



## ABSTRACT

This user's guide describes the characteristics, operation, and use of TI's evaluation module (EVM) for the TPS62810-Q1, TPS62811-Q1, TPS62812-Q1, and TPS62813-Q1 devices. The TPS62810EVM-015 is designed to help the user easily evaluate and test the operation and functionality of the TPS6281x buck converters. The EVM converts a 2.7-V to 6.0-V input voltage to a regulated 1.8-V output voltage that delivers up to 4 A. This user's guide includes setup instructions for the hardware, a printed-circuit board (PCB) layout, a schematic diagram and a bill of materials (BOM).

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## Trademarks

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## 1 Introduction

The TPS6281x device is a high-frequency, synchronous, step-down converter optimized for a small solution size and high efficiency. The devices focus on high-efficiency, step-down conversion over a wide output current range. At medium to heavy loads, the converter operates in PWM mode and automatically enters *Power Save Mode* operation at light load to maintain high efficiency over the entire load-current range. The internal compensation circuit allows a compact solution and small external components. The device is available in a 3.0-mm × 2.0-mm, 9-pin VQFN package.

### 1.1 Performance Specification

Table 1-1 provides a summary of the TPS62810EVM-015 performance specifications.

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

Specification		Test Conditions	MIN	TYP	MAX	Unit
Input voltage			2.7		6.0	V
Output voltage setpoint				1.8		V
Output current	TPS62810EVM-015		0		4.0	A

### 1.2 Modifications

The printed-circuit board (PCB) for this EVM is designed to accommodate the different adjustable output voltage versions of this integrated circuit (IC). On the EVM, additional input and output capacitors can be added, the soft-start time can be changed and the switching frequency can be modified.

#### 1.2.1 Input and Output Capacitors

Footprints for an additional input capacitor (C22) as well as for additional output capacitors (C31, C32 and C33) are provided. These capacitors are not required for proper operation but can be used to reduce the input and output voltage ripple and to improve the load transient response. For proper operation the total output capacitance must remain within the recommended range described in the [TPS6281x-Q1 Low Input Voltage, Adjustable-Frequency Step-Down Converter data sheet](#).

#### 1.2.2 Adjustable-Output IC U1 Operation

U1 is configured for evaluation of the adjustable-output version. This unit is set to 1.8 V. Resistors R1 and R2 can be used to set the output voltage between 0.6 V and 5.5 V. For recommended values, see the [TPS6281x-Q1 Low Input Voltage, Adjustable-Frequency Step-Down Converter data sheet](#).

#### 1.2.3 Feedforward Capacitor

C5 is the feedforward capacitor. If the feedback divider (R1 and R2) has been modified it may be required to adjust the value of the feedforward capacitor as well. For recommended values, see the [TPS6281x-Q1 Low Input Voltage, Adjustable-Frequency Step-Down Converter data sheet](#).

#### 1.2.4 Soft-Start Time

C4 controls the soft-start time of the output voltage. It can be changed for a faster or slower ramp up of the output voltage. For recommended capacitor values, see the [TPS6281x-Q1 Low Input Voltage, Adjustable-Frequency Step-Down Converter data sheet](#).

#### 1.2.5 Tracking

A control voltage connected to J6 can be used to control the output voltage. For more details see the [TPS6281x-Q1 Low Input Voltage, Adjustable-Frequency Step-Down Converter data sheet](#).

#### 1.2.6 Switching Frequency and Control Loop Compensation

R4 controls the switching frequency of the converter. It is also used to select a predefined control loop compensation setting. For recommended values, see the [TPS6281x-Q1 Low Input Voltage, Adjustable-Frequency Step-Down Converter data sheet](#).

## 2 Setup

This section describes how to correctly use the TPS62810EVM-015.

### 2.1 Connector Descriptions

<b>J1, Pin 1 and 2 – VIN</b>	Positive input voltage connection from the input supply for the EVM
<b>J1, Pin 3 and 4 – S+/S–</b>	Input voltage sense connections, measure the input voltage at this point
<b>J1, Pin 5 and 6 – GND</b>	Input return connection from the input supply for the EVM
<b>J2, Pin 1 and 2 – VOUT</b>	Positive output voltage connection
<b>J2, Pin 3 and 4 – S+/S–</b>	Output voltage sense connections, measure the output voltage at this point
<b>J2, Pin 5 and 6 – GND</b>	Output return connection
<b>J3 – EN</b>	EN pin jumper. Place the supplied jumper across ON and EN to turn on the IC. Place the jumper across OFF and EN to turn off the IC.
<b>J4 – MODE/SYNC</b>	MODE/SYNC pin jumper. Place the supplied jumper across VIN and MODE/SYNC to force the device in fixed frequency PWM operation at all load currents. Place the jumper across MODE/SYNC and GND to enable power save mode. Connect a clock signal to MODE/SYNC referenced to GND to synchronize the switching frequency to the clock signal.
<b>J5 – PG</b>	The PG output appears on pin 1 of this header with a convenient ground on pin 2.
<b>J6 – SS/TR</b>	SS/TR input, a voltage connected on pin 1 of this header referenced to GND on pin 2 can be used to control the output voltage (tracking).

