THE DATASHEET OF

LM74610-SQEVM

LM74610-SQEVM

User's Guide

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1 Introduction

The Texas Instruments LM74610-SQ Evaluation Module helps designers evaluate the operation and performance of the LM74610-Q1 Reverse Polarity Protection Smart Diode Controller. This evaluation module demonstrates how an N-Channel power MOSFET can emulate a very low forward voltage diode with zero Iq and low leakage current flowing through the IC. In this design scheme the LM74610-Q1 is combined with a MOSFET and used in series with battery as a replacement for schottky diode and PFET in reverse polarity protection circuitry as shown in Figure 1 . For more information on the LM74610 functional and electrical characteristics, see the LM74610-Q1 Reverse Polarity Protection Smart Diode Controller Data Sheet (LM74610).

Table 1. Device and Package Configurations

CONVERTER	IC	PACKAGE
U1	LM74610-Q1	VSSOP-8

2 Setup

This section describes the jumpers and connectors on the EVM as well and how to properly connect, set up and use the LM74610-SQEVM. Ensure the power supply is turned off while making connections on the board.

2.1 Input/Output Connector Description

- **VBAT_1**: Power input connector to the positive rail of the input power supply.
- **GND**: Battery ground connector.
- **VOUT:** is the power output connector to the positive side of the load.
- **TEST POINTS:** are also available at **VBAT_1**, **GND**, **VOUT**, **DRV_1** (MOSFET Gate Voltage), and **VCAP_1** (Charge pump capacitor).

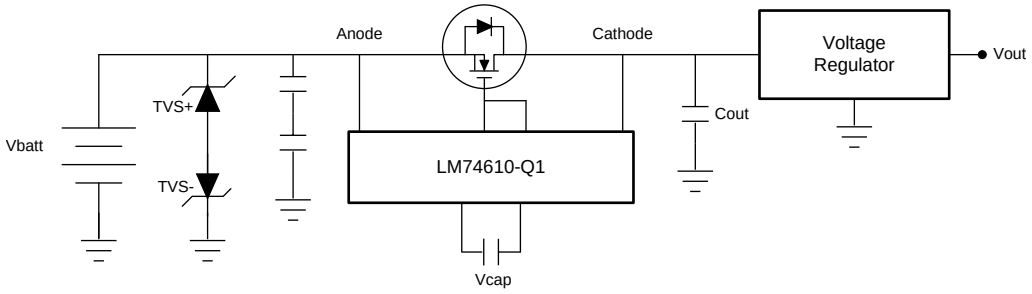

Figure 1. LM74610-Q1 Typical Application Circuit

2.2 Board Setup

Before applying power to the LM74610EVM, all external connections should be verified. External power supplies should be turned off and connected with proper polarity to the VBAT_1 and GND connectors. **An electronic or resistive load must be connected at the output.**. The LM74610-Q1 will not initiate the charge pump operation if a closed loop system is in standby mode or the drain current is smaller than 1mA (typical). The tests outlined in this document 3A constant current as the load and 12V at the input (VBAT_1). 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 LM74610-SQEVM are verified, power can be applied to VBAT_1. The EVM will then begin to operate.

