EVM User's Guide: UCC57108EVM

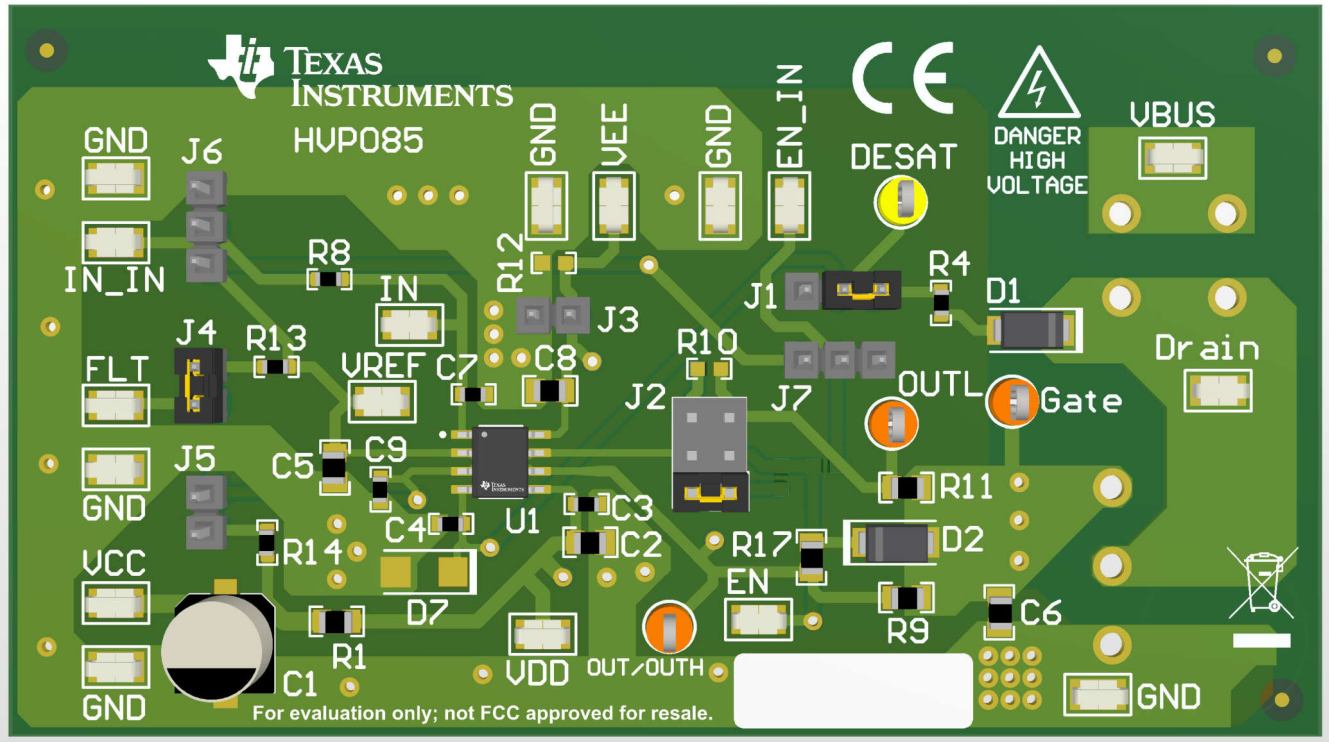
UCC57108 Evaluation Module

Description

The UCC57108EVM is designed to primarily evaluate the UCC57108 functionality. The performance of the driver can be evaluated for capacitive loads or power devices with TO-220 footprints. The UCC57108EVM evaluation boards allow for connection to various test points, such as IN, FLT, DESAT, and VREF, via surface-mount test points. The UCC57108EVM can also support different UCC57108 IC variants with the use of jumpers.

Features

- Test points allow probing all the key pins of the UCC57108
- Allows quick verification of most of the data sheet parameters
- Uses jumpers to allow compatibility across all UCC57108 variants
- External TO-220 power device low-side connection
- PCB layout optimized for bias supply bypassing cap, gate-drive resistance selection



UCC57108 Evaluation Module

1 Evaluation Module Overview

1.1 Introduction

This user's guide describes the characteristics, operation, and use of the UCC57108 Evaluation Module (EVM). A complete schematic diagram, PCB layouts, and BOM are included in this document. This family of devices provides desaturation protection and effectively drives MOSFET, SiC MOSFET, and IGBT power switches.

1.2 Kit Contents

The UCC57108EVM kit includes:

- UCC57108 EVM
- Generic Evaluation Kit User's Guide
- Texas Instruments High Voltage User Safety Guidelines

1.3 Specification

For the full range of recommended operating specifications and design guidelines for driving loads, see the *UCC5710x-Q1 High-Speed, Low-Side Gate Driver With DESAT Protection For Automotive Applications* data sheet (SLUSF94).

CAUTION

The UCC57108EVM is designed for low-voltage evaluation only, and is not certified for evaluation for voltages beyond the absolute maximums listed in the electrical specifications. Do not evaluate high-voltage parameters with this board.

1.4 Device Information

The UCC57108 is a 30V, single channel low-side gate driver with 3A peak source and 3A peak sink current for driving Si MOSFETs, SiC MOSFETs, and IGBT. The UCC57108 also has 8.5V UVLO protection, desaturation protection (DESAT), and fault signal output. The UCC57108 has low propagation delay and fast rise and fall time. The UCC57108 inputs can tolerate signals as high as 30V regardless of the VDD voltage which enhances device robustness. The UCC57108EVM board can be used to evaluate other pin-to-pin compatible parts in the supported packages.

