

Using the LM5108EVM

This user's guide describes the characteristics, operation, and use of the LM5108 Evaluation Module (EVM). A complete schematic diagram, PCB layouts, and BOM are included in this document.

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1 Introduction

The LM5108EVM is designed to primarily evaluate the LM5108 performance. This driver is a 100-V boot voltage, high-side, low-side driver with 1.5-A peak source and 2.5-A sink current for driving two N-Channel MOSFETs. The same board can be used to evaluate other pin-to-pin compatible parts in the supported package. The LM5108 has low propagation delay and low propagation delay matching between the high- and low-side rising and falling edges of the driver outputs for reliable timing of the gate-drive signals. The LM5108 inputs can tolerate signals as high as 16 V regardless of the V_{DD} voltage which enhances device robustness.

The LM5108 driver includes an enable function which enables the driver outputs when pulled high, and disables the driver into a very low standby current mode when low. The LM5108 also includes an interlock feature which sets both LO and HO driver outputs low when both LI and HI inputs are high at the same time. This prevents turning on the high-side and low-side MOSFETs at the same time enhancing robustness of the power train design.

2 Description

The EVM is developed in such a way that the LM5108 driver performance can be evaluated and compared to data sheet parameters, or externally connected to power devices with provisions for source and sink gate-resistance flexibility. The LM5108EVM evaluation board uses surface-mount test points allowing connection to LI, HI, VDD, and HB inputs. A variety of other test points are available for probing the LM5108. The input bias is configured such that 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- and low-side driver output returns are separated on HS and GND respectively to allow evaluation of the LM5108 HS negative voltage capabilities. For detailed device information, see [LM5108 Datasheet](#).

2.1 Features

The EVM supports the following features:

- EVM for the low-voltage features of the LM5108 gate driver
- 6-V to 16-V VCC power supply range
- TTL-compatible inputs
- PCB layout optimized for bias supply bypassing cap, gate-drive resistance selection
- Capacitive load, external gate drive resistor and diode for gate drive network evaluation
- Allows quick verification of most of the data sheet parameters
- Test points allow probing all the key pins of the LM5108

2.2 I/O Description

Table 1 details the connection descriptions.

Table 1. Connection Descriptions

| Pins | Description |
|--------|---|
| VCC | V _{CC} positive input test point. Powers IC VDD pin, use 6-V to 16-V range. |
| VDD | V _{DD} positive input of LM5108 IC |
| GND | Multiple test points. V _{CC} negative input, HI_IN, LI_IN, and ENA_IN negative inputs, and ground at LM5108 IC |
| HI_IN | High-side input to EVM |
| HI | High-side input pin, HI |
| LI_IN | Low-side input to EVM |
| LI | Low-side input pin, LI |
| ENA_IN | Enable input to EVM. Connect to GND to disable driver. |
| VHB | HB pin voltage |
| HO LD | High-side output at capacitive load |
| HO | High-side output pin |
| HS | High-side driver return pin. Usually connected to high-side MOSFET source. |
| LO LD | Low-side output at capacitive load |
| LO | Low-side output pin |

3 Electrical Specifications

Refer to the [LM5108 Datasheet](#) for the full range of recommended operating specifications and design guidelines for driving loads.

CAUTION

The LM5108EVM 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 LM5108EVM evaluation board. Within this test procedure, the following naming conventions are applied. Refer to the LM5108EVM *Bench Setup Diagram and Configuration*, [Figure 1](#), for details.

DMM: Digital multimeter

EVM: Evaluation module

4.2 Equipment

4.2.1 Power Supply

DC power supply with voltage and current above 20 V and 1 A, for example: Agilent E3634A

4.2.2 Function Generator

Two-channel function generator over 10 MHz, for example: Tektronics AFG3252

4.2.3 DMM

DMM with voltage and current above 25 V and 1 A, for example: Fluke 187

4.2.4 Oscilloscope

Four channel oscilloscope with 500MHz or greater bandwidth, for example DPO 7054

4.3 Equipment Setup

4.3.1 DC Power Supply Settings

- DC power supply #1
 - Voltage setting: 12 V
 - Current limit: 0.05 A

4.3.2 Digital Multi-Meter Settings

- DMM #1
 - DC current measurement, auto-range. Expected current is within 1 mA to 15 mA.

4.3.3 Two-Channel Function Generator Settings

[Table 2](#) displays the two-channel function generator settings.

Table 2. Two-Channel Function Generator Settings

| | Mode | Frequency | Width | Delay | High | Low | Output Impedance |
|-----------|-------|-----------|-------------|-----------|------|-----|------------------|
| Channel A | Pulse | 100 kHz | 2.5 μ s | 0 μ s | 5 V | 0 V | High Z |
| Channel B | | | 2.5 μ s | 5 μ s | | | |

The LM5108 interlock function will result in HO and LO in the low state if HI and LI are high at the same time.

4.3.4 Oscilloscope Settings

Table 3 details the oscilloscope settings.

