
LAB2 – NATIONAL LM267X VOLTAGE REGULATOR

EE562: POWER ELECTRONICS

COLORADO STATE UNIVERSITY

Lab2 – National LM267X Voltage Regulator

PURPOSE:

The purpose of this lab is to test the LM267X voltage regulating chip. National Semiconductor makes the LM267X chip that will be utilized in these labs. There are a couple variations available for the LM267X SIMPLE SWITCHER evaluation board; a series 3A and 5A. The series 5A will be utilized throughout this course. The series that a particular evaluation board uses is printed on the board. The LM2673S-5.0 is the chip that will be used on the board. The 3S-5.0 indicates that the chip operates at 3 amps and 5 volts. This model is a buck converter with 5V output voltage and 3A maximum load current. This lab will explore the following:

- INTRODUCTION to the LM267X series step-down voltage regulators.
- GENERAL DESCRIPTION
- PHYSICALLY TESTING

INTRODUCTION:

In this course, the important concepts of buck converters and the mathematics behind them have been extensively covered. These labs are set up to actually test a buck converter circuit and make some general observations about its characteristics. The simulations that will be performed in this lab will also reinforce your understanding of the buck converter topology.

GENERAL DESCRIPTION:

Figure 1, shown below, is a circuit diagram of the evaluation board used for this lab. Carefully inspect the board in your possession. Especially note the connection pins. Find the V_{IN} , V_{OUT} , SW_{OUT} and the four GND pins on your board.

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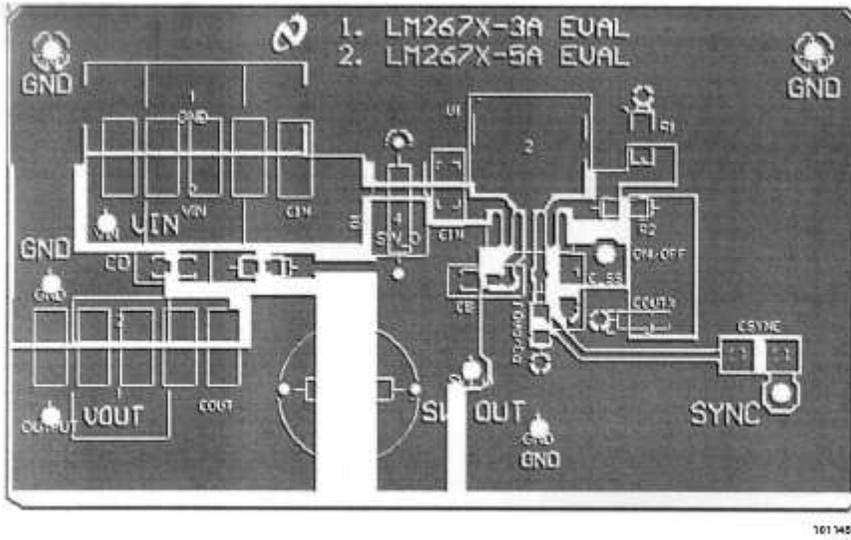


