

DRV591 PWM Power Driver Evaluation Module

User's Guide

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Mailing Address:

Texas Instruments
Post Office Box 655303
Dallas, Texas 75265

EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the supply voltage range of 2.8 V to 5.5 V.

Exceeding the specified supply range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the supply range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's 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, some circuit components may have case temperatures greater than 125°C. The EVM is designed to operate properly with certain components above 125°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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Post Office Box 655303
Dallas, Texas 75265

Preface

How to Use This Manual

This document contains the following chapters:

- ☐ Chapter 1—Introduction
- ☐ Chapter 2—Operating Instructions

Related Documentation From Texas Instruments

- ☐ **DRV591** data sheet (literature number SLOS389).

FCC Warning

This equipment is intended for use in a laboratory test environment only. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to subpart J of part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

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Introduction

This chapter provides an overview of the Texas Instruments (TI) DRV591VFP high-efficiency power driver amplifier evaluation module. It includes a list of EVM features, a brief illustrated description of the module, and a list of EVM specifications.

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1.1 Feature Highlights

The DRV591VFP evaluation module includes the following features:

- ☐ PWM operation with full output filter
- ☐ High efficiency
- ☐ Small solution size
- ☐ Low supply current in active and shutdown modes
- ☐ LEDs and test points for fault monitoring
- ☐ Jumpers for selecting device options
- ☐ Easy connections for inputs, outputs, and power supply

1.2 Description

The DRV591VFP PWM power driver evaluation module is a complete power stage solution. It consists of the TI DRV591VFP PWM power driver IC along with a few discrete passive components required for operation. It also includes jumpers for configuring the features of the device, LEDs and test points for fault monitoring, and a full output filter that may be easily modified. The 5-way jacks for the inputs, outputs, and power supply provide for ease of connection to any system, from an existing design to a bread-boarded prototype.

1.3 EVM Specifications

Supply voltage range, V_{DD} 2.8 V to 5.5 V
Supply current, I_{DD} 3.1 A max

Operating Instructions

Follow the steps in this chapter to quickly prepare the DRV591VFP EVM for use.

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2.1 Precautions

Power Supply Input Polarity and Maximum Voltage

Always ensure that the polarity and voltage of the external power connected V_{DD} power input connector J8 is correct. Overvoltage or reverse-polarity power applied to this terminal can damage the evaluation module.

2.2 Operating Instructions List

Figure 2–1. Top View

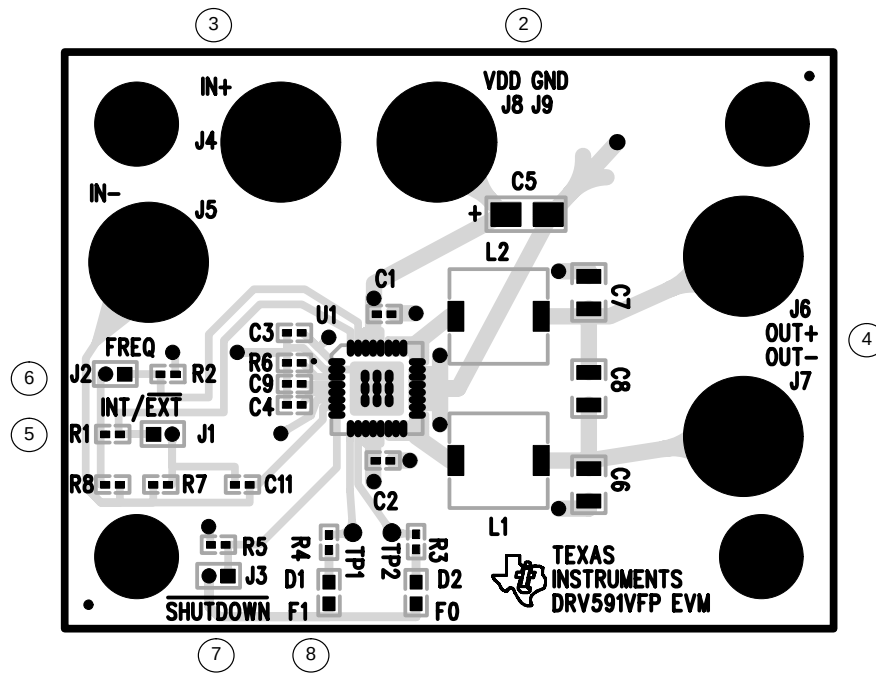


Table 2–1. Typical Jumper Settings

J1 (INT/EXT)	J2 (FREQ)	J3 (SHUTDOWN)
ON	ON	ON

☐ Power supply

- 1) Ensure that all external power sources are set to OFF.
- 2) Connect a 2.8-V to 5.5-V power supply to J8 (V_{DD}) and J9 (GND), taking care to observe proper polarity.