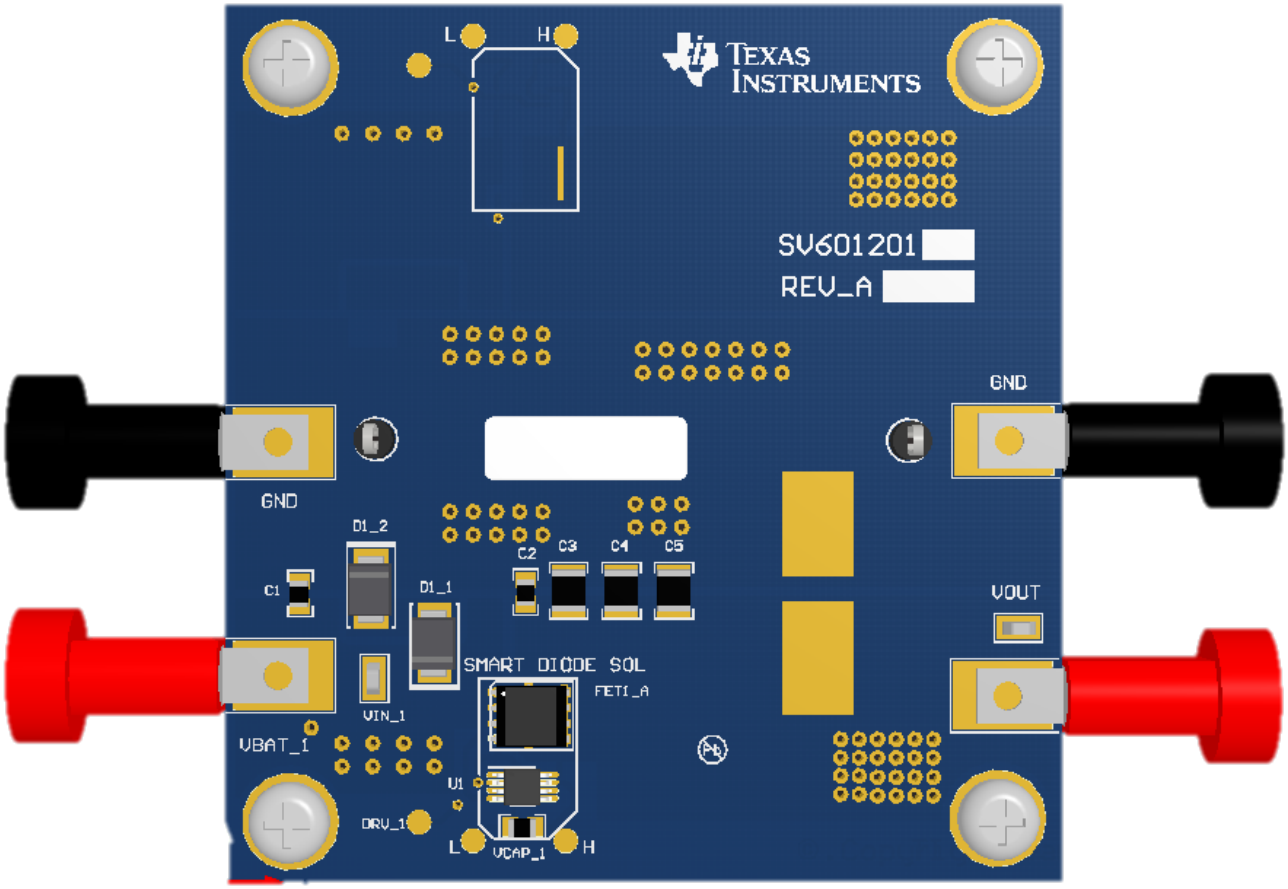

Figure 2. LM74610-SQ EVM

3 Operation

3.1 Reverse Polarity Protection

A dynamic voltage pulse from +12V to -20V is applied at the VBAT_1 input of the LM74610-SQEVM. Figure 3 shows when the input voltage (yellow) drops down to -20V, the output voltage (blue) does not go negative, and therefore, the load is protected from dynamic reverse pulses at the input. The LM74610-Q1 reacts the negative voltage surge within 2µsec and shuts down the MOSFET by pulling the gate voltage to zero (green). The output slowly decays due to the large output capacitors and increased time constant.

