

# LMZ14203H/02H/01H Evaluation Board

National Semiconductor  
Application Note 2089  
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## Introduction

The LMZ14203H/02H/01H SIMPLE SWITCHER® power modules for high output voltage are easy-to-use DC-DC solutions capable of driving up to a 3A load with exceptional power conversion efficiency, output voltage accuracy, line and load regulation. They are available in an innovative package that enhances thermal performance and allows for hand or machine soldering.

The LMZ14203H/02H/01H Evaluation Board is configured for 12V output voltage from 15V to 42V input. The precision enable input allows for programmable UVLO of the input supply. The resistor voltage divider  $R_{ENT}$  and  $R_{ENB}$  set the input UVLO threshold. Connect the  $V_{IN}$  turret terminal to the EN turret on the board to enable operation.

The external soft-start capacitor  $C_{SS}$  facilitates controlled startup output rise time. The resistors  $R_{FBT}$  and  $R_{FBB}$  set the output voltage. An output feed-forward capacitor  $C_{FF}$  across the upper feedback resistor trims for optimum transient response. The control loop operates well with low ESR output capacitors such as ceramic and polymer electrolytic capacitors. The resistor  $R_{ON}$  sets the operating frequency. See datasheet for component selection details.

The LMZ14203H/02H/01H PCB layout offers excellent thermal performance, achieving junction-to-ambient thermal resistance  $\theta_{JA}$  of 14.9°C/W. The evaluation board with its default Bill of Materials offers great EMI performance, complying with the EN 55022 Class B radiated emissions standard. The solution also complies with the CISPR22 conducted emissions standard with the addition of a small input filter.

## Board Specifications

- $V_{IN} = 15V$  to 42V
- $V_{OUT} = 12V$
- 3A max load at 24V<sub>IN</sub> and 65°C T<sub>AMB</sub>
- Low radiated EMI (EN 55022 Class B compliant)
- 400kHz switching frequency
- Enable UVLO set at 13.5V
- $\theta_{JA} = 14.9^{\circ}C/W$
- 4 copper layers
- 2 oz copper on top and bottom layer
- 1 oz copper on internal layers
- 6.985 cm x 7.620 cm (2.75 in x 3 in) with 1.575 cm (.062 in) thickness of FR4 laminate material

## Additional Footprints

Additional component mounting pads are available to experiment with alternative input and output capacitor combinations or a zener clamp on the enable input. See Figure 6 for corresponding schematic locations.

