User's Guide
LMR12010 Step-Down Converter Evaluation Module User's Guide

TEXAS INSTRUMENTS

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1 Introduction

The LMR12010 is a step down DC-DC regulator that operates at the following switching frequencies: the LMR12010X at 1.6 MHz and the LMR12010Y at 3 MHz. The demo board is configured to convert 5-V input to 1.8-V output at 1-A load current using the Y version. The tiny low profile thin SOT23 package allows the design to use less than 1 square inch of board area.

The circuit is configured with the boost diode connected to V_{IN}. V_{IN} must not exceed the maximum operating limit of 5.5 V + V_{fD2} using this configuration. This makes sure that the voltage between the boost and SW pins, $V_{BOOST} - V_{SW}$, does not exceed 5.5 V for proper operation. For more information regarding this requirement, see the *LMR12010 SIMPLE SWITCHER® 20Vin, 1A Step-Down Voltage Regulator in SOT-23 Data Sheet*.

The schematics at the end of this document show how to reconfigure this demo board for various input and output conditions as discussed in the *LMR12010 SIMPLE SWITCHER® 20Vin, 1A Step-Down Voltage Regulator in SOT-23 Data Sheet*. Short or leave open the connections as indicated in the schematics. The previously mentioned restrictions for the input voltage are valid only for the demo board as shipped with the demo board schematic shown in Figure 4-3

2 Features

- 3.0-V to 5-V input voltage range (as shipped)
- 1.8-V output voltage
- Up to 1-A output current
- Switching frequency of 3 MHz
- Small solution size (17 mm × 17 mm)

3 Enable Operation

The demo board includes a spot for a pullup resistor R5 (not stuffed) to enable the device once V_{IN} has exceeded 1.8 V (typical). A typical value for this resistor is 100 KΩ. Otherwise, use the EN post to apply a logic signal to test start-up and shutdown of the device. Never allow the EN voltage to exceed V_{IN}.

4 Adjusting the Output Voltage

The output voltage can be changed from 1.8V to another voltage by adjusting the feedback resistors using Equation 1:

$$V_{OUT} = V_{FB}(1 + (RFBT / RFBB)) \qquad (1)$$

where

- V_{FB} is 0.8 V.

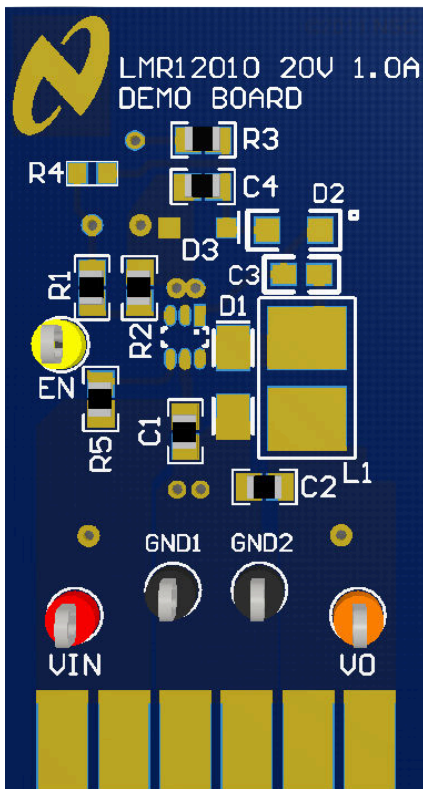For more information on component selection and features, see the device-specific data sheet.

