

TPSM82850x-Q1 Automotive Step-Down Converter Evaluation Module



Description

The TPSM82850x-Q1 devices are a family of pin-to-pin compatible, 1A and 2A automotive high-efficiency synchronous step-down DC/DC power modules with integrated inductors. The devices use a fixed-frequency peak current-mode control topology. These modules work in automotive applications requiring high power density and ease of use. Low-resistance switches allow up to 2A continuous output current at high ambient temperatures.

The switching frequency can be fixed at 2.25MHz through pin-strapping or selected from a range of 1.8MHz to 4MHz through a set resistor. The module can also be synchronized to an external clock in the range from 1.8MHz to 4MHz. In PFM and PWM mode, the TPSM82850x-Q1 automatically enters power save mode at light loads to maintain high efficiency across the whole load range.

Features

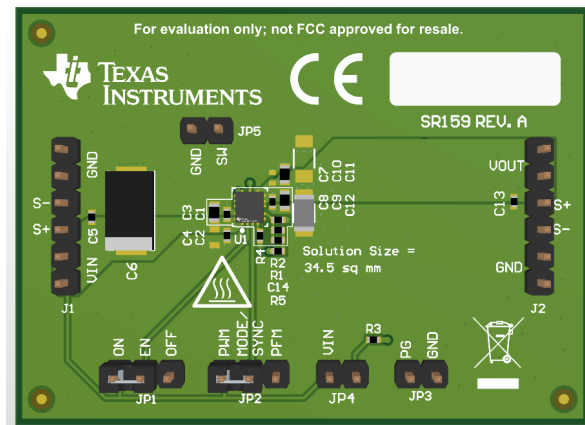
- Input voltage range: 2.7V to 6V
- Adjustable output voltage range: 0.6V to 5.5V
- 100% mode operation
- Quiescent current: 17 μ A typical
- Output voltage accuracy $\pm 1\%$ (PWM operation)
- Switching frequency: 1.8MHz to 4MHz
- Power save mode or PWM option available

Applications

- [Advanced driver assistance systems \(ADAS\) camera](#)
- [ADAS sensor fusion and surround view ECU](#)
- [Hybrid and reconfigurable instrument cluster](#)
- [Automotive head unit and telematics control unit](#)
- [External audio amplifier](#)

Get Started

1. Order the EVM on ti.com.
2. Download the [TPSM82851x 2.7-V to 6-V Input, 0.5-A/1-A/2-A Step-Down Power Module With Integrated Inductor](#) data sheet.
3. Use the data sheet to adjust the bill of materials (BOM) with the device for the desired output voltage.



TPSM828502QEVM-159 (Top View)

1 Evaluation Module Overview

1.1 Introduction

This EVM is designed to help the user easily evaluate and test the operation and functionality of the TPSM82850x-Q1 buck converter module with integrated inductor. The EVM converts a 2.7V to 6V input voltage to a regulated 1.8V output voltage that delivers up to 2A maximum. This user's guide describes the characteristics, operation, and use of TI's TPSM82850x-Q1 evaluation module (EVM). The document includes setup instructions for the following:

- Hardware
- A printed-circuit board (PCB) layout
- Schematic diagram
- Bill of materials (BOM)

1.2 Kit Contents

Table 1-1. TPSM828502QEVM-159 Kit Contents

Item	Description	Quantity
TPSM828502QEVM-159	PCB	1

1.3 Specification

Table 1-2. Performance Specification Summary

Specification	Test Conditions	MIN	TYP	MAX	Unit
Input voltage		2.7		6	V
Output voltage			1.8		V
Output current	TPSM828502QEVM-159	0		2	A

1.4 Device Information

The PCB for this EVM is designed to accommodate the adjustable voltage version of this IC. On the EVM, the desired output voltage can be set by adjusting the resistor divider branch with the feedback pin. Additional input and output capacitors can also be added.

2 Hardware

2.1 Setup

This section describes how to properly use the TPSM828502QEVM-159.

