

LM2738 Evaluation Board

[查询LM2738供应商](#)

National Semiconductor
Application Note 1837
Francis Houde
April 10, 2008



Introduction

The LM2738 demo board is configured to convert 12V input to 3.3V output at 1.5A load current using the LM2738X 1.6MHz or the LM2738Y 550kHz step down DC-DC regulator. The tiny low profile eMSOP-8 and LLP-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 datasheet, V_{OUT} must not exceed the maximum operating limit of $5.5V + V_{FD2}$ using this configuration. This will ensure that the voltage between the Boost and SW pins, $V_{BOOST} - V_{SW}$, does not exceed 5.5V for proper operation. Please see the LM2738 datasheet for more information regarding this requirement.

A bill of materials below describes the parts used on this demo board. A schematic and layout have also been included below

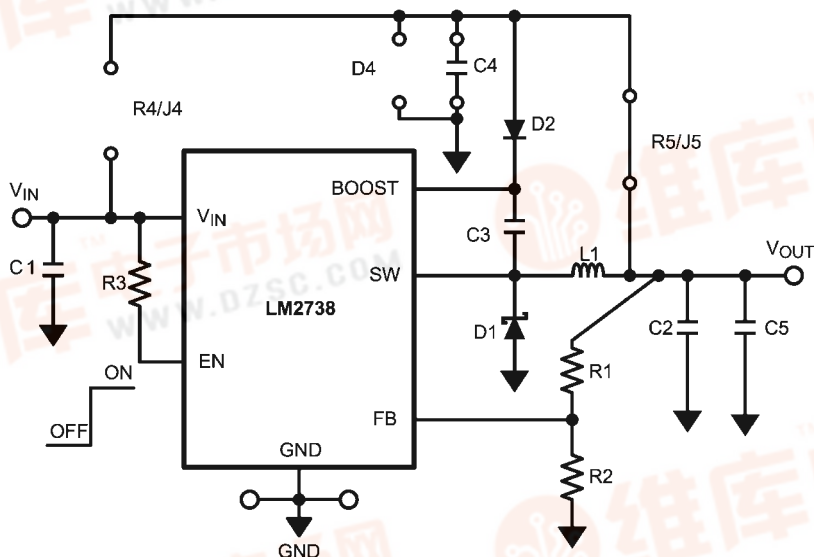
along with measured performance characteristics. The schematics at the end of this document show how to re-configure this demo board for various input and output conditions as discussed in the LM2738 datasheet. Short or leave open the indicated connection as indicated in the schematics. The above restrictions for the input voltage are valid only for the demo board as shipped with the demo board schematic below.

Operating Conditions

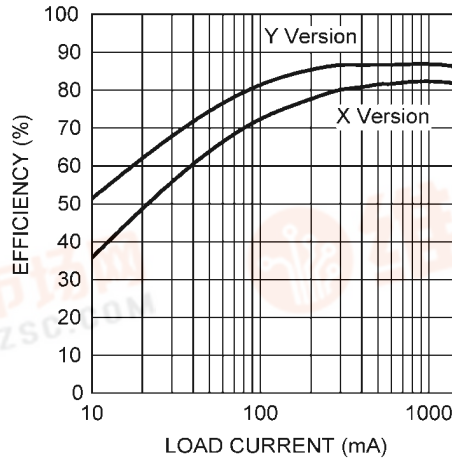
$$V_{IN} = 12V$$

$$V_O = 3.3V$$

$$I_O = 1.5A$$



LM2738 Demo Board Schematic - V_{BOOST} derived from $V_{OUT} = 3.3V$, $V_{IN} = 12V$ ³⁰⁰⁶¹⁴²⁶

[查询LM2738供应商](#)

 Efficiency vs Load Current - $V_{IN} = 12V$, $V_{OUT} = 3.3V$ ³⁰⁰⁶¹⁴¹⁹

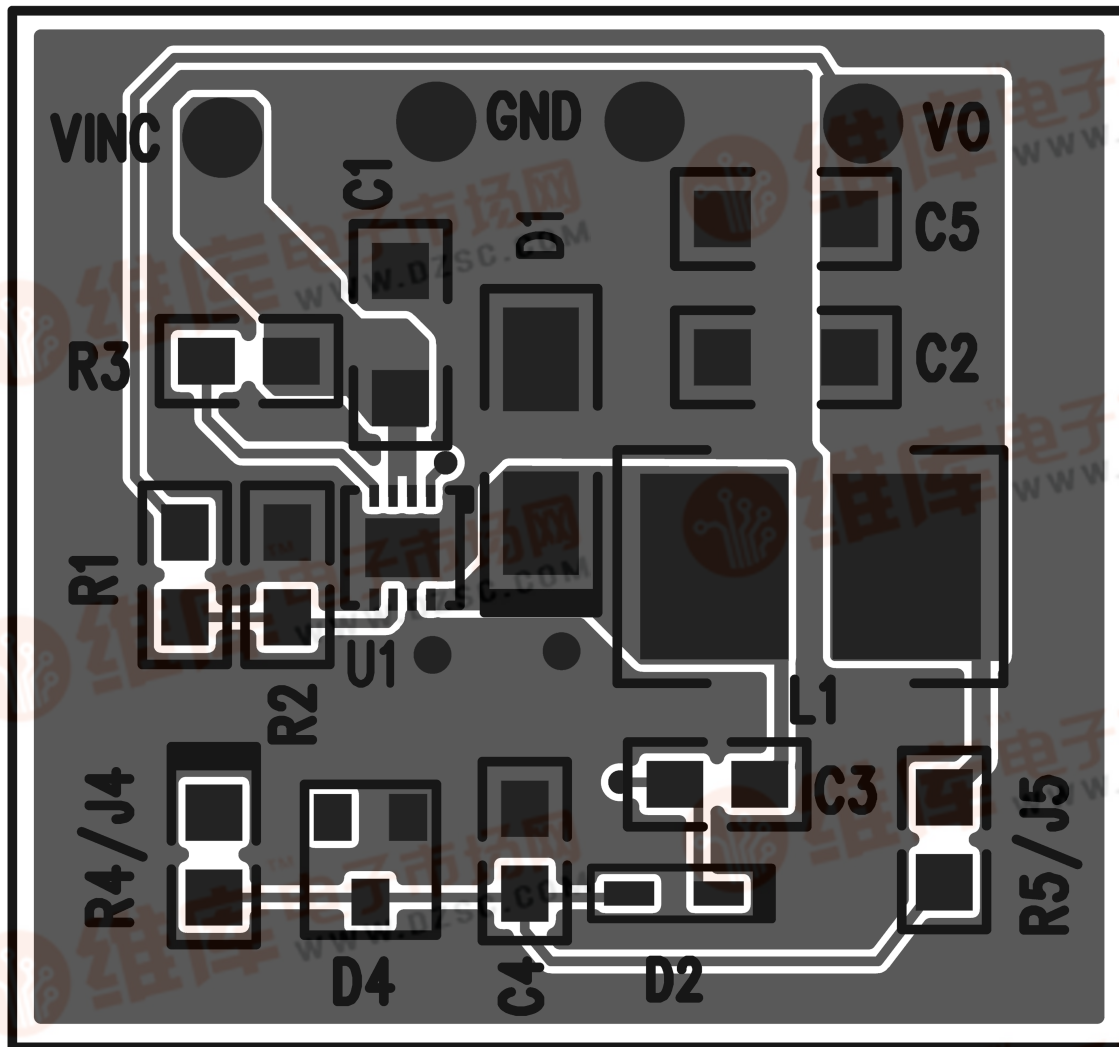
Bill of Materials X-Version (1.6MHz)

