

# LM2651\_3.3V\_EVAL 1.5A High Efficiency Synchronous Switching Regulator Evaluation Board

National Semiconductor  
Application Note 1143  
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## Introduction

The LM2651 switching regulator provides high efficiency power conversion over a 100:1 load range (1.5A to 15mA). This feature makes the LM2651 an ideal fit in battery powered applications.

Synchronous rectification and 75 mΩ internal switches provide up to 97% efficiency. At light loads, the LM2651 enters a low power hysteretic or sleep mode to keep the efficiency high. In many applications, the efficiency still exceeds 80% at 15 mA load.

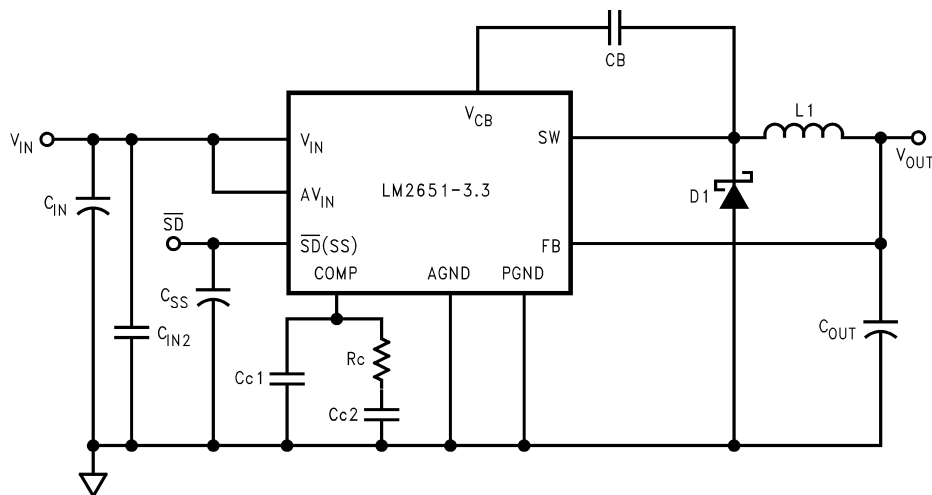
A shutdown pin is available to disable the LM2651 and reduce the supply current to 7 μA but the shutdown function is not available on this board. The IC contains patented current sensing circuitry for current mode control. This feature eliminates the external current sensing required by other current mode DC to DC converters. The IC has a 300kHz fixed frequency internal oscillator. The high oscillator frequency allows the use of extremely small, low profile components.

The evaluation board can be obtained by ordering part number LM2651\_3.3V\_EVAL from your local National Semiconductor sales office, or National's website at [www.national.com](http://www.national.com).

## Evaluation Board Design

The evaluation board is designed to supply 3.3V at 15 mA up to 1.5A. The input voltage range is 4V to 14V. Components were selected based on the design procedure in the LM2651

datasheet. PCB layout is critical to reduce noise and ensure specified performance for any power supply design. To minimize the parasitic inductance in the loop of input capacitors and the internal MOSFETs, connect the capacitors to  $V_{IN}$  and PGND pins with short and wide traces. This is important because the rapidly switching current, together with wiring inductance can generate large voltage spikes that may cause noise problems. The feedback trace from the output to the feedback pin should be wide, short and kept away from the flux field of the inductor. The artwork for the evaluation board is shown at the end of this application note and the schematic shown in *Figure 1*. The parts list is given in *Table 1*. The pictorial representations of top, bottom and silk-screen layers are shown at the end of this application note. When an undervoltage situation occurs, the output voltage can be pulled below ground as the inductor current is reversed through the synchronous FET. For applications which need to be protected from a negative voltage, a clamping diode D2 is recommended. When used, D2 should be connected cathode to  $V_{OUT}$  and anode to ground. A diode rated for a minimum of 2A is recommended.