□ Inputs and outputs

- 3) Connect a dc control voltage to J4 (IN+) ranging from ground to V_{DD} . The terminal J5 (IN-) is held to $V_{DD}/2$ with a resistor voltage divider, as shown in the schematic. Therefore, a dc control voltage of $V_{DD}/2$ provides 0-V output from OUT+ to OUT-.

If a different bias or offset is required, the voltage divider resistors R1 and R2 may be replaced. The value of R1 and R2 in parallel should not exceed 1 k Ω to minimize gain error due to imbalance in the impedance of the differential input stage. Alternatively, the resistor divider may be removed and a different common voltage output (such as from an op-amp buffer or a power supply) may be connected to J5 (IN-).

Note:

The common mode input range of the DRV591VFP is 1.2 V to 3.8 V when using a 5-V supply, and 1.2 V to 2.1 V when using a 3.3-V supply. Refer to the DRV591 data sheet, TI literature number SLOS389.

- 4) Connect a load across J6 (OUT+) and J7 (OUT-). The polarity of the connection depends on the operation of the dc control voltage. As the voltage at IN+ becomes greater than the voltage at IN-, the voltage at OUT+ increases, causing current to flow from OUT+ to OUT-. Similarly, as the voltage at IN+ decreases lower than IN-, the voltage at OUT- increases, causing current to flow from OUT- to OUT+.

For example, consider the load to be a TEC element and the dc control voltage to be the output of a temperature control circuit. In this example, as temperature increases the output of the temperature control circuit increases. The TEC element should therefore be connected with the anode at OUT+ and the cathode at OUT- to ensure that the TEC element cools when the temperature increases.

□ Evaluation module jumpers, LEDs, and test points

- 5) Jumper J1 (INT/ $\overline{\text{EXT}}$) should be ON for normal operation.

When J1 is ON, the internal oscillator is used to generate the switching outputs. When J1 is OFF, an external TTL-compatible clock signal may be driven into the COSC pin of the DRV591VFP. The capacitor C9 must be removed and a wire may be soldered to the pad closest to the IC for connecting the external clock.

- 6) Jumper J2 (FREQ) should be ON for normal operation.

When J2 is ON, the device is configured for 500-kHz operation.

When J2 is OFF, the device is configured for 100-kHz operation. However, capacitor C9 must be removed and replaced with a 1-nF capacitor for proper operation.

- 7) Jumper J3 ($\overline{\text{SHUTDOWN}}$) should be ON for normal operation. (Remove J1 to place the DRV591VFP in shutdown mode.)

If an external shutdown control signal is to be used, it should be connected to the right-hand pin of J1 (which is connected to resistor R3). The control signal must be TTL-compatible; a logic high provides normal operation, a logic low places the DRV591VFP in shutdown.

- 8) The LED D1 lights if FAULT1 is active and LED D2 lights if FAULT0 is active. If external fault monitoring is to be used, test point TP1 is connected to FAULT1 and test point TP2 is connected to FAULT0. The pins and test points go low when a fault is present, lighting the LEDs. The faults are shown in the table below. Refer to the DRV591 data sheet (SLOS389) for additional information on the fault indicators.

Table 2–2. Fault Indicators

FAULT1	FAULT0	
0	0	Overcurrent
1	0	Undervoltage
0	1	Overtemperature
1	1	Normal operation