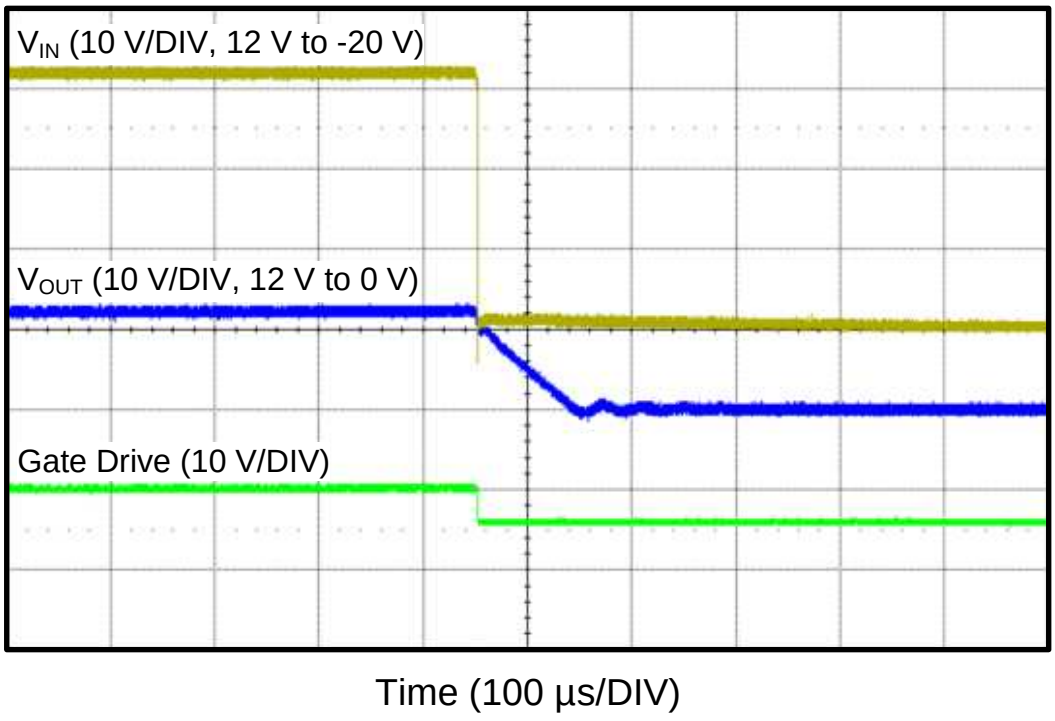

Figure 3. Response to Reverse Polarity 12V to -20V

A -12V source is connected to the VBAT_1 input of the LM74610-SQEVM. Figure 4 shows that the Output voltage will stay at a constant 0V in this situation. This test simulates the event of connecting a 12V battery in the reverse direction, and therefore, protects the load from negative voltages.

