EVM User's Guide: TPS62A204QEVM-116

TPS62A204-Q1 Step-Down Converter Evaluation Module

Description

TPS62A204QEVM-116 is an evaluation board for the TPS62A20XQ family of automotive, synchronous step-down buck converters optimized for high efficiency and compact design size. TPS62A204QEVM-116 delivers an output current up to 4A. This EVM can be used for TPS62A20x-Q1 as well as for the TPS62A2Nx-Q1 series.

Get Started

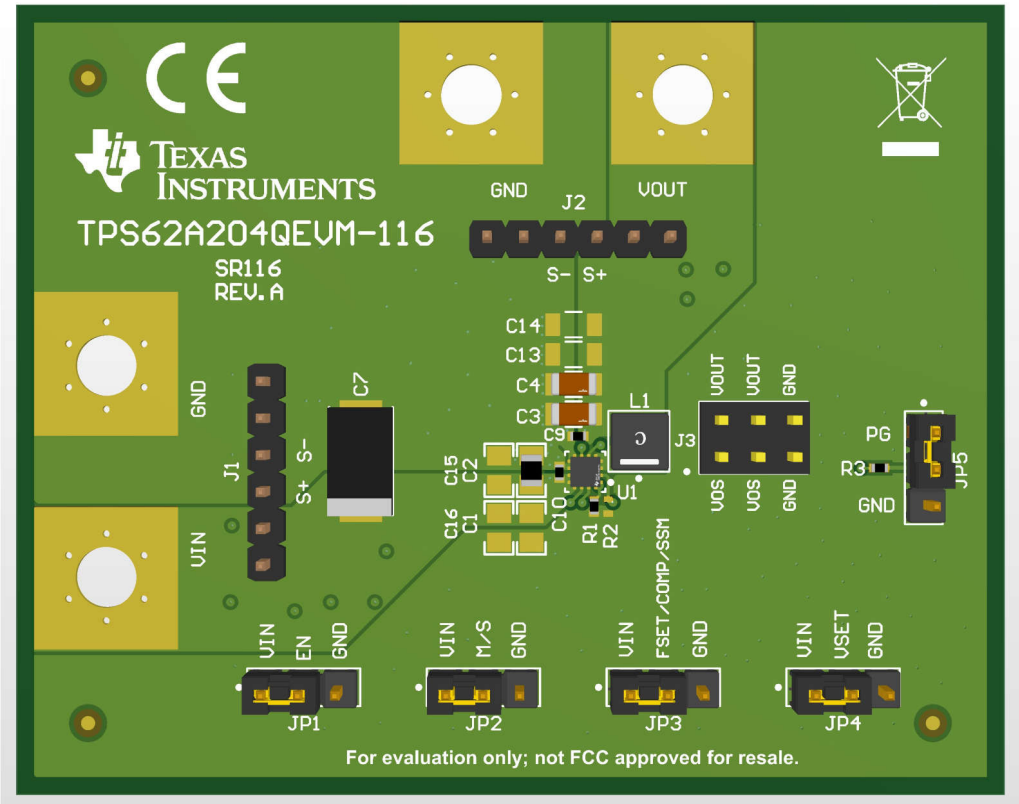
1. Order the EVM on ti.com.
2. Download the device data sheet on ti.com.
3. Use the data sheet to adjust the BOM with the device for desired output voltage.

Features

- Input voltage range: 2.75V to 6V
- Adjustable output voltage range: 0.4V to 3.6V
- Quiescent current: < 33µA
- Output voltage accuracy: 0.8% (–40°C to 150°C)
- Switching frequency: 1.5MHz to 4MHz
- Power save mode or PWM option available

Applications

- Front camera
- Surround view system ECU
- Automotive cluster display



TPS62A204QEVM-116

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 TPS62A20x-Q1 and TPS62A2Nx-Q1 series buck converters. EVM converts a 2.75V to 6V input voltage to a regulated 3.6V output voltage (JP4 tied to VIN) or 1.8V output voltage (JP4 tied to GND) that delivers up to 4A maximum. This user's guide describes the characteristics, operation, and use of ICs TPS62A20x-Q1 or TPS62A2Nx-Q1. The document includes setup instructions for the following:

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

TPS62A204QEVM-116 has TPS62A204DQWRZXRQ1 IC on board. One can change the IC on board for other OPNs depending upon use case.