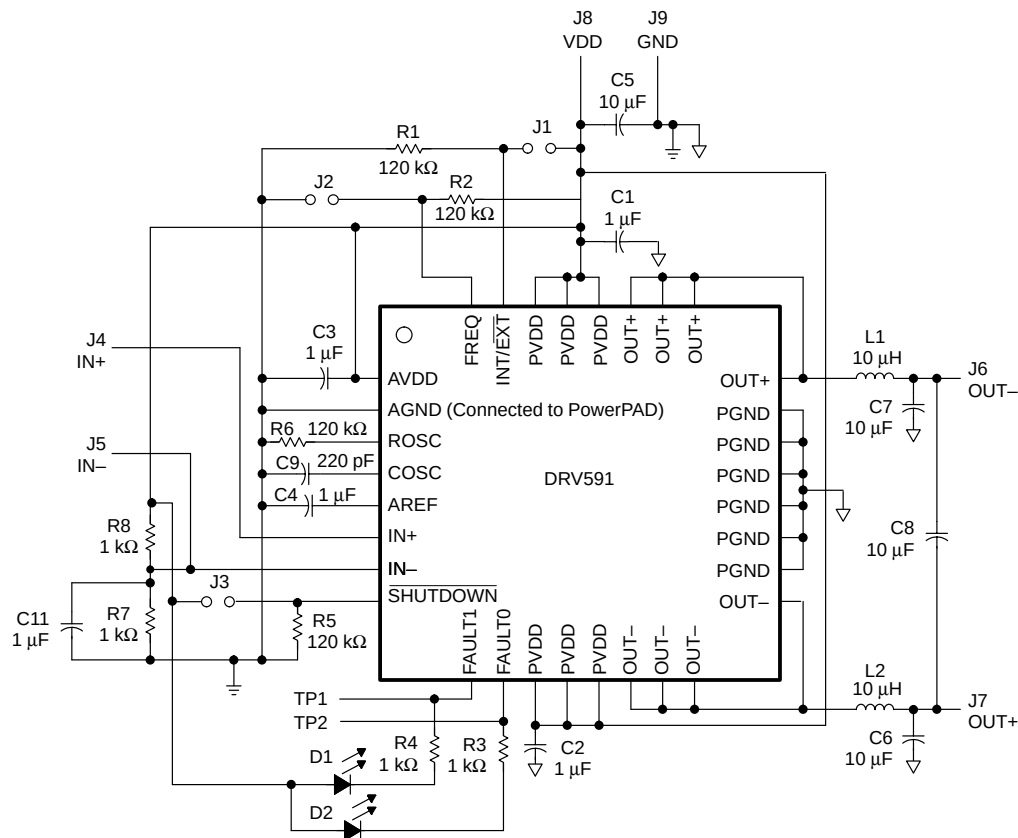
Note: 0 = LED ON (Fault) 1 = LED OFF (Normal)

☐ Power up

- 9) Verify correct voltage, input polarity, and set the external power supply to ON. The EVM will begin operation.

2.2.1 DRV591VFP EVM Schematic

Figure 2–2. DRV591VFP EVM Schematic Diagram



2.2.2 DRV591VFP EVM Bill of Materials

Table 2–3. DRV591VFP EVM Bill of Materials

Reference	Description	Size	Qty.	MFG	Part #	Vendor/#
C1–4, C11	Capacitor, ceramic, 1 μ F, $\pm 10\%$, X5R, 6.3 V	0603	5	Panasonic	ECJ1VB0J105K	Digi-Key/ PCC1915CT-ND
C5–C8	Capacitor, ceramic, 10 μ F, $\pm 10\%$, X5R, 16 V	1210	4	Panasonic	ECJ-4YB1C106K	Digi-Key/ PCC2169CT-ND
C9	Capacitor, ceramic, 220 pF, $\pm 10\%$, X7R	0603	1	Panasonic	ECUV1J221KBV	Digi-Key/ PCC221BVCT-ND
C10	Capacitor (not assembled)					
R1, R2, R5, R6	Resistor, chip, 120 k Ω , 1/16 W, 1%	0603	4	Phycomp	9C06031A1203F KHFT	Digi-Key/ 311-120KHCT-ND
R3, R4, R7, R8	Resistor, chip, 1 k Ω , 1/16 W, 1%	0603	4	Phycomp	9C06031A1001F KHFT	Digi-Key/ 311-1.00KHCT-ND
D1, D2	LED, red, 2 V, 140° view angle	0805	2	Lumex	SML–LXT0805IW	Digi-Key/ 67–1552–2–ND
L1, L2	Inductor, SMT, 10 μ H, 0.026 m Ω DCR (typical), 4.4 A max dc current		2	Sumida	CDRH104R-100	Harvey King/ CDRH104R–100
L3, L4	Chip bead (not assembled)	1806	2			
J1, J2, J3	Header, 2 position	2 mm	3	Norcomp	2163-2-01-P2	Digi-Key/ 2163S-02-ND
	Shunts	2 mm	3	3M	953170-00	Digi-Key/ 953170-00
TP1, TP2	Test points		2			Farnell/240-333
IN–, IN+, V _{DD} , GND, OUT+, OUT– (J5–J9)	Uninsulated binding post with knurled thumb, nut-grounded type		6	Johnson Components	111-2223-001	Digi-Key/J587-ND
	Standoffs	4–40	4			Digi-Key/534-1804
U1	DRV591, 32-pin Quad Flatpack		1	TI	DRV591VFP	TI/DRV591VFP

