LM2738 Evaluation Board

National Semiconductor
Application Note 1837
Francis Houde
April 10, 2008

Introduction

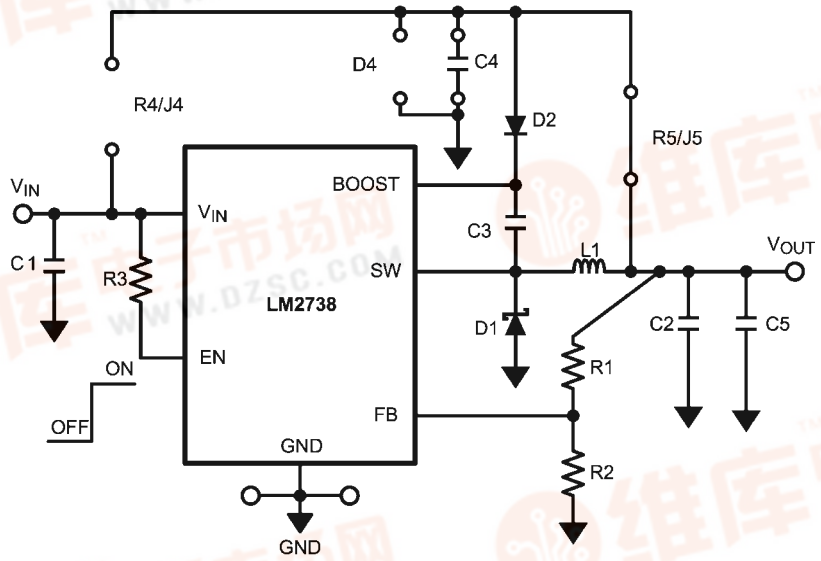
The LM2738 demo board is configured to convert 12V input to 3.3V output at 1.5A load current using the LM2738X 1.6MHz or the LM2738Y 550kHz step down DC-DC regulator. The tiny low profile eMSOP-8 and LLP-8 packages allows the demo board to be manufactured using just over one square inch of a 4-layer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



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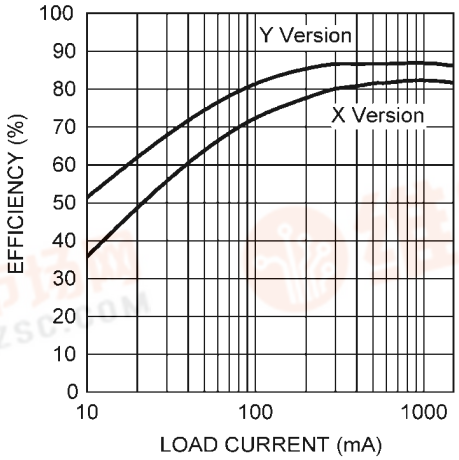
LM2738 Demo Board Schematic - V_{BOOST} derived from V_{OUT} = 3.3V, V_{IN} = 12V



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

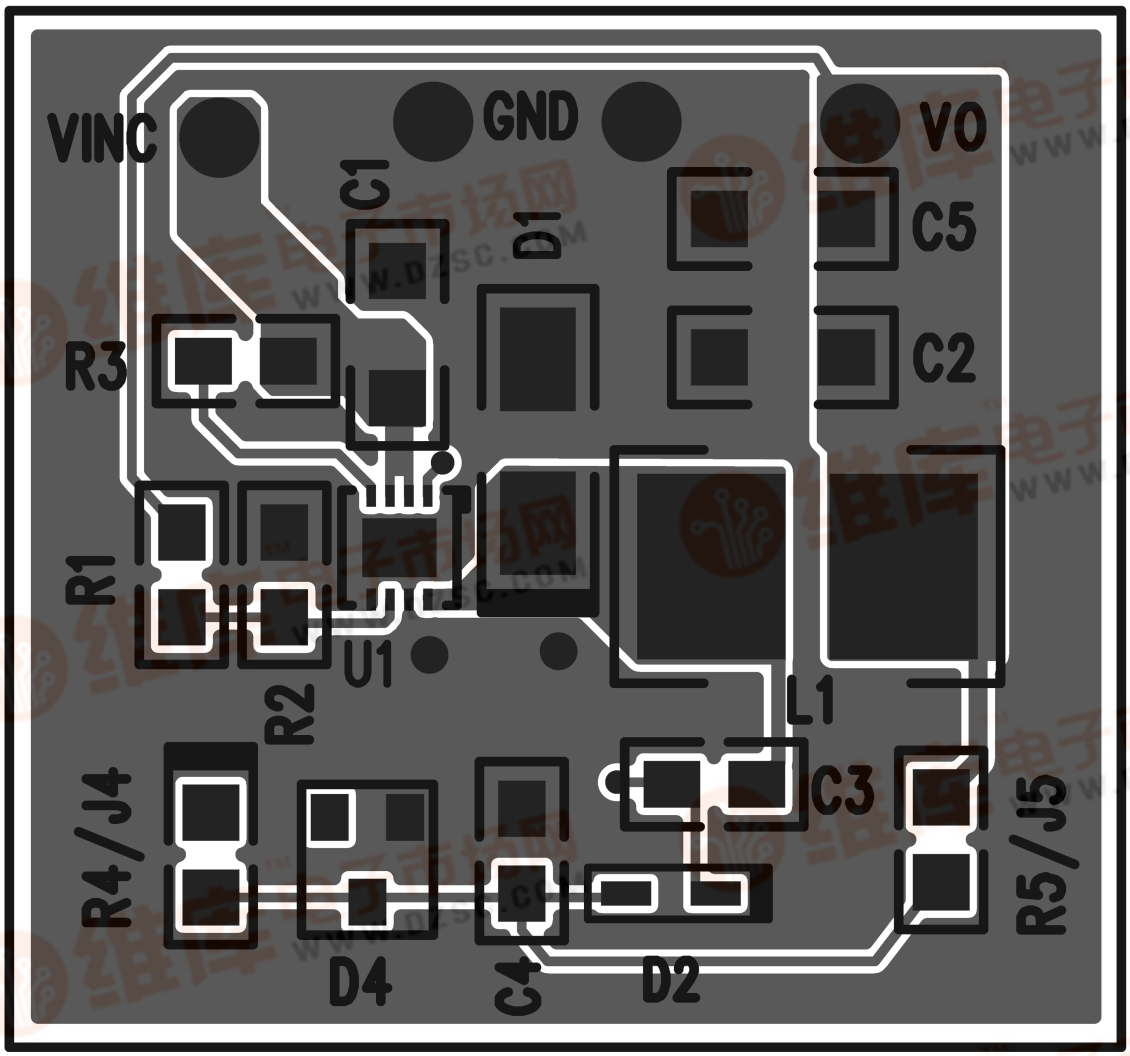
Bill of Materials X-Version (1.6MHz)

