TPS61085-Q1EVM User Guide (MSA027)

The TPS61085-Q1EVM is an Evaluation Module (EVM) for the TPS61085-Q1 boost converter device used in automotive applications that require a high-efficiency step-up DC-DC converter with an integrated power switch. The TPS61085-Q1 requires minimal external components, making it easy to design and resulting in a compact solution size. The TPS61085-Q1 device implementation is in a variety of automotive applications such as Infotainment Cluster, Body Control Modules, and Advanced Driver Assistance Systems (ADAS). The TPS61085-Q1 device is especially useful when the battery line is pre-regulated to a lower voltage to suppress line transients, but another device such as a digital camera, audio amplifier, or small LED back-light matrix (for example, 3SPS) requires a higher voltage to operate.

This document provides a description of how to setup and configure the EVM for operation. The document also includes the board layout, schematic, and bill of materials (BOM) for the EVM.

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1 Introduction

The TPS61085-Q1EVM evaluation module (EVM) allows engineers to evaluate the operation and performance of the TPS61085-Q1 boost converter. The TPS61085-Q1EVM is simple to test, requiring only a power supply at the input to power up the EVM and a load at the output to measure performance. The EVM has two different inductor sizes populated to quickly select and evaluate a switching frequency of either 1.2 MHz (for designs requiring smaller component sizes) or 650 kHz (for designs requiring higher system efficiency) with a couple jumper modifications, but the final solution requires only a single inductor. The large-sized and conveniently placed resistors in the feedback-divider network allow easy modification of the TPS61085-Q1EVM from the default output voltage of 12 V to any value within the TPS61085-Q1 operating range of V_{IN}, 0.5 V to 18.5 V.

Figure 1 shows the TPS61085-Q1EVM Evaluation Module.

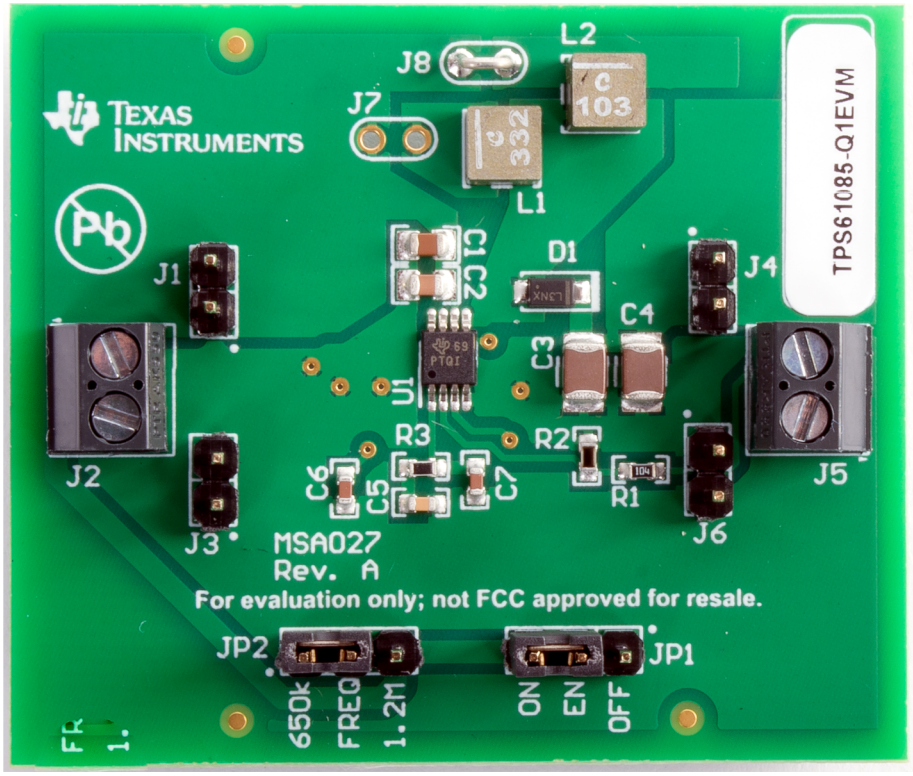


Figure 1. TPS61085-Q1EVM Board

1.1 Related Documentation

Texas Instruments, *TPS61085-Q1 650-kHz and 1.2-MHz, 18.5-V Step-Up DC-DC Converter* data sheet, SLVSAI9

