User's Guide
SLUUC86–March 2020

Using the UCC5304EVM-035

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1 Introduction

The UCC5304EVM-035 device is designed for evaluation of the UCC5304 device, with a 4-A source and 6-A sink peak current for driving Si MOSFETs and GaN FETs. Developed for high voltage applications where isolation and reliability are required, the UCC5304 device delivers reinforced isolation of 5.7-kV_{RMS} and a surge immunity tested up to 7.8-kV, with a common mode transient immunity (CMTI) greater than 100 V/ns. The device has an impressive propagation delay of 28 ns and the tightest part-to-part delay matching in the industry of less than 5 ns, which enables high-switching frequency, greater power density, and higher efficiency.

The flexible, universal capability of the UCC5304 device, with up to 5.5-V VCCI and 18-V VDD, allows it to be used as a low-side or high-side driver with independent PWM inputs. With its integrated functions, advanced protection features (UVLO), and optimized switching performances, the UCC5304 device enables designers to build smaller, more robust designs for enterprise, telecom, automotive, and industrial applications, allowing for faster time to market.

2 Description

The UCC5304EVM-035 kit has independent connection points for VCCI and VDD supplies, including separate ground points. A three-position header with jumpers for the input signal, lets designers easily tie input high or low. A variety of testing points are provided for easy connection, including some designated for use with ground springs for shorter measurement loops of key signals. Moreover, the PCB layout is optimized with minimized loop area in both the gate driver and power supply loops with bypassing capacitors. For detailed device information, see the UCC5304 4-A/6-A, 5.7-kVRMS Isolated Single-Channel Reinforced Gate Driver with High Noise Immunity data sheet and Isolated Gate Driver Solutions, from TI.

2.1 Features

- Evaluation module for UCC5304 and other pin-to-pin compatible drivers in SOIC-8 wide body (DWV) package
- 3-V to 5.5-V VCCI power supply range, with up to 18-V VDD power supply range
- 4-A source and 6-A sink current capability
- 5.7-kV_{RMS} isolation for 1 minute per UL 1577
- TTL/CMOS compatible inputs
- 3-position header for IN pin
- PCB layout optimized for power supply bypassing capacitors, gate driver loop
- Testing points allow probing all the key pins of the UCC5304 device

2.2 I/O Description

Table 1 lists the test points and jumpers.

Table 1. Test Points and Jumpers

Pins	Pin Label	Description
TP1	IN	Positive input, measured after input resistor
TP2	OUT	Output, measured before gate drive resistor
TP3	OUT_CAP	Output, measured at output capacitor
TP4	IN	Positive input
TP5	VDD	Output supply positive input
TP6	IN	Positive input
TP7	VDD	Output supply positive input
TP8	GND	Primary GND
TP9	OUT	Output
TP10	GND	Primary GND
TP11	OUT	Output
TP12	VCCI	Primary supply positive input
TP13	VSS	Output supply negative input
TP14	VCCI	Primary supply positive input
TP15	VSS	Output supply negative input
TP16	GND	Primary GND
TP17	GND	Primary GND
J1-1	-	Connected to GND
J1-2	-	Connected to IN
J1-3	-	Connected to VCCI

2.3 Jumpers (Shunt) Setting

Table 2 lists the jumper settings.

Table 2. Jumpers Setting

Header	Jumper Setting Options		Factory Setting
J1	Option A	Jumper not installed, IN provided by external signal and this pin is low by default if left open.	Option A
	Option B	Jumper on J1-2 and J1-1 sets IN low.	
	Option C	Jumper on J1-2 and J1-3 sets IN high.	

3 Electrical Specifications

Table 3 lists the UCC5304EVM-035 electrical specifications.

Table 3. UCC5304EVM-035 Electrical Specifications

Description		MIN	TYP	MAX	UNIT
V_{CCI}	Primary-side power supply	3		5.5	V
V_{DD}	Driver output power supply for UCC5304	6.0		18	V
T_J	Operating junction temperature range	–40		130	°C

4 Test Summary

In this section, the default factory configuration for the jumper settings must be confirmed with the reference image in Figure 1. Different jumper settings, PWM signal input options, and voltage source settings are described in Section 2 and Section 3.

4.1 Equipment

4.1.1 Power Supplies

Two DC power supplies with voltage/current above 18 V and 1 A, respectively are required, for example: Agilent E3634A.

4.1.2 Function Generators

One 2-channel function generator over 200 kHz is required, for example: Tektronix AFG3252.