Part ID	Part Value	Manufacturer	Part Number	Package Type
C1, Input Cap	10µF, 25V, X7R	TDK	C3216X5R1E106	1206
C2, C5, Output Cap	22µF, 10V, X5R	TDK	C3216X5R1A226	1206
C3 (Boost Cap), C4	0.1µF	TDK	C2012X7R1A104	0805
D2, Boost Diode	1V_F @ 100mA Diode	Diodes, Inc.	BAT54WS-TP	SOD-323
R2, R3	10kΩ, 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	5.0µH, 2.9A	Coilcraft	MSS7341-502NL	-
R1	31.6kΩ, 1%	Vishay	CRCW12063162F	0805
R5	0Ω	Vishay	CRCW12060R00F	0805
D4, R4	Open or No Load			

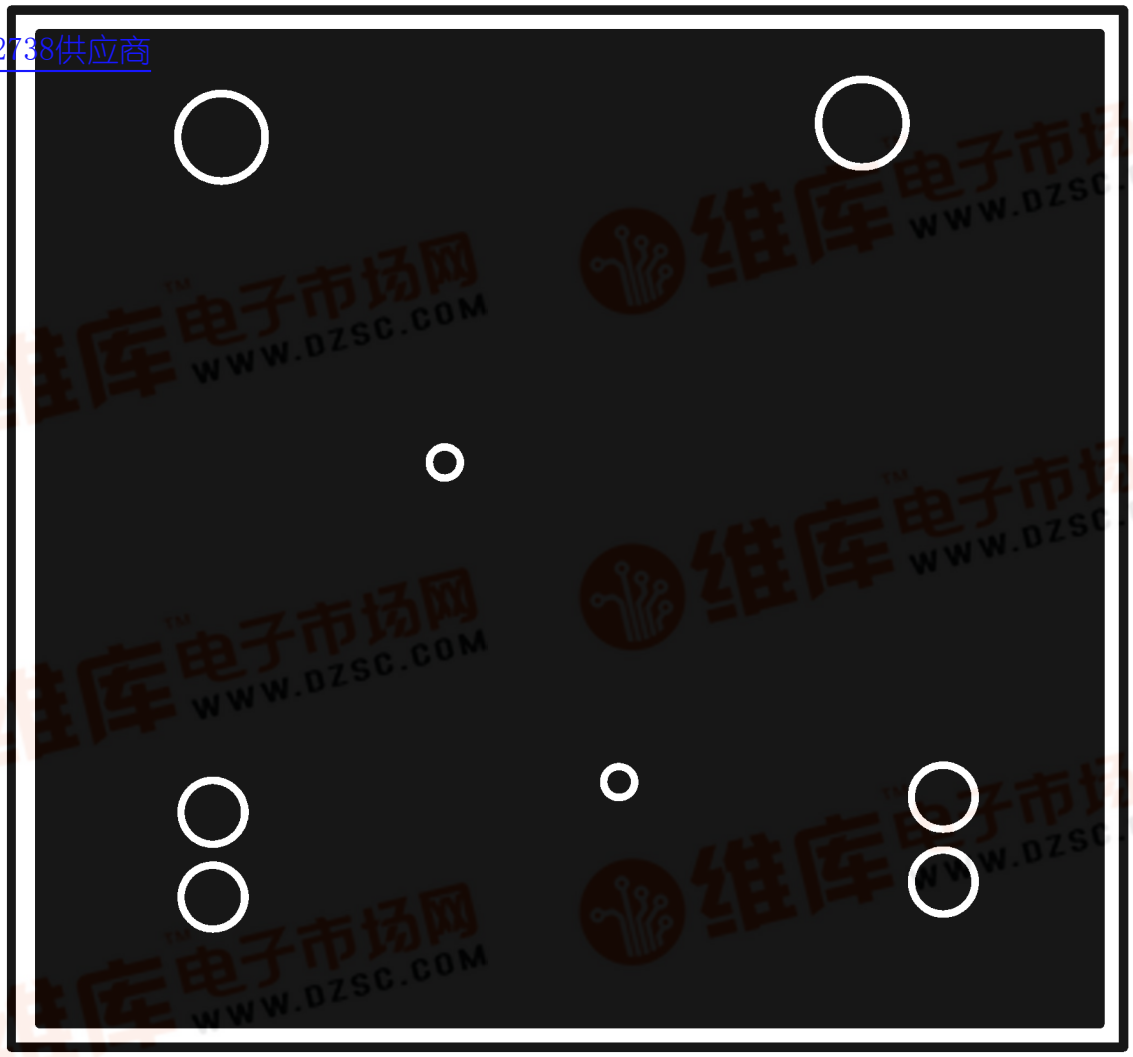
Bill of Materials Y-Version (550kHz)

Part ID	Part Value	Manufacturer	Part Number	Package Type
C1, Input Cap	10µF, 25V, X7R	TDK	C3216X5R1E106	1206
C2, C5, Output Cap	22µF, 10V, X5R	TDK	C3216X5R1A226	1206
C3 (Boost Cap), C4	0.1µF	TDK	C2012X7R1A104	0805
D2, Boost Diode	1V_F @ 100mA Diode	Diodes, Inc.	BAT54WS-TP	SOD-323
R2, R3	10kΩ, 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	10.0µH, 2.0A	Coilcraft	MSS7341-103NL	-
R1	31.6kΩ, 1%	Vishay	CRCW12063162F	0805
R5	0Ω	Vishay	CRCW12060R00F	0805
D4, R4	Open or No Load			