1.2 TPS61085-Q1 Applications

- Automotive Infotainment Cluster
- Automotive Body Electronics
- Telemetrics and eCalls
- Advanced Driver Assistance Systems (ADAS)

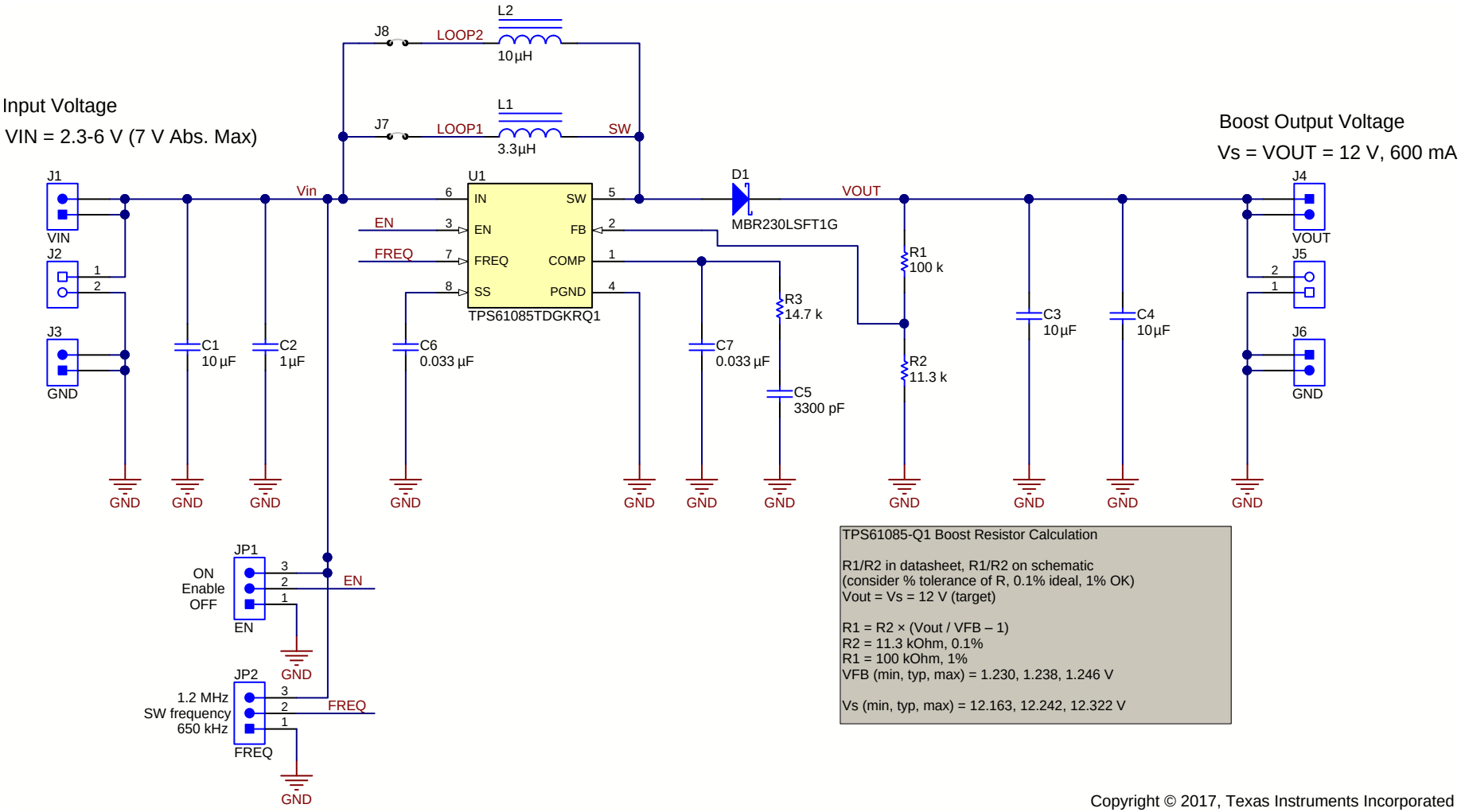
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2 Schematic, Bill of Materials, and Layout

This section provides a more detailed description of the TPS61085-Q1EVM schematic, BOM, and layout.

2.1 Schematic

Figure 2 shows the schematic of the TPS61085-Q1EVM.