4.2 Equipment Setup

4.2.1 DC Power Supply Settings

- DC power supply 1
  - Voltage setting: 5 V
  - Current limit: 0.100 A
- DC power supply 2
  - Voltage setting: 12 V
  - Current limit: 0.100 A

4.2.2 Digital Multi-Meter (DMM) Settings

- Digital multi-meter 1:
  - DC current measurement, auto-range.
- Digital multi-meter 2:
  - DC current measurement, auto-range.

4.2.3 Two-Channel Function Generator Settings

Table 4 lists the 2-channel function generator settings.

Table 4. Two-Channel Function Generator Settings

	Mode	Frequency	Duty	Delay	High	Low	Output Impedance
Channel 1	Pulse	200 kHz	50%	0 µs	3.3 V	0 V	High Z

4.2.4 Oscilloscope Setting

Table 5 lists the oscilloscope setting.

Table 5. Oscilloscope Settings

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

4.2.5 Jumper (Shunt) Settings

The jumper on header J1 should NOT be installed for normal testing (see Figure 1).

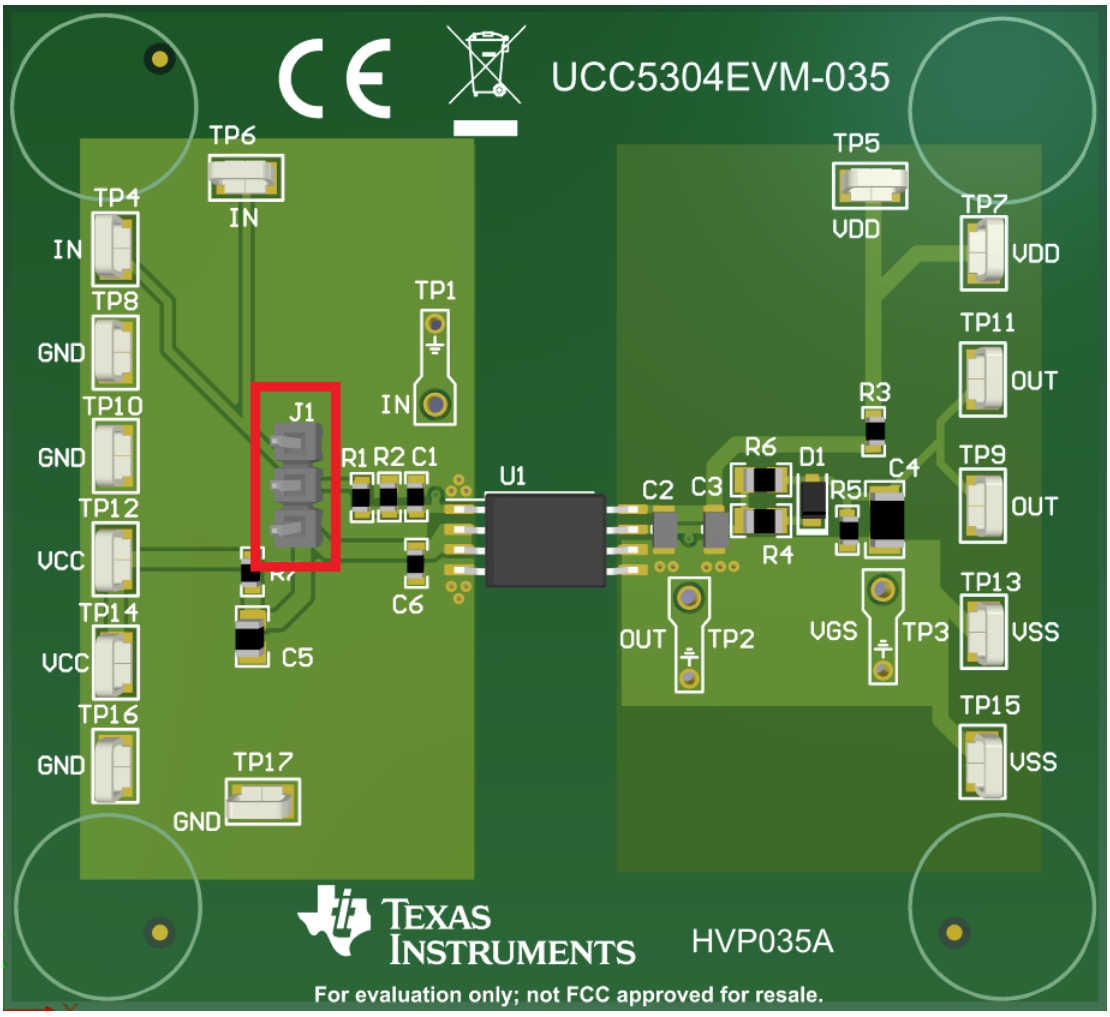

Figure 1. Jumpers Installation Position

4.2.6 Bench Setup Diagram

The current bench setup diagram includes the function generator and oscilloscope connections.