PCB Layout - LLP



Top Layer



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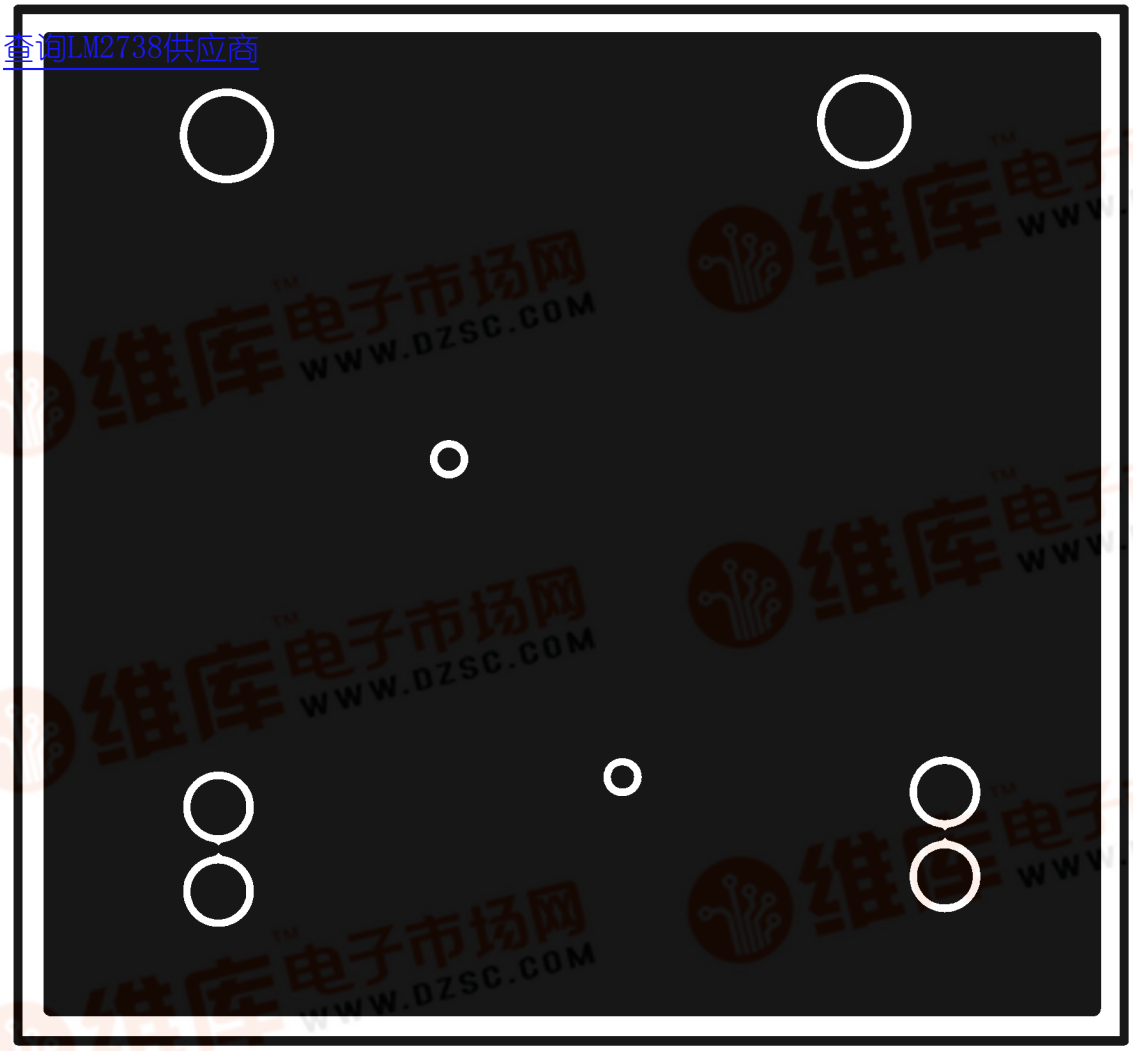
Internal Plane - Layer 2 (GND)