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Figure 2. TPS61085-Q1EVM Schematic

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2.2 Bill of Materials

Table 1. TPS61085-Q1EVM BOM

DESIGNATOR	QUANTITY	VALUE	DESCRIPTION	PACKAGE REFERENCE	PART NUMBER	MANUFACTURER
!PCB	1		Printed Circuit Board		MSA027	Any
C1	1	10uF	CAP, CERM, 10 µF, 16 V, ±10%, X7S, AEC-Q200 Grade 1, 0805	0805	CGA4J1X7S1C106K125AC	TDK
C2	1	1uF	CAP, CERM, 1 µF, 50 V, ±10%, X7R, AEC-Q200 Grade 1, 0805	0805	CGA4J3X7R1H105K125AB	TDK
C3, C4	2	10uF	CAP, CERM, 10 µF, 25 V, ±20%, X7R, AEC-Q200 Grade 1, 1210	1210	CGA6P1X7R1E106M250AC	TDK
C5	1	3300pF	CAP, CERM, 3300 pF, 100 V, ±10%, X7R, AEC-Q200 Grade 1, 0603	0603	CGA3E2X7R2A332K080AA	TDK
C6, C7	2	0.033uF	CAP, CERM, 0.033 µF, 100 V, ±10%, X7S, AEC-Q200 Grade 1, 0603	0603	CGA3E3X7S2A333K080AB	TDK
D1	1	30V	Diode, Schottky, 30 V, 2 A, AEC-Q101, SOD-123FL	SOD-123FL	MBR230LSFT1G	ON Semiconductor
H1, H2, H3, H4	4		Bumpon, Cylindrical, 0.312 X 0.200, Black	Black Bumpon	SJ61A1	3M
J1, J3, J4, J6	4		Header, 100mil, 2x1, Gold, TH	Header, 100mil, 2x1, TH	HTSW-102-07-G-S	Samtec
J2, J5	2		Terminal Block, 3.5mm Pitch, 2x1, TH	7.0x8.2x6.5mm	ED555/2DS	On-Shore Technology
J8	1		Jumper Wire, 100mil spacing, pkg of 200, TH	Wire Jumper	923345-01-C	3M
JP1, JP2	2		Header, 100mil, 3x1, Gold, TH	Header, 100mil, 3x1, TH	HTSW-103-07-G-S	Samtec
L1	1	3.3uH	Inductor, Shielded, Composite, 3.3 µH, 5.5 A, 0.026 ohm, SMD	4.0x3.1x4.0mm	XAL4030-332MEB	Coilcraft
L2	1	10uH	Inductor, Shielded, Composite, 10 µH, 3 A, 0.084 ohm, SMD	4.0x4.1x4.0mm	XAL4040-103MEB	Coilcraft
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	PCB Label 0.650"H x 0.200"W	THT-14-423-10	Brady
R1	1	100k	RES, 100 k, 0.05%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	ERA-3ARW104V	Panasonic
R2	1	11.3k	RES, 11.3 k, 0.1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	ERA-3AEB1132V	Panasonic
R3	1	14.7k	RES, 14.7 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	ERJ-3EKF1472V	Panasonic
SH-J1, SH-J2	2	1x2	Shunt, 100mil, Gold plated, Black	Shunt	969102-0000-DA	3M
U1	1		Automotive Catalog 18.5 V, 2 A, 650 KHz / 1.2 MHz Step-Up DC-DC Converter with Forced PWM Mode, 2.3 to 6 V, –40 to 105 degC, 8-pin SOP (DGK8), Green (RoHS and no Sb/Br)	DGK0008A	TPS61085TDGKRQ1	Texas Instruments

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Table 1. TPS61085-Q1EVM BOM (continued)

DESIGNATOR	QUANTITY	VALUE	DESCRIPTION	PACKAGE REFERENCE	PART NUMBER	MANUFACTURER
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	Fiducial	N/A	N/A
J7	0		Jumper Wire, 100mil spacing, pkg of 200, TH	Wire Jumper	923345-01-C	3M

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2.3 Layout and Component Placement

Figure 3 shows the top assembly component placement and Figure 4 shows the bottom assembly component placement for the EVM.