Part ID	Part Value	Manufacturer	Part Number	Package Type
C1, Input Cap	10 μ F, 25V, X7R	TDK	C3216X5R1E106	1206
C2, C5, Output Cap	22 μ F, 10V, X5R	TDK	C3216X5R1A226	1206
C3 (Boost Cap), C4	0.1 μ F	TDK	C2012X7R1A104	0805
D2, Boost Diode	1V _F @ 100mA Diode	Diodes, Inc.	BAT54WS-TP	SOD-323
R2, R3	10k Ω , 1%	Vishay	CRCW12061002F	0805
U1	1.5A Buck Regulator	National Semiconductor	LM2738X-SD	LLP-8
			LM2738X-MY	eMSOP-8
D1, Catch Diode	0.34V _F Schottky 1.5A, 30VR	Toshiba	CRS08	-
L1	5.0 μ H, 2.9A	Coilcraft	MSS7341-502NL	-
R1	31.6k Ω , 1%	Vishay	CRCW12063162F	0805
R5	0 Ω	Vishay	CRCW12060R00F	0805
D4, R4	Open or No Load			

Bill of Materials Y-Version (550kHz)

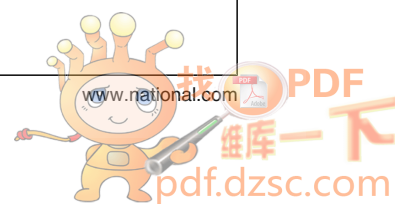
Part ID	Part Value	Manufacturer	Part Number	Package Type
C1, Input Cap	10 μ F, 25V, X7R	TDK	C3216X5R1E106	1206
C2, C5, Output Cap	22 μ F, 10V, X5R	TDK	C3216X5R1A226	1206
C3 (Boost Cap), C4	0.1 μ F	TDK	C2012X7R1A104	0805
D2, Boost Diode	1V _F @ 100mA Diode	Diodes, Inc.	BAT54WS-TP	SOD-323
R2, R3	10k Ω , 1%	Vishay	CRCW12061002F	0805
U1	1.5A Buck Regulator	National Semiconductor	LM2738Y-SD	LLP-8
			LM2738Y-MY	eMSOP-8
D1, Catch Diode	0.34V _F Schottky 1.5A, 30VR	Toshiba	CRS08	-
L1	10.0 μ H, 2.0A	Coilcraft	MSS7341-103NL	-
R1	31.6k Ω , 1%	Vishay	CRCW12063162F	0805
R5	0 Ω	Vishay	CRCW12060R00F	0805
D4, R4	Open or No Load			



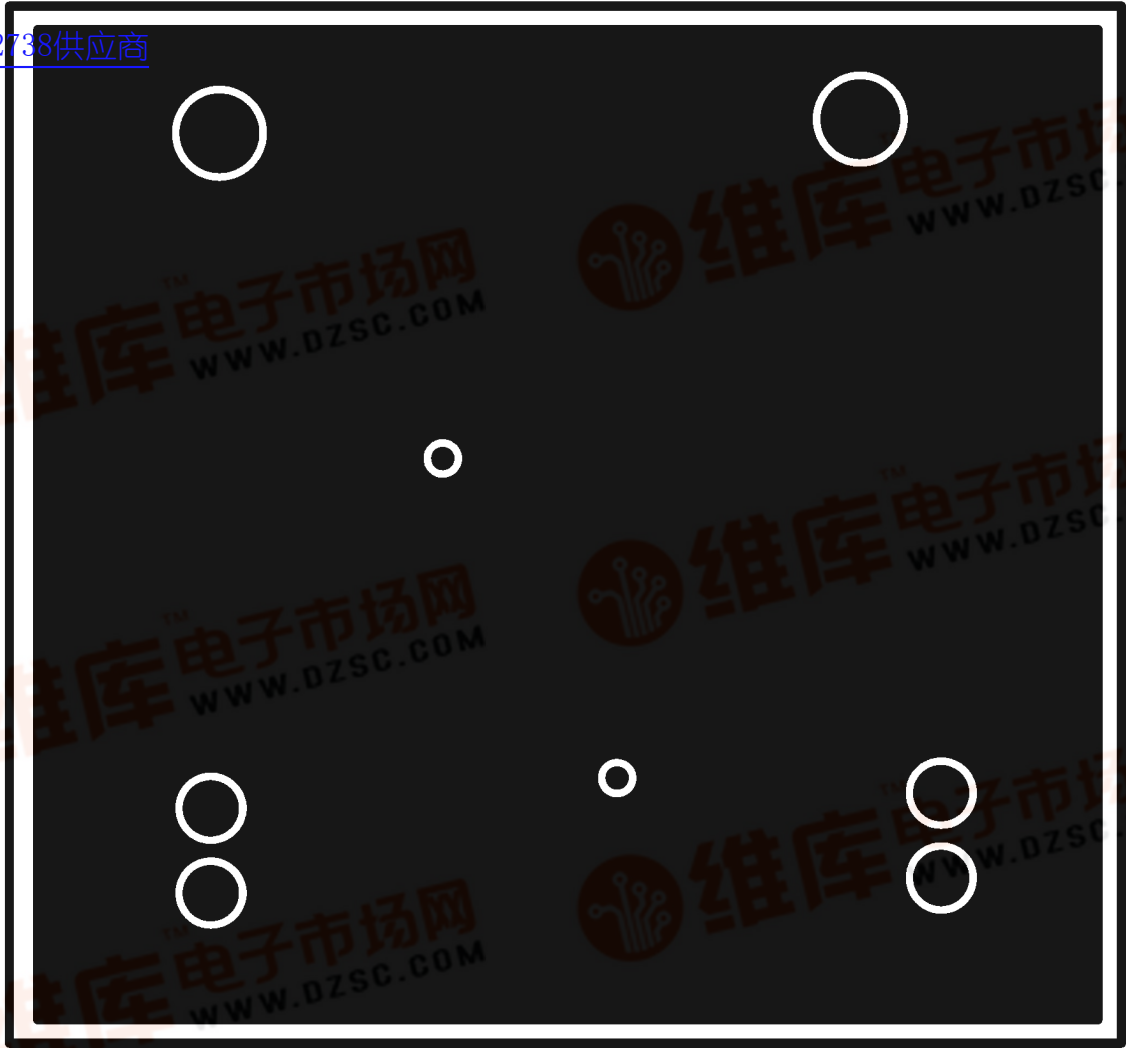


Top Layer

30061411



[查询LM2738供应商](#)