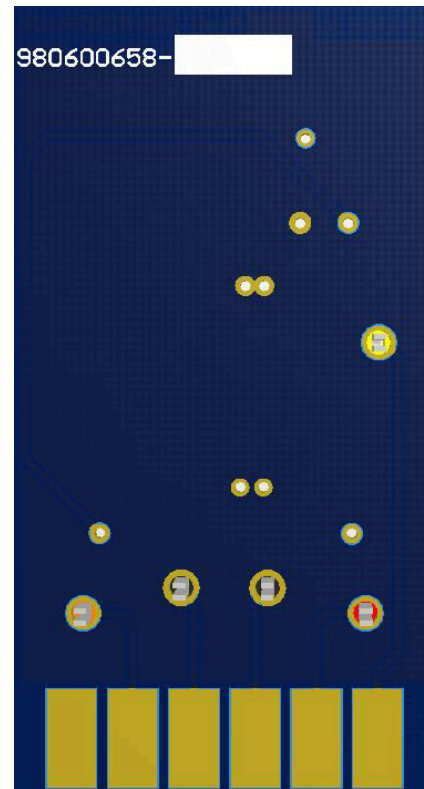**Figure 4-1. LMR12010 Demo Board Top View**
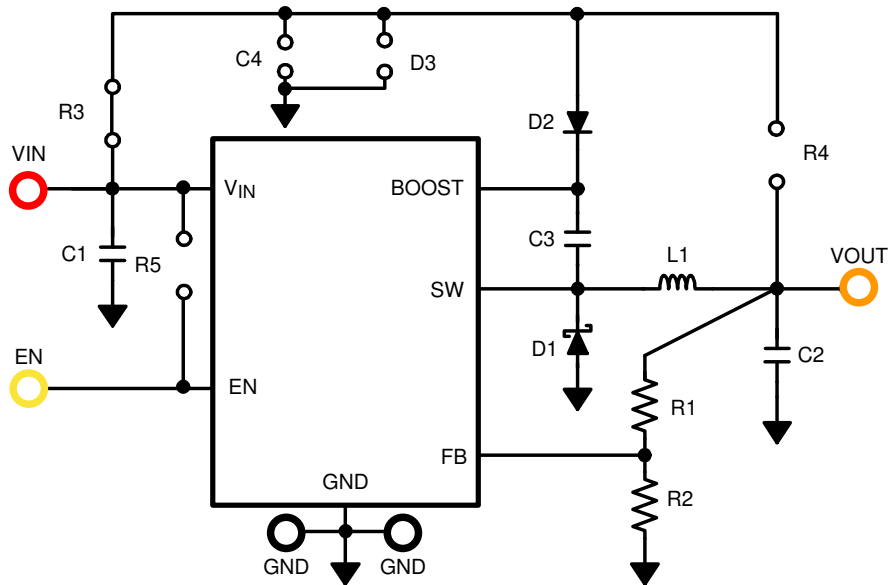

Figure 4-2. LMR12010 Demo Board Bottom View

Figure 4-3. LMR12010Y Demo Board Schematic

Table 4-1. Bill of Materials (BOM) for LMR12010Y

Part ID	Part Value	Manufacturer	Part Number	Package Type
U1	1-A Buck Regulator	Texas Instruments	LMR12010	Thin SOT23-6
C1, Input Cap	10 μF, 10 V, X5R	Murata	GRM316R61A475KE19D	1206
C2, Output Cap	10 μF, 6.3 V, X5R	Murata	GRM319R60J106KE01D	1206
C3, Boost Cap	0.01 μF	Vishay	VJ0805Y103KXAAC	0805
D1, Catch Diode	0.45 Vf Schottky 1 A, 20VR	Vishay	MBRA120TRPBF	SMA

Table 4-1. Bill of Materials (BOM) for LMR12010Y (continued)

Part ID	Part Value	Manufacturer	Part Number	Package Type
D2, Boost Diode	1 Vf at 50-mA Diode	Diodes, Inc.	1N4148W-7-F	SOD-123
L1	2.7 µH, 1.8 A, 33 mΩ	TDK	VLCF5028T-2R7N1R8-2	6028
R1	12.4 kΩ, 1%	Vishay	CRCW080512K4FKEA	0805
R2	10 kΩ, 1%	Vishay	CRCW080510K0FKEA	0805
R3	0 Ω	Vishay	CRCW08050000Z0EA	0805
D3, C4, R4, R5	Open			

5 Test Setup

Table 5-1. Demonstration Board Quick Setup Procedures

Step	Description	Notes
1	Connect a power supply to VIN terminals.	
2	Connect a load to VO terminals.	
3	EN should be connected to VIN for normal operation. Short this to ground to shut down the part.	
4	Set V_{IN} = 5 V, with 0-A load applied. Check V_O with a voltmeter.	Nominal 1.8 V
5	Apply a 1-A load and check V_O.	Nominal 1.8 V

