LM74700 Evaluation Module

This user's guide describes the evaluation module (EVM) for TI's ideal diode controller, LM74700-Q1. This document provides configuration information and test setup details for evaluating LM74700-Q1 devices. An EVM schematic, board layout images, and bill of materials (BOM) are included.

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1 Introduction

TI's LM74700 evaluation module (LM74700EVM) helps designers evaluate the operation and performance of the LM74700-Q1 ideal diode controller. This evaluation module demonstrates how an N-channel power MOSFET can emulate a very-low forward voltage diode with low I_Q and low-leakage current flowing through the IC. In this design scheme, the LM74700-Q1 is combined with a MOSFET and used in series with a battery as a replacement for a Schottky diode and PFET, in reverse-polarity protection circuitry as shown in Figure 1. For more information on the LM74700 functional and electrical characteristics, see *LM74700-Q1 Low I_Q reverse battery protection ideal diode controller*.

2 Setup

This section describes the jumpers and connectors on the EVM, and how to properly connect, setup, and use the LM74700EVM. Ensure the power supply is turned off while making connections on the board.

2.1 I/O Connector Description

- **VIN** J1: Power input connector to the positive rail of the input power supply
- **GND1** J3: Ground connection for the power supply
- **VOUT** J2: Power output connector to the positive side of the load
- **GND2** J4: Ground connection for the load
- **Test Points**: VIN, VOUT, GND1, and GND2 are test points

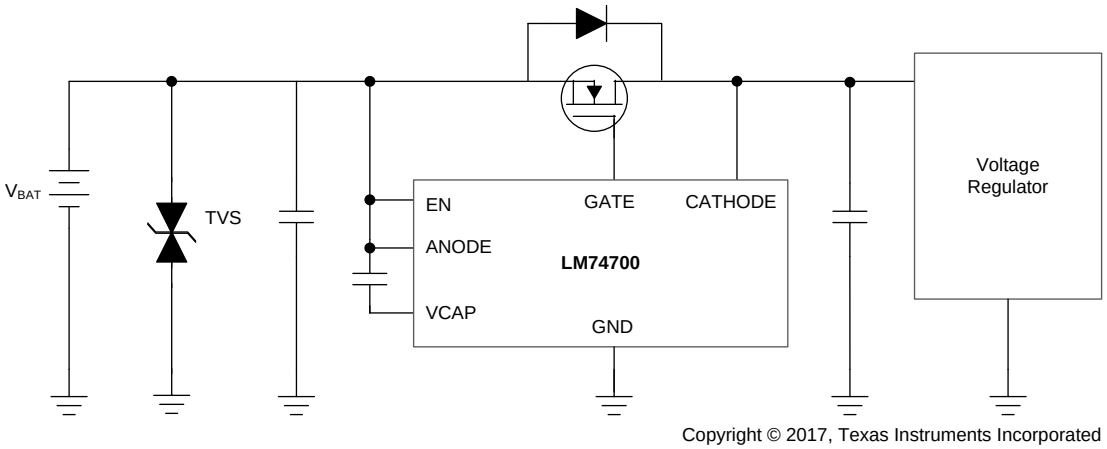

Figure 1. LM74700EVM Typical Application Circuit

2.2 Board Setup

Before applying power to the LM74700EVM, verify all external connections. Turn off external power supplies and connect them with the proper polarity to the VIN and GND1 connectors. An electronic or resistive load must be connected at the output VOUT and GND2 connectors. The tests outlined in this document are conducted with 3-A constant current as the load and 12 V at the input. Make sure that the external power-supply source for the input voltage is capable of providing enough current to the output load so that the output voltage can be obtained.

Once all connections to the LM74700EVM are verified, apply power to VIN. Figure 2 captures EVM board setup.