### 2.2 Hardware Setup

To operate the EVM, set jumpers J3 and J4 to the desired positions using the [Section 2.1](#). Connect the input supply to J1, between VIN and GND and connect the load to J2 between VOUT and GND.

## 3 TPS62810EVM-015 Test Results

The TPS62810EVM-015 was used to take the typical characteristics data in the TPS62810-Q1 data sheet. See [TPS6281x-Q1 Low Input Voltage, Adjustable-Frequency Step-Down Converter data sheet](#) for the performance of this EVM.

## 4 Board Layout

This section provides the TPS62810EVM-015 board layout. The Gerber files are available on the [TPS62810EVM-015](#) tool page

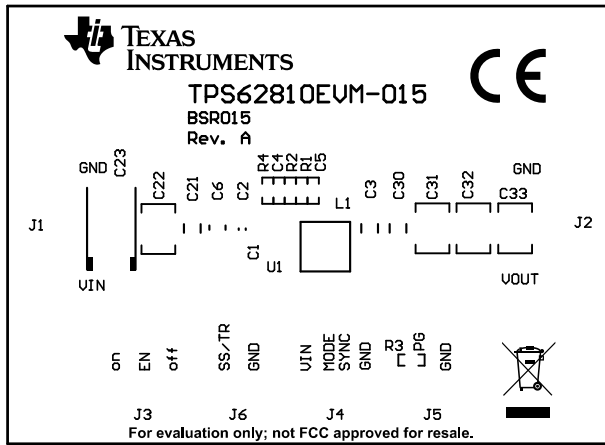


Figure 4-1. Top Silk

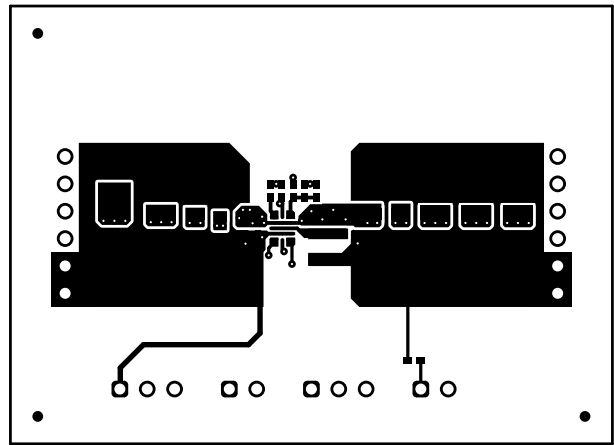


Figure 4-2. Top Layer

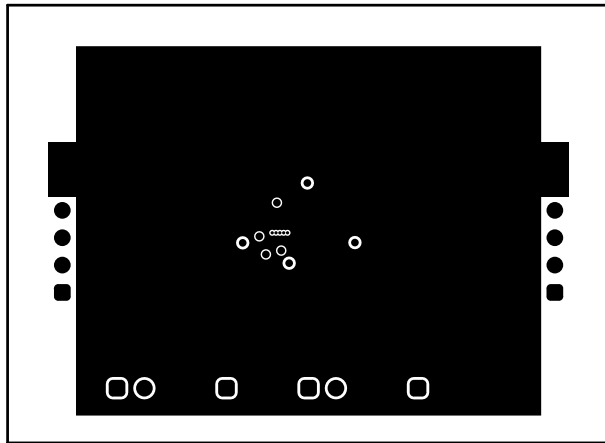


Figure 4-3. Layer 2

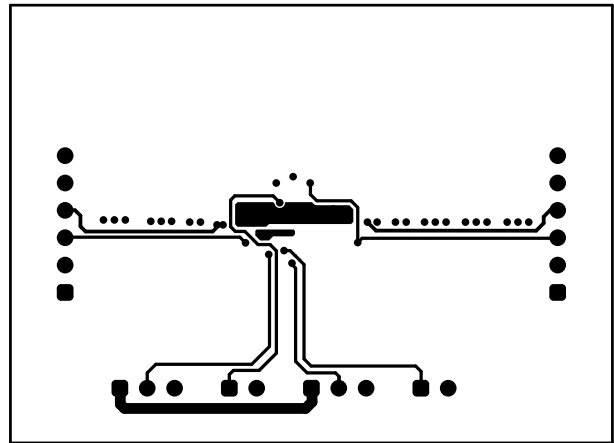


Figure 4-4. Layer 3

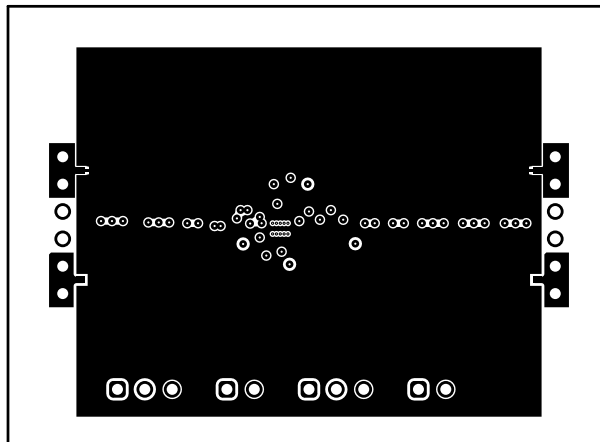


Figure 4-5. Bottom Layer

## 5 Schematic

Figure 5-1 shows the TPS62810EVM-015 EVM schematic.