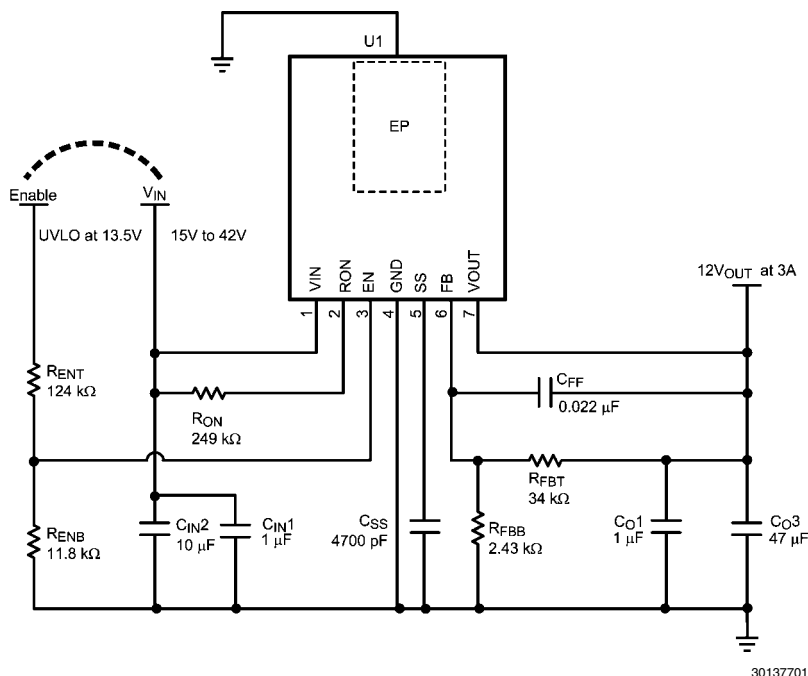


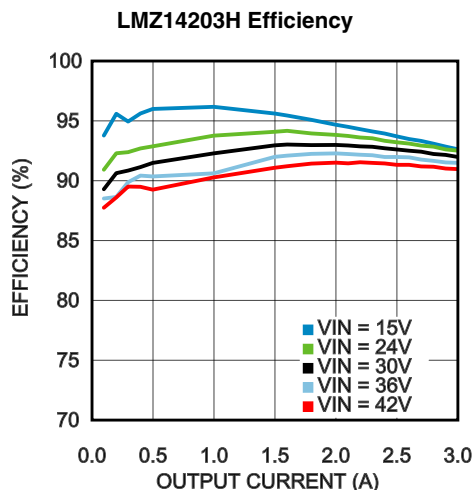
FIGURE 1. Evaluation Board Schematic

**TABLE 1. LMZ1420xH Bill of Materials,  $V_{IN} = 15V$  to  $42V$ ,  $V_{OUT} = 12V$ ,  $I_{OUT(MAX)} = 3A / 2A / 1A$** 

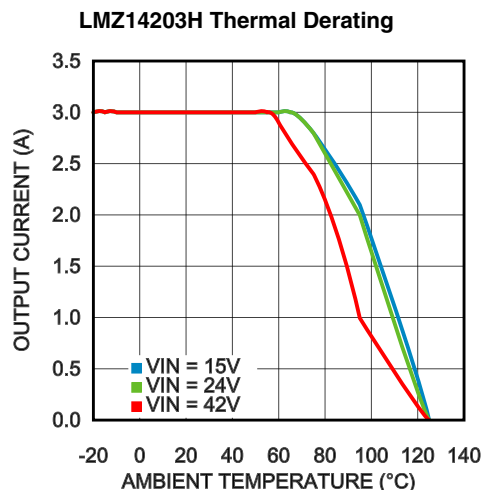
Designator	Description	Case Size	Manufacturer	Manufacturer P/N	Quantity
U1	SIMPLE SWITCHER®	TO-PMOD-7	National Semiconductor	LMZ14203HTZ or LMZ14202HTZ or LMZ14201HTZ	1
$C_{IN4}, C_{O1}$	1 $\mu F$ , X7R, 50V	1206	Taiyo Yuden	UMK316B7105KL-T	2
$C_{IN2}$	10 $\mu F$ , X5R, 50V	1210	Taiyo Yuden	UMK325BJ106MM-T	1
$C_{O3}$	47 $\mu F$ , 35 m $\Omega$ , 16V, Polymer	7343-43	KEMET	T525D476M016ATE035	1
$C_{FF}$	0.022 $\mu F$ , X7R, 100V	0805	AVX	08051C223JAT2A	1
$C_{SS}$	4700 pF, X7R, 25V	0805	AVX	08053A472JAT2A	1
$R_{ENB}$	11.8 k $\Omega$	0805	Panasonic	ERJ-6ENF1182V	1
$R_{ENT}$	124 k $\Omega$	0805	Panasonic	ERJ-6ENF1243V	1
$R_{FBT}$	34 k $\Omega$	0805	Vishay-Dale	CRCW080534K0FKEA	1
$R_{FBB}$	2.43 k $\Omega$	0805	Panasonic	ERJ-6ENF2431V	1
$R_{ON}$	249 k $\Omega$	0805	Vishay-Dale	CRCW0805249KFKEA	1

