LM317A-337N-EVM

User's Guide

Literature Number: SNLU193
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Contents

Introduction

The Texas Instruments LM317A-337N-EVM evaluation module (EVM) helps designers operate and understand the LM317A 3-Terminal Adjustable Regulator and LM337-N 3-Terminal Adjustable Negative Regulator. The board is assembled with the SOT-223 package option for both devices. This user guide is meant to provide guidance and examples in order to understand how the EVM can be used to test the LM317A and LM337-N. For more information about the functional and electrical characteristics of these devices, consult the LM317A (SNVSAC2) and LM337-N (SNVS778) data sheets.

The EVM contains footprints for two package options of the LM317A adjustable positive regulator and the LM337-N adjustable negative regulator. (See Table 1-1.)

Table 1-1. Device and Package Configurations

REF DESIGNATOR	IC	PACKAGE	OUTPUT CURRENT
U1	LM317AEMP/NOPB	SOT-223	1.0 A
U2	LM317AT/NOPB	TO-220	1.5 A
U3	LM337T/NOPB	TO-220	– 1.5 A
U4	LM337IMP/NOPB	SOT-223	– 1.5 A

1.1 Features

- Output voltage adjustable from 1.2 V to 37 V for LM317A and −1.2 V to −37 V for LM337-N
- U2 and U3 footprints for TO-220 option evaluation
- Heat sink footprint space for TO-220
- Large input/output capacitor footprints for customization
- Board size: 3.5” × 3.5”

Setup

This section describes the connectors and test points on the EVM as well as how to properly connect, set up, and use the LM317A-337N-EVM. Ensure the external power supply is turned off while making connections on the board.

2.1 Input/Output Connector Description

- **VBAT+** is the positive input voltage supply for the LM317A.
- **VBAT-** is the negative input voltage supply for the LM337-N.
- **VOUT+** is the positive output voltage regulated by the LM317A.
- **VOUT-** is the negative output voltage regulated by the LM337-N.
- **GND** is the ground in which all other voltages on the EVM are referenced to. Ground banana jacks are placed on both the input and output side of the EVM.

2.2 Test Point Description

- **TP1 – VIN+** is the input to the LM317A.
- **TP2 – ADJ+** is the adjustment pin of the LM317A.
- **TP3 – VOUT+** is the output of the LM317A.
- **TP4 – VIN-** is the input to the LM337-N.
- **TP5 – ADJ-** is the adjustment pin of the LM337-N.
- **TP6 – VOUT-** is the output of the LM337-N.
- **TP7 – GND** is the ground rail of the EVM.

2.3 Board Setup

2.3.1 How to Set the Output Voltage

Both the LM317A and LM337-N are designed to sustain a nominal 1.25-V reference voltage VREF. Details can be found on the data sheets, but most importantly the output voltage for the LM317A is given by Equation 1.

$$V_{OUT+} = V_{REF} (1 + R3/R1) + (I_{ADJ} \times R3) \quad (1)$$

The output voltage for the LM337-N is given by Equation 2.

$$V_{OUT-} = -V_{REF} (1 + R4/R2) + (-I_{ADJ} \times R4) \quad (2)$$

I_{ADJ} is the current flowing out of the adjustment pin. The EVM will be populated according to a ±5-V output voltage, but the user can change this according to their needs.

It should be carefully noted that a minimum load current should be established to keep the device under regulation.

2.3.2 Evaluation

Before applying power to the LM317A-337N-EVM, all external connections should be verified. The nominal operating conditions that have been tested for the purpose of evaluation are shown in Table 2-1.

Important Note: If operation outside Table 2-1 is tested, then proper care should be taken to limit the power dissipation across the LM317A and LM337-N so that its absolute maximum ratings are not exceeded. Thermal management techniques such as heatsinks and airflow should be used in cases of high power dissipation.

Table 2-1. Nominal Operating Conditions

CONNECTOR NAME	VOLTAGE
VBAT+	8 V
VBAT-	–8 V
VOUT+	5 V
VOUT-	–5 V
Load for VOUT+	500 mA
Load for VOUT-	–500 mA
Power Dissipation of LM317A/LM337-N	1.5 W

To begin evaluation of the LM317A, an external power supply should be turned off and connected with proper polarity to the VBAT+ and GND connectors. The VIN+ (TP1) test point can be used to measure the positive input while the VOUT+ (TP3) test point can be measure the positive output. The ADJ+ (TP2) test point can be used to measure the adjustment pin of the LM317A.

To evaluate the LM337-N, an external power supply should be turned off and connected with proper polarity to VBAT- and GND. The VIN- (TP4) test point is used to measure the negative input, while the VOUT- (TP6) test point is used to measure the negative output. The ADJ- (TP5) test point can be used to measure the adjustment pin of the LM337-N.

Furthermore, the LM317A-337N-EVM provides solder space for a wide range of input and output capacitors. Specifically, there is space for electrolytic and ceramic capacitors. At the output, R5 and R6 resistor footprints are provided to add ESR for ceramics. Stock component values can be found on the schematic (Figure 5-1).

