

TPS62A212-Q1 Buck Converter Evaluation Module



Description

The TPS62A212EVM-059 is designed to help the user easily evaluate and test the operation and functionality of the TPS62A2xx-Q1 buck converters, which are intended for automotive application. The EVM converts a 2.7V to 6.0V input voltage to a regulated 1.2V output voltage with 0.8% accuracy at output current up to 12A.

Get Started

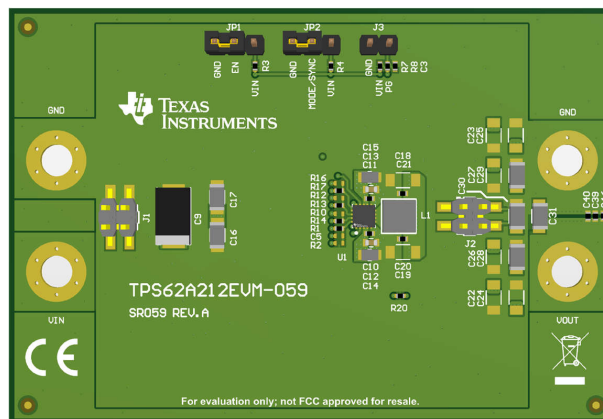
1. Order the TPS62A212EVM-059.
2. Refer to the [TPS62A2xx-Q1 2.7V to 6V Input, 8A, 10A, 12A Automotive Fast Transient Synchronous Step-Down Converter datasheet](#).
3. Use the following platforms to assist with component selection:
 - a. Models: WEBENCH® circuit design and selection simulation services, SIMPLIS, Gerber files, and calculator sheet

Features

- Input voltage range from 2.7V to 6.0V
- Resistor selectable start-up output voltage range from 0.4V to 3.3V
- Resistor selectable switching frequency from 1.5MHz, 2.25MHz, 2.5MHz, or 4MHz
- Resistor selectable compensation settings
- Power save mode for light-load efficiency

Applications

- [ADAS domain controller](#)
- [Digital cockpit processing unit](#)
- [Driver monitoring](#)
- [Front camera](#)



TPS62A212EVM-059 (Top View)

1 Evaluation Module Overview

1.1 Introduction

This user's guide describes the characteristics, operation, and use of TI's evaluation module (EVM) for the TPS62A2xx-Q1 devices. The TPS62A212EVM-059 can be used to evaluate the TPS62A208-Q1, TPS62A210-Q1, and TPS62A212-Q1 device family. The EVM converts 2.7V to 6.0V input voltage to a regulated 1.2V output voltage and switching frequency set at 2.5MHz. The output current can go up to 12A for the TPS62A212EVM-059. This user's guide includes setup instructions for the hardware, a printed-circuit board (PCB) layout, a schematic diagram, and a bill of materials (BOM).

1.2 Kit Contents

Table 1-1. TPS62A212EVM-059 Kit Contents

Item	Description	Quantity
TPS62A212EVM-059	PCB	1

1.3 Specification

Table 1-2 provides a summary of the TPS62A212EVM-059 performance specifications.

Table 1-2. Performance Specification Summary

Specification		Test Conditions	MIN	TYP	MAX	Unit
Input voltage			2.7		6.0	V
Output voltage setpoint				1.2		V
Output current	TPS62A212EVM-059		0		12.0	A

1.4 Device Information

The TPS62A2xx-Q1 are synchronous, step-down, DC/DC converters implementing a PLL constant-on-time control scheme that supports fast transients with fixed-frequency operation. The TPS62A208-Q1, TPS62A210-Q1, TPS62A212-Q1 are a family of pin-to-pin 8A, 10A, 12A synchronous, step-down DC/DC converters with WQFN 3mm × 3mm package. The converter has a 2.7V to 6.0V input voltage range with resistor selectable start-up output voltage range from 0.4V to 3.3V. Low resistive switches allow for high-efficiency operation at high output currents and at high ambient temperatures. The switching frequency of the devices is externally adjustable from 1.5MHz to 4MHz through R2D at the CONF pin and can also be synchronized to an external clock in the same frequency range on the MODE/SYNC pin. In auto mode, the TPS62A2xx-Q1 automatically enters power save mode at light loads to maintain high efficiency across the whole load range. For more details, please see the [TPS62A2xx-Q1 2.7V to 6V Input, 8A, 10A, 12A Automotive Fast Transient Synchronous Step-Down Converter datasheet](#).

