

User's Guide

TPS62745 降圧コンバータ評価基板ユーザー ガイド



概要

このユーザー ガイドでは、テキサス インスツルメンツ TPS62745 評価基板 (EVM) の特性、動作、および使用方法について説明します。この評価基板は、TPS62745 の動作や機能の評価とテストを容易に実行できる設計を採用しています。この評価基板は、2.2V ~ 5.5V の入力電圧を、1.8V ~ 3.3V に設定されたレギュレーション済み出力電圧に変換し、最大 300mA まで供給します。TPS62745 は、ロード スイッチとパワー グッド出力も内蔵しており、静止電流は 400nA と非常に低くなっています。本ユーザー ガイドには、ハードウェアのセットアップ手順、評価基板のプリント基板 (PCB) レイアウト、回路図、部品表 (BOM)、および評価基板のテスト結果が記載されています。

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Trademarks

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1 概要

TPS62745 は、2 x 3mm、10 ピン SON パッケージに封止した 300mA 同期整流降圧コンバータです。出力電圧は、4 つの VSELx ピンの接続状態により、デバイス内部で固定されます。

1.1 背景

TPS62745EVM-622 は TPS62745 デバイスを使用します。この評価基板は、3.3V ~ 10V の入力電圧範囲で、フル定格の性能で動作します。

2 構成

このセクションでは、TPS62745EVM-622 の適切な使用方法について説明します。

2.1 入力/出力コネクタの説明

J1 - VIN	評価基板の入力電源 (3.3V ~ 10V) からの正の入力接続
J2 - S+/S-	入力電圧センス接続。このポイントで入力電圧を測定します。
J3 - GND	評価基板の入力電源からのリターン接続。
J4 - VOUT	出力電圧の接続。
J5 - S+/S-	出力電圧センス接続。このポイントで出力電圧を測定します。
J6 - GND	出力リターン接続。
J7 - PG/GND	このヘッダーのピン 1 に PG 出力が現れ、ピン 2 に便利なグラウンドが配置されています。
J8 - VIN_SW	VIN スイッチ出力接続。
J9 - SW/GND	スイッチ ノード センス接続。
JP1 - EN	EN ピン入力ジャンパ。ON と EN の間に付属のジャンパを配置すると、IC をオンにします。OFF と EN の間にジャンパを配置すると、IC がオフになります。
JP2 - EN_VIN_SW	VIN スイッチを有効化するジャンパ。付属のジャンパを VIN_SW_ON と EN_VIN_SW の間に配置すると、内部 VIN スイッチが有効 (クローズ) になります。VIN_SW_OFF と EN_VIN_SW の間にジャンパを配置すると、内部 VIN スイッチが無効 (オープン) になります。
JP3 ~ JP6 - VSELx	これらの 4 つの入力が、出力電圧を設定します。各ピンを High または Low に接続することで、出力電圧は表 2-1 に従ってプログラムされます。正常に動作させるために、ジャンパをオープンのままにしないでください。

表 2-1 に、TPS62745EVM-622 の出力電圧設定を示します。0 はロジック Low を、1 はロジック High を表します。

表 2-1. 出力電圧設定

VOUT	VSEL 4	VSEL 3	VSEL 2	VSEL 1
1.8	0	0	0	0
1.9	0	0	0	1
2.0	0	0	1	0
2.1	0	0	1	1
2.2	0	1	0	0
2.3	0	1	0	1
2.4	0	1	1	0
2.5	0	1	1	1
2.6	1	0	0	0
2.7	1	0	0	1
2.8	1	0	1	0
2.9	1	0	1	1
3.0	1	1	0	0
3.1	1	1	0	1
3.2	1	1	1	0
3.3	1	1	1	1

2.2 動作

この評価基板を動作させるには、セクション 2.1 に従ってジャンパ JP1 から JP6 を目的の位置に設定してください。入力電源を J1 および J3 に接続し、負荷を J4 および J6 に接続します。