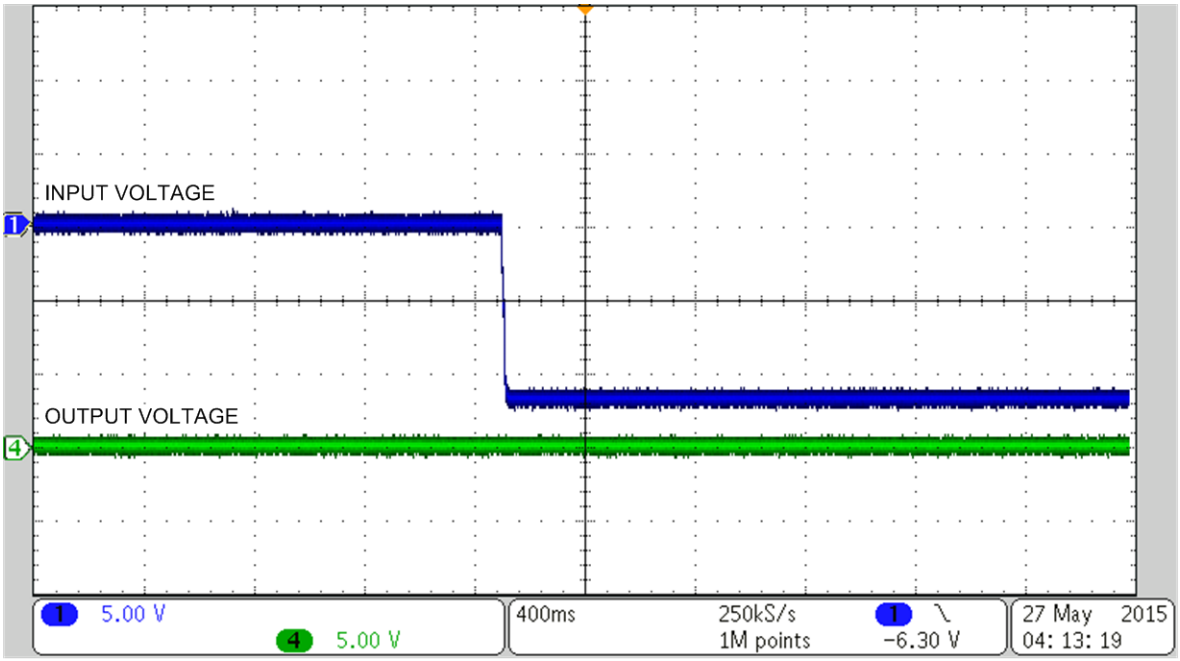

Figure 4. Response to Start Up Reverse Polarity

Note: Please note that the leakage current is 60uA (typ). This means that if you apply a voltage on the output you will see some voltage on input and this voltage will collapse if you draw more current than the leakage current. The same applies for a reverse voltage applied on the input.

3.2 Output Voltage

When power is initially applied, the load current (I_D) will flow through the body diode of the MOSFET. This current will produce a forward voltage drop (V_f) across the MOSFET body diode. This voltage is used to charge up the charge pump capacitor Vcap. This periodic voltage drop will be equal to the MOSFET body diode forward voltage drop and occurs for about 25.6msec as shown in Figure 5.

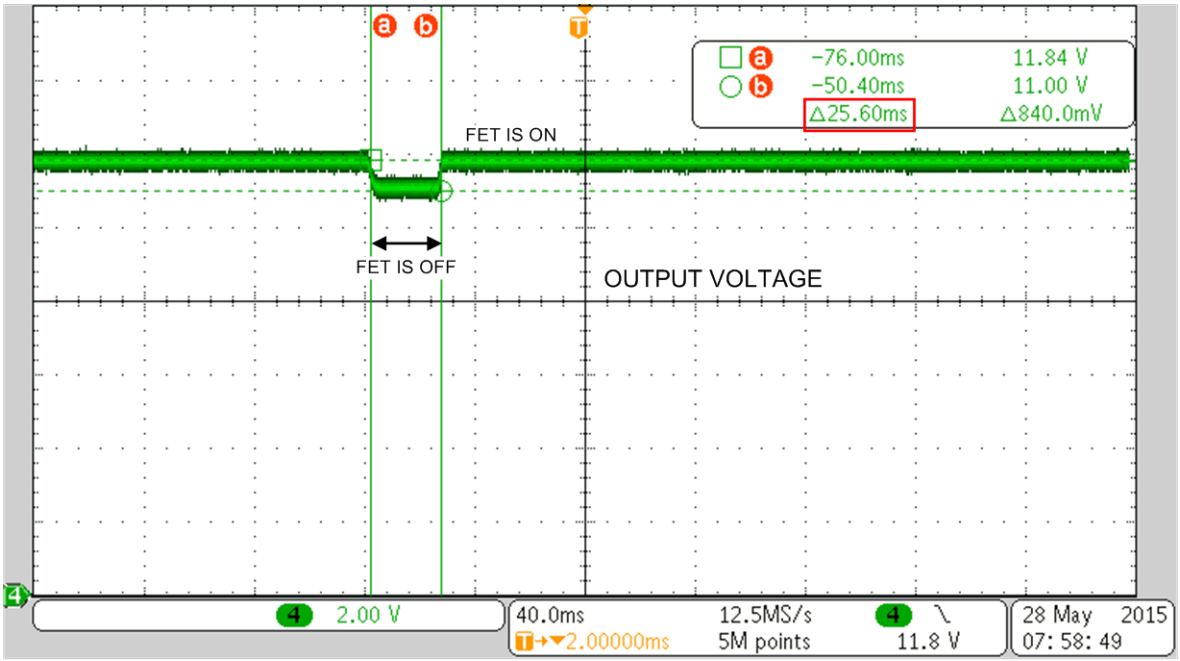

Figure 5. Periodic body diode voltage drop at the output

During the rest of the period of conduction, the LM74610-Q1 will drive the gate of the MOSFET. When the MOSFET is ON, it provides a low resistive path for the drain current to flow and minimizes the power dissipation associated with forward conduction. The power losses during the MOSFET ON state depend primarily on the R_{DSON} of the selected MOSFET and load current. The LM74610-Q1 operation keeps the MOSFET ON at approximately 98% as shown in Figure 6, leading to very little overall power dissipation when compared to a typical diode.