For detailed device information, see the *UCC5710x-Q1 High-Speed, Low-Side Gate Driver With DESAT Protection For Automotive Applications* device data sheet (SLUSF94).

2 Hardware

2.1 Recommended Power Requirements

Table 2-1. UCC57108EVM Power Requirements

PARAMETER	MIN	TYP	MAX	UNIT
Input and Output Characteristics				
Input V_{DD}	8.5(1)		26	VDC
Input V_{EE}	-15		0	VDC
Input current	0		0.1	A
System Characteristics				
Switching frequency	0	100	500	kHz

(1) The UCC57108EVM also supports the UCC57102 IC. In this case, the minimum input V_{DD} is 12.5V.

2.2 I/O Description

Table 2-2. UCC57108EVM I/O Description

Pins	Description
VCC	V_{cc} positive supply test point. Powers IC VDD pin.
VDD	V_{DD} positive supply of UCC57108 IC
VEE	V_{EE} negative supply of UCC57108 IC. Used only for UCC57108B variant.
VREF	V_{REF} test point. Used only for UCC57108B and UCC57108C variants.
VBUS	V_{BUS} positive supply test point. Bus voltage for external power device.
GND	Multiple test points. Ground at UCC57108 IC.
IN_IN	Input signal test point. Powers IC IN pin.
IN	Signal input of UCC57108 IC.
EN_IN	Enable signal test point. Powers IC EN pin. Used only for UCC57108W variant.
EN	Enable of UCC57108 IC. Used only for UCC57108W variant.
DESAT	DESAT input of UCC57108 IC.
FLT	Fault output of UCC57108 IC.
Gate	Gate test point of UCC57108 IC. Connected to 1nF capacitor and gate of external FET.
OUT/OUTH	Output pin of UCC57108 IC before external gate resistor. OUTH is used only for UCC57108C variant.
OUTL	Low output pin for UCC57108. Used only for UCC57108C variant.
Drain	Drain test point for external FET.

2.3 Jumper Description

Table 2-3. UCC57108EVM Jumper Description

Jumper	Name	Description
J1	DESAT Jumper	Connects the DESAT pin to ground or FET drain
J2	Pin 7 Designator	Allows pin 7 compatibility with other UCC57108 variants
J3	Pin 8 Designator	Allows pin 8 compatibility with other UCC57108 variants
J4	V_{REF} Pullup	Pulls up fault signal to V_{REF}
J5	V_{DD} Pullup	Pulls up fault signal to V_{DD}
J6	Input Jumper	Allows IN to be tied to V_{REF}
J7	Enable Jumper	Allows EN to be tied to V_{REF}

2.4 Setup for Different UCC57108 Variants

The UCC57108EVM comes installed with the bipolar-voltage UCC57108B variant of the UCC57108 IC, and the EVM out-the-box is setup according to that variant. The UCC57108 family of devices comes in two more variants: the UCC57108C, which has split output, and the UCC57108W, which has enable function.

The UCC57108EVM also supports the UCC57102 IC, which is the 12.5V UVLO version of the UCC57108 IC. The UCC57102 has the same variant types as the UCC57108, and the information in this section applies to the UCC57102 IC as well. See the *UCC5710x-Q1 High-Speed, Low-Side Gate Driver With DESAT Protection For Automotive Applications* data sheet for more information.

Because each UCC57108 variant has slightly different pinouts, the EVM has jumpers to support the different variants. Jumpers J2 and J3 allow the user to short or open between connectors depending on which variant is being used. Figure 2-1 shows how J2 and J3 must be configured with each UCC57108 variant. Do not short more than one connection on J2. If the user is using variants other than the UCC57108B, then desolder resistor R16.