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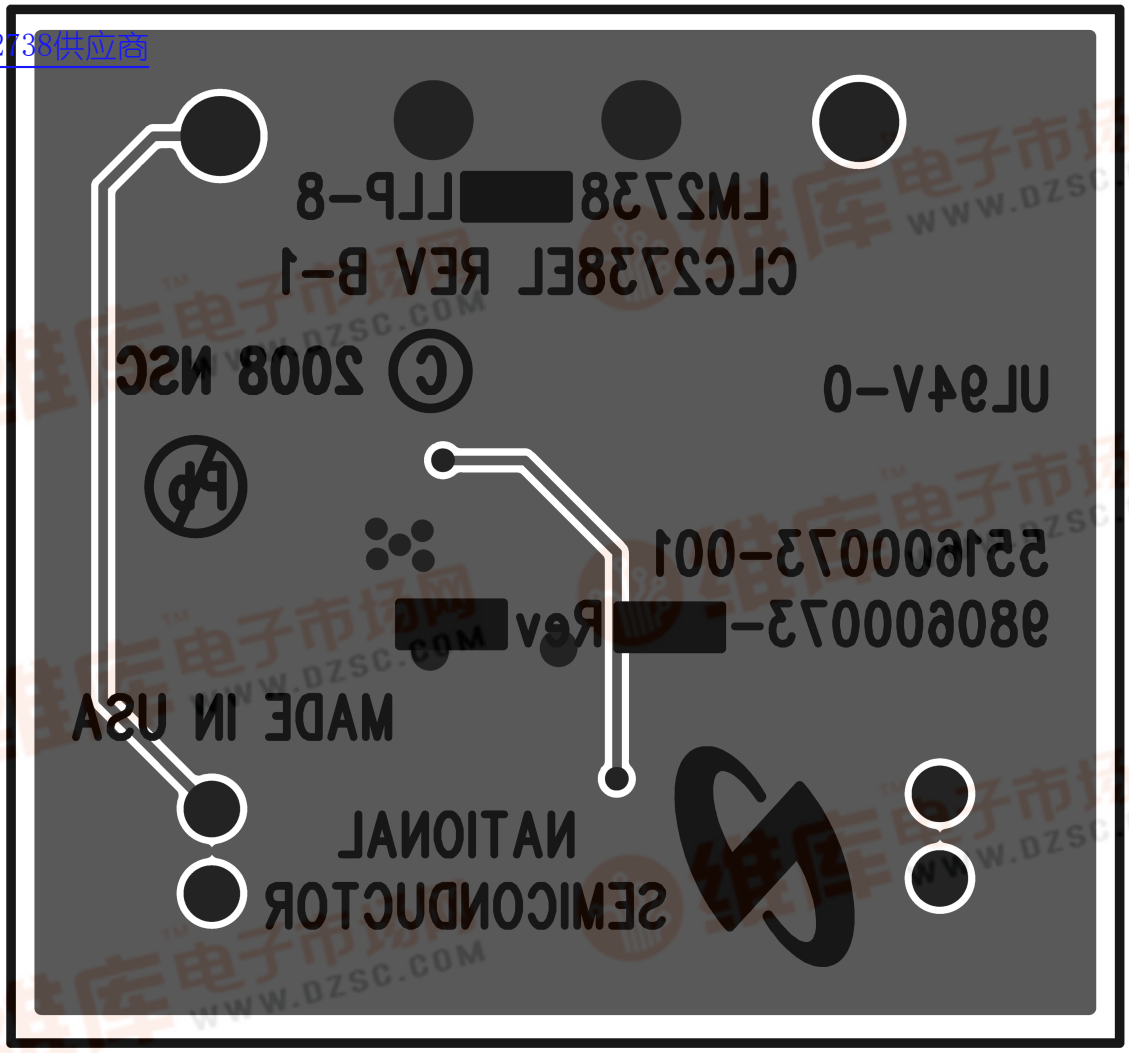
Internal Plane - Layer 3 (GND)



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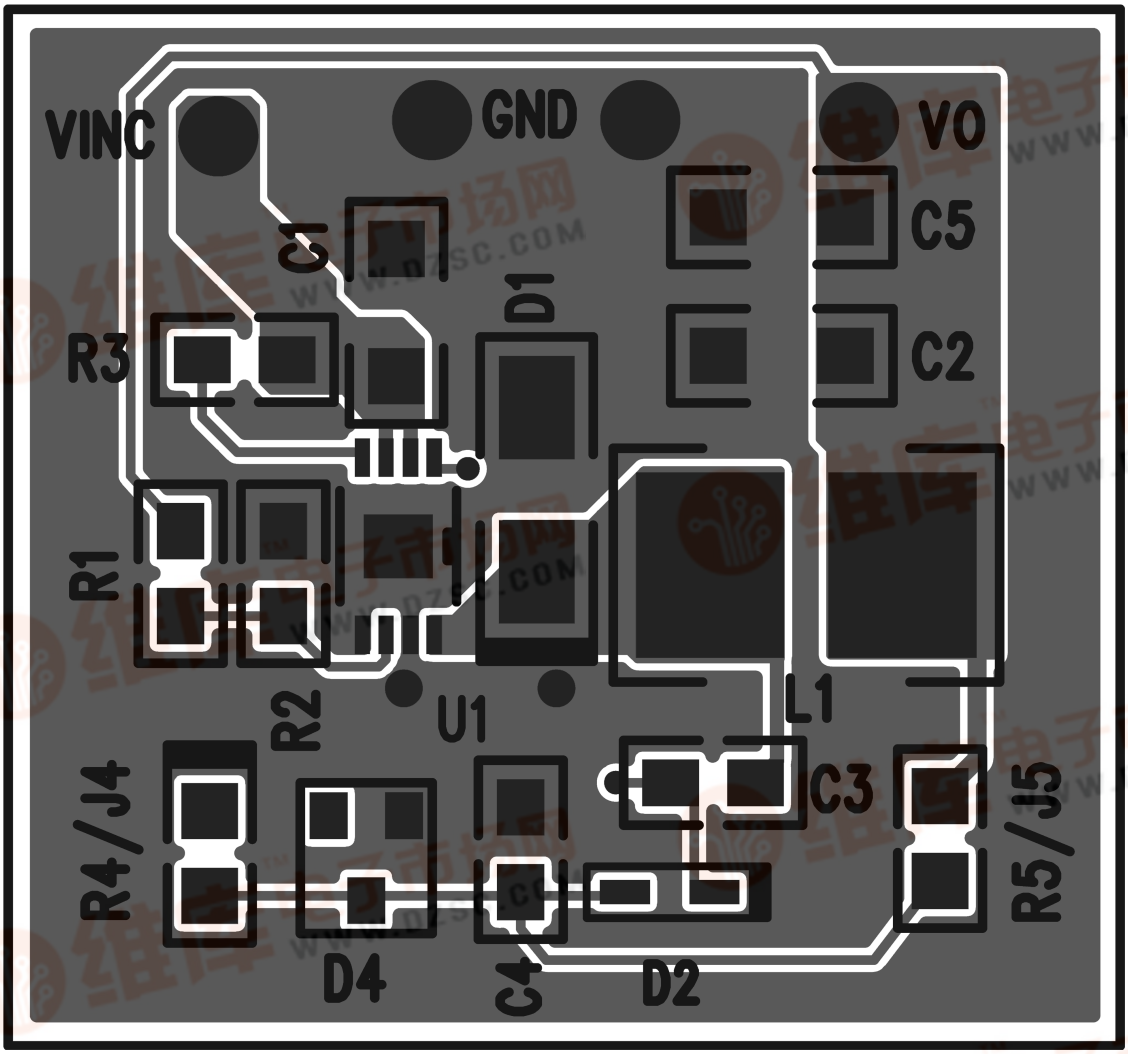
Bottom Layer