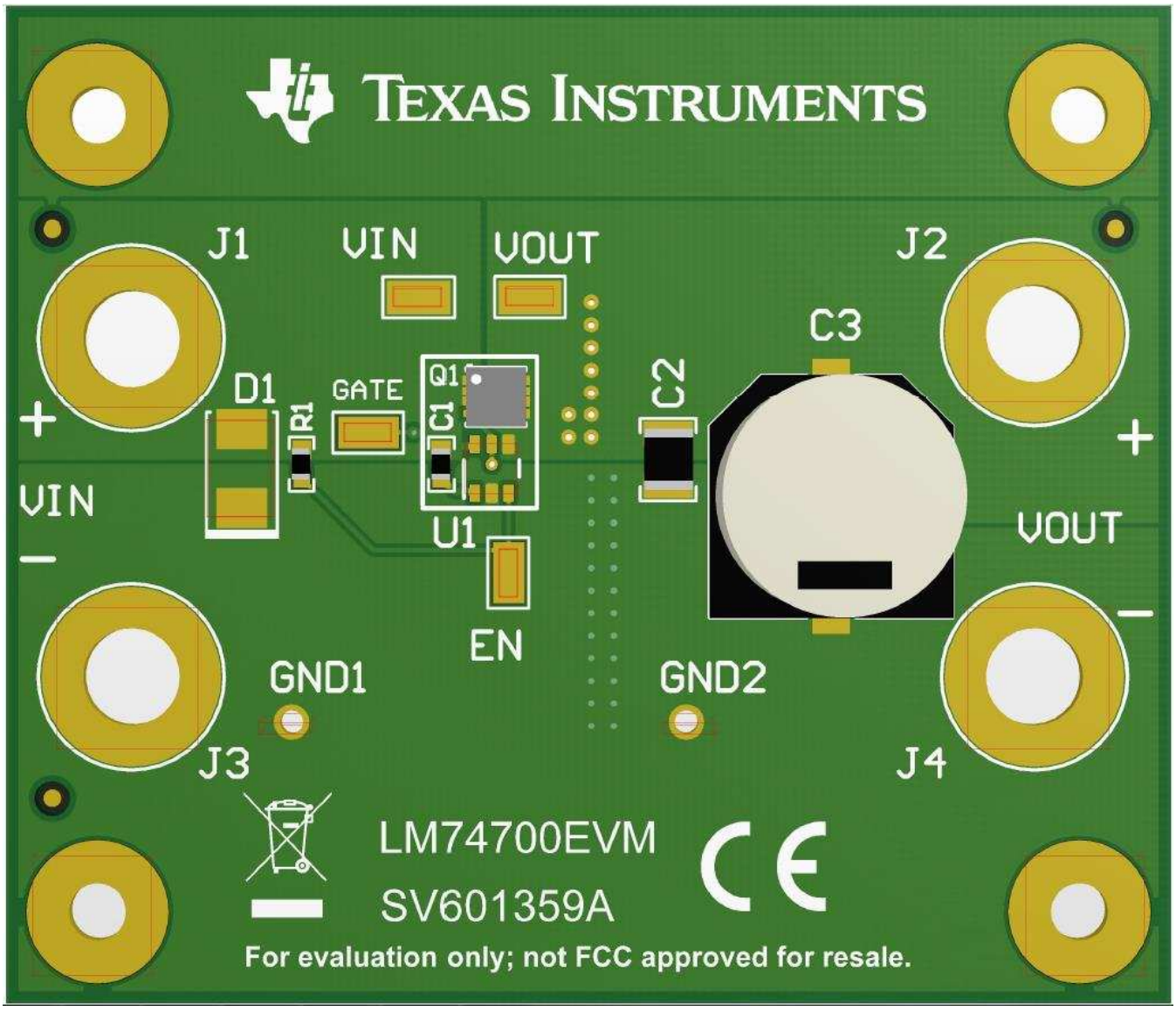

Figure 2. LM74700EVM

2.3 Schematic

Figure 3 illustrates the EVM schematic.