2.1.1 Connector Descriptions

J1, Pin 1 and 2 – VIN	Positive input voltage connection from the input supply for the EVM
J1, Pin 3 and 4 – S+/S–	Input voltage sense connections. Measure the input voltage at this point.
J1, Pin 5 and 6 – GND	Input return connection from the input supply for the EVM
J2, Pin 1 and 2 – VOUT	Positive output voltage connection
J2, Pin 3 and 4 – S+/S–	Output voltage sense connections. Measure the output voltage at this point.
J2, Pin 5 and 6 – GND	Output return connection
JP1 – EN	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.
JP2 – MODE/SYNC	MODE/SYNC pin jumper. Place the supplied jumper across PWM and MODE/SYNC to operate the device in forced PWM mode. Place the jumper across PFM and MODE/SYNC to operate the device in PFM/PWM mode
JP3 – PG/GND	The PG output appears on pin 1 of this header with a convenient ground on pin 2
JP4 – PG Pullup Voltage	PG pin pullup voltage jumper. Place the supplied jumper on JP4 to connect the PG pin pullup resistor to the input voltage. Alternatively, the jumper can be removed and a different voltage can be supplied on pin 1 to pull up the PG pin to a different level. This externally applied voltage must remain below $V_{in} + 0.3V$.
JP5 – SW Test point	This test point is the SW node test point. Use only if needed. Can be left floating.

2.1.2 Hardware Setup

To operate the EVM, set jumper JP1 to the desired positions per [Connector Descriptions](#). Connect the input supply to J1 and connect the load to J2.

2.2 Modifications

The printed-circuit board (PCB) for this EVM is designed to accommodate some modifications by users. Additional input and output capacitors or a feedforward capacitor according to the output voltage can be added. Also, the output voltage can be changed through a resistor divider. Use the provided resistor R5 to inject noise for loop stability measurements.

2.2.1 Input and Output Capacitors

C4 is provided for an additional input capacitor. This capacitor is not required for proper operation but can be used to reduce the input voltage ripple.

C7 and C11 are provided for additional output capacitors. These capacitors are not required for proper operation but can be used to reduce the output voltage ripple and to improve the load transient response. The output capacitance must remain within the recommended range in the device data sheet for proper operation.

2.2.2 Feedforward Capacitor

C14 is the feedforward capacitor. This EVM has a feedforward capacitor of 10pF. TI recommends a feedforward capacitor (CFF) in parallel with R1 to improve the transient response. Regardless of the FB resistor values, the CFF value must always be 10pF.

3.2 PCB Layouts

This section provides the board layout and illustrations of TPSM828502QEV-159. TPSM828502QEV-159 is a four-layer PCB.