1.2 Kit Contents

Table 1-1. TPS62A204QEVM-116 Kit Contents

Item	Description	Quantity
TPS62A204QEVM-116	PCB	1

1.3 Specification

Table 1-2. Performance Specification Summary

Specification	Test Conditions	MIN	TYP	MAX	Unit
Input voltage		2.75		6	V
Output voltage	JP4 VSET tied to VIN		3.6		V
	JP4 VSET tied to GND		1.8		
Output current	TPS62A204QEVM-116	0		4	A

1.4 Device Information

The PCB for this EVM is designed to accommodate the adjustable voltage version of this IC. On the EVM, desired output voltage can be set by adjusting the resistor with the VSET pin. Additional input and output capacitors can also be added. Mode can be set by connecting JP2 to VIN for FPWM or by connecting to GND for PFM. The switching frequency of the device can be adjusted by resistor R1 with CONF (FSET/COMP/SSM) pin. On the EVM, CONF pin is connected to VIN with JP3.

2 Hardware

2.1 Setup

This section describes how to properly use the TPS62A204QEVM-116.

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
JP2– M/S (Mode/Sync)	M/S pin can be connected to VIN for FPWM by jumper or connected to GND for PFM mode.
JP1 – EN	EN pin jumper. Place the supplied jumper across VIN and EN to turn on the IC. Place the jumper across GND and EN to turn off the IC.
JP3 – FSET/COMP/SSM(CONF)	This pin can be connected to VIN or GND or with resistor to GND according to required setting. Refer to CONF pin configuration options in the *TPS62A20x-Q1 and TPS62A2Nx-Q1: 2.75V to 6V Input, 1A, 2A, 3A, 4A Automotive, Fast Transient, Synchronous Step-Down Converter* data sheet.
JP5 – PG Pullup Voltage	PG pin pullup voltage jumper. Place the supplied jumper on JP5 to connect the PG pin pullup resistor to the output 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 5.5V.

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 the user. Additional input and output capacitors according to the output voltage can be added. Also, the output voltage can be changed with the help of resistor with the VSET pin. Please check the startup output voltage table in the data sheet.

2.2.1 Input and Output Capacitors

C1, C15 and C16 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.

C13 and C14 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 *TPS62A20x-Q1 and TPS62A2Nx-Q1: 2.75V to 6V Input, 1A, 2A, 3A, 4A Automotive, Fast Transient, Synchronous Step-Down Converter* data sheet for proper operation. Please check section 9.1.1.3 for selecting the output capacitors.

3 Hardware Design Files

3.1 Schematic

Figure 3-1 illustrates the EVM schematic of TPS62A204QEVM-116.