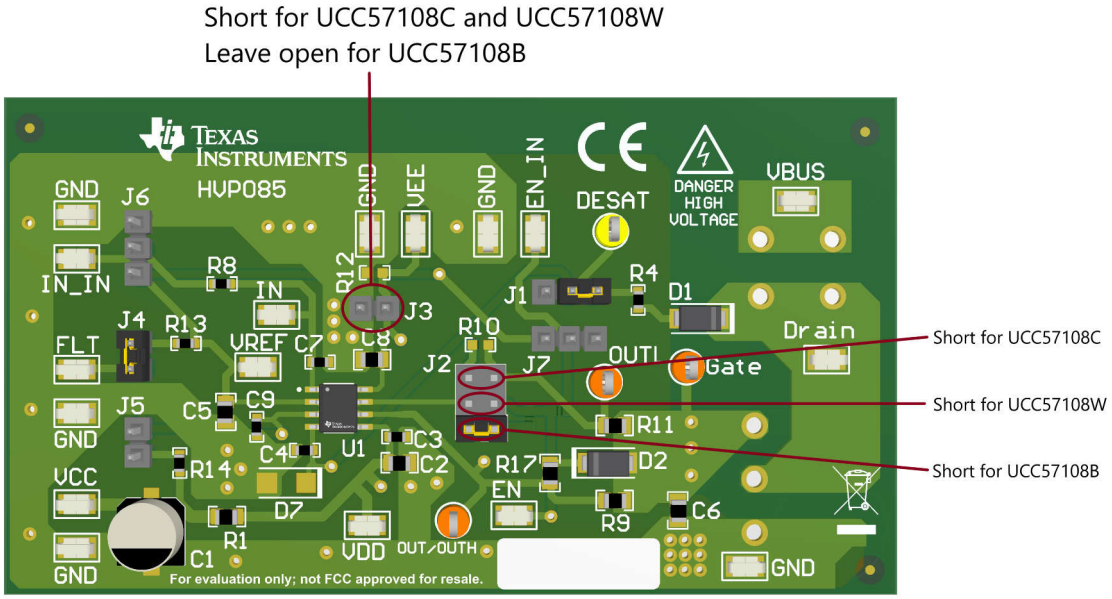


Figure 2-1. Jumper J2 and J3 Selection for Each UCC57108 IC Variant

In addition to jumpers J2 and J3, there is also an option to solder 0Ω jumper resistors (R10, R12, or R16) for a low-parasitic way to short connections. The EVM out-the-box supports the UCC57108B variant, which has R16 installed on the board. Resistors R10 and R12 are not installed. If you are using the other variants, you must desolder R16. Table 2-4 to Table 2-6 showcases a guide to soldering or desoldering the 0Ω jumper resistors for each UCC57108 variant.

Table 2-4. Resistor Solder Guide for UCC57108B

	R10	R12	R16
UCC57108B	Desolder	Desolder	Solder

Table 2-5. Resistor Solder Guide for UCC57108C

	R10	R12	R16
UCC57108C	Solder	Solder	Desolder

Table 2-6. Resistor Solder Guide for UCC57108W

	R10	R12	R16
UCC57108W	Desolder	Solder	Desolder

2.5 DESAT Setup

The UCC57108EVM out-the-box evaluates the DESAT protection feature of the UCC57108 when the device is on. This is done with jumper J1 connecting the DESAT pin to the FET drain out-the-box. Because the EVM does not come with a FET, the DESAT input detects open voltage. This triggers the desaturation protection of the device when the user turns the device on and inputs a signal, which ultimately pulls the fault output signal low. Figure 4-1 shows this feature in practice.

If the user needs to evaluate the switching capabilities of the UCC57108 without a FET, then short the DESAT pin to ground by moving the jumper on J1 to connect the left and middle pin headers, as circled in Figure 2-2.

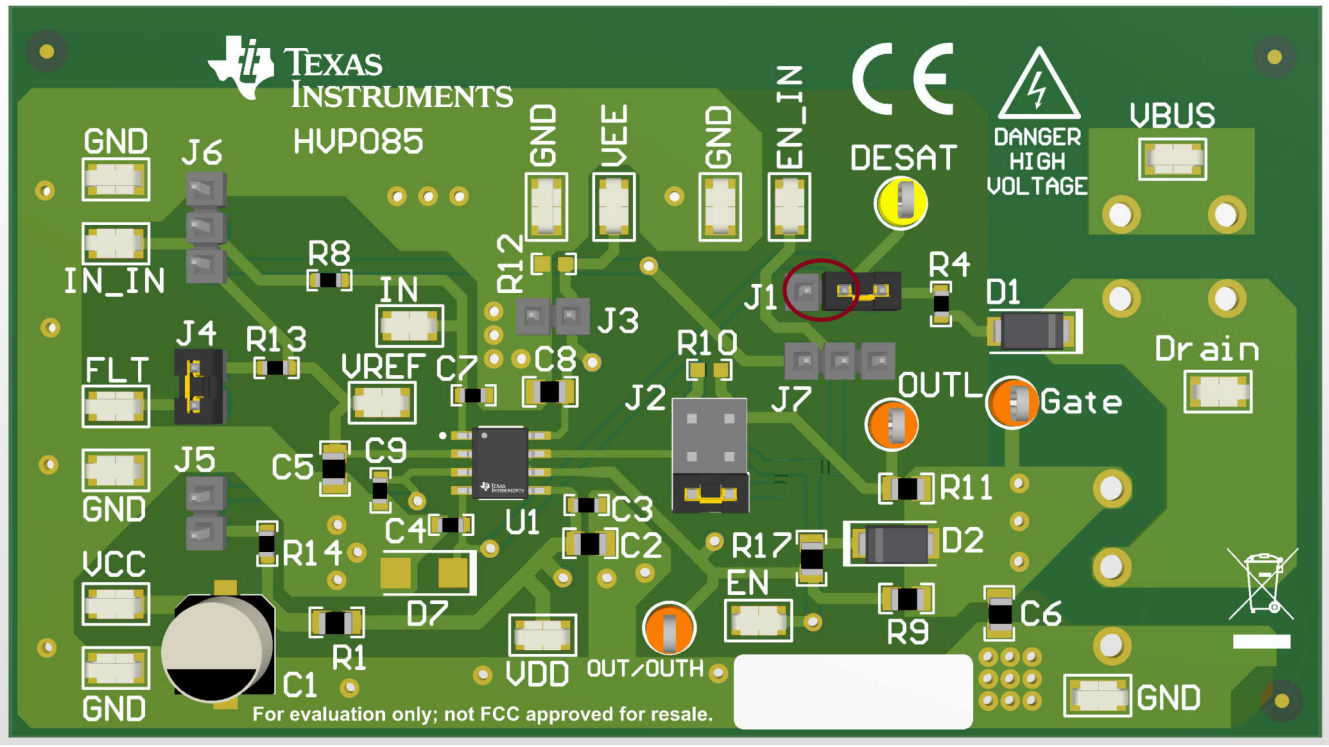


Figure 2-2. UCC57108EVM Jumper J1 Adjustment to Ground DESAT

3 Implementation Results

3.1 Out-The-Box Evaluation

This evaluation is to test the UCC57108EVM functionality out the box. The assumption is that the user did not make any adjustments to the board.