## Performance Characteristics

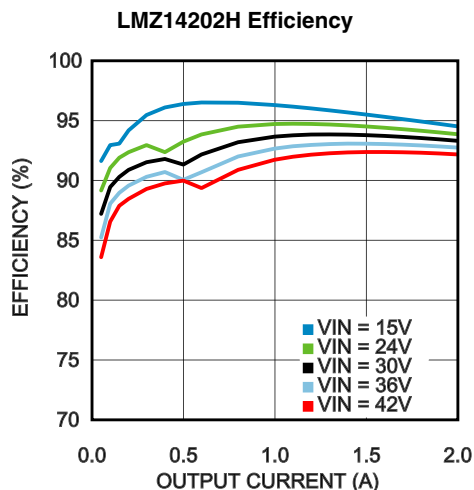
Unless otherwise specified the following conditions apply:  $V_{IN} = 24V$ ,  $V_{OUT} = 12V$ ,  $T_{AMB} = 25^{\circ}C$



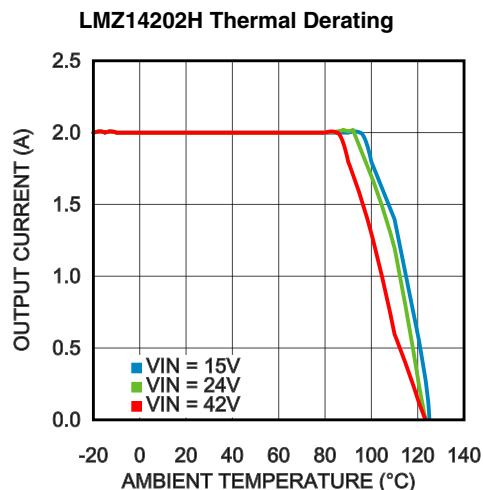
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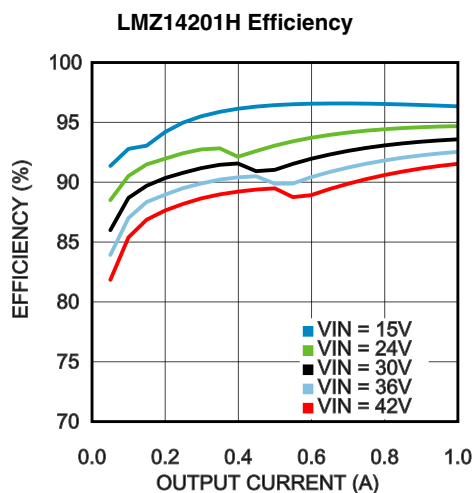
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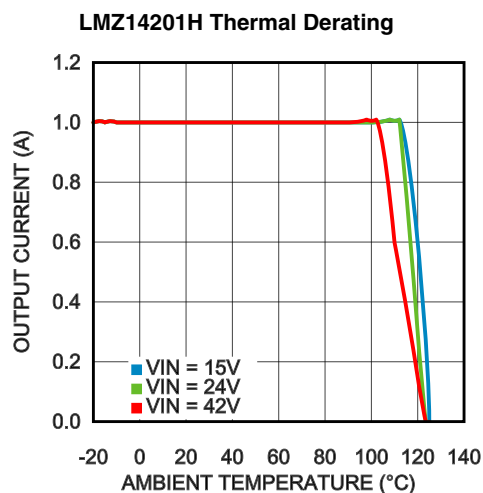
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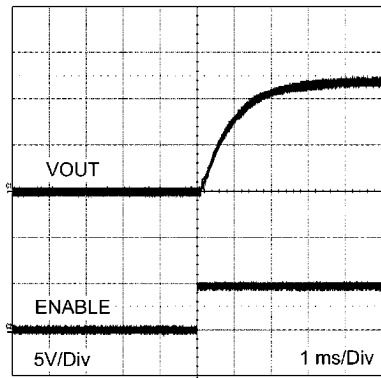


