AN-2164 LMR12010 Demo Board

1 Introduction

The LMR12010 is a step down DC-DC regulator that operates at the following switching frequencies: the LMR12010X at 1.6MHz and the LMR12010Y at 3MHz. The demo board is configured to convert 5V input to 1.8V output at 1A 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 5.5V + V_{fD2} using this configuration. This ensures that the voltage between the Boost and SW pins, V_{BOOST} - V_{SW}, does not exceed 5.5V 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* (SNVS731).

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* (SNVS731). Short or leave open the connections as indicated in the schematics. The above restrictions for the input voltage are valid only for the demo board as shipped with the demo board schematic shown in Figure 3

2 Features

- 3.0V to 5V Input Voltage Range (as shipped)
- 1.8V Output Voltage
- Up to 1A Output Current
- Switching Frequency of 3MHz
- Small Solution Size (17mm x 17mm)

3 Enable Operation

The demo board includes a spot for a pull-up resistor R5 (not stuffed) to enable the device once V_{IN} has exceeded 1.8V (typ). A typical value for this resistor is 100KΩ. Otherwise use the EN post to apply a logic signal to test startup 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:

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

Where V_{FB} is 0.8V.

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

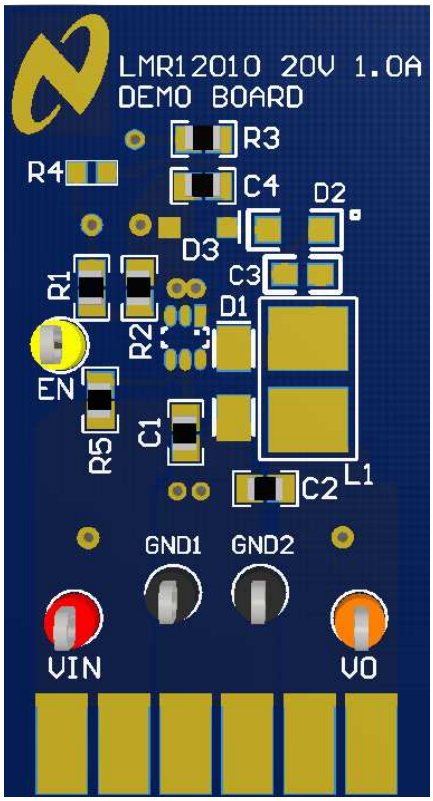


Figure 1. LMR12010 Demo Board Top View

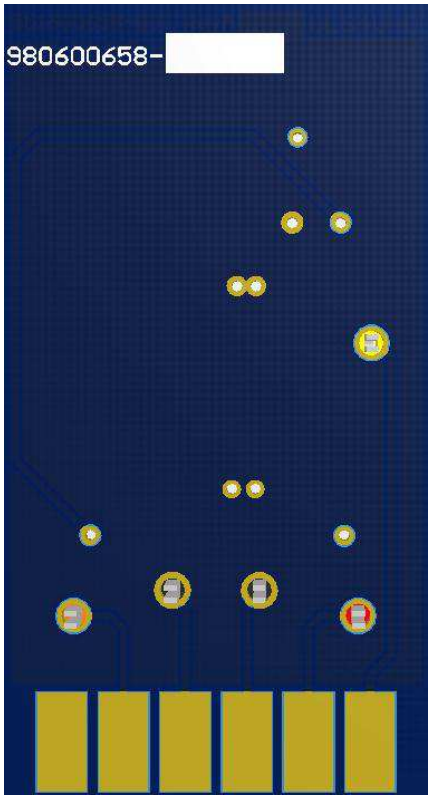


Figure 2. LMR12010 Demo Board Bottom View

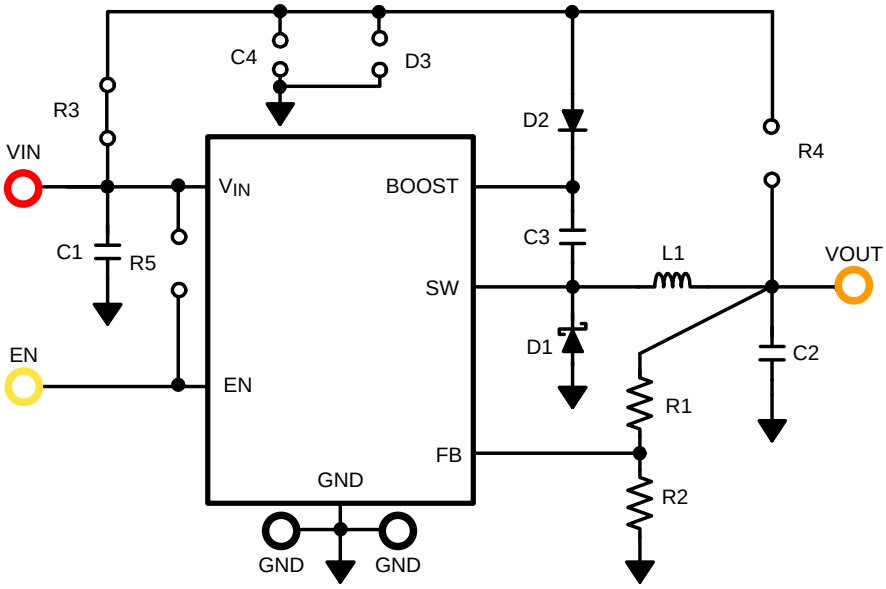


Figure 3. LMR12010Y Demo Board Schematic

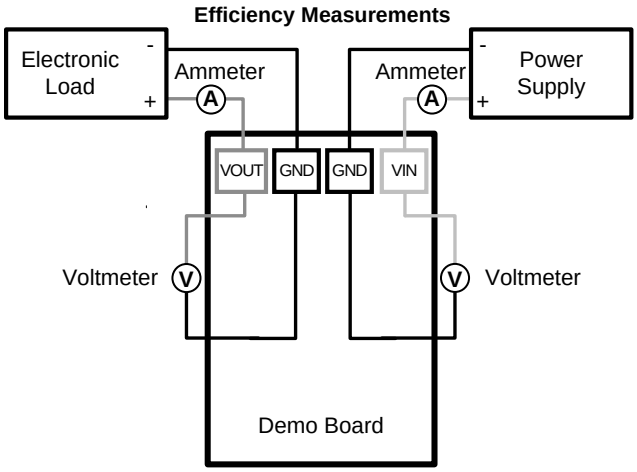
Table 1. Bill of Materials (BOM) for LMR12010Y

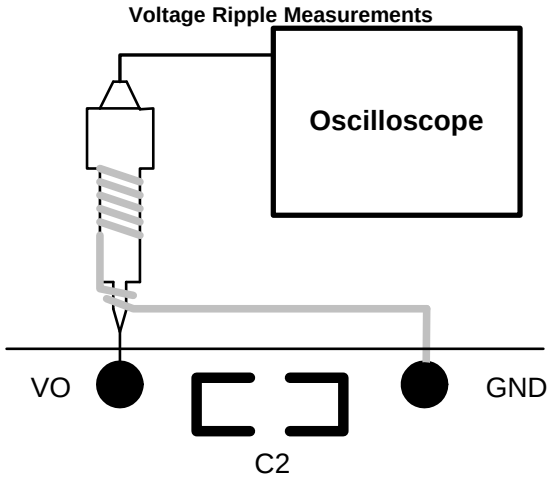
Part ID	Part Value	Manufacturer	Part Number	Package Type
U1	1A Buck Regulator	Texas Instruments	LMR12010	Thin SOT23-6
C1, Input Cap	10µF, 10V, X5R	Murata	GRM316R61A475KE19D	1206
C2, Output Cap	10µF, 6.3V, X5R	Murata	GRM319R60J106KE01D	1206
C3, Boost Cap	0.01µF	Vishay	VJ0805Y103KXAAC	0805
D1, Catch Diode	0.45Vf Schottky 1A, 20VR	Vishay	MBRA120TRPBF	SMA
D2, Boost Diode	1Vf @ 50mA Diode	Diodes, Inc.	1N4148W-7-F	SOD-123
L1	2.7 µH, 1.8A, 33mΩ	TDK	VLCF5028T-2R7N1R8-2	6028
R1	12.4kΩ, 1%	Vishay	CRCW080512K4FKEA	0805
R2	10kΩ, 1%	Vishay	CRCW080510K0FKEA	0805
R3	0Ω	Vishay	CRCW08050000Z0EA	0805
D3, C4, R4, R5	Open			