Follow this connection procedure, Figure 2 can be used as a reference.

1. Ensure the output of the function generator and voltage sources are disabled before connection.
2. Connect the function generator channel 1 to TP4 (IN) and TP8 (GND), see Figure 2.
3. Power supply 1: Connect the positive lead to the current meter input of DMM1, and connect the current meter output of DMM1 to TP12 (VCCI), and negative node applied to TP16 (GND).
4. Power supply 2: Connect the positive lead to the current meter input of DMM2, and connect the current meter output of DMM2 to TP7 (VDD), and negative node directly to TP15 (VSS).
5. Oscilloscope Ch-1: If a TPP1000 or other ground spring compatible probe is available, attach oscilloscope channel-1 probe to TP3. Otherwise, connect positive node to TP9 (OUT) and TP13 (VSS).

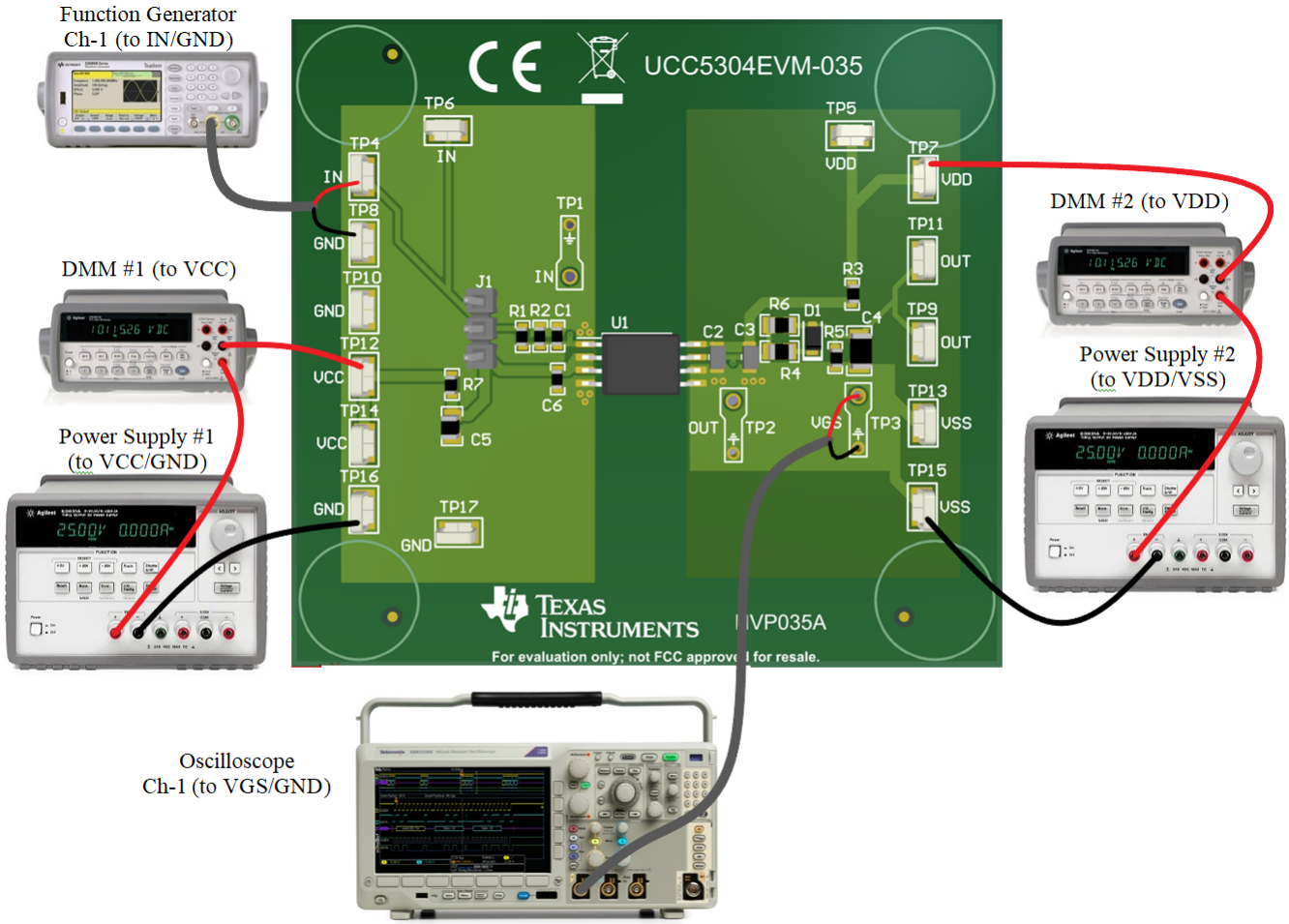

Figure 2. Bench Setup Diagram and Configuration

5 Power Up and Power Down Procedure

5.1 Power Up

1. Before proceeding with the power up test procedure, ensure that the steps in Section 4.2.6 are complete. Then, Figure 3 can be used as a reference for the expected behavior of the EVM.
2. Enable power supply 1. The quiescent current on DMM1 should be approximately 1mA to 2mA.
3. Enable power supply 2. The quiescent current on DMM2 should be approximately 0.75 mA to 2 mA if everything is set correctly.
4. Enable the function generator outputs.
5. Verify that the following occurs:
    1. Stable pulse output appears on channel 1 in the oscilloscope, see Figure 3.
    2. Oscilloscope frequency measurement matches programmed function generator frequency.
    3. DMM2 current should read 6.5 ± 0.5 mA with the default 1.8-nF load installed. For more information about the operating current, see the applications section of the UCC5304 data sheet.

