User's Guide
SLUUBQ6A–August 2017–Revised October 2017

UCC27710-005 Evaluation Module

This user's guide describes the characteristics, operation, and use of the UCC27710 evaluation module (EVM). A complete schematic diagram, printed-circuit board layouts, and list of materials are included in this document.

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Trademarks

All trademarks are the property of their respective owners.

1 Introduction

The UCC27710EVM-005 evaluation module is designed for evaluation of the UCC27710, a member of TI's 620-V high-side and low-side gate-driver family. This driver is a 620-V, 0.5-A source, and 1.0-A sink peak current device for driving two MOSFETs or IGBTs. The pullup and pulldown resistance of the UCC27710 allows for driving large power MOSFETs at modest switching frequencies in VFD or inverter applications, or lower charge power devices at higher switching frequencies. It has excellent propagation delay matching between the high-side and low-side drivers and rising and falling edges for reliable timing of the gate-drive signals. Gate-drive robustness is enhanced by the output interlock feature which guarantees a 150-ns dead time between the output signals in the case of input signals with no dead time or overlapping. The UCC27710 inputs can tolerate negative voltage and signals as high as 20 V, regardless of the VDD voltage which allow for interface to pulse transformers and enhances device robustness.

The UCC27710 driver HS node can tolerate significant short-term negative voltage spikes and maintain the correct output behavior, a key consideration with many high-voltage power trains.

2 Description

The board is developed so the UCC27710 driver performance can be evaluated compared to data sheet parameters, or externally connected to power devices with provisions for source and sink gate resistance flexibility. The UCC27710EVM-005 evaluation board uses surface-mount test points that allow connection to LI, HI, VCC, and VHB inputs. A variety of test points are available for probing the UCC27710. The input bias is configured so the VHB-VHS high-side bias can be sourced from VCC, or an external additional bias can be added to provide VHB-VHS directly. The high-side and low-side driver output returns are separated on HS and GND to allow evaluation of the UCC27710 HS negative voltage capabilities. Moreover, the PCB layout is optimized with minimized loop area in each gate-driver loop and power-supply loop with bypassing capacitors. For detailed device information, refer to the UCC27710 data sheet (SLUSD05).

2.1 Features

The EVM has the following features:

- Evaluation module for the low-voltage features of UCC27710 gate driver
- 10-V to 20-V VCC power-supply range
- TTL-compatible inputs
- PCB layout optimized for power supply bypassing capacitor, gate-driver loop
- Capacitive load with external gate-drive resistor and diode for power and thermal testing
- Allows quick verification of most of the data sheet parameters
- Test points allow probing all the key pins of the UCC27710EVM-005

2.2 I/O Description

Table 1 lists and describes the pins on the EVM.

Table 1. Connection Descriptions

Pins	Description
VCC	VCC positive input. Powers IC VDD pin, use 10-V to 20-V range.
GND	Multiple test points. VCC negative input, PWMIN and PWMINx negative input, and primary ground at U1
PWMIN	High-side input to driver
PWMINx	Low-side input to driver
VDD	VDD positive input of UCC27710 IC
HI	High-side HI input pin
LI	Low-side LI input pin
HO	High-side output pin
LO	Low-side output pin
HO LD	High-side output at capacitive load
LO LD	Low-side output at capacitive load
VHB	HB pin voltage

3 Electrical Specifications

Table 2 displays the EVM electrical specifications.

Table 2. UCC27710EVM-005 Electrical Specifications

Description		MIN	TYP	MAX	Unit
V_{CC}	Input bias power supply	10		20	V
F_S	Switching frequency	0		500	kHz
T_J	Operating junction temperature range	–40		125	°C

NOTE: The UCC27710EVM-005 is designed for low voltage evaluation only, and is not certified for evaluation with voltages beyond the absolute maximums listed in the electrical specifications. **Do not evaluate high-voltage parameters with this board.**

4 Test Summary

4.1 Definitions

This procedure details how to configure the UCC27710EVM-005 evaluation board. Within this test procedure, the following naming conventions are followed.

DMM: Digital multimeter

EVM: Evaluation module assembly

Refer to *Bench Setup Diagram and Configuration* for details.

4.2 Equipment

4.2.1 Power Supplies

A DC power supply with voltage and current above 25 V and 1 A, for example: Agilent E3634A

4.2.2 Function Generators

One two-channel function generator over 20 MHz, for example, Tektronics AFG3252

4.3 Equipment Setup

4.3.1 DC Power Supply Settings

- DC power supply #1
  - Voltage setting: 15 V
  - Current limit: 0.05 A

4.3.2 Digital Multimeter Settings

- Digital multimeter #1
  - DC current measurement, auto-range, the expected current is from 1 mA to 15 mA

4.3.3 Two-Channel Function Generator Settings

Table 3 lists the two-channel function generator settings.

Table 3. Two-Channel Function Generator Settings

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

4.3.4 Oscilloscope Settings

Table 4 details the oscilloscope settings.