The board also contains footprint space for a TO-220 heat sink, which will aid in heat dissipation for high power applications. A recommended heat sink is provided in the Bill of Materials section.

Once all connections and components on the LM317A-337N-EVM have been verified, power can be applied to VBAT+ and/or VBAT-, and evaluation can begin.

Operation

For the following operation examples, we use the Nominal Operating Conditions as described in Table 2-1, with only stock components populated:

- Input capacitors C1 and C2 with a value of 22 µF
- Resistors R1 and R2 with a value of 240 Ω
- Resistors R3 and R4 with a value of 715 Ω
- Adjustment capacitors C5 and C6 with a value of 10 µF
- Output capacitors C3 and C4 with a value of 22 µF

3.1 Positive Input Power-Up and Power-Down (SOT-223)

In a typical application of the LM317A, a desired positive output voltage is set by selecting the resistor divider, and the linear regulator will regulate the output to a constant voltage. Linear regulators like the LM317A span a wide range of applications, all including some form of power management. In this section, the following conditions are used: input voltage = 8 V, output voltage = 5 V, load = 500 mA, and IC power dissipation = 1.5 W.

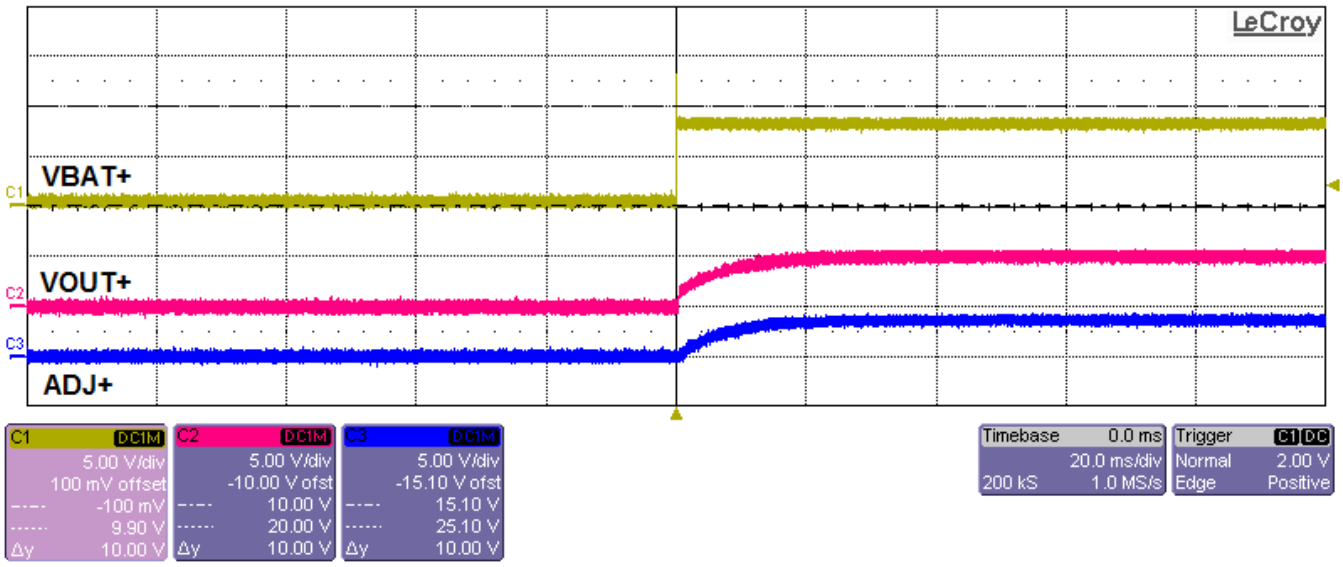

Figure 3-1. Positive Input Power-Up

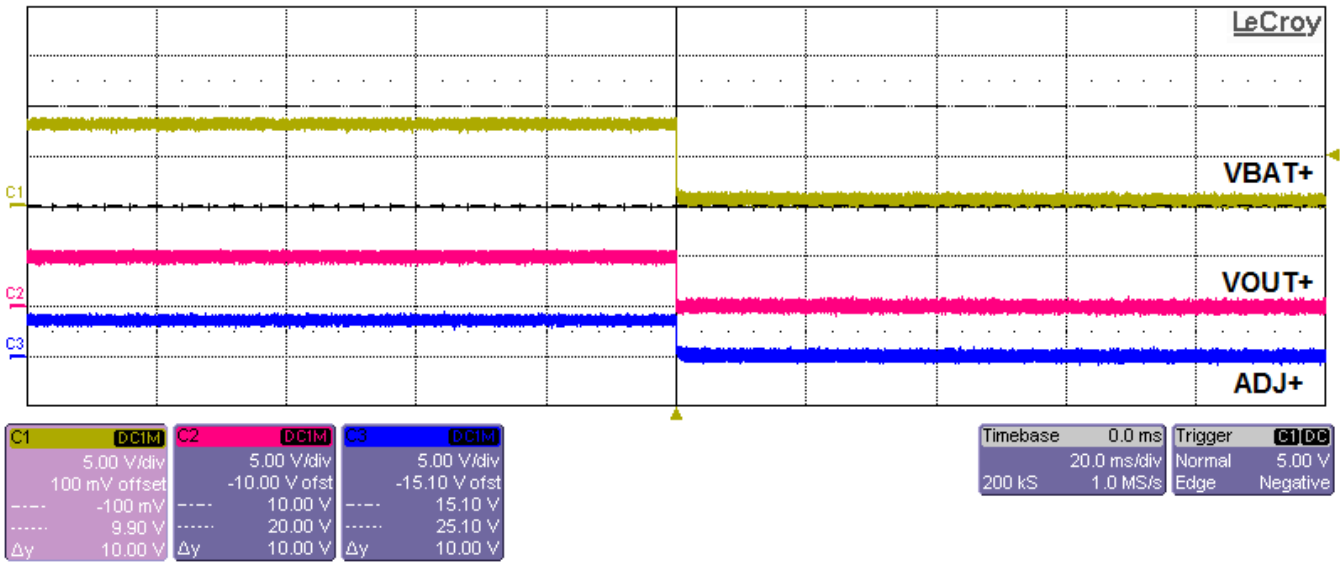

Figure 3-2. Positive Input Power-Down

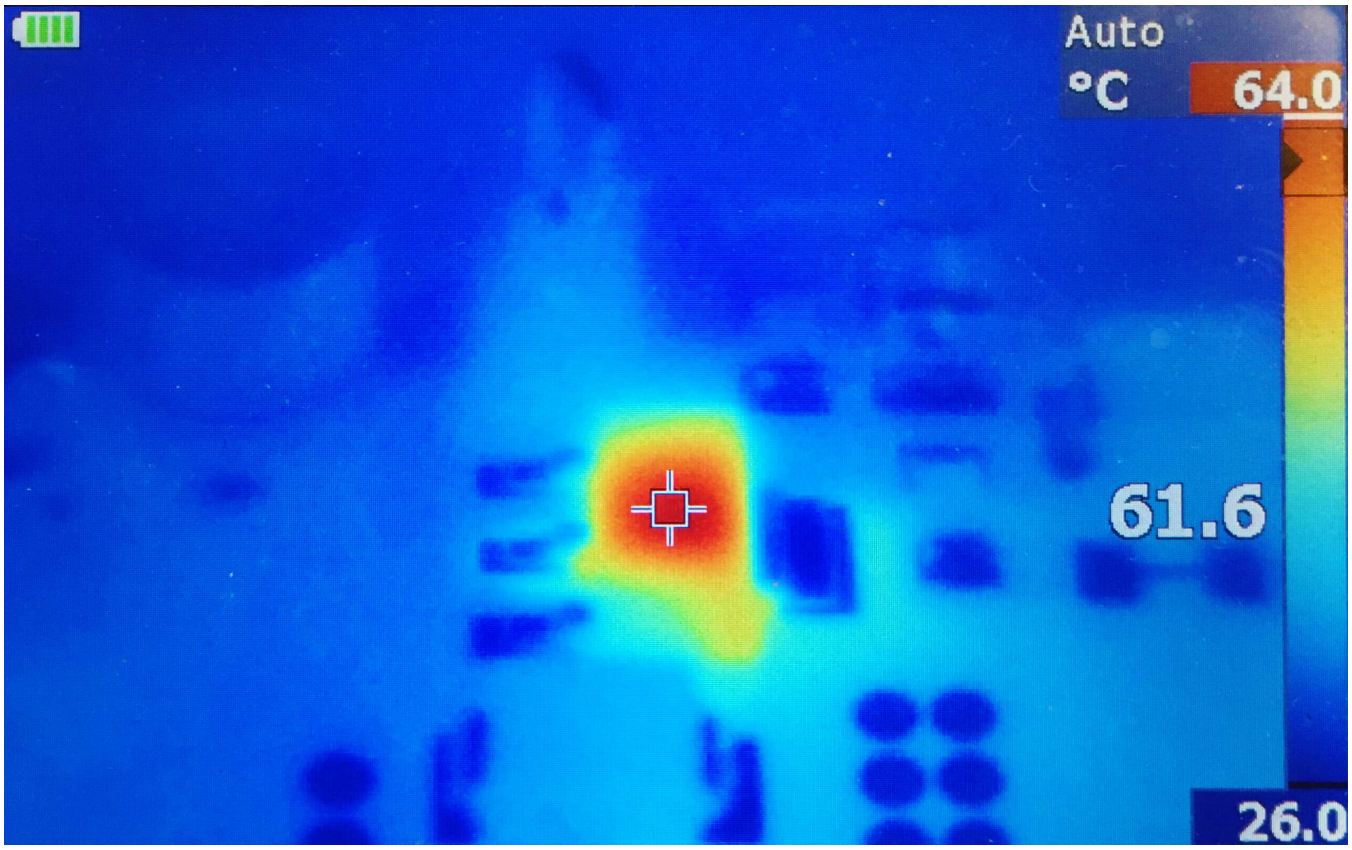

Figure 3-3. LM317A Thermal Image (After 5-min Run Time at 1.5 W)

3.2 Negative Input Power-Up and Power-Down (SOT-223)

The LM337-N provides regulation of a negative voltage at the output if the input-output differential is above the dropout voltage, and the input is within the operating range. The LM337-N finds use in applications that involve providing a reliable negative rail, such as in bipolar amplifier circuits and op amps. In this section, the following conditions are used: input voltage = –8 V, output voltage = –5 V, load = –500 mA, and IC power dissipation = 1.5 W.