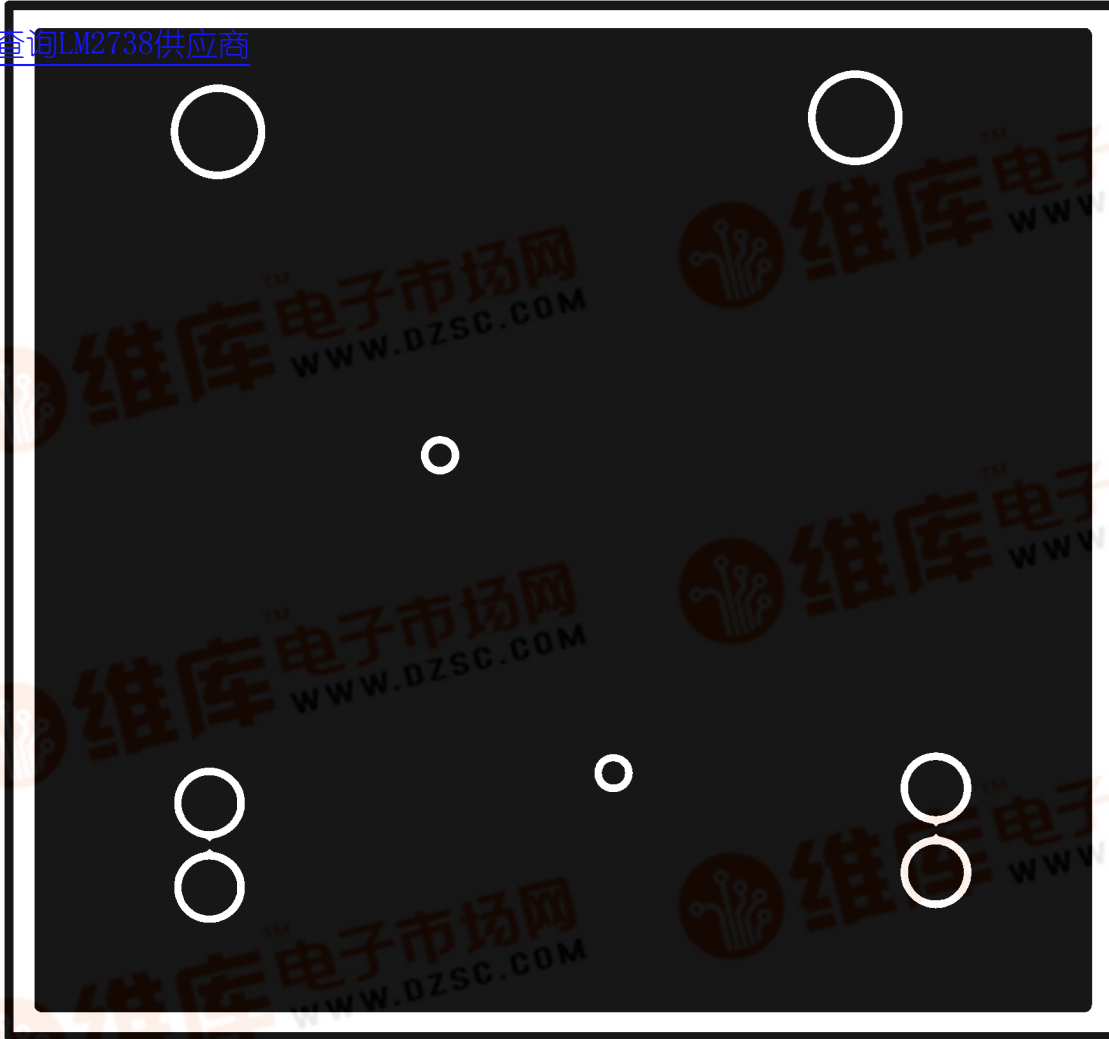


Internal Plane - Layer 2 (GND)

30061412

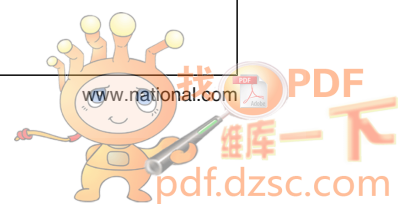


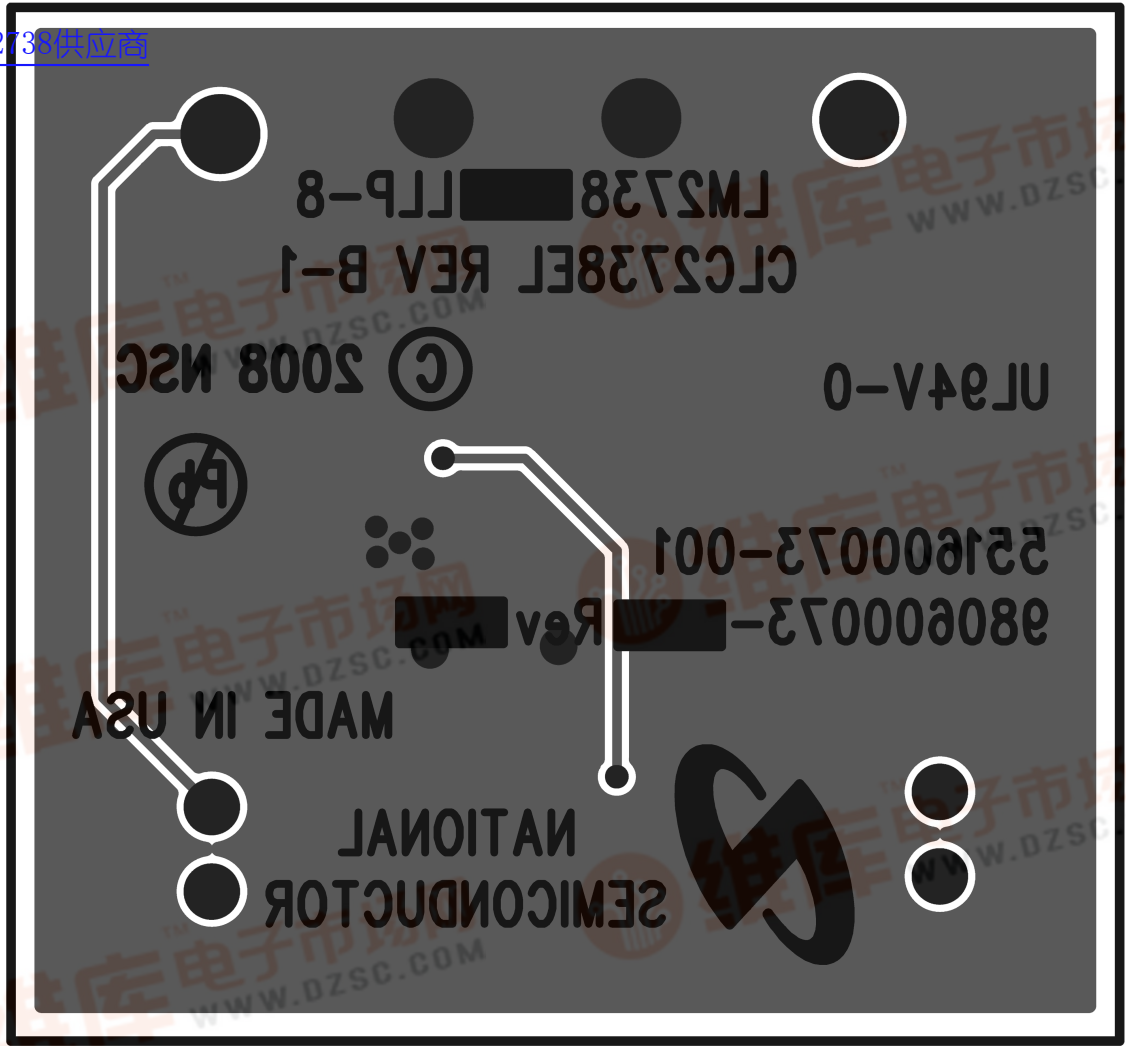
[查询LM2738供应商](#)