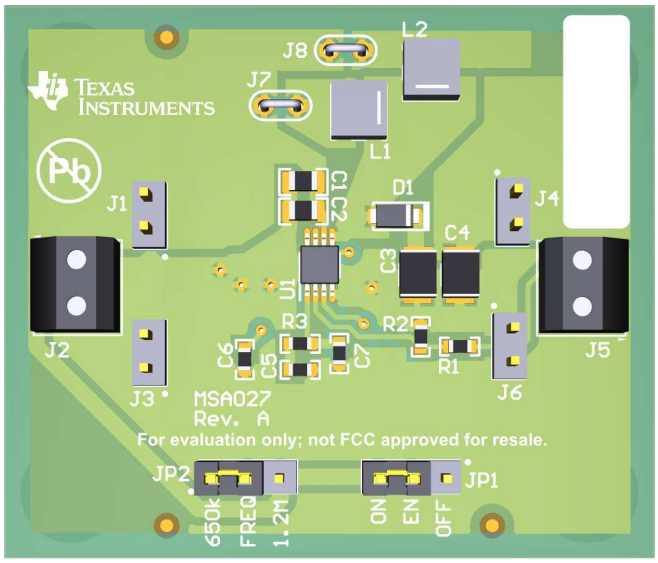


Figure 3. Component Placement—Top Assembly

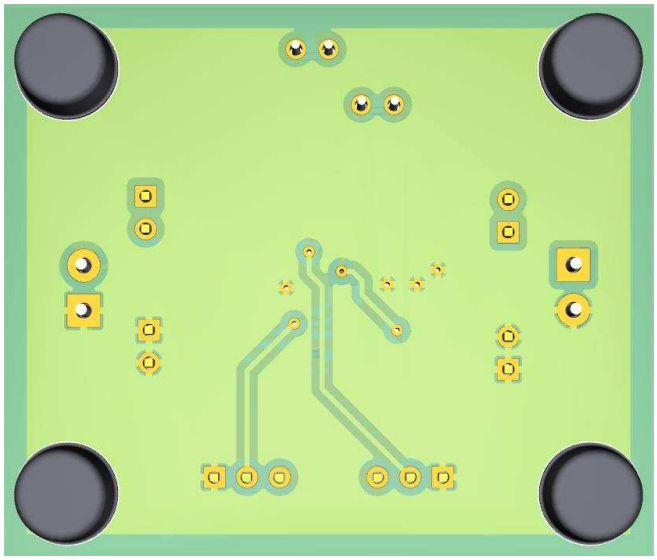


Figure 4. Component Placement—Bottom Assembly

Figure 5 shows the top and Figure 6 shows the bottom layout composites. Figure 7 and Figure 8 show the top and bottom layers, respectively.