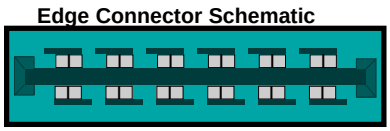
5 Test Setup

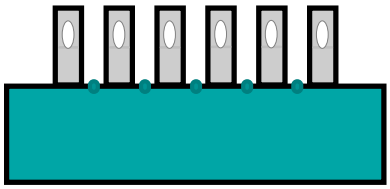
Table 2. Demonstration Board Quick Setup Procedures

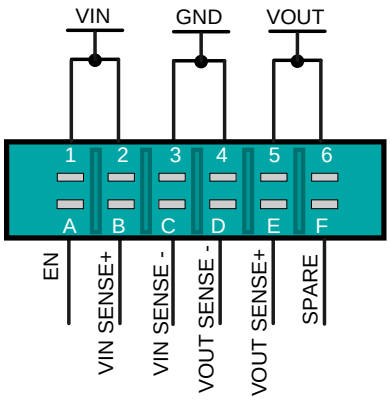
Step	Description	Notes
1	Connect a power supply to VIN terminals	
2	Connect a load to VO terminals	
3	EN should beconnected to VIN for normal operation. Short this to ground to shutdown the part.	
4	Set V_{IN} = 5V, with 0A load applied, check V_O with a voltmeter	Nominal 1.8V
5	Apply a 1A load and check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





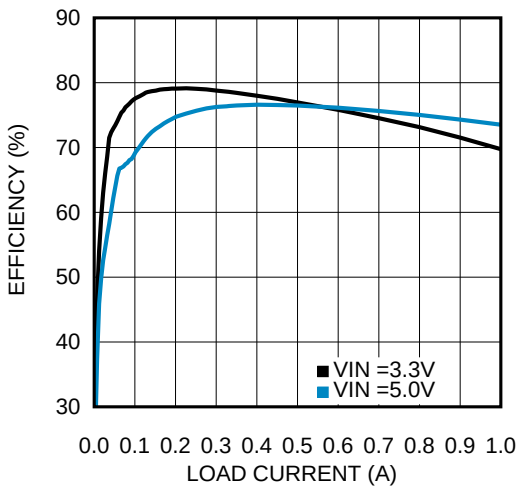




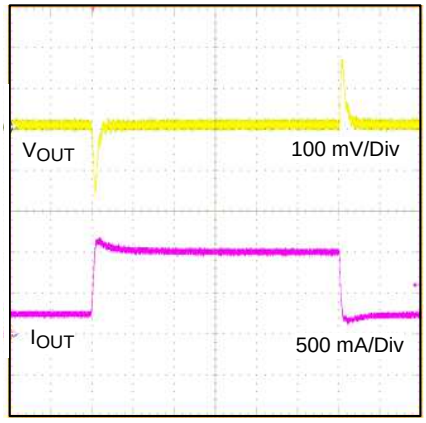


6 Typical Performance Characteristics

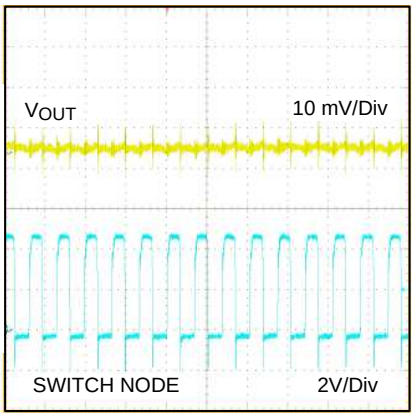
Efficiency vs. Load Current LMR12010Y, VO = 1.8V