Figure 5-1. Efficiency Measurements
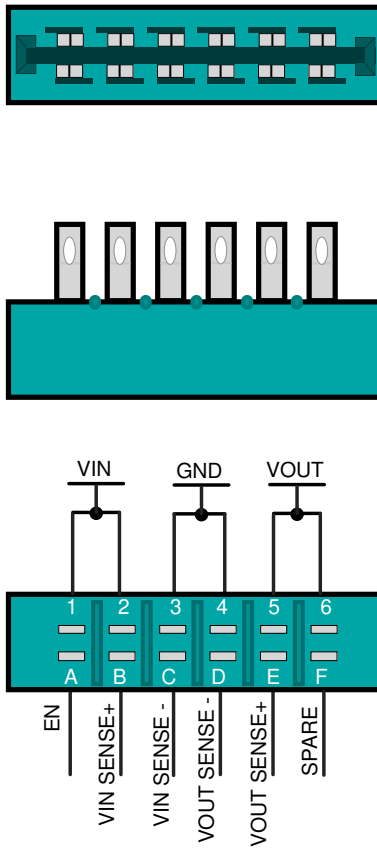

Figure 5-2. Voltage Ripple Measurements

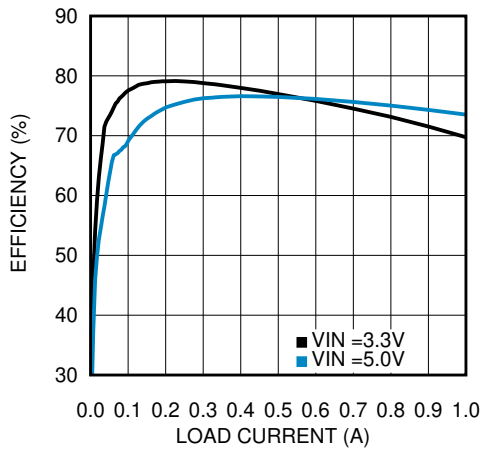**Figure 5-3. Edge Connector Schematic**

6 Typical Performance Characteristics

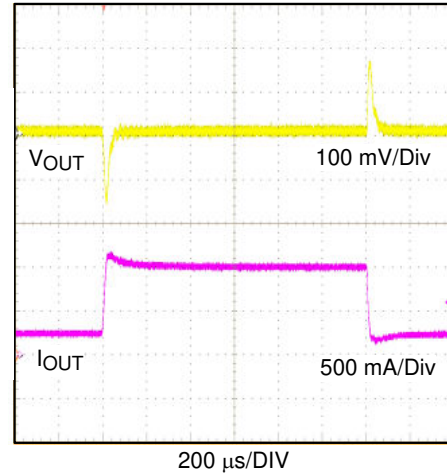**Figure 6-1. Efficiency vs. Load Current LMR12010Y, V$_O$ = 1.8 V**

Figure 6-2. Load Transient Waveforms LMR12010Y, I$_{OUT}$ = 100 mA to 1000 mA
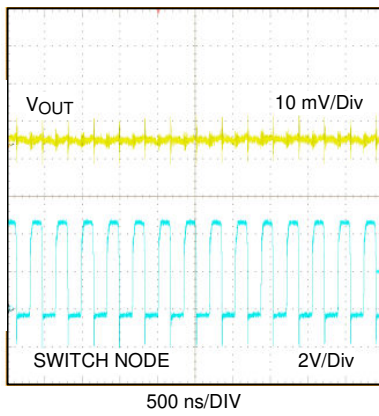