3.2 Equipment Setup

3.2.1 Power Supply

- DC power supply #1
  - Voltage setting: 15V
  - Current limit: 0.1A

3.2.2 Function Generator

Table 3-1. Function Generator Setup

	Mode	Frequency	Width	Delay	High	Low	Output Impedance
Channel A	Pulse	100kHz	2.5µs	0µs	5V	0V	High Z

3.2.3 Oscilloscope

Table 3-2. Oscilloscope Setup

	Bandwidth	Coupling	Termination	Scale Settings	Inverting
Channel 1-4	500 MHz or above	DC	1 MΩ or automatic	10 × or automatic	OFF

3.2.4 Digital Multimeter (DMM)

DMM #1 with voltage and current above 26V and 1A, for example: Fluke 187

3.3 Bench Setup

Please follow the connection procedure below and Figure 3-1 can be used as a reference.

- Make sure all the output of the function generator, and voltage source are off before connection.
- Function generator Ch-A channel applied on IN_IN.
- Power Supply:
  - Power supply #1: positive node connected to input of DMM #1 and DMM #1 output connected to test point marked as VCC, negative node of Power Supply #1 connected directly to test point marked as GND.
- Oscilloscope:
  - **FAULT Signal:** Connect oscilloscope Ch-1 probes to test points marked as **FLT to GND**, smaller measurement loop is preferred.
  - **IN Signal:** Connect oscilloscope Ch-2 probes to test points marked as **IN_IN to GND**, smaller measurement loop is preferred.
  - **OUT Signal:** Connect oscilloscope Ch-3 probes to test points marked as **Gate to GND**, smaller measurement loop is preferred.
  - **VREF Signal:** Connect oscilloscope Ch-4 probes to test points marked as **VREF to GND**, smaller measurement loop is preferred.

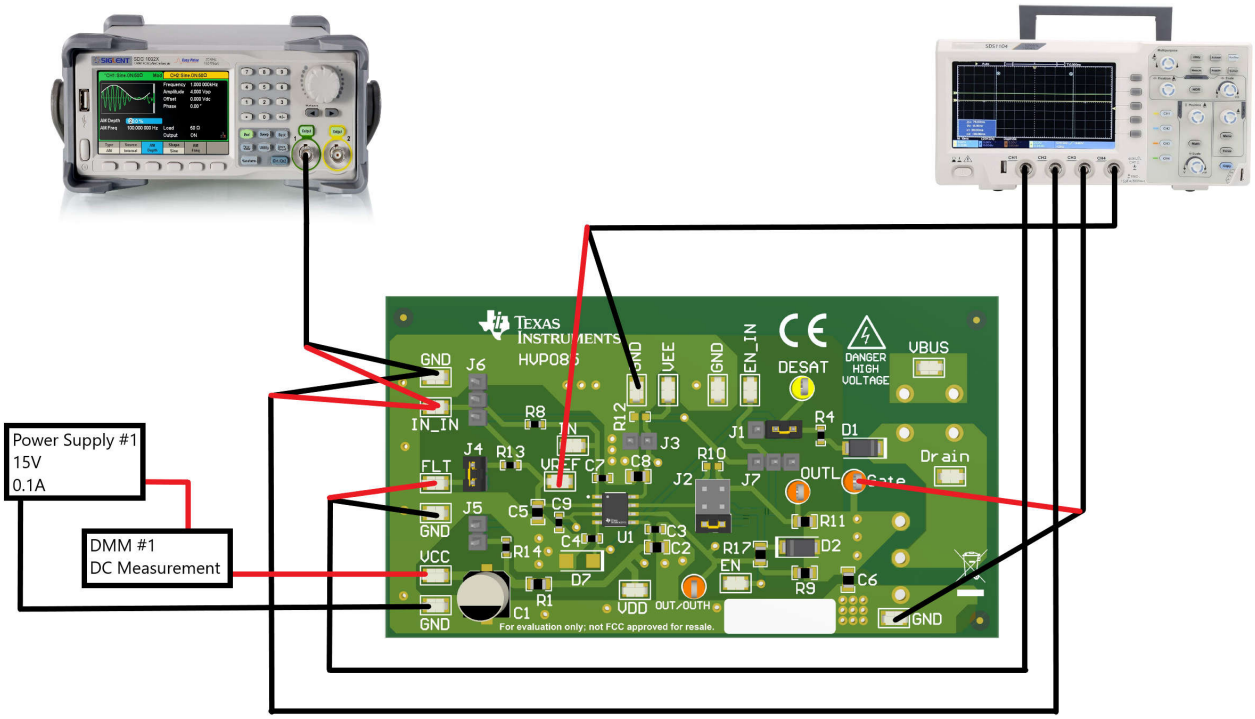


Figure 3-1. Bench Setup Diagram

3.4 Procedure and Results

Before powering up the test procedure, make sure that the connections are correct as shown as in Section 3.3.