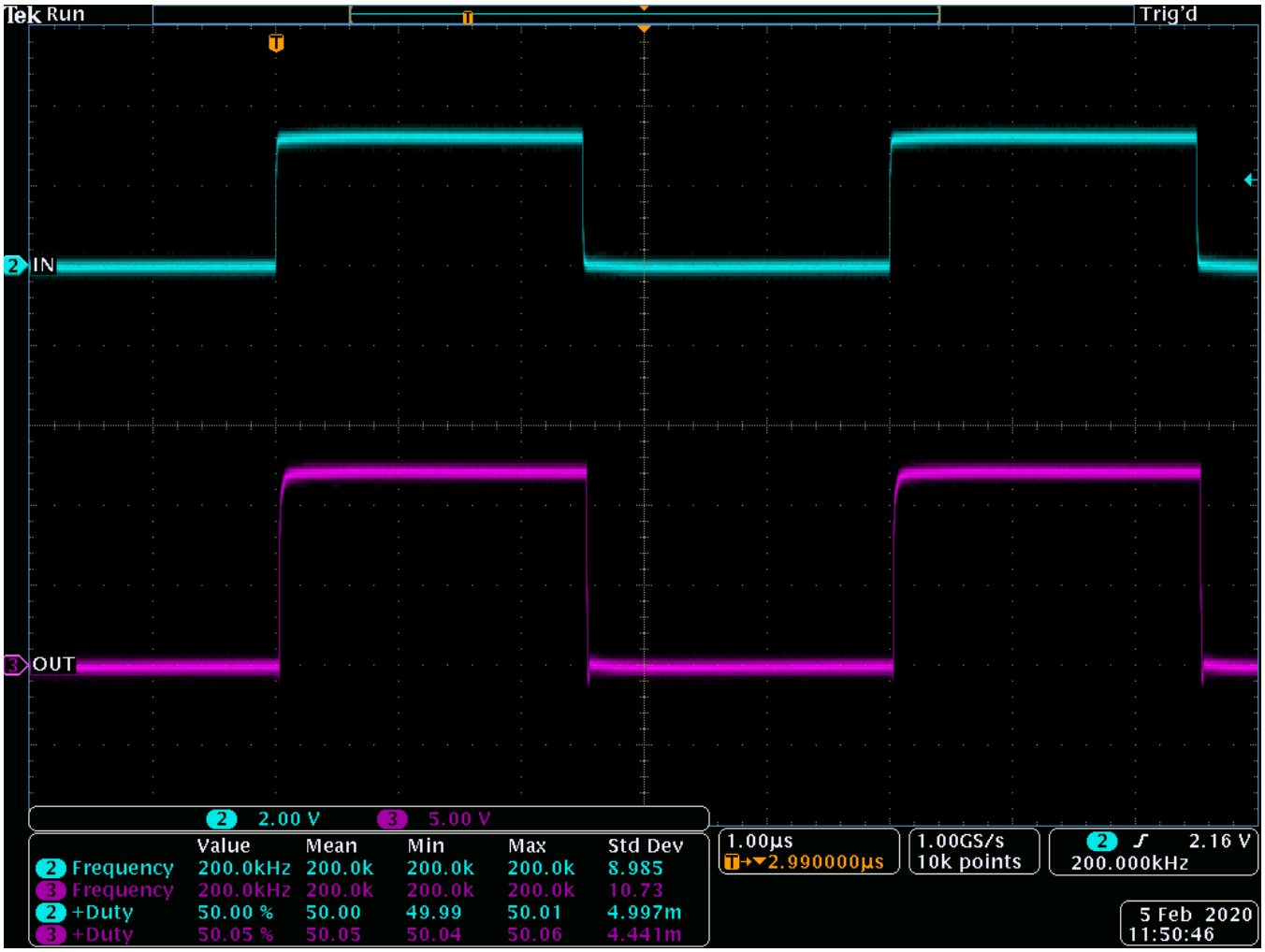

Figure 3. Example Input and Output Waveforms (Inputs: CH2, Outputs: CH3)

Figure 4 shows a zoomed-in view of the example input and output waveforms.