Table 3. Oscilloscope Settings

| | Bandwidth | Coupling | Termination | Scale Settings | Inverting |
|-----------|------------------|----------|---------------------------|--------------------------|-----------|
| Channel A | 500 MHz or above | DC | 1 M Ω or automatic | 10 \times 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, refer to Figure 1.

- First, make sure the output of the function generator and power supplies are disabled before connection.
- Apply function generator channel-A on HI_IN-GND.
- Apply function generator channel-B on LI_IN-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-HS, minimizing the loop area as much as possible. Note the scope ground is connected to HS test point.
- Apply oscilloscope channel-2 probes on LO LD-GND, minimizing the loop area as much as possible.

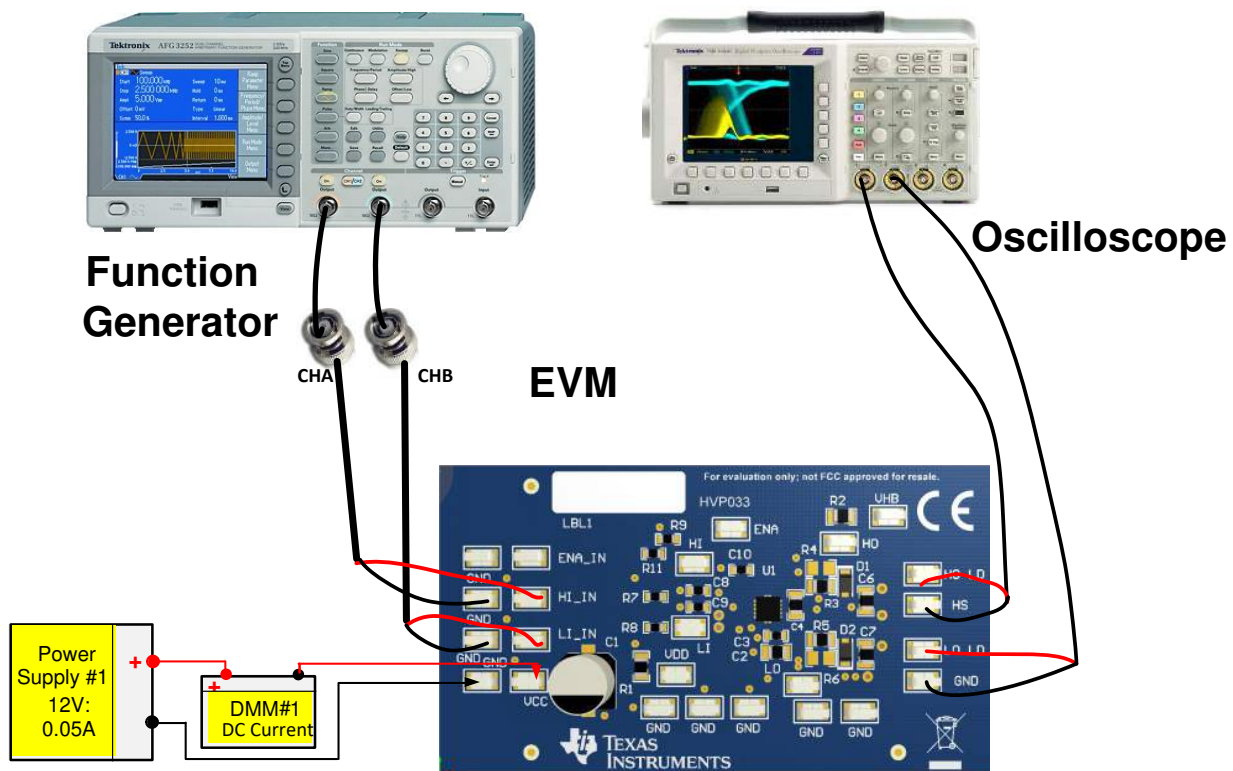


Figure 1. Bench Setup Diagram and Configuration

5 Power Up and Power Down Procedure

5.1 Power Up

1. Before beginning the power up test procedure, verify the connections with [Figure 1](#).
2. Enable supply #1, if the current on DMM1 is more than 0.25 mA and less than 0.71 mA, everything is set correctly.
3. Enable function generator outputs channel-A and channel-B.
4. The following conditions should be present:
 1. Stable pulse output on channel-1 and channel-2 in the oscilloscope, refer to [Figure 2](#)
 2. Frequency measurement should be 100 kHz, ± 5 kHz or equal to the programmed function generator frequency
 3. DMM #1 should display around 4.6 mA, ± 2 mA with the default load capacitance of 1.0nF. For more information about operating current, refer to [UCC2728x Datasheet](#).
5. Connect ENA_IN test point to GND test point with a Jumper. The pulse outputs on channel-1 and channel-2 will cease operation and the voltage level should be near ground.