3 超低 Iq デバイスでの一般的な効率測定誤差

効率、電源における一般的な測定項目です。TPS62745 などの静止電流が非常に小さいデバイスでは、特に負荷電流が非常に小さい (100µA 未満) 場合、測定誤差が効率の測定結果に大きな影響を及ぼす可能性があります。

3.1 効率測定のセットアップ

TPS62745EVM-622 の効率を正確に測定するには、[SLVA236](#) の図 6 に記載している設定を使用します。

TPS62745EVM-622 には C5 がすでに搭載されているため、このアプリケーション ノートで言及している「追加の入力コンデンサ」は必要ありません。入力容量の追加は推奨しません。入力のリーケージが増加し、効率の測定結果が低下するためです。

[SLVA236](#) のセットアップにより効率を測定する場合、測定装置の消費電流を効率の計算から取り除くよう、特に注意を払う必要があります。このような測定装置には通常、入力電圧と出力電圧のマルチメータや、入力電源のリモート センスライン (この機能がある場合) が含まれます。これらのポイントに流れ込む電流は、非常に軽い負荷で測定される効率に影響を及ぼします。この問題を克服する 2 つの方法は、これらのポイントに入る電流 (マルチメータやリモート センスラインに流れる電流) を測定し、この電流を効率計算から減算するか、単純にテスト構成からこれらの機器を取り除くことです。負荷電流が非常に小さい場合、最も正確な効率測定を実現するためには、通常、入力電源のリモート センスラインを取り外して、入力および出力電圧マルチメータに流れ込む電流を測定するのが最善です。

3.2 プルアップおよびプルダウン抵抗

[セクション 3.1](#) に示した入力コンデンサとリモート センスラインに加えて、プルアップまたはプルダウン抵抗も大きな電流を引き込み、測定効率に影響を及ぼす可能性があります。たとえば、VSEL2 ピンを $1\text{M}\Omega$ の抵抗で入力電圧にプルアップし、JP4 経由で Low に接続すると、 3.6V の入力電圧において、入力ソースから追加の $3.6\mu\text{A}$ が消費されます。このことは、超軽負荷時の効率に大きな影響を及ぼします。このため、TPS62745EVM-622 ではプルアップ抵抗またはプルダウン抵抗は使用していません。最終的なアプリケーション回路では、デバイスのデータシートに従って、TPS62745 へのすべてのデジタル入力が High または Low のいずれかで終端され、フローティングのままにならないようにする必要があります。

4 基板レイアウト

このセクションでは、TPS62745EVM-622 の基板レイアウトと図を示します。ガーバーは、評価基板の製品ページ [TPS62745EVM-622](#) で入手できます。