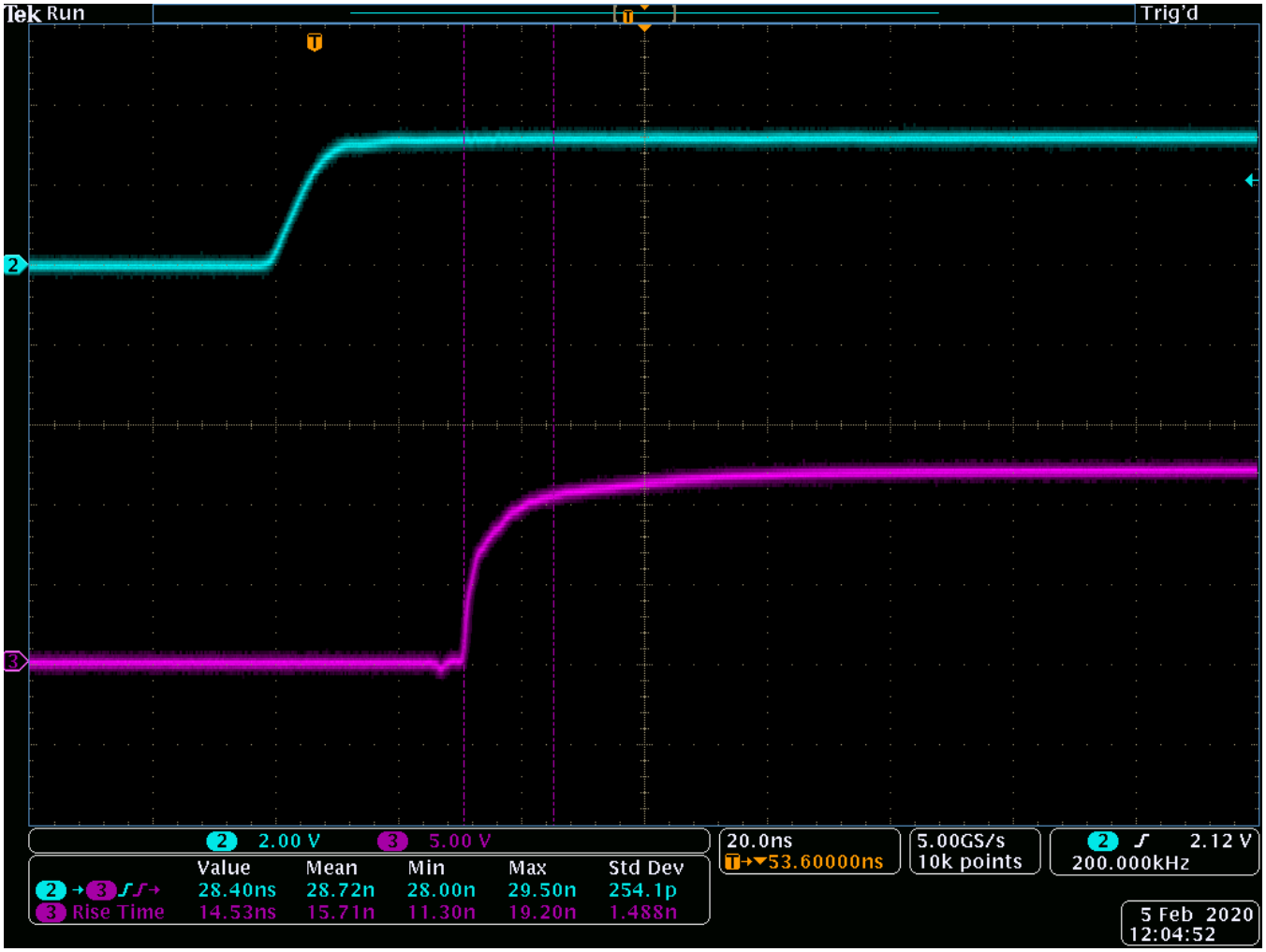

Figure 4. Example Input and Output Waveforms, Zoom In on Rise (Inputs: CH2, Outputs: CH3)

Figure 5 shows a zoomed-in view of the example input and output waveforms.

Figure 5. Example Input and Output Waveforms, Zoom In on Fall (Input: Ch2, Output Ch3)

5.2 Power Down

The following list describes the procedure to power down the EVM.

1. Disable the function generator.
2. Disable power supply 2.
3. Disable power supply 1.
4. Disconnect the cables and probes.