PCB Layout - eMSOP



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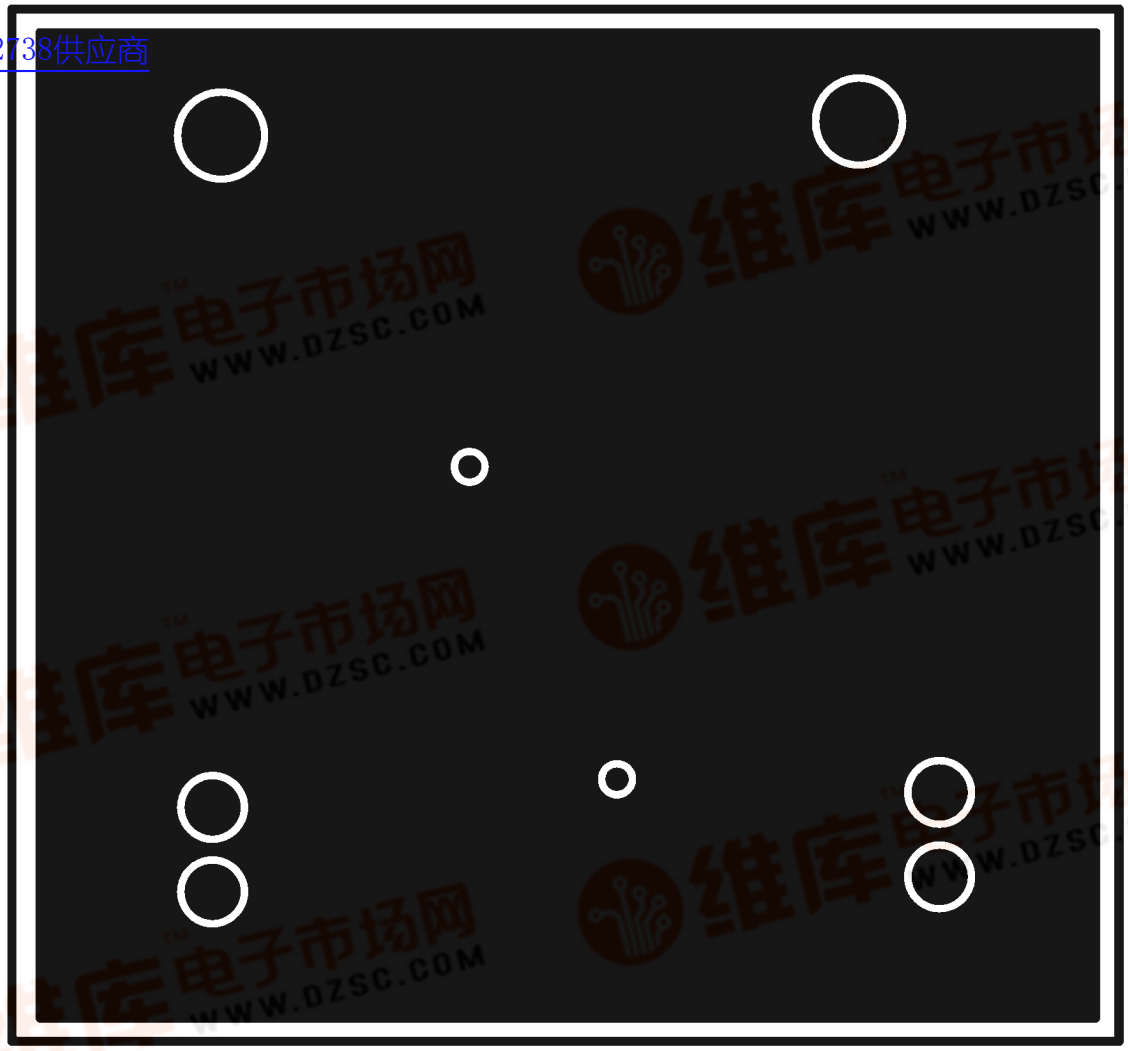

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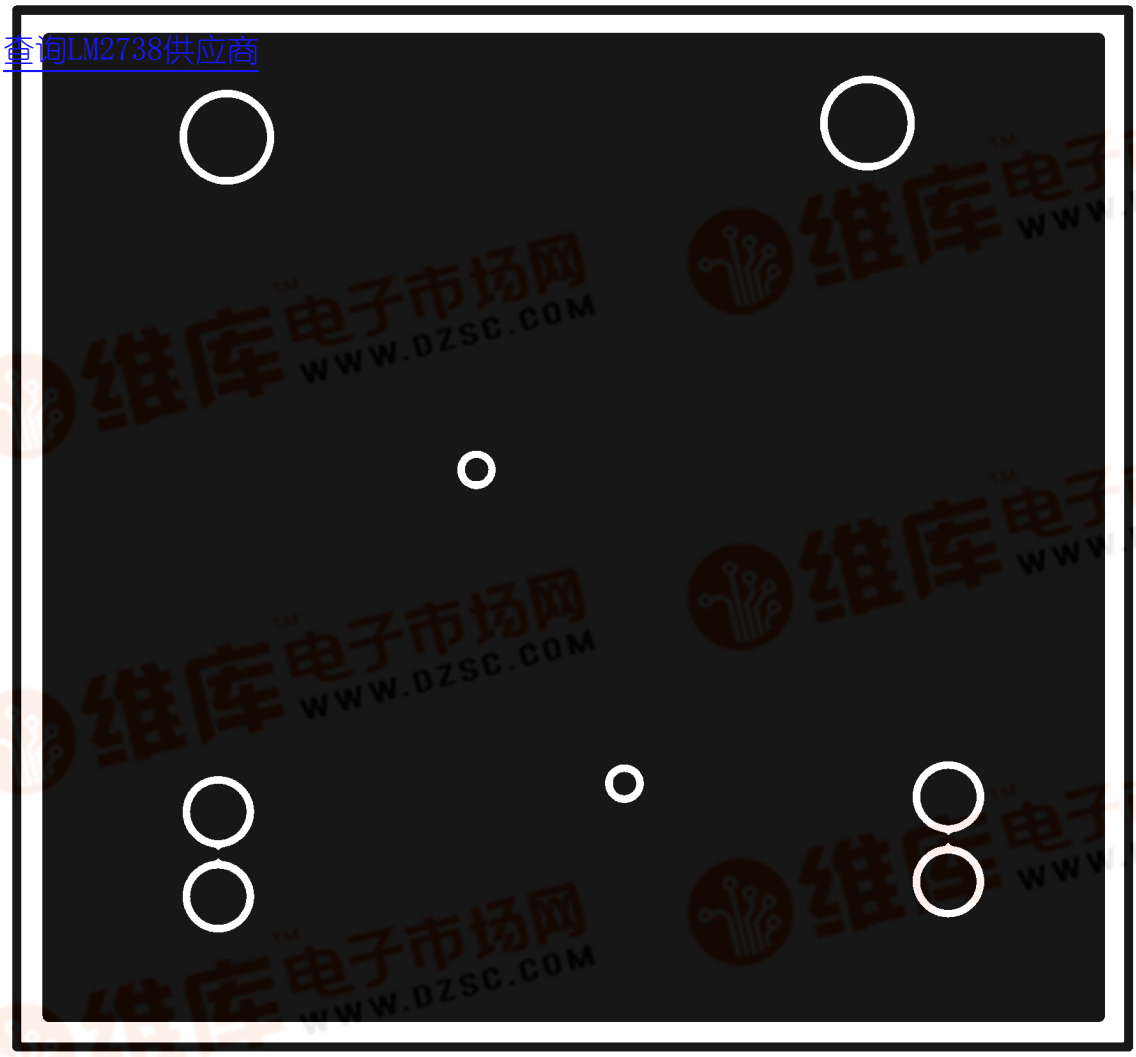
Internal Plane - Layer 2 (GND)