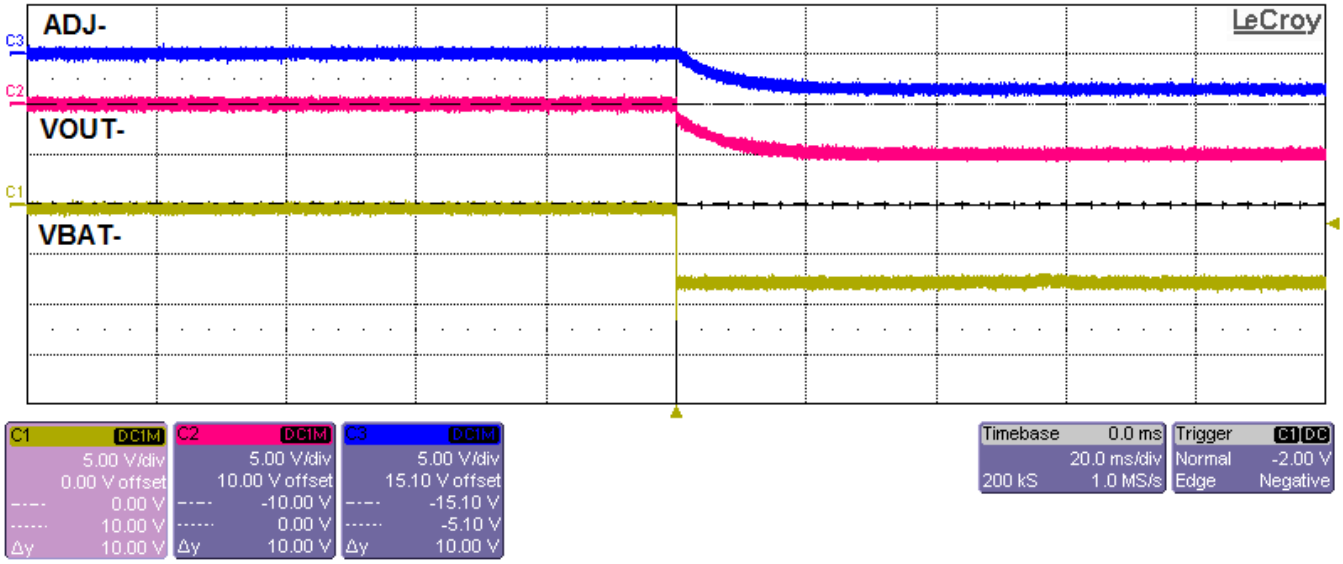

Figure 3-4. Negative Input Power-Up

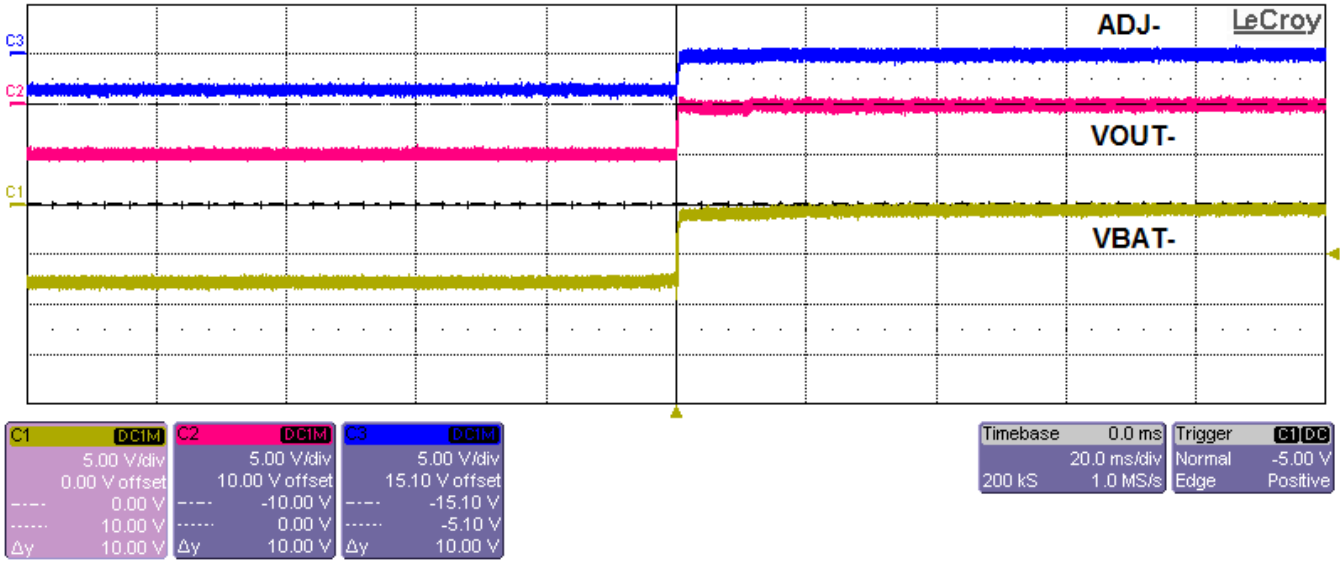

Figure 3-5. Negative Input Power-Down

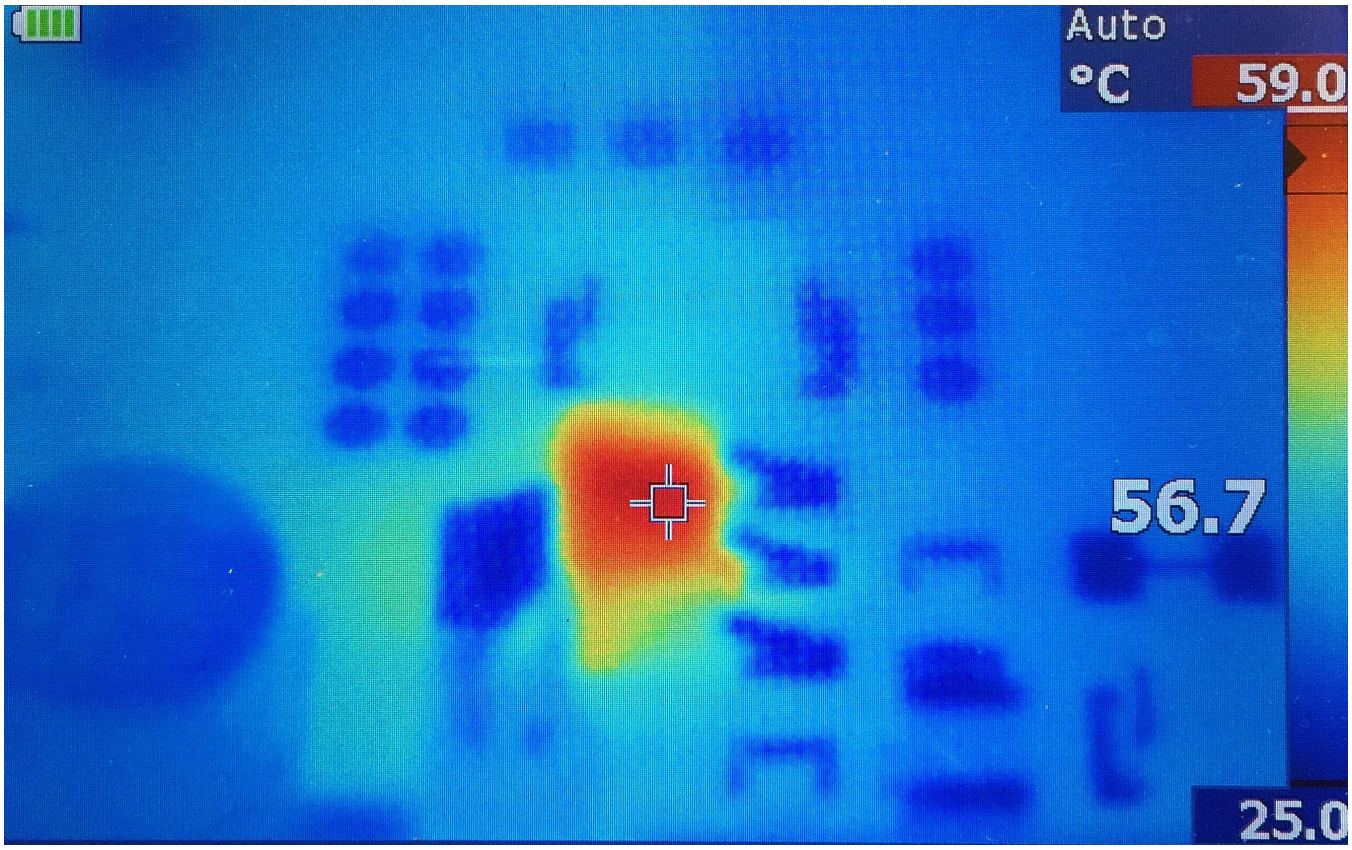

Figure 3-6. LM337-N Thermal Image (after 5 min run time @ 1.5W)

Board Layout

Figure 4-1, Figure 4-2 and Figure 5-1 show the board layout for the LM317A-337N-EVM. Please note C7, C8, R5, R6, S1, and S2 will be left unpopulated. If the TO-220 package options for the LM317A and LM337-N are to be evaluated, then remove U1 and U4, and populate U3 and U2 along with the heatsinks.

