*EVM User's Guide: TPSM828303AEVM-245*

# *TPSM82830xAEVM Evaluation Module*

## Description

TPSM82830xAEVM evaluation module (EVM) is a simple, easy-to-use synchronous step-down DC/DC power module with integrated inductor. The EVM is available for different output current versions such as TPSM828301AEVM for 1A, TPSM828302AEVM for 2A and TPSM828303AEVM for 3A. The EVMs regulate the output voltage to 1.8 V with the input voltage from 2.25 V to 5.5V.

## Get Started

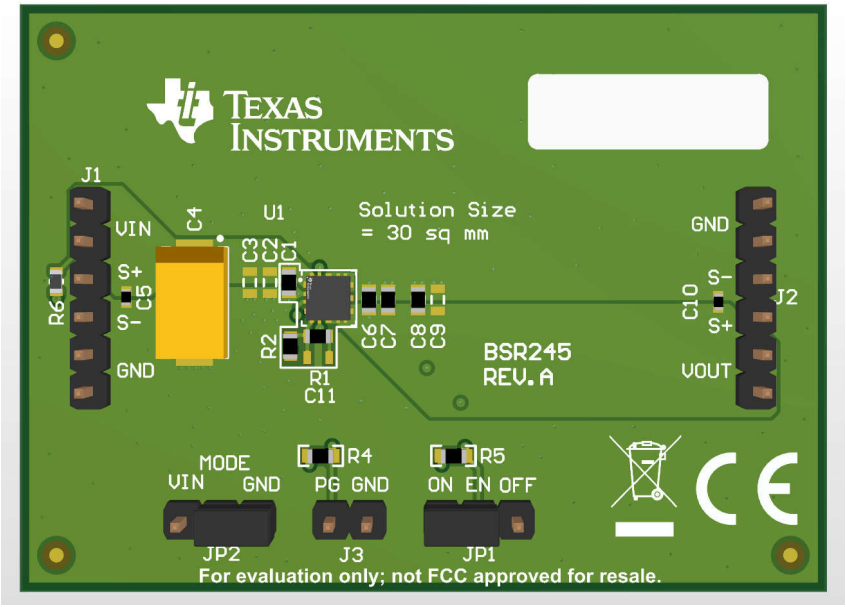
1. Order the EVM on ti.com.
2. Download the data sheet (SLVSGM1).
3. Use data sheet or WEBENCH® to modify the output voltage & to change the input &/or output capacitors.

## Features

- 2.25-V to 5.5-V input voltage range
- 0.5-V to 4.5-V adjustable output voltage
- 1% FB voltage accuracy (–40°C to 125°C $T_J$)
- 2.0-MHz switching frequency
- DCS-Control topology
- Optimized EMI performance
- Facilitates CISPR 11/32 compliance
  - Integrated on-chip noise-filtering capacitors
  - Measurements according to CISPR available
- Excellent transient response
- MODE pin, power-good output
- Supports 1.2-V GPIO
- 100% duty cycle for lowest dropout
- Active output discharge
- Thermal shutdown protection
- Hiccup or latch-off OCP/OVP

## Applications

- Factory automation and control
- Industrial PC
- ASIC, SoC, and MCU supply
- Generic point of load




**TPSM82830xAEVM Hardware Image (Top View)**

# 1 Evaluation Module Overview

## 1.1 Introduction

The TPSM82830xAEVM facilitates the evaluation of the TPSM82830x 1-A, 2-A and 3-A pin to pin compatible step-down converter power modules in a 3.0-mm × 3.0-mm × 2-mm QFN package. BSR245A-001 uses the 1-A TPSM828301 device, BSR245A-002 uses the 2-A TPSM828302 device and BSR245A-003 uses the 3-A TPSM828303 device. The EVMs regulate the output voltage to 1.8 V with the input voltage from 2.25 V to 5.5V. This user's guide describes the characteristics, operation, and use of the TPSM82830xAEVM Evaluation Module (EVM) with a complete schematic diagram, printed circuit board layouts, and bill of materials are included in this document.

