

LM2738 Step-Down Converter Evaluation Module User's Guide



Table of Contents

1 Introduction.....	2
2 Operating Conditions.....	2
3 PCB Layout - WSON.....	4
4 PCB Layout - MSOP-PowerPAD.....	6
5 Additional Circuit Configuration Schematics.....	8
6 Revision History.....	11

List of Figures

Figure 2-1. LM2738 Demo Board Schematic - V_{BOOST} Derived from $V_{OUT} = 3.3\text{ V}$, $V_{IN} = 12\text{ V}$	2
Figure 2-2. Efficiency vs Load Current - $V_{IN} = 12\text{ V}$, $V_{OUT} = 3.3\text{ V}$	2
Figure 3-1. Top Layer.....	4
Figure 3-2. Internal Plane - Layer 2 (GND).....	4
Figure 3-3. Internal Plane - Layer 3 (GND).....	5
Figure 3-4. Bottom Layer.....	5
Figure 4-1. Top Layer.....	6
Figure 4-2. Internal Plane - Layer 2 (GND).....	6
Figure 4-3. Internal Plane - Layer 3 (GND).....	7
Figure 4-4. Bottom Layer.....	7
Figure 5-1. V_{BOOST} Derived from $V_{IN} = 5\text{ V}$, for $V_{OUT} = 1.5\text{ V}$	8
Figure 5-2. V_{BOOST} Derived from V_{SHUNT} Coming from $V_{IN} = 18\text{ V}$, $V_{OUT} = 1.5\text{ V}$	9
Figure 5-3. V_{BOOST} Derived from Series Zener Diode from $V_{IN} = 15\text{ V}$, $V_{OUT} = 1.5\text{ V}$	10
Figure 5-4. V_{BOOST} Derived from Series Zener Diode from $V_{OUT} = 9\text{ V}$, $V_{IN} = 15\text{ V}$	11

List of Tables

Table 2-1. Bill of Materials X-Version (1.6 MHz).....	3
Table 2-2. Bill of Materials Y-Version (550 kHz).....	3
Table 5-1. Bill of Materials X-Version (1.6 MHz).....	8
Table 5-2. Bill of Materials Y-Version (550 kHz).....	8
Table 5-3. Bill of Materials X-Version (1.6 MHz).....	9
Table 5-4. Bill of Materials Y-Version (550 kHz).....	9
Table 5-5. Bill of Materials X-Version (1.6 MHz).....	10
Table 5-6. Bill of Materials Y-Version (550 kHz).....	10
Table 5-7. Bill of Materials X-Version (1.6 MHz).....	11
Table 5-8. Bill of Materials Y-Version (550 kHz).....	11

Trademarks

All trademarks are the property of their respective owners.

1 Introduction

The LM2738 demo board is configured to convert 12-V input to 3.3-V output at 1.5-A load current using the LM2738X 1.6-MHz or the LM2738Y 550-kHz step down DC-DC regulator. The tiny low profile MSOP-PowerPAD-8 and WSON-8 packages allows the demo board to be manufactured using just over one square inch of a 4-layer printed circuit board.

The circuit is configured with the boost diode connected to V_{OUT} , and according to the data sheet, V_{OUT} must not exceed the maximum operating limit of $5.5\text{ V} + V_{FD2}$ 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. Please see the [LM2738 550kHz/1.6MHz 1.5A Step-Down DC-DC Switching Regulator](#) data sheet for more information regarding this requirement.

A bill of materials describes the parts used on this demo board. A schematic and layout have also been included along with measured performance characteristics. The schematics at the end of this document show how to re-configure this demo board for various input and output conditions as discussed in the [LM2738 550kHz/1.6MHz 1.5A Step-Down DC-DC Switching Regulator](#) data sheet. Short or leave open the indicated connection 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 (see [Figure 2-1](#)).

