 J1, Pin 1 and 2 – VIN

Positive input voltage connection from the input power supply for the EVM.

2.1.2 J1, Pin 3 and 4 – S+/S-

Input voltage sense connections. Measure the input voltage at this point.

2.1.3 J1, Pin 5 and 6 – GND

Input voltage GND return connection from the input power supply for the EVM.

2.1.4 J2, Pin 1 and 2 – VOUT

Positive output voltage connection

2.1.5 J2, Pin 3 and 4 – S+/S-

Output voltage sense connections. Measure the output voltage at this point.

2.1.6 J2, Pin 5 and 6 – GND

Output voltage GND return connection.

2.1.7 J3 – I2C

10-pin header used to connect the USB2ANY adaptor to the EVM

2.1.8 JP1 – EN

EN pin input jumper. Place the jumper across ON and EN to turn on the IC. Place the jumper across OFF and EN to turn off the IC.

2.1.9 JP2 – VSEL

Placing a jumper across VSEL and High pins sets the output voltage to the value in VOUT1 register. Placing a jumper across VSEL and Low pins sets teh output voltage to the value in VOUT2 register.

2.2 Setup

Connect the input supply and the EVM by attaching the positive terminal to J1 (VIN pins), and the negative terminal to J1 (GND pins) to power the board. Link the positive terminal of the electronic load to J2 (VOUT pins) and the negative terminal to J2 (GND pins) of the EVM. Pull high the EN pin to turn on the device and pull low to disable the part.

3 Board Layout

This section provides the TPS6286x0EVM-109 board layout and illustrations.

3.1 Layout

Figure 3-1 through Figure 3-5 show the component placement and PCB layout of the TPS62861xEVM.