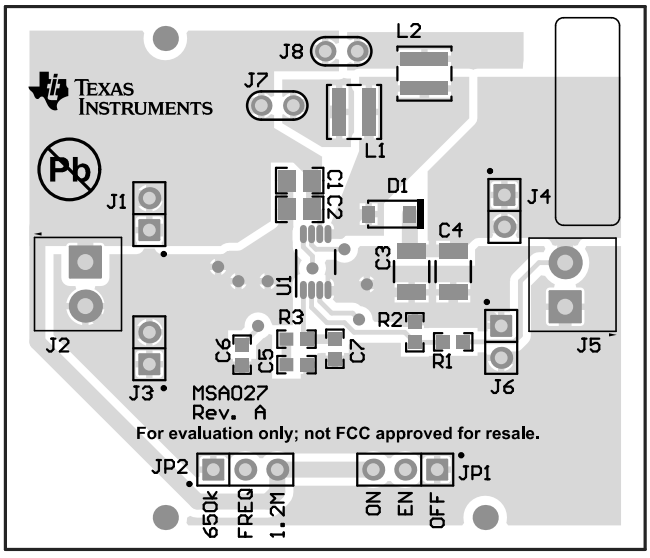


Figure 5. Layout—Top Composite

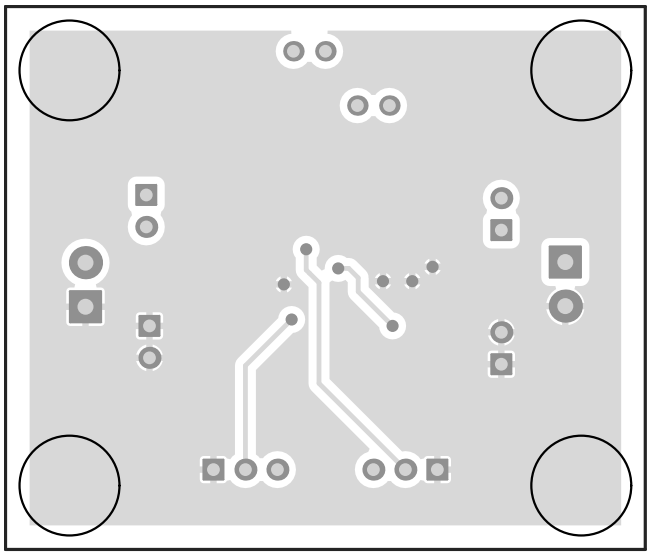


Figure 6. Layout—Bottom Composite

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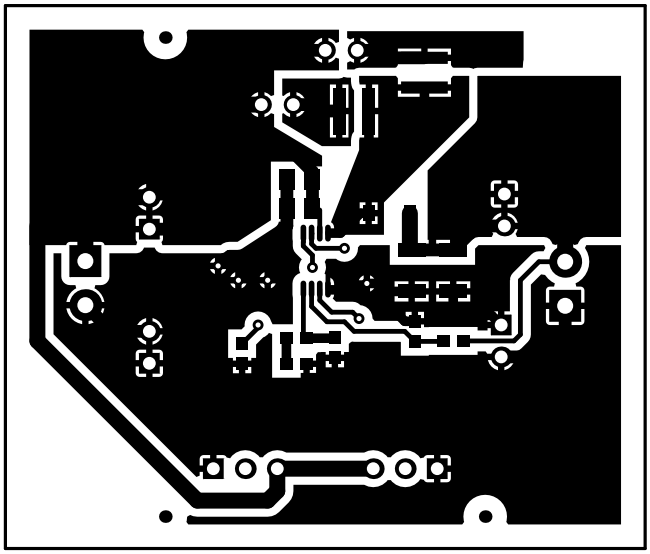


Figure 7. Top Layer

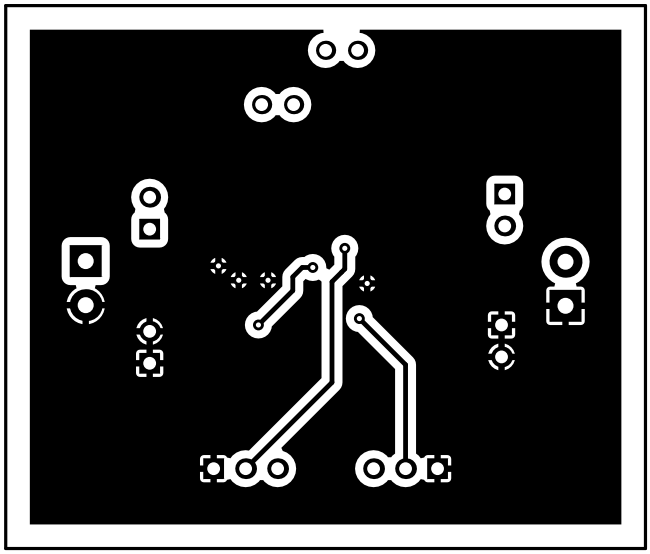


Figure 8. Bottom Layer (Top View)

3 Setup and Operation

This section describes the input connectors, output connectors, and configurable jumpers on the EVM. Also, how to connect, set up, and properly use the EVM. There is also an example of EVM operation with the jumpers installed in their default positions.

3.1 Input and Output Connectors

This section describes the header and screw terminal connectors for applying input power to and delivering output power from the TPS61085-Q1EVM.

- **J1 (VIN)** — This header provides two pins connected to the same node, Vin, for quickly applying the positive lead of the input power supply
- **J2 (Vin, GND)** — This screw terminal is for connecting both the positive (+ or Vin) and negative (– or GND) leads of a power supply directly to the board with thick gauge wires for evaluating the EVM at high currents with minimal resistive losses due to wiring and connectors
- **J3 (GND)** — This header provides two pins connected to GND for quickly applying the negative lead of the input power supply
- **J4 (VOUT)** — This header provides two pins connected to the same node, VOUT, for quickly attaching a load to the positive lead at the output of the boost converter circuit
- **J5 (VOUT, GND)** — This screw terminal is for connecting both the positive (+ or Vout) and negative (– or GND) leads of a power supply directly to the board with thick gauge wires for evaluating the EVM at high current with minimal resistive losses due to wiring and connectors
- **J6 (GND)** — This header provides two pins connected to GND for quickly applying the negative lead of the input power supply

3.2 Jumper Setting and Configuration

This section describes the jumper connections on the TPS61085-Q1EVM and how the jumpers can be configured for alternate operation modes.