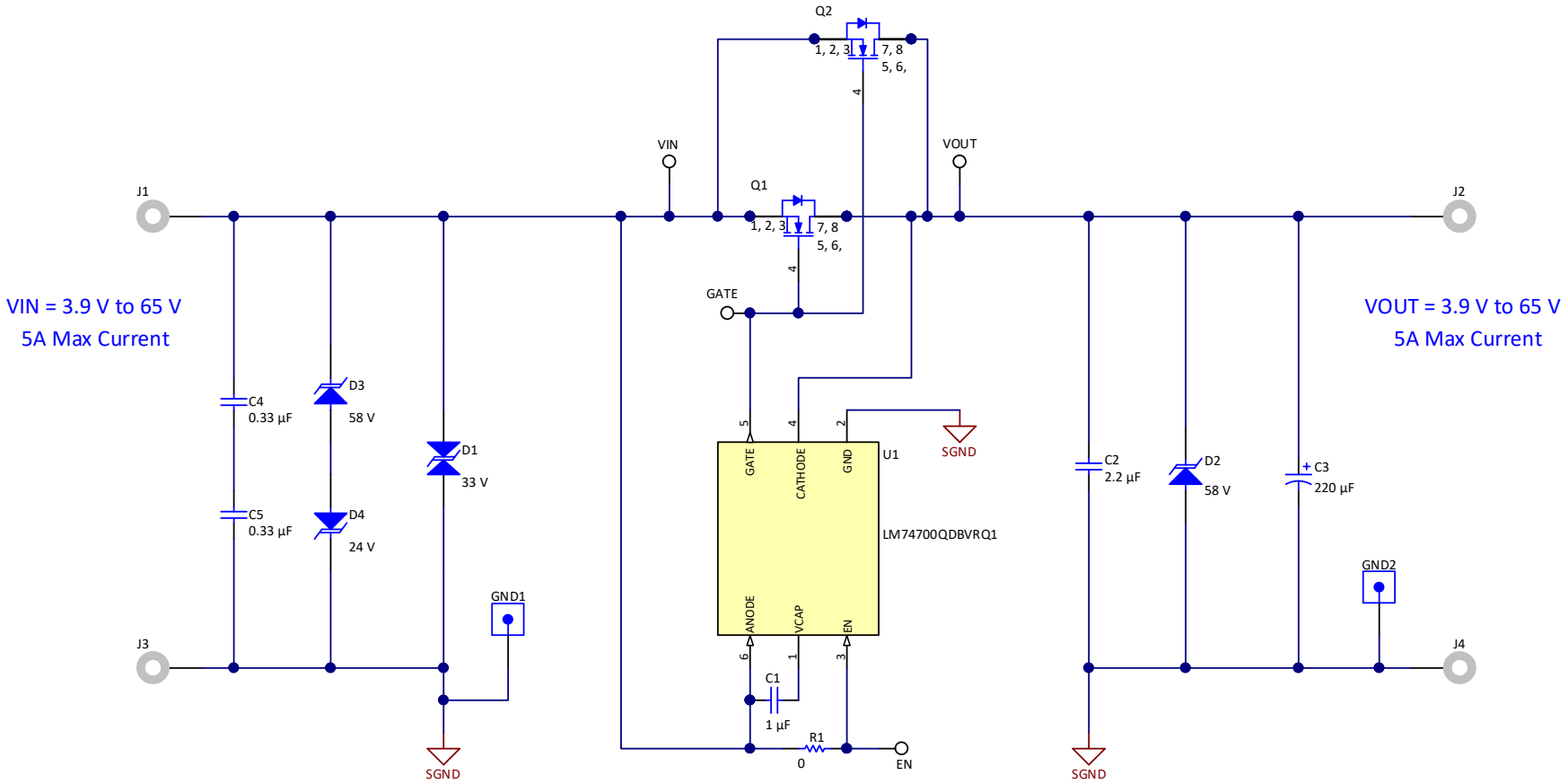

Figure 3. LM74700EVM Schematic

3 Operation

3.1 Reverse Polarity Protection

A dynamic voltage pulse from 12 V to –12 V is applied at the input of the LM74700EVM. Figure 4 shows the input voltage (CH1) drops down to –12 V and the output voltage (CH2) does not go negative. Therefore, the load is protected from dynamic reverse pulses at the input. The LM74700-Q1 reacts to the negative voltage within 2 μs and it shuts down the MOSFET by pulling the gate (CH3) voltage down. The output slowly decays due to the large output capacitors and increased time constant.

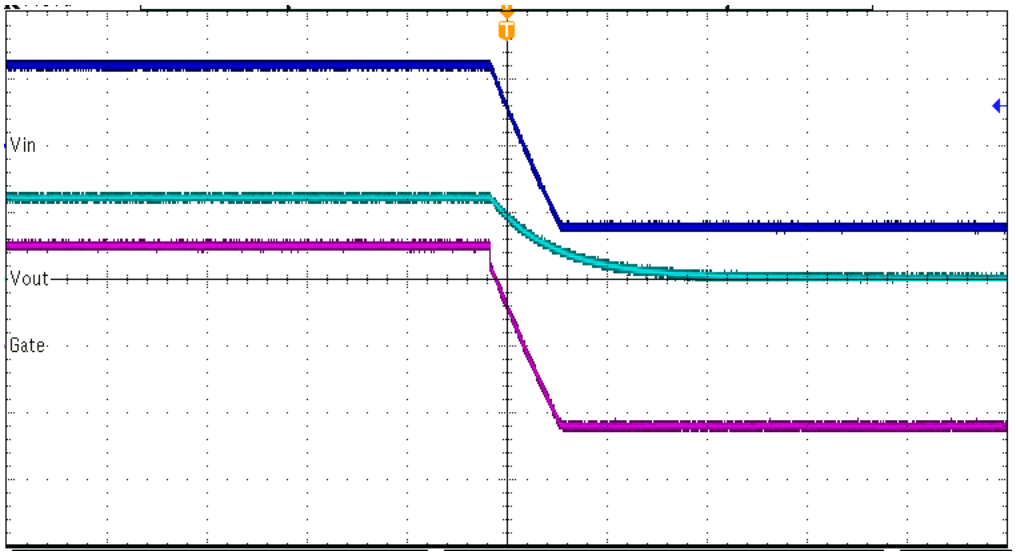

Figure 4. Reverse Polarity 12 V to –12 V

A –12-V source is connected to the VIN input of the LM74700EVM. Figure 5 shows that the output voltage remains at a constant 0 V in this situation. This test simulates the event of connecting a 12-V battery in the reverse direction; therefore, protecting the load from negative input voltages.

