User's Guide
SLVU955B–December 2013–Revised April 2018

TPS61280-585 Evaluation Module

This User's Guide describes the characteristics, operation, and use of the TPS61280 evaluation module (EVM). This EVM enables test and evaluation of the Texas Instruments' TPS61280 device, a 2.3-MHz (typ.), up to 4.8-V input, step-up dc-dc converter with integrated Pass-Through Mode. This User's Guide includes EVM specifications, user software description, the schematic diagram, bill of materials, and board layout. After the release of the A-version device in the summer of 2014, the EVM is assembled with the TPS61280A (supports PWM mode during startup which is not available for TPS61280). In 2018, the EVM is assembled with D-version IC TPS61280D.

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Trademarks

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1 Introduction

The TPS61280 device provides a power-supply solution for products powered by either a three-cell alkaline, NiCd or NiMH battery, or a single-cell Li-Ion or Li-polymer battery. The wide input voltage range is ideal for portable power applications such as mobile phones or computer peripherals. In addition, the TPS61280 can also maintain its output biased at the input voltage level. In this mode, the synchronous rectifier is current-limited, and allows external loads (for example, an audio amplifier) to be powered with a restricted supply. In this mode, quiescent current is reduced to 18 μA. Input current in shutdown mode is less than 5 μA in order to maximize battery life.

1.1 Requirements

The TPS61280EVM is designed to operate over the full input voltage range and produces a fixed output voltage.

In order to operate this EVM, only a dc power supply able to deliver between 2.3 V and 4.8 V is required.

1.2 Applications

- Single-Cell Ni-Rich, Si-Anode, Li-Ion, LiFePO4 smart-phones or tablet PCs
- 2.5G, 3G, and 4G mini-module data cards
- Current-limited applications featuring high peak power loads

1.3 Features

- 95% Efficiency at 2.3-MHz operation
- V_{IN} range from 2.3 V to 4.8 V
- 2-μA quiescent current in low IQ pass-through mode
- Integrated pass-through mode (35 mΩ)
- Programmable valley inductor current limit and output voltage via I²C interface
- True pass-through mode during shutdown
- Thermal shutdown and overload protection
- Total solution size < 20 mm², sub 1-mm Profil

2 TPS61280EVM Schematic

Figure 1 illustrates the TPS61280EVM schematic.