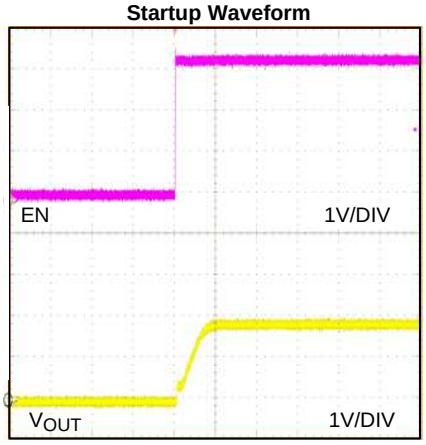
Load Transient Waveforms LMR12010Y IOUT = 100 to 1000mA



Switching Node and Output Voltage Waveforms



Startup Waveform



7 Layout

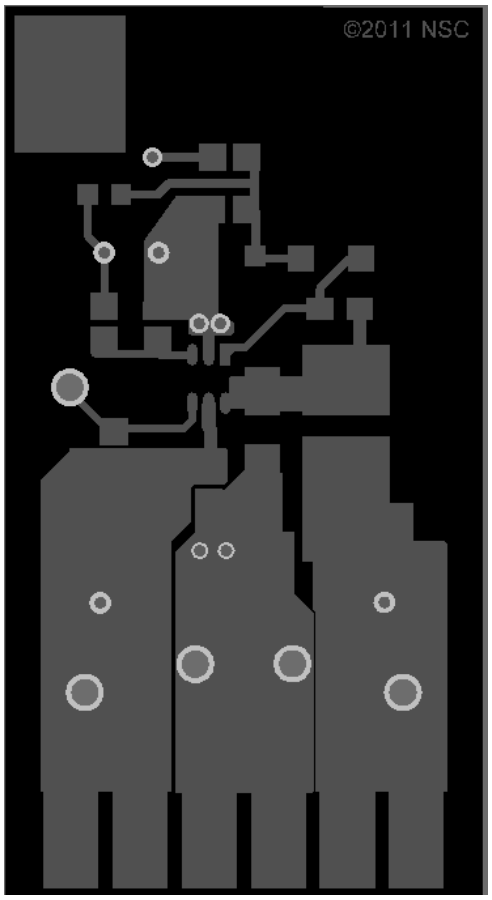


Figure 4. Top Layer

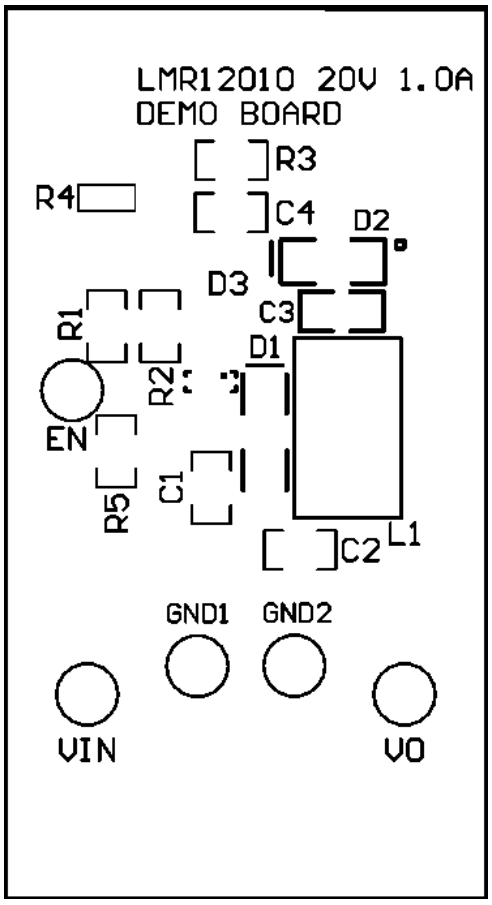


Figure 5. Top Overlay