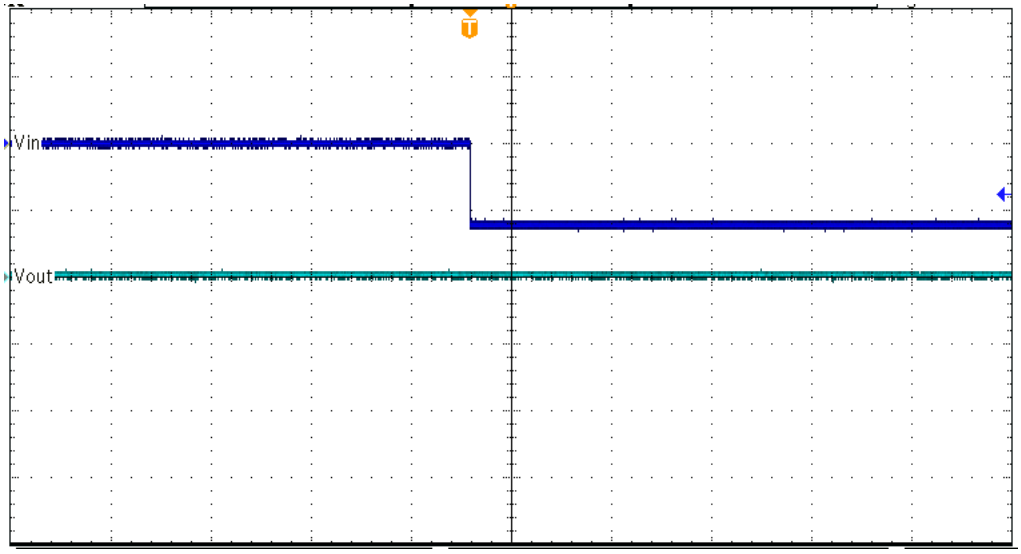

Figure 5. Startup Reverse Polarity (–12 V)

3.2 ORing Application

When using the LM74700-Q1 as an ORing device, if the input supplies operate at slightly different voltages, the voltage at the common load point will follow the higher voltage. The LM74700-Q1 prevents reverse current flow from the common load point to the lower voltage supply rail. This test uses two LM74700EVMs with 15 V at the input of the first EVM and 12 V at the input of the second EVM and the output of both the EVMs are shorted. As Figure 6 shows, the 15-V source at EVM1 is turned off for a period of time and the output (CH2) drops to 12-V source from EVM2. When the 15-V source is turned on again, the output rises to 15 V from EVM1. CH1 shows the input to EVM1, CH2 shows the output and CH3 shows input of EVM2.

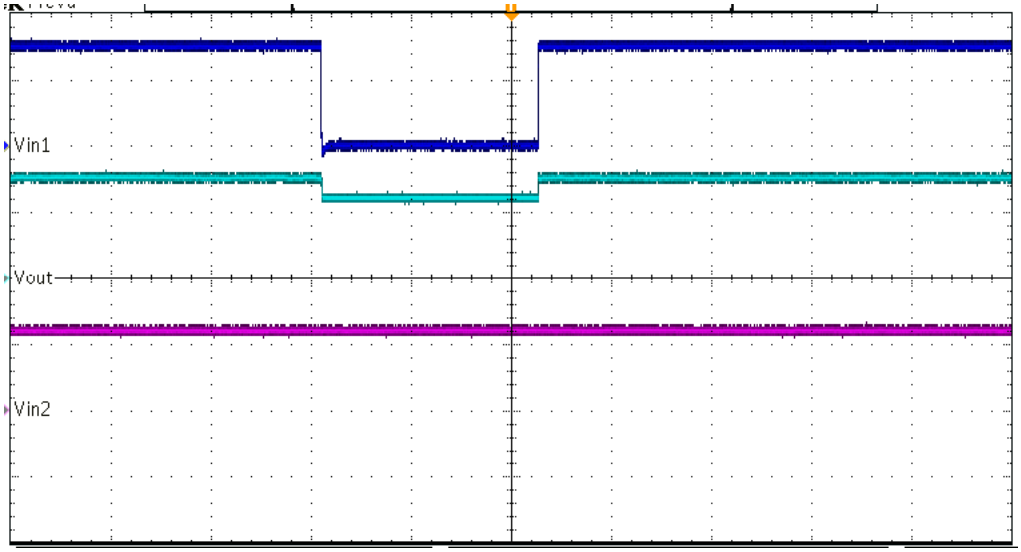

Figure 6. ORing Application – Higher Supply Switchover

Next, the 12-V source at EVM2 is turned off for a period of time and turned on again, the output (CH2) does not change. Figure 7 captures this test.

