

User's Guide

TPS62745 降压转换器评估模块用户指南



摘要

本用户指南介绍了德州仪器 (TI) TPS62745 评估模块 (EVM) 的特性、运行和使用。此 EVM 旨在帮助用户轻松评估和测试 TPS62745 的运行和功能。此 EVM 可将 2.2V 至 5.5V 的输入电压转换为 1.8V 至 3.3V 的稳压可输出电压，输出电流最高为 300mA。TPS62745 还具有负载开关和电源正常输出，同时具有 400nA 的超低静态电流。本用户指南包含硬件的设置说明、EVM 的印刷电路板 (PCB) 布局布线、原理图、物料清单 (BOM) 以及 EVM 的测试结果。

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1 简介

TPS62745 是一款采用 2mm x 3mm、10 引脚 SON 封装的 300mA 同步降压转换器。通过连接四个 VSELx 引脚，输出电压在器件内部固定。

1.1 背景

TPS62745EVM-622 使用 TPS62745 器件。该 EVM 在 3.3V 至 10V 之间的输入电压范围运行时，可实现全额定性能。

2 设置

本节介绍如何正确使用 TPS62745EVM-622。

2.1 输入/输出连接器说明

J1 - VIN	EVM 输入电源的正输入连接 (3.3V 至 10V)
J2 - S+/S-	输入电压感测连接。测量此处的输入电压。
J3 - GND	EVM 从输入电源的返回连接。
J4 - VOUT	输出电压连接。
J5 - S+/S-	输出电压感测连接。测量此处的输出电压。
J6 - GND	输出返回连接。
J7 - PG/GND	PG 输出位于该接头的引脚 1 上，在引脚 2 上 轻松接地。
J8 - VIN_SW	VIN 开关输出连接。
J9 - SW/GND	开关节点检测连接。
JP1 - EN	EN 引脚输入跳线。使提供的跳线跨接 ON 和 EN 以开启 IC。使跳线跨接 OFF 和 EN 以关断 IC。
JP2 - EN_VIN_SW	启用 VIN 开关跳线。使提供的跳线跨接 VIN_SW_ON 和 EN_VIN_SW，以激活 (闭合) 内部 VIN 开关。使跳线跨接 VIN_SW_OFF 和 EN_VIN_SW，以停用 (开路) 内部 VIN 开关。
JP3 至 JP6 - VSELx	这四个输入设定输出电压。通过将每个引脚连接至高电平或低电平，可根据 表 2-1 对输出电压进行编程。请勿将任何跳线保持开路状态，以确保正常运行。

表 2-1 提供了 TPS62745EVM-622 的输出电压设置。0 表示逻辑低电平，而 1 表示逻辑高电平。

表 2-1. 输出电压设置

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 运行

要运行 EVM，请按照节 2.1 所述将跳线 JP1 至 JP6 设置到所需位置。将输入电源连接到 J1 和 J3，并将负载连接到 J4 和 J6。

3 超低 IQ 器件的常见效率测量误差

效率是电源的常见测量。借助 TPS62745 等超低静态电流器件，测量误差可能会对测量的效率产生很大影响，尤其是在负载电流非常低 ($< 100\mu\text{A}$) 的情况下。

3.1 效率测量设置

要准确测量 TPS62745EVM-622 的效率，请使用 [SLVA236](#) 图 6 中所述的设置。不需要该应用手册中提到的“附加输入电容器”，因为 TPS62745EVM-622 中已经包含 C5。不建议使用任何额外的输入电容，因为这会导致输入端的漏电流增加，从而降低测量效率。

通过 [SLVA236](#) 中的设置测量效率时，必须特别注意从效率计算中去除测量仪器消耗的电流。此类测量仪器通常包括输入电压和输出电压万用表以及输入电源的遥感线（如果具有此功能）。进入这些点的电流会影响极轻负载下的测量效率。要克服这一问题，有两种可能的方法：测量流入这些点的电流（测量流入万用表和/或遥感线路的电流），然后从效率计算中减去该电流，或者只是将这些仪器从测试设置中移除。在极轻负载电流下，通常最好移除输入电源的遥感线路，然后测量进入输入和输出电压万用表的电流，以便获得最精确的效率测量结果。