**Figure 2. Example Input and Output Waveforms
(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 function generator
2. Disable power supply #1
3. Disconnect cables and probes

6 Operation With External Bootstrap Diode

The LM5108EVM has an internal bootstrap diode included, the series resistor (R10) is not populated. This allows the user to evaluate pin compatible drivers that do not have the internal bootstrap diode which is included with the LM5108 High-Side and Low-Side Driver.

As a general guideline, when using the external bootstrap diode a resistance value of 2.2Ω to 10Ω is recommended. Install R10 1206 size resistor for evaluation of pin compatible drivers without the internal bootstrap diode.

7 Typical Performance Waveforms ($C_L = 1000 \text{ pF}$)

7.1 Propagation Delays

The waveforms below illustrate the HI input and HO output on the top traces, and the LI input and LO output on the bottom traces in each plot.

To evaluate propagation delays and rising and falling details, it is recommended to have scope probe connections with short ground leads, see [Figure 3](#) and [Figure 4](#).

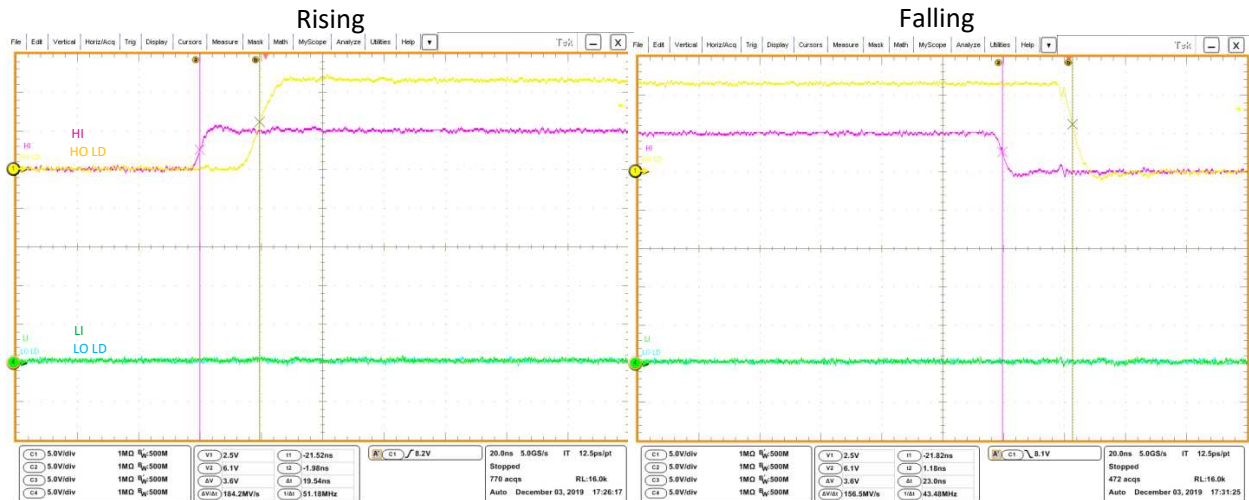


Figure 3. HI and HO Propagation Delay Waveforms (Green and Magenta are PWM Inputs, Yellow and Blue are Driver Outputs)

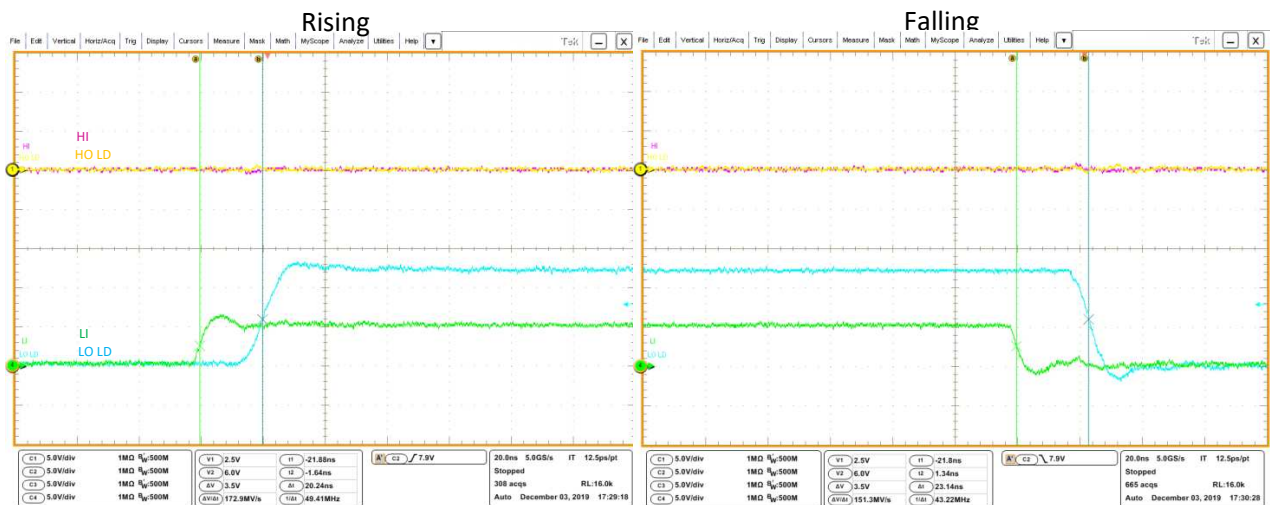


Figure 4. LI and LO Propagation Delay Waveforms (Green and Magenta are PWM Inputs, Yellow and Blue are Driver Outputs)

8 Schematic

Figure 5 shows the LM5108EVM schematic diagram.