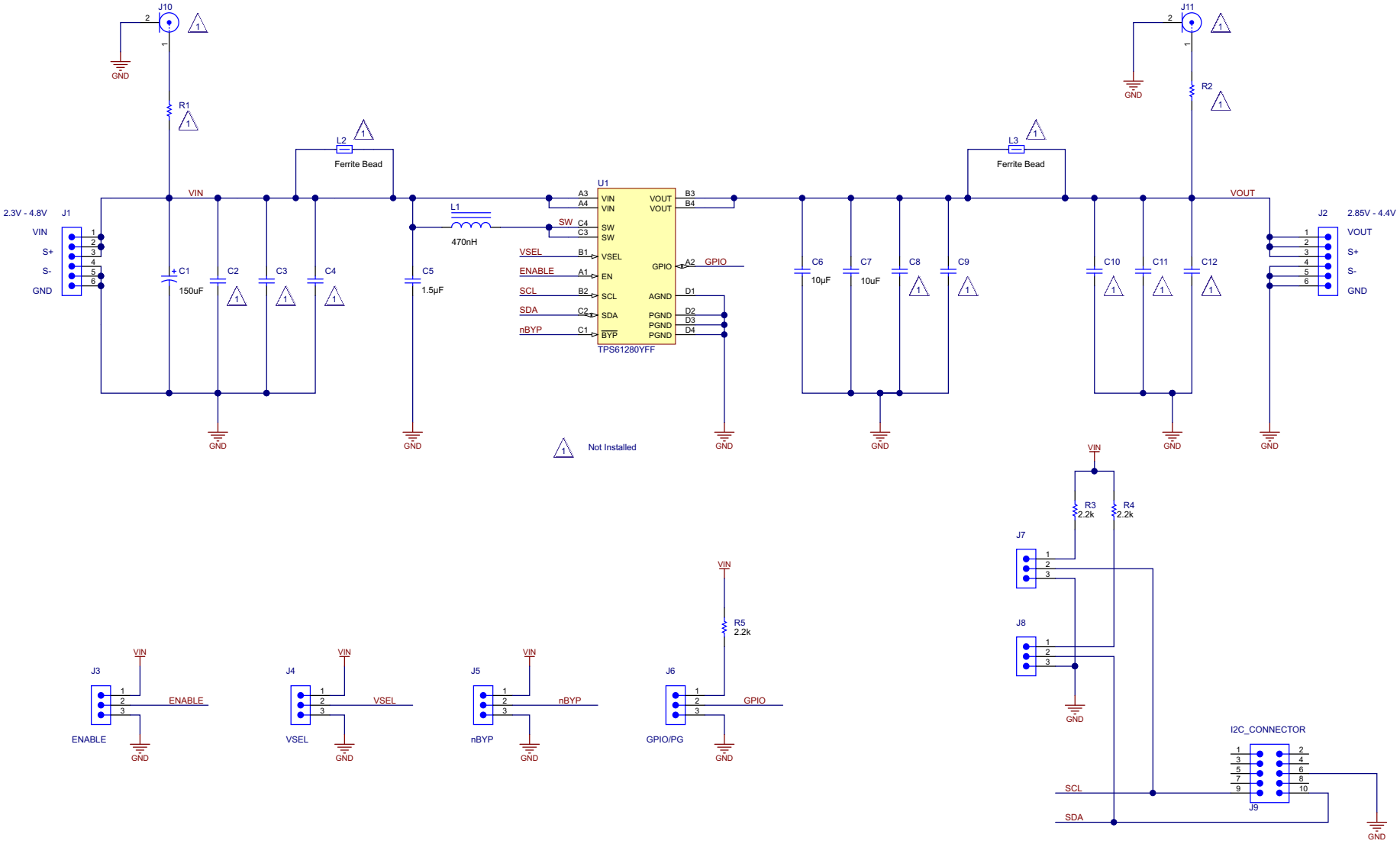

Figure 1. TPS61280EVM-585 Schematic

3 Connector and Test Point Descriptions

3.1 J1 Input Connectors

3.1.1 Pin 1 and 2: VIN

This header is the positive connection to the input power supply. The power supply must be connected between these pins and pins 5 and 6 (GND). Twist the leads to the input supply and keep them as short as possible. The input voltage must be between 2.3 V and 4.8 V.

3.1.2 Pin 3: Input Sense VIN

This header is intended to measure the input voltage directly on the input capacitor close to the device. Therefore, a four-wire power and sense supply can be connected. Twist the leads to the sensing connector.

3.1.3 Pin 4: Input Sense GND

This header is intended to measure the GND close to the input of the device. Therefore, a four-wire power and sense supply can be connected. Twist the leads to the sensing connector.

3.1.4 Pin 5 and 6: GND

This header is the return connection to the input power supply. Connect the power supply between these pins and pins 1 and 2 (VIN). Twist the leads to the input supply and keep them as short as possible. The input voltage must be between 2.3 V and 4.8 V.

3.2 J2 Output Connector

3.2.1 Pin 1 and 2: VOUT

This header is the positive connection of the output voltage. Connect the load between these pins and pins 5 and 6 (GND).

3.2.2 Pin 3: Output Sense VOUT

This header is intended to measure the output voltage directly on the output capacitors.

3.2.3 Pin 4: Output Sense GND

This header is intended to measure the GND close to the output of the device.

3.2.4 Pin 5 and 6: GND

This is the return connection of the output voltage. Connect the load between these pins and Pin 1 and 2 (VOUT).

3.3 Other Connectors

3.3.1 J9: I²C Connector

This 10-pin header connects the USB-to-GPIO adaptor to the TPS61280EVM-585.

3.3.2 J10: SMA Input Connector

This SMA connector is connected to the input voltage of the converter. It can be used to easily analyze the noise spectrum of the input voltage with a spectrum analyzer. By default, J10 is not assembled on the EVM.

3.3.3 J11: SMA Output Connector

This SMA connector is connected to the output voltage of the converter. It can be used to easily analyze the noise spectrum of the output voltage with a spectrum analyzer. By default, J11 is not assembled on the EVM.