Figure 6-3. Switching Node and Output Voltage Waveforms

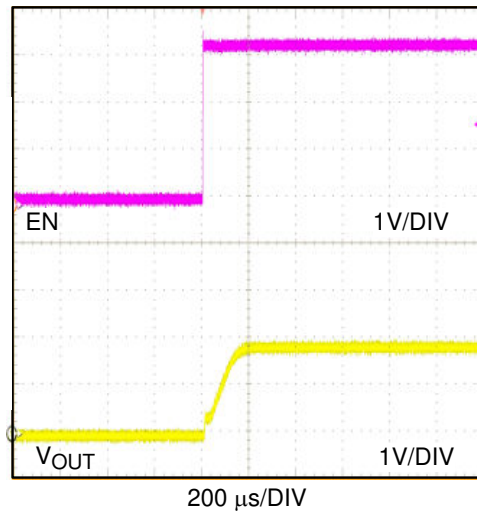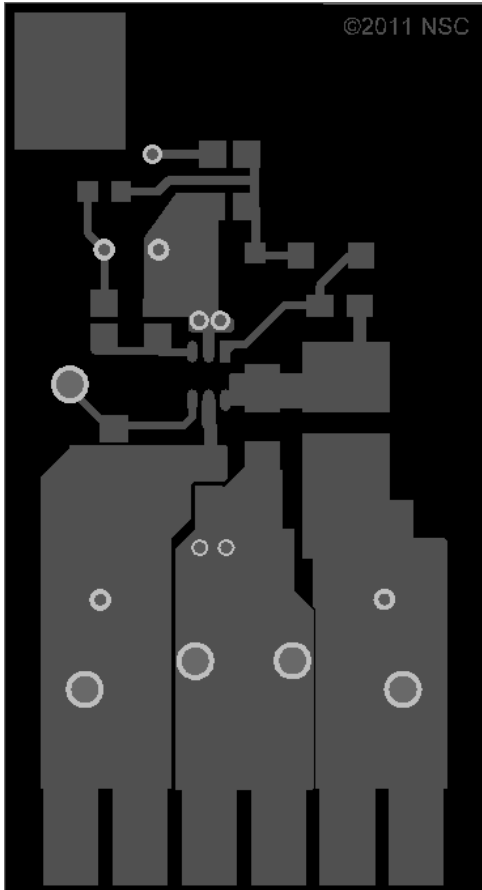**Figure 6-4. Start-Up Waveform**
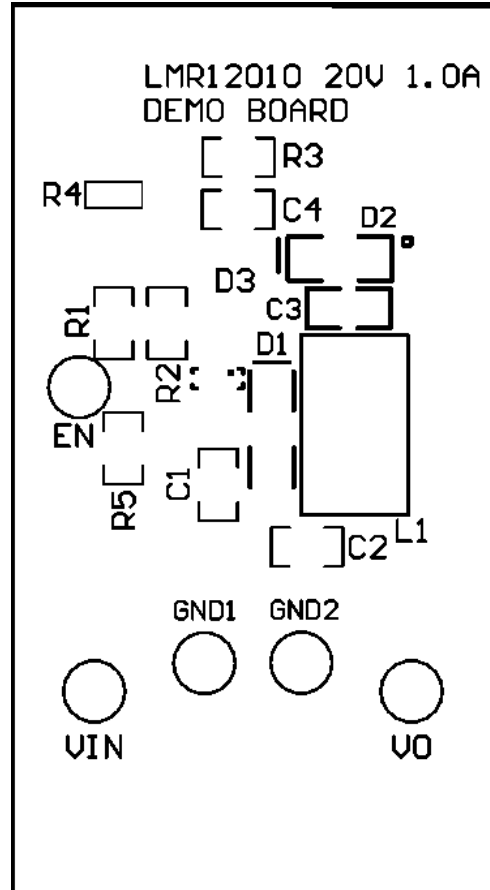
7 Layout