1. Turn on PSU #1 and check the current on DMM #1. If the current shown is more than 0.5mA and less than 1.25mA, then everything is set correctly.
2. Turn on the function generator output and examine for the following conditions:
   a. The current on DMM #1 with the function generator ON must show 2.7mA±1mA.
   b. The OUT signal must have a narrower width compared to the IN signal. Use Figure 3-2 as reference.
   c. Look at the FAULT signal, this must be high at all times except when the OUT signal is low during the period where IN is high. When IN becomes low, the FAULT rises to high again. Use Figure 3-2 as reference.
   d. There must be a 5V signal on V_{REF}.
3. Once testing is satisfied, power down the EVM by following the order:
   a. Turn off function generator.
   b. Turn off power supply #1.
   c. Disconnect cables and probes.

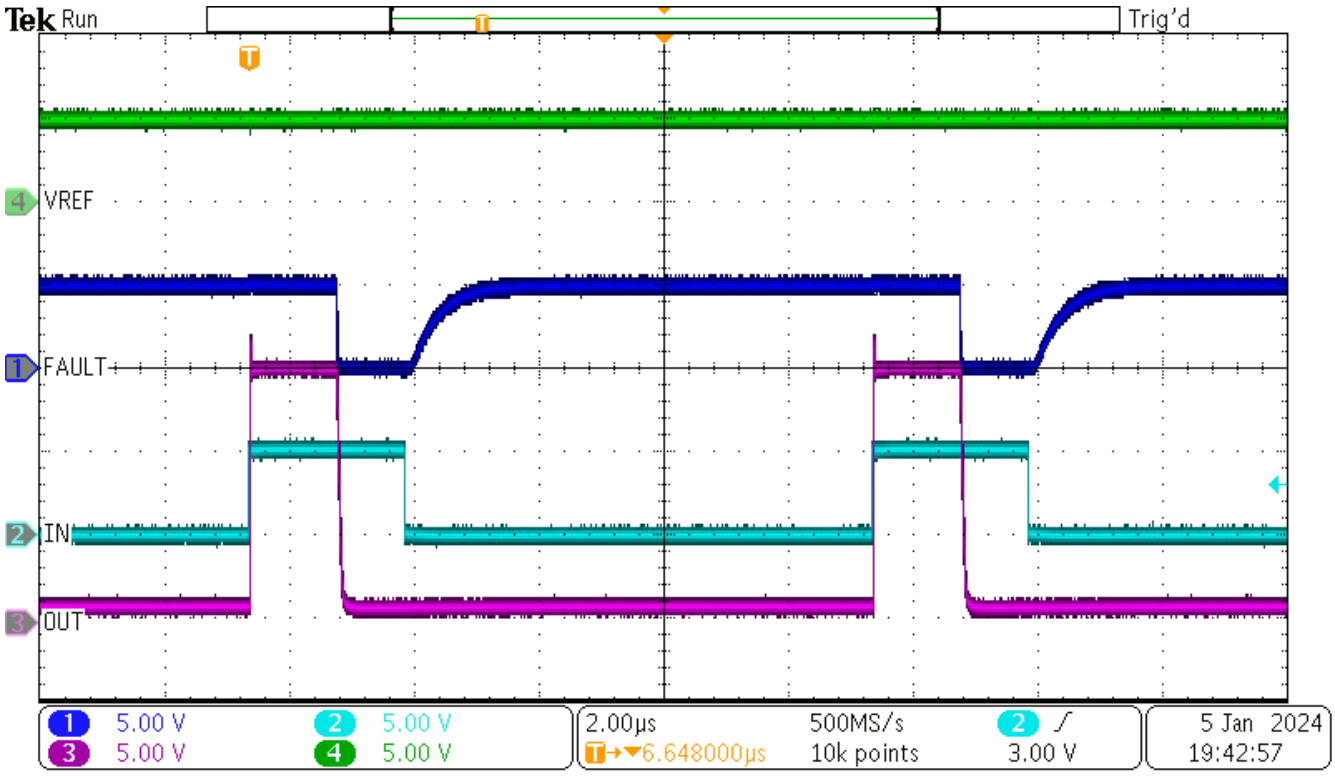


Figure 3-2. Reference waveforms for UCC57108EVM out-of-box evaluation.

Note

To learn more about why the Out-The-Box Evaluation causes this behavior to occur, see Section 2.5.