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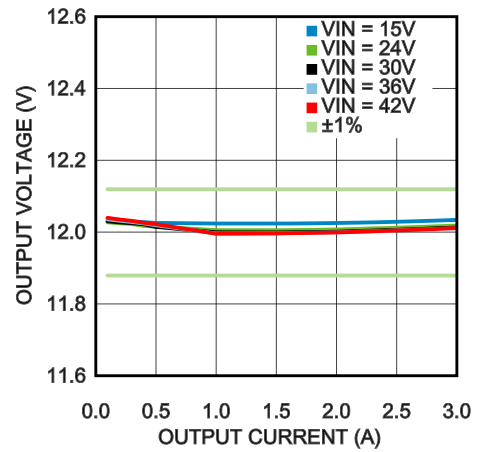
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LMZ14203H Startup

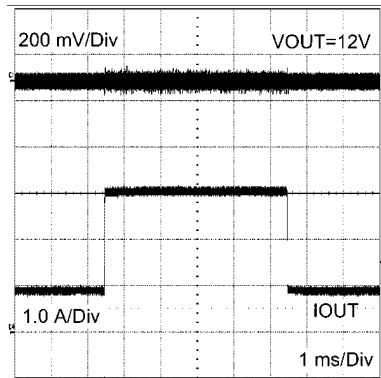


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LMZ14203H Line and Load Regulation

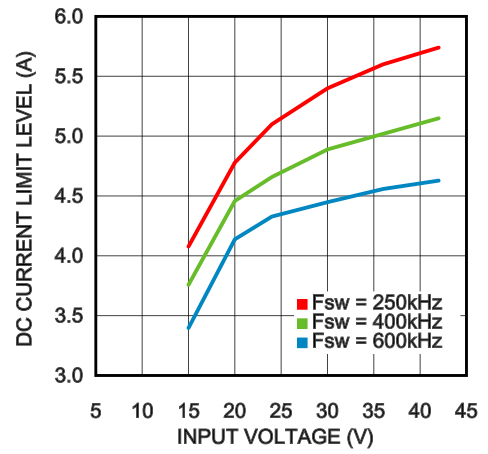


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LMZ14203H Transient Response  
30% to 100% Load Step

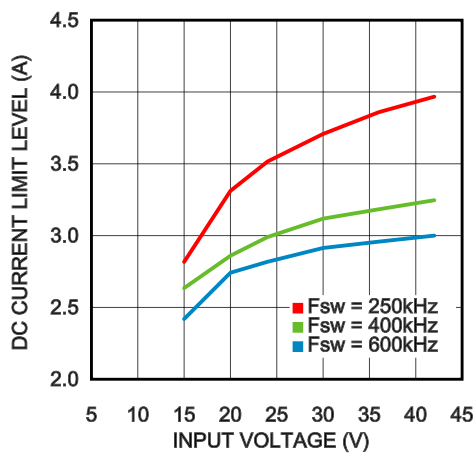
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LMZ14203H Current Limit



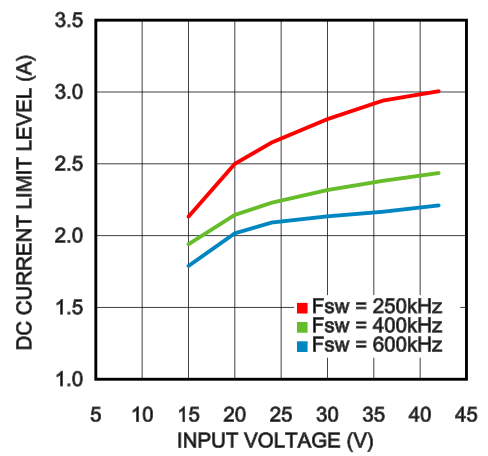
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LMZ14202H Current Limit