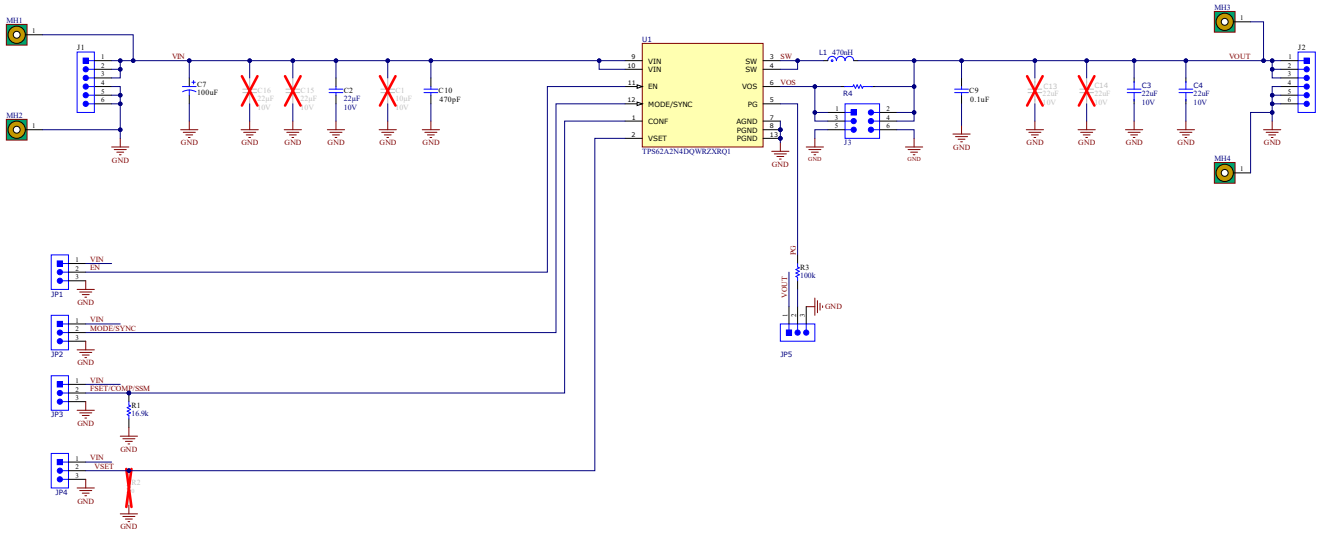


Figure 3-1. TPS62A204QEVM-116 Schematic

3.2 PCB Layouts

This section provides the board layout and illustrations of TPS62A204QEVM-116, which is also valid for all the variants of TPS62A20x-Q1 and TPS62A2Nx-Q1 series. TPS62A204QEVM is a 4 layer PCB.