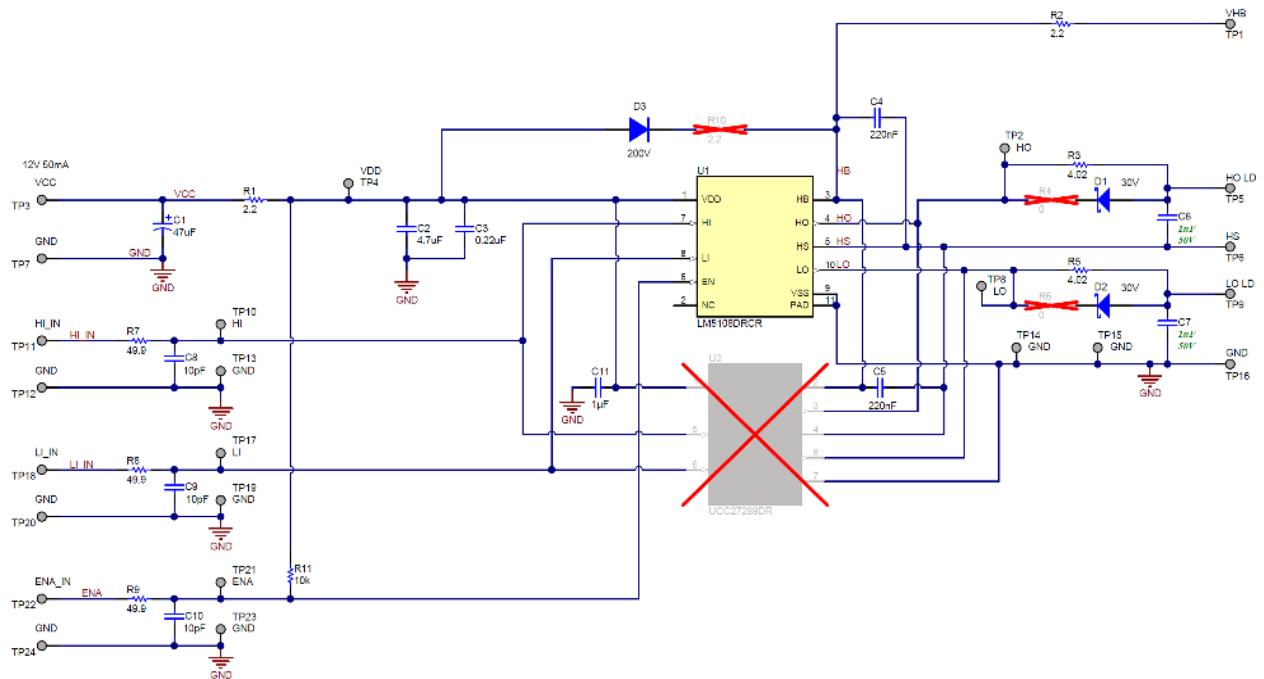


Figure 5. LM5108EVM Schematic

U2 is not installed since it is an alternate driver IC used on a different board assembly variation.

9 Layout Diagrams

The PCB layout information for LM5108EVM is shown in [Figure 6](#) through [Figure 11](#).