- **J7 (Vin, LOOP1), not installed by default** — When pins 2 and 3 of JP2 are shorted together with a jumper, this jumper wire must be installed for L1 (3.3-µH inductor) to be in the circuit, which allows the TPS61085-Q1 to operate at the higher-switching frequency of 1.2 MHz. This jumper wire may be replaced with a 2-pin header with 100-mil spacing (pitch) to short Vin to LOOP1 with a shunt, but Vin must not be connected to LOOP1 and LOOP2 simultaneously.

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- **J8 (Vin, LOOP2)** — When pins 1 and 2 of JP2 are shorted together with a jumper, this jumper wire must be installed for L2 (10-µH inductor) to be in the circuit, which allows the TPS61085-Q1 to operate at the lower-switching frequency of 650 kHz. This jumper wire may be replaced with a 2-pin header with 100-mil spacing (pitch) to short Vin to LOOP2 with a shunt, but Vin must not be connected to LOOP2 and LOOP1 simultaneously.
- **JP1 (configure EN pin)** — A 3-pin header to install a jumper (shunt) and enable the TPS61085-Q1 (pins 2 and 3 shorted) by pulling up the EN pin to Vin, or disable the TPS61085-Q1 (pins 1 and 2 shorted) by pulling down the EN pin to GND. The EN pin does not have an internal pull-up or pull-down resistor and cannot be left floating; the shunt must be installed in one of the two positions and cannot be removed completely.
- **JP2 (configure FREQ pin)** — A 3-pin header to install a jumper (shunt) and configure the TPS61085-Q1 to operate at a switching frequency of 650 kHz (pins 1 and 2 shorted) by pulling up the FREQ pin to Vin, or a switching frequency of 1.2 MHz (pins 2 and 3 shorted) by pulling down the FREQ pin of the TPS61085-Q1 to GND. The FREQ pin cannot be left floating; the shunt must be installed in one of the two positions and cannot be removed completely.

3.3 Test Point Description

The TPS61085-Q1EVM does not contain any test points explicitly denoted with the **TPx** annotation. However, depending on the switching frequency selected by the JP2 jumper position, replace either J7 or J8 with a longer jumper wire to insert a current probe and measure the current through inductor L1 or L2, respectively. Additionally, use one of the pins provided at J1 and J4 to measure the input voltage (Vin) and output voltage (VOUT), respectively, and use the other pin to apply power and a load. Similarly, use one of the unused pins at J3 or J6 as a ground (GND) reference for a multimeter or oscilloscope. Also, due to the large polygonal copper pour connecting L1 or L2 to D1 at the switching node (SW), it is easy to remove the solder mask for access to the copper to apply a jumper wire to measure the voltage at the SW-pin of the TPS61085-Q1. The usage of large polygonal pours, physically large components, and exposed vias allows for easy access to most nets of the PCB.

3.4 EVM Setup

Figure 9 shows the setup of the TPS61085-Q1EVM for power on and basic testing. Figure 9 shows and Table 2 lists the default jumper settings.

The following equipment is required to power on and perform basic tests on the TPS61085-Q1EVM:

- **DC Power Supply** — A single DC power supply capable of supplying 2.3 to 6 Volts at up to 3 Amps, connected at headers J1 (Vin) and J3 (GND)
- **Digital Multi-Meter (DMM)** — One DMM, capable of measuring DC Voltage, connected at headers J4 (VOUT) and J6 (GND)
- **Load (optional)** — A load can be optionally be applied between headers J4 (VOUT) and J6 (GND) in the form of power resistors, a power resistor decade box, or electronic load to sink up to 600 mA of current