2 Operating Conditions

- $V_{IN} = 12\text{ V}$
- $V_O = 3.3\text{ V}$
- $I_O = 1.5\text{ A}$

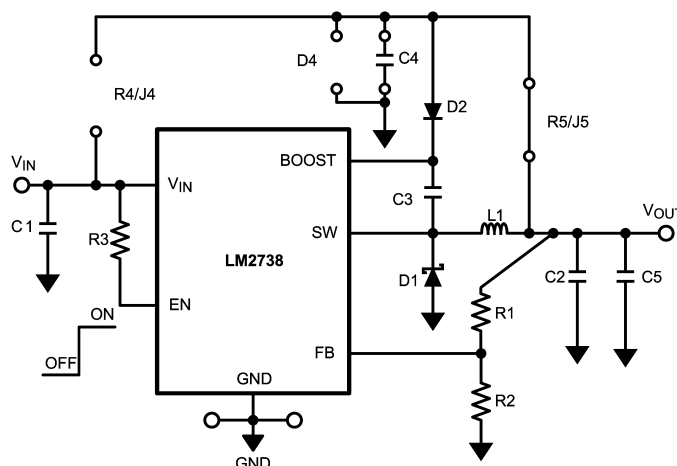


Figure 2-1. LM2738 Demo Board Schematic - V_{BOOST} Derived from $V_{OUT} = 3.3\text{ V}$, $V_{IN} = 12\text{ V}$

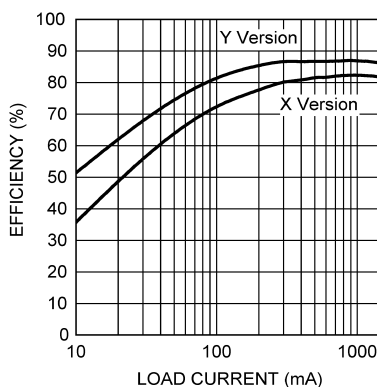


Figure 2-2. Efficiency vs Load Current - $V_{IN} = 12\text{ V}$, $V_{OUT} = 3.3\text{ V}$

Table 2-1. Bill of Materials X-Version (1.6 MHz)

Part ID	Part Value	Manufacturer	Part Number	Package Type
C1, Input Cap	10 μ F, 25 V, X7R	TDK	C3216X5R1E106	1206
C2, C5, Output Cap	22 μ F, 10 V, X5R	TDK	C3216X5R1A226	1206
C3 (Boost Cap), C4	0.1 μ F	TDK	C2012X7R1A104	0805
D2, Boost Diode	1 V _F at 100-mA Diode	Diodes, Inc.	BAT54WS-TP	SOD-323
R2, R3	10 k Ω , 1%	Vishay	CRCW12061002F	0805
U1	1.5-A Buck Regulator	Texas Instruments	LM2738	WSO8-8
			LM2738	MSOP-PowerPAD-8
D1, Catch Diode	0.34-V _F Schottky, 1.5 A, 30 VR	Toshiba	CRS08	-
L1	5.0 μ H, 2.9 A	Coilcraft	MSS7341-502NL	-
R1	31.6 k Ω , 1%	Vishay	CRCW12063162F	0805
R5	0 Ω	Vishay	CRCW12060R00F	0805
D4, R4	Open or No Load			

Table 2-2. Bill of Materials Y-Version (550 kHz)

Part ID	Part Value	Manufacturer	Part Number	Package Type
C1, Input Cap	10 μ F, 25 V, X7R	TDK	C3216X5R1E106	1206
C2, C5, Output Cap	22 μ F, 10 V, X5R	TDK	C3216X5R1A226	1206
C3 (Boost Cap), C4	0.1 μ F	TDK	C2012X7R1A104	0805
D2, Boost Diode	1 V _F at 100 mA Diode	Diodes, Inc.	BAT54WS-TP	SOD-323
R2, R3	10 k Ω , 1%	Vishay	CRCW12061002F	0805
U1	1.5-A Buck Regulator	Texas Instruments	LM2738	WSO8-8
			LM2738	MSOP-PowerPAD-8
D1, Catch Diode	0.34 V _F Schottky, 1.5 A, 30 VR	Toshiba	CRS08	-
L1	10.0 μ H, 2.0 A	Coilcraft	MSS7341-103NL	-
R1	31.6 k Ω , 1%	Vishay	CRCW12063162F	0805
R5	0 Ω	Vishay	CRCW12060R00F	0805
D4, R4	Open or No Load			