Internal Plane - Layer 3 (GND)

30061413





Bottom Layer

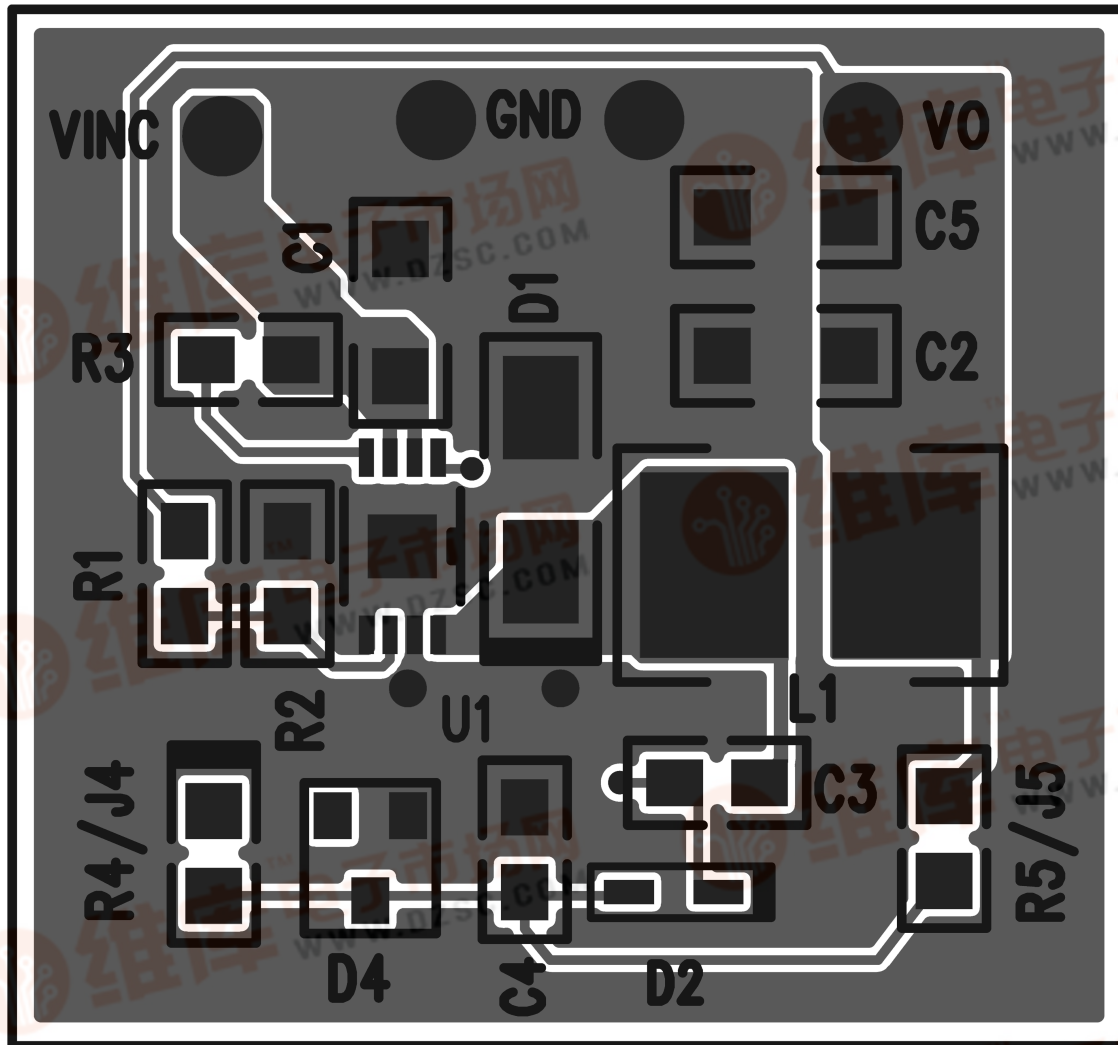
30061414



PCB Layout - eMSOP

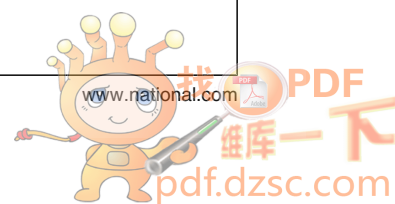
[查询LM2738供应商](#)

AN-1837

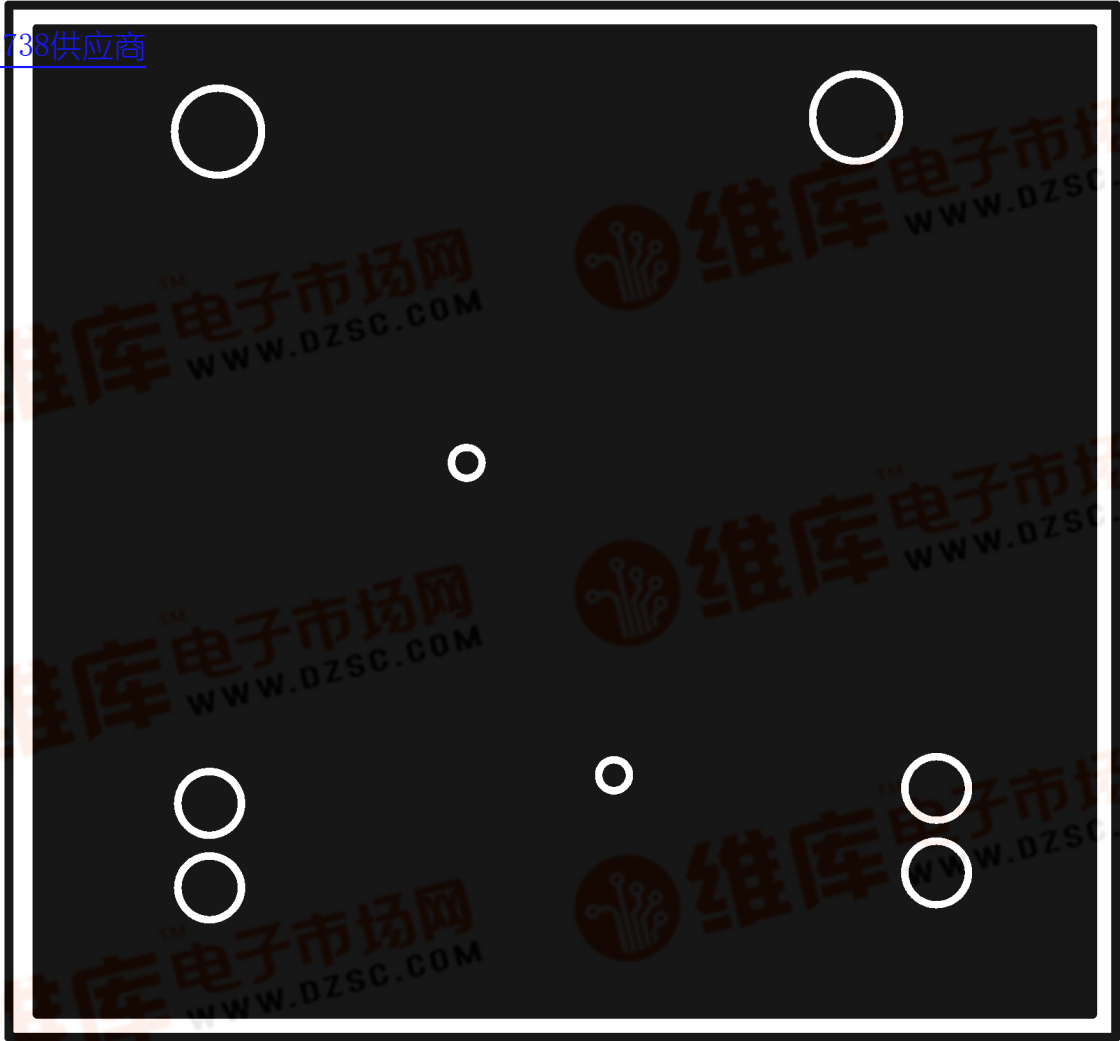


Top Layer

30061415



[查询LM2738供应商](#)