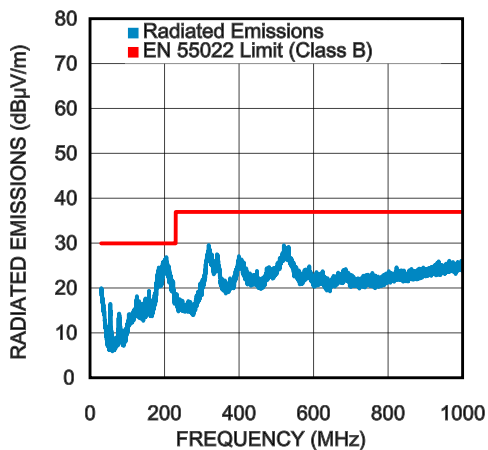


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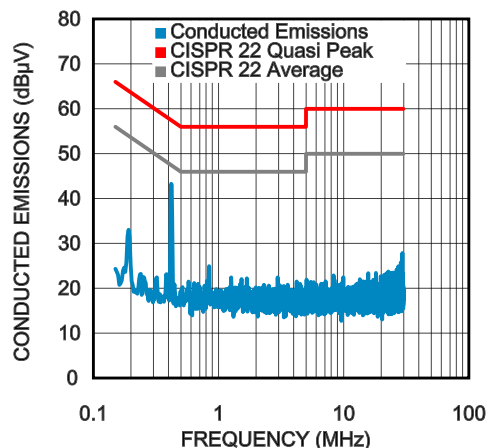
LMZ14201H Current Limit



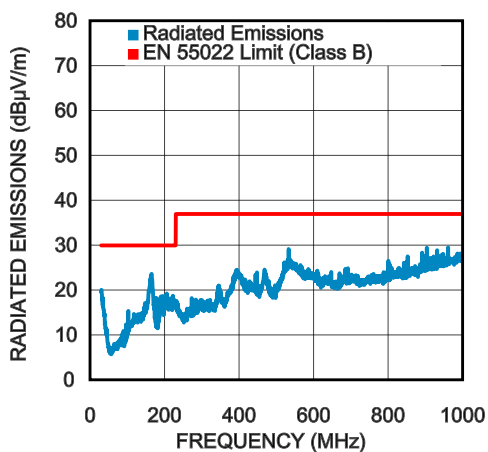
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LMZ14203H Radiated EMI,  $I_{OUT} = 3A$ 

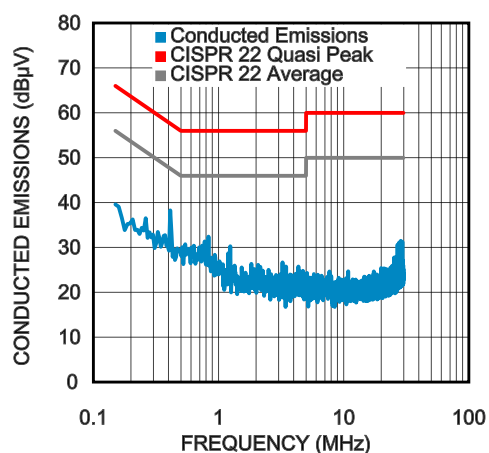
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LMZ14203H Conducted EMI,  $I_{OUT} = 3A$   
with 3.3μH 2x10μF LC line filter added

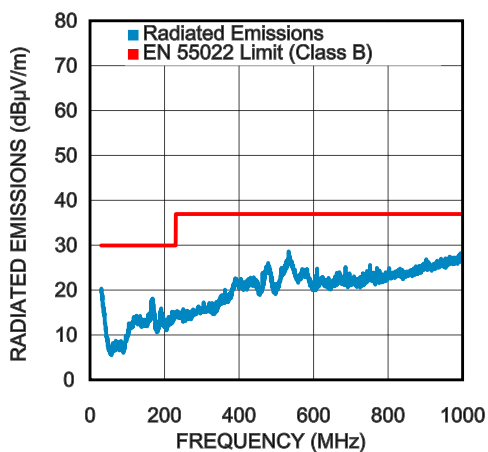
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LMZ14202H Radiated EMI,  $I_{OUT} = 2A$ 