Table 4. Oscilloscope Settings

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

4.3.5 Bench Setup Diagram

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

Use the following connection procedure, and Figure 1 as a reference:

- Make sure the output of the function generator and power supplies are disabled before connection.
- Apply function generator channel-A on PWMIN and GND.
- Apply function generator channel-B on PWMINx and GND.
- Power supply #1: apply positive lead to current input of DMM #1 and current output of DMM #1 to test point VCC; apply negative lead to test point GND.
- Apply oscilloscope channel-1 probes on HO LD and HS, minimizing the loop area as much as possible. Note the scope ground is connected to the HS test point.
- Apply oscilloscope channel-2 probes on LO LD and GND, minimizing the loop area as much as possible.

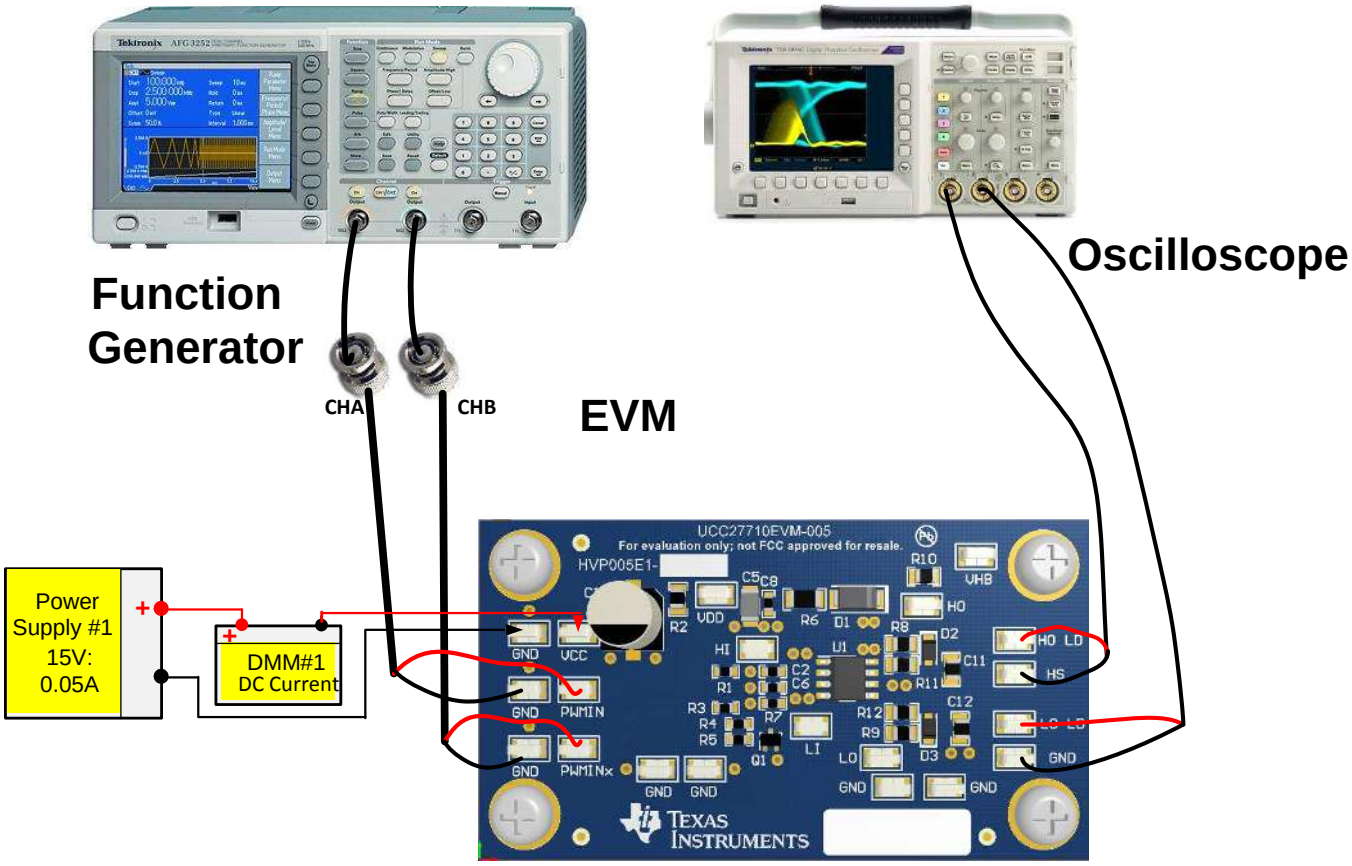

Figure 1. Bench Setup Diagram and Configuration

5 Power Up and Power Down Procedure

5.1 Power Up

Use the following steps for power up:

1. Before beginning the power-up test procedure, verify the connections using Section 4.3.5.
2. Enable supply #1, if the quiescent current on DMM1 is less than 350 µA, everything is set correctly.
3. Enable function generator outputs channel-A and channel-B.
4. The following conditions exist:
   1. A stable pulse output on channel-1 and channel-2 in the oscilloscope, refer to Figure 2
   2. The frequency measurement should be 100 kHz, ±5 kHz, or equal to the programmed function generator frequency
   3. DMM #1 displays around 3.6 mA, ±1 mA. For more information about operating current, refer to the UCC27710 data sheet (SLUSD05).