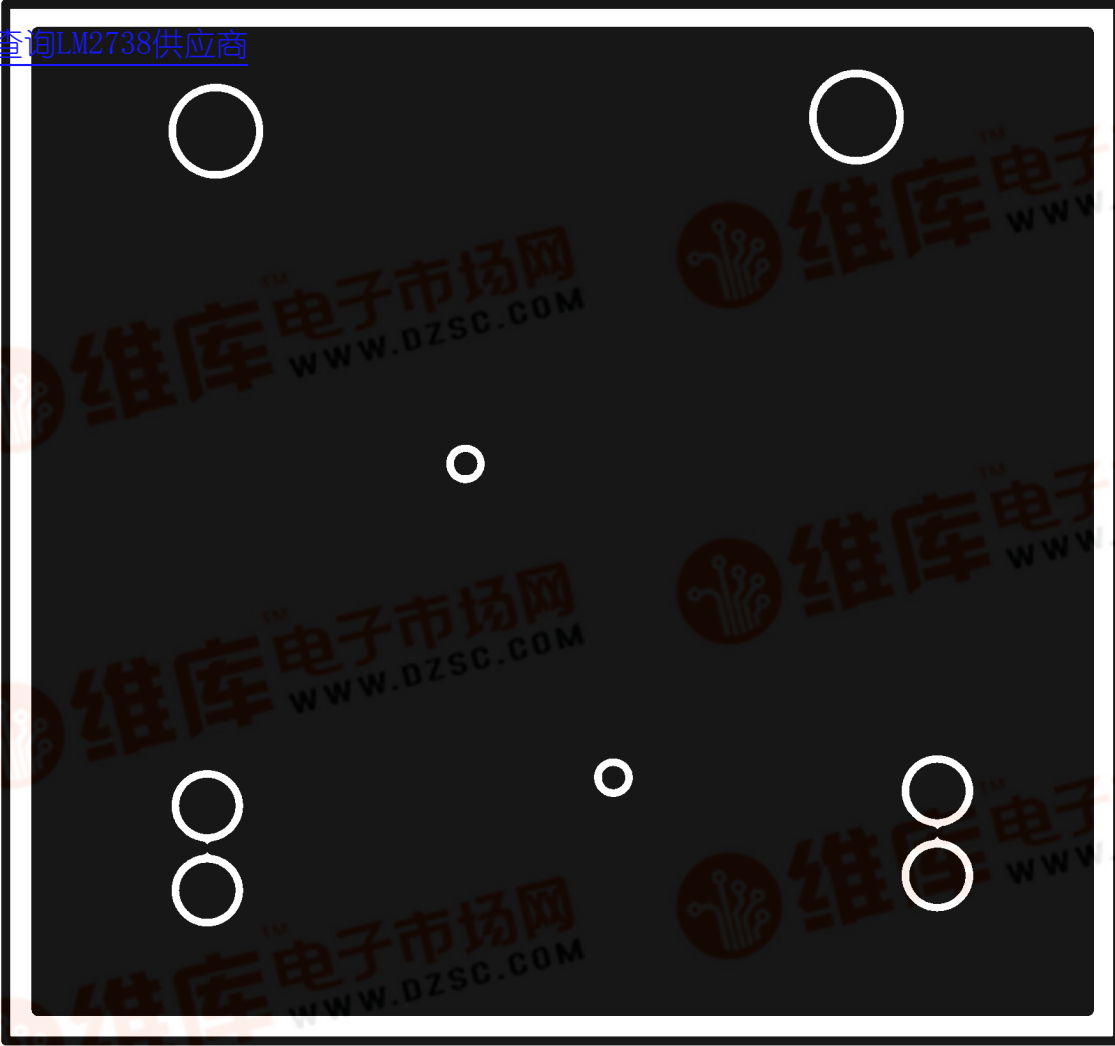


Internal Plane - Layer 2 (GND)

30061416

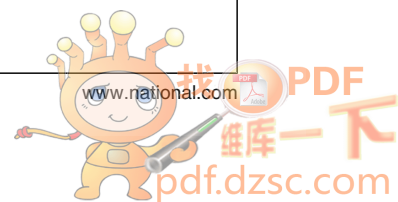


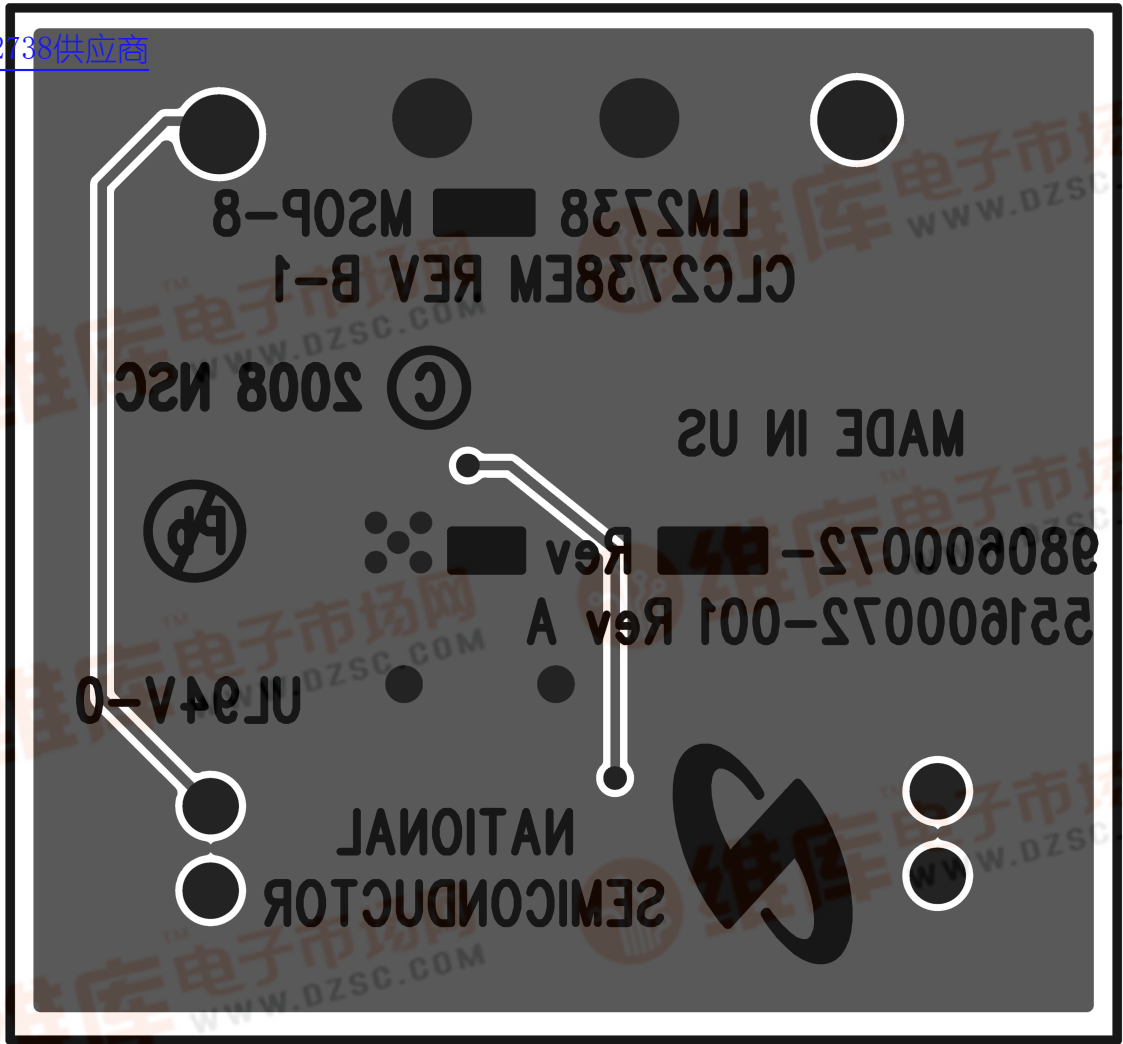
[查询LM2738供应商](#)