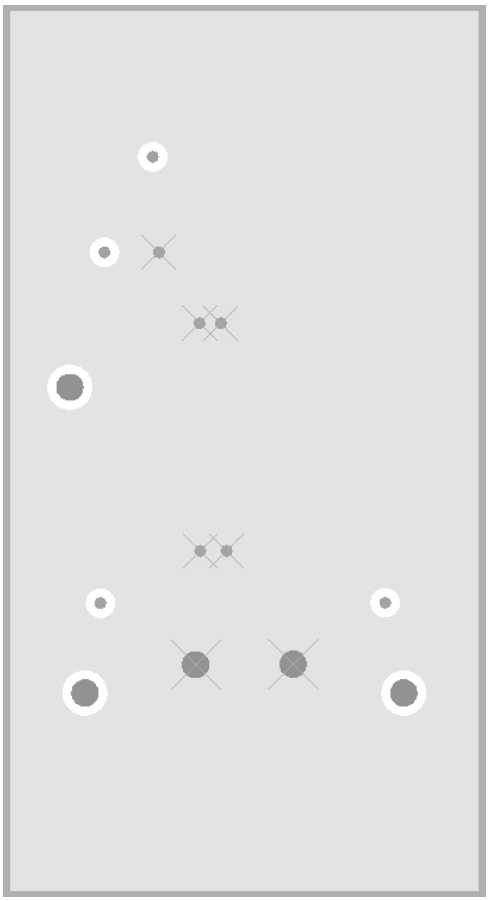


Figure 6. Inner Layer 1

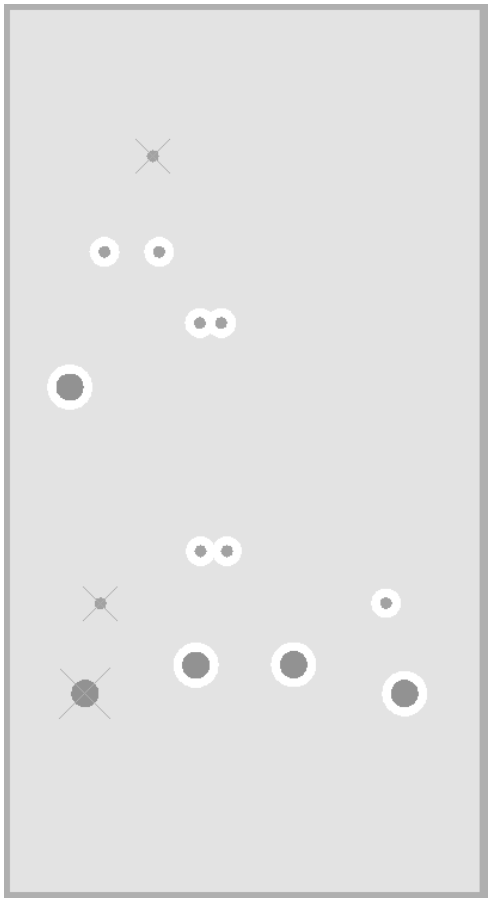


Figure 7. Inner Layer 2

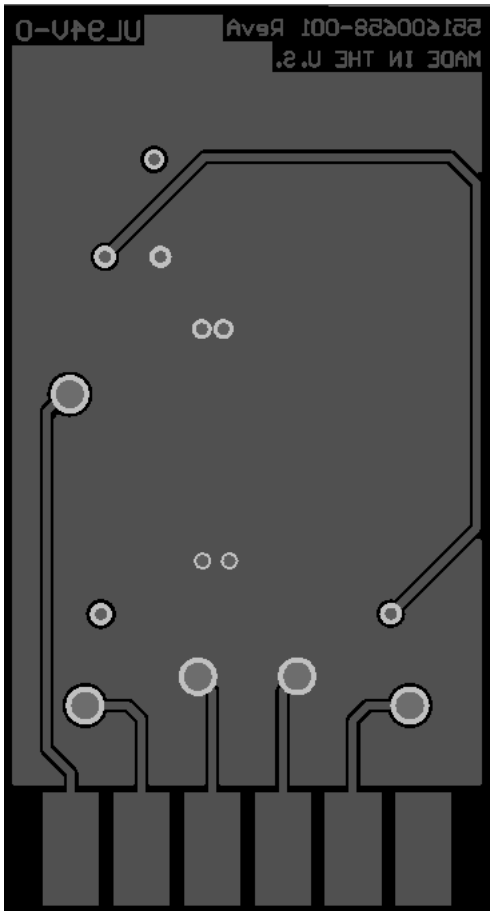


Figure 8. Bottom Layer

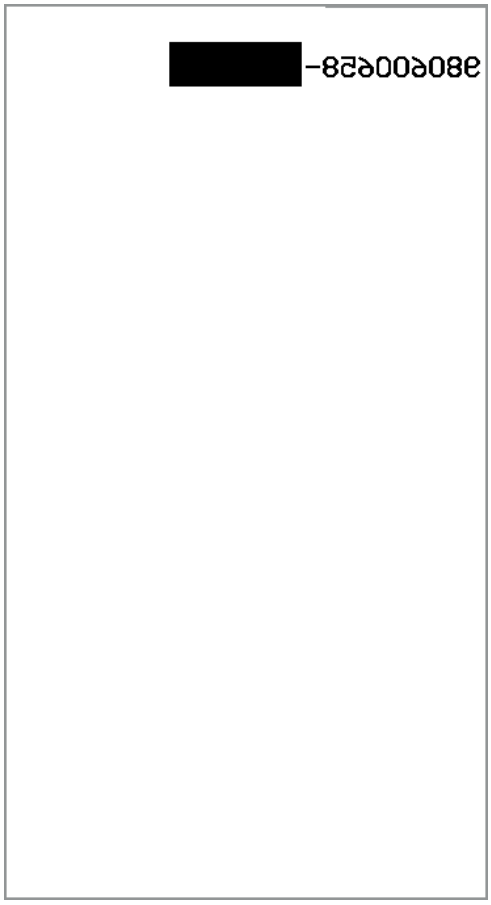


Figure 9. Bottom Overlay