3.4 Jumpers

3.4.1 J3: Enable Jumper

Placing a jumper across pins EN and ON ties the EN pin to VIN, and enables the device. Placing a jumper across pins EN and OFF ties the EN pin to GND, which disables the device.

3.4.2 J4: VSEL, Output Voltage Selection

Placing a jumper across pins HIGH and VSEL ties the VSEL pin to VIN, and selects the default output roof voltage. Placing a jumper across pins LOW and VSEL ties the VSEL pin to GND, and selects the default output floor voltage.

Table 1. TPS61280 VSEL Settings

Value	Description	Default Output Voltage
HIGH	Selects the Output Roof Voltage as stored in register 0x03	3.15 V
LOW	Selects the Output Floor Voltage as stored in register 0x02	3.35 V

3.4.3 J5: nBYP, Forced Bypass Selection

Placing a jumper across pins nBYP and ON ties the nBYP pin to GND and enables the pass-through mode. Placing a jumper across pins nBYP and OFF ties the nBYP pin to VIN and enables auto DC/DC boost mode.

Table 2. TPS61280 Mode of Operations

EN Input	nBYP Input	Device Status
LOW	LOW	The device is shut down in pass-through mode featuring a shutdown current down to ca. 2 μA typ. The load current capability is limited (up to ca. 250 mA).
LOW	HIGH	The device is shut down and the output voltage is reduced to a minimum value (VIN – VOUT ≤ 3.6 V). The device shutdown current is approximately 8.5 μA typ.
HIGH	LOW	The device is active in forced pass-through mode. The device supply current is approximately 15 μA typ. from the battery. The device is short-circuit protected by a current limit of ca. 7300 mA.
HIGH	HIGH	The device is active in auto mode (dc/dc boost, pass-through). The device supply current is approximately 50 μA typ. from the battery.

3.4.4 J6: GPIO/PG, General Purpose In/Out and Power Good

This pin can either be configured as a input (mode selection) or as dual role input/open-drain output (nRST/nFAULT) pin. Per default, the pin is configured as nRST/nFAULT input/output.

Pin GPIO/PG is connected to HIGH per default. This pin is tied to VIN via pull-Up resistor R5.

3.4.5 J7: SCL Pull-Up Resistor

This header enables the possibility to apply the onboard pull-Up resistor R3 as well as to track the I²C Clock signal on pin 2.

Placing a jumper across pins 1 and 2 ties SCL via resistor R3 to VIN. Per default, the USB-to-GPIO Interface Adapter has a Pull-Up resistor applied. Therefore this Jumper is not fitted.

3.4.6 J8: SDA Pull-Up Resistor

This header enables the possibility to apply the onboard pull-Up resistor R4 as well as to track the I²C Data signal on pin 2.

Placing a jumper across pins 1 and 2 ties SDA via resistor R4 to VIN. Per default, the USB-to-GPIO Interface Adapter has a Pull-Up resistor applied. Therefore, this jumper is not fitted.

4 TPS61280EVM Assembly Drawings and Layout

Figure 2 through Figure 6 show the design of the TPS61280EVM-585 PCBs. The EVM has been designed using a four-layer, 1-ounce copper-clad PCB with all components in an active area on the top side of the board. Moving components to both sides of the PCB can offer additional size reduction for space-constrained systems.

All layers are viewed from top side.