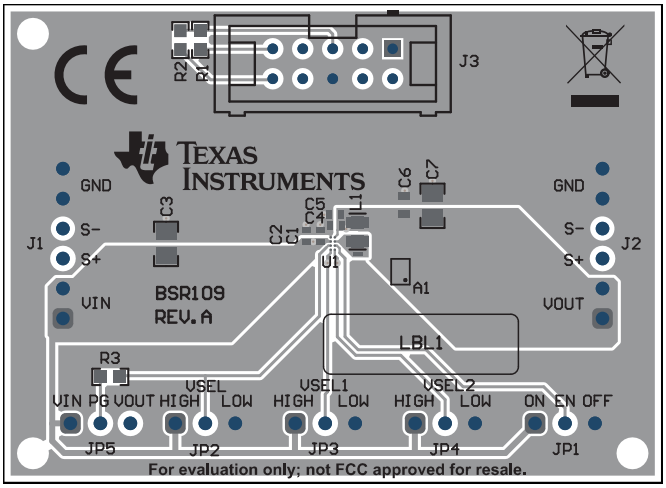

Figure 3-1. TPS6286x0EVM PCB - Assembly Layer

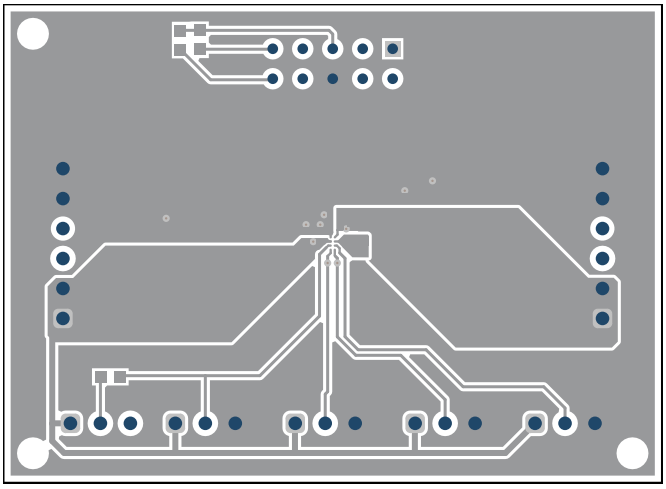

Figure 3-2. TPS6286x0EVM PCB - Top Layer

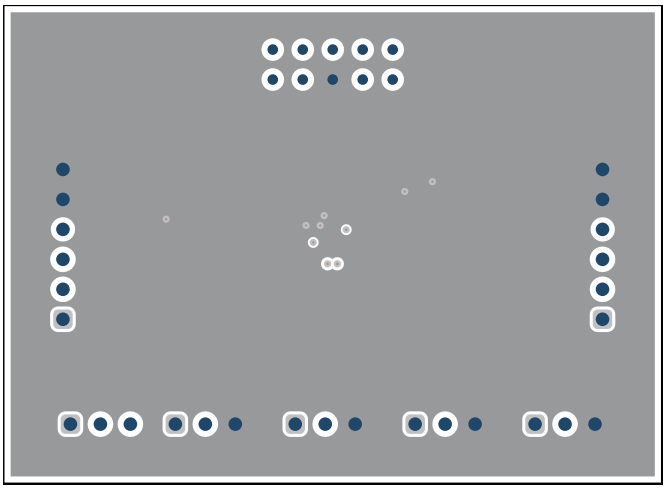

Figure 3-3. TPS6286x0EVM PCB - Signal Layer 1 (Top View)

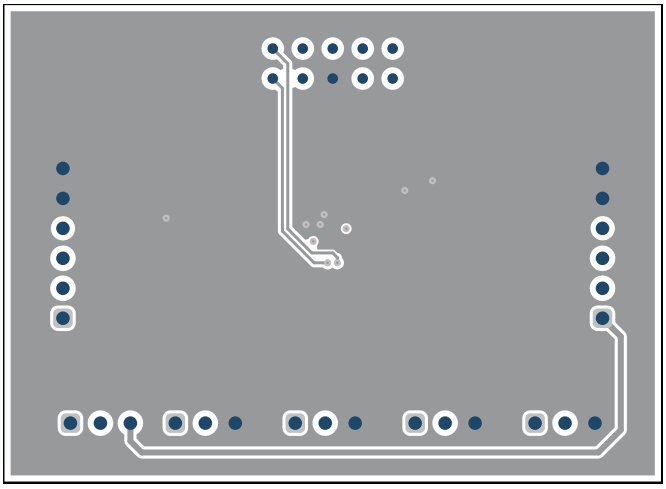

Figure 3-4. TPS6286x0EVM PCB - Signal Layer 2 (Top View)

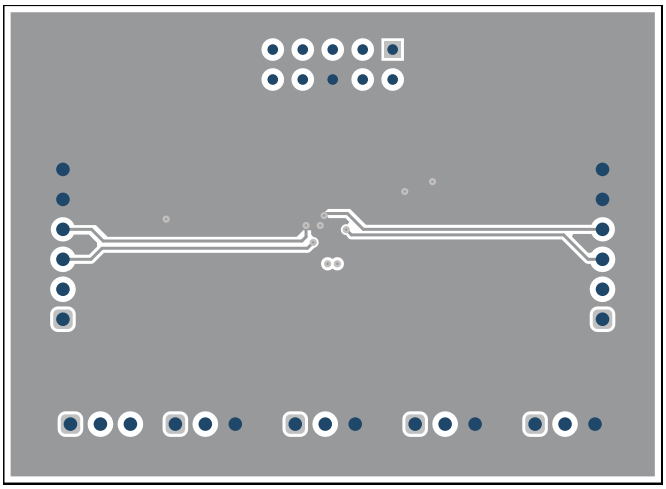

Figure 3-5. TPS6286x0EVM PCB - Bottom Layer (Top View)