FIGURE 2. Top Layer Foil Pattern of Printed Circuit Board

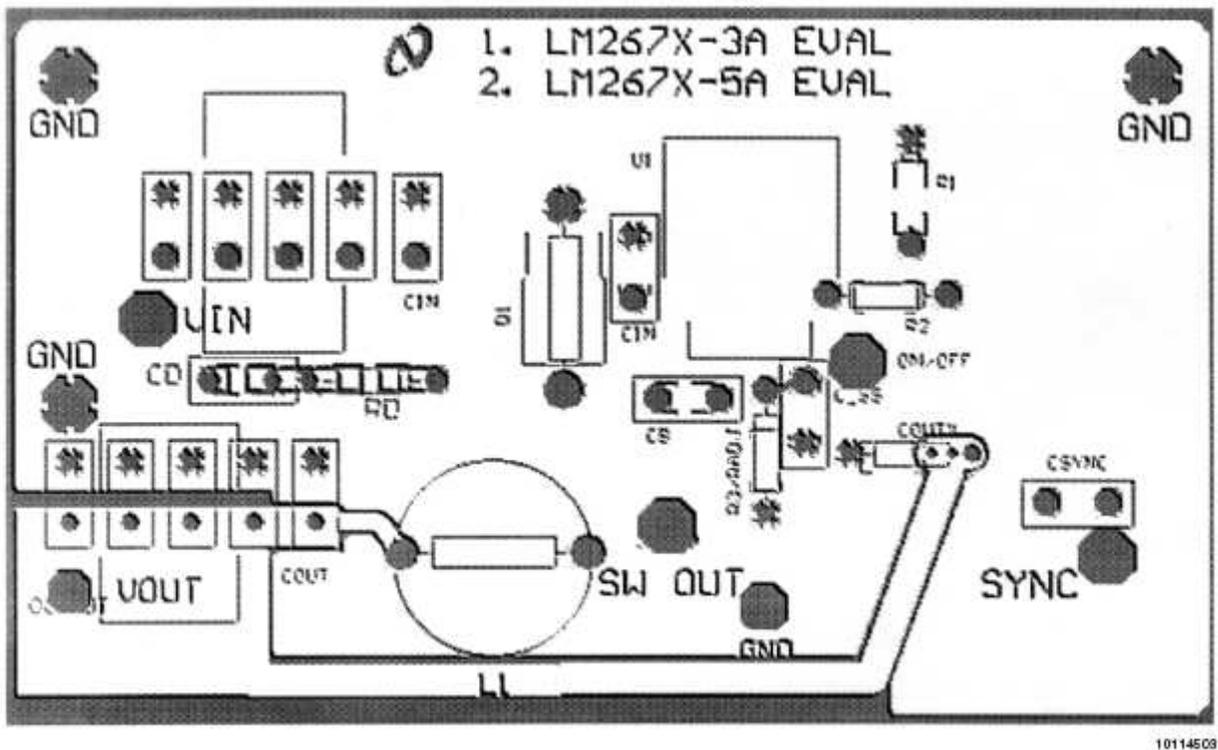


FIGURE 3. Bottom Layer Foil Pattern of Printed Circuit Board

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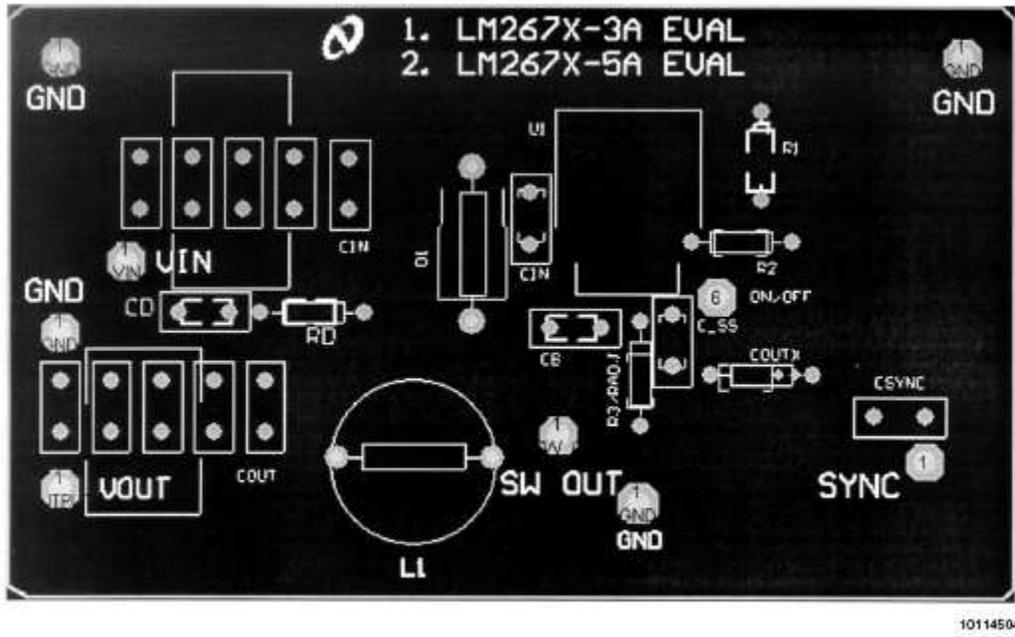


FIGURE 4. Silkscreen Image Of Printed Circuit Board

For this evaluation board, the LM267X-3A, all of the components are included on the board. The only variables are the input voltage and the switching speed. Everything else, including the output voltage, is fixed.