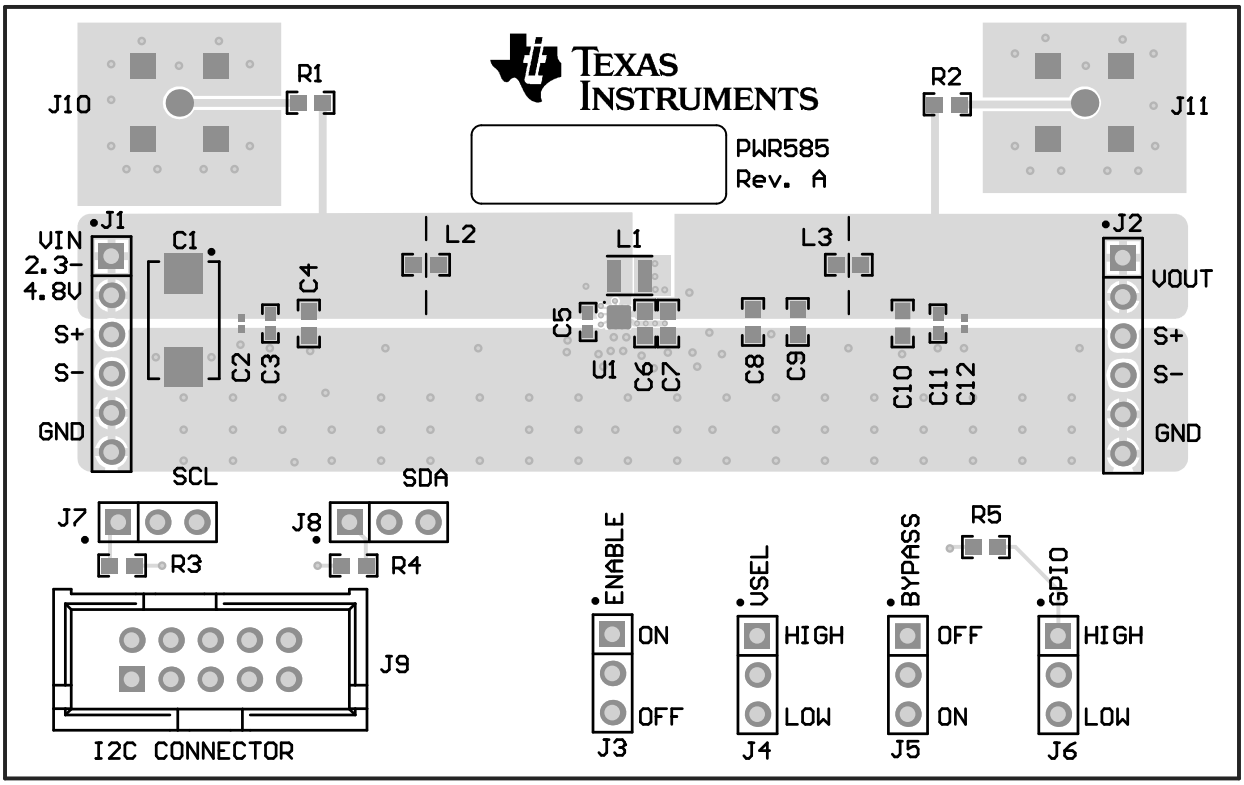

Figure 2. TPS61280EVM-585 Component Placement

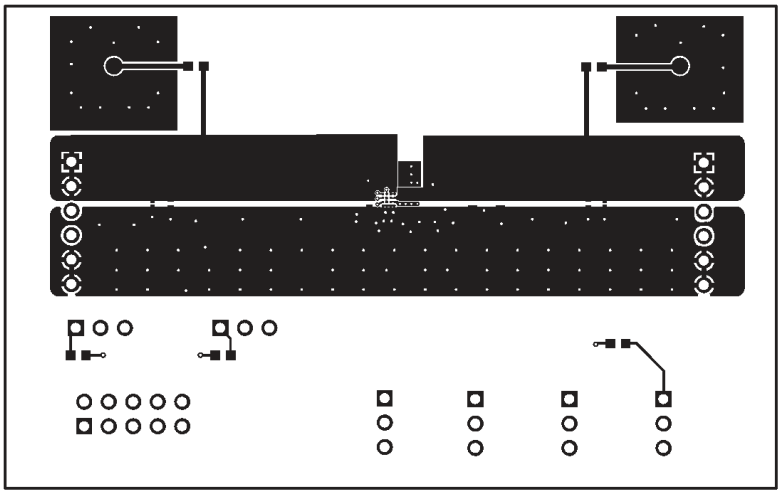

Figure 3. TPS61280EVM-585 Top Copper

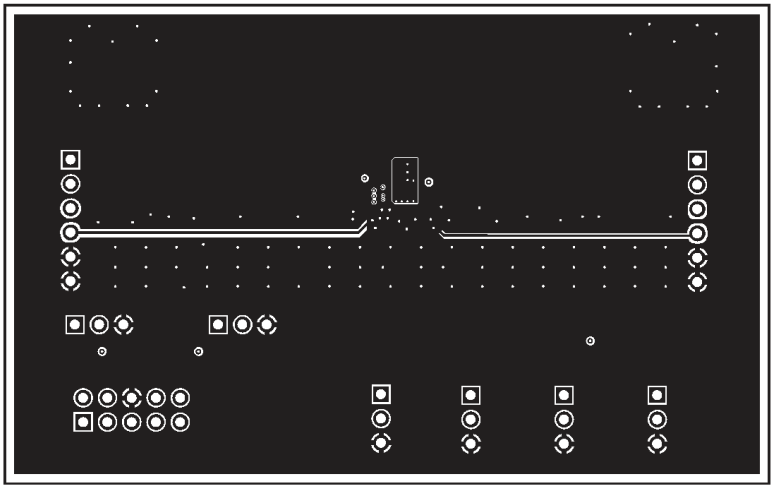

Figure 4. TPS61280EVM-585 Inner Layer 1