NOTE: With complimentary input signals as in this setup, the UCC27710 will have approximately 150-ns dead time on the outputs.

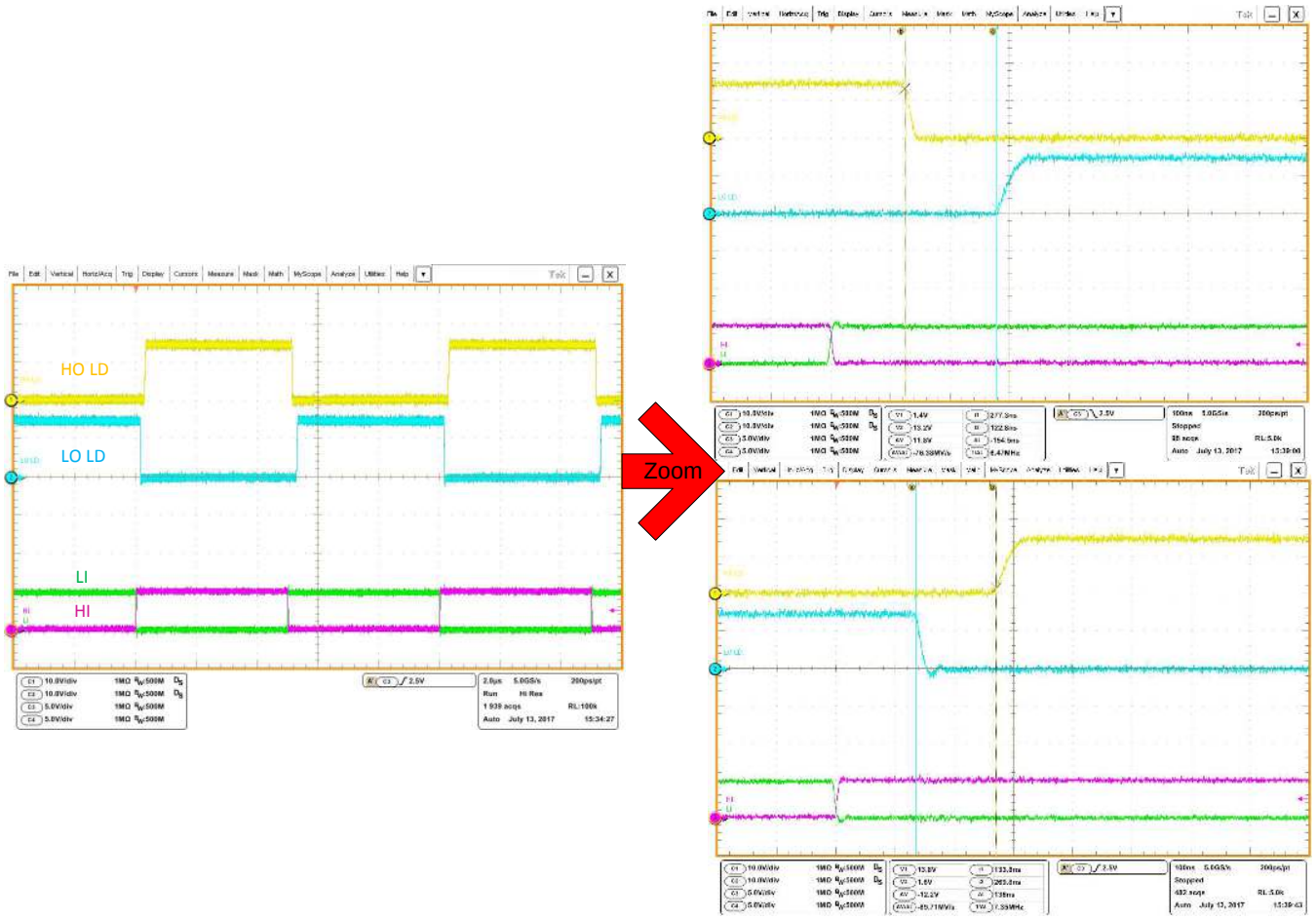

Figure 2. Example Input and Output Waveforms with Complimentary Input Signals (Green and Magenta are PWM Inputs, Yellow and Blue are Driver Outputs)

5.2 Power Down

Use the following steps to power down the EVM:

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

6 Typical Performance Waveforms (C_L = 1000 pF)

6.1 Input Signals With Greater Than 150-ns Dead Time

To evaluate propagation delay, the input signals must have dead time greater than the internal 150-ns dead time. See Figure 3 and Figure 4.