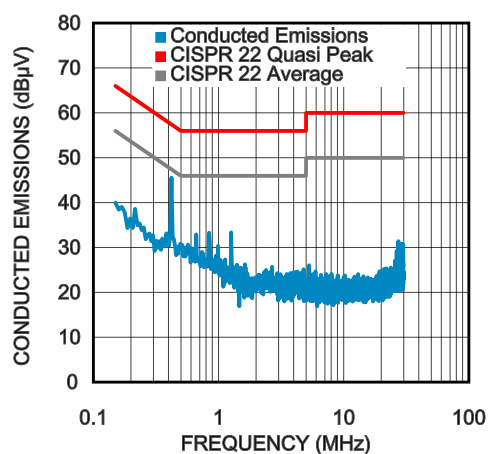
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LMZ14202H Conducted EMI,  $I_{OUT} = 2A$   
with 3.3μH 2x10μF LC line filter added

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LMZ14201H Radiated EMI,  $I_{OUT} = 1A$ 

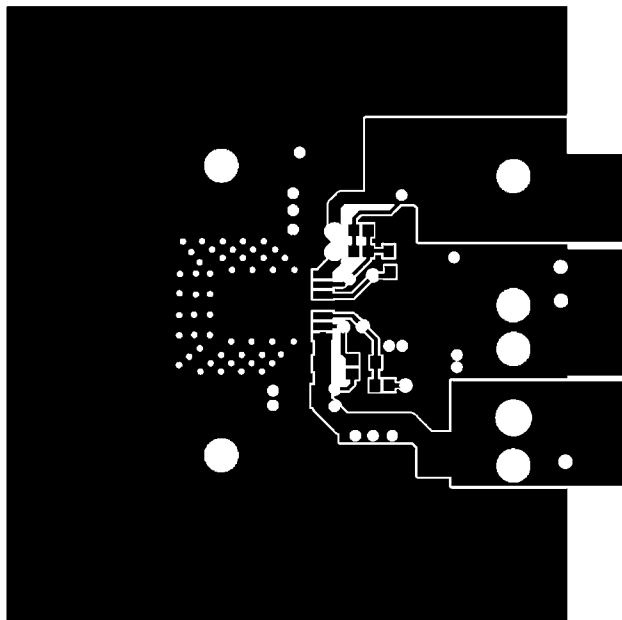
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LMZ14201H Conducted EMI,  $I_{OUT} = 1A$   
with 3.3μH 1μF LC line filter added

30137753

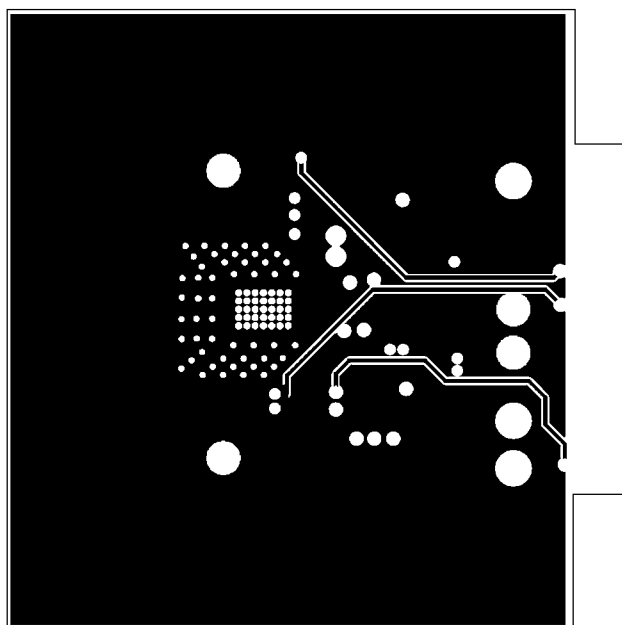
## PCB Layout Diagrams

Gerber and CAD files can be download from the LMZ14203H product folder.