3 PCB Layout - WSON

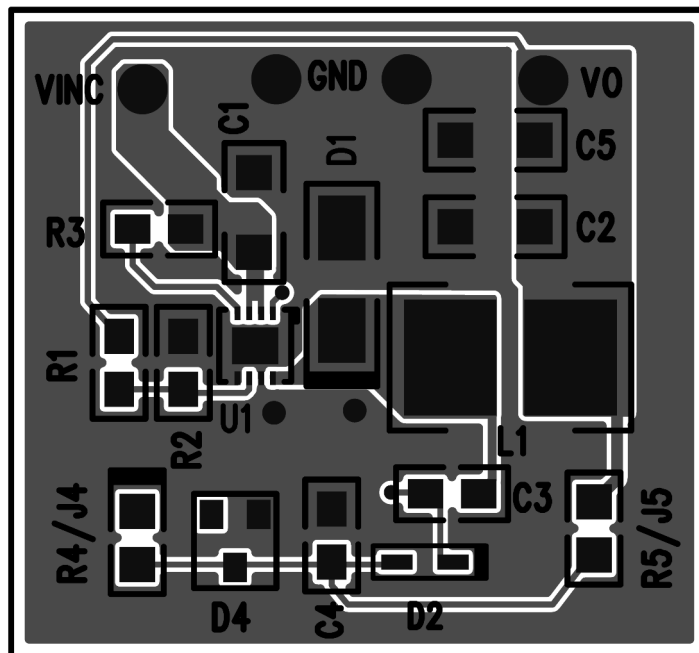


Figure 3-1. Top Layer

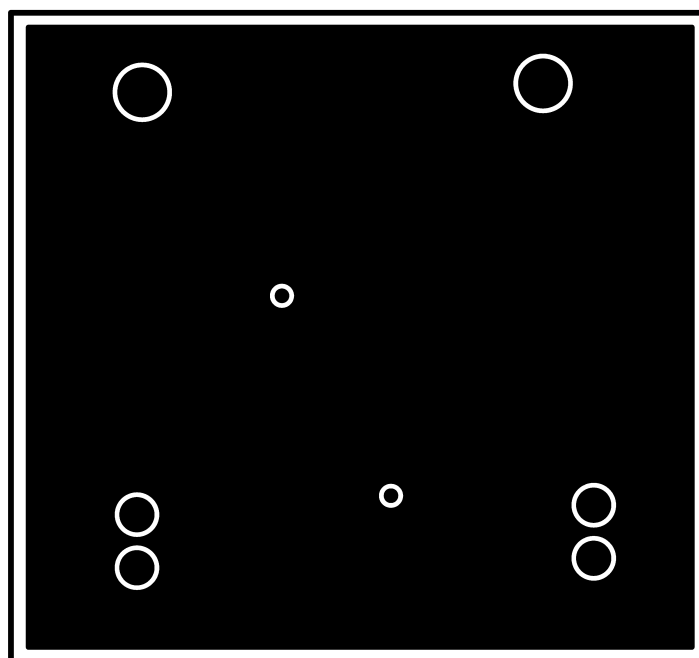


Figure 3-2. Internal Plane - Layer 2 (GND)

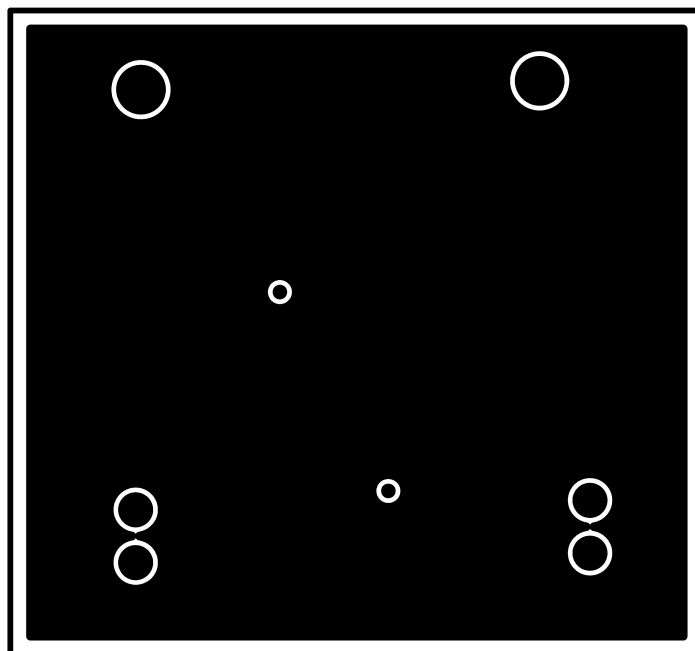


Figure 3-3. Internal Plane - Layer 3 (GND)