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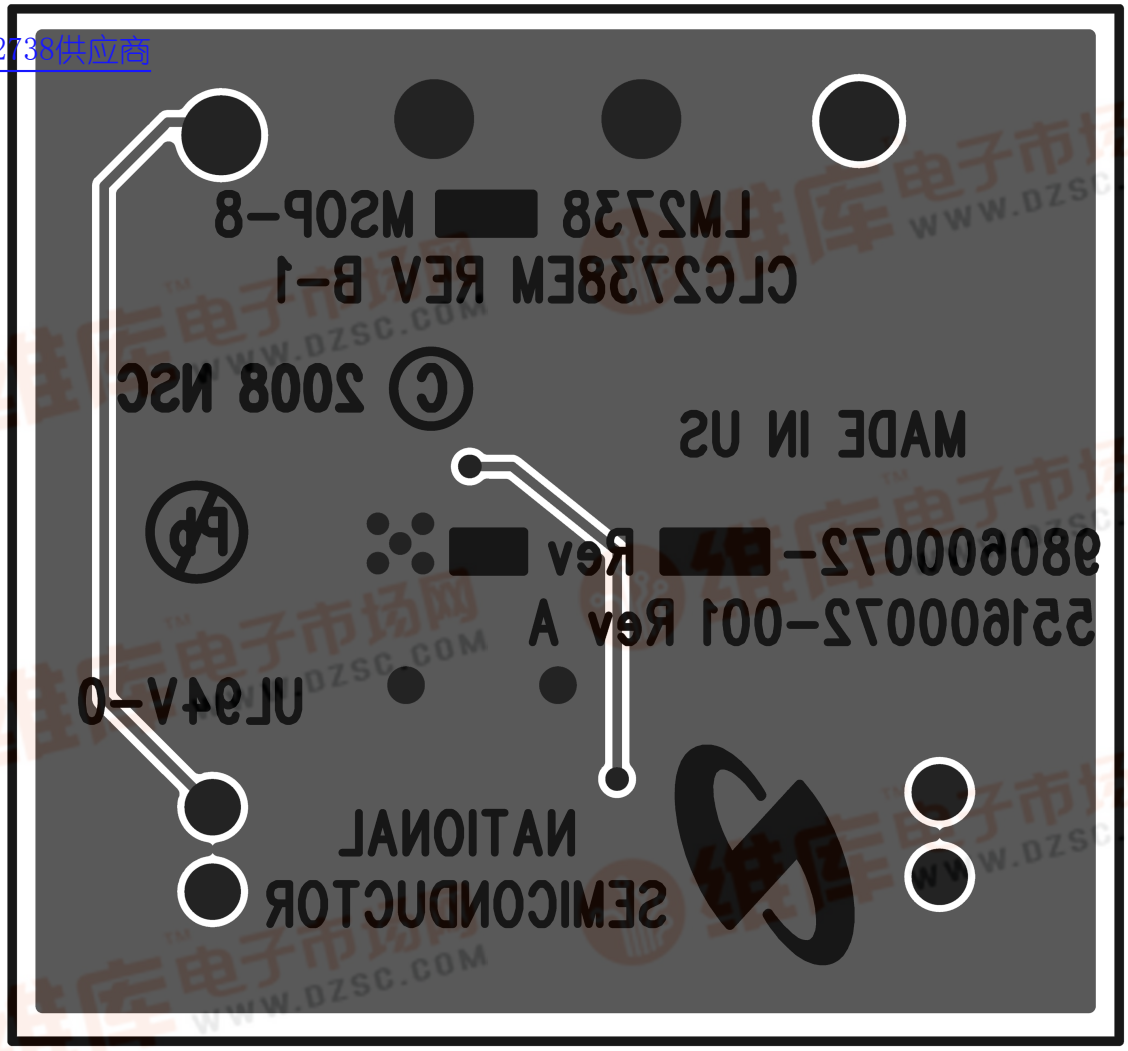
Internal Plane - Layer 3 (GND)