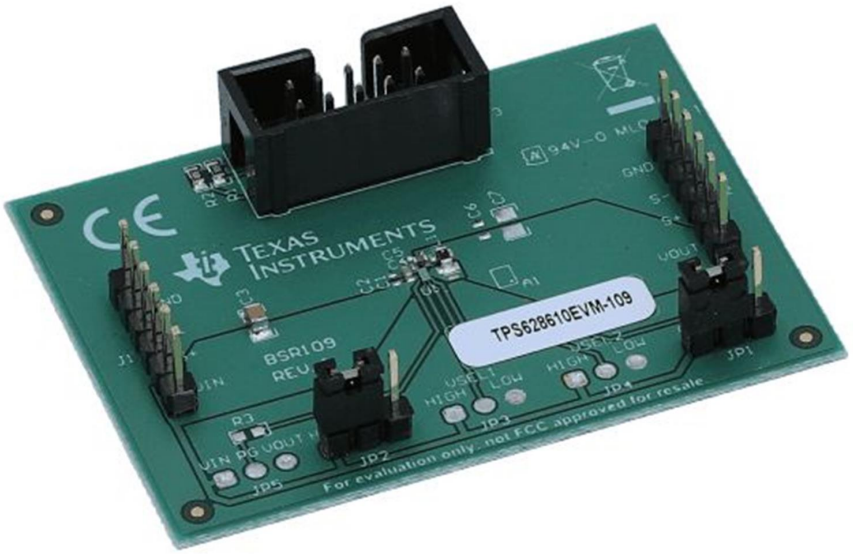

Figure 3-6. TPS628610EVM Angled View

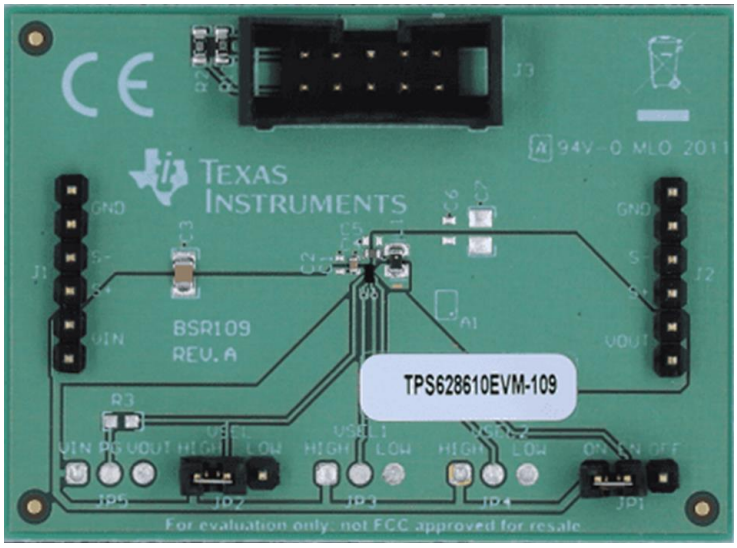

Figure 3-7. TPS628610EVM Overhead View

4 Schematic and Bill of Materials

This section provides the TPS62861xEVM schematic and bill of materials.

4.1 Schematic

Figure 4-1 illustrates the EVM schematic.

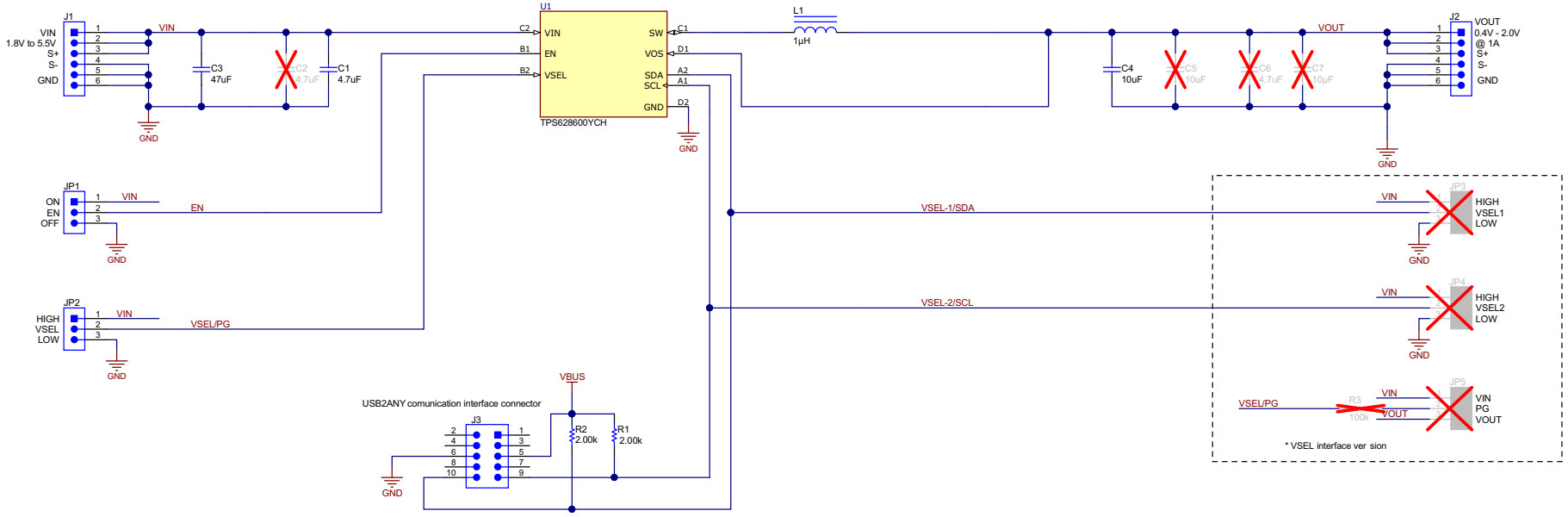

Figure 4-1. TPS628600EVM Schematic

Figure 4-2 illustrates the EVM schematic.