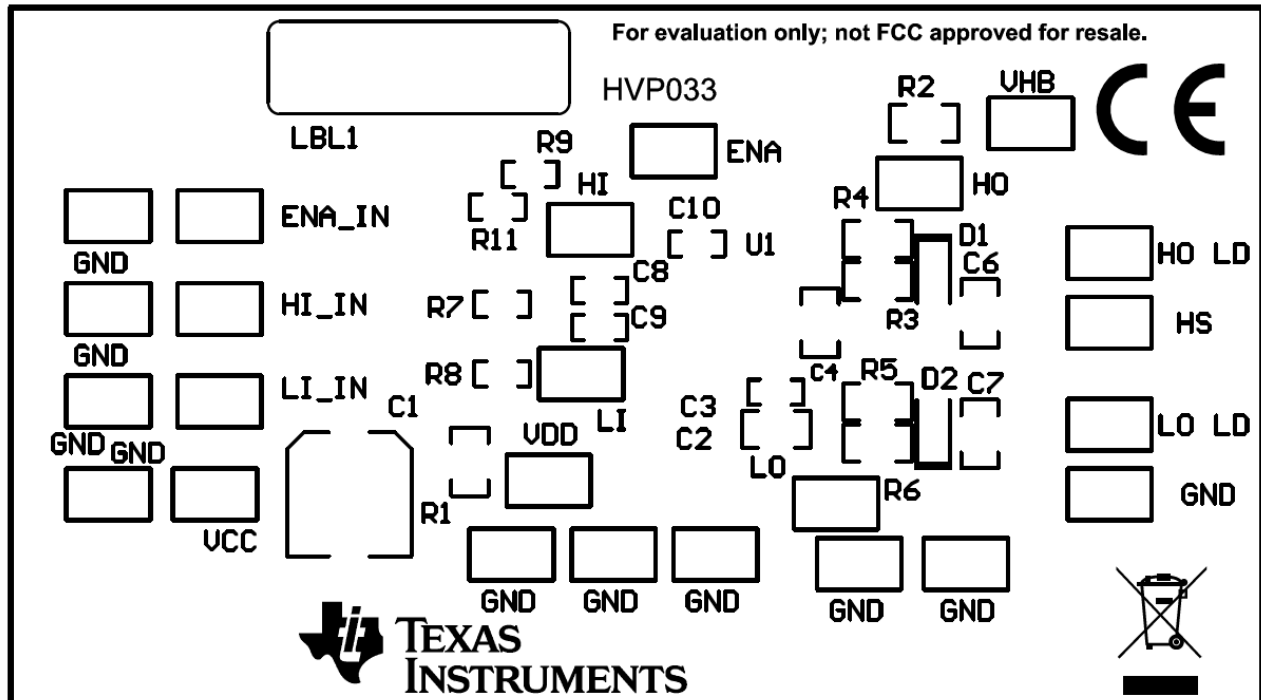


Figure 6. Top Overlay

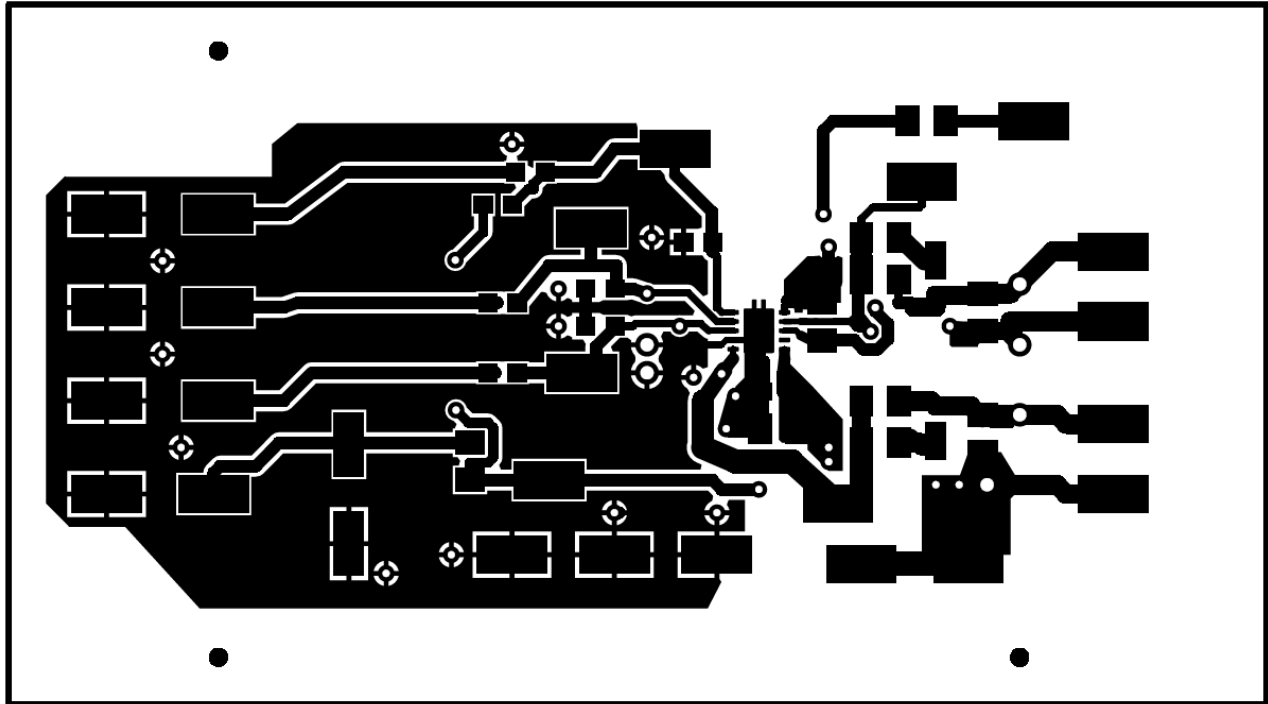


Figure 7. Top Layer

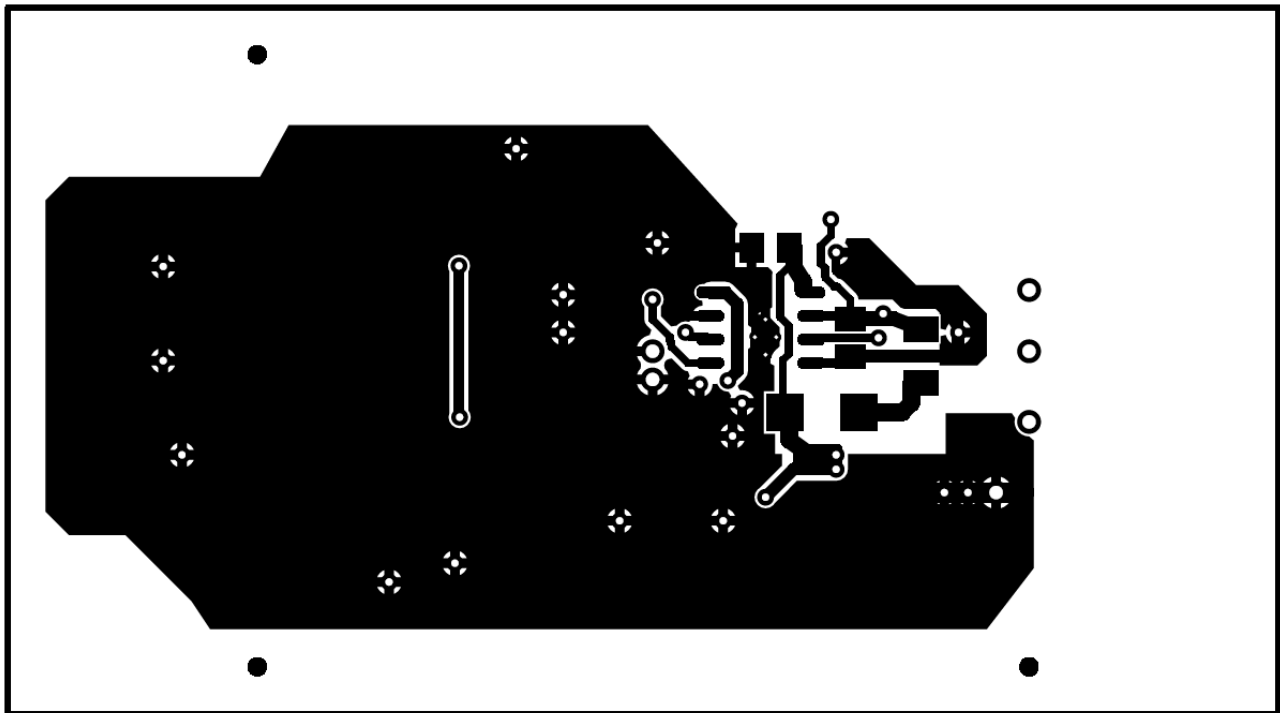


Figure 8. Bottom Layer

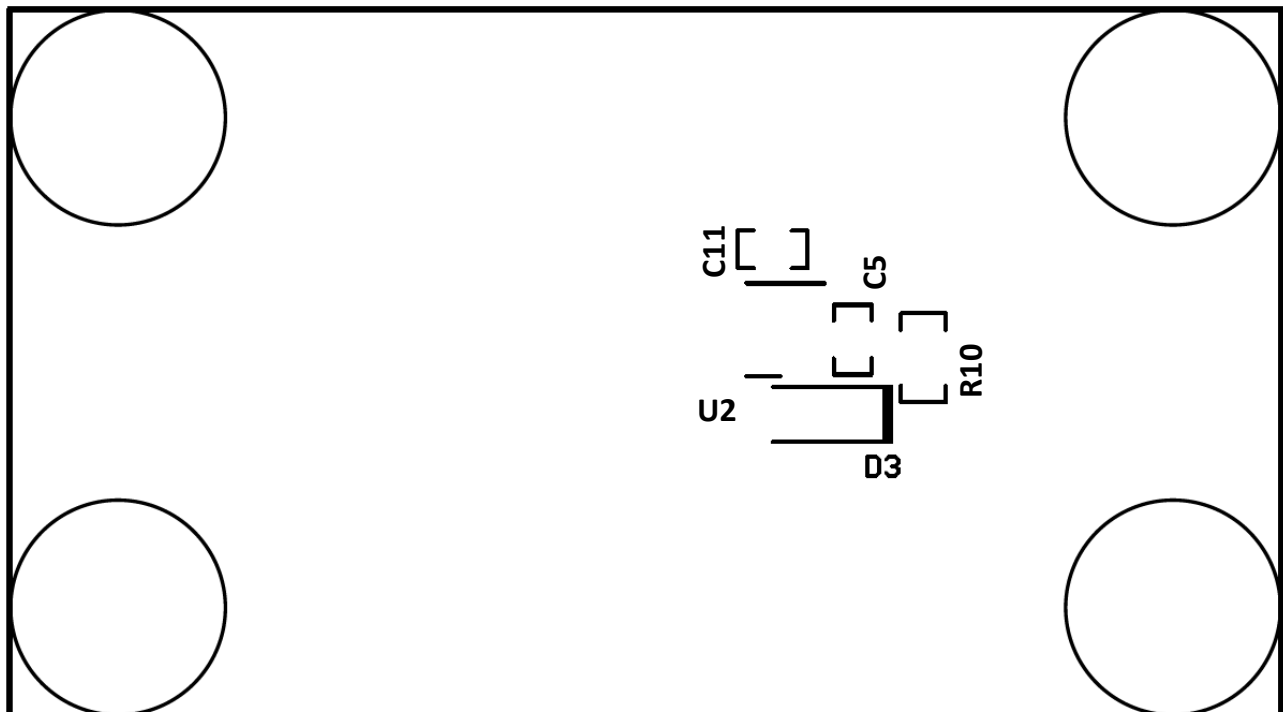


Figure 9. Bottom Overlay

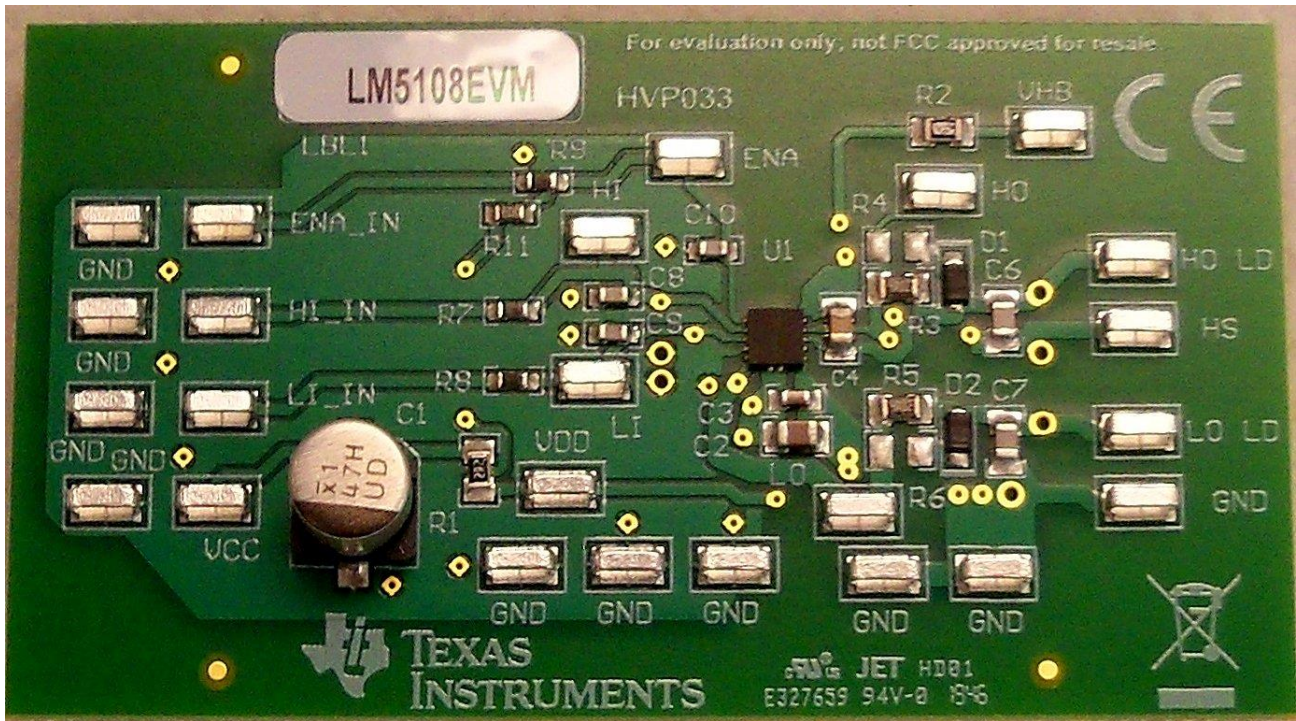


Figure 10. Top Image

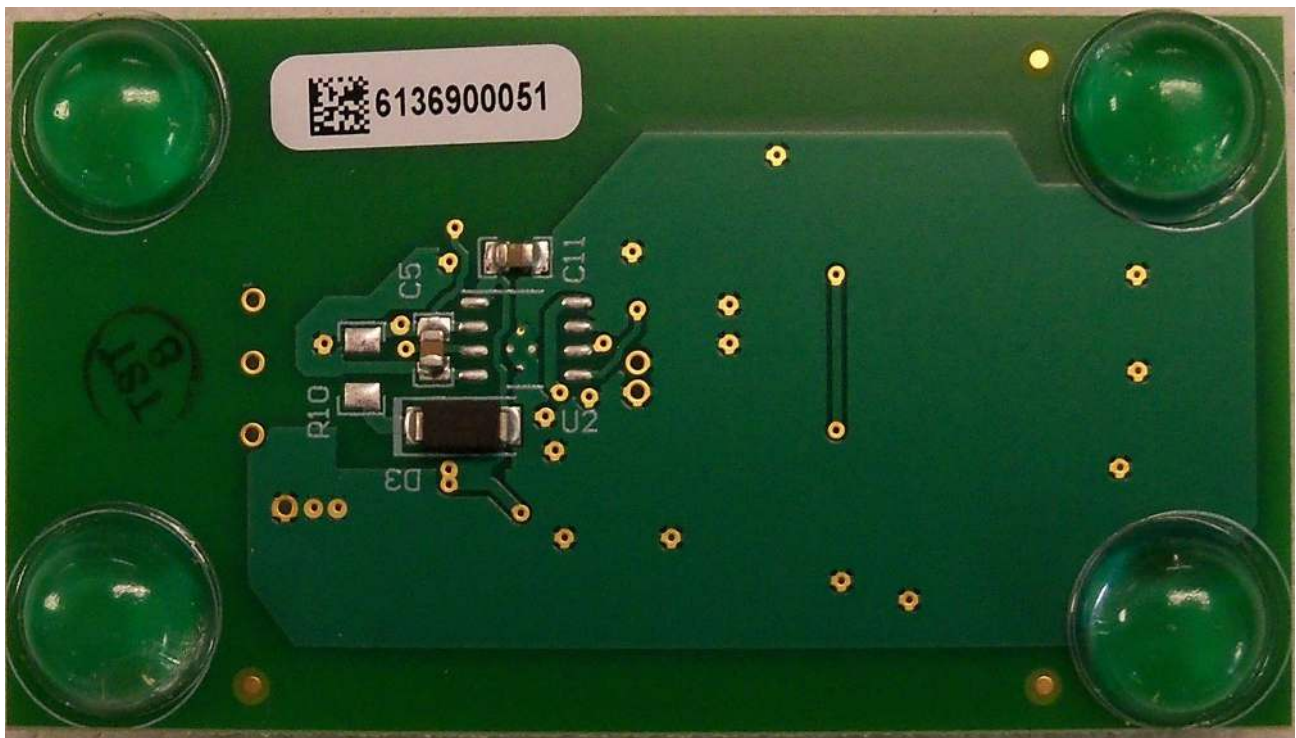


Figure 11. Bottom Image

10 List of Materials

Table 4 lists the LM5108EVM list of materials.

Table 4. LM5108EVM List of Materials

| DES | QTY | Description | Part Number | Manufacturer |
|---|-----|---|---------------------|---------------------------|
| C1 | 1 | CAP, AL, 47 μ F, 50 V, \pm 20%, 0.68 ohm, SMD | UUD1H470MCL1GS | Nichicon |