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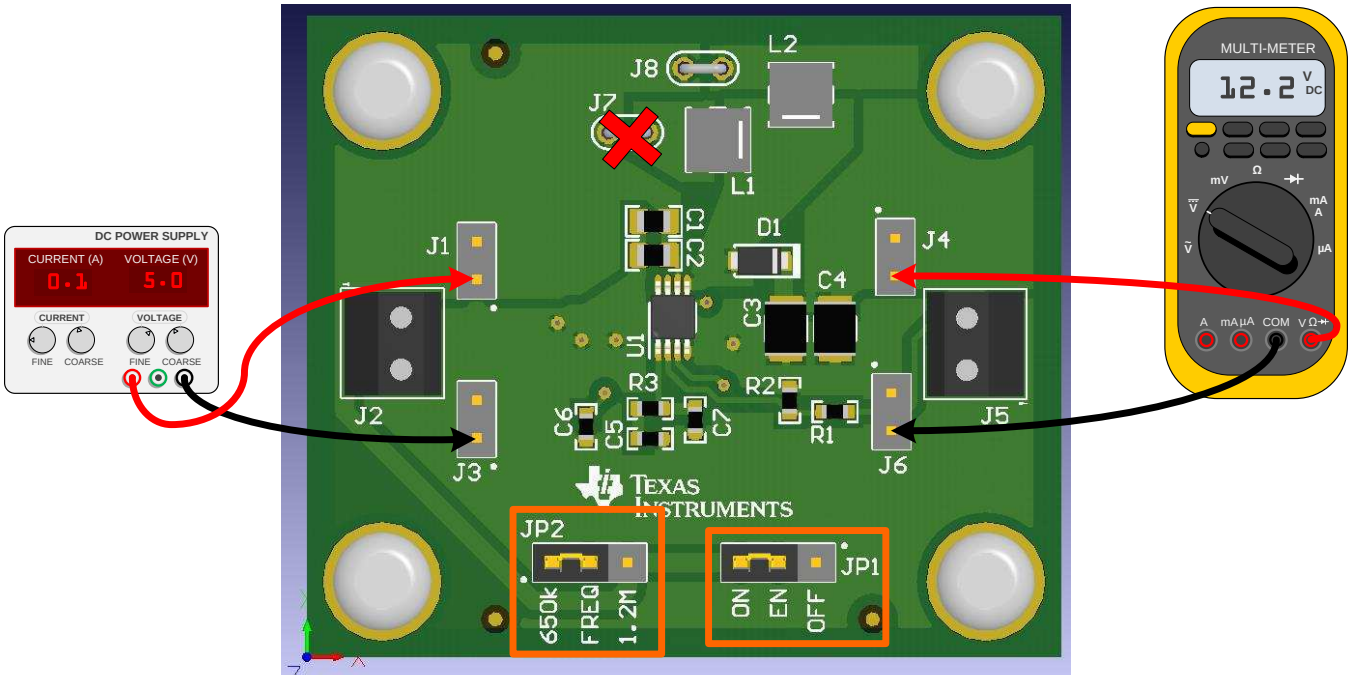


Figure 9. TPS61085-Q1EVM Test Setup

Table 2. Default Jumper Settings

HEADER DESIGNATOR	SIGNAL NAME	PINS SHUNTED TOGETHER	RESULT
JP1	EN	2 and 3	TPS61085-Q1 is enabled
JP2	FREQ	1 and 2	Switching frequency is 650 kHz

3.5 Basic Operation

When the EVM is setup correctly according to Section 3.4, turn on the power supply with the voltage set to 6 V. Monitor the output voltage on the digital multi-meter (DMM). Verify it is approximately 12 V.

To verify the TPS61085-Q1 operates down to the minimum recommended operating condition, ramp the power supply down to 2.3 V and monitor the output voltage on the DMM. Verify it is still approximately 12 V.

To disable the TPS61085-Q1, move the shunt on header JP1 to short pins 1 and 2 together, labeled **OFF** on the silkscreen. Monitor the output voltage on the DMM to verify it approaches 0 V as the output capacitors discharge. If a load is applied at VOUT, the capacitors will discharge quickly and VOUT will fall to 0 V quickly.

To change the switching frequency of the TPS61085-Q1, modify the jumper setting on header JP2. By default, the jumper setting is set for a switching frequency of 650 kHz with jumper wire J8 installed so that the larger 10-µH inductor (L2) is in the circuit. If the jumper setting on JP2 is moved to short pins 2 and 3 for a switching frequency of 1.2 MHz, the operator must remove jumper wire J8 and install jumper wire J7, so that the smaller 3.3-µH inductor (L1) is in the circuit.

Revision History

DATE	REVISION	NOTES
February 2017	*	Initial Release

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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.

2 *Limited Warranty and Related Remedies/Disclaimers*:

   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.

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*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSS standard(s). 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。
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. 技術基準適合証明を取得後ご使用いただく。

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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

電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

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:*

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.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

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