## 1.2 Kit Contents

**Table 1-1. TPSM82830xAEVM Kit Contents**

| Item | Description | Quantity |
|---|---|---|
| TPSM82830xAEVM | PCB | 1 |

## 1.3 Specifications

**Table 1-2. Performance Specifications Summary**

| SPECIFICATIONS | | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|
| Input voltage | | | 2.25 | | 5.5 | V |
| Output voltage setpoint | | | | 1.8 | | V |
| Output current | TPSM828301AEVM | | 0 | | 1.0 | A |
| | TPSM828302AEVM | | 0 | | 2.0 | A |
| | TPSM828303AEVM | | 0 | | 3.0 | A |

## 1.4 Device Information

The EVM is for TPSM82830x device family. The TPSM82830x is a family of pin-to-pin compatible 1-A, 2-A and 3-A high efficiency and easy to use synchronous step-down DC/DC power modules with integrated inductors. Based on the DCS-Control topology, the device provides a fast transient response with small output capacitance. The internal reference allows to regulate the output voltage down to 0.5 V with a high feedback voltage accuracy of 1% over the junction temperature range of –40°C to 125°C. The nominal switching frequency is 2 MHz with a controlled variation over the input voltage range. The MODE pin allows for an easy selection for the mode of operation. If PSM is selected, the converter operates in DCM at light load conditions with a reduced switching frequency to maintain a high efficiency, and seamlessly transition to CCM as the load current increases to medium or heavy ranges. If forced-PWM is selected, the converter maintains a CCM operation regardless of the load current to maintain a minimum output voltage ripple. The family offers excellent EMI performance and comes in a 3-mm × 3-mm × 2-mm QFN package.

# 2 Hardware

## 2.1 Setup

This section describes how to correctly use the TPSM82830xAEVM.

### 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. |
| **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** | MODE pin jumper. Place the supplied jumper across VIN and MODE to force the device in fixed frequency PWM operation at all load currents. Place the jumper across MODE and GND to enable power save mode |
| **J3 – PG/GND** | 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 JP1 and JP2 to the desired positions per Section 2.1.1. Connect the input supply to J1 between VIN and GND and connect the load to J2 between VOUT and GND. J3 can be left floating.

## 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 or a feedforward capacitor can be added. Also, the MODE setting and output voltage setting can be changed. Finally, the loop response of the TPSM82830xAEVM can be measured.

### 2.2.1 Input and Output Capacitors

Footprints for additional input capacitors (C2, C3) and output capacitor (C9) 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 TPSM82830x 5.5-V input, 1-A / 2-A/ 3-A Step-down Module with Integrated Inductor in a QFN Package.

### 2.2.2 Setting The Output Voltage

This EVM can be configured for evaluation of the adjustable output voltage. Default output voltage setting is 1.8 V on TPSM82830xAEVM. Resistors R1 and R2 can be used to set the output voltage between 0.5-V and 4.5-V For calculating R1& R2, see the TPSM82830x 5.5-V input, 1-A / 2-A/ 3-A Step-down Module with Integrated Inductor in a QFN Package.

### 2.2.3 Loop Response Measurement

The loop response of the TPSM82830xAEVM can be measured by cutting the trace parallel to R3 and assembling a 50-Ω resistor as R3 to inject the noise signal.

# 3 Implementation Results

## 3.1 TPSM82830xAEVM Test Results

The TPSM82830xAEVM was used to take the typical characteristics data in the TPSM82830x data sheet (SLVSGM1). See the TPSM82830x 5.5-V input, 1-A / 2-A/ 3-A Step-down Module with Integrated Inductor in a QFN Package for the performance of this EVM.

# 4 Hardware Design Files

## 4.1 Schematic

Figure 4-1 shows the EVM schematic.

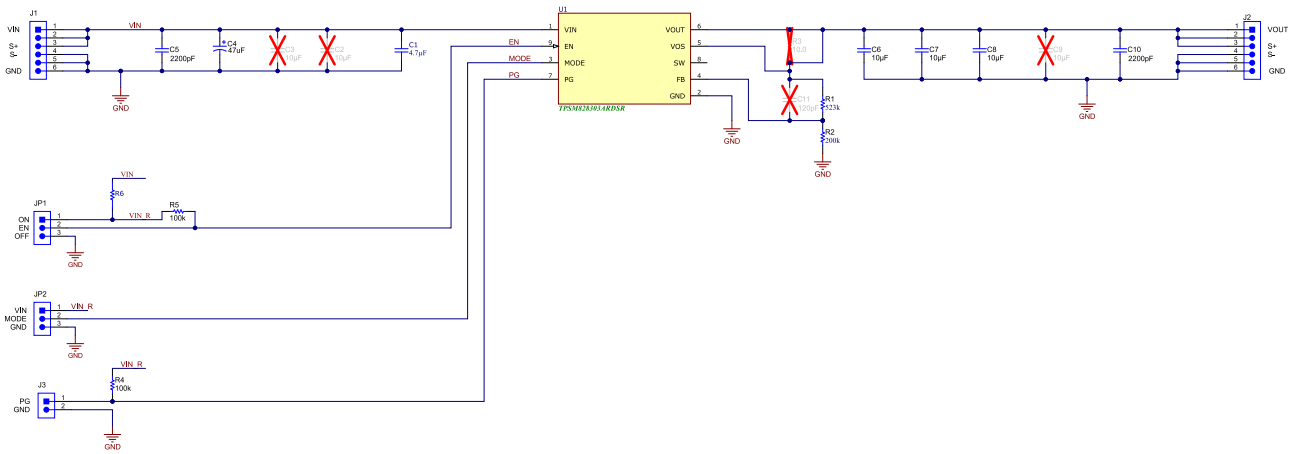



**Figure 4-1. TPSM82830xAEVM Schematic**

## 4.2 PCB Layouts

This section provides the TPSM82830xAEVM board layout. See the TPSM82830xAEVM tool page for more details.