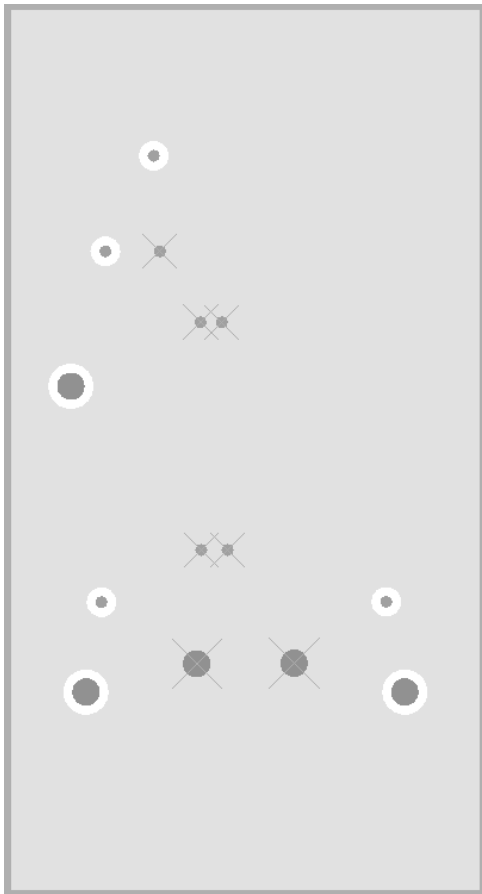**Figure 7-1. Top Layer**
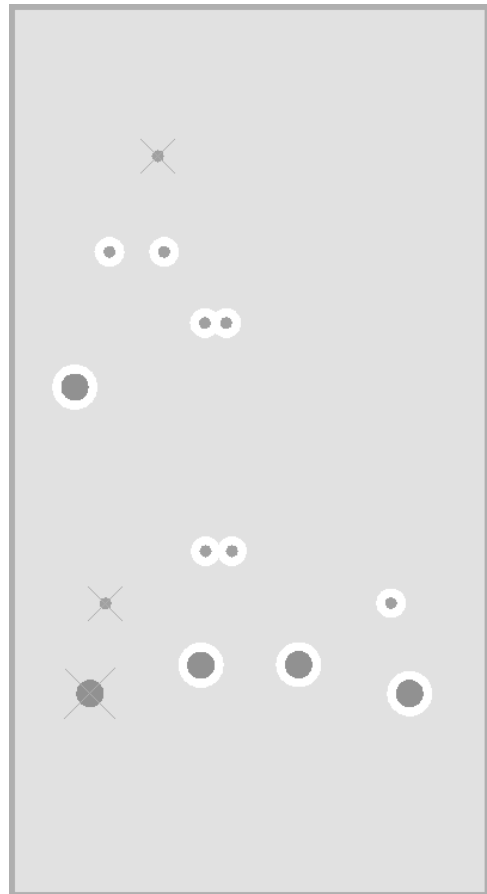