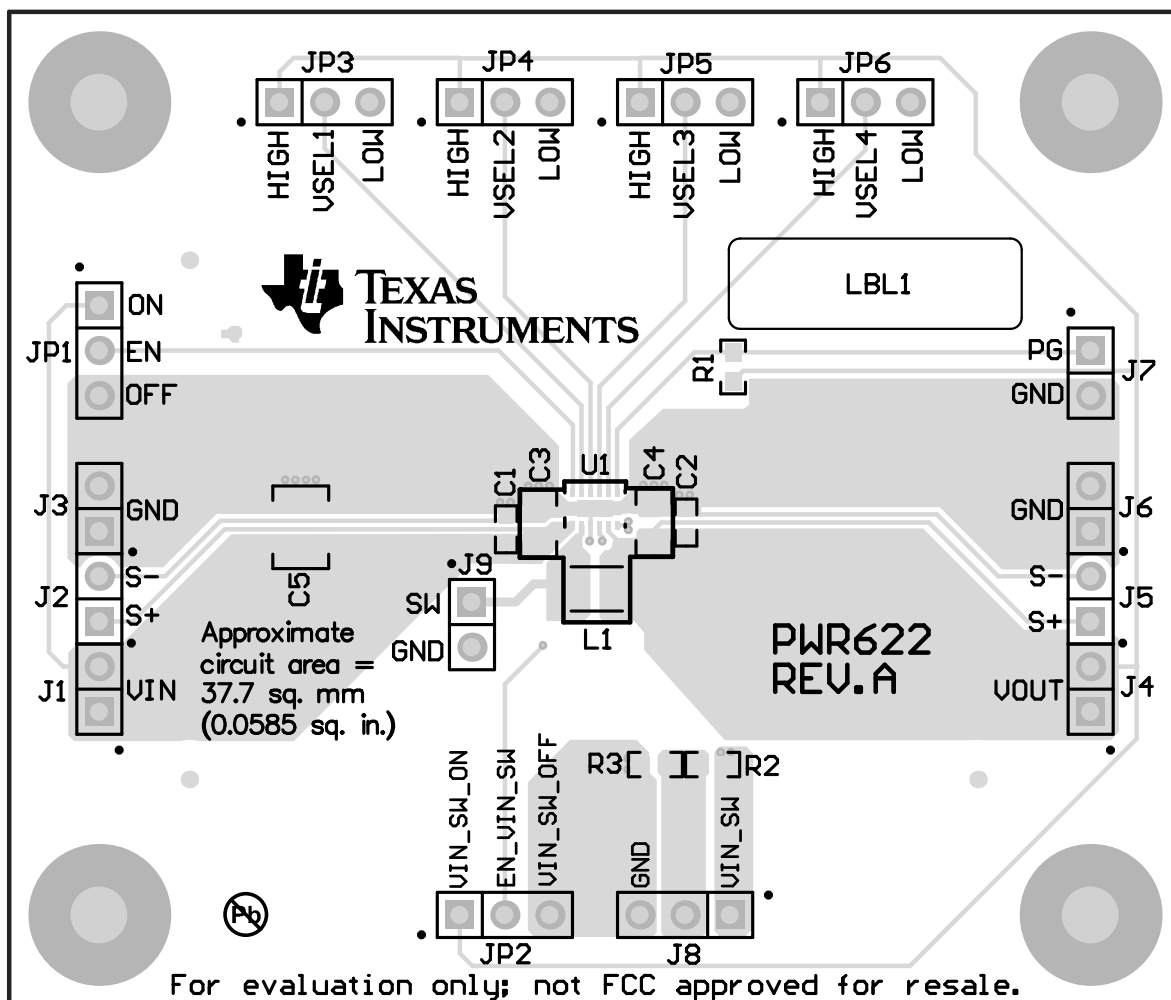


図 4-1. 部品層

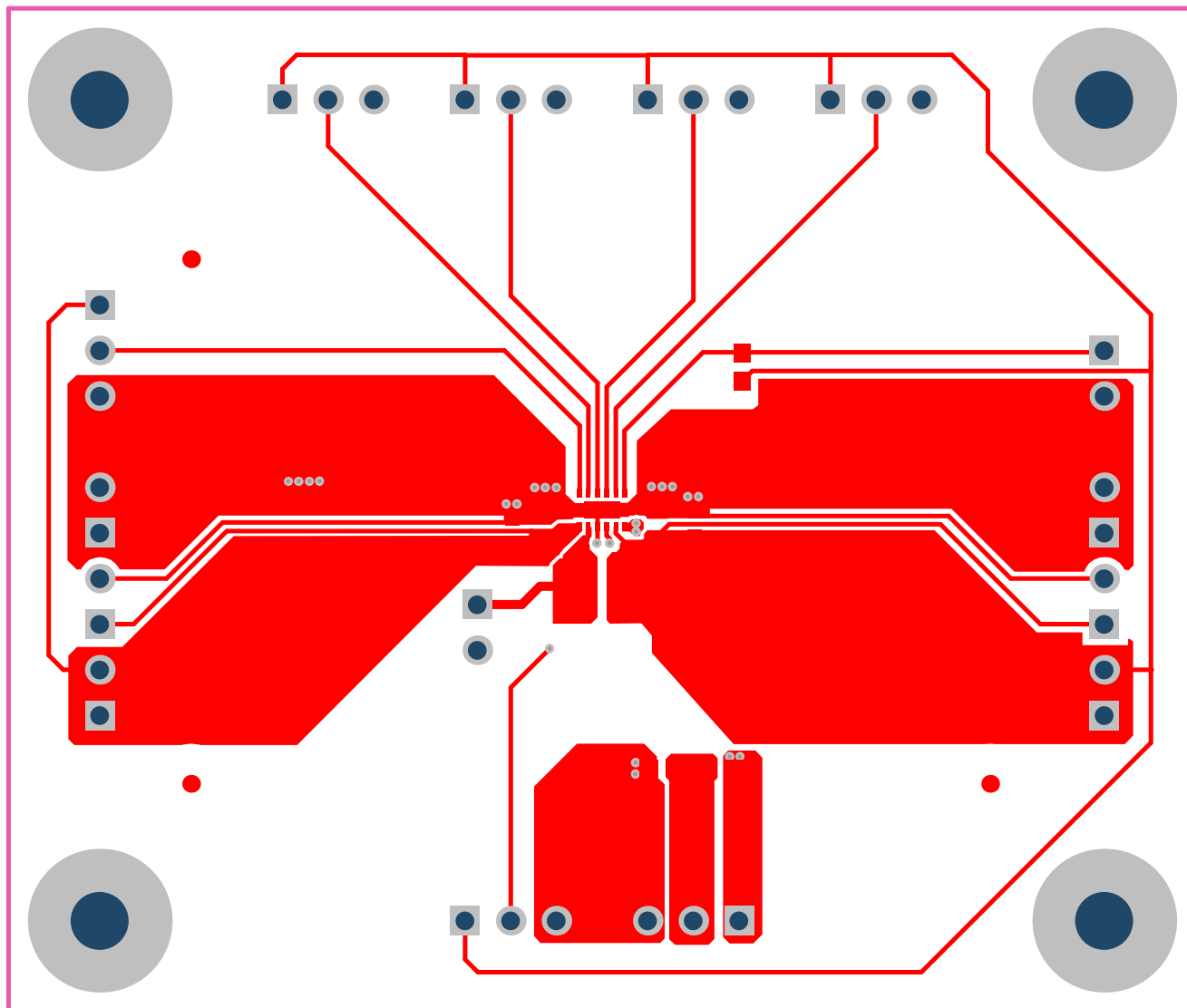


図 4-2. 上層

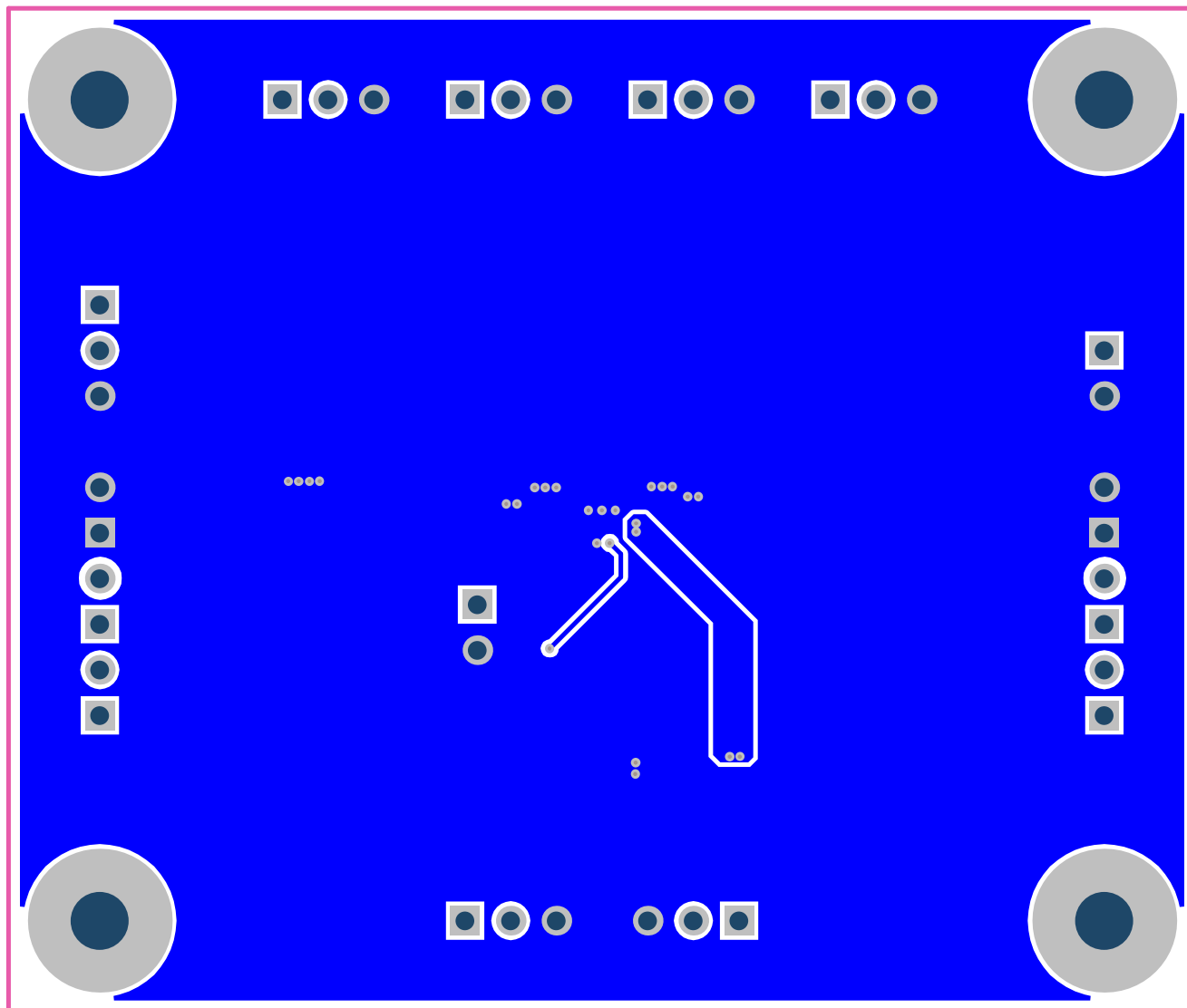


図 4-3. 下層

5 回路図と部品表

このセクションには、TPS62745EVM-622 の回路図および部品表が含まれています。

5.1 回路図

図 5-1 に、TPS62745EVM-622 の回路図を示します。

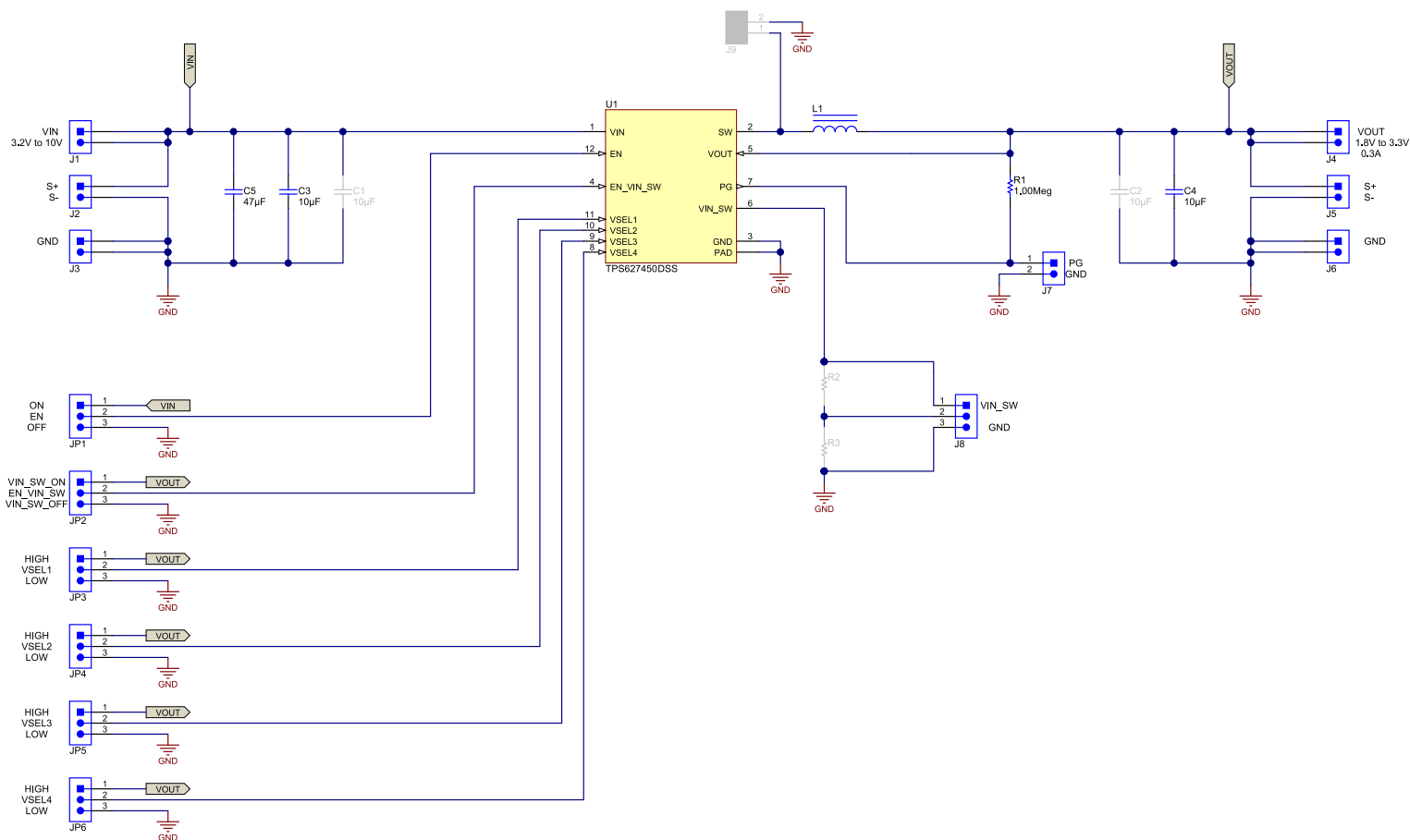


図 5-1. TPS62745EVM-622 の回路図

5.2 部品表

表 5-1 に、TPS62745EVM-622 の部品表を示します。

表 5-1. TPS62745EVM-622 部品表

カウント	リファレンス デザイン	値	説明	サイズ	部品番号	メーカー
3	C1、C2	未実装	コンデンサ、セラミック	0603		
2	C3、C4	10uF	コンデンサ、セラミック、X5R、10V、10%	0805	LMK212BJ106KG-T	Taiyo Yuden
1	C5	47uF	コンデンサ、セラミック、X5R、16V、20%	1210	GRM32ER61C476ME15L	Murata
1	L1	4.7uH	インダクタ、マルチレイヤ、1.7A、165mΩ	1008	DFE252012P-4R7M	Toko
1	R1	1.00M	抵抗、チップ、1/16W、1%	0603	RC0603FR-071ML	Yageo
1	U1	TPS62745	IC、400nA I _Q の降圧コンバータ	2mm x 3mm WSON	TPS62745DSS	TI

6 改訂履歴

資料番号末尾の英字は改訂を表しています。その改訂履歴は英語版に準じています。

Changes from Revision * (June 2015) to Revision A (May 2021)	Page
• ユーザー ガイドのタイトルを更新.....	2
• ドキュメント全体にわたって表、図、相互参照の採番方法を更新。.....	2

STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an "EVM" or "EVMs") to the User ("User") in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.
 - 1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM ("Software") shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software
 - 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.
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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:

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.

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 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.

3.3 Japan

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/sds/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。

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

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.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けていないものがあります。技術適合証明を受けていないもののご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

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2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

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西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/sds/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。<https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-for-power-line-communication.html>

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.

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