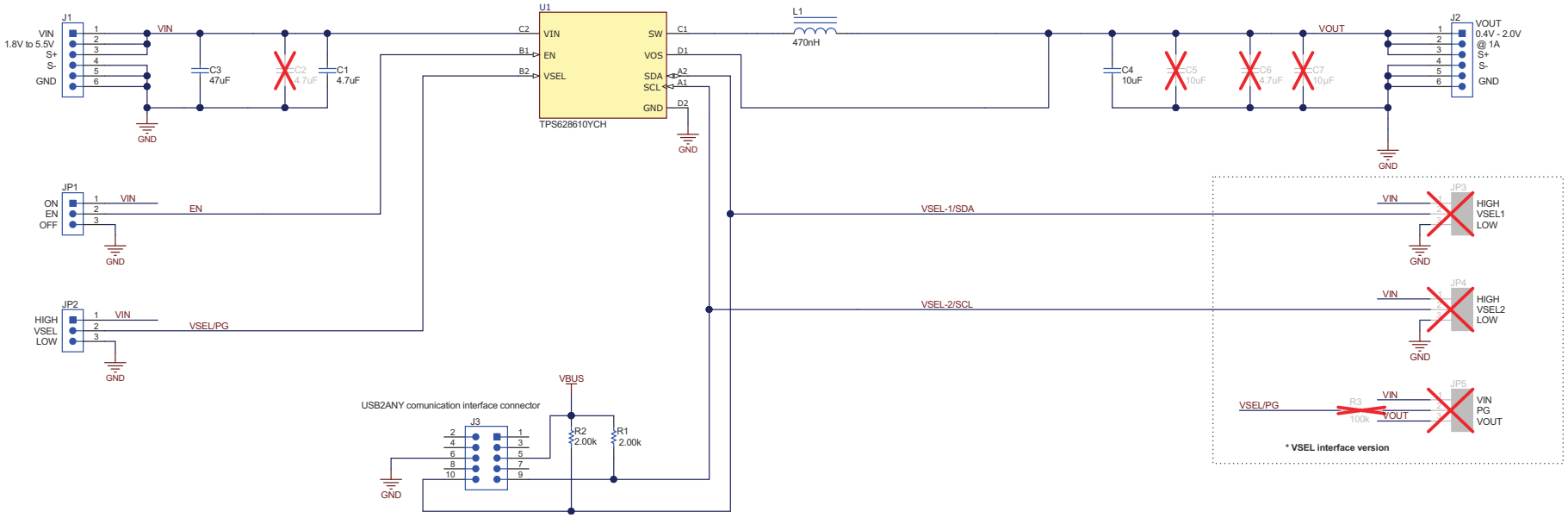

Figure 4-2. TPS628610EVM Schematic

4.2 Bill of Materials

Table 4-1 lists the EVM bill of materials.

Table 4-1. TPS628600EVM-109 BOM

Designator	Quantity	Value	Description	Package Reference	PartNumber	Manufacturer
C1	1	4.7uF	CAP, CERM, 4.7 uF, 6.3 V, +/- 20%, X5R, 0402	0402	GRM155R60J475ME47D	MuRata
C3	1	47uF	CAP, CERM, 47 uF, 6.3 V, +/- 20%, X5R, 0805	0805	GRM21BR60J476ME15L	MuRata
C4	1	10uF	CAP, CERM, 10 uF, 6.3 V, +/- 20%, X5R, 0402	0402	GRM155R60J106ME15D	MuRata
L1	1	1uH	Inductor, Shielded, Metal Composite, 1 µH, 2.7 A, 0.057 ohm, SMD	1.6x2mm	DFE201610E-1R0M=P2	MuRata
R1, R2	2	2.00k	RES, 2.00 k, 1%, 0.1 W, 0603	0603	RC0603FR-072KL	Yageo
U1	1		1.8-V to 5.5-V Input, 0.6-A Synchronous Step-Down Converter with I2C/VSEL Interface	DSBGA8	TPS628600YCH	Texas Instruments

Table 4-2 lists the EVM bill of materials.