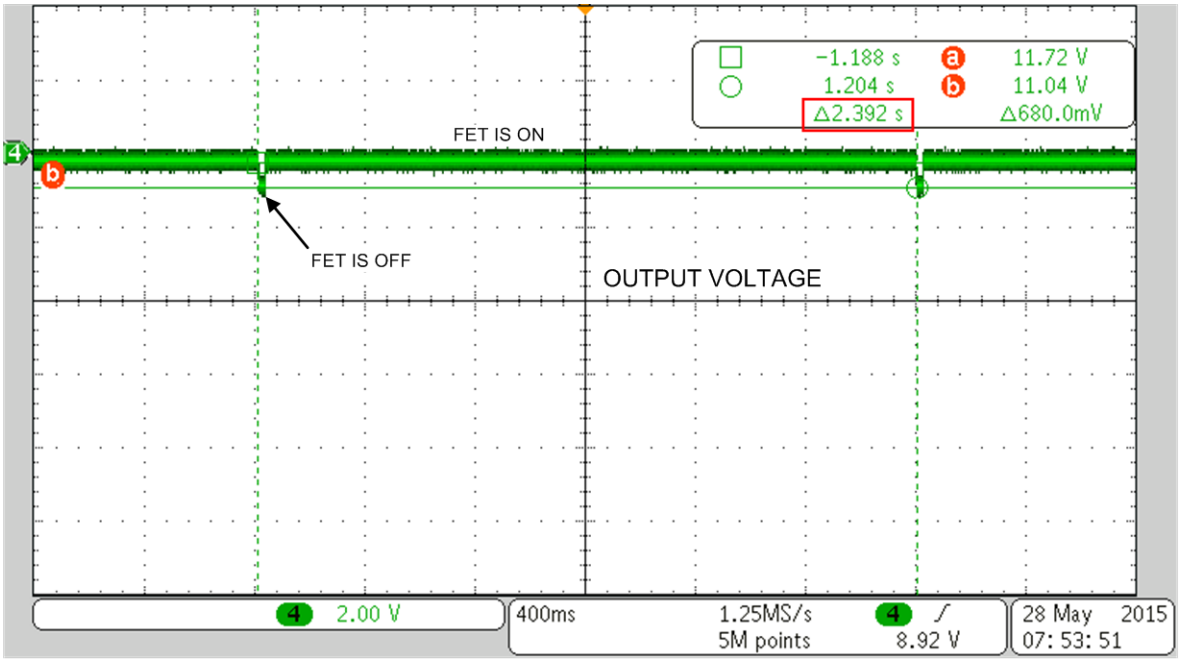

Figure 6. The LM74610-SQEVM Output voltage waveform

4 Board Layout

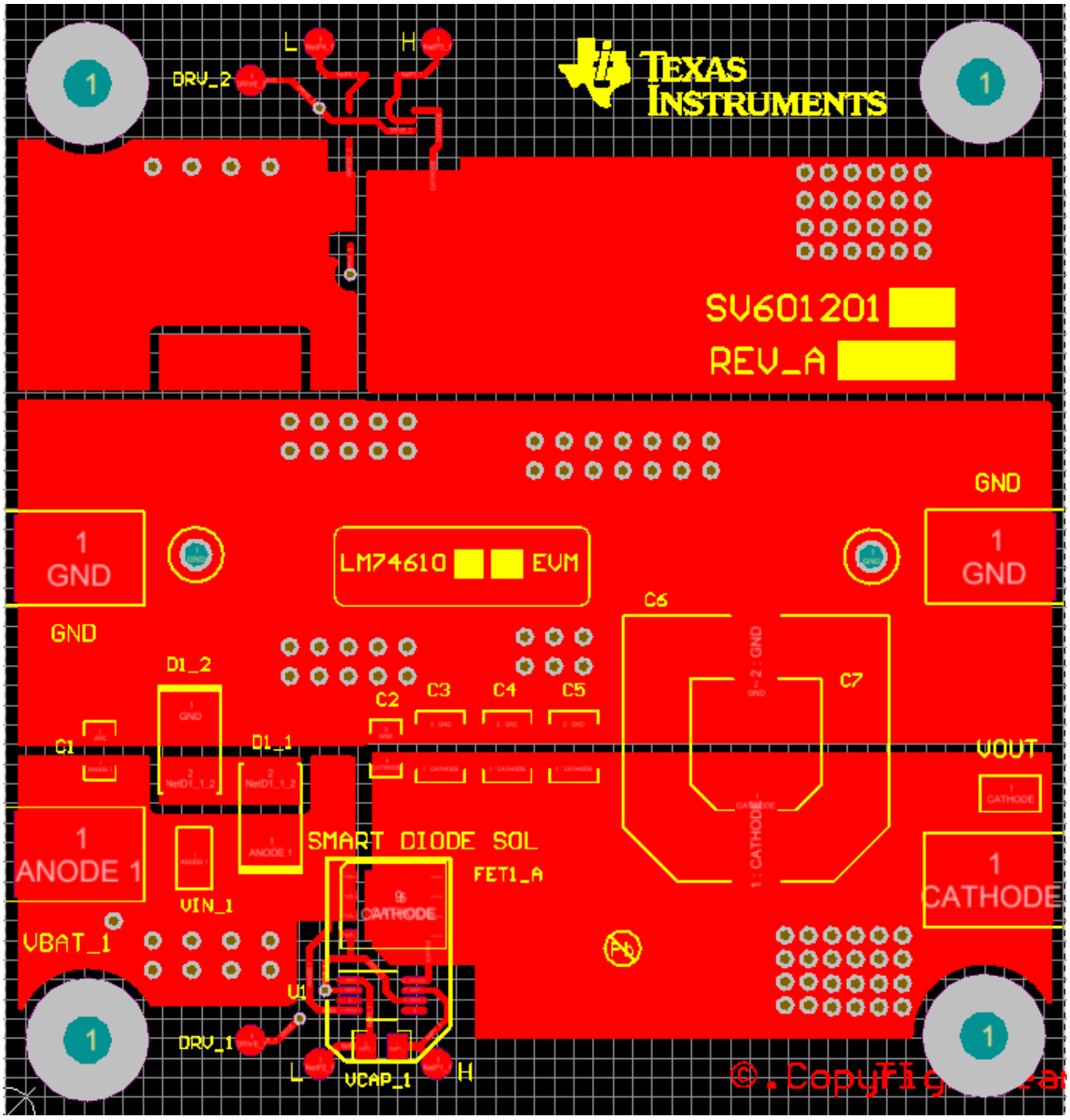

Figure 7. Top Assembly Layer

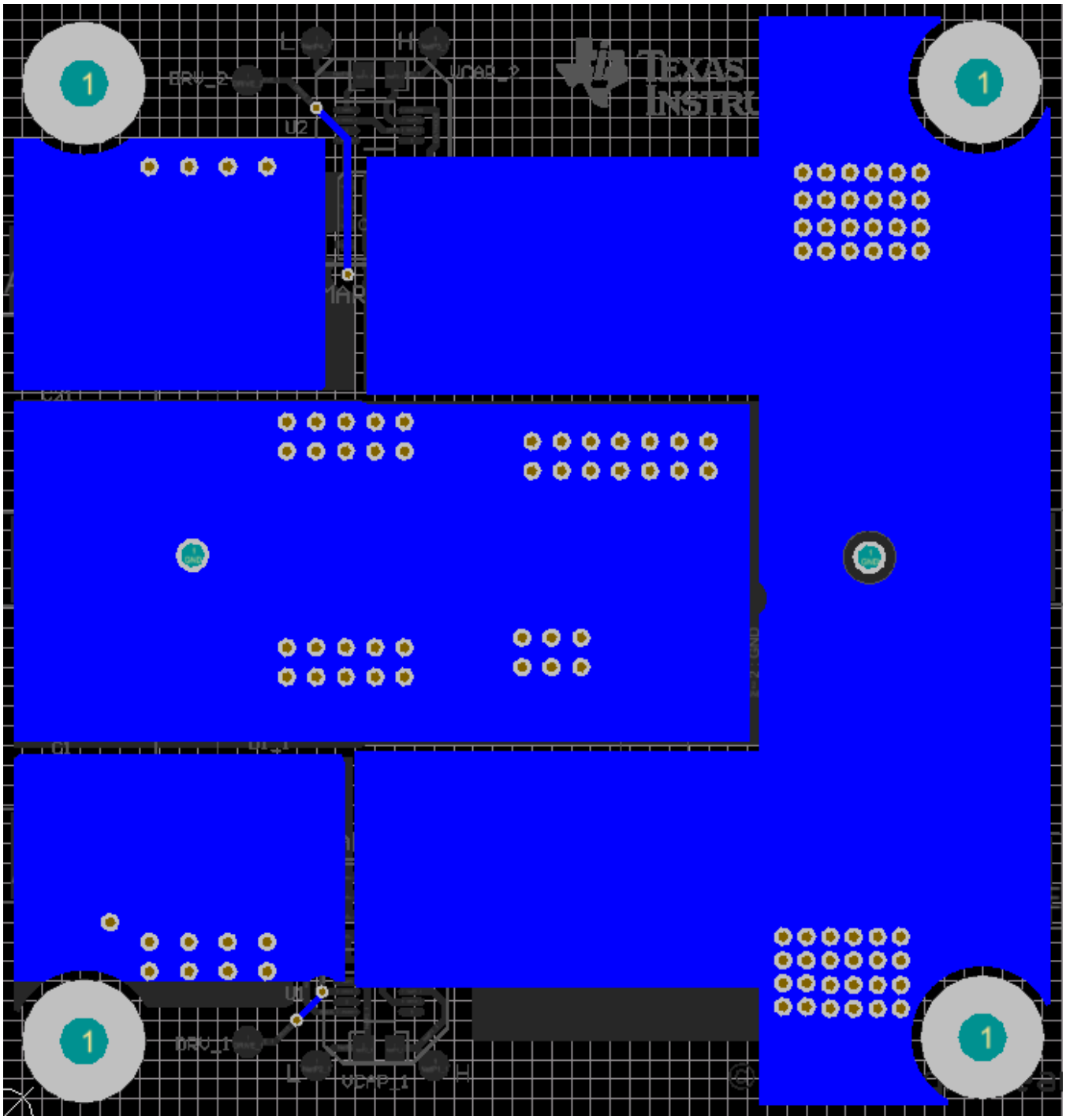

Figure 8. Bottom Layer

5 Schematic

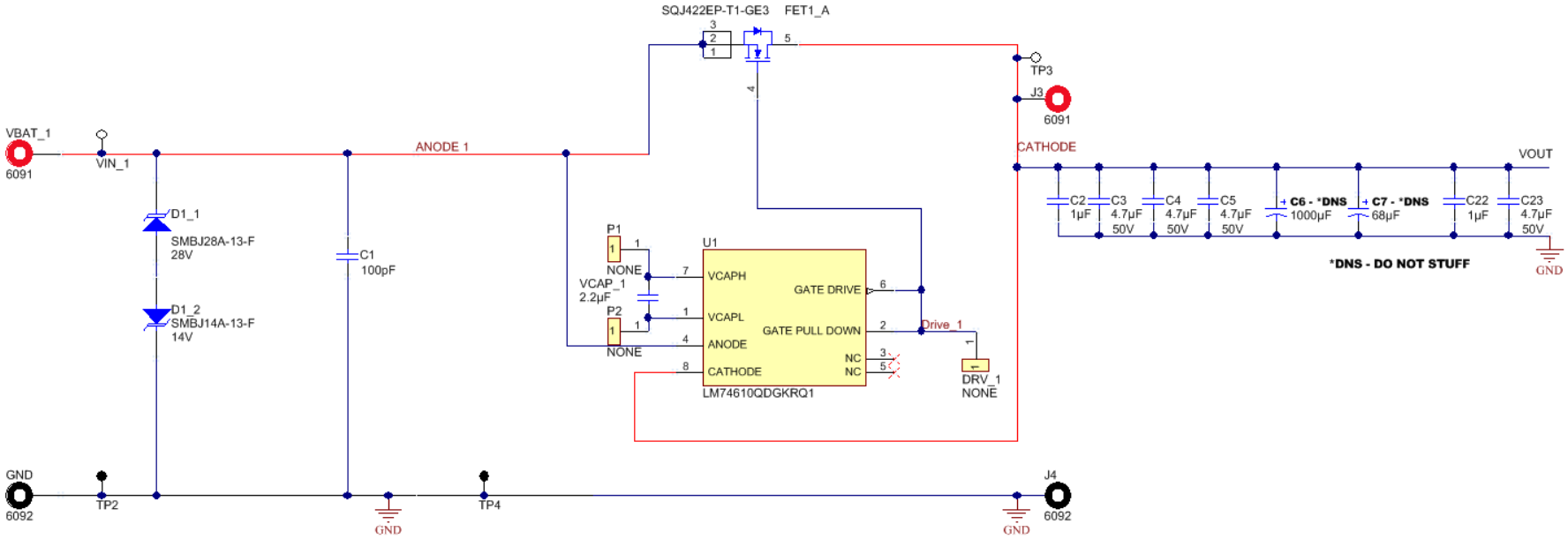

Figure 9. LM74610-SQEVM Schematic

Note: The TVS+ and TVS- are not required for the LM74610-Q1. However, they are typically used to clamp the positive and negative voltage surges respectively. The output capacitors are recommended to protect the immediate output voltage collapse as a result of line disturbance.