2 Hardware

2.1 Setup

This section describes how to correctly use the TPS62A212EVM-059.


2.1.1 Connector Descriptions

MH1 – VIN	Positive input voltage connection from the input supply for the EVM.
J1.1, J1.3 – VINsense	Input voltage sense connections, measure the input voltage at this point.
J1.2, J1.4 – GNDsense	
MH2 – GND	Input return connection from the input supply for the EVM.
MH3 – VOUT	Positive output voltage connection.
J2.3, J2.4 – VOUTsense	Output voltage sense connections, measure the output voltage at this point.
J2.1, J2.2 – GNDsense	
MH4 – GND	Output return connection.
JP1 – EN	EN pin jumper. Place the supplied jumper across ON and EN to turn on the IC. Place the jumper across OFF and EN to turn off the IC.
JP2	MODE/SYNC pin jumper. Place the supplied jumper across MODE/SYNC and GND to force the device in fixed frequency PWM operation at all load currents. Place the jumper across VIN and MODE/SYNC to enable power save mode. Leave the pin floating and connect a clock signal to MODE/SYNC referenced to GND to synchronize the switching frequency to the external clock signal.
J3 – PG	The PG output appears on pin 1 of this header with a convenient ground on pin 2.

2.1.2 Hardware Setup

To operate the EVM, set jumpers at JMP1 to the desired positions per [Section 2.1.1](#). Connect the input supply to MH1 and MH2, between VIN and GND, and connect the load to MH3 and MH4 between VOUT and GND.

2.2 Caution

	<p>CAUTION</p> <p>Hot surface. Contact can cause burns. Do not touch!</p>
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3 Implementation Results

3.1 TPS62A212EVM-059 Test Results

The TPS62A212EVM-059 is used to take the typical characteristics data in the TPS62A2xx-Q1 datasheet. See the [TPS62A2xx-Q1 2.7V to 6V Input, 8A, 10A, 12A Automotive Fast Transient Synchronous Step-Down Converter datasheet](#) for the performance of this EVM.

3.2 Modifications

The printed-circuit board (PCB) for this EVM is designed to accommodate the different output current versions of this integrated circuit (IC). On the EVM, additional input and output capacitors can be added and the default output voltage, switching frequency, and compensation settings can be changed.

3.2.1 Input and Output Capacitors

Footprints for additional input capacitors as well as for additional output capacitors are provided. These capacitors are not required for proper operation but can be used to reduce the input and output voltage ripple and to improve the load transient response. For proper operation, the total output capacitance must remain within the recommended range described in the [TPS62A2xx-Q1 2.7V to 6V Input, 8A, 10A, 12A Automotive Fast Transient Synchronous Step-Down Converter datasheet](#).

3.2.2 Output Voltage Setting

The output voltage of U1 is set to a default of 1.2V. Other default voltages can be set using appropriate values for the VSET pin resistors R7 and R8 to change between 64 different voltage setpoints. For corresponding Vout settings, see the [TPS62A2xx-Q1 2.7V to 6V Input, 8A, 10A, 12A Automotive Fast Transient Synchronous Step-Down Converter datasheet](#).

3.2.3 Compensation

The Comp pin is connected to the resistors R10 and R11, which are used to change the compensation setting of the control loop. The EVM has a COMP setting of 3.75, and R10 and R11 can be changed to make adjustments to the 16 different internal compensation settings. For more details, see the [TPS62A2xx-Q1 2.7V to 6V Input, 8A, 10A, 12A Automotive Fast Transient Synchronous Step-Down Converter datasheet](#).

3.2.4 Switching Frequency

The CONF pin is connected to the resistors R12 and R13 to adjust the switching frequency. The EVM has the default setting of 2.5MHz, and R12 and R13 can be changed to make adjustments to the switching frequency from 1.5MHz, 2.25MHz, 2.5MHz, and 4MHz. For more details, see the [TPS62A2xx-Q1 2.7V to 6V Input, 8A, 10A, 12A Automotive Fast Transient Synchronous Step-Down Converter datasheet](#).