6 Schematic

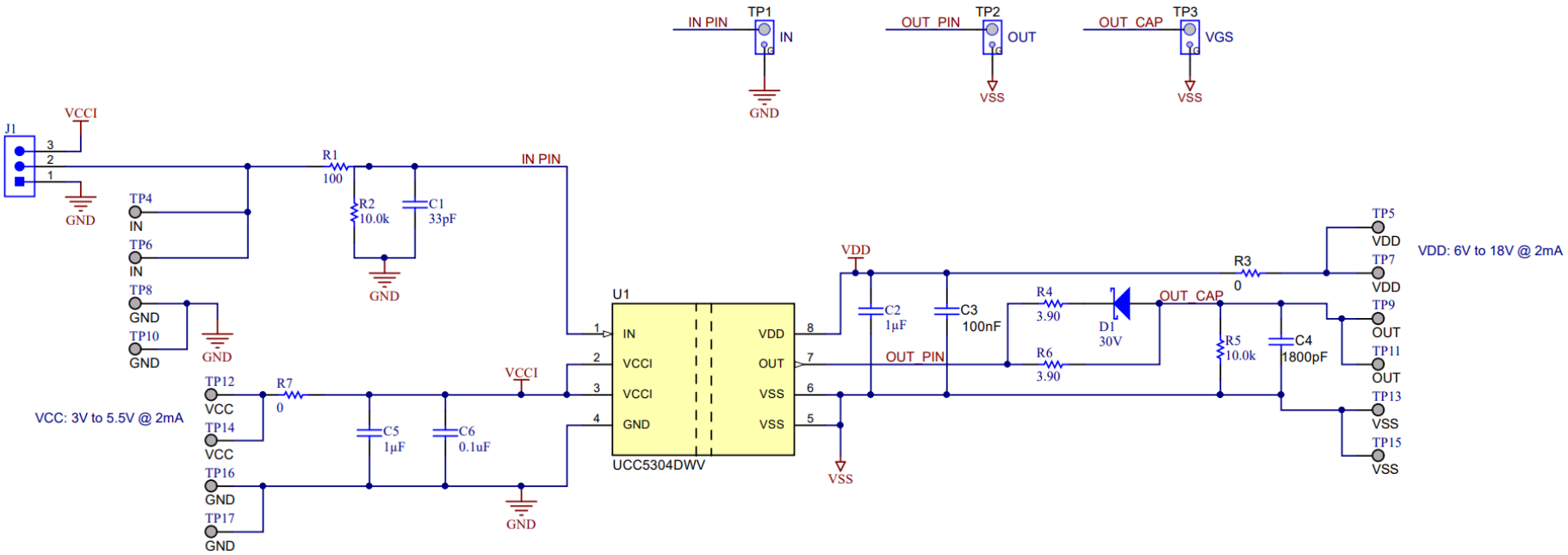

Figure 6. UCC5304EVM-035 Schematic

7 Layout Diagrams

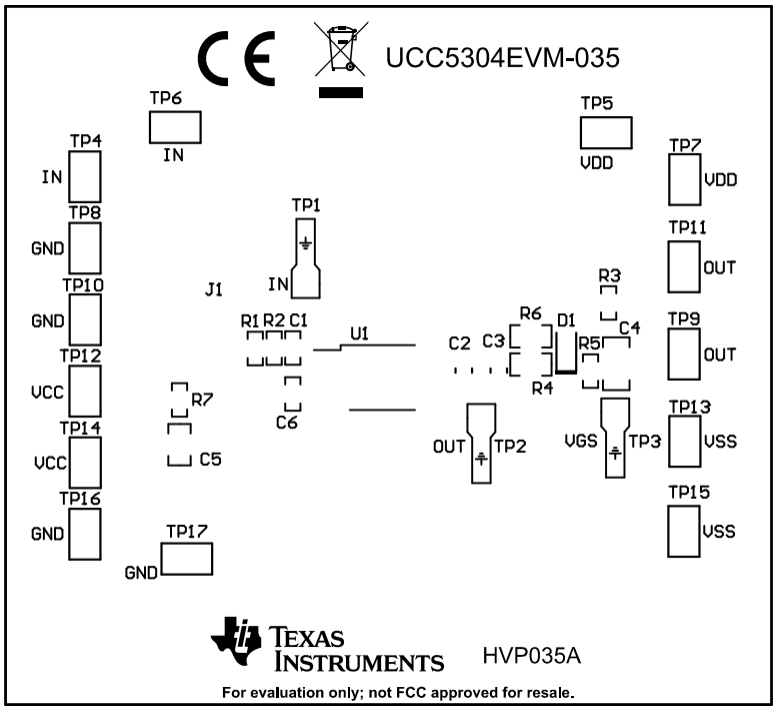

Figure 7. Top Overlay

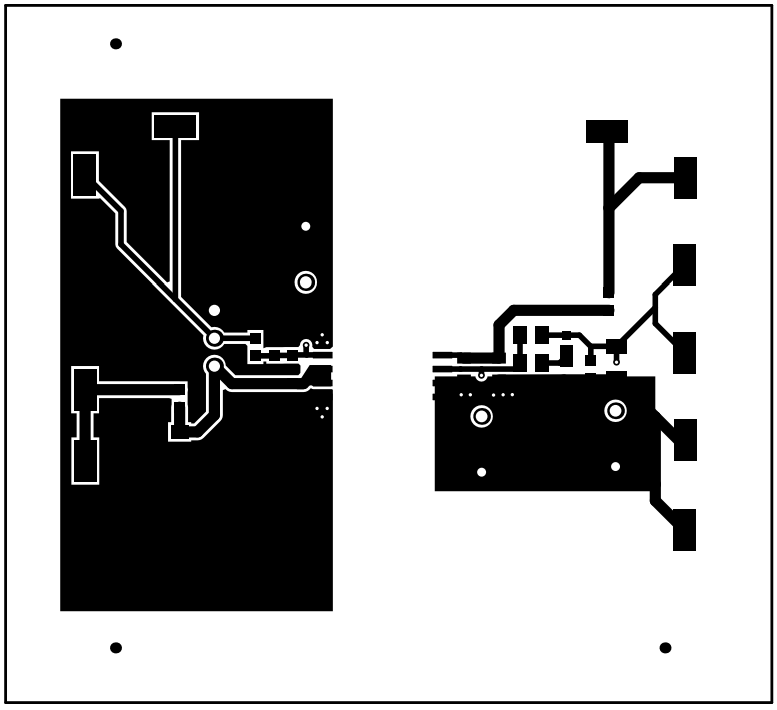

Figure 8. Top Layer

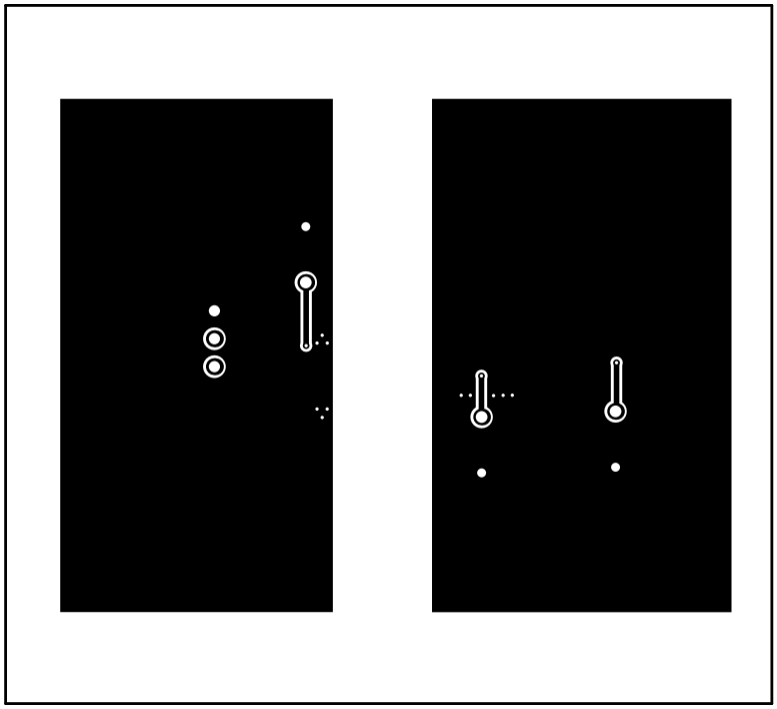

Figure 9. Bottom Layer

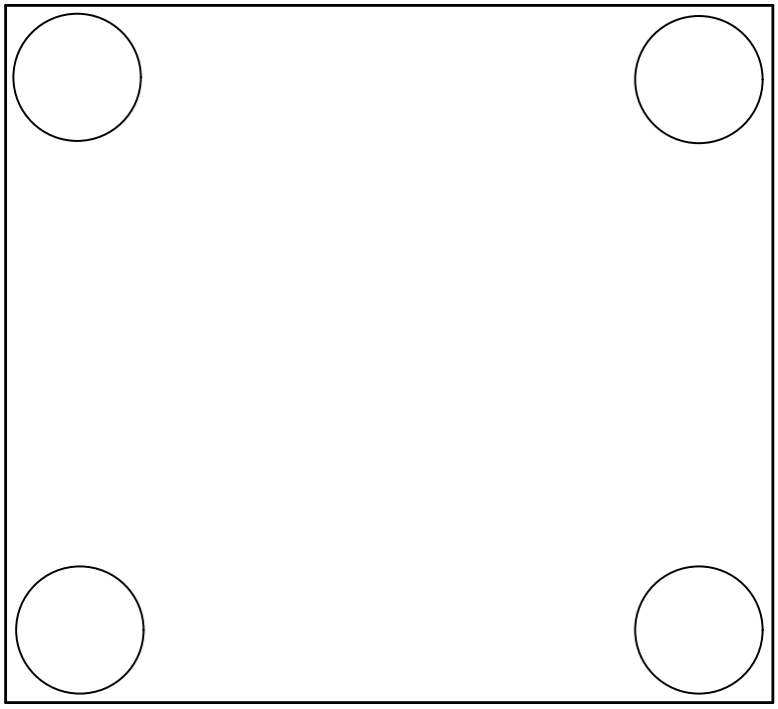

Figure 10. Bottom Overlay

8 List of Materials

Table 6. UCC5304EVM-035 List of Materials

QTY	Designator	Description
1	C1	Capacitor, ceramic, 33 pF, 50 V, ± 5%, C0G/NP0, 0603
2	C2, C5	Capacitor, ceramic, 1 µF, 50 V, ±10%, X7R, 0805
1	C3	Capacitor, ceramic, 0.1 µF, 50 V, ±10%, X7R, 0805
1	C4	Capacitor, ceramic, 1800 pF, 50 V, ±10%, X7R, 1206
1	C6	Capacitor, ceramic, 0.1 µF, 25 V, ±10%, X7R, 0603
1	D1	Diode, Schottky, 30 V, 1 A, MicroSMP
1	J1	Header, 2.54 mm, 3x1, Tin, TH
1	R1	Resistor, 100, 1%, 0.1 W, AEC-Q200 grade 0, 0603
2	R2, R5	Resistor, 10.0 k, 1%, 0.1 W, 0603
2	R3, R7	Resistor, 0, 0%, 0.25 W, AEC-Q200 grade 0, 0603
2	R4, R6	Resistor, 3.90, 1%, 0.125 W, 0805
14	TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16, TP17	Test point, miniature, SMT
1	U1	4-A/6-A, Single-Channel 5.7-kV_{RMS} Reinforced Isolation Gate Driver with High Noise Immunity, DWV0008A (SOIC-8)

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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 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.

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- *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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http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

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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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4.2 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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4.3.1 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.

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