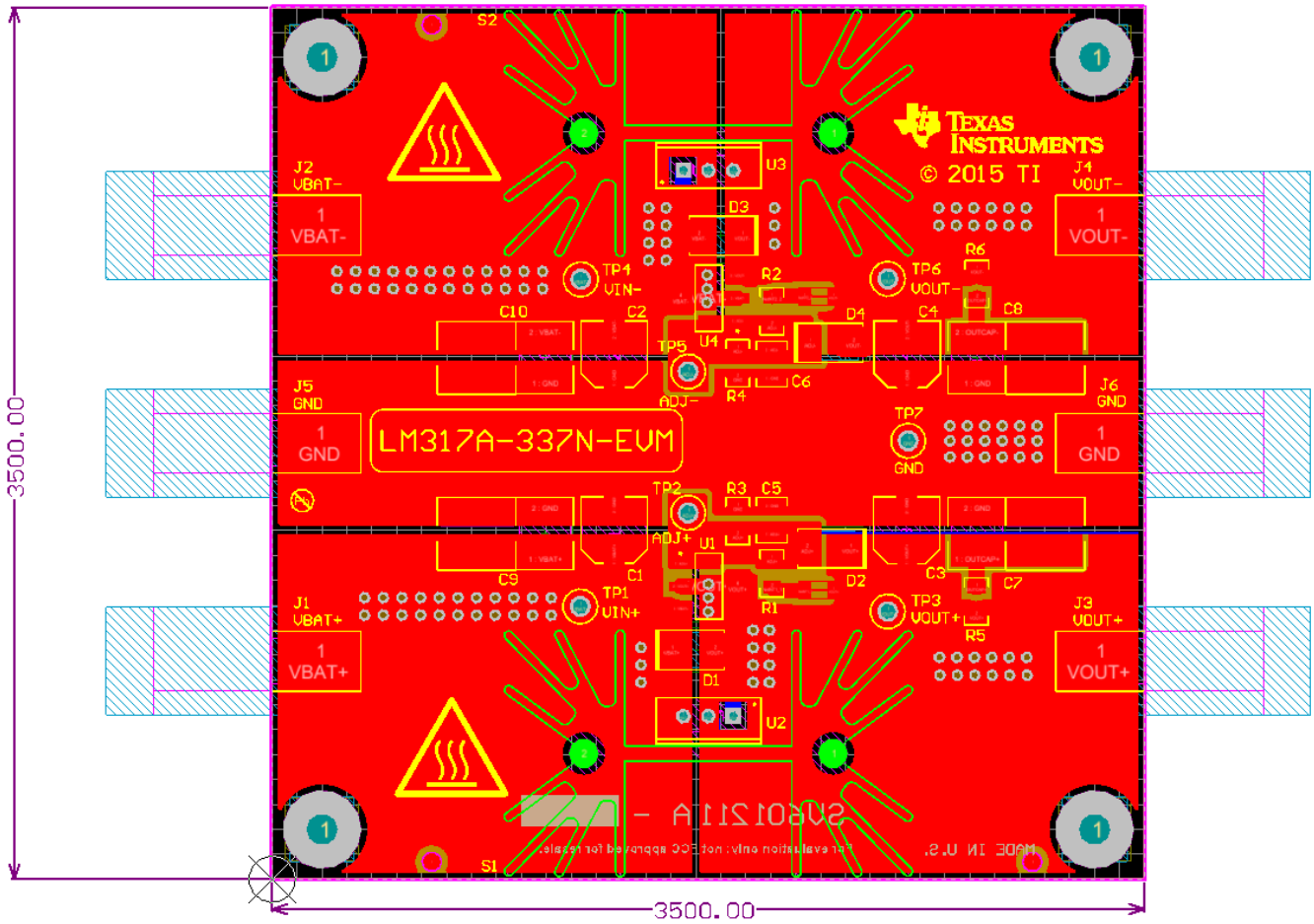

Figure 4-1. Top Layer Layout

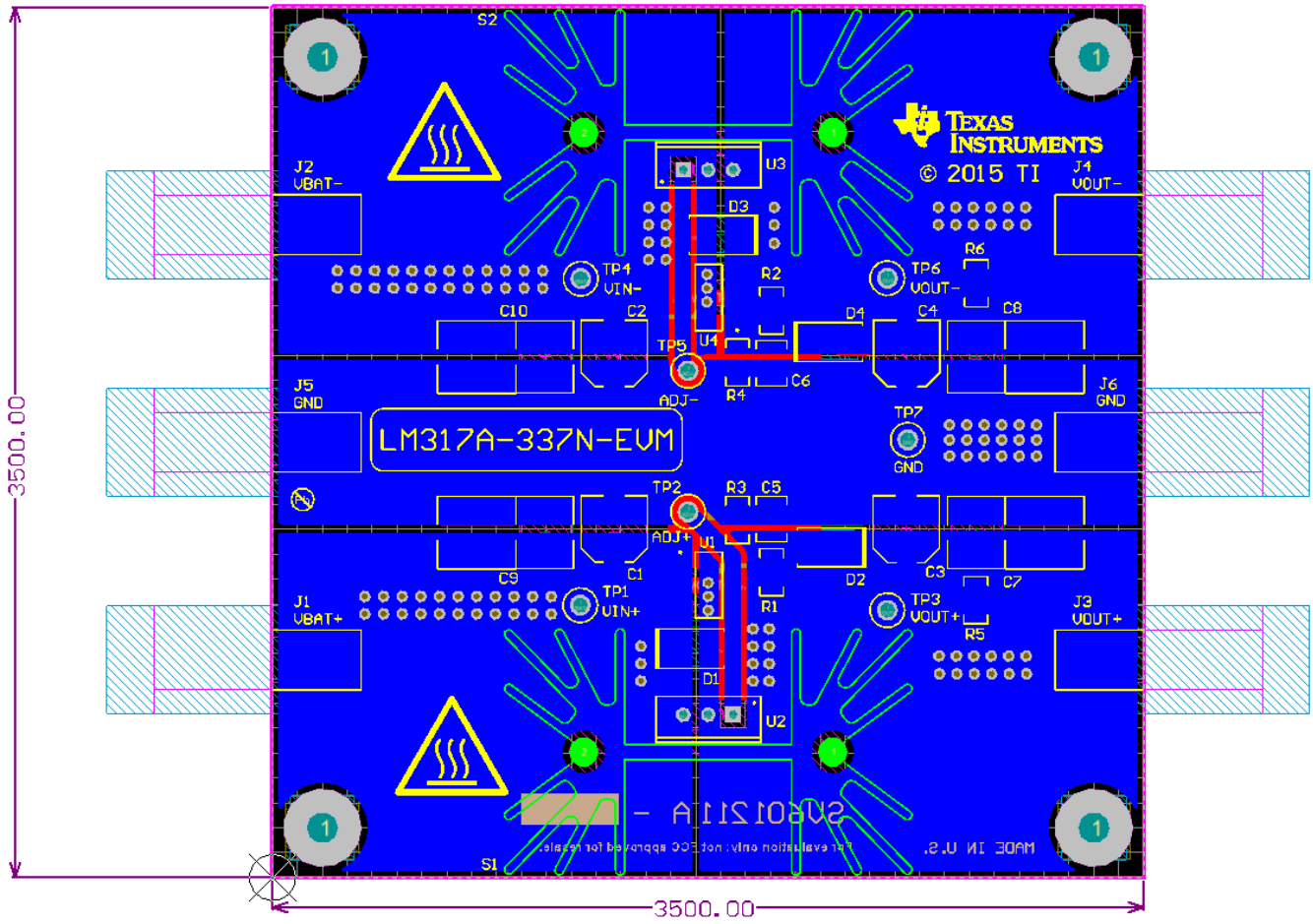

Figure 4-2. Bottom Layer Layout

Schematic

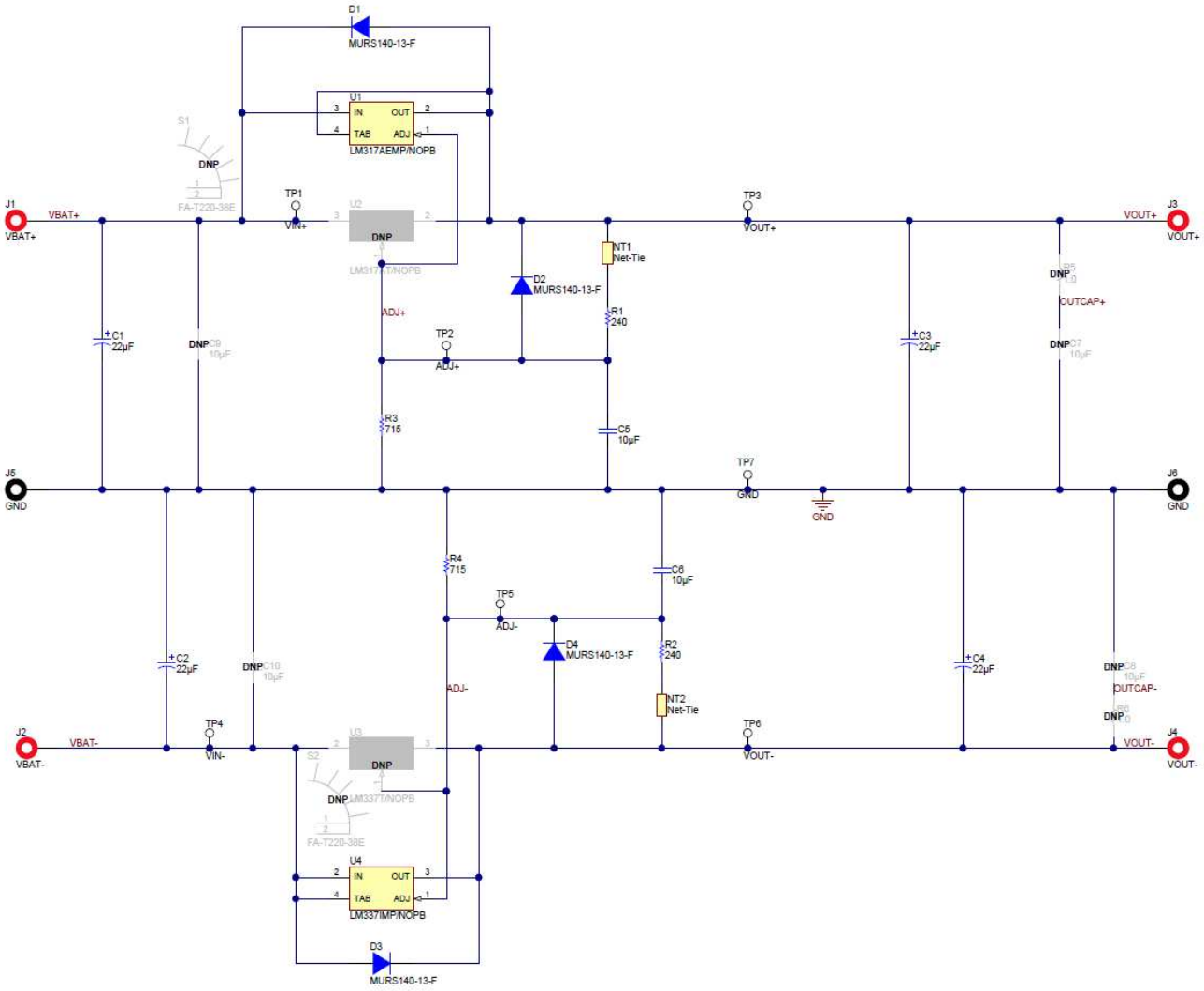

Figure 5-1. LM317N-LM337N10EVM Schematic

Table 5-1. LM317N-LM337N10EVM Bill of Materials

DESIGNATOR	QTY	VALUE	DESCRIPTION	PACKAGE REFERENCE	PART NUMBER	MANUFACTURER
!PCB	1		Printed Circuit Board		SV601211	Any
C1, C2, C3, C4	4	22 µF	CAP, AL, 22 µF, 50 V, ±20%, 0.88 ohm, SMD	SMT Radial D	EEE-FK1H220P	Panasonic
C5, C6	2	10 µF	CAP, CERM, 10 µF, 50 V, ±10%, X7R, 1210	1210	GRM32ER71H106KA12L	MuRata
D1, D2, D3, D4	4	400 V	Diode, Ultrafast, 400 V, 1 A, SMB	SMB	MURS140-13-F	Diodes Inc.
H1, H2, H3, H4	4		Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	Screw	NY PMS 440 0025 PH	B&F Fastener Supply
H5, H6, H7, H8	4		Standoff, Hex, 0.5"L #4-40 Nylon	Standoff	1902C	Keystone
J1, J2, J3, J4	4		Standard Banana Jack, Insulated, Red	6091	6091	Keystone
J5, J6	2		Standard Banana Jack, Insulated, Black	6092	6092	Keystone