4 Hardware Design Files

4.1 Schematic

Figure 4-1 shows the TPS62A212EVM-059 schematic.

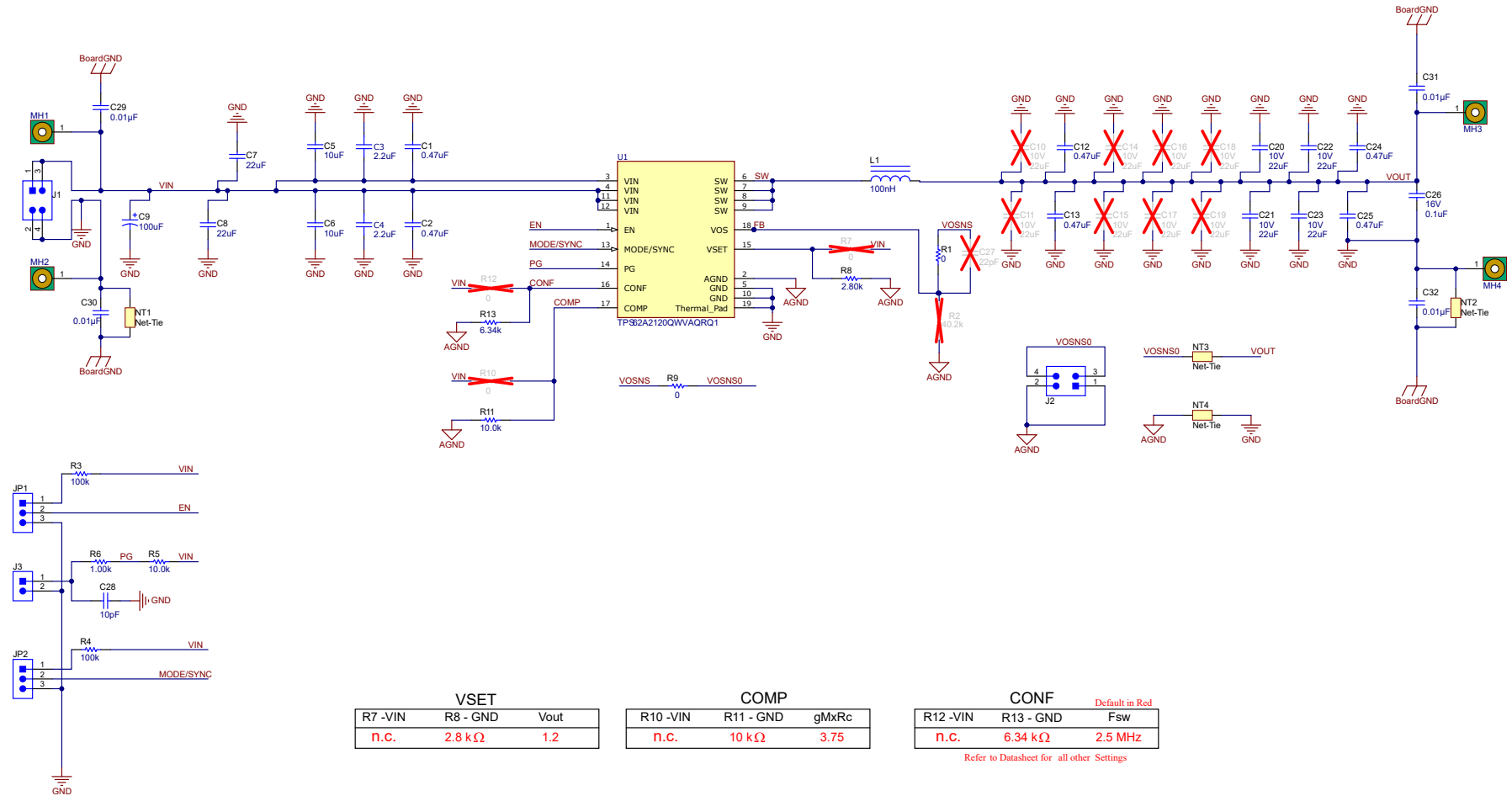


Figure 4-1. TPS62A212EVM-059 Schematic

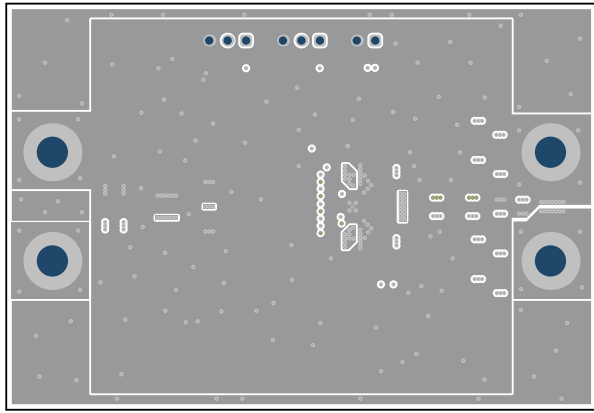


Figure 4-8. Signal Layer 5

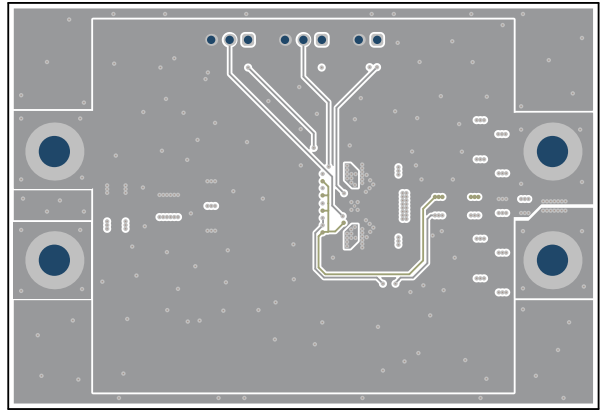


