EVM User's Guide: TPS61129Q1EVM

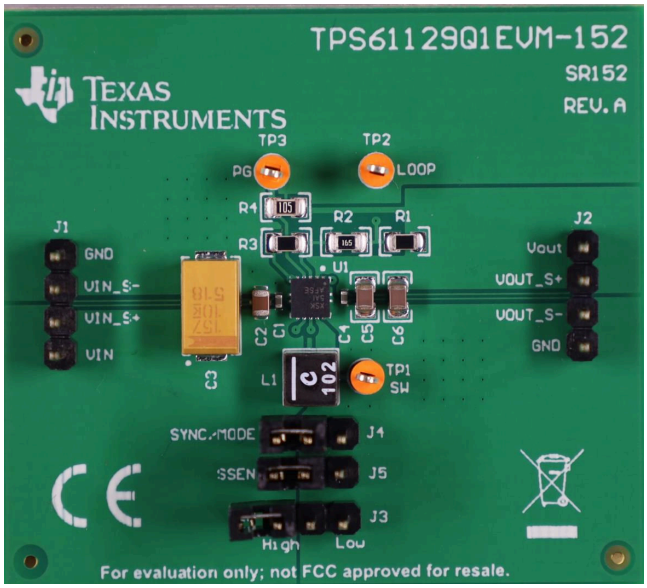
TPS61129-Q1 Evaluation Module

Description

The TPS61129Q1EVM facilitates thorough evaluation of the TPS61129-Q1 behavior and performance across various operating conditions, including different input voltages (ranging from 0.9V to 5.5V), output voltages, and load scenarios. The module allows output voltage adjustment from 2.6V to 5.5V through an external feedback resistor configuration and features three strategic jumpers that enable testing of the EN, SSEN, and MODE pin functions.

Features

- AEC-Q100 qualified for automotive applications
  - Device temperature grade 1: –40°C to 125°C ambient operating temperature range
- Output voltage: 2.6V to 5.5V
  - Fixed 5V or adjustable Vout: TPS61129-Q1
- Typical 5µA quiescent current into VOUT pin
- Output discharge and windowed power good (PGOOD)
- Peak switching current limit: 3.0A minimum, 3.5A typical
- PFM, forced PWM mode, SYNC selectable



TPS61129Q1EVM

1 Evaluation Module Overview

1.1 Introduction

This user's guide describes the setup, schematic, and layout of the evaluation module (EVM) for the TPS61129-Q1. The EVM helps to evaluate the behavior and performance of the device at different input voltages, output voltages, and load conditions.

This EVM is designed for 0.9V to 5.5V input voltage and 5V output voltage applications. The SYNC/MODE jumper (J4) controls the operating mode of the device. At light load, the device has two operating modes that can be selected through the SYNC/MODE pin. When MODE is connected to Low, the device works in pulse frequency modulation (PFM) mode to improve light-load efficiency. When MODE is connected to High, the device works in forced PWM mode to avoid audible noise and to improve light load ripple performance. The SYNC/MODE pin can also be used to synchronize the device switching frequency with an external clock signal from 1.5MHz to 3.3MHz. This EVM has test points of TP1, TP2, and TP3 for SW voltage, loop voltage, and Power-Good indicator voltage measurement, respectively. The peak inductor current limit is typically 3.5A. The feedback divider and compensation network can be modified for other application conditions as per the datasheet. The TPS61129-Q1 can also be easily set to 5V when FB is connected to VOUT pin.

The TPS61129-Q1 features an additional spread spectrum function through the SSEN jumper (J5), and uses a triangle waveform to spread the switching frequency with ±6% of normal frequency. These features mean that with the normal 2.2MHz switching frequency, the spread spectrum function modulates the switching frequency in the range of 2.07MHz to 2.33MHz in a triangle behavior with a 10kHz rate. When SSEN is high, the spread spectrum function is enabled. When SSEN is low, the spread spectrum function is disabled.

1.2 Kit Contents

Table 1-1. Kit List

Designator	Quantity	Description	Material Type	Packaging
PCB1	1	TPS61129Q1EVM; Circuit Board	EEE	Bag, ESD
BOX1	1	Box, Cardboard	Cardboard	Box
FM1	2	Foam, Antistatic	Plastic	Foam
LBL1	1	Label, Small and Large standard labels	Paper, card stock	Paper
LIT1	1	Literature, EVM Disclaimer Read Me	Paper, card stock	Paper
LIT2	1	Literature, EVM Disclaimer Read Me	Paper, card stock	Paper

1.3 Specification

Table 1-2 provides the summary of the TPS61129Q1EVM performance specifications. All the specifications are given for an ambient temperature of 25°C.