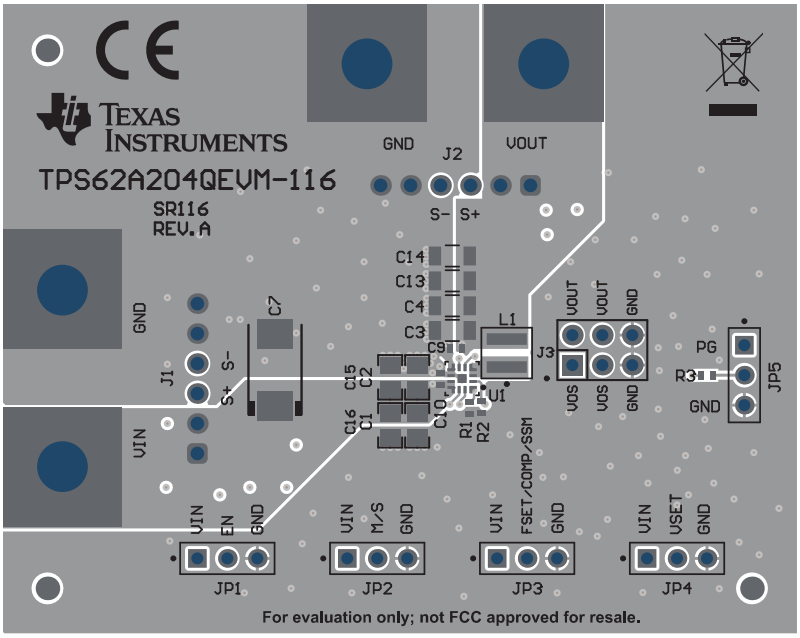


Figure 3-2. Top View Mask

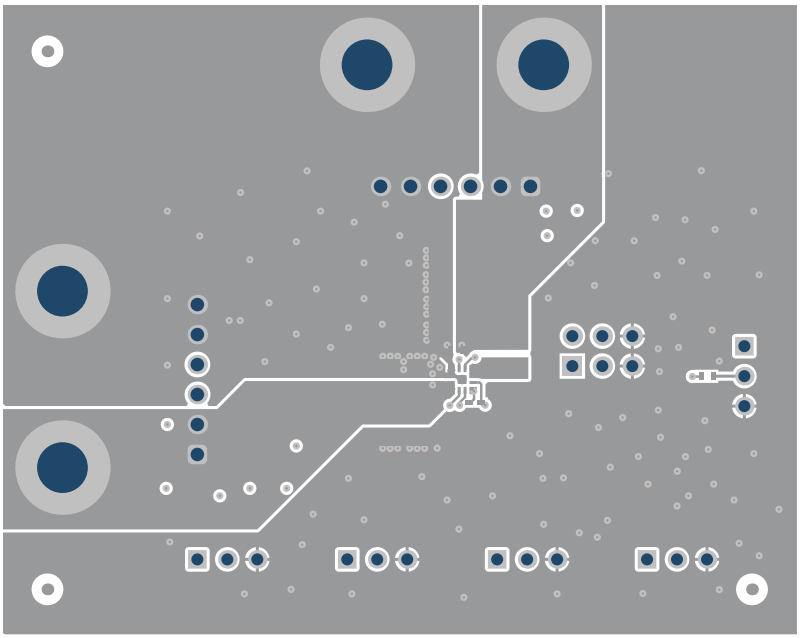


Figure 3-3. Top Layer

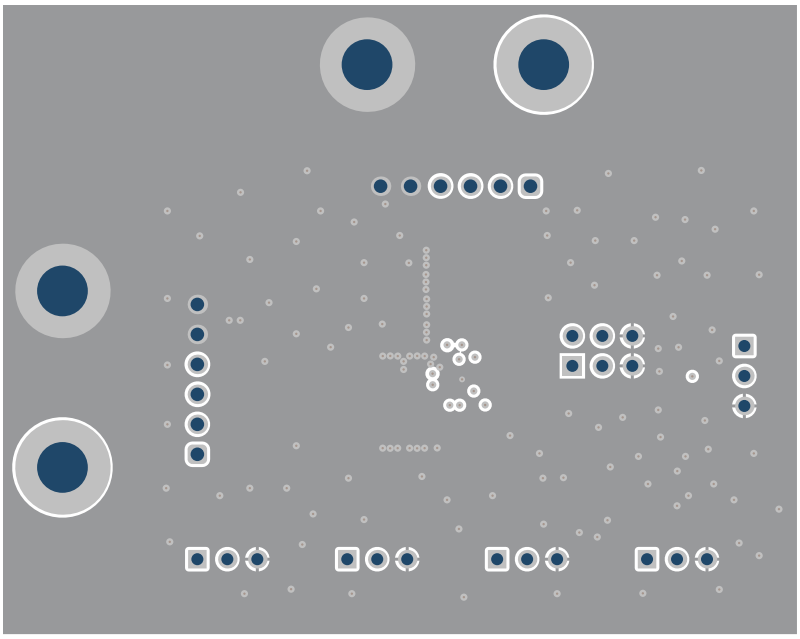


Figure 3-4. Signal Layer 1

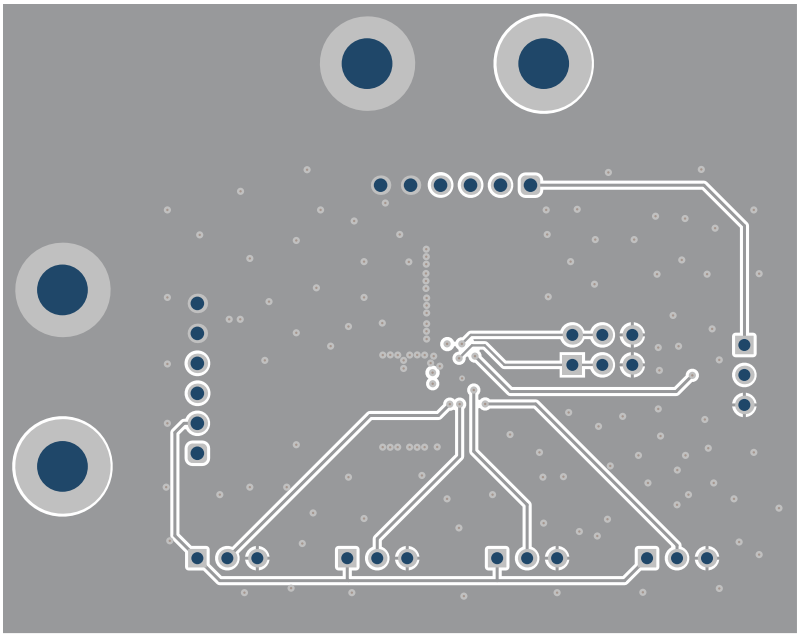


Figure 3-5. Signal Layer 2

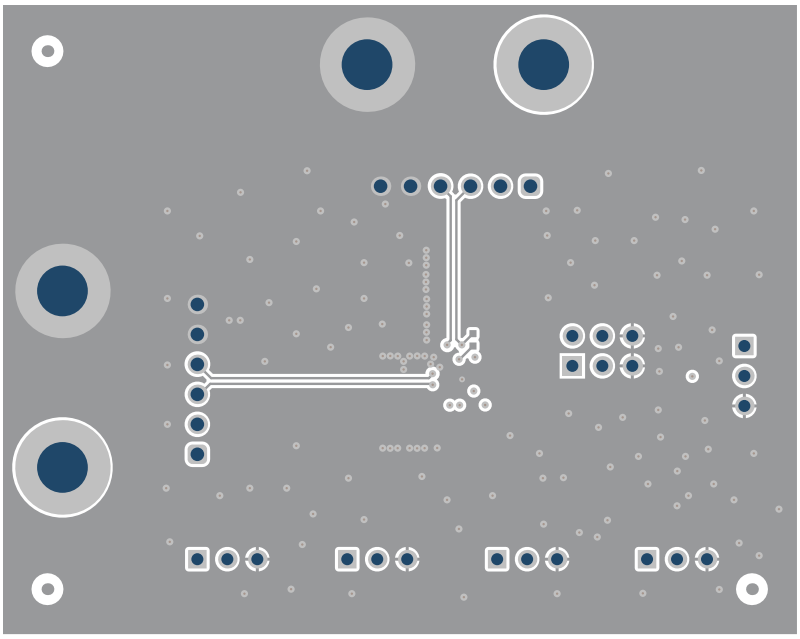


Figure 3-6. Bottom Layer

3.3 Bill of Materials (BOM)

Table 3-1 lists the bill of materials for this EVM.

Table 3-1. TPS62A204QEVM-116 Bill of Materials

Quantity TPS62A204QEVM-116	Ref Des	Value	Description	Size	Part Number	MFR
1	C1	10uF	Capacitor, Ceramic, 10V, X7R, ±10%	0805	GRM21BR71A106KE51L	Murata
1	C2	22uF	Capacitor, Ceramic, 10V, X7R, ±20%	0805	GRM21BZ71A226ME15L	Murata
1	C3,C4	22uF	Capacitor, Ceramic, 10V, X7R, ±20%	1206	GCM31CR71A226KE02L	Murata
1	C7	100uF	Capacitor, Tantalum Polymer, 20V, ±20%	7.3x4.3mm	C0402C104K4RACAUTO	Kemet
1	C9	0.1uF	Capacitor, Ceramic, 16V, X7R, ±10%	0402	C0402C104K4RACAUTO	Kemet
1	C10	470pF	Capacitor, Ceramic, 50V, ±10%	0402	CGA2B2X7R1H471K050BA	TDK
1	L1	0.47 uH	Inductor, Shielded, 14.2A, 0.0039Ω	4040 metric	XGL4030-471MEC	Coilcraft
1	R1	16.9k	Resistor, Chip, 0.063W, 1%	0402	Std	Std
1	R3	100k	Resistor, Chip, 0.0625W, 1%	0402	Std	Std
1	R4	0	Resistor, Chip	0402	Std	Std
1	U1	TPS62A204DQWRZXRQ1	IC, 6V, 4A Step-Down Converter with Fast Transient Response	2.1 × 2.1mm	TPS62A204DQWRZXRQ1	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 product folder of TPS62A204-Q1.

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.

   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.

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 DEGREDATION 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/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。

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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2. 実験局の免許を取得後ご使用いただく。
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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.

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.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

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