Internal Plane - Layer 3 (GND)

30061417





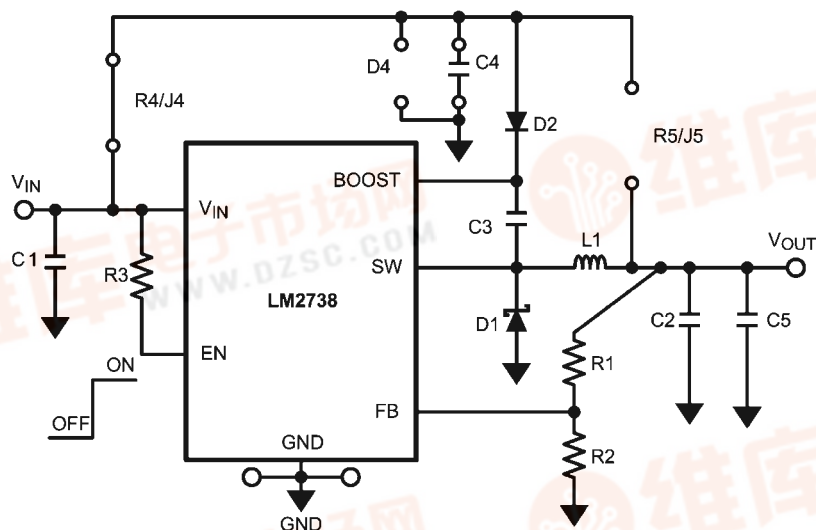
Bottom Layer

30061418



Additional Circuit Configuration Schematics

[查询LM2738供应商](#)



V_{BOOST} derived from $V_{\text{IN}} = 5\text{V}$, for $V_{\text{OUT}} = 1.5\text{V}$

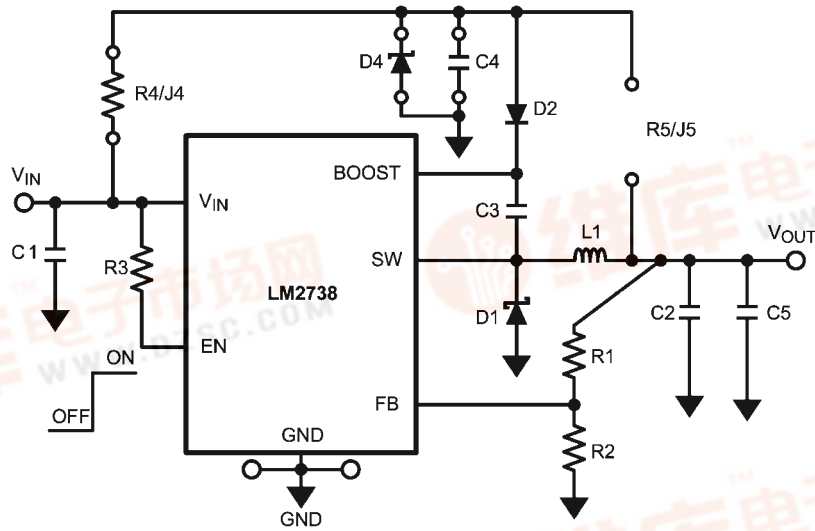
30061428

Bill of Materials X-Version (1.6MHz)

Part ID	Part Value	Manufacturer	Part Number	Package Type
C1, Input Cap	10 μF , 25V, X7R	TDK	C3216X5R1E106	1206
C2, Output Cap	22 μF , 6.3V, X5R	TDK	C3216X5R0J2266	1206
C3 (Boost Cap), C4	0.1 μF	TDK	C2012X7R1A104	0805
D2, Boost Diode	1V _F @ 100mA Diode	Diodes, Inc.	BAT54WS-TP	SOD-323
R2, R3	10k Ω , 1%	Vishay	CRCW12061002F	0805
U1	1.5A Buck Regulator	National Semiconductor	LM2738X-SD	LLP-8
			LM2738X-MY	eMSOP-8
D1, Catch Diode	0.34V _F Schottky 1.5A, 30V	Toshiba	CRS08	-
L1	2.2 μH , 1.9A	Coilcraft	MSS5131-222ML	-
R1	8.87k Ω , 1%	Vishay	CRCW12068871F	0805
R4	0 Ω	Vishay	CRCW12060R00F	0805
D4, R5, C5	Open or No Load			

Bill of Materials Y-Version (550kHz)

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	C3216X5R0J2266	1206
C3 (Boost Cap), C4	0.1 μF	TDK	C2012X7R1A104	0805
D2, Boost Diode	1V _F @ 100mA Diode	Diodes, Inc.	BAT54WS-TP	SOD-323
R2, R3	10k Ω , 1%	Vishay	CRCW12061002F	0805
U1	1.5A Buck Regulator	National Semiconductor	LM2738X-SD	LLP-8
			LM2738X-MY	eMSOP-8
D1, Catch Diode	0.34V _F Schottky 1.5A, 30V	Toshiba	CRS08	-
L1	6.2 μH , 2.5A	Coilcraft	MSS7341-622NL	-
R1	8.87k Ω , 1%	Vishay	CRCW12068871F	0805
R4	0 Ω	Vishay	CRCW12060R00F	0805
D4, R5	Open or No Load			

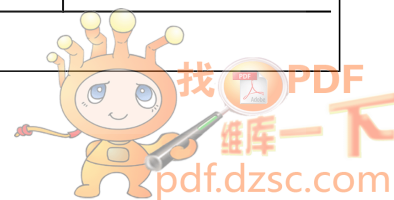
[查询LM2738供应商](#)

 V_{BOOST} derived from V_{SHUNT} coming from $V_{\text{IN}} = 18\text{V}$, $V_{\text{OUT}} = 1.5\text{V}$

Bill of Materials X-Version (1.6MHz)