8 Additional Circuit Configuration Schematics

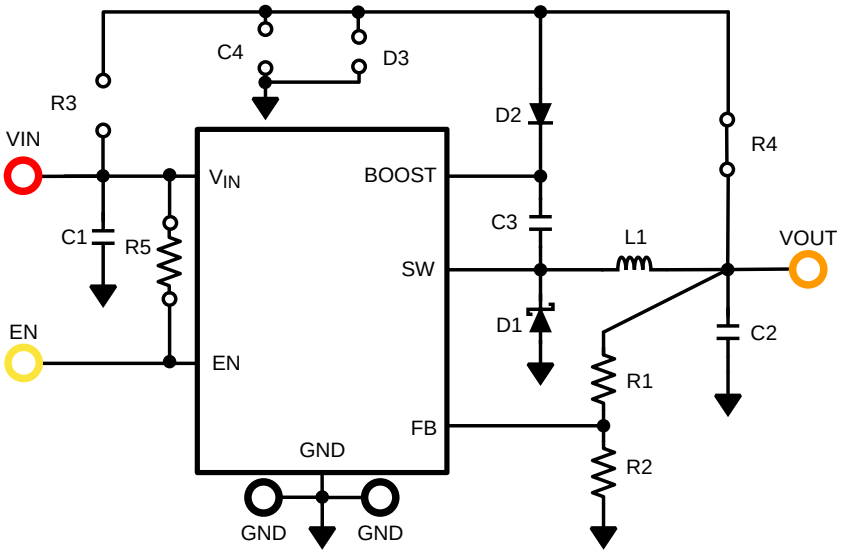


Figure 10. V_{BOOST} Derived from V_{OUT}

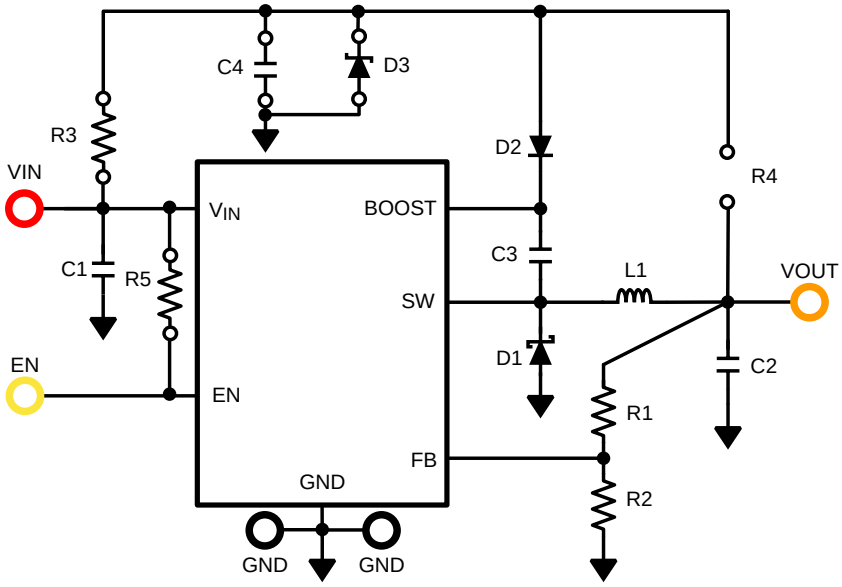


Figure 11. V_{BOOST} Derived from V_{SHUNT}

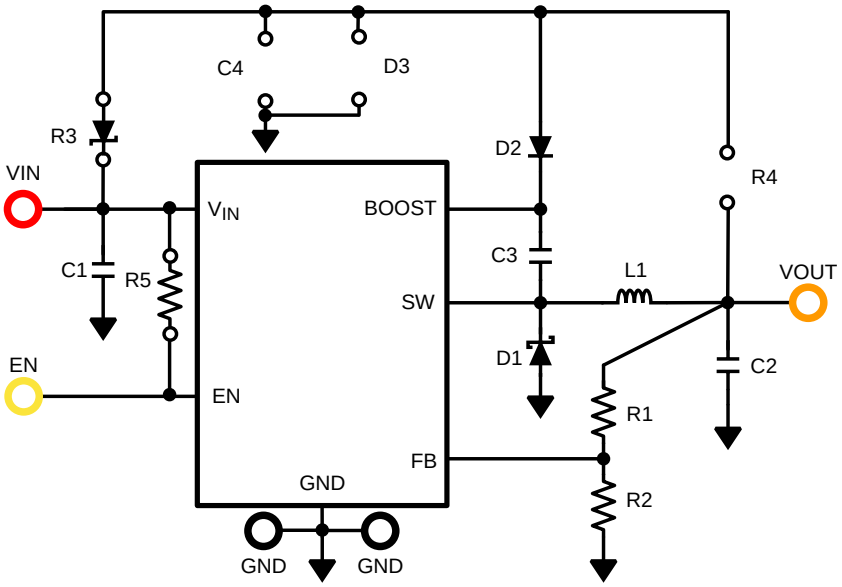


Figure 12. V_{BOOST} Derived from Series Zener Diode (V_{IN})