Table 1-2. Performance Specification

Parameter	Value	Unit
Input voltage	0.9 – 5.5	V
Output voltage	5	V
Typical peak current limit	3.5	A
Default switching frequency	2.2	MHz

1.4 Device Information

The TPS61129-Q1 is a low voltage, synchronous boost converter with a 90mΩ low side power switch and a 120mΩ high side rectifier switch to provide a high efficiency and small size design. The TPS61129-Q1 has a 3.5A (typical) peak switch current limit and employs peak current mode control with fixed switching frequency 2.2MHz. The TPS61129-Q1 has a wide input voltage range of 0.9V to 5.5V and the output voltage covers from 2.6V up to 5.5V and selectable auto PFM, forced PWM mode, or synchronized to an external clock. In addition, the TPS61129-Q1 has output overvoltage protection and overcurrent protection to prevent the device from overheat. The TPS61129-Q1 provides a power supply design for portable equipment and smart devices, powered by various batteries and other power supplies. The TPS61129-Q1 uses the spread spectrum of the internal clock to be more EMI friendly at FPWM mode. Moreover, there is an internal soft-start time to limit the inrush current.

2 Hardware

2.1 Test Setup

Jumper	Description
J1	Input voltage positive connection and input voltage return connection.
J2	Output voltage positive connection and output voltage return connection.
J3	EN pin input jumper. Place a jumper across EN and High to turn on the IC. Place a jumper across EN and Low to turn off the IC.
J4	SYNC/MODE pin input jumper. Place a jumper across SYNC/MODE and High to set the device in forced PWM mode. Put the jumper across SYNC/MODE and Low to set the device in auto PFM mode. The jumper can also be removed and the external clock can be synchronized through SYNC/MODE.
J5	SSEN pin input jumper. Place a jumper across SSEN and High to enable spread spectrum modulation. Put the jumper across SSEN and Low to disable spread spectrum modulation.
TP1	Test point to measure SW pin waveform.
TP2	Test point to measure bode plot.
TP3	Test point to measure Power-Good indicator voltage.

2.2 Modification

The external components of the TPS61129-Q1 device can be modified to adjust the output voltage and output ripple of real applications.

2.3 Input Capacitor C6

The 150µF, 10V TAN capacitor C6 is added as the input capacitor in the EVM. The capacitor is not necessary and can be removed in a real application.

3 Hardware Design Files

3.1 Schematic

Figure 3-1 shows the TPS61129-Q1 EVM schematic.

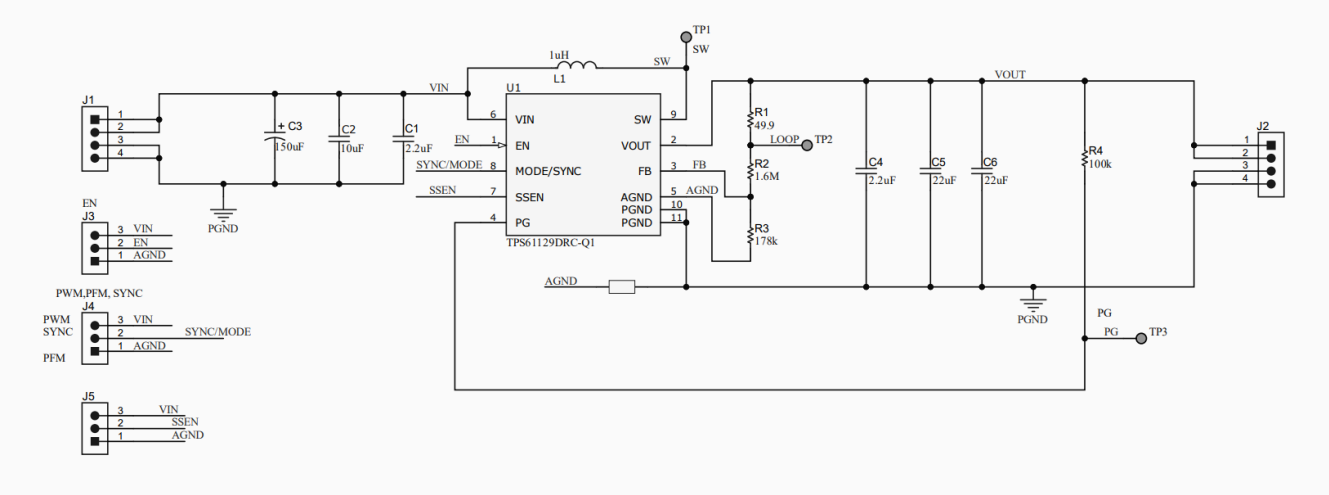


Figure 3-1. Schematic

3.2 PCB Layout

The TPS61129-Q1 EVM board is a 2-layer, 2oz copper thick PCB. All the components are placed on the top layer. Figure 3-2 and Figure 3-3 show the top view and bottom view, respectively.