Table 4-2. TPS628610EVM-109 BOM

Designator	Quantity	Value	Description	Package Reference	PartNumber	Manufacturer
C1	1	4.7uF	CAP, CERM, 4.7 uF, 6.3 V, +/- 20%, X5R, 0402	0402	GRM155R60J475ME47D	MuRata
C3	1	47uF	CAP, CERM, 47 uF, 6.3 V, +/- 20%, X5R, 0805	0805	GRM21BR60J476ME15L	MuRata
C4	1	10uF	CAP, CERM, 10 uF, 6.3 V, +/- 20%, X5R, 0402	0402	GRM155R60J106ME15D	MuRata
L1	1	470nH	Inductor, Shielded, Metal Composite, 470 nH, 2.6 A, 0.054 ohm, SMD	0603	DFE18SANR47MG0L	MuRata
R1, R2	2	2.00k	RES, 2.00 k, 1%, 0.1 W, 0603	0603	RC0603FR-072KL	Yageo
U1	1		1.8-V to 5.5-V Input, 1-A Synchronous Step-Down Converter with I2C/VSEL Interface in 0.7- mm x 1.4-mm WCSP Package	DSBGA8	TPS628610YCH	Texas Instruments

5 Software User Interface

5.1 Software Setup

A graphical user interface (GUI) is available from the TPS62861 tools and software page, which allows simple and convenient programming of the device through the TI USB2ANY (http://www.ti.com/tool/USB2ANY) interface board. Alternatively, you can use any I^2C-standardized programming tool or I^2C host to configure the device. Mind the I^2C pins specification, such as timing parameters and proper pullup resistors, specified in the *TPS62860, TPS62861 1.8-V to 5.5-V Input, 1-A Synchronous Step-Down Converter Data Sheet*.

5.2 Interface Hardware Setup

Connect the USB2ANY adapter to the PC using the supplied USB cable. Attach the EVM connector, J3 to the USB2ANY adapter using the supplied 10-pin ribbon cable. The ribbon cable connector is keyed to prevent incorrect installation..

Figure 5-1 shows a quick adapter connection overview.

USB Interface Adaptor Quick Connection Diagram

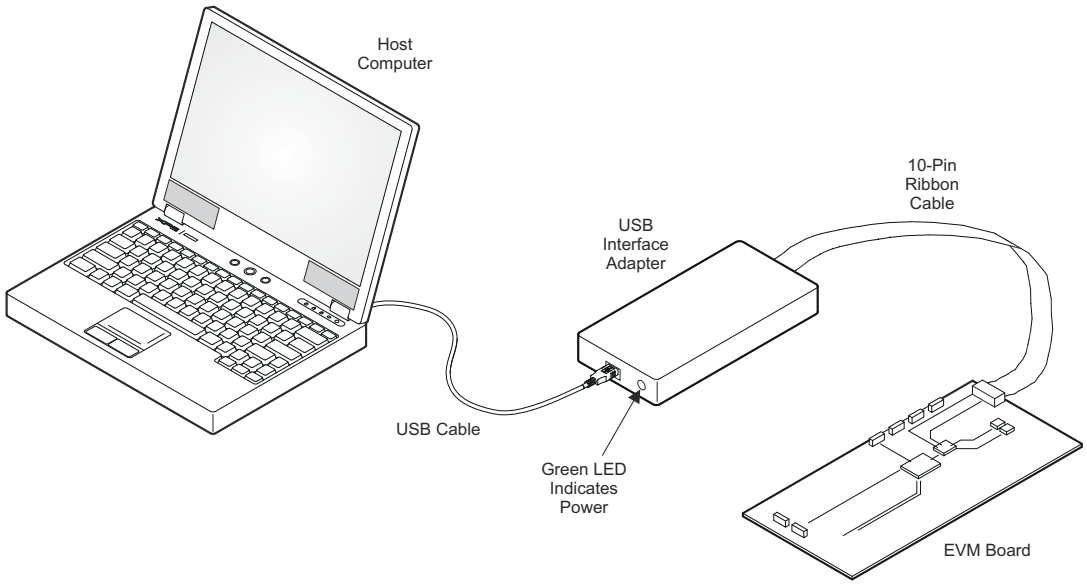

Figure 5-1. Quick Connection Overview

5.3 User Interface Operation

Upon start-up, the GUI automatically connects to the EVM. If not, then click on the "Connect" button in the lower-left corner of the GUI window. Ensure the I2C Slave Address is correct. The following sections give a short overview of the three main GUI screens.