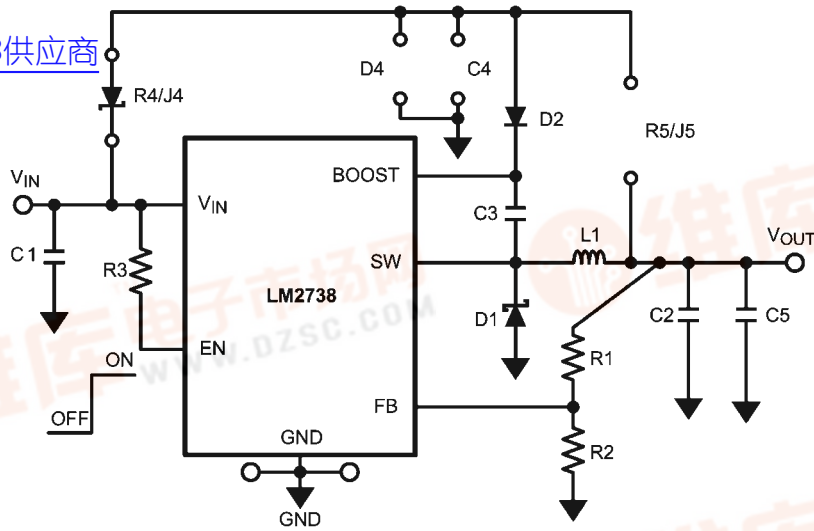
Part ID	Part Value	Manufacturer	Part Number	Package Type
C1, Input Cap	10 μF , 25V, X7R	TDK	C3216X5R1E106	1206
C2, C5, Output Caps	22 μF , 6.3V, X5R	TDK	C3216X5R0J226	1206
C3 (Boost Cap), C4	0.1 μF	TDK	C2012X7R1A104	0805
D2, Boost Diode	1V _F @ 100mA Diode	Diodes, Inc.	BAT54WS-TP	SOD-323
D4, Zener	5.1V, 200mW	Diodes, Inc.	BZX84C5V1W	SOT-323
R2, R3	10k Ω , 1%	Vishay	CRCW12061002F	0805
U1	1.5A Buck Regulator	National Semiconductor	LM2738X-SD	LLP-8
			LM2738X-MY	eMSOP-8
D1, Catch Diode	0.34V _F Schottky 1.5A, 30V	Toshiba	CRS08	-
L1	2.7 μH , 1.76A	TDK	VLGF5020T-2R7N1R7	-
R1	8.87k Ω , 1%	Vishay	CRCW12068871F	0805
R4	4.12k Ω , 1%	Vishay	CRCW12064121F	0805
R5	Open or No Load			

Bill of Materials Y-Version (550kHz)

Part ID	Part Value	Manufacturer	Part Number	Package Type
C1, Input Cap	10 μF , 25V, X7R	TDK	C3216X5R1E106	1206
C2, C5, Output Caps	47 μF , 6.3V, X5R	TDK	C3216X5R0J476	1206
C3 (Boost Cap), C4	0.1 μF	TDK	C2012X7R1A104	0805
D2, Boost Diode	1V _F @ 100mA Diode	Diodes, Inc.	BAT54WS-TP	SOD-323
D4, Zener	5.1V, 200mW	Diodes, Inc.	BZX84C5V1W	SOT-323
R2, R3	10k Ω , 1%	Vishay	CRCW12061002F	0805
U1	1.5A Buck Regulator	National Semiconductor	LM2738Y-SD	LLP-8
			LM2738Y-MY	eMSOP-8
D1, Catch Diode	0.34V _F Schottky 1.5A, 30V	Toshiba	CRS08	-
L1	8.7 μH , 2.2A	Coilcraft	MSS7341-872NL	-
R1	8.87k Ω , 1%	Vishay	CRCW12068871F	0805
R4	4.21k Ω , 1%	Vishay	CRCW12064211F	0805
R5	Open or No Load			



[查询LM2738供应商](#)



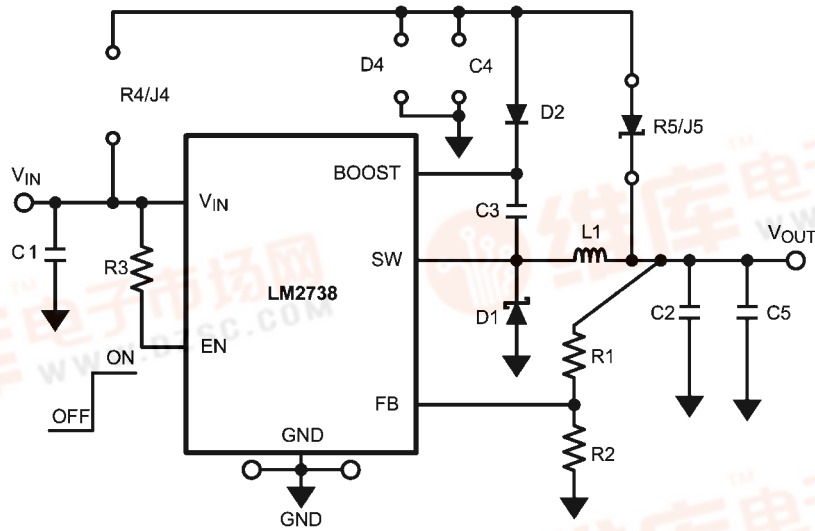
V_{BOOST} derived from Series Zener Diode from $V_{\text{IN}} = 15\text{V}$, $V_{\text{OUT}} = 1.5\text{V}$ 30061430

Bill of Materials X-Version (1.6MHz)

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)	0.1 μF	TDK	C2012X7R1A104	0805
D2, Boost Diode	1V _F @ 100mA Diode	Diodes, Inc.	BAT54WS-TP	SOD-323
R2, R3	10k Ω , 1%	Vishay	CRCW12061002F	0805
U1	1.5A Buck Regulator	National Semiconductor	LM2738X-SD	LLP-8
			LM2738X-MY	eMSOP-8
D1, Catch Diode	0.34V _F Schottky 1.5A, 30V	Toshiba	CRS08	-
L1	3.3 μH , 3.5A	Coilcraft	MSS7341-332NL	-
R1	8.87k Ω , 1%	Vishay	CRCW12068871F	0805
R4	11V, 200mW, Zener	Vishay	BZX384C11-V	SOD-323
D4, R5, C4	Open or No Load			

Bill of Materials Y-Version (550kHz)

Part ID	Part Value	Manufacturer	Part Number	Package Type
C1, Input Cap	10 μF , 25V, X7R	TDK	C3216X5R1E106	1206
C2, C5, Output Caps	47 μF , 6.3V, X5R	TDK	C3216X5R0J476	1206
C3 (Boost Cap)	0.1 μF	TDK	C2012X7R1A104	0805
D2, Boost Diode	1V _F @ 100mA Diode	Diodes, Inc.	BAT54WS-TP	SOD-323
R2, R3	10k Ω , 1%	Vishay	CRCW12061002F	0805
U1	1.5A Buck Regulator	National Semiconductor	LM2738Y-SD	LLP-8
			LM2738Y-MY	eMSOP-8
D1, Catch Diode	0.34V _F Schottky 1.5A, 30V	Toshiba	CRS08	-
L1	8.7 μH , 2.2A	Coilcraft	MSS7341-872NL	-
R1	8.87k Ω , 1%	Vishay	CRCW12068871F	0805
R4	11V, 200mW, Zener	Vishay	BZX384C11-V	SOD-323
D4, R5, C4	Open or No Load			

[查询LM2738供应商](#)