4 Typical Performance Waveforms

4.1 DESAT Feature

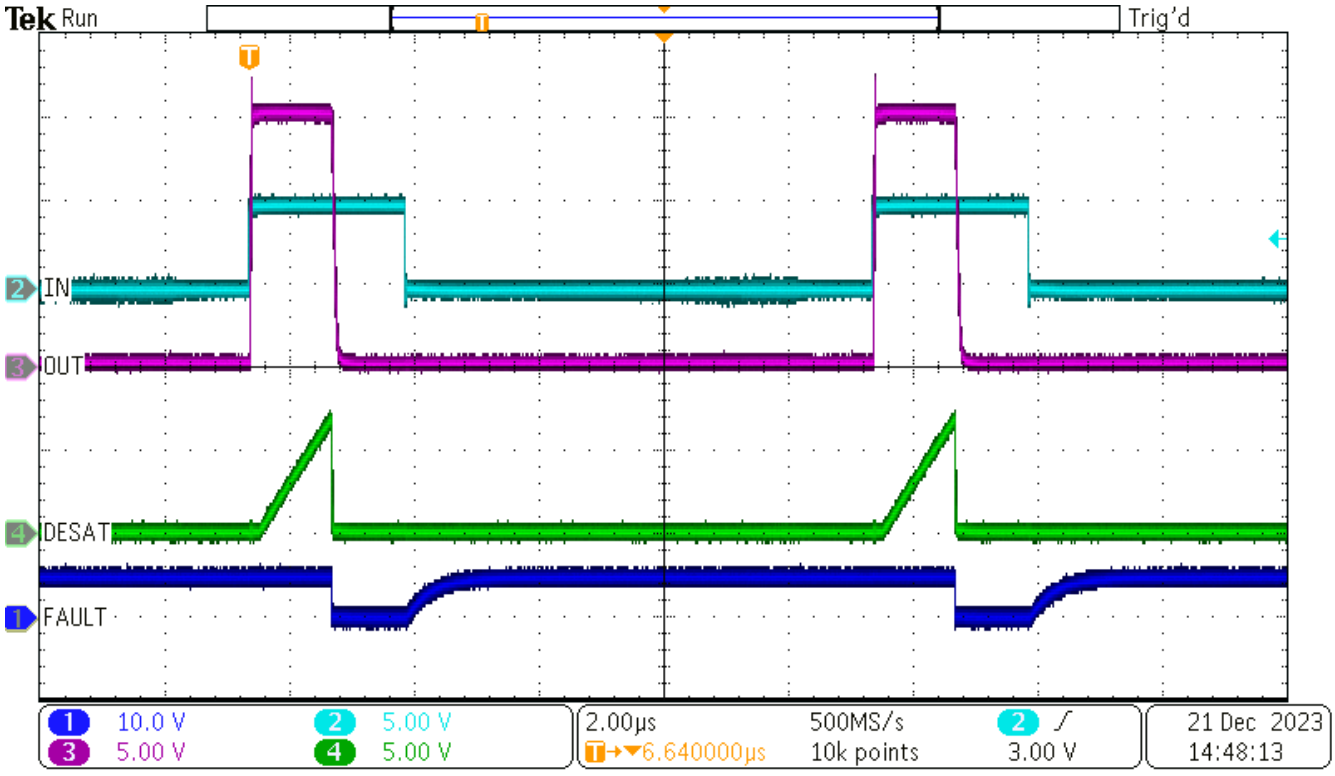


Figure 4-1. DESAT Feature of the UCC57108

4.2 Bipolar Feature of UCC57108B

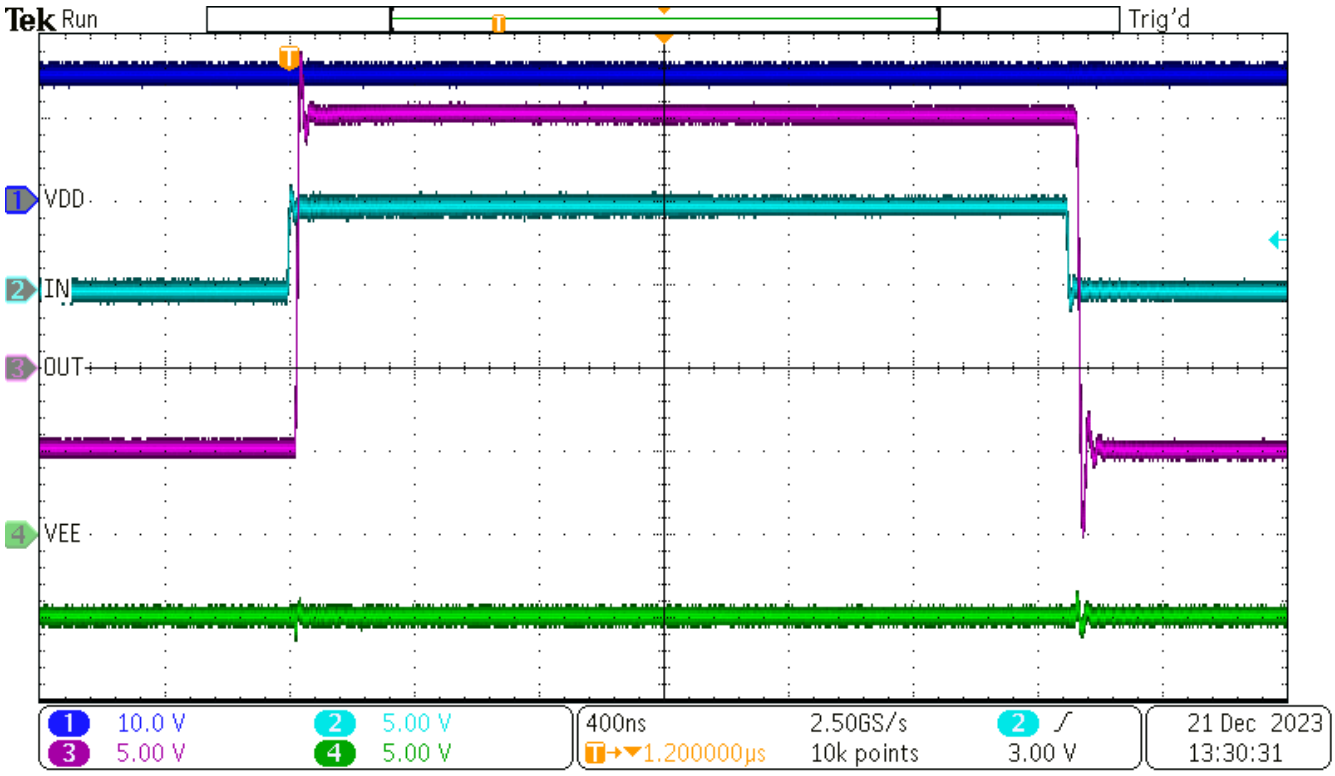


Figure 4-2. Bipolar-Voltage with UCC57108B Installed

5 Hardware Design Files

5.1 Schematics

Figure 5-1 shows the UCC57108EVM schematic diagram.