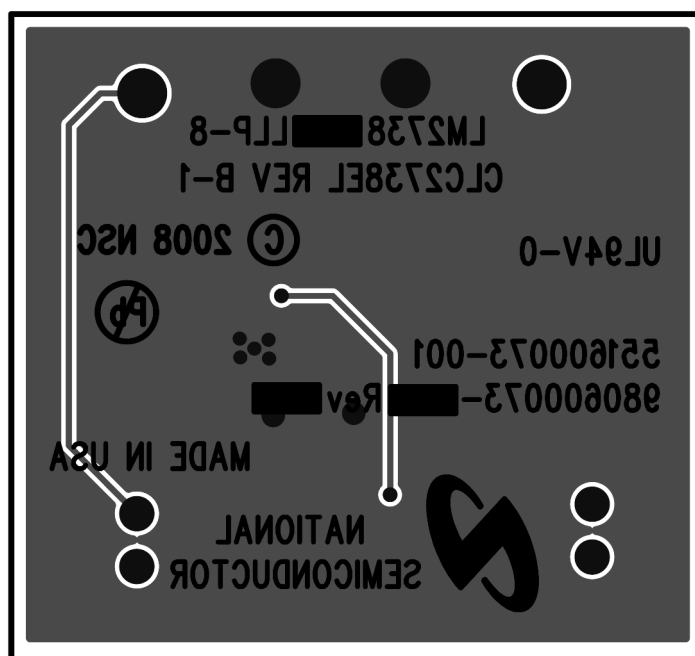


Figure 3-4. Bottom Layer

4 PCB Layout - MSOP-PowerPAD

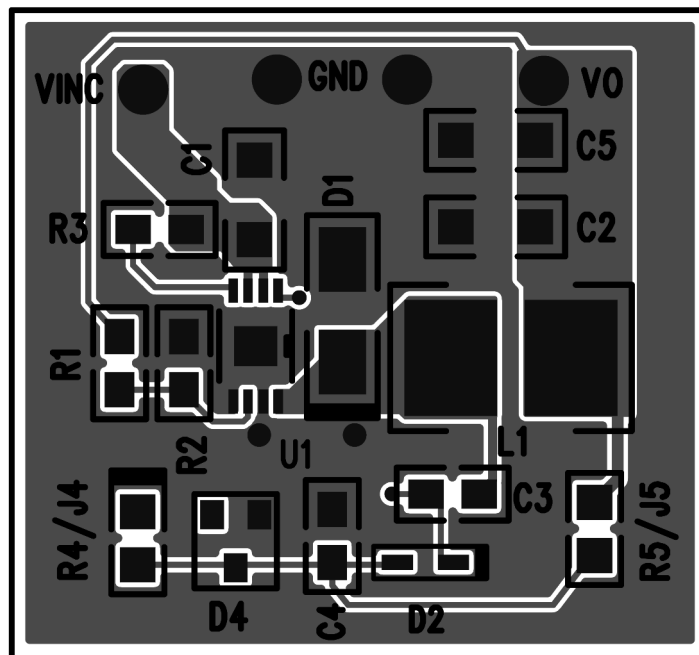


Figure 4-1. Top Layer

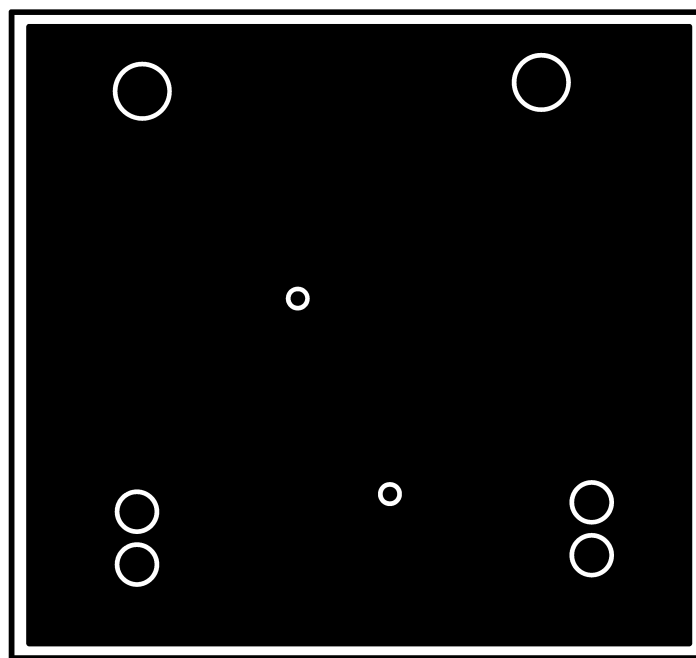


Figure 4-2. Internal Plane - Layer 2 (GND)