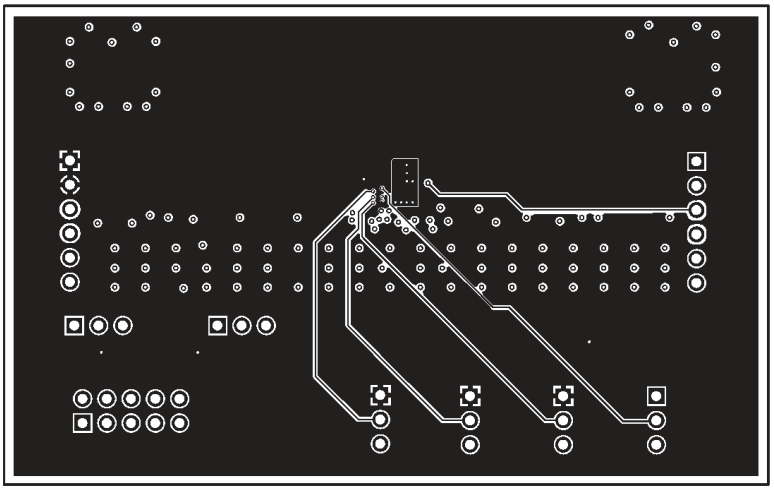

Figure 5. TPS61280EVM-585 Inner Layer 2

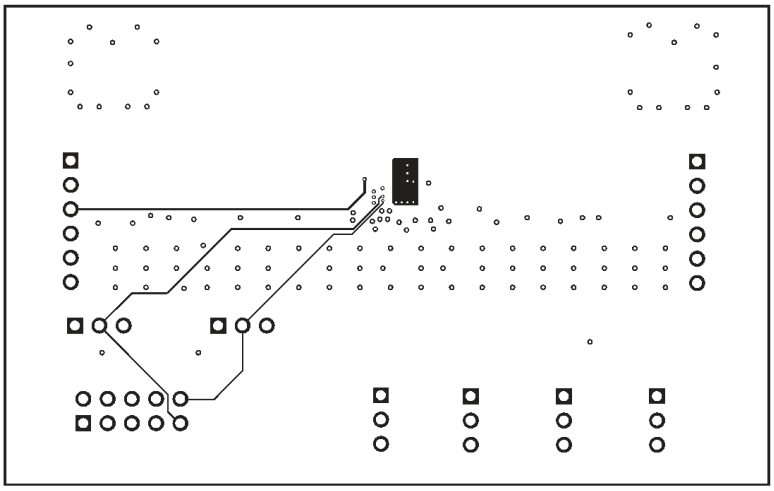

Figure 6. TPS61280EVM-585 Bottom Copper

5 List of Materials

Table 3 lists the EVM components as configured according to the schematic shown in Figure 1.