3.2 上拉和下拉电阻器

除了 [节 3.1](#) 中所述的输入电容器和遥感线路，外任何上拉或下拉电阻都会消耗大量电流并影响测量效率。例如，如果使用 $1\text{M}\Omega$ 电阻将 VSEL2 引脚上拉至输入电压，并且该引脚通过 JP4 连接至低电平，则在 3.6V 输入电压下会从输入源汲取额外的 $3.6\mu\text{A}$ 。这将极大地影响极轻负载时的效率。因此，TPS62745EVM-622 上未使用上拉或下拉电阻器。根据器件数据表，最终应用电路应确保 TPS62745 的所有数字输入端接至高电平或低电平，而不是悬空。

4 电路板布局

本节提供了 TPS62745EVM-622 电路板布局布线和图示。光绘文件可在 EVM 产品页面上找到：
[TPS62745EVM-622](#)。

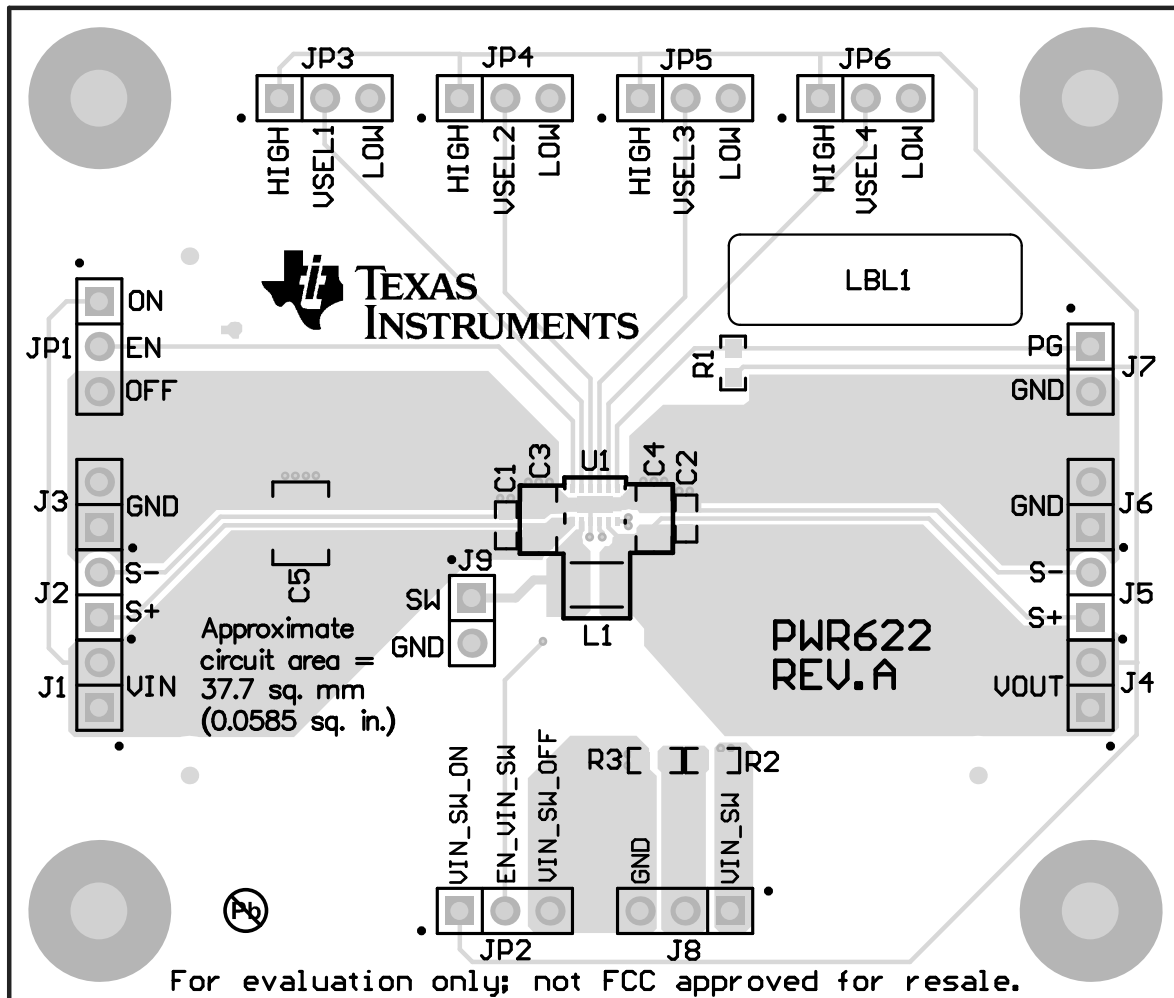


图 4-1. 装配层