2.2.3 DRV591VFP EVM PCB Layers

Figure 2–3. Top Layer

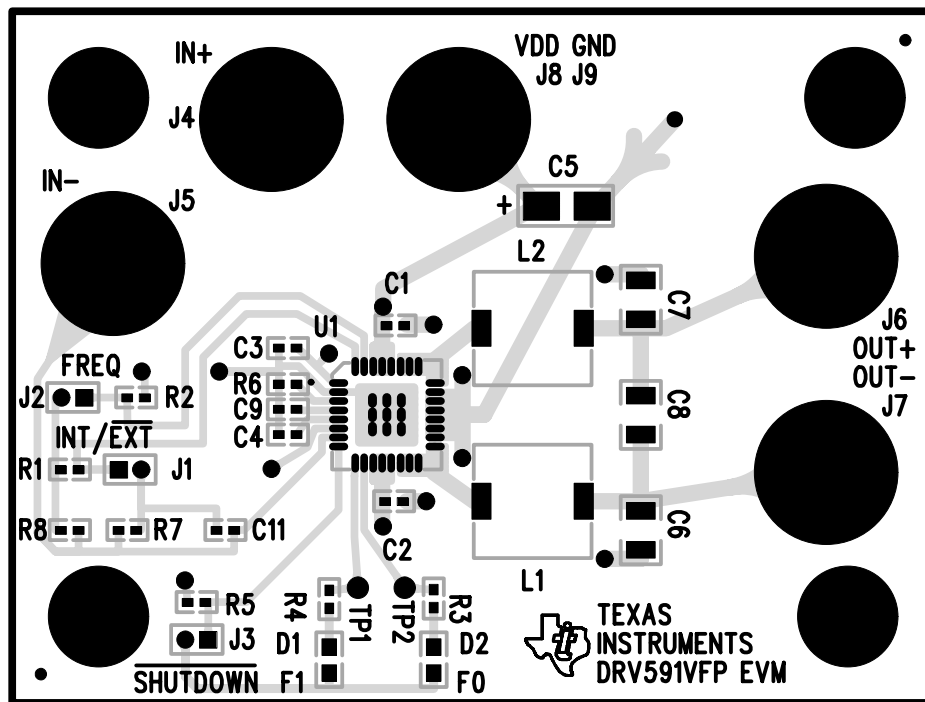
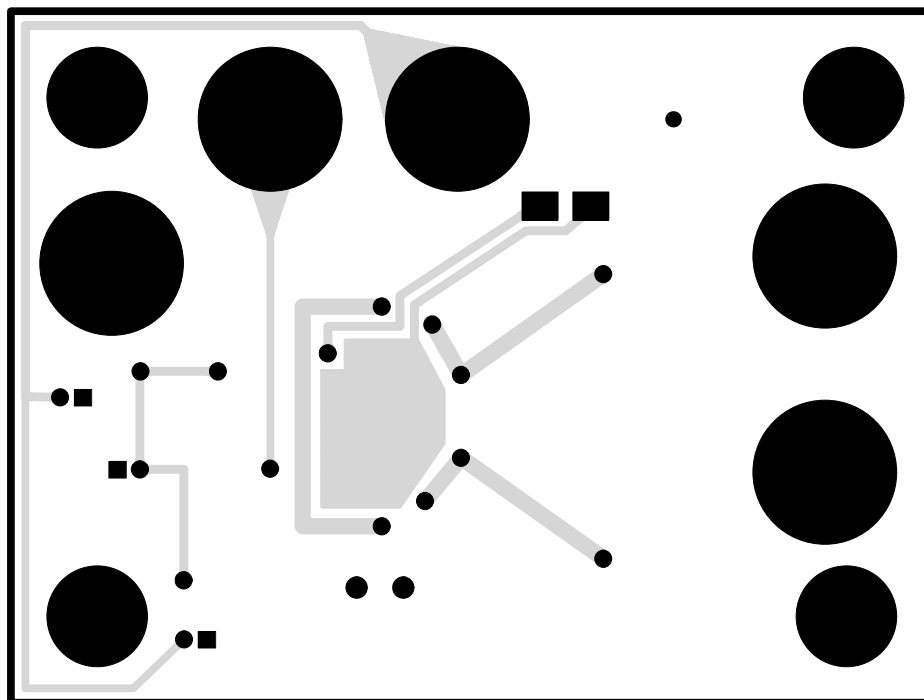


Figure 2–4. Bottom Layer



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NOTE:

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3 Regulatory Notices:

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3.1.1 Notice applicable to EVMs not FCC-Approved:

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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>

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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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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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4.2 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.

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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.

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Last updated 10/2025