

EVM User's Guide: UCC23711DWREVM

UCC23711DWREVM Isolated Gate Driver Evaluation Module

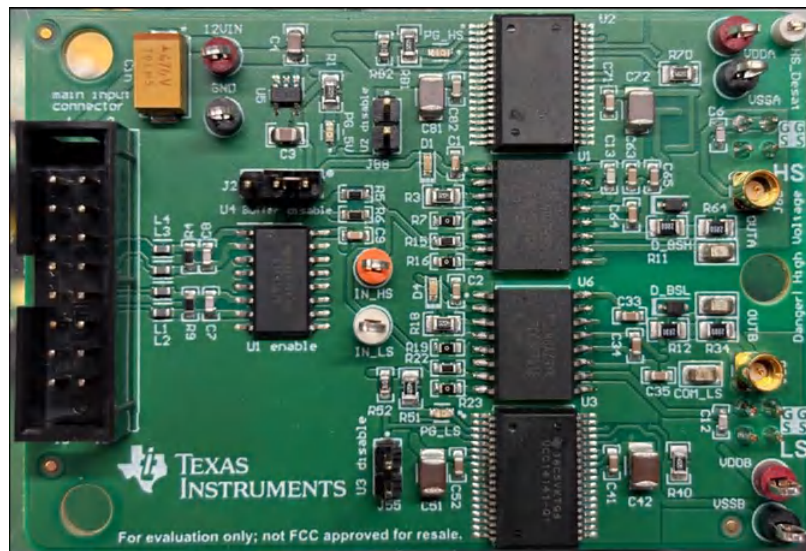


Description

The UCC23711DWREVM is a gate driver evaluation board that features two isolated protection gate drivers. These drive two series FETs or IGBTs in a half-bridge, for analysis of drive strength, timing, DESAT protection, noise immunity, and thermal impedance. The UCC23711 is designed to both protect FETs and IGBTs from overcurrent damage and help meet functional safety requirements. This board also features two isolated power devices which supply \pm DC rails for both the high-side and low-side gate driver channels. The rail voltages can be adjusted using the UCC14141 feedback resistors. For ease of alteration in low-voltage testing, a series resistor out of these integrated supplies can be removed and the power rails can instead be provided externally.

Features

- Simplified, intuitive evaluation module design to allow quick start-up and testing
- Compatible with Wolfspeed® Power Devices SpeedVal Kit™ Modular Evaluation Platform to evaluate performance with different discrete SiC FETs for evaluation
- Compatible with FM3 and XM3 power module platforms
- UCC14141 integrated bias supplies can deliver up to 2W, sufficient for these 1W maximum gate drivers
- Three green status LEDs verify power good, and two fault LED to monitor the DESAT circuit of each driver
- Both MMCX connectors and hook connectors are available for output monitoring
- Power supply rail circuit is configurable to evaluate several types of high-side power supplies: isolated supply, bootstrap capacitor, Zener bias for negative rail
- Ability to test and calibrate the DESAT timing circuit





PCB Top Side


1 Evaluation Module Overview

1.1 Introduction

This evaluation module (EVM) is a simplified gate driver daughter card that can be used to evaluate both low-voltage gate driver features and electrical characteristics, as well as high-voltage switching performance. This EVM was designed with an XM3 output interface for compatibility with the Wolfspeed® 1200-V SiC platforms. These include both XM3 SiC FET modules and the SpeedVal Kit™, which is designed to evaluate smaller discrete SiC FETs. The footprint is easily configurable to the different variants of the UCC237XX family, as well as 3rd party gate drivers, for comparison and competitive analysis.

CAUTION		
	Caution	Read the user's guide before use.

CAUTION		
	Caution	Hot surface. Contact can cause burns. Do not touch!

WARNING		
	Danger	Do not use EVM to test isolation above IC rated voltage High voltage.

1.2 Kit Contents

- UCC23711DWREVM 4-layer PCB

1.3 Specification

This evaluation module features two isolated gate drivers, two isolated bias supplies, an input LDO, and an optional differential-to-single ended converter (for use with the differential input found in the SpeedVal Kit™ Modular Evaluation Platform). Several feedback resistors on the back side are available to adjust the output voltages of the isolated bias supplies.

1.4 Device Information

The UCC23711 isolated gate driver supports reinforced isolation with a 1.5kV_{DC} rated working voltage. UCC23711 supports up to a 30V maximum output range, which can supply ±5A peak drive strength and R_{OH}=2.5Ω and R_{OL}=0.7Ω. UCC23711 has <100ns of typical t_{PLH}, and <2mA of supply current required per channel. Designated as a protection gate driver, UCC23711 has a DESAT pin to monitor the conduction V_{CE/DS} of an IGBT or SiC FET. If a short-circuit is detected, the output enagages a soft turn off that will turn the switch off preventing large power stage overshoots.

1.5 General TI High Voltage Evaluation User Safety Guidelines



Always follow TI's set-up and application instructions, including use of all interface components within the recommended electrical rated voltage and power limits. Always use electrical safety precautions to help ensure your personal safety and the safety of those working around you. Contact TI's Product Information Center <http://support/ti.com> for further information.