5.3.1 Home Screen

The Home screen provides a short overview of the TPS6286x0 devices. To start evaluating the device, click the **Start** button. Click the **I2C Slave Address** button to change the address, and the default I2C address is 0x40. All the links related to the device are all indicated on the bottom portion of the window.

Figure 5-2. GUI Home Screen

5.3.2 Settings Screen

The Settings screen provides control over the VOUT and CONTROL Registers. The Status Register is available in this window as well. Real-time updates are possible if the Auto Read function is set to *As fast as possible* in the Register Map page.

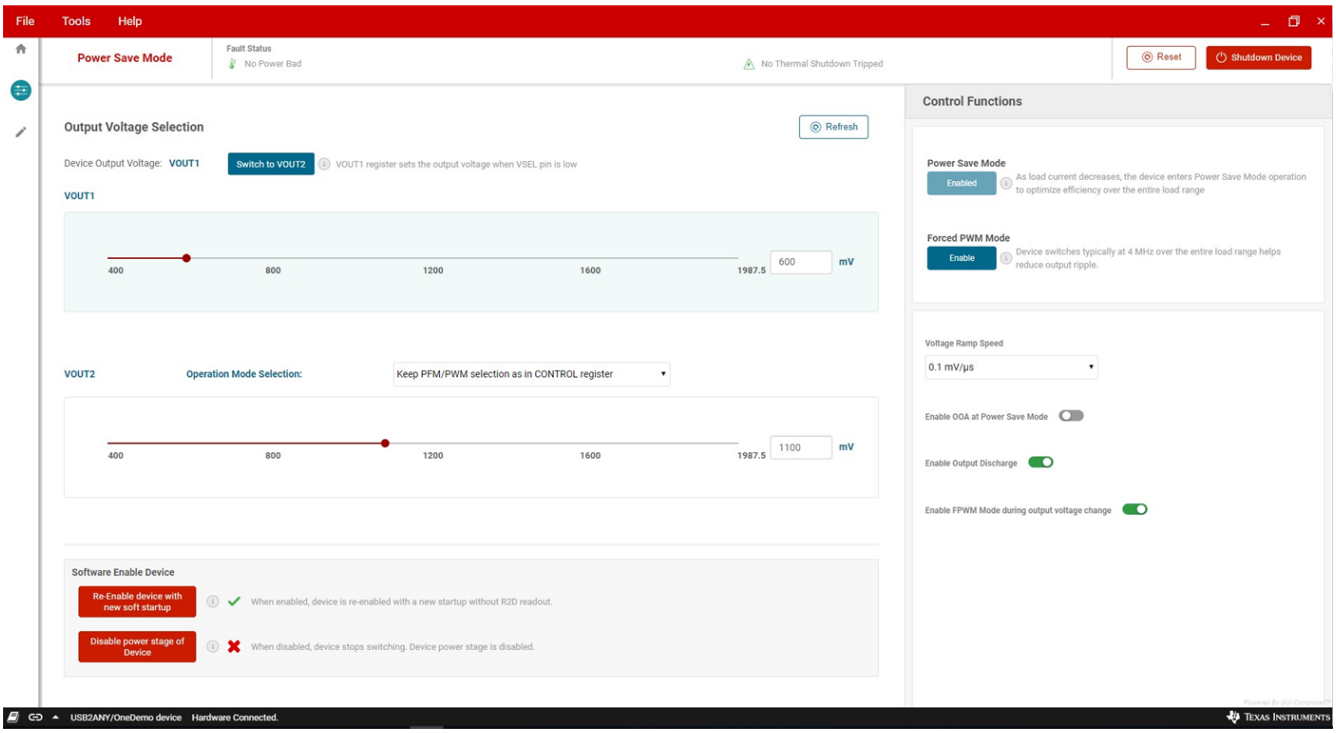

Figure 5-3. GUI Settings Screen

5.3.3 Register Map Screen

The Register Map screen shows bit values of all parameters. In this section, single registers can be read or written to the device (if applicable). Refer to the register map in the *TPS62860, TPS62861 1.8-V to 5.5-V Input, 1-A Synchronous Step-Down Converter Data Sheet* for a detailed description of the TPS6286x0 registers.