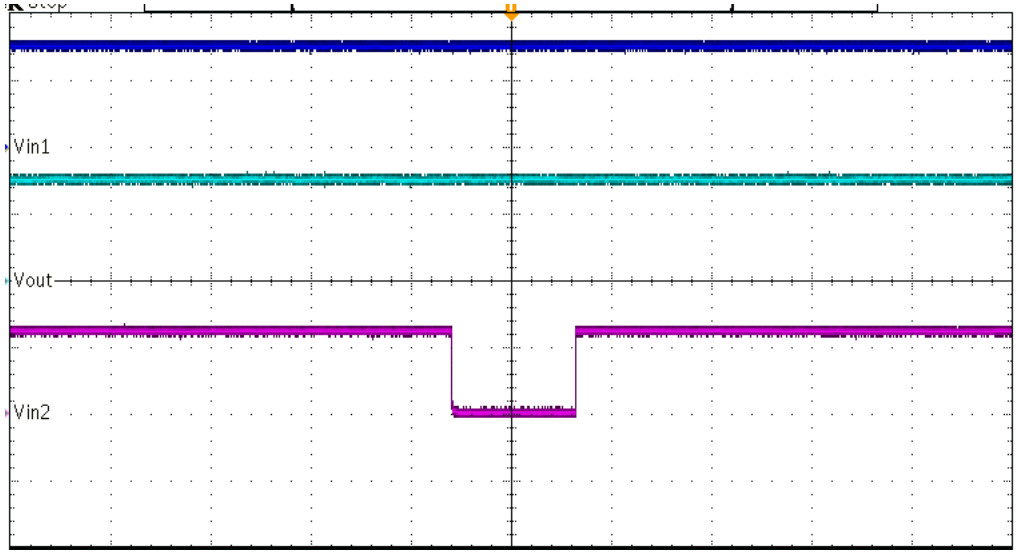

Figure 7. ORing Application 12-V – Lower Supply Test

4 EVM Board Assembly Drawings and Layout Guidelines

4.1 PCB Drawings

Figure 8 through Figure 11 show component placement and layout of this EVM.