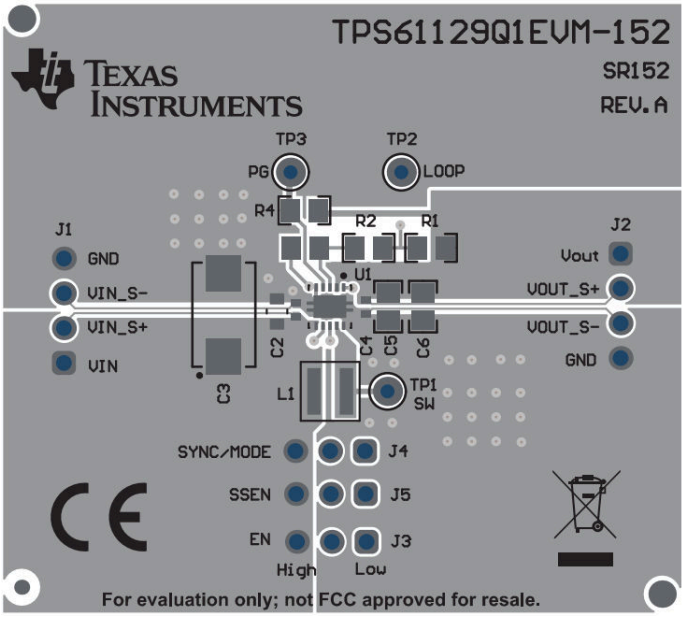


Figure 3-2. Top-Side Layout

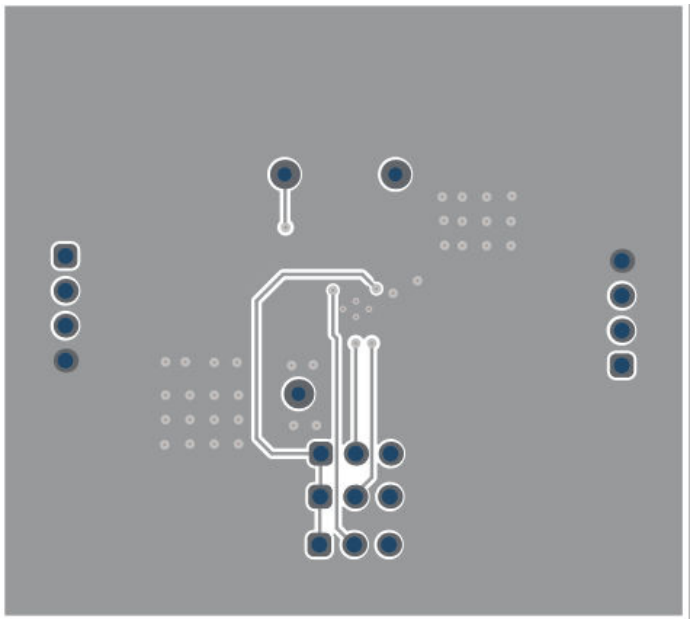


Figure 3-3. Bottom-Side Layout

3.3 Bill of Materials

Table 3-1 lists the BOM of the TPS61129-Q1 EVM.

Table 3-1. TPS61129Q1EVM Bill of Materials

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
C1	1	10µF	10µF ±10% 10V Ceramic Capacitor X8L 0805 (2012 Metric)	0805	C2012X8L1A106K125AC	TDK
C2, C5	2	2.2µF	CAP, CERM, 2.2µF, 10V, +/- 20%, X5R, 0402	0402	GRM155R61A225ME95	MuRata
C3, C4	2	22µF	CAP, CERM, 22µF, 25V, +/- 20%, X5R, 0805	0805	CL21A226MAQNNNE	Samsung Electro-Mechanics
C6	1	150uF	CAP, TA, 150uF, 10V, +/- 10%, 0.1ohm, SMD	7132-28	T495D157K010ATE100	Kemet
FID1, FID2, FID3	3		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A
J1, J2	2		Header, 2.54mm, 4x1, Gold, TH	Header, 2.54mm, 4x1	61300411121	Wurth Elektronik
J3,J4,J5	3		Header, 2.54mm, 3x1, Gold, TH	Header, 2.54mm, 3x1	61300311121	Wurth Elektronik
L1	1	1µH	Power Inductor, shielded, composite, 1uH 20% tol, DCR 7.2mOhms, SRF 65MHz, Isat 4.8A, Irms 13A, AEC-Q200	SMD——INDUCTOR	XGL4030-102MEC	Coilcraft
R3	1	1.6MΩ	RES, 1.6M, 5%, 0.125W, AEC-Q200 Grade 0, 0805	0805	ERJ-6GEYJ165V	Panasonic
R4	1	178kΩ	RES, 178k, 1%, 0.125W, AEC-Q200 Grade 0, 0805	0805	CRCW0805178KFKEA	Vishay-Dale
R5	1	100kΩ	RES, 100k M, 0.1%, 0.125W, 0805	0805	RT0805BRD071ML	Yageo America
R6	1	49.9Ω	RES, 49.9, 1%, 0.125W, AEC-Q200 Grade 0, 0805	0805	CRCW080549R9FKEA	Vishay-Dale
TP1, TP2, TP3	3		Test Point, Miniature, Orange, TH	Orange Miniature Testpoint	5003	Keystone Electronics
U1	1		Adjustable, 3.5A Switch, 96% Efficient Boost Converter with Down-Mode, QFN-10, DRC0010J (VSON-10)	VSON-10	TPS61129DRC-Q1	Texas Instruments

4 Additional Information

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   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:

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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

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

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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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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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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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