Table 3. TPS61280 Bill of Materials

Count	RefDes	Value	Description	Size	Part Number	MFR
TPS61280 Solution Required Components						
1	C5	1.5µF	Capacitor, Ceramic, 6.3V +/- 20%, X5R	0402	GRM155R60J155ME80D	MuRata
2	C6, C7	10µF	Capacitor, Ceramic, 6.3V, +/- 20%, X5R	0603	GRM188R60J106ME84D	MuRata
1	L1	470nH	Inductor, Ferrite, 3.7A, 29mΩ	2512	1239AS-H-R47M	Toko
1	U1	TPS61280D	IC, Step-Up DC/DC Converter with Pass-Through Mode	4x4 WCSP	TPS61280DYFF	Texas Instruments
TPS61280EVM-585 Evaluation Components						
1	C1	150µF	Capacitor, Tantalum, 6.3V +/-10%, 70mΩ	7343-20	T495V157K006ATE070	Kemet
3	R3, R4, R5	2.2kΩ	Resistor, +/-5%, 100mW	0603	RC0603JR-072K2L	Yageo America
2	J1, J2		Header, 6x1, 100mil spacing		TSW-106-07-G-S	Samtec
6	J3, J4, J5, J6, J7, J8		Header, 2x1, 100mil spacing		TSW-102-07-G-S	Samtec
1	J9		Connector, 5x2, Shrouded, 100mil spacing		5103308-1	TE Connectivity

6 Software User Interface

6.1 Software Setup

The software is available at the TI.com website (SLVC543).

Download and unzip the file. Run setup.msi and follow the instructions appearing during the installation. After the installation is completed, run the software by going to:

START -> All Programs -> Texas Instruments -> TPS61280 EVM -> TPS61280 EVM

6.2 Interface Hardware Setup

Connect the USB-to-GPIO adapter to your PC using the supplied USB cable. Connect the TPS61280EVM connector J9 to the USB-to-GPIO adapter using the supplied 10-pin ribbon cable. The connectors on the ribbon cable are keyed to prevent incorrect installation.

Figure 7 shows a quick adapter connection overview.