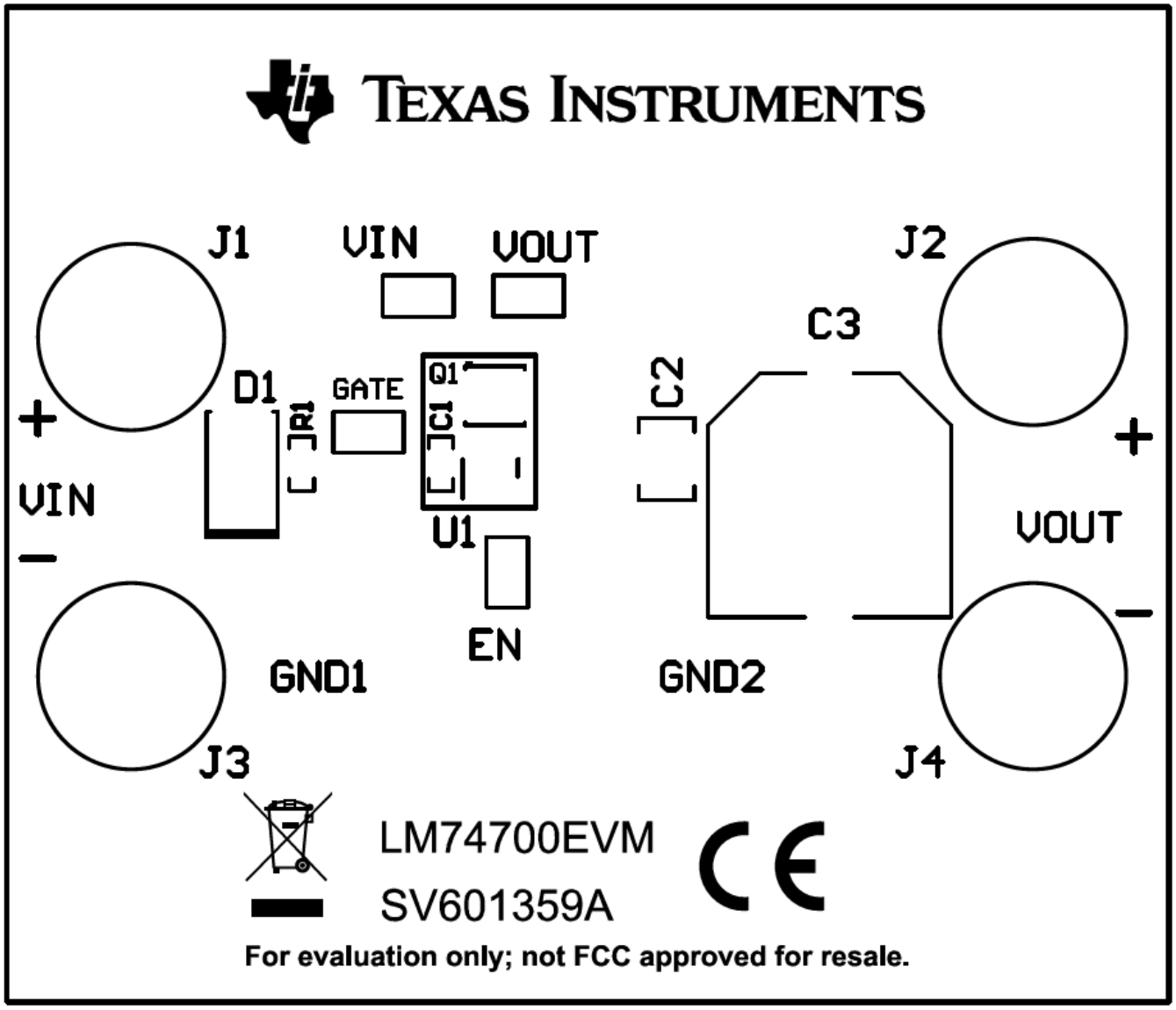

Figure 8. LM74700EVM Top Side Placement

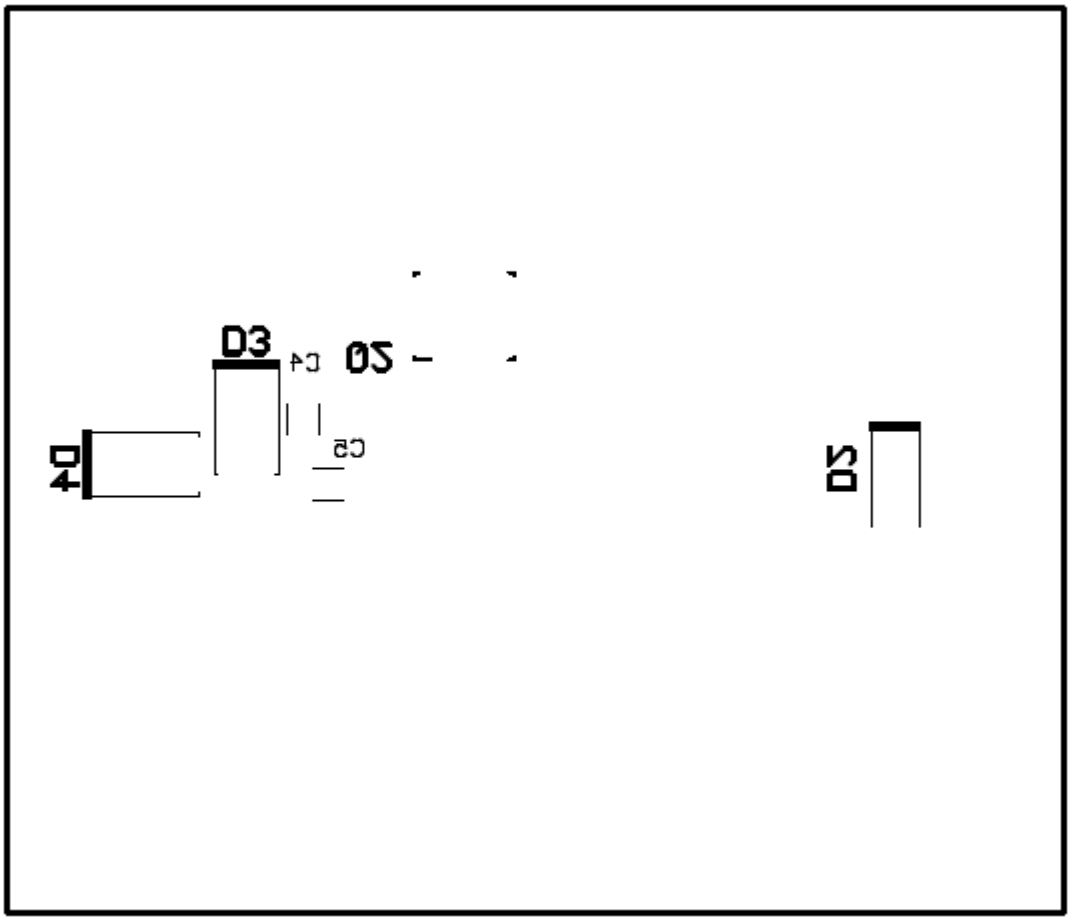

Figure 9. LM74700EVM Bottom Side Placement

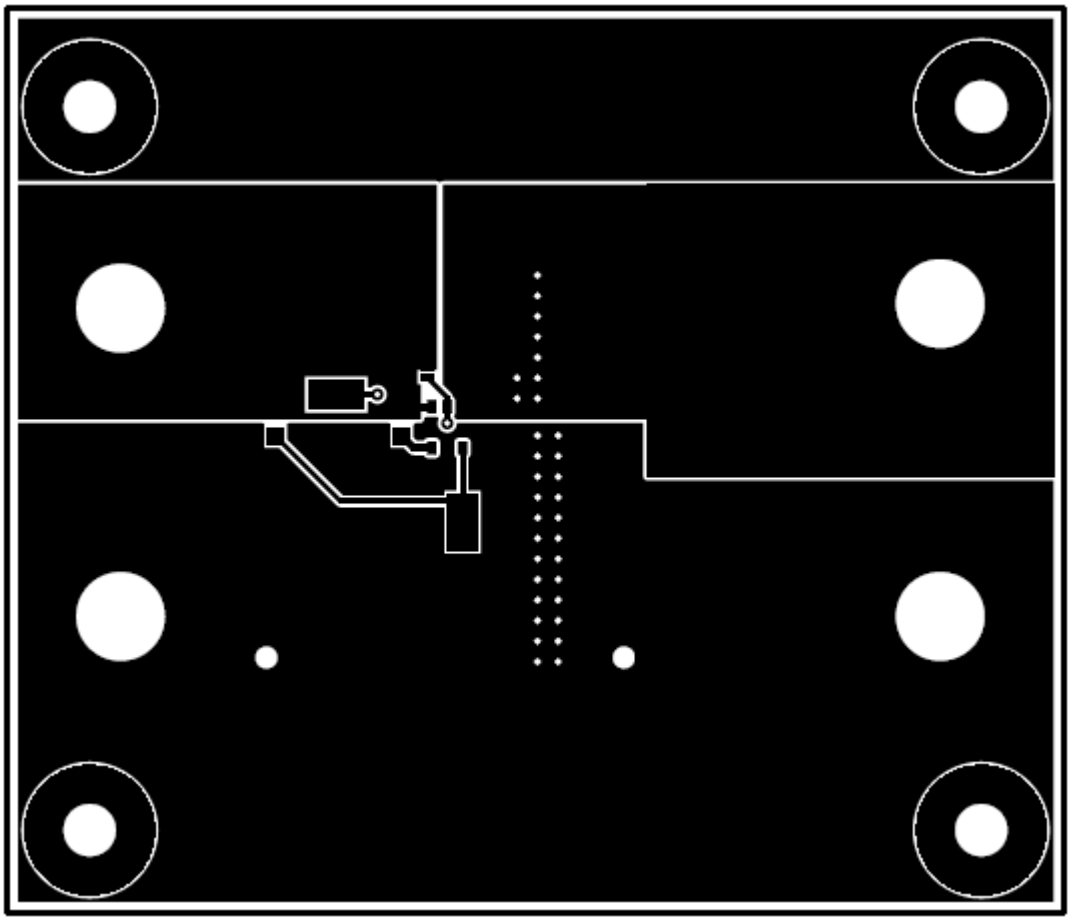

Figure 10. LM74700EVM Top Layer Routing

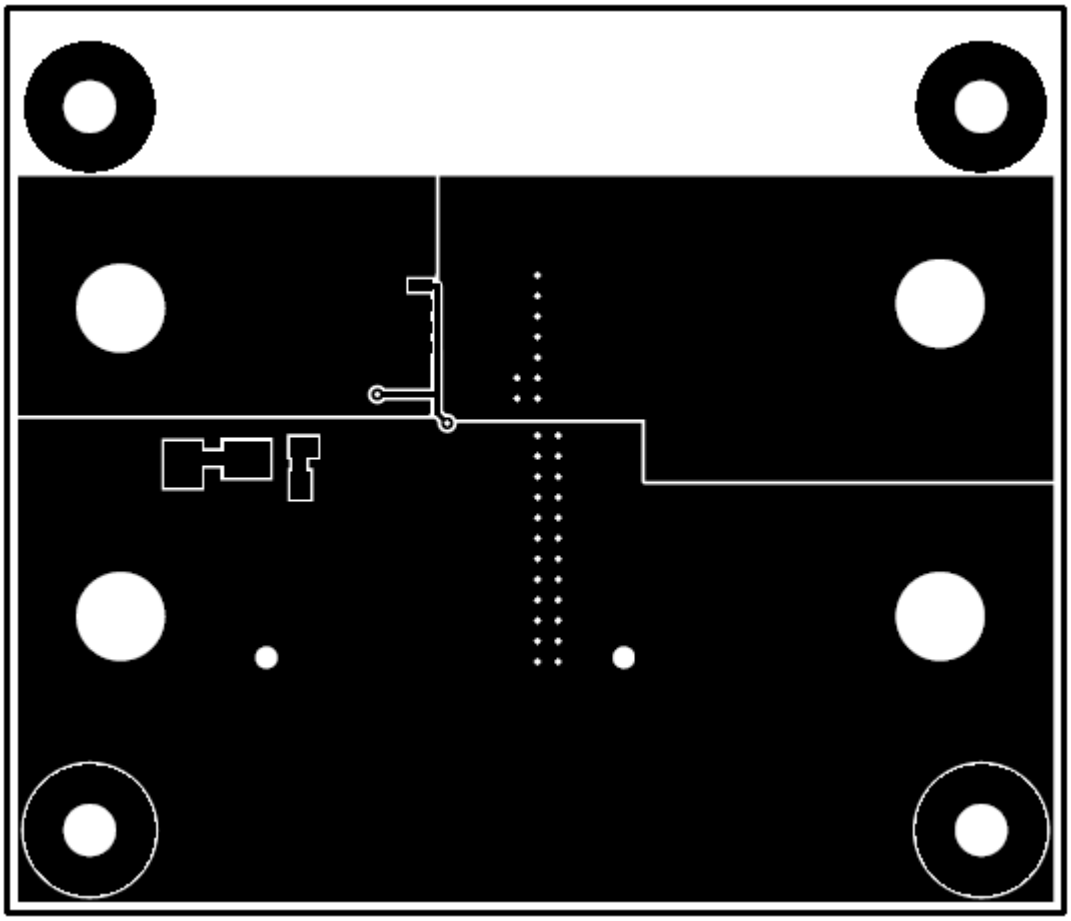

Figure 11. LM74700EVM Bottom Layer Routing

4.2 Bill of Materials

Section 4.2 lists the LM74700EVM BOM.

Table 1. Bill of Materials

Fitted	Description	Designator	Part Number	QTY	Manufacturer	Package Reference	Value
Fitted	CAP, CERM, 1 µF, 25 V,+/- 10%, X7R, AEC-Q200 Grade 1, 0603	C1	CGA3E1X7R1E105K080AD	1	TDK	0603	1 uF
Fitted	CAP, CERM, 2.2 uF, 100 V, +/- 10%, X7R, 1210	C2	C1210C225K1RACTU	1	Kemet	1210	2.2 uF
Fitted	CAP, AL, 220 µF, 63 V, +/- 20%, 0.16 ohm, AEC-Q200 Grade 2, SMD	C3	EEV-FK1J221Q	1	Panasonic	SMT Radial H13	220 uF
Fitted	CAP, CERM, 0.33 µF, 50 V,+/- 10%, X8R, AEC-Q200 Grade 0, 1206	C4, C5	CGA5L2X8R1H334K160AA	2	TDK	1206	0.33 uF
Fitted	Diode, TVS, Bi, 33 V, SMB	D1	SMBJ33CA-13-F	1	Diodes Inc.	SMB	33 V