Figure 7-2. Top Overlay

Figure 7-3. Inner Layer 1
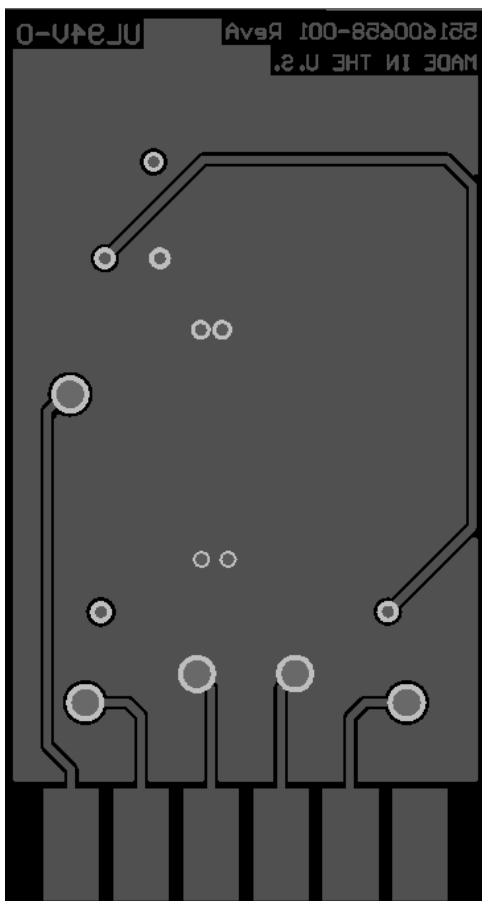

Figure 7-4. Inner Layer 2
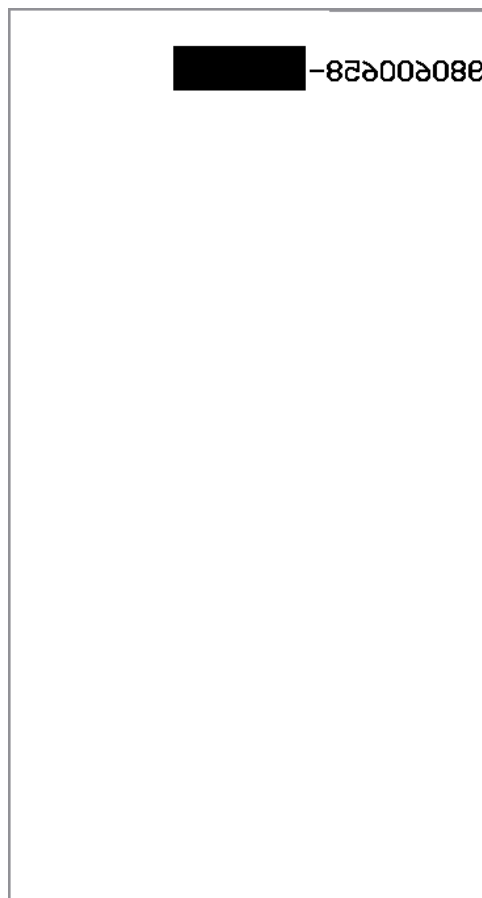
Figure 7-5. Bottom Layer

Figure 7-6. Bottom Overlay

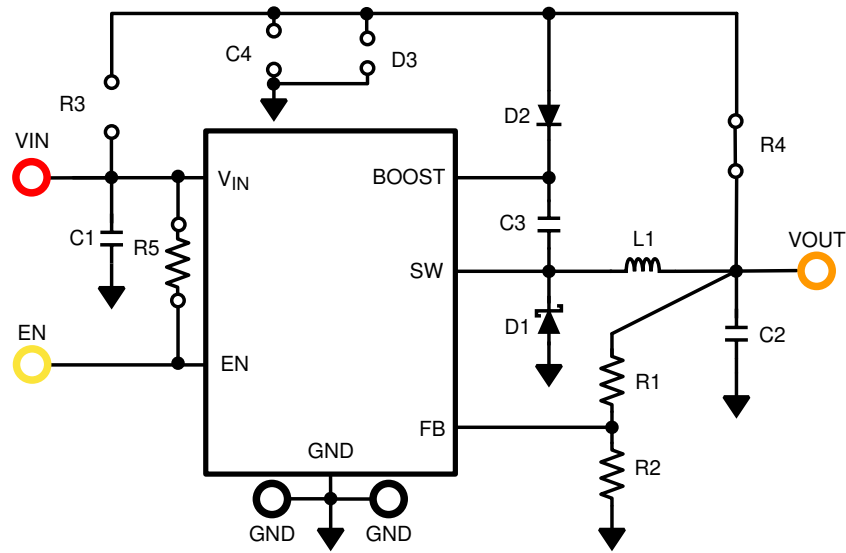## 8 Additional Circuit Configuration Schematics

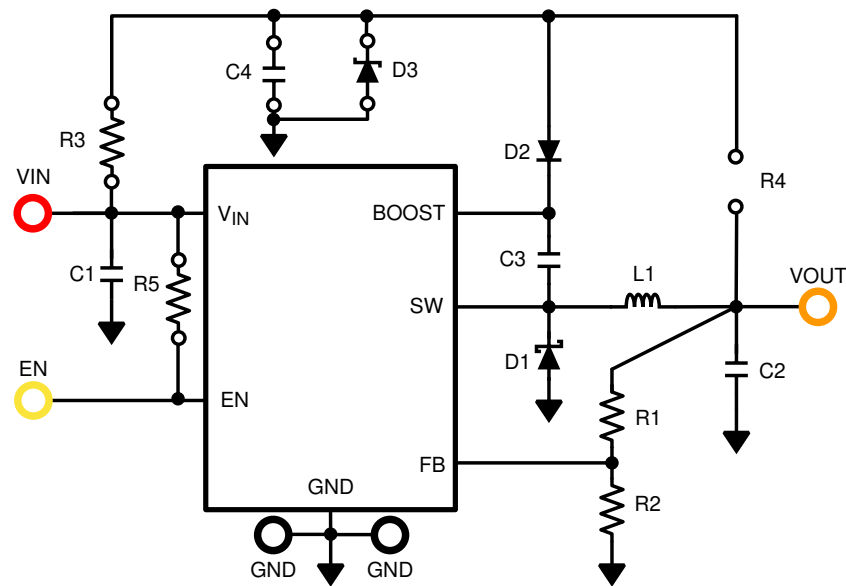**Figure 8-1. V$_{BOOST}$ Derived from V$_{OUT}$**