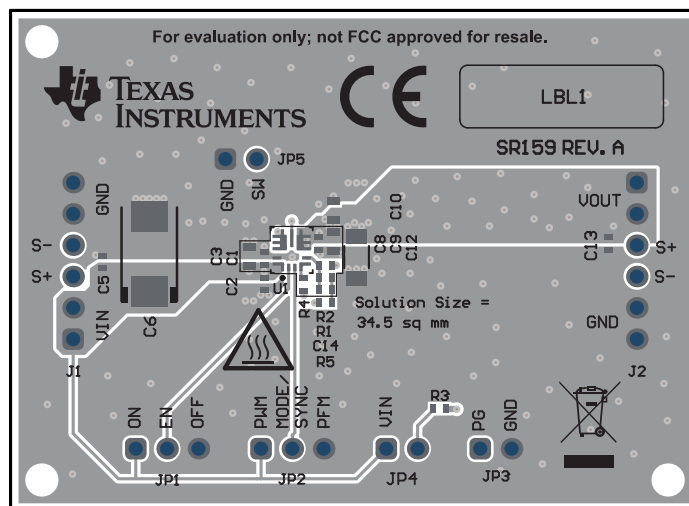


Figure 3-2. Top View

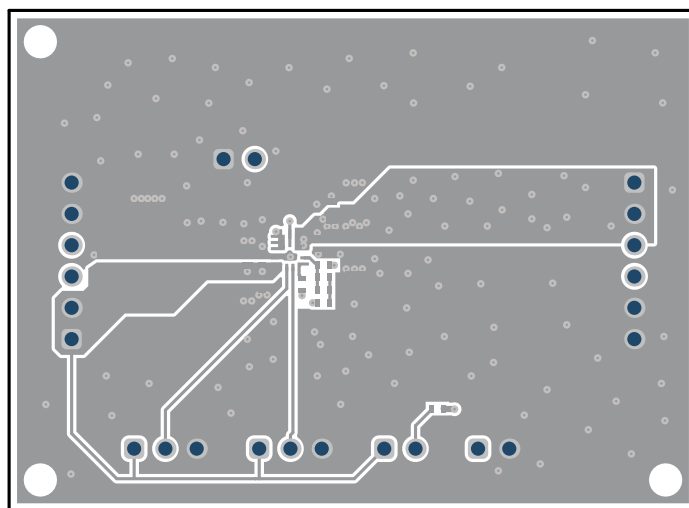
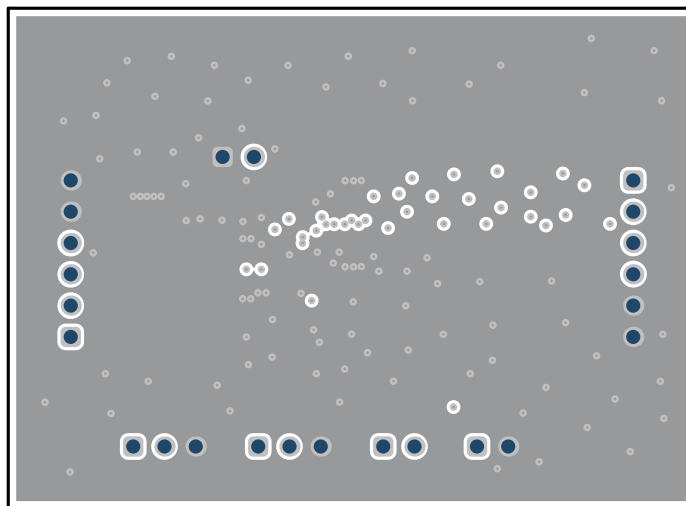
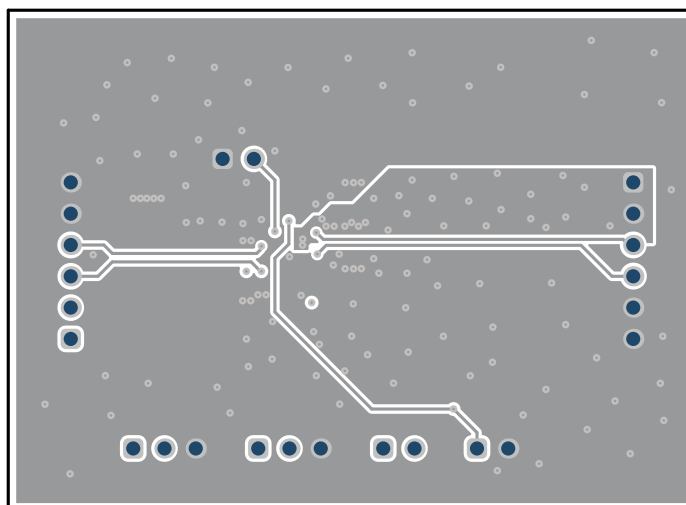
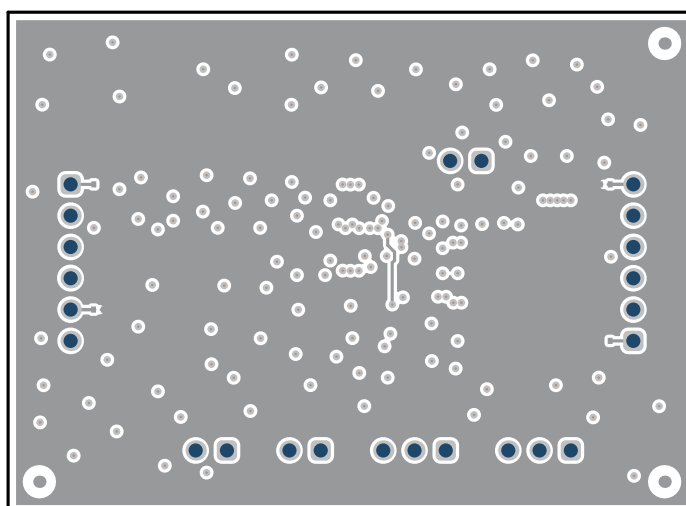