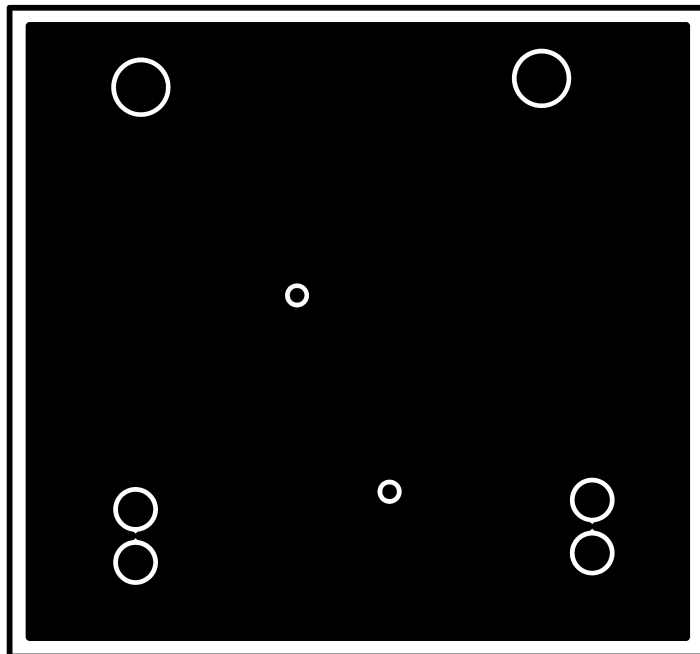


Figure 4-3. Internal Plane - Layer 3 (GND)

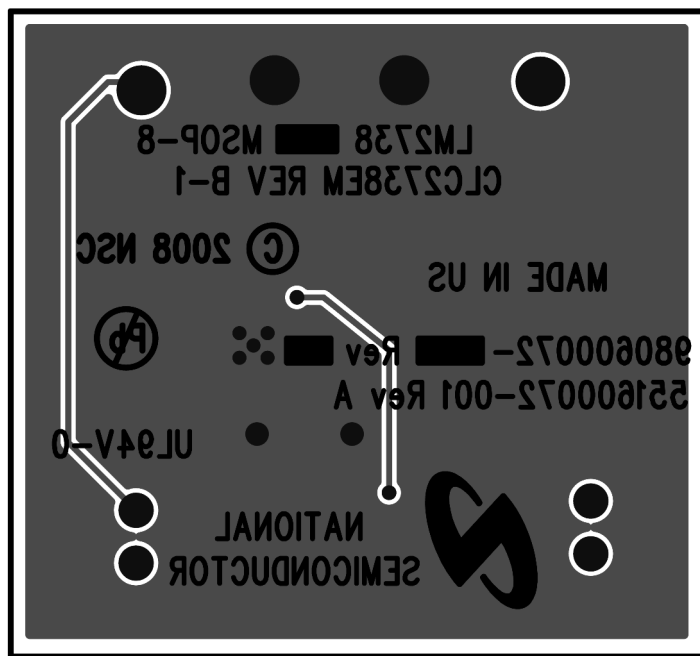


Figure 4-4. Bottom Layer

5 Additional Circuit Configuration Schematics

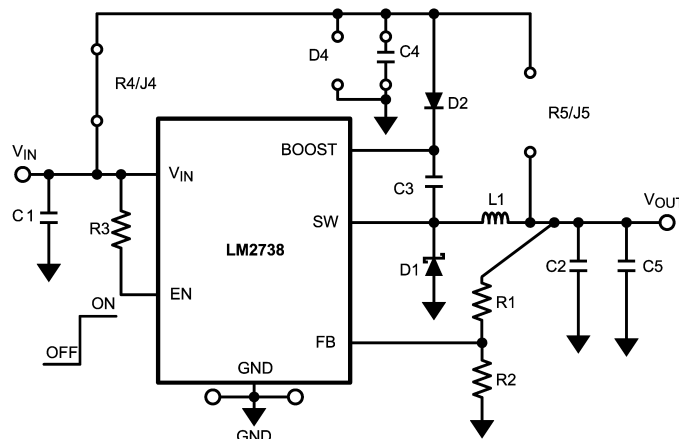


Figure 5-1. V_{BOOST} Derived from $V_{IN} = 5\text{ V}$, for $V_{OUT} = 1.5\text{ V}$

Table 5-1. Bill of Materials X-Version (1.6 MHz)