V_{BOOST} derived from Series Zener Diode from $V_{\text{OUT}} = 9\text{V}$, $V_{\text{IN}} = 15\text{V}$ ³⁰⁰⁶¹⁴³¹

Bill of Materials X-Version (1.6MHz)

Part ID	Part Value	Manufacturer	Part Number	Package Type
C1, Input Cap	10 μF , 25V, X7R	TDK	C3216X5R1E106	1206
C2, Output Cap	22 μF , 10V, X5R	TDK	C3216X5R1A226	1206
C3 (Boost Cap), C4	0.1 μF	TDK	C2012X7R1A104	0805
D2, Boost Diode	1V _F @ 100mA Diode	Diodes, Inc.	BAT54WS-TP	SOD-323
R2, R3	10k Ω , 1%	Vishay	CRCW12061002F	0805
U1	1.5A Buck Regulator	National Semiconductor	LM2738X-SD	LLP-8
			LM2738X-MY	eMSOP-8
D1, Catch Diode	0.34V _F Schottky 1.5A, 30V	Toshiba	CRS08	-
L1	6.2 μH , 2.5A	Coilcraft	MSS7341-622NL	-
R1	102k Ω , 1%	Vishay	CRCW1206123F	0805
R5	4.3V, 200mW, Zener	Vishay	BZX384C4V3-V	SOD-323
D4, R4	Open or No Load			

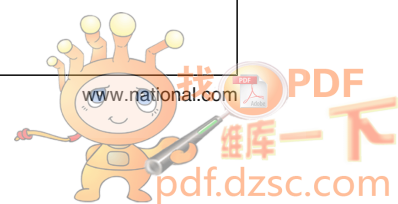
Bill of Materials Y-Version (550kHz)

Part ID	Part Value	Manufacturer	Part Number	Package Type
C1, Input Cap	10 μF , 25V, X7R	TDK	C3216X5R1E106	1206
C2, Output Cap	22 μF , 10V, X5R	TDK	C3216X5R1A226	1206
C3 (Boost Cap), C4	0.1 μF	TDK	C2012X7R1A104	0805
D2, Boost Diode	1V _F @ 100mA Diode	Diodes, Inc.	BAT54WS-TP	SOD-323
R2, R3	10k Ω , 1%	Vishay	CRCW12061002F	0805
U1	1.5A Buck Regulator	National Semiconductor	LM2738Y-SD	LLP-8
			LM2738Y-MY	eMSOP-8
D1, Catch Diode	0.34V _F Schottky 1.5A, 30V	Toshiba	CRS08	-
L1	5.0 μH , 2.9A	Coilcraft	MSS7341-502NL	-
R1	102k Ω , 1%	Vishay	CRCW12061023F	0805
R5	4.3V, 200mW, Zener	Vishay	BZX384C4V3-V	SOD-323
D4, R4	Open or No Load			



[查询LM2738供应商](#)

Notes



[查询LM2738供应商](#)

Notes

For more National Semiconductor product information and proven design tools, visit the following Web sites at:

Products		Design Support	
Amplifiers	www.national.com/amplifiers	WEBENCH	www.national.com/webench
Audio	www.national.com/audio	Analog University	www.national.com/AU
Clock Conditioners	www.national.com/timing	App Notes	www.national.com/appnotes
Data Converters	www.national.com/adc	Distributors	www.national.com/contacts
Displays	www.national.com/displays	Green Compliance	www.national.com/quality/green
Ethernet	www.national.com/ethernet	Packaging	www.national.com/packaging
Interface	www.national.com/interface	Quality and Reliability	www.national.com/quality
LVDS	www.national.com/lvds	Reference Designs	www.national.com/refdesigns
Power Management	www.national.com/power	Feedback	www.national.com/feedback
Switching Regulators	www.national.com/switchers		
LDOs	www.national.com/ldo		
LED Lighting	www.national.com/led		
PowerWise	www.national.com/powerwise		
Serial Digital Interface (SDI)	www.national.com/sdi		
Temperature Sensors	www.national.com/tempsensors		
Wireless (PLL/VCO)	www.national.com/wireless		

THE CONTENTS OF THIS DOCUMENT ARE PROVIDED IN CONNECTION WITH NATIONAL SEMICONDUCTOR CORPORATION ("NATIONAL") PRODUCTS. NATIONAL MAKES NO REPRESENTATIONS OR WARRANTIES WITH RESPECT TO THE ACCURACY OR COMPLETENESS OF THE CONTENTS OF THIS PUBLICATION AND RESERVES THE RIGHT TO MAKE CHANGES TO SPECIFICATIONS AND PRODUCT DESCRIPTIONS AT ANY TIME WITHOUT NOTICE. NO LICENSE, WHETHER EXPRESS, IMPLIED, ARISING BY ESTOPPEL OR OTHERWISE, TO ANY INTELLECTUAL PROPERTY RIGHTS IS GRANTED BY THIS DOCUMENT.

TESTING AND OTHER QUALITY CONTROLS ARE USED TO THE EXTENT NATIONAL DEEMS NECESSARY TO SUPPORT NATIONAL'S PRODUCT WARRANTY. EXCEPT WHERE MANDATED BY GOVERNMENT REQUIREMENTS, TESTING OF ALL PARAMETERS OF EACH PRODUCT IS NOT NECESSARILY PERFORMED. NATIONAL ASSUMES NO LIABILITY FOR APPLICATIONS ASSISTANCE OR BUYER PRODUCT DESIGN. BUYERS ARE RESPONSIBLE FOR THEIR PRODUCTS AND APPLICATIONS USING NATIONAL COMPONENTS. PRIOR TO USING OR DISTRIBUTING ANY PRODUCTS THAT INCLUDE NATIONAL COMPONENTS, BUYERS SHOULD PROVIDE ADEQUATE DESIGN, TESTING AND OPERATING SAFEGUARDS.

EXCEPT AS PROVIDED IN NATIONAL'S TERMS AND CONDITIONS OF SALE FOR SUCH PRODUCTS, NATIONAL ASSUMES NO LIABILITY WHATSOEVER, AND NATIONAL DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY RELATING TO THE SALE AND/OR USE OF NATIONAL PRODUCTS INCLUDING LIABILITY OR WARRANTIES RELATING TO FITNESS FOR A PARTICULAR PURPOSE, MERCHANTABILITY, OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS PRIOR WRITTEN APPROVAL OF THE CHIEF EXECUTIVE OFFICER AND GENERAL COUNSEL OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

Life support devices or systems are devices which (a) are intended for surgical implant into the body, or (b) support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in a significant injury to the user. A critical component is any component in a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system or to affect its safety or effectiveness.

National Semiconductor and the National Semiconductor logo are registered trademarks of National Semiconductor Corporation. All other brand or product names may be trademarks or registered trademarks of their respective holders.

Copyright© 2008 National Semiconductor Corporation

For the most current product information visit us at www.national.com



**National Semiconductor
Americas Technical
Support Center**
Email:
new.feedback@nsc.com
Tel: 1-800-272-9959

**National Semiconductor Europe
Technical Support Center**
Email: europe.support@nsc.com
German Tel: +49 (0) 180 5010 771
English Tel: +44 (0) 870 850 4288

**National Semiconductor Asia
Pacific Technical Support Center**
Email: ap.support@nsc.com

**National Semiconductor Japan
Technical Support Center**
Email: jpn.feedback@nsc.com