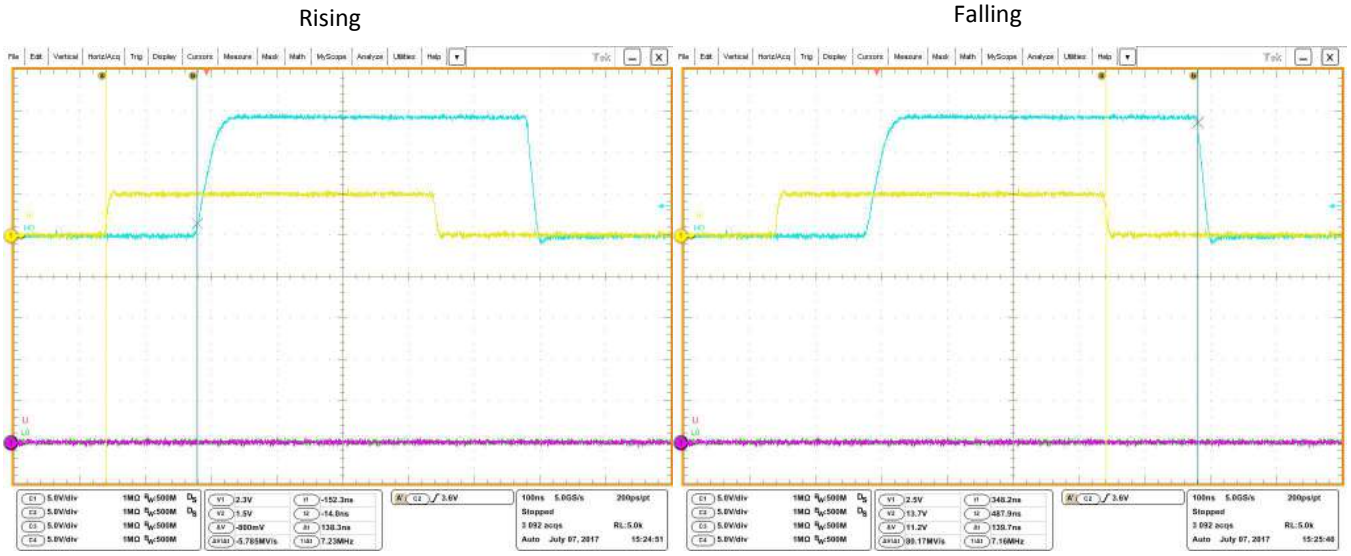

Figure 3. HI and HO Waveforms if Input Dead Time is Greater Than Internal Dead Time (Yellow and Magenta are PWM Inputs, Green and Blue are Driver Outputs)

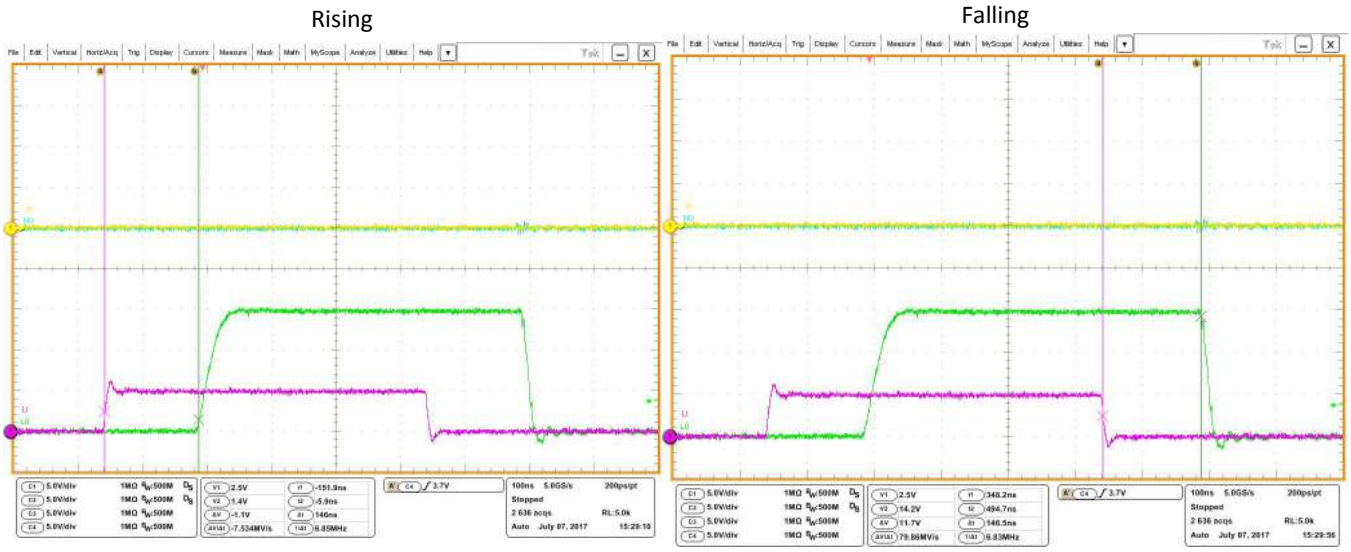

Figure 4. LI and LO Waveforms if Input Dead Time is Greater Than Internal Dead Time (Yellow and Magenta are PWM Inputs, Green and Blue are Driver Outputs)

7 Schematic

Figure 5 shows the schematic diagram for the UCC27710EVM-005.