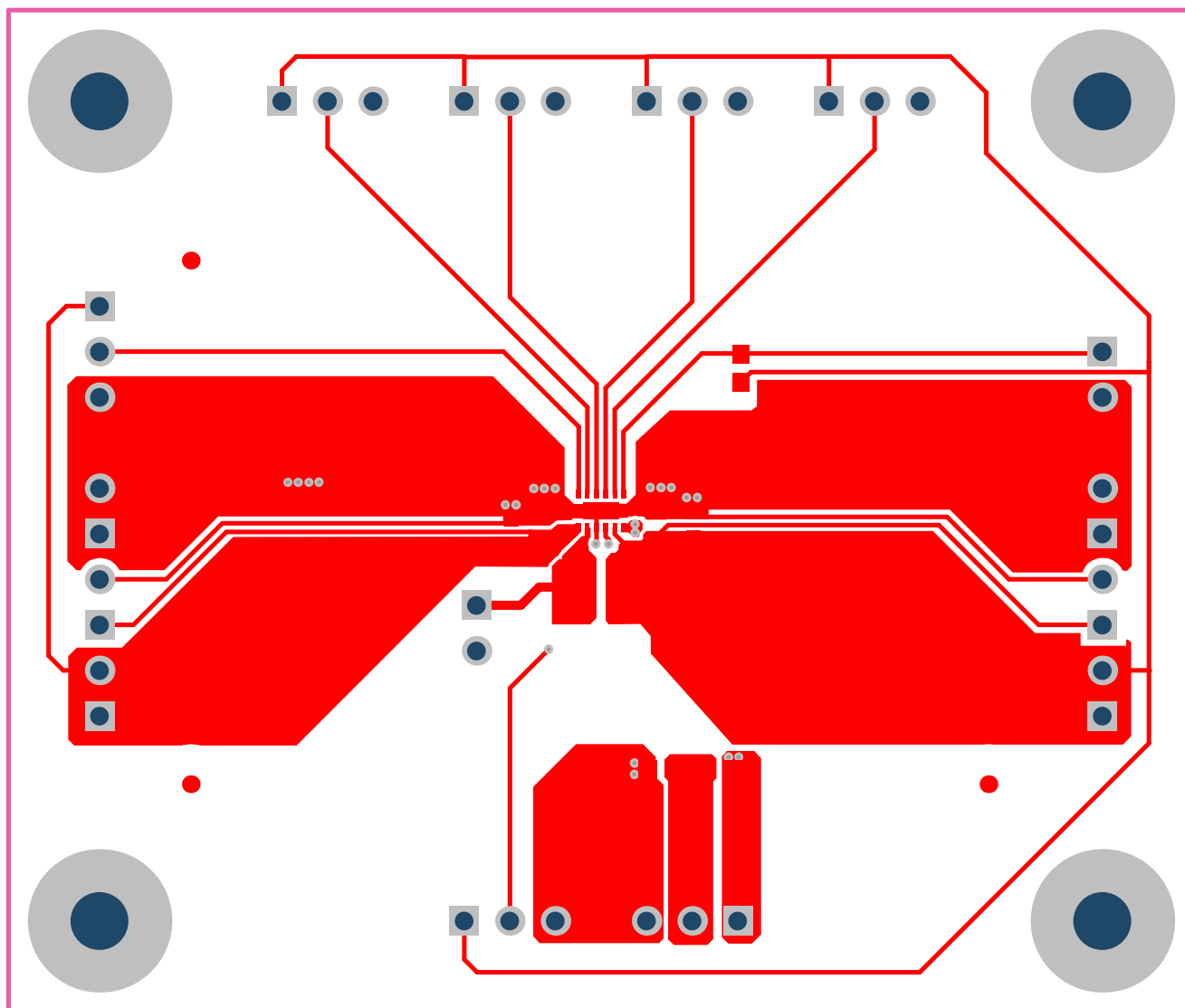


图 4-2. 顶层

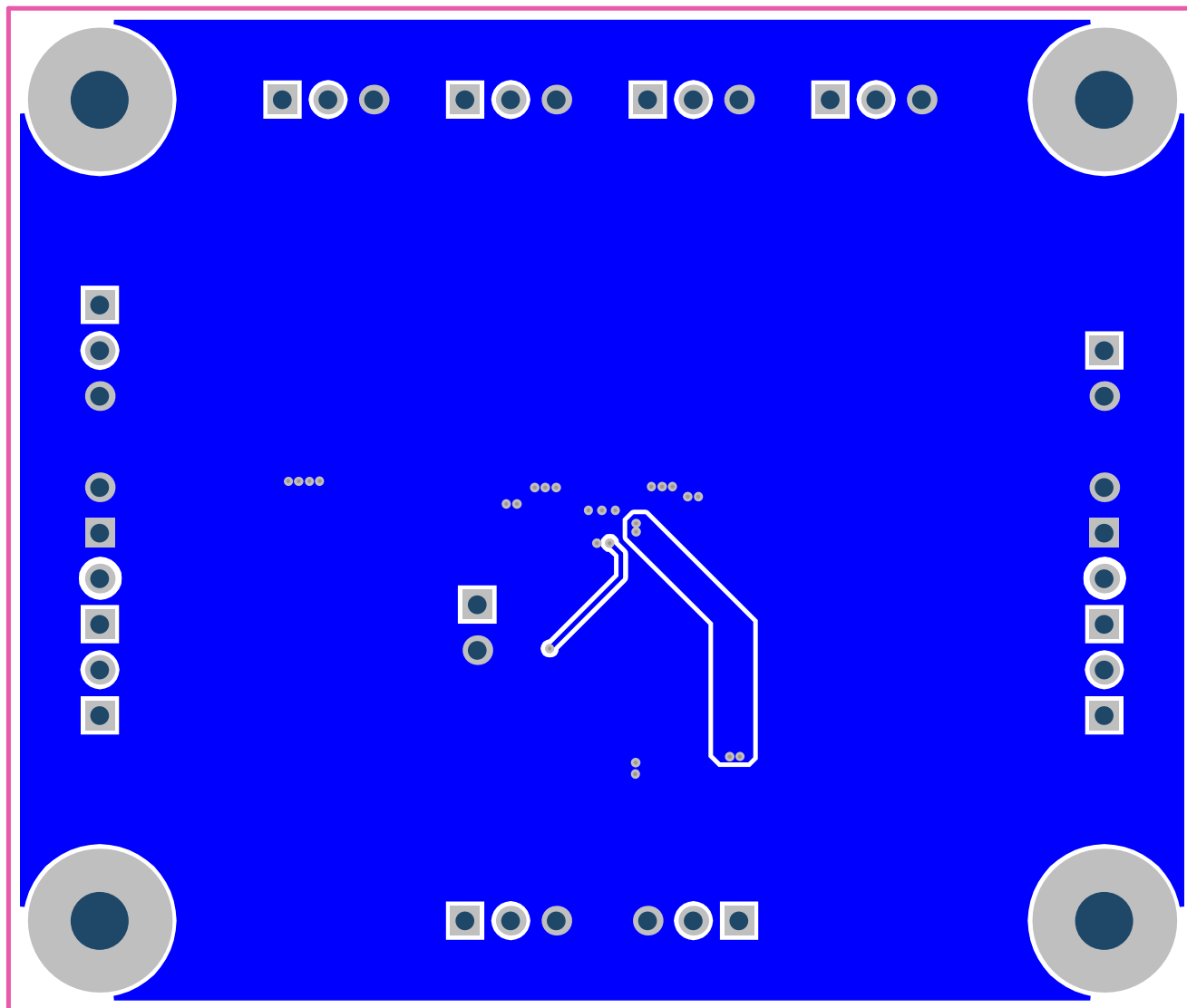


图 4-3. 底层

5 原理图和物料清单

本节提供了 TPS62745EVM-622 原理图和物料清单。

5.1 原理图

图 5-1 展示了 TPS62745EVM-622 原理图。

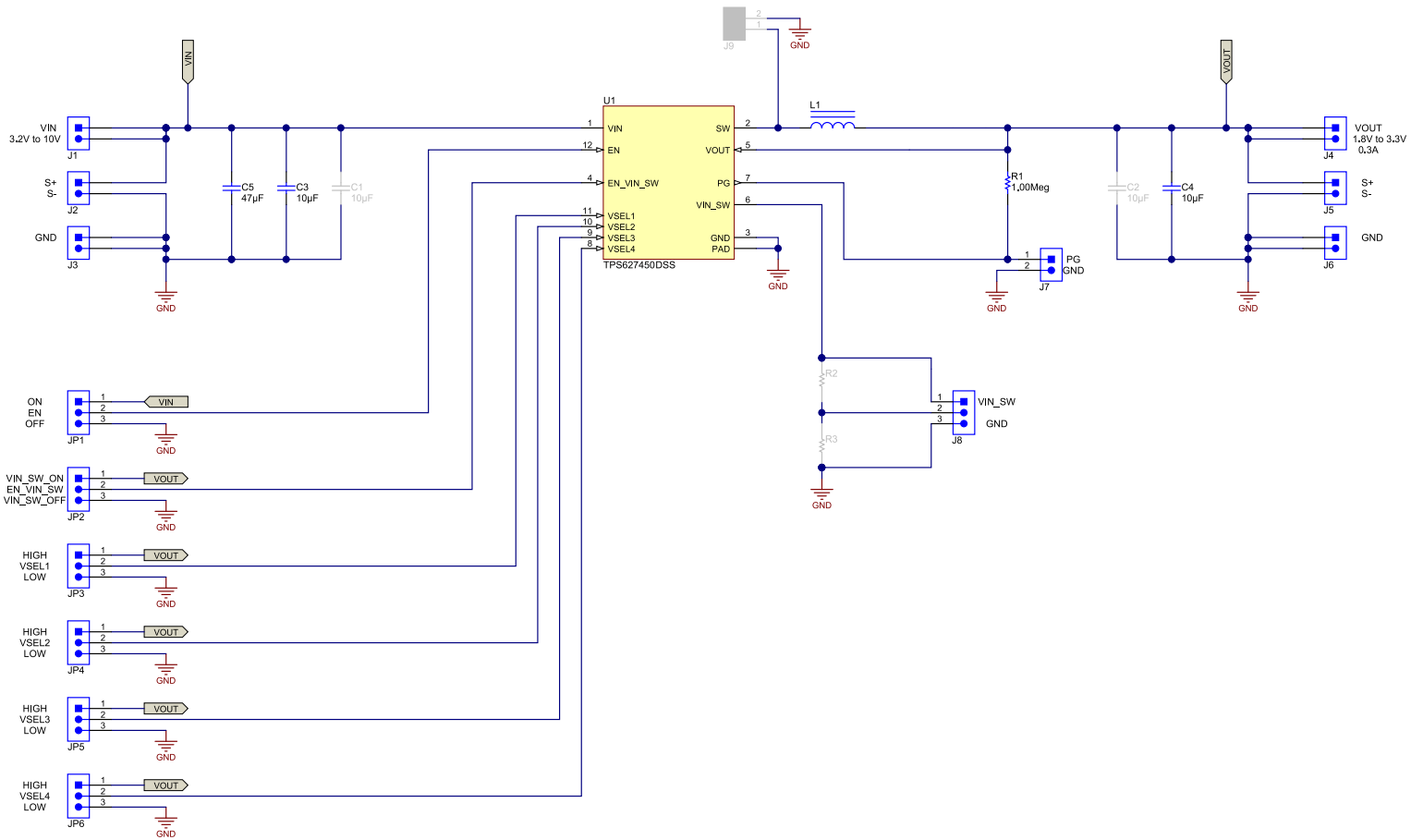


图 5-1. TPS62745EVM-622 原理图

5.2 物料清单

表 5-1 列出了 TPS62745EVM-622 物料清单。

表 5-1. TPS62745EVM-622 物料清单

数量	参考指示符	值	说明	尺寸	器件型号	制造商
3	C1, C2	未组装	电容, 陶瓷	0603		
2	C3、C4	10 μ F	电容器, 陶瓷, X5R, 10V, 10%	0805	LMK212BJ106KG-T	Taiyo Yuden
1	C5	47 μ F	电容器, 陶瓷, X5R, 16V, 20%	1210	GRM32ER61C476ME15L	Murata
1	L1	4.7 μ H	电感器, 多层, 1.7A, 165m Ω	1008	DFE252012P-4R7M	Toko (东光)
1	R1	1.00M	电阻, 贴片, 1/16W, 1%	0603	RC0603FR-071ML	Yageo
1	U1	TPS62745	IC, 400nA I _Q 降压转换器	2mm x 3mm WSON	TPS62745DSS	TI

6 修订历史记录

注：以前版本的页码可能与当前版本的页码不同

Changes from Revision * (June 2015) to Revision A (May 2021)	Page
• 更新了用户指南的标题.....	2
• 更新了整个文档中的表格、图和交叉参考的编号格式。.....	2

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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 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.

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.

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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:*

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