Save all warnings and instructions for future reference.

Failure to follow warnings and instructions can result in personal injury, property damage, or death due to electrical shock and/or burn hazards.

The term TI HV EVM refers to an electronic device typically provided as an open framed, unenclosed printed circuit board assembly. It is intended strictly for use in development laboratory environments, solely for qualified professional users having training, expertise, and knowledge of electrical safety risks in development and application of high-voltage electrical circuits. Any other use and/or application are strictly prohibited by Texas Instruments. If you are not suitably qualified, you must immediately stop from further use of the HV EVM.

- **Work Area Safety:**

- Maintain a clean and orderly work area .
- Qualified observers must be present anytime circuits are energized.
- Effective barriers and signage must be present in the area where the TI HV EVM and the interface electronics are energized, indicating operation of accessible high voltages can be present, for the purpose of protecting inadvertent access.
- All interface circuits, power supplies, evaluation modules, instruments, meters, scopes and other related apparatus used in a development environment exceeding 50 V_{RMS}/75 VDC must be electrically located within a protected Emergency Power Off (EPO) protected power strip.
- Use a stable and non-conductive work surface.
- Use adequately insulated clamps and wires to attach measurement probes and instruments. No freehand testing whenever possible.

- **Electrical Safety:**

As a precautionary measure, a good engineering practice is to assume that the entire EVM can have fully accessible and active high voltages.

- De-energize the TI HV EVM and all the inputs, outputs, and electrical loads before performing any electrical or other diagnostic measurements. Confirm that TI HV EVM power has been safely de-energized.
- With the EVM confirmed de-energized, proceed with required electrical circuit configurations, wiring, measurement equipment hook-ups and other application needs, while still assuming the EVM circuit and measuring instruments are electrically live.
- When EVM readiness is complete, energize the EVM as intended.

WARNING

WARNING: While the EVM is energized, never touch the EVM or the electrical circuits as the EVM or electrical circuits can be at high voltages capable of causing electrical shock hazard.

- **Personal Safety:**

- Wear personal protective equipment, for example, latex gloves and/or safety glasses with side shields or protect EVM in an adequate lucent plastic box with interlocks from accidental touch.

- **Limitation for Safe Use:**

- EVMs are not to be used as all or part of a production unit.

Safety and Precautions

The EVM is designed for professionals who have received the appropriate technical training, and is designed to operate from an AC power supply or a high-voltage DC supply. Please read this user guide and the safety-related documents that come with the EVM package before operating this EVM.

CAUTION



Do not leave the EVM powered when unattended.

WARNING



High Voltage! Electric shock is possible when connecting board to live wire. Board must be handled with care by a professional.

For safety, use of isolated test equipment with overvoltage and overcurrent protection is highly recommended.

2 Hardware

2.1 Power Requirements

Table 2-1. UCC23711DWREVM Electrical Specifications

	Description	Min	Typ	Max	Units
12VIN	EVM Power Supply	8	12	18	V
VIN	Primary side input voltage UCC14141-Q1	8	12	18	V
VDD-VEE	UCC23711 See data sheet for additional details	13		30	V
Fs	Switching frequency	0		500	KHz
DC	Voltage on DC+ for half bridge application	0		800	V
Tj	Operating junction temperature	-40		150	°C

2.2 Header Information

Table 2-2. Headers Description

Header Marker	Description
J1	Optional connector for supply and gate driver input signals
J2	Differential-to-single ended buffer enable/disable
J88	High-side isolated bias supply enable/disable
J55	Low-side isolated bias supply enable/disable

2.3 Jumper Information

Table 2-3. Jumper Configurations

Header	Jumper Settings	Default
J2	2-1 3-2	2-1 disables differential-to-single ended buffer (Default)
J88	Connected Unconnected	Connection disables high-side isolated bias supply to connect bench supply to VDD-VEE (Must remove R70)
J55	Connected Unconnected	Connection disables low-side isolated bias supply to connect bench supply to VDD-VEE (Must remove R40)

2.4 Interfaces Information

Table 2-4. Interfaces Description

Interface	Description
J3	Low-side GATE
J6	High-side GATE

2.5 Test Points

Table 2-5. Test Point Description

Test Point Board Marker	Description
12VIN	EVM board 12V input
IN_HS	Input for high-side channel
IN_LS	Input for low-side channel
GND	Input side ground
VDDA	Output side high-side supply
VSSA	Output side high-side ground
J66	MMCX pad for high-side GATE
HS_DESAT	High-side DESAT feature connection to high-side DRAIN/COLLECTOR

Table 2-5. Test Point Description (continued)

Test Point Board Marker	Description
VDDB	Output side low-side supply
VSSB	Output side low-side ground
J33	MMCX pad for low-side GATE

3 Hardware Design Files

3.1 Schematics

Schematic can be downloaded from the [UCC23711 EVM tool page](#) on TI.com.

3.2 PCB Layouts

PCB layouts can be downloaded from the [UCC23711 EVM tool page](#) on TI.com.

3.3 Bill of Materials (BOM)

Bill of Materials (BOM) can be downloaded from the [UCC23711 EVM tool page](#) on TI.com.

4 Additional Information

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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

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

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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
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