Figure 4-9. Signal Layer 6

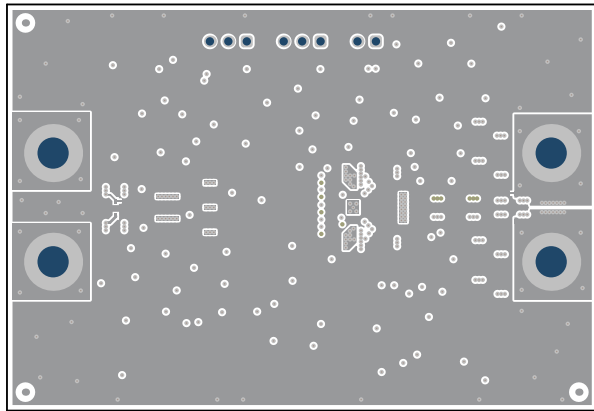


Figure 4-10. Bottom Layer

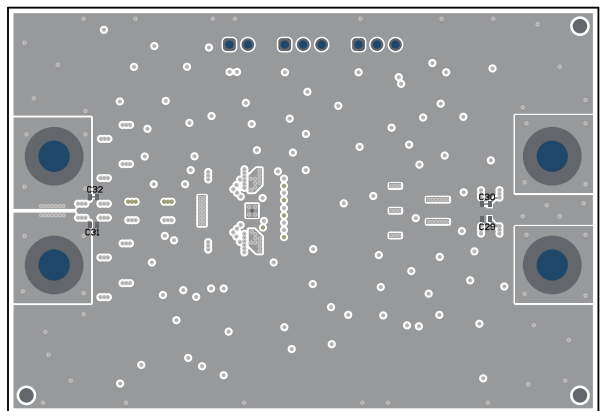


Figure 4-11. Bottom View

4.3 Bill of Materials (BOM)

The following table shows the bill of materials for TPS62A212EVM-059.