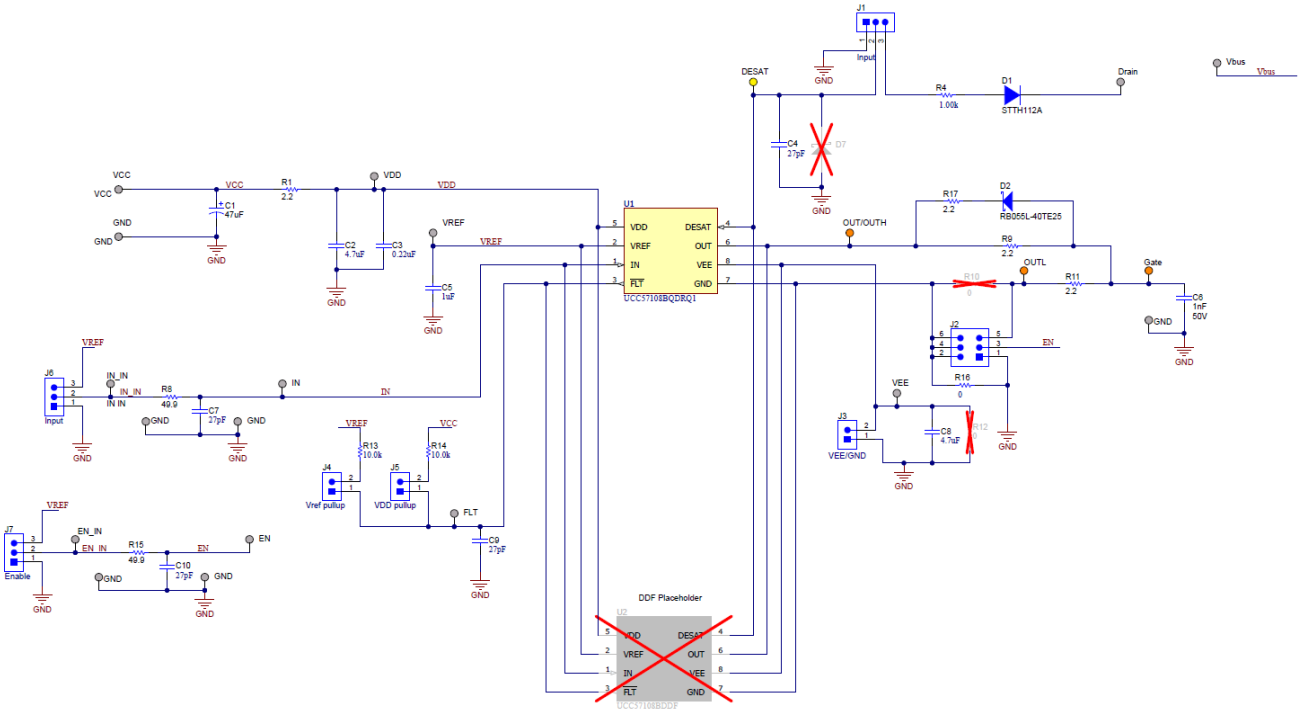


Figure 5-1. UCC57108EVM Schematic

5.2 PCB Layouts

Figure 5-2 through Figure 5-5 show the PCB layout information for the UCC57108EVM.