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FIGURE 1. LM2651\_3.3V\_EVAL Schematic

TABLE 1. LM2651\_3.3V\_EVAL Bill of Material

| Component                             | Value              | Suggested Part Number   |
|---------------------------------------|--------------------|-------------------------|
| U1                                    |                    | National's LM2651-3.3   |
| L1                                    | 22 $\mu$ H         | Coilcraft D03316P-223   |
| C <sub>IN</sub> (Input Capacitor)     | 100 $\mu$ F, 16V   | Sprague 594D107X0016D2T |
| C <sub>IN2</sub> (Input Capacitor)    | 0.1 $\mu$ F        | Ceramic Capacitor       |
| CB (Bootstrap Capacitor)              | 0.1 $\mu$ F        | Ceramic Capacitor       |
| C <sub>SS</sub> (softstart Capacitor) | 4.7nF              | Ceramic Capacitor       |
| C <sub>OUT</sub> (Output Capacitor)   | 120 $\mu$ F, 6.3V  | Sprague 594D127X06R3C2T |
| CC1 (Compensation Capacitor)          | 2.2nF              | Ceramic Capacitor       |
| CC2 (Compensation Capacitor)          | 100pF              | Ceramic Capacitor       |
| RC (Compensation Resistor)            | 30 k $\Omega$ , 5% | Resistor                |
| D1                                    | 1A Schottky Diode  | Motorola MBRA130LT3     |

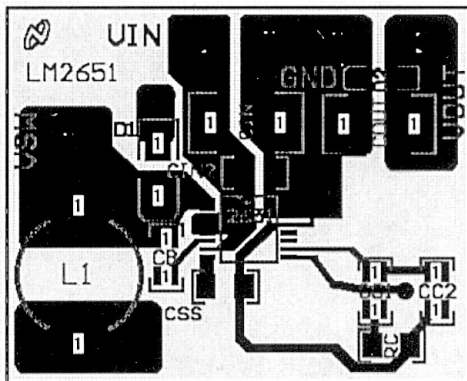
### Operating The Evaluation Board

#### Setup

The LM2651\_3.3V\_EVAL evaluation board comes ready to be tested. The only setup needed is connecting the input voltage to the V<sub>IN</sub> and GND posts. The load and output are connected to the V<sub>OUT</sub> post.

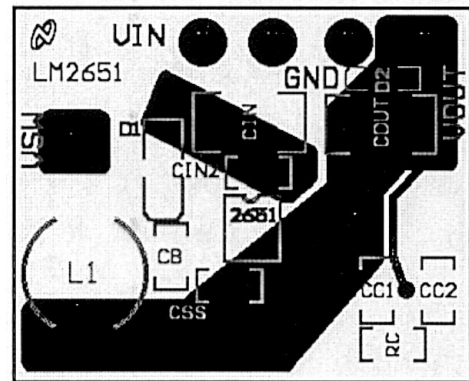
#### Operating Conditions

The input voltage to the LM2651-3.3 regulator must be within the range of 4V to 14V DC for proper operation. The device will not function properly with voltages below 4V and damage may occur if any voltage greater than 16V is applied.



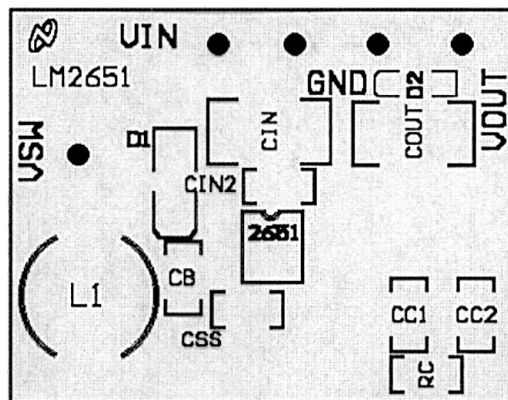
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Layout Top Layer



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Layout Bottom Layer



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Layout Silkscreen

## Notes

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