Fitted	Test Point, Miniature, SMT	EN, GATE, VIN, VOUT	5015	4	Keystone	Testpoint_Keystone_ Miniature	
Fitted	TEST POINT SLOTTED .118", TH	GND1, GND2	1040	2	Keystone	Test point, TH Slot Test point	
Fitted	Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	H1, H2, H3, H4	NY PMS 440 0025 PH	4	B&F Fastener Supply	Screw	
Fitted	Standoff, Hex, 0.5"L #4-40 Nylon	H5, H6, H7, H8	1902C	4	Keystone	Standoff	
Fitted	Standard Banana Jack, Uninsulated, 8.9mm	J1, J2, J3, J4	575-8	4	Keystone	Keystone575-8	
Fitted	MOSFET, N-CH, 60 V, 15 A, AEC-Q101, 8-PowerVDFN	Q1	DMT6007LFG-13	1	Diodes Inc.	8-PowerVDFN	60 V
Fitted	RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	R1	CRCW06030000Z0EA	1	Vishay-Dale	0603	0
Fitted	IC, Ideal Didoe	U1	LM74700Q	1	Texas Instruments	SOT23-6	
Not Fitted	Diode, TVS, Uni, 58 V, SMA	D2	SMAJ58A	0	Diodes Inc.	SMA	58 V
Not Fitted	Diode, TVS, Uni, 58 V, 93.6 Vc, SMB	D3	SMBJ58A-13-F	0	Diodes Inc.	SMB	58 V
Not Fitted	Diode, TVS, Uni, 24 V, 38.9 Vc, SMB	D4	SMBJ24A-13-F	0	Diodes Inc.	SMB	24 V
Not Fitted	Fiducial mark. There is nothing to buy or mount.	FID1, FID2, FID3, FID4, FID5, FID6	N/A	0	N/A	N/A	
Not Fitted	MOSFET, N-CH, 60 V, 17.9 A, AEC-Q101, 8-PowerTDFN	Q2	DMT6005LPS-13	0	Diodes Inc.	8-PowerTDFN	60 V

Revision History

Changes from Original (October 2017) to A Revision **Page**

- Changed from TI's smart diode controller to ideal diode controller 2
- Updated Figure 2 3
- Changed connectors from VINA to VIN 3
- Changed connectors from VOUTA to VOUT 3
- Updated Figure 3 4
- Updated *Bill of Materials* table 11

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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.

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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.*
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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.

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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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