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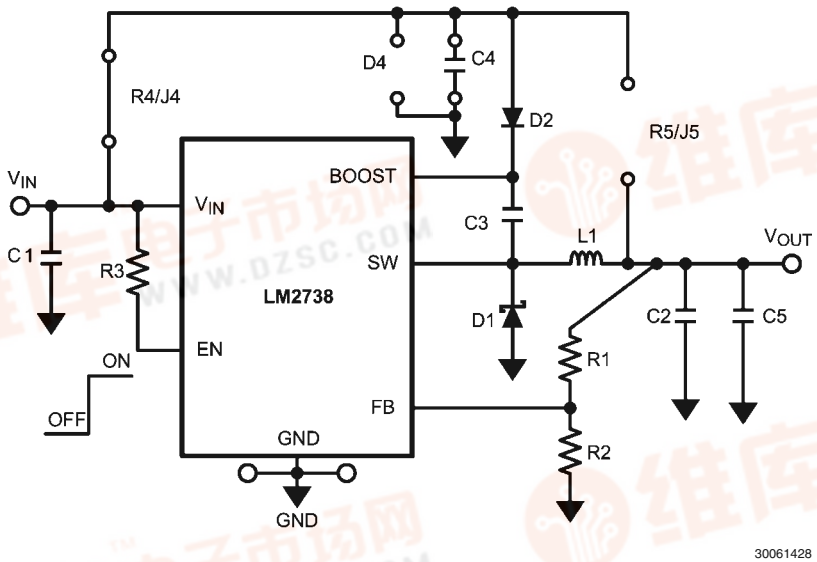
Bottom Layer

Additional Circuit Configuration Schematics



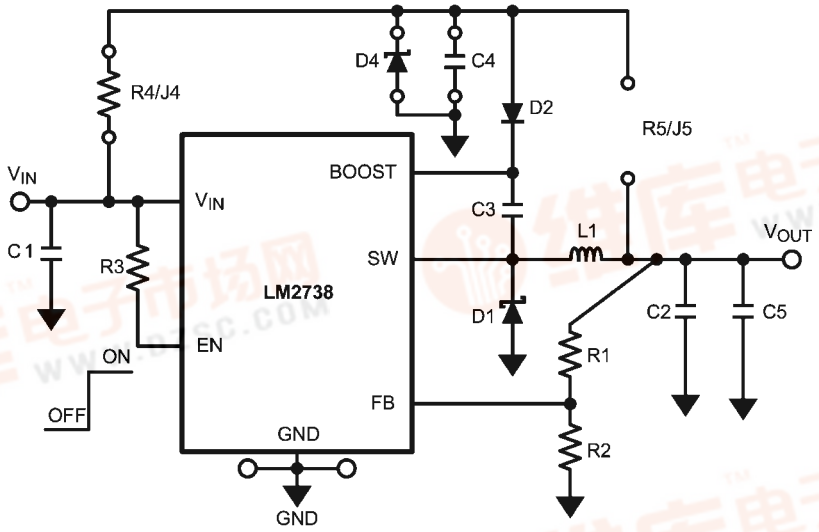
V_{BOOST} derived from V_{IN} = 5V, for V_{OUT} = 1.5V

Bill of Materials X-Version (1.6MHz)

Part ID	Part Value	Manufacturer	Part Number	Package Type
C1, Input Cap	10µF, 25V, X7R	TDK	C3216X5R1E106	1206
C2, Output Cap	22µF, 6.3V, X5R	TDK	C3216X5R0J2266	1206
C3 (Boost Cap), C4	0.1µF	TDK	C2012X7R1A104	0805
D2, Boost Diode	$1V_F$ @ 100mA Diode	Diodes, Inc.	BAT54WS-TP	SOD-323
R2, R3	10kΩ, 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	2.2µH, 1.9A	Coilcraft	MSS5131-222ML	-
R1	8.87kΩ, 1%	Vishay	CRCW12068871F	0805
R4	0Ω	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	10µF, 25V, X7R	TDK	C3216X5R1E106	1206
C2, C5, Output Caps	22µF, 6.3V, X5R	TDK	C3216X5R0J226	1206
C3 (Boost Cap), C4	0.1µF	TDK	C2012X7R1A104	0805
D2, Boost Diode	$1V_F$ @ 100mA Diode	Diodes, Inc.	BAT54WS-TP	SOD-323
R2, R3	10kΩ, 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	6.2µH, 2.5A	Coilcraft	MSS7341-622NL	-
R1	8.87kΩ, 1%	Vishay	CRCW12068871F	0805
R4	0Ω	Vishay	CRCW12060R00F	0805
D4, R5	Open or No Load			



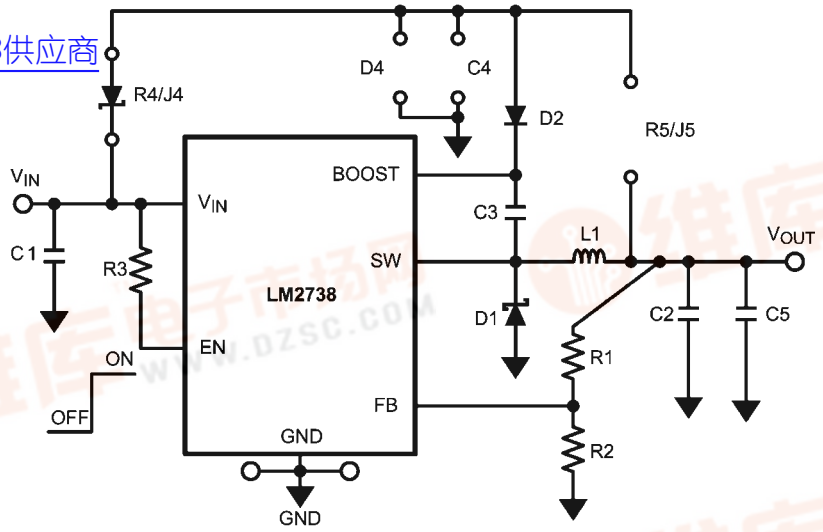
V_{BOOST} derived from V_{SHUNT} coming from V_{IN} = 18V, V_{OUT} = 1.5V

Bill of Materials X-Version (1.6MHz)