Part ID	Part Value	Manufacturer	Part Number	Package Type
C1, Input Cap	10 μF , 25 V, X7R	TDK	C3216X5R1E106	1206
C2, Output Cap	22 μF , 6.3 V, X5R	TDK	C3216X5R0J2266	1206
C3 (Boost Cap), C4	0.1 μF	TDK	C2012X7R1A104	0805
D2, Boost Diode	1 V_F at 100-mA Diode	Diodes, Inc.	BAT54WS-TP	SOD-323
R2, R3	10 k Ω , 1%	Vishay	CRCW12061002F	0805
U1	1.5-A Buck Regulator	Texas Instruments	LM2738	WSO-8
			LM2738	MSOP-PowerPAD-8
D1, Catch Diode	0.34 V_F Schottky, 1.5 A, 30 V	Toshiba	CRS08	-
L1	2.2 μH , 1.9A	Coilcraft	MSS5131-222ML	-
R1	8.87 k Ω , 1%	Vishay	CRCW12068871F	0805
R4	0 Ω	Vishay	CRCW12060R00F	0805
D4, R5, C5	Open or No Load			

Table 5-2. Bill of Materials Y-Version (550 kHz)

Part ID	Part Value	Manufacturer	Part Number	Package Type
C1, Input Cap	10 μF , 25 V, X7R	TDK	C3216X5R1E106	1206
C2, C5, Output Caps	22 μF , 6.3 V, X5R	TDK	C3216X5R0J2266	1206
C3 (Boost Cap), C4	0.1 μF	TDK	C2012X7R1A104	0805
D2, Boost Diode	1 V_F at 100-mA Diode	Diodes, Inc.	BAT54WS-TP	SOD-323
R2, R3	10 k Ω , 1%	Vishay	CRCW12061002F	0805
U1	1.5-A Buck Regulator	Texas Instruments	LM2738	WSO-8
			LM2738	MSOP-PowerPAD-8
D1, Catch Diode	0.34 V_F Schottky, 1.5 A, 30 V	Toshiba	CRS08	-
L1	6.2 μH , 2.5 A	Coilcraft	MSS7341-622NL	-
R1	8.87 k Ω , 1%	Vishay	CRCW12068871F	0805
R4	0 Ω	Vishay	CRCW12060R00F	0805
D4, R5	Open or No Load			

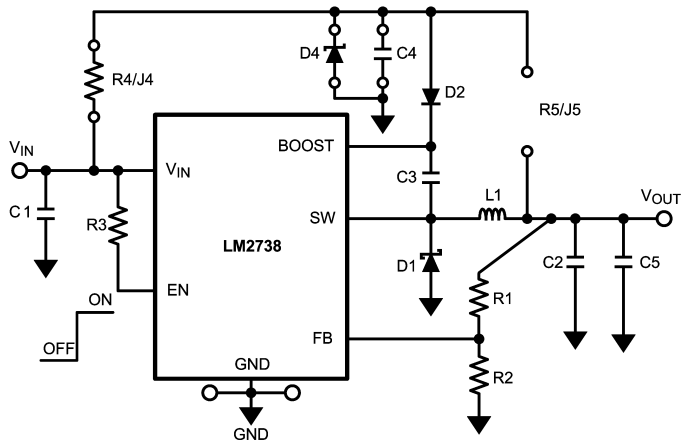


Figure 5-2. V_{BOOST} Derived from V_{SHUNT} Coming from $V_{IN} = 18\text{ V}$, $V_{OUT} = 1.5\text{ V}$

Table 5-3. Bill of Materials X-Version (1.6 MHz)

Part ID	Part Value	Manufacturer	Part Number	Package Type
C1, Input Cap	10 μF , 25V, X7R	TDK	C3216X5R1E106	1206
C2, C5, Output Caps	22 μF , 6.3V, X5R	TDK	C3216X5R0J226	1206
C3 (Boost Cap), C4	0.1 μF	TDK	C2012X7R1A104	0805
D2, Boost Diode	1 V_F at 100-mA Diode	Diodes, Inc.	BAT54WS-TP	SOD-323
D4, Zener	5.1 V, 200 mW	Diodes, Inc.	BZX84C5V1W	SOT-323
R2, R3	10 k Ω , 1%	Vishay	CRCW12061002F	0805
U1	1.5-A Buck Regulator	Texas Instruments	LM2738	WSO8-8
			LM2738	MSOP-PowerPAD-8
D1, Catch Diode	0.34 V_F Schottky, 1.5 A, 30 V	Toshiba	CRS08	-
L1	2.7 μH , 1.76 A	TDK	VLCF5020T-2R7N1R7	-
R1	8.87 k Ω , 1%	Vishay	CRCW12068871F	0805
R4	4.12 k Ω , 1%	Vishay	CRCW12064121F	0805
R5	Open or No Load			