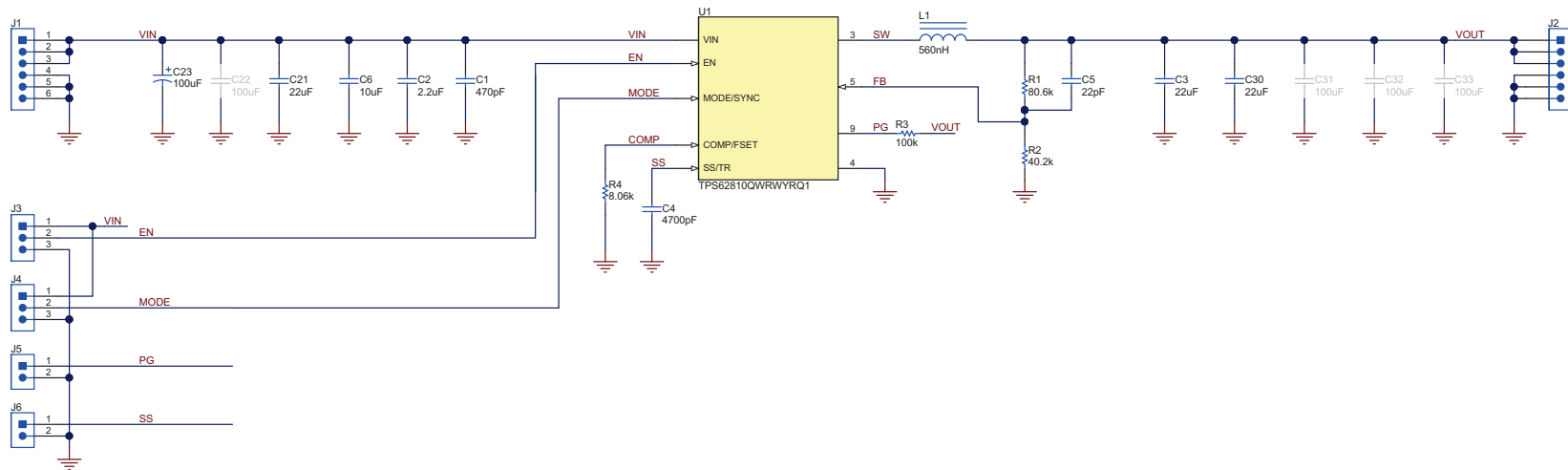


Figure 5-1. TPS62810EVM-015 Schematic

## 6 Bill of Materials

Table 6-1 lists the BOM for TPS62810EVM-015 EVM.

**Table 6-1. TPS62810EVM-015 BOM**

Qty	Ref Des	Value	Description	Size	Part Number	MFR
1	C1	470 pF	Ceramic Capacitor, 50V, X7R	0402		any
1	C2	2.2 $\mu$ F	Ceramic Capacitor, 10V, X7S	0603	CGA3E3X7S1A225K080AB	TDK
3	C3, C21, C30	22 $\mu$ F	Ceramic Capacitor, 10V, X7R	1206	GCM31CR71A226KE02	MuRata
1	C4	4700 pF	Ceramic Capacitor, 50V, X7R	0402		any
1	C5	22pF	Ceramic Capacitor, 50V, COG/NPO	0402		any
1	C6	10 $\mu$ F	Ceramic Capacitor, 10V, X7R	0805	GCM21BR71A106KE22	MuRata
1	C23	100 $\mu$ F	Polymer Capacitor, 20V	7.3x4.3mm	20TQC100MYF	Panasonic
1	L1	560 nH	Inductor	4.0 x 4.0 x 2.0 mm	XEL4020-561MEB	Coilcraft
1	R1	80.6 k $\Omega$	Resistor 1%, 0.1 W	0402		any
1	R2	40.2 k $\Omega$	Resistor 1%, 0.1 W	0402		any
1	R3	100 k $\Omega$	Resistor 1%, 0.1 W	0402		any
1	R4	8.06 k $\Omega$	Resistor 1%, 0.1 W	0402		any
1	U1		Low Input Voltage, Adjustable-Frequency Step-down Converter	VQFN-HR-9	TPS62810QWRWYRQ1	Texas Instruments

## 7 Revision History

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

Changes from Revision * (July 2018) to Revision A (March 2021)	Page
• Updated Schematic.....	5

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##### 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.

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*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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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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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.

- 
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