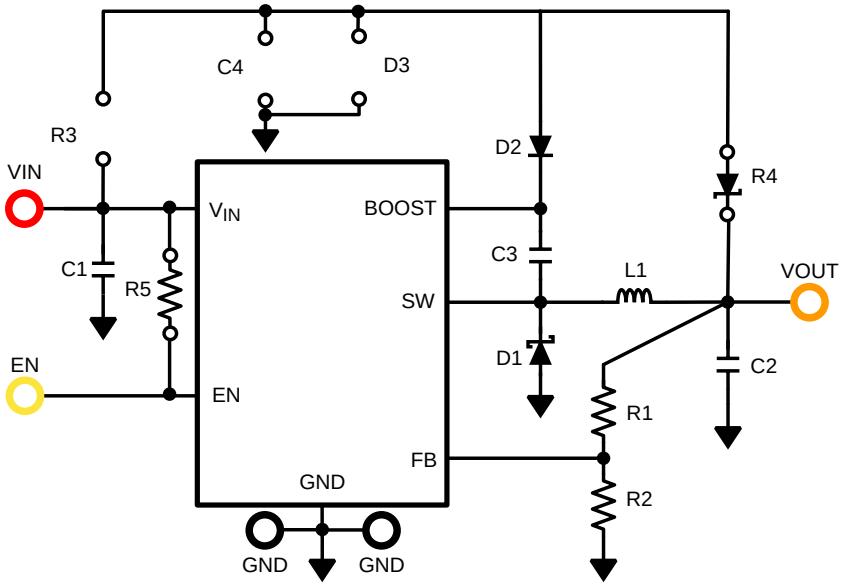


Figure 13. V_{BOOST} Derived from Series Zener Diode (V_{OUT})

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers’ products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers’ products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265