LBL1	1		Thermal Transfer Printable Labels, 1.250" W x 0.250" H - 10,000 per roll	PCB Label 1.25"H x 0.250"W	THT-13-457-10	Brady
R1, R2	2		RES, 240, 5%, 0.25 W, 1206	1206	CRCW1206240RJNEA	Vishay-Dale
R3, R4	2		RES, 715, 1%, 0.25 W, 1206	1206	CRCW1206715RFKEA	Vishay-Dale
TP1, TP2, TP3, TP4, TP5, TP6, TP7	7	White	Test Point, Multipurpose, White, TH	White Multipurpose Testpoint	5012	Keystone
U1	1		3-Terminal Adjustable Regulator, 4-pin SOT-223, Pb-Free	MP04A	LM317AEMP/NOPB	Texas Instruments
U4	1		3-Terminal Adjustable Negative Regulator, 4-pin SOT-223, Pb-Free	MP04A	LM337IMP/NOPB	Texas Instruments
C7, C8, C9, C10	0	10 µF	CAP, CERM, 10 µF, 50 V, ±20%, X7R, 2220	2220	C5750X7R1H106M	TDK
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	Fiducial	—	—
R5, R6	0	1	RES, 1.0, 5%, 0.25 W, 1206	1206	CRCW12061R00JNEA	Vishay-Dale
S1, S2	0		Heat Sink, TO-220, Vertical	Heat Sink, TO-220, Vertical	FA-T220-38E	Ohmite
U2	0		3-Terminal Adjustable Regulator, 3-pin TO-220, Pb-Free	T03B	LM317AT/NOPB	Texas Instruments
U3	0		3-Terminal Adjustable Negative Regulator, 3-pin TO-220, Pb-Free	T03B	LM337T/NOPB	Texas Instruments

Related Documentation

- LM317A 3-Terminal Adjustable Positive Regulator data sheet (SNVSAC2)
- LM337-N 3-Terminal Adjustable Negative Regulator data sheet (SNVS778)

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      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.*

3.2 *Canada*

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

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSS standard(s). 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.

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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 by Radio Law of Japan to follow the instructions below with respect to EVMs:

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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4.1 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.

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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.

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