Table 5-4. Bill of Materials Y-Version (550 kHz)

Part ID	Part Value	Manufacturer	Part Number	Package Type
C1, Input Cap	10 μF , 25 V, X7R	TDK	C3216X5R1E106	1206
C2, C5, Output Caps	47 μF , 6.3 V, X5R	TDK	C3216X5R0J476	1206
C3 (Boost Cap), C4	0.1 μF	TDK	C2012X7R1A104	0805
D2, Boost Diode	1 V_F at 100-mA Diode	Diodes, Inc.	BAT54WS-TP	SOD-323
D4, Zener	5.1 V, 200 mW	Diodes, Inc.	BZX84C5V1W	SOT-323
R2, R3	10 k Ω , 1%	Vishay	CRCW12061002F	0805
U1	1.5-A Buck Regulator	Texas Instruments	LM2738	WSO8-8
			LM2738	MSOP-PowerPAD-8
D1, Catch Diode	0.34 V_F Schottky, 1.5 A, 30 V	Toshiba	CRS08	-
L1	8.7 μH , 2.2 A	Coilcraft	MSS7341-872NL	-
R1	8.87 k Ω , 1%	Vishay	CRCW12068871F	0805
R4	4.21 k Ω , 1%	Vishay	CRCW12064211F	0805
R5	Open or No Load			

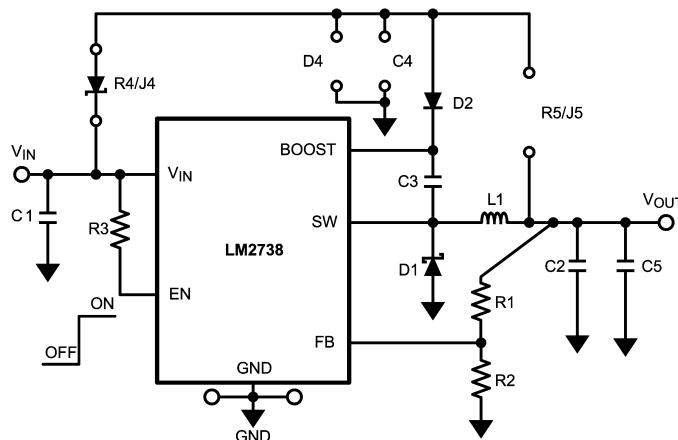


Figure 5-3. V_{BOOST} Derived from Series Zener Diode from $V_{IN} = 15\text{ V}$, $V_{OUT} = 1.5\text{ V}$

Table 5-5. Bill of Materials X-Version (1.6 MHz)

Part ID	Part Value	Manufacturer	Part Number	Package Type
C1, Input Cap	10 μF , 25 V, X7R	TDK	C3216X5R1E106	1206
C2, C5, Output Caps	22 μF , 6.3 V, X5R	TDK	C3216X5R0J226	1206
C3 (Boost Cap)	0.1 μF	TDK	C2012X7R1A104	0805
D2, Boost Diode	1 V_F at 100-mA Diode	Diodes, Inc.	BAT54WS-TP	SOD-323
R2, R3	10 k Ω , 1%	Vishay	CRCW12061002F	0805
U1	1.5-A Buck Regulator	Texas Instruments	LM2738	WSO-8
			LM2738	MSOP-PowerPAD-8
D1, Catch Diode	0.34 V_F Schottky, 1.5 A, 30 V	Toshiba	CRS08	-
L1	3.3 μH , 3.5 A	Coilcraft	MSS7341-332NL	-
R1	8.87 k Ω , 1%	Vishay	CRCW12068871F	0805
R4	11 V, 200 mW, Zener	Vishay	BZX384C11-V	SOD-323
D4, R5, C4	Open or No Load			

Table 5-6. Bill of Materials Y-Version (550 kHz)