Figure 3-3. Top Layer

**Figure 3-4. Signal Layer 1****Figure 3-5. Signal Layer 2****Figure 3-6. Bottom Layer**

3.3 Bill of Materials (BOM)

Table 3-1 lists the TPSM828502QEV-159 bill of materials.

Table 3-1. TPSM828502QEV-159 Bill of Materials

Quantity	Ref Des	Value	Description	Size	Part Number	MFR
TPSM828502QEV-159						
3	C1, C6, C13	470pF	Capacitor, Ceramic, 100 V, $\pm 10\%$, X7R	0402	GRM155R72A471KA01D	Murata
2	C2, C8	0.1 μ F	Capacitor, Ceramic, 16 V, $\pm 10\%$, X7R	0402	CL05B104KO5NNNC	Walsin
3	C3, C9, C10	10uF	Capacitor, Ceramic, 10 V, $\pm 20\%$, X7R	0603	GRM188Z71A106MA73D	Murata
1	C12	22uF	Capacitor, Ceramic, 10V, $\pm 10\%$, X7R	1206	GRM31CR71A226KE15L	Murata
1	C14	10pF	Capacitor, Ceramic, 50V, C0G/NP0, $\pm 5\%$	0402	GRM1555C1H100JA01D	Murata
1	C5	100uF	Capacitor, Tantalum Polymer, 20V, $\pm 20\%$	7.3x4.3mm	20TQC100MYF	Panasonic Electronic Components
4	C15, C16, C17, C18	10nF	Capacitor, Ceramic, 50V, $\pm 10\%$, X7R	0402	GCM155R71H103KA55D	Murata
1	R1	80.6 k	Resistor, Chip, 0.063 W, 1%	0402	Std	Std
1	R2	40.2 k	Resistor, Chip, 0.063 W, 1%	0402	Std	Std
1	R3	100 k	Resistor, Chip, 0.0625W, 1%	0402	Std	Std
1	R4	8.06 k	Resistor, Chip, 0.063W, 1%	0402	Std	Std
1	R5	0	Resistor, Chip, 0.063W, 5%	0402	Std	Std
1	U1	TPSM828502-Q1	IC, 6V, 2A Step-Down Power Module	2.7mm $\times$ 3.0mm	TPSM828502-Q1	TI

4 Additional Information

4.1 Trademarks

All trademarks are the property of their respective owners.

5 Related Documentation

The data sheet and other documentation of the device is available in the [TPSM828502-Q1](#) product folder.

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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.

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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 instructions, 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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<https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html>

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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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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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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.

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10. *Governing Law:* These terms and conditions shall be governed by and interpreted in accordance with the laws of the State of Texas, without reference to conflict-of-laws principles. User agrees that non-exclusive jurisdiction for any dispute arising out of or relating to these terms and conditions lies within courts located in the State of Texas and consents to venue in Dallas County, Texas. Notwithstanding the foregoing, any judgment may be enforced in any United States or foreign court, and TI may seek injunctive relief in any United States or foreign court.

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