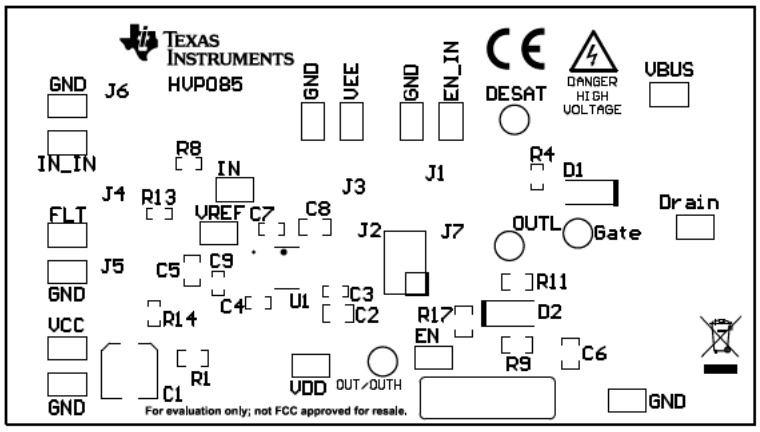


Figure 5-2. Top Overlay

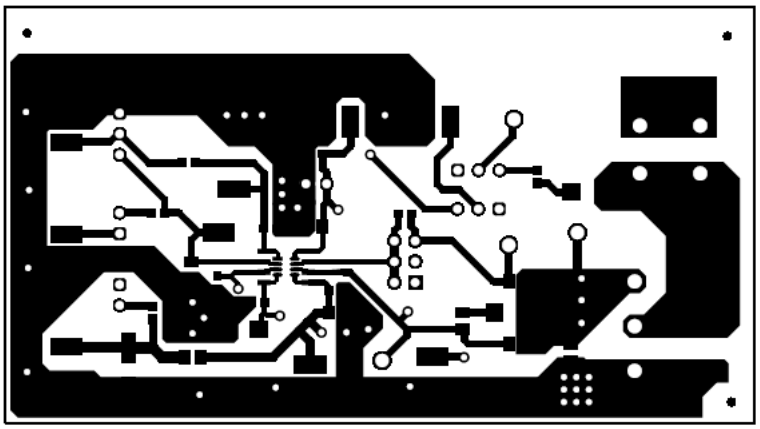


Figure 5-3. Top Layer

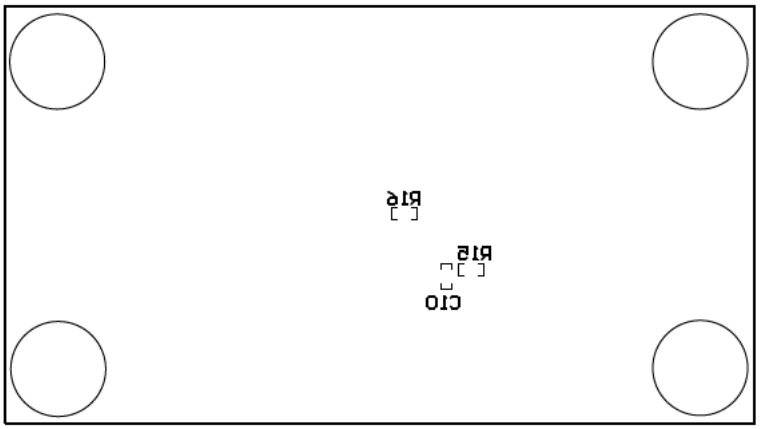


Figure 5-4. Bottom Overlay

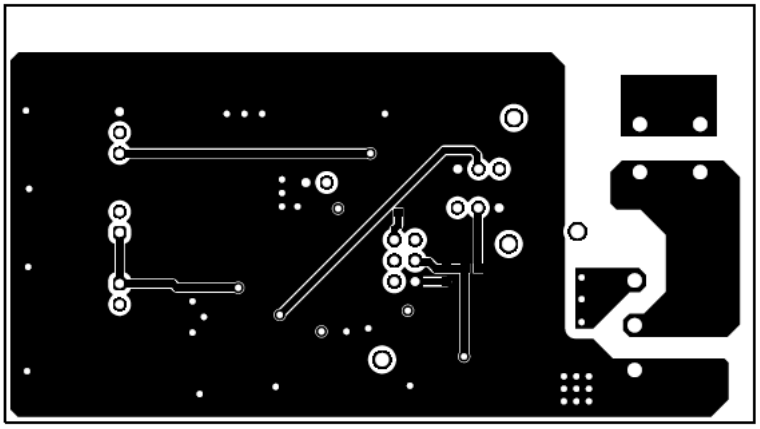


Figure 5-5. Bottom Layer

5.3 Bill of Materials

Table 5-1. UCC57108EVM Bill of Materials

Designator	Quantity	Description
C1	1	CAP, AL, 47uF, 50V, +/- 20%, 0.68 ohm, SMD
C2, C8	2	CAP, CERM, 4.7uF, 35V, +/- 10%, X7R, 0805
C3	1	CAP, CERM, 0.22uF, 50V, +/- 10%, X7R, 0603
C4, C7, C9, C10	4	CAP, CERM, 27pF, 50V, +/- 5%, C0G/NP0, 0603
C5	1	CAP, CERM, 1uF, 10V, +/- 10%, X7R, 0805
C6	1	CAP, CERM, 1000pF, 50V, +/- 5%, X7R, 0805
D1	1	Diode, Ultrafast, 1200V, 1A, SMA
D2	1	Diode, Schottky, 40V, 3A, SMA
FID1, FID2, FID3	3	Fiducial mark. There is nothing to buy or mount.
GND, IN_IN, TP8, TP10, TP13, TP14, TP15, TP16, TP17, TP19, TP20, TP21, TP22, TP23, Vbus, VCC, VDD	17	Test Point, Miniature, SMT
H1, H2, H3, H4	4	Bumpon, Hemisphere, 0.44 X 0.20, Clear
J1, J6, J7	3	Header, 2.54mm, 3x1, Tin, TH
J2	1	Header, 100mil, 3x2, Tin, TH
J3, J4, J5	3	Header, 2.54mm, 2x1, Tin, TH
LBL1	1	Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll
R1, R9, R11, R17	4	RES, 2.2, 5%, 0.125 W, AEC-Q200 Grade 0, 0805
R4	1	RES, 1.00 k, 0.5%, 0.1 W, 0603
R8, R15	2	RES, 49.9, 1%, 0.1 W, AEC-Q200 Grade 0, 0603
R13, R14	2	RES, 10.0 k, 1%, 0.1 W, 0603
R16	1	RES, 0, 5%, 0.1 W, 0603
SH-J1, SH-J2, SH-J4	3	Shunt, 100mil, Gold plated, Black
TP6	1	Test Point, Multipurpose, Yellow, TH
TP9, TP11, TP12	3	Test Point, Multipurpose, Orange, TH
U1	1	High-Speed, Low-Side Gate Driver With DESAT Protection

6 Compliance Information

The UCC57108EVM is in compliance with RoHS and REACH.

7 Additional Information

7.1 Trademarks

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 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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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。

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。 日本テキサス・インスツルメンツ株式会社

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

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.

6. *Disclaimers:*

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