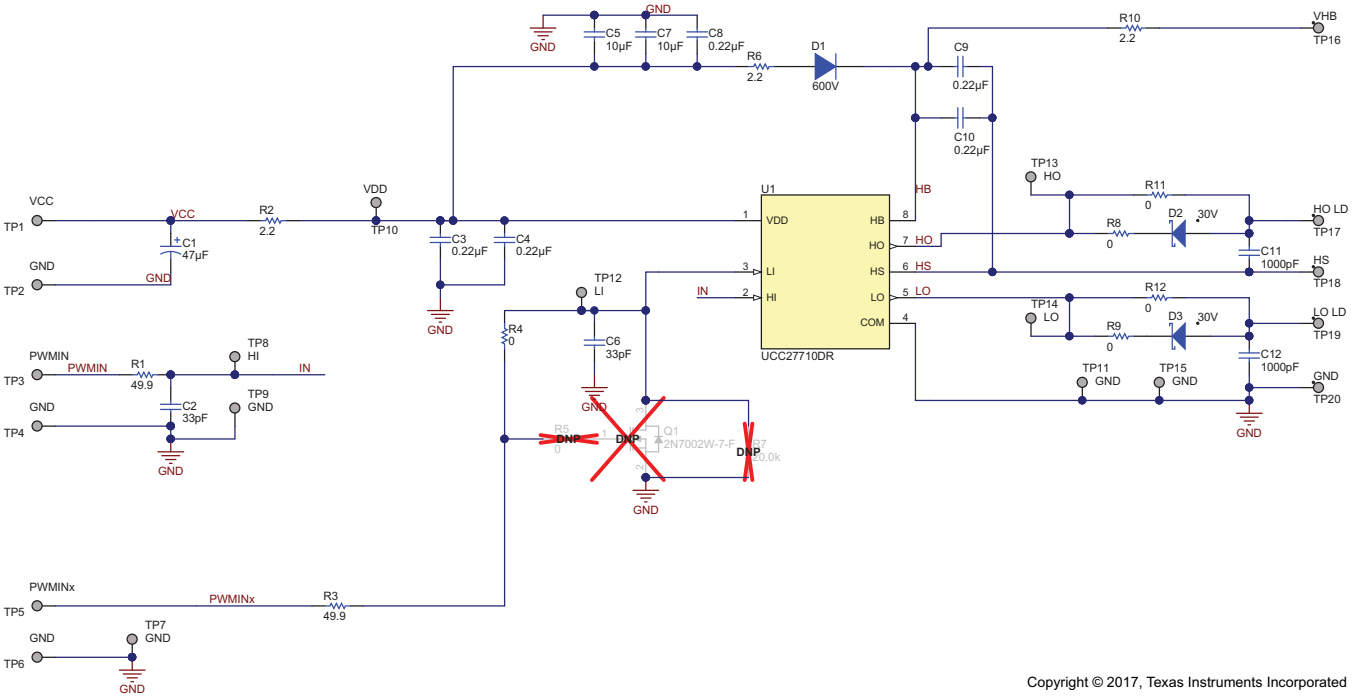

Figure 5. UCC27710EVM-005 Schematic

8 Layout Diagrams

The PCB layout information for UCC27710EVM-005 is shown in Figure 6, Figure 7, Figure 8 and Figure 9.