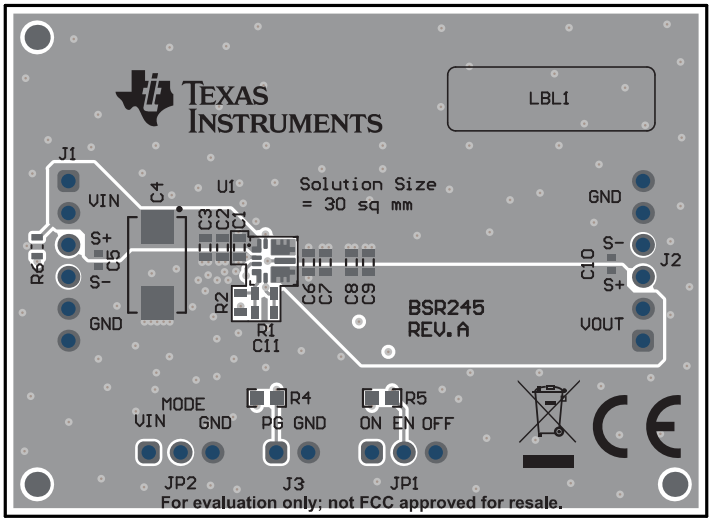



**Figure 4-2. Top Silk**

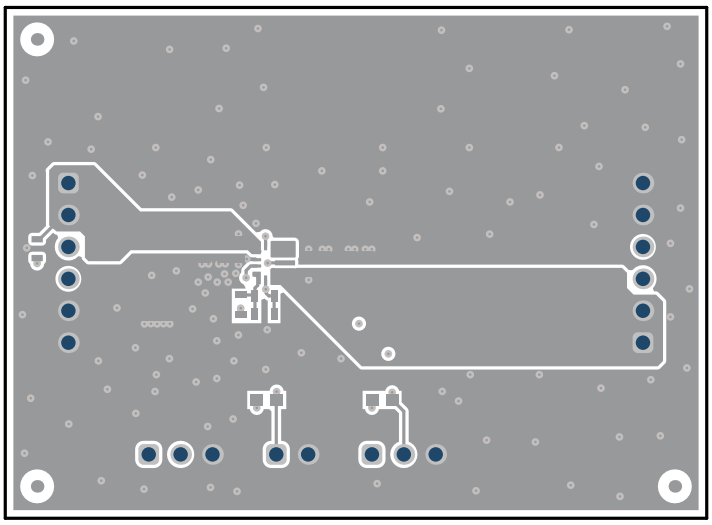


**Figure 4-3. Top Layer**

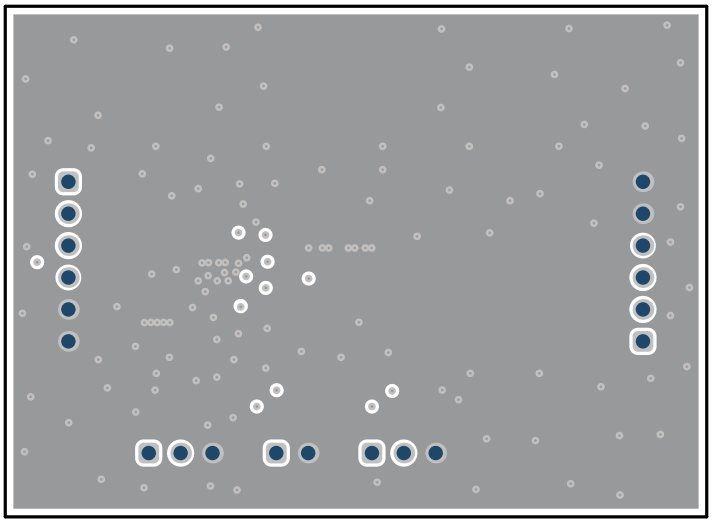


**Figure 4-4. Signal Layer 1**

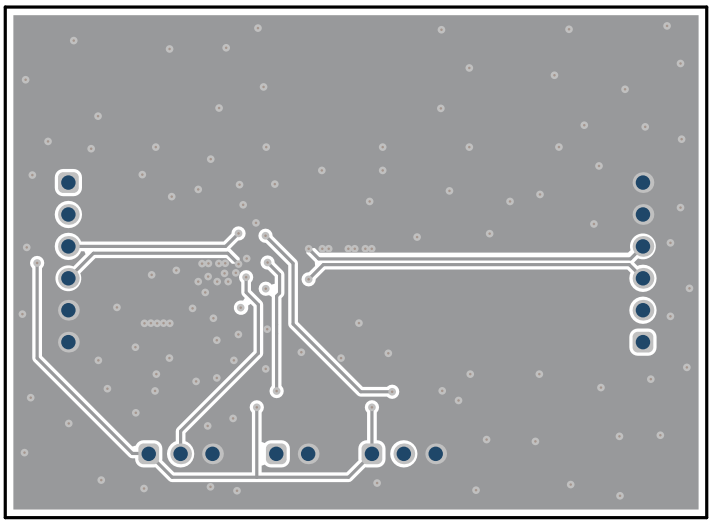


**Figure 4-5. Signal Layer 2**

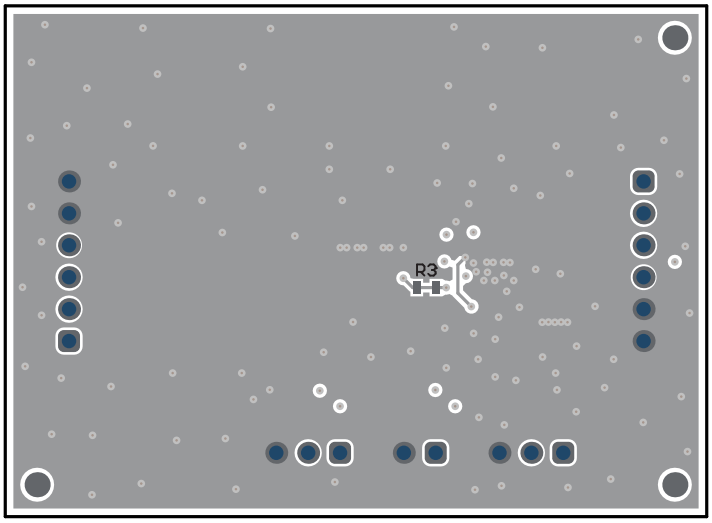



**Figure 4-6. Bottom Layer**

## 4.3 Bill of Materials

Table 4-1 lists the bill of materials for this EVM.

**Table 4-1. TPSM82830xAEVM Bill of Materials**

| QTY | | | REF DES | VALUE | DESCRIPTION | SIZE | PART NUMBER | MFR |
|---|---|---|---|---|---|---|---|---|
| -001 | -002 | -003 | | | | | | |
| 1 | 1 | 1 | C1 | 4.7 µF | Ceramic Capacitor, 6.3V, X7R | 0603 | JMK107BB7475KA-T | Taiyo Yuden |
| 1 | 1 | 1 | C4 | 47 µF | Tantalum Capacitor, 35 V | 7343 | T495X476K035ATE300 | Kemet |
| 2 | 2 | 2 | C5, C10 | 2200 pF | Ceramic Capacitor, 50 V, X7R | 0402 | GRM155R71H222KA01D | MuRata |
| 3 | 3 | 3 | C6, C7, C8 | 10 µF | Ceramic Capacitor, 10 V, X7R | 0603 | GRM188Z71A106KA73D | MuRata |
| 1 | 1 | 1 | R1 | 523 kΩ | Resistor 1%, 0.1 W | 0603 | | any |
| 1 | 1 | 1 | R2 | 200 kΩ | Resistor 1%, 0.1 W | 0603 | | any |
| 2 | 2 | 2 | R4, R5 | 100 kΩ | Resistor 1%, 0.1 W | 0603 | | any |
| 1 | 1 | 1 | R6 | 1 kΩ | Resistor 1%, 0.1 W | 0603 | | any |
| 0 | 0 | 1 | U1 | | 2.25-V to 5.5-V Adjustable Output voltage Step-Down Power Module | QFN | TPSM828303ARDSR | Texas Instruments |
| 0 | 1 | 0 | U1 | | 2.25-V to 5.5-V Adjustable Output voltage Step-Down Power Module | QFN | TPSM828302ARDSR | Texas Instruments |
| 1 | 0 | 0 | U1 | | 2.25-V to 5.5-V Adjustable Output voltage Step-Down Power Module | QFN | TPSM828301ARDSR | Texas Instruments |

# 5 Additional Information

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**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.

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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

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

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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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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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