6 Bill of Materials

Table 2. LM74610-SQ EVM Bill of Materials for Configuration

COUNT	REF DES	DESCRIPTION	MFR	PART NUMBER
1	C1	CAP, CERM, 100 pF, 50 V, +/- 5%, C0G/NP0, 0805	AVX	08055A101JAT2A
2	C2, C22	CAP, CERM, 1 µF, 50 V, +/- 10%, X7R, 0805	TDK	C2012X7R1H105K125AB
4	C3, C4, C5, C23	CAP, CERM, 4.7 µF, 50 V, +/- 10%, X7R, 1210	MuRata	GRM32ER71H475KA88L
DNS	C6	CAP, AL, 1000 µF, 50 V, +/- 20%, 0.073 ohm, SMD	Panasonic	EEV-FK1H102M
DNS	C7	CAP, AL, 68 µF, 50 V, +/- 20%, 0.6 ohm, SMD	Nippon Chemi-Con	EMVY500ADA680MHA0G
1	D1_1	Diode, TVS, Uni, 28 V, 600 W, SMB	Diodes Inc.	SMBJ28A-13-F
1	D1_2	Diode, TVS, Uni, 14 V, 600 W, SMB	Diodes Inc.	SMBJ14A-13-F
3	DRV_1, P1, P2		NONE	NONE
1	FET1_A	MOSFET, N-CH, 40 V, 75 A, PowerPAK_SO-8L	Vishay-Siliconix	SQJ422EP-T1-GE3
2	GND, J4	Standard Banana Jack, Insulated, Black	Keystone	6092
2	J3, VBAT_1	Standard Banana Jack, Insulated, Red	Keystone	6091
2	TP2, TP4	Test Point, Multipurpose, Black, TH	Keystone	5011
2	TP3, VIN_1	Test Point, Miniature, SMT	Keystone	5015
1	U1	Smart Diode Controller, DGK0008A	Texas Instruments	LM74610QDGKRQ1
1	VCAP_1	CAP, CERM, 2.2 µF, 50 V, +/- 10%, X5R, 0805	TDK	C2012X5R1H225K125AB

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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.*

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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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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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