Figure 8-2. V$_{BOOST}$ Derived from V$_{SHUNT}$
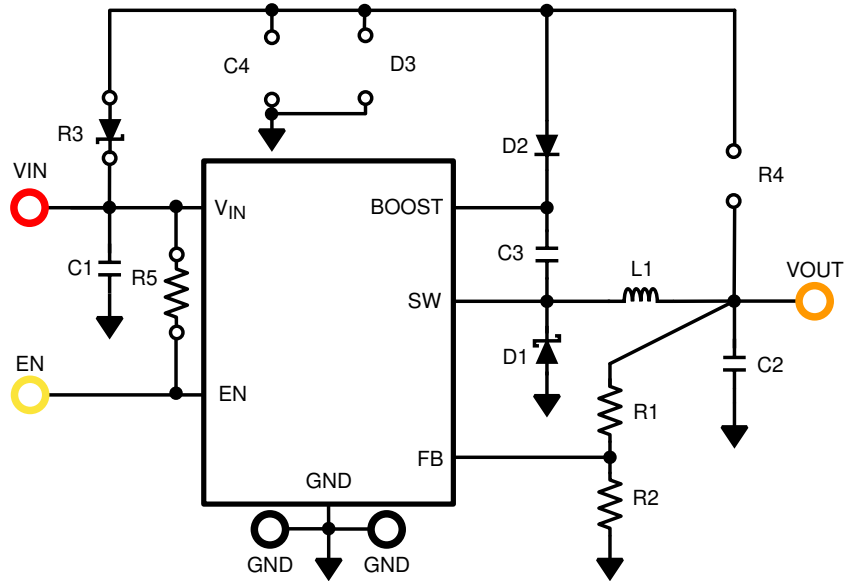
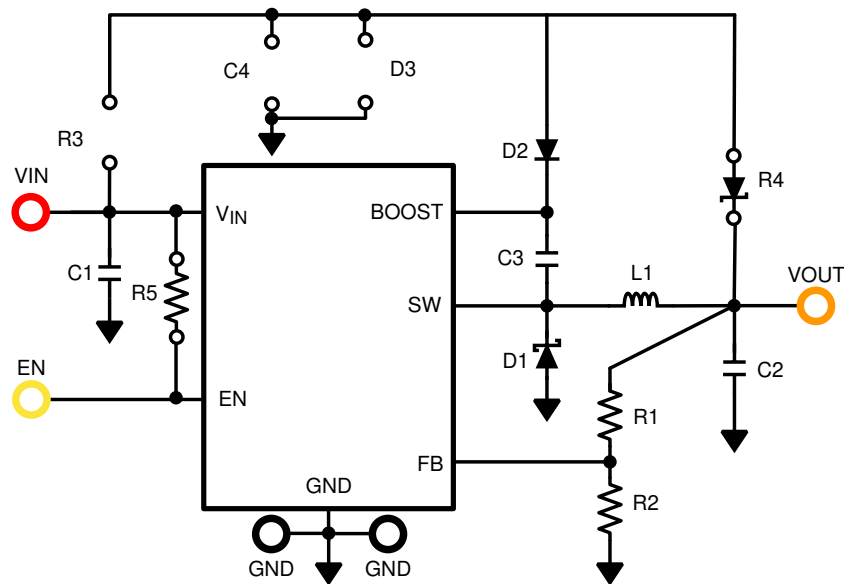**Figure 8-3. V$_{BOOST}$ Derived from Series Zener Diode (V$_{IN}$)**

Figure 8-4. V$_{BOOST}$ Derived from Series Zener Diode (V$_{OUT}$)

9 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision A (April 2013) to Revision B (December 2021)	Page

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