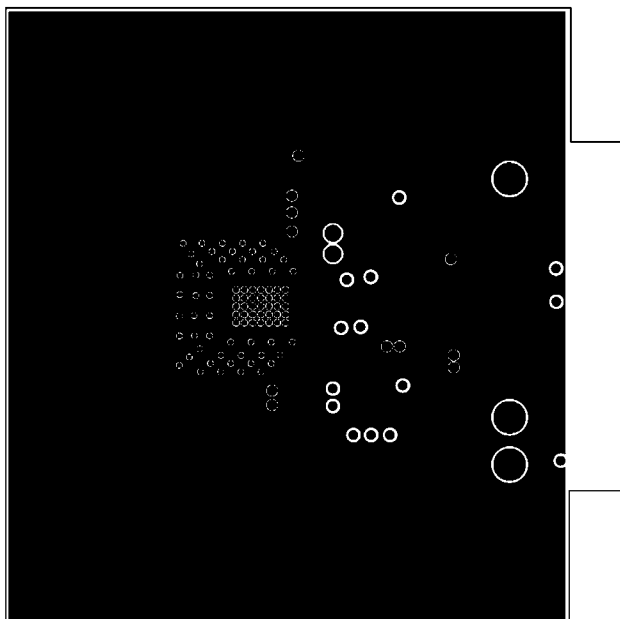
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**FIGURE 2. Top Layer**



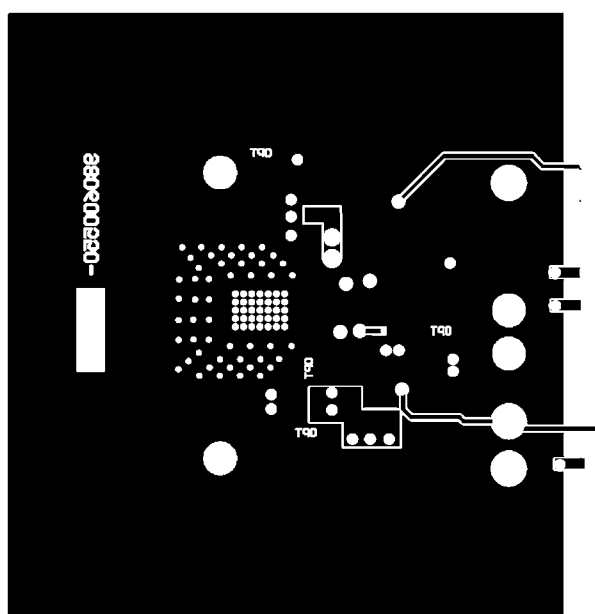
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**FIGURE 3. Internal Layer I (Ground)  
Heat Sinking Layer**