| C2 | 1 | CAP, CERM, 4.7 μ F, 25 V, \pm 10%, X7R, 0805 | C2012X7R1E475K125AB | TDK |
| C3 | 1 | CAP, CERM, 0.22 μ F, 50 V, \pm 10%, X7R, 0603 | C1608X7R1H224K080AB | TDK |
| C4, C5 | 2 | CAP, CERM, 0.22 μ F, 50 V, \pm 10%, X7R, 0805 | C0805C224K5RACTU | TDK |
| C6, C7 | 2 | CAP, CERM, 1000 pF, 50 V, \pm 5%, X7R, 0805 | C0805C102J5RACTU | Kemet |
| C8, C9, C10 | 3 | CAP, CERM, 10 pF, 50 V, \pm 5%, C0G/NP0, 0603 | C0603C100J5GACTU | Kemet |
| D1, D2 | 2 | Diode, Schottky, 30 V, 1 A, AEC-Q101, MicroSMP | MSS1P3L-M3/89A | Vishay-Semiconductor |
| D3 | 1 | Diode, Ultrafast, 200 V, 1 A, SMA | ES1D-13-F | Diodes Inc. |
| H1, H2, H3, H4 | 4 | Bumpon, Hemisphere, 0.44 X 0.20, Clear | SJ-5303 (CLEAR) | 3M |
| LBL1 | 1 | Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll | THT-14-423-10 | Brady |
| R1, R2 | 2 | RES, 2.2, 5%, 0.125 W, 0805 | CRCW08052R20JNEA | Vishay-Dale |
| R3, R5 | 2 | RES, 4.02, 1%, 0.125 W, 0805 | RC0805FR-074R02L | Yageo America |
| R7, R8, R9 | 3 | RES, 49.9, 1%, 0.1 W, 0603 | CRCW060349R9FKEA | Vishay-Dale |
| R11 | 1 | RES, 10 k, 5%, 0.1 W, 0603 | RC1608J103CS | Samsung Electro-Mechanics |
| TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16, TP17, TP18, TP19, TP20, TP21, TP22, TP23, TP24 | 24 | Test Point, Miniature, SMT | 5019 | Keystone |
| U1 | 1 | 110-V, 1.5-A 2.5-A Peak, 5-V UVLO, 3x3, High-Side/Low-Side Driver, DRC0010J (VSON-10) | LM5108DRCR | Texas Instruments |

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NOTE:

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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.

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.

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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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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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 - 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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