PHYSICALLY TESTING:

In order to produce the graphical data required for this lab, you will need to use the following equipment:

- Agilent Infiniium Oscilloscope
- DC power supply
- Multimeter
- Waveform generator
- Three sets of leads
- One probe for the oscilloscope
- One of each: 10 Ω , 100 Ω and a 1k Ω resistor
- A floppy disk (to record oscilloscope images)

The first step is to set up all of the equipment mentioned above. If necessary, review equipment manuals for proper set up.

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Oscilloscope: Record the output voltage from Channel 1.

DC Power Supply: Connect the leads to +25V and Ground. Initially set the voltage to +10V.

Multimeter: Configure to record current readings.

Waveform Generator: Set for a square wave with an amplitude of 1V and a frequency of 1 kHz.

The next step will be to prepare the circuit for testing. First, connect the oscilloscope to record the voltage between the V_{OUT} pin and ground. Next, connect the positive lead of the waveform generator to the SWOUT pin and the negative to a GND pin. Finally, connect the positive lead from the DC power supply to the V_{IN} pin and the negative lead to a GND pin. **This is extremely important. The maximum input voltage for this circuit is 16V so do not, under any circumstances, let the DC power supply exceed that voltage to the evaluation board, as it may cause irreversible damage.** You will notice that there are several GND pins, but they are all, electrically speaking, the same point in the circuit. To make things easier, spread out the ground connections to several different GND pins. You are now ready to test your circuit.

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QUESTIONS:

- 1) With all the variables set, as mentioned above, record the V_{MAX} , V_{MIN} , V_{P-P} and the output frequency from the oscilloscope. Include a screenshot from the oscilloscope with these values displayed.
- 2) Now adjust V_{IN} . Set the DC power supply to +15V and record your observations. Did increasing the V_{IN} change V_{OUT} ? _____
Include a screenshot from the oscilloscope with the same values displayed. Now set V_{IN} back to +10V. Keep decreasing V_{IN} until V_{OUT} changes. At what voltage of V_{IN} did V_{OUT} change and how did V_{OUT} change? _____
- 3) Now adjust the input frequency. With V_{IN} reset to +10V, increase the frequency of the waveform generator until V_{OUT} changes. At what maximum frequency did V_{OUT} change and how did V_{OUT} change? _____
Now, decrease the frequency of the waveform generator until V_{OUT} changes. At what minimum frequency did V_{OUT} change and how did V_{OUT} change? _____
- 4) Now, turn all of the equipment off and connect the V_{OUT} pin and a GND pin to your circuit board with your resistor completing the circuit. Reset V_{IN} to +10V and the frequency to 1 kHz (on the SWOUT pin). Connect the multimeter to measure the current flowing through the resistor. Before you actually run the experiment, what current would you expect to see with the 10 Ω resistor connected in the circuit? The 100 Ω resistor? The 1k Ω resistor? _____
Now, repeat the experiment with the 10 Ω resistor connected in the circuit. What is the output current with the 10 Ω load resistor? _____
Now, repeat the experiment with the 100 Ω resistor connected in the circuit. What is the output current with the 100 Ω load resistor? _____
Now, repeat the experiment with the 1k Ω resistor connected in the circuit. What is the output current with the 1k Ω load resistor? _____
Did the experimental results match your predictions? _____
Explain any differences you might see. _____

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- 5) Based on the data you have accrued, what can you say about this circuit regarding the output voltage and the maximum load current? _____
- 6) Think like an engineer. Your company has ordered 10,000 of the LM2673S-5.0 simple switcher chips (the same chip used in this lab) to develop prototypes to show the investors. However, when the technician begins testing the chips, he finds that the output voltage was registering at approximately 3V and the load current at approximately 5A. Obviously, the manufacturer had mislabeled the chips and sent you the wrong ones. Assuming the chip is in the LM267X family, which chip do you think the manufacturer actually sent out? _____

WRITTEN REPORT:

When writing the report, answer all questions posed throughout this lab.

Written Report shall include:

- Cover page
- Purpose
- Answers to questions – show all work!
- All oscilloscope snapshots
- Conclusion