Part ID	Part Value	Manufacturer	Part Number	Package Type
C1, Input Cap	10µF, 25V, X7R	TDK	C3216X5R1E106	1206
C2, C5, Output Caps	22µF, 6.3V, X5R	TDK	C3216X5R0J226	1206
C3 (Boost Cap), C4	0.1µF	TDK	C2012X7R1A104	0805
D2, Boost Diode	$1V_F$ @ 100mA Diode	Diodes, Inc.	BAT54WS-TP	SOD-323
D4, Zeneer	5.1V, 200mW	Diodes, Inc.	BZX84C5V1W	SOT-323
R2, R3	10kΩ, 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	2.7µH, 1.76A	TDK	VLCF5020T-2R7N1R7	-
R1	8.87kΩ, 1%	Vishay	CRCW12068871F	0805
R4	4.12kΩ. 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	10µF, 25V, X7R	TDK	C3216X5R1E106	1206
C2, C5, Output Caps	47µF, 6.3V, X5R	TDK	C3216X5R0J476	1206
C3 (Boost Cap), C4	0.1µF	TDK	C2012X7R1A104	0805
D2, Boost Diode	$1V_F$ @ 100mA Diode	Diodes, Inc.	BAT54WS-TP	SOD-323
D4, Zeneer	5.1V, 200mW	Diodes, Inc.	BZX84C5V1W	SOT-323
R2, R3	10kΩ, 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	8.7µH, 2.2A	Coilcraft	MSS7341-872NL	-
R1	8.87kΩ, 1%	Vishay	CRCW12068871F	0805
R4	4.21kΩ, 1%	Vishay	CRCW12064211F	0805
R5	Open or No Load			



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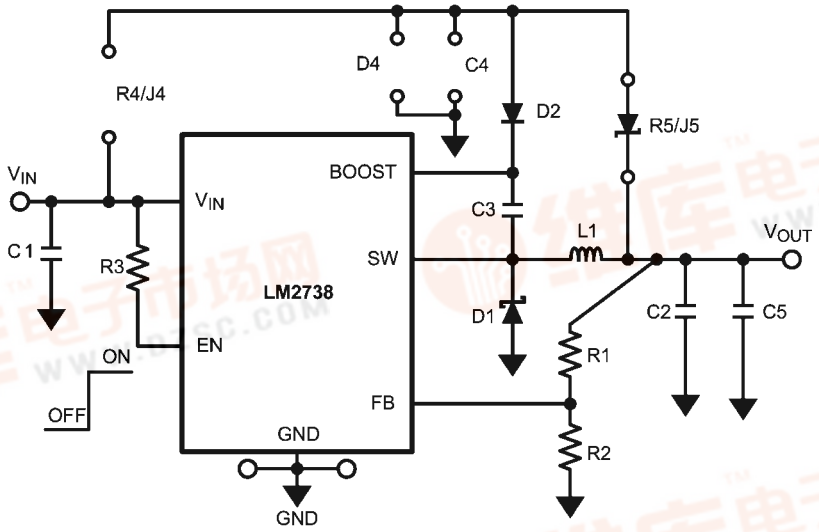
V_{BOOST} derived from Series Zener Diode from V_{IN} = 15V, V_{OUT} = 1.5V

Bill of Materials X-Version (1.6MHz)

Part ID	Part Value	Manufacturer	Part Number	Package Type
C1, Input Cap	10µF, 25V, X7R	TDK	C3216X5R1E106	1206
C2, C5, Output Caps	22µF, 6.3V, X5R	TDK	C3216X5R0J226	1206
C3 (Boost Cap)	0.1µF	TDK	C2012X7R1A104	0805
D2, Boost Diode	1V_F @ 100mA Diode	Diodes, Inc.	BAT54WS-TP	SOD-323
R2, R3	10kΩ, 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	3.3µH, 3.5A	Coilcraft	MSS7341-332NL	-
R1	8.87kΩ, 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	10µF, 25V, X7R	TDK	C3216X5R1E106	1206
C2, C5, Output Caps	47µF, 6.3V, X5R	TDK	C3216X5R0J476	1206
C3 (Boost Cap)	0.1µF	TDK	C2012X7R1A104	0805
D2, Boost Diode	1V_F @ 100mA Diode	Diodes, Inc.	BAT54WS-TP	SOD-323
R2, R3	10kΩ, 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	8.7µH, 2.2A	Coilcraft	MSS7341-872NL	-
R1	8.87kΩ, 1%	Vishay	CRCW12068871F	0805
R4	11V, 200mW, Zener	Vishay	BZX384C11-V	SOD-323
D4, R5, C4	Open or No Load			



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

Bill of Materials X-Version (1.6MHz)

Part ID	Part Value	Manufacturer	Part Number	Package Type
C1, Input Cap	10µF, 25V, X7R	TDK	C3216X5R1E106	1206
C2, Output Cap	22µF, 10V, X5R	TDK	C3216X5R1A226	1206
C3 (Boost Cap), C4	0.1µF	TDK	C2012X7R1A104	0805
D2, Boost Diode	$1V_F$ @ 100mA Diode	Diodes, Inc.	BAT54WS-TP	SOD-323
R2, R3	10kΩ, 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	6.2µH, 2.5A	Coilcraft	MSS7341-622NL	-
R1	102kΩ, 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	10µF, 25V, X7R	TDK	C3216X5R1E106	1206
C2, Output Cap	22µF, 10V, X5R	TDK	C3216X5R1A226	1206
C3 (Boost Cap), C4	0.1µF	TDK	C2012X7R1A104	0805
D2, Boost Diode	$1V_F$ @ 100mA Diode	Diodes, Inc.	BAT54WS-TP	SOD-323
R2, R3	10kΩ, 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	5.0µH, 2.9A	Coilcraft	MSS7341-502NL	-
R1	102kΩ, 1%	Vishay	CRCW12061023F	0805
R5	4.3V, 200mW, Zener	Vishay	BZX384C4V3-V	SOD-323
D4, R4	Open or No Load			

Notes

Notes

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