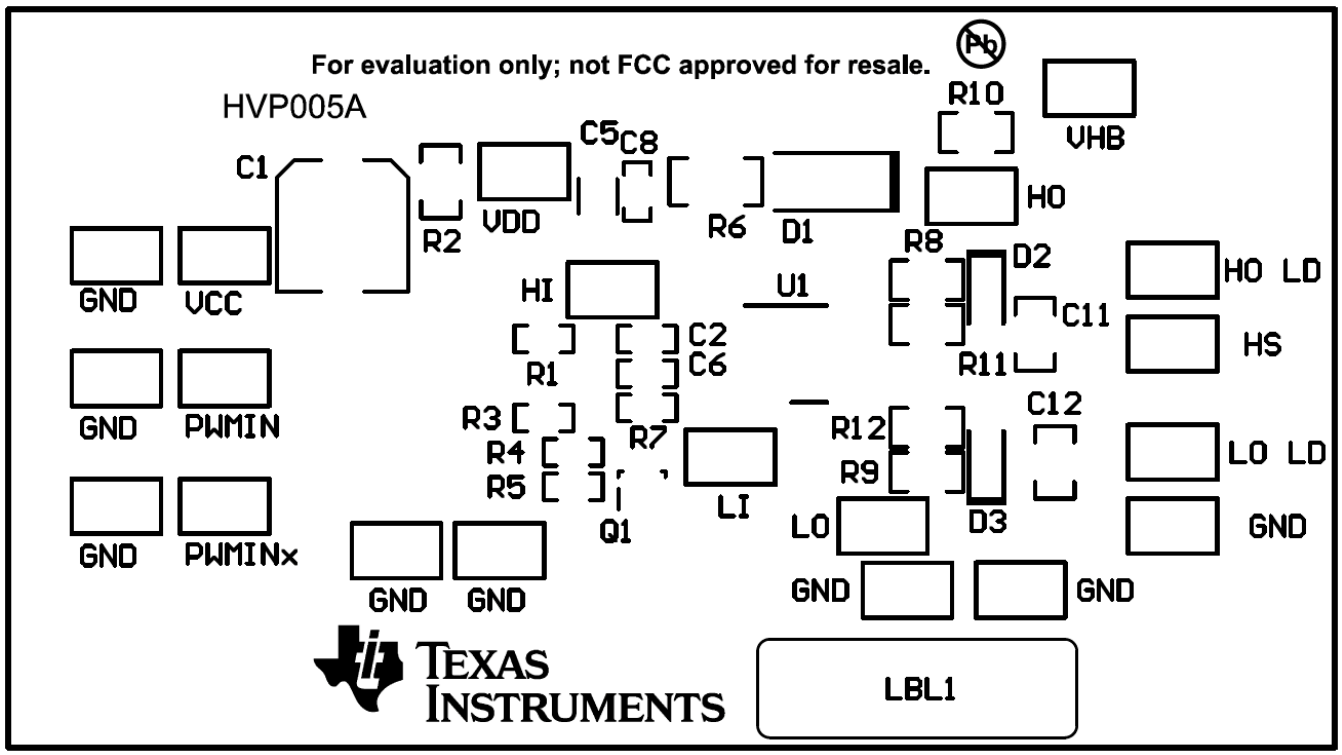

Figure 6. Top Overlay

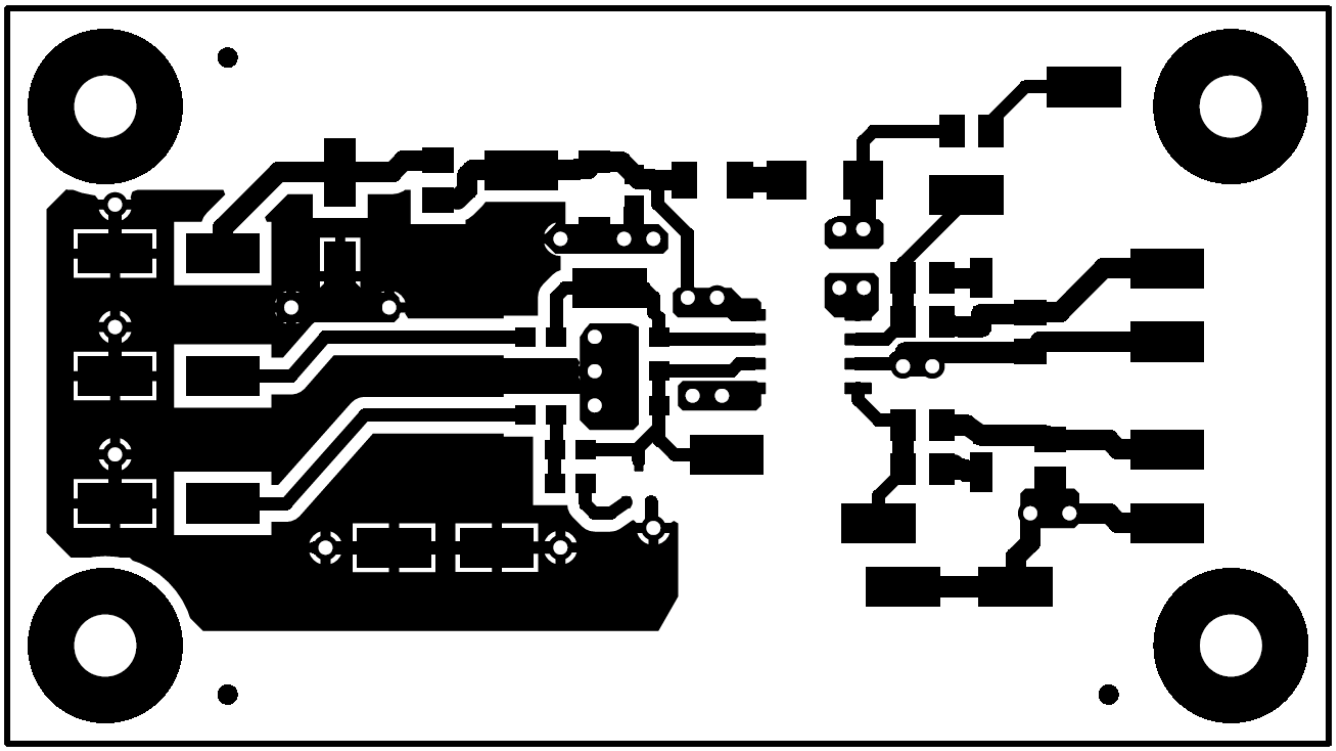

Figure 7. Top Layer

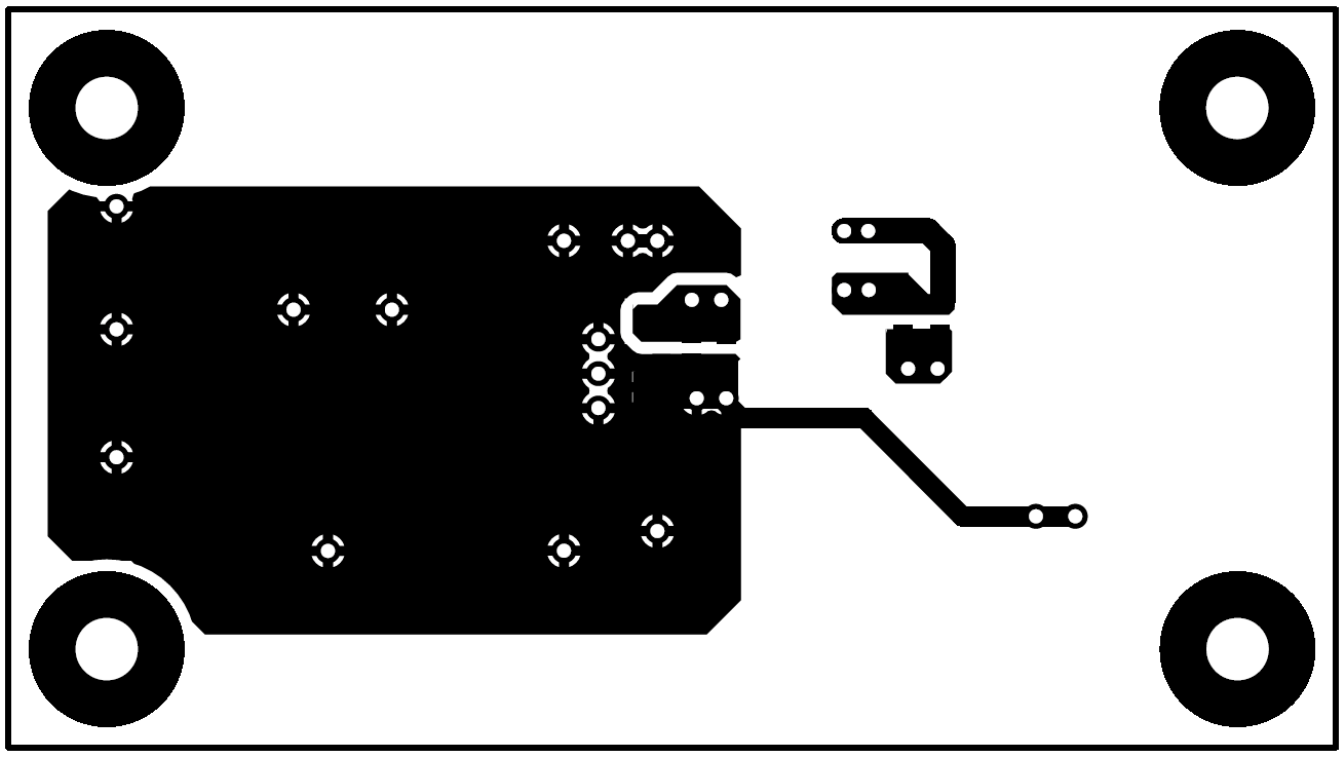

Figure 8. Bottom Layer

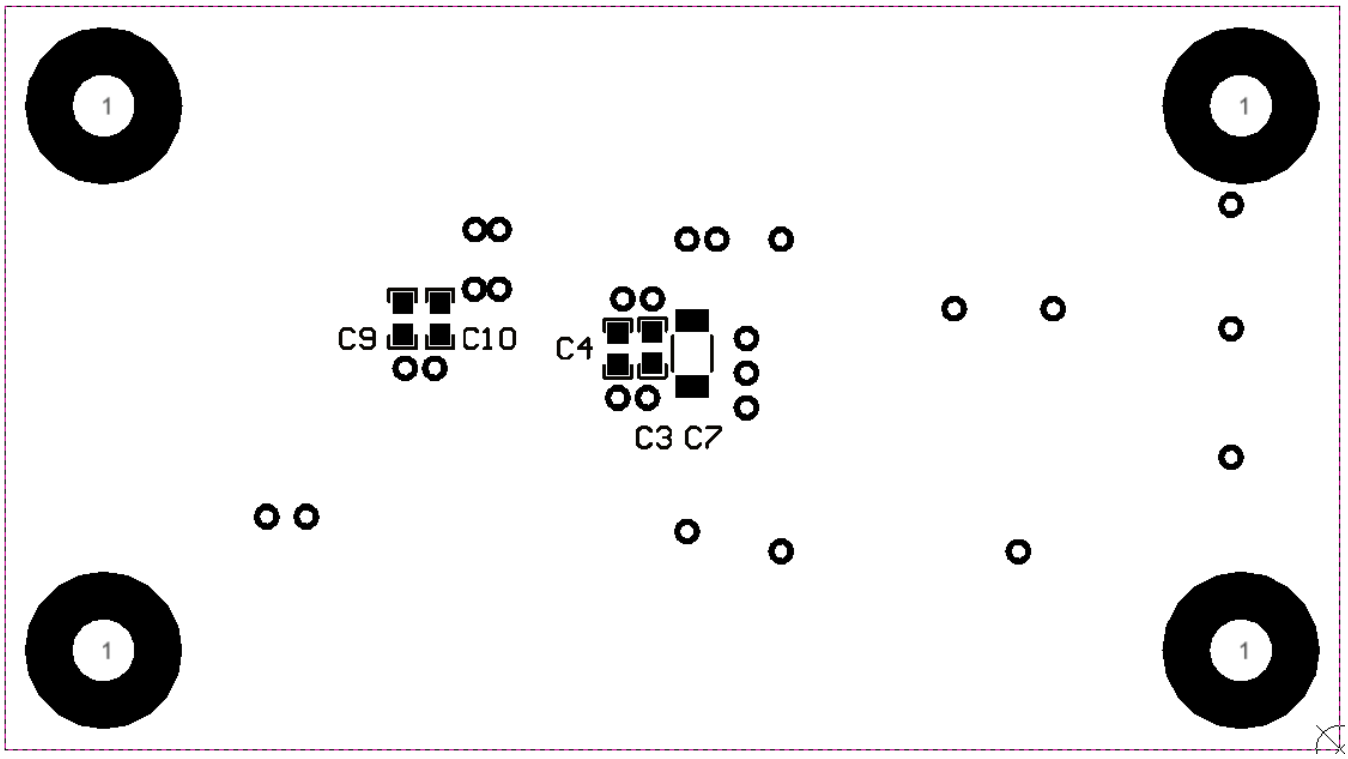

Figure 9. Bottom Overlay

9 List of Materials

Table 5 displays the EVM list of materials.

Table 5. UCC27710EVM-005 List of Materials

Item #	Designator	Qty	Value	Part Number	Manufacturer	Description	Package Reference
1	!PCB?	1		HVP005	Any	Printed Circuit Board	
2	C1	1	47uF	UUD1H470MCL1GS	Nichicon	CAP, AL, 47 µF, 50 V, +/- 20%, 0.68 ohm, SMD	6.3x7.7
3	C2, C6	2	33pF	C0603C330J5GACTU	Kemet	CAP, CERM, 33 pF, 50 V,+/- 5%, C0G/NP0, 0603	0603
4	C3, C4, C8, C9, C10	5	0.22uF	C1608X7R1H224K080AB	TDK	CAP, CERM, 0.22 µF, 50 V, +/- 10%, X7R, 0603	0603
5	C5, C7	2	10uF	C3216X7R1V106M160AC	TDK	CAP, CERM, 10 µF, 35 V, +/- 20%, X7R, 1206_190	1206_190
6	C11, C12	2	1000pF	C0805C102J5RACTU	Kemet	CAP, CERM, 1000 pF, 50 V, +/- 5%, X7R, 0805	0805
7	D1	1	600V	MURA160T3G	ON Semiconductor	Diode, Ultrafast, 600 V, 1 A, AEC-Q101, SMA	SMA
8	D2, D3	2	30V	MSS1P3L-M3/89A	Vishay-Semiconductor	Diode, Schottky, 30 V, 1 A, AEC-Q101, MicroSMP	MicroSMP