Table 4-1. Bill of Materials

Item	Designator	Quantity	Value	Part Number	Manufacturer	Description	Package Reference
1	!PCB	1		SR059	Any	Printed Circuit Board	
2	C1, C2, C12, C13, C24, C25	6	0.47uF	GCM155C71A474KE36D	MuRata	CAP, CERM, 0.47uF, 10V,+/- 10%, X7S, 0402	0402
3	C3, C4	2	2.2μF	CGA3E3X7S1A225K080AB	TDK	Cap Ceramic 2.2uF 10V X7S 10% Pad SMD 0603 +125°C Automotive T/R	0603
4	C5, C6	2	10uF	GCM21BR71A106KE22L	MuRata	CAP, CERM, 10uF, 10V, +/- 10%, X7R, 0805	0805
5	C7, C8, C20, C21, C22, C23	6	22uF	GCM31CR71A226KE02L	MuRata	CAP, CERM, 22uF, 10V, +/- 10%, X7R, AEC-Q200 Grade 1, 1206	1206
6	C9	1	100uF	20TQC100MYF	Panasonic	CAP, Tantalum Polymer, 100uF, 20V, +/- 20%, 0.055ohm, 7.3x4.3mm SMD	7.3x4.3mm
7	C26	1	0.1uF	GRM155R61C104KA88D	MuRata	CAP, CERM, 0.1uF, 16V, +/- 10%, X5R, 0402	0402
8	C28	1	10pF	GCM1555C1H100JA16D	MuRata	CAP, CERM, 10pF, 50V,+/- 5%, C0G/NP0, AEC-Q200 Grade 1, 0402	0402
9	C29, C30, C31, C32	4	0.01uF	CGA2B3X8R1H103K050BB	TDK	CAP, CERM, 0.01 μF, 50V,+/- 10%, X8R, AEC-Q200 Grade 0, 0402	0402
10	FID4, FID5, FID6	3		N/A	N/A	Fiducial mark. There is nothing to buy or mount.	N/A
11	J1, J2	2		TSM-102-01L-DV	Samtec	Header, 2.54mm, 2x2, Gold, SMT	Header, 2.54mm, 2x2, SMT
12	J3	1		61300211121	Würth Elektronik	Header, 2.54mm, 2x1, Gold, TH	Header, 2.54mm, 2x1, TH
13	JP1, JP2	2		61300311121	Würth Elektronik	Header, 2.54mm, 3x1, Gold, TH	Header, 2.54mm, 3x1, TH
14	L1	1	100nH	XEL4030-101MEB	Coilcraft	Inductor, Shielded, 100nH, 20.4A, 0.0018ohm, SMD	4x4mm
15	R1, R9	2	0	CRCW04020000Z0ED	Vishay-Dale	RES, 0, 5%, 0.063W, AEC-Q200 Grade 0, 0402	0402
16	R3, R4	2	100k	CRCW0402100KFKED	Vishay-Dale	RES, 100k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402
17	R5, R11	2	10.0k	CRCW040210K0FKED	Vishay-Dale	RES, 10.0k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402
18	R6	1	1.00k	CRCW04021K00FKED	Vishay-Dale	RES, 1.00k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402

Table 4-1. Bill of Materials (continued)

Item	Designator	Quantity	Value	Part Number	Manufacturer	Description	Package Reference
19	R8	1	2.80k	CRCW04022K80FKED	Vishay-Dale	RES, 2.80k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402
20	R13	1	6.34k	CRCW04026K34FKED	Vishay-Dale	RES, 6.34k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402
21	SH-J1, SH-J2	2	1x2	SNT-100-BK-G	Samtec	Shunt, 100mil, Gold plated, Black	Shunt
22	U1	1		TPS62A2120QWVAQRQ1	Texas Instruments	2.7V to 6V Input, 12A Automotive Fast Transient Synchronous Step-Down Converter	WQFN-FCRLF18
23	C10, C11, C14, C15, C16, C17, C18, C19	0	22uF	GCM31CR71A226KE02L	MuRata	CAP, CERM, 22uF, 10V, +/- 10%, X7R, AEC-Q200 Grade 1, 1206	1206
24	C27	0	22pF	GCM1555C1H220JA16D	MuRata	CAP, CERM, 22pF, 50V, +/- 5%, C0G/NP0, AEC-Q200 Grade 1, 0402	0402
25	FID1, FID2, FID3	0		N/A	N/A	Fiducial mark. There is nothing to buy or mount.	N/A
26	R2	0	40.2k	CRCW040240K2FKED	Vishay-Dale	RES, 40.2k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	0402
27	R7, R10, R12	0	0	CRCW04020000Z0ED	Vishay-Dale	RES, 0, 5%, 0.063W, AEC-Q200 Grade 0, 0402	0402

5 Additional Information

5.1 Trademarks

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All trademarks are the property of their respective owners.

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 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/lstds/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。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
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。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

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3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lstds/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.

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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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