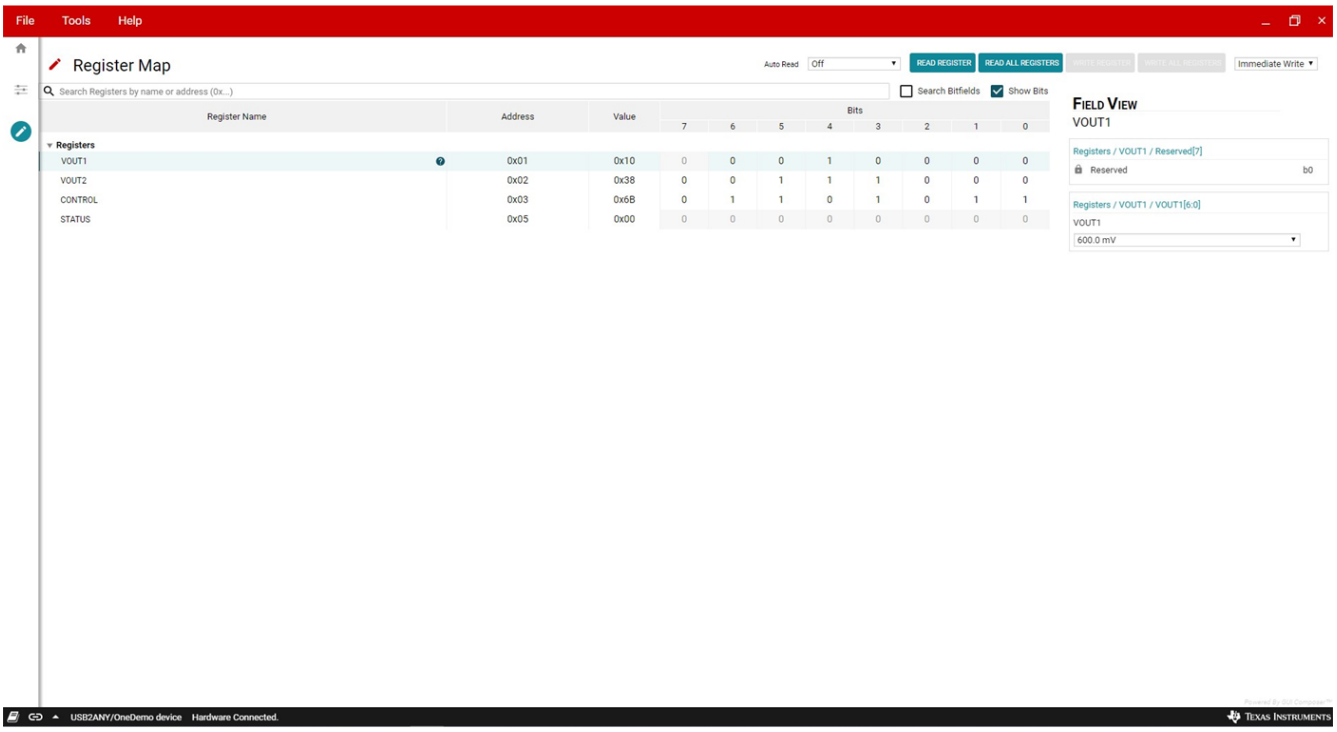

Figure 5-4. GUI Register Map Screen

Revision History

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

Changes from Revision A (June 2020) to Revision B (September 2020)	Page
• Changed title from *TPS62861xEVM-109 Evaluation Module* to *TPS62861x0EVM-109 Evaluation Module*	2
• Changed entire bill of materials	9

Changes from Revision * (April 2020) to Revision A (May 2020)	Page
• Removed pre-production note	2
• Edited Section 1	2
• Added "and EN pin voltage divider" to Section 1.3	2
• Changed entire schematic	7
• Changed entire bill of materials	9

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   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.

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   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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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

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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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