USB Interface Adaptor Quick Connection Diagram

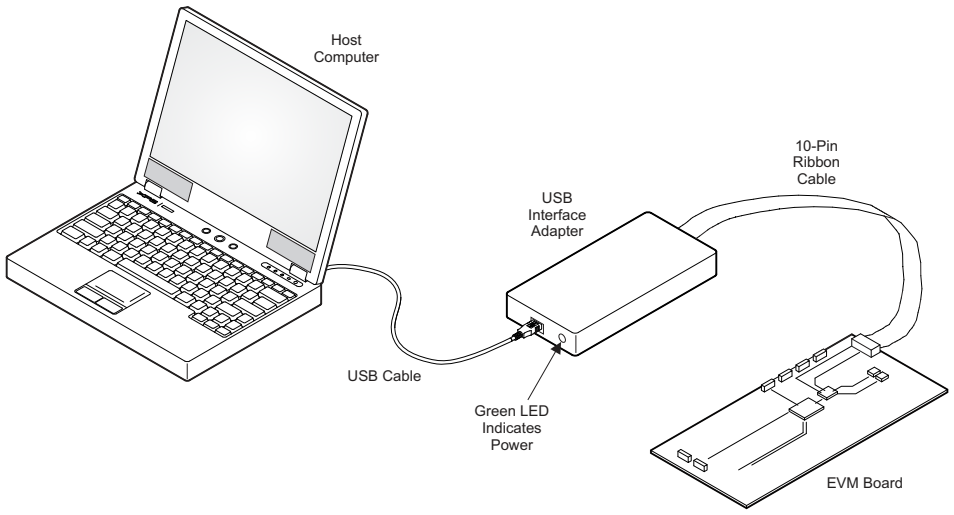

Figure 7. Quick Connection Overview

6.3 User Interface Operation

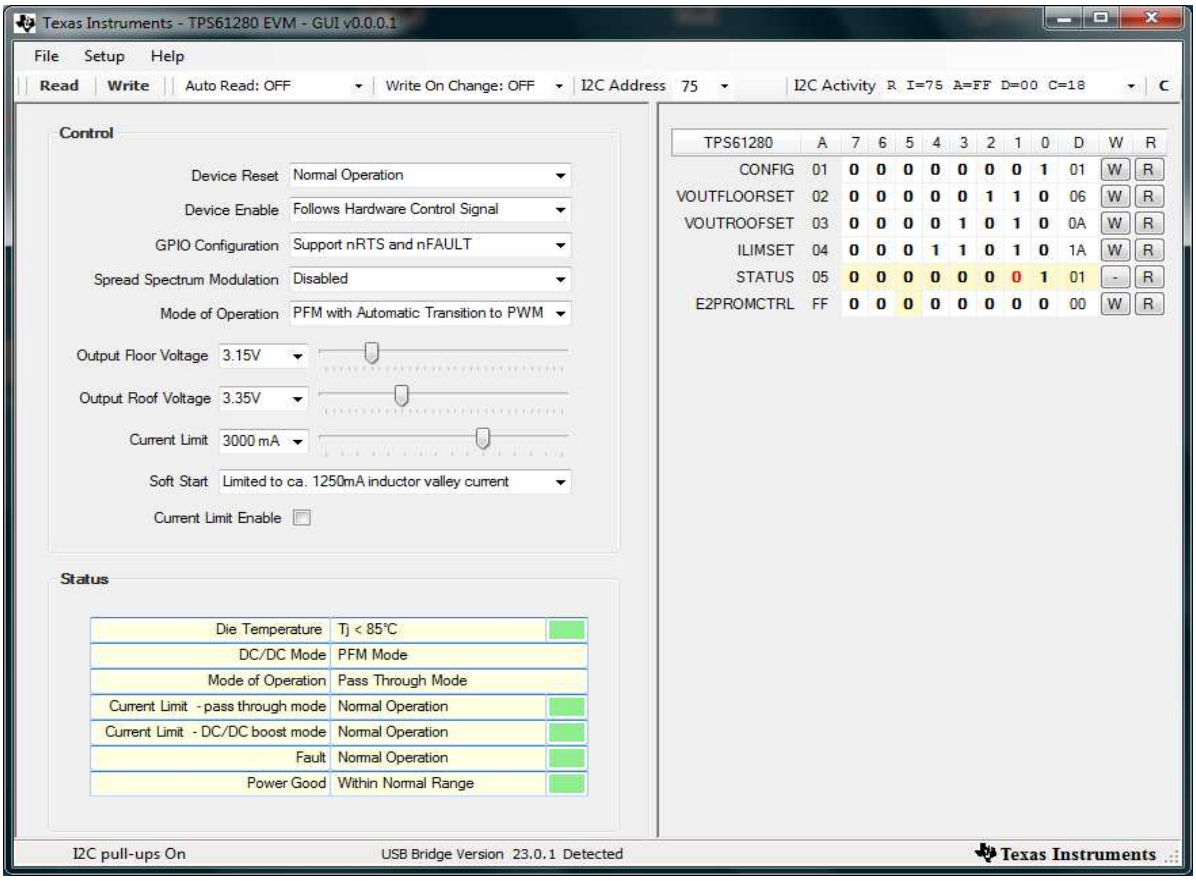

Figure 8. User Interface of TPS61280EVM-585

6.3.1 Control Section

This section in the left, upper region reflects the User Control Registers. Here all adjustments can be done on the user level.

6.3.2 Status Section

This section located in the left, lower region reflects the Status Register of the device.

6.3.3 Register View

The right part of the Interface shows a register-wise view of all parameters. This section reflects the settings displayed in the left part as described in Section 6.3.2.

Here single registers can be read, or written to the device (if applicable).

6.3.4 Hardware Pull-Up Resistor Selection

Clicking on the SETUP Button in the top, a Pull-Up Resistor selection appears. Here the internal resistors of the USB-to-GPIO interface can be switched ON/OFF. The status is displayed in the status bar.

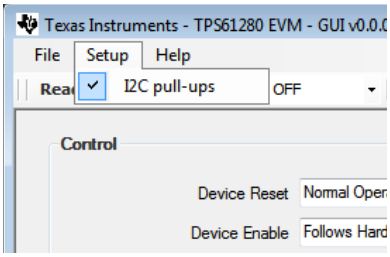

Figure 9. I²C Pull-Up Resistor Setting

Revision History

Changes from A Revision (June 2014) to B Revision	Page
• Added support for the TPS61280D device.	1
• Changed TPS61280A to TPS61280D in the bill of materials.	9

Revision History

Changes from Original (December 2013) to A Revision	Page
• Added support for the TPS61280A device.	1
• Changed TPS61280 to TPS61280A in the bill of materials.	9

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      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.

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      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

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http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

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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3.4.1 *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.

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