9	H1, H2, H3, H4	4		NY PMS 440 0025 PH	B&F Fastener Supply	Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	Screw
10	H5, H6, H7, H8	4		1902C	Keystone	Standoff, Hex, 0.5"L #4-40 Nylon	Standoff
11	LBL1	1		THT-14-423-10	Brady	Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	PCB Label 0.650"H x 0.200"W
12	R1, R3	2	49.9	CRCW060349R9FKEA	Vishay-Dale	RES, 49.9, 1%, 0.1 W, 0603	0603
13	R2, R10	2	2.2	CRCW08052R20JNEA	Vishay-Dale	RES, 2.2, 5%, 0.125 W, 0805	0805
14	R4	1	0	CRCW06030000Z0EA	Vishay-Dale	RES, 0, 5%, 0.1 W, 0603	0603
15	R6	1	2.2	CRCW12062R20JNEA	Vishay-Dale	RES, 2.2, 5%, 0.25 W, 1206	1206
16	R8, R9, R11, R12	4	0	ERJ-6GEY0R00V	Panasonic	RES, 0, 5%, 0.125 W, 0805	0805
17	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16, TP17, TP18, TP19, TP20	20		5019	Keystone	Test Point, Miniature, SMT	Test Point, Miniature, SMT
18	U1	1		UCC27710DR	Texas Instruments	620-V High-Side Low-Side Gate Driver with 0.5/1.0A Peak Output and RobustDrive, D0008B (SOIC-8)	D0008B
19	FID1, FID2, FID3	0		N/A	N/A	Fiducial mark. There is nothing to buy or mount.	Fiducial
20	Q1	0	60V	2N7002W-7-F	Diodes Inc.	MOSFET, N-CH, 60 V, 0.115 A, SOT-323	SOT-323
21	R5	0	0	CRCW06030000Z0EA	Vishay-Dale	RES, 0, 5%, 0.1 W, 0603	0603
22	R7	0	20.0k	RC0603FR-0720KL	Yageo America	RES, 20.0 k, 1%, 0.1 W, 0603	0603

Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original (August 2017) to A Revision	Page
• Deleted 'CMOS' from the inputs listed in *Features*	2
• Deleted reference to power supply #3 in *Bench Setup Diagram*	5

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      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.*

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3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247*

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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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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。
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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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:*

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