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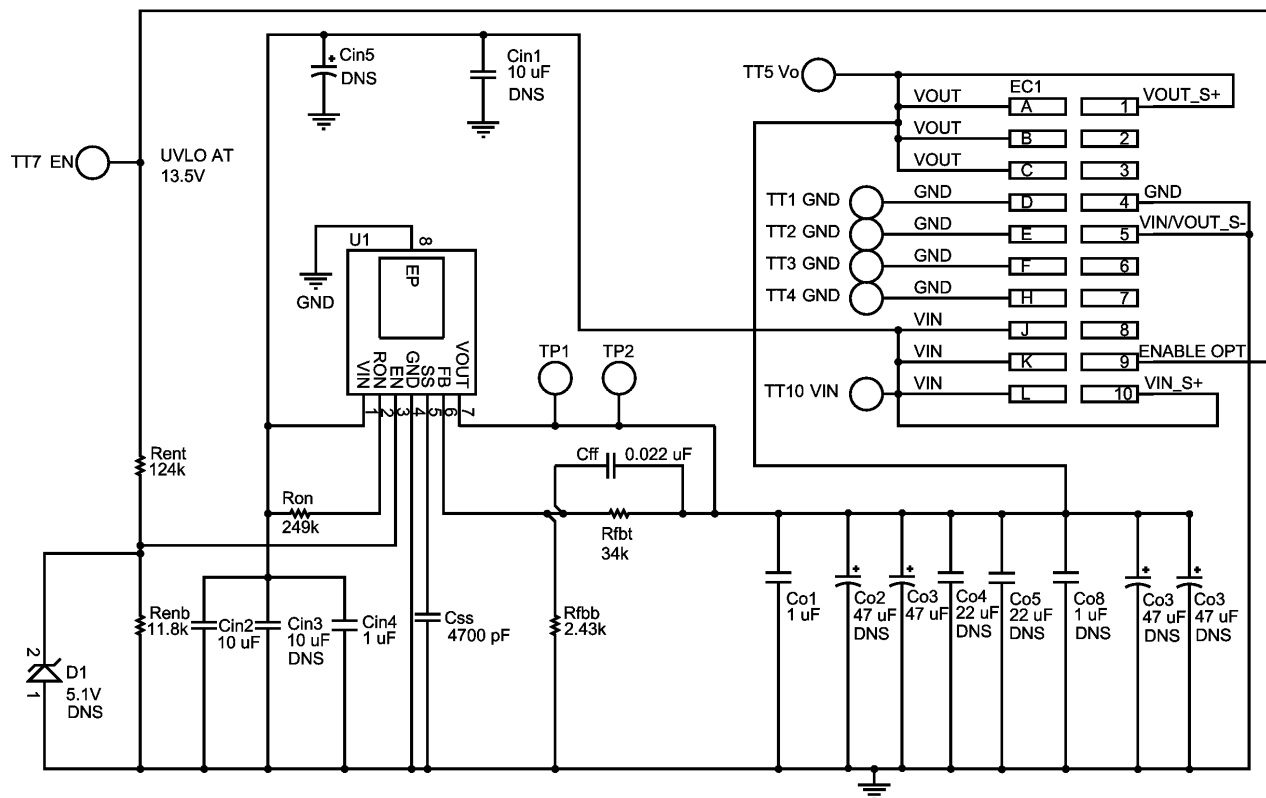
**FIGURE 4. Internal Layer II (Ground)  
Heat Sinking Layer**



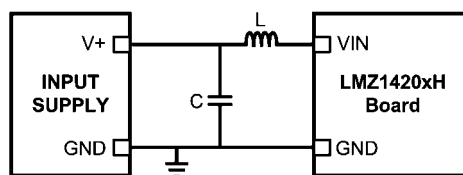
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**FIGURE 5. Bottom Layer (Ground and Routing)  
Heat Sinking Layer**

## PCB Schematic



**FIGURE 6. Detailed Schematic**  
**DNS = Component not installed**



**FIGURE 7. Conducted EMI LC Filter Configuration**





## Notes

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Power Management	<a href="http://www.national.com/power">www.national.com/power</a>	Green Compliance	<a href="http://www.national.com/quality/green">www.national.com/quality/green</a>
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LED Lighting	<a href="http://www.national.com/led">www.national.com/led</a>	Feedback/Support	<a href="http://www.national.com/feedback">www.national.com/feedback</a>
Voltage References	<a href="http://www.national.com/vref">www.national.com/vref</a>	Design Made Easy	<a href="http://www.national.com/easy">www.national.com/easy</a>
PowerWise® Solutions	<a href="http://www.national.com/powerwise">www.national.com/powerwise</a>	Applications & Markets	<a href="http://www.national.com/solutions">www.national.com/solutions</a>
Serial Digital Interface (SDI)	<a href="http://www.national.com/sdi">www.national.com/sdi</a>	Mil/Aero	<a href="http://www.national.com/milaero">www.national.com/milaero</a>
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