Part ID	Part Value	Manufacturer	Part Number	Package Type
C1, Input Cap	10 μF , 25 V, X7R	TDK	C3216X5R1E106	1206
C2, C5, Output Caps	47 μF , 6.3 V, X5R	TDK	C3216X5R0J476	1206
C3 (Boost Cap)	0.1 μF	TDK	C2012X7R1A104	0805
D2, Boost Diode	1 V_F at 100-mA Diode	Diodes, Inc.	BAT54WS-TP	SOD-323
R2, R3	10 k Ω , 1%	Vishay	CRCW12061002F	0805
U1	1.5-A Buck Regulator	Texas Instruments	LM2738	WSO-8
			LM2738	MSOP-PowerPAD-8
D1, Catch Diode	0.34 V_F Schottky, 1.5 A, 30 V	Toshiba	CRS08	-
L1	8.7 μH , 2.2 A	Coilcraft	MSS7341-872NL	-
R1	8.87 k Ω , 1%	Vishay	CRCW12068871F	0805
R4	11 V, 200 mW, Zener	Vishay	BZX384C11-V	SOD-323
D4, R5, C4	Open or No Load			

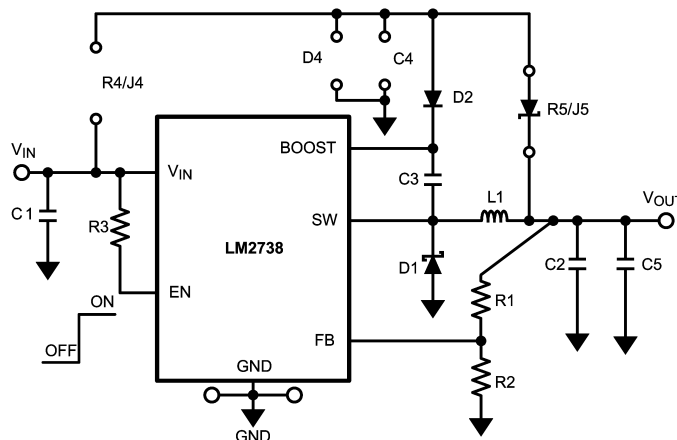


Figure 5-4. V_{BOOST} Derived from Series Zener Diode from $V_{OUT} = 9\text{ V}$, $V_{IN} = 15\text{ V}$

Table 5-7. Bill of Materials X-Version (1.6 MHz)

Part ID	Part Value	Manufacturer	Part Number	Package Type
C1, Input Cap	10 μF , 25 V, X7R	TDK	C3216X5R1E106	1206
C2, Output Cap	22 μF , 10 V, X5R	TDK	C3216X5R1A226	1206
C3 (Boost Cap), C4	0.1 μF	TDK	C2012X7R1A104	0805
D2, Boost Diode	1 V_F at 100-mA Diode	Diodes, Inc.	BAT54WS-TP	SOD-323
R2, R3	10 k Ω , 1%	Vishay	CRCW12061002F	0805
U1	1.5-A Buck Regulator	Texas Instruments	LM2738	WSO-8
			LM2738	MSOP-PowerPAD-8
D1, Catch Diode	0.34 V_F Schottky, 1.5 A, 30 V	Toshiba	CRS08	-
L1	6.2 μH , 2.5 A	Coilcraft	MSS7341-622NL	-
R1	102 k Ω , 1%	Vishay	CRCW1206123F	0805
R5	4.3 V, 200 mW, Zener	Vishay	BZX384C4V3-V	SOD-323
D4, R4	Open or No Load			

Table 5-8. Bill of Materials Y-Version (550 kHz)

Part ID	Part Value	Manufacturer	Part Number	Package Type
C1, Input Cap	10 μF , 25 V, X7R	TDK	C3216X5R1E106	1206
C2, Output Cap	22 μF , 10 V, X5R	TDK	C3216X5R1A226	1206
C3 (Boost Cap), C4	0.1 μF	TDK	C2012X7R1A104	0805
D2, Boost Diode	1 V_F at 100-mA Diode	Diodes, Inc.	BAT54WS-TP	SOD-323
R2, R3	10 k Ω , 1%	Vishay	CRCW12061002F	0805
U1	1.5-A Buck Regulator	Texas Instruments	LM2738	WSO-8
			LM2738	MSOP-PowerPAD-8
D1, Catch Diode	0.34 V_F Schottky, 1.5 A, 30V	Toshiba	CRS08	-
L1	5.0 μH , 2.9 A	Coilcraft	MSS7341-502NL	-
R1	102 k Ω , 1%	Vishay	CRCW12061023F	0805
R5	4.3 V, 200 mW, Zener	Vishay	BZX384C4V3-V	SOD-323
D4, R4	Open or No Load			

6 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

- Updated the numbering format for tables, figures, and cross-references throughout the document.2

Revision History

• Updated the user's guide title.....	2
• Edited user's guide for clarity.....	2

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#) or other applicable terms available either on [ti.com](#) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2022, Texas Instruments Incorporated