

# LMZ1420xEXT / LMZ1200xEXT Evaluation Board

National Semiconductor  
Application Note 2084  
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August 16, 2010



## Introduction

The LMZ1420xEXT and LMZ1200xEXT SIMPLE SWITCH-ER® power modules are easy-to-use DC-DC solution 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 LMZ14203EXT/2EXT/1EXT can accept an input voltage rail between 6V and 42V and the LMZ12003EXT/2EXT/1EXT can accept an input voltage rail between 4.5V and 20V. The devices can deliver an adjustable and highly accurate output voltage as low as 0.8V and as high as 6V. The control structure is constant on-time with input voltage feed forward. This creates a nearly constant switching frequency across the input voltage range. The control loop operates well with low ESR output capacitors such as ceramics. An output feed-forward capacitor across the upper feedback resistor trims for optimum transient response. The precision enable input allows for programmable UVLO of the input supply. The external soft-start capacitor facilitates controlled startup output rise time. The LMZ1420xEXT and LMZ1200xEXT family is a reliable and robust solution with the following features: lossless cycle-by-cycle valley current limit to protect for over current or short-circuit fault, thermal shutdown, input under-voltage lock-out, and will start up into a pre-biased output. The LMZ1420xEXT and LMZ1200xEXT families are shock and vibration certified and rated for operation down to  $-55^{\circ}\text{C}$ .

## Board Specifications

- LMZ1420xEXT  $V_{\text{IN}} = 6\text{V}$  to  $42\text{V}$
- LMZ1420xEXT enable UVLO =  $8\text{V}$
- LMZ1420xEXT  $V_{\text{OUT}} = 3.3\text{V}$
- LMZ1200xEXT  $V_{\text{IN}} = 4.5\text{V}$  to  $20\text{V}$
- LMZ1200xEXT enable UVLO =  $4.5\text{V}$
- LMZ1200xEXT  $V_{\text{OUT}} = 1.8\text{V}$
- Operates at full load up to  $80^{\circ}\text{C}$  ambient at  $12\text{V}$  input
- $\theta_{\text{JA}} = 20^{\circ}\text{C} / \text{W}$ ,  $\theta_{\text{JC}} = 1.9^{\circ}\text{C} / \text{W}$
- Designed on four layers, all four layers are 1 oz. copper weight
- The two internal ground planes are identical
- Measures 1.705 in. x 3.03 in. (4.33 cm x 7.7cm) and is 62mil (.062") thick of FR4 laminate material

For additional circuit modifications refer to the Design Consideration section of the LMZ1420xEXT or LMZ1200xEXT data sheet. For negative output voltage connections see AN-2027.

## Additional Footprints

Additional component mounting pads are available to experiment with alternative  $C_{\text{in}}$  and  $C_{\text{out}}$  combinations or a zener clamp on the enable input. See Figure 6 for corresponding schematic locations.

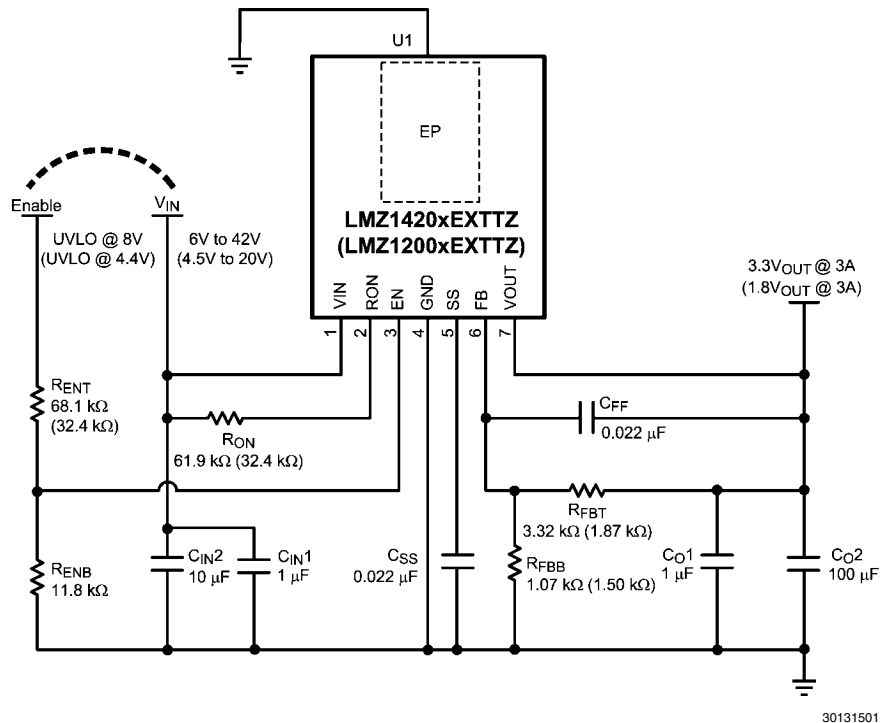


FIGURE 1. Evaluation Board Schematic  
(LMZ1200xEXT 1.8V application values shown in parentheses)

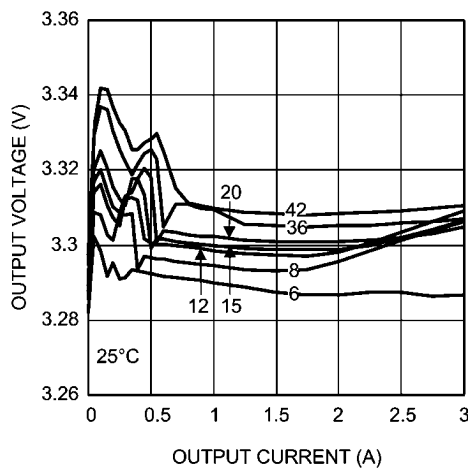
**TABLE 1. LMZ1420xEXT Bill of Materials,  $V_{IN} = 8V$  to  $42V$ ,  $V_{OUT} = 3.3V$ ,  $I_{OUT(MAX)} = 3A / 2A / 1A$** 

Designator	Description	Case Size	Manufacturer	Manufacturer P/N	Quantity
U1	SIMPLE SWITCHER®	TO-PMOD-7	National Semiconductor	LMZ14203EXTTZ or LMZ14202EXTTZ or LMZ14201EXTTZ	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
$C_{O2}$	100 $\mu F$ , X5R, 6.3V	1210	Taiyo Yuden	JMK325BJ107MM-T	1
$C_{SS}, C_{FF}$	0.022 $\mu F$ , X7R, 100V	0805	AVX	08051C223JAT2A	2
$R_{ENB}$	11.8k	0805	Panasonic	ERJ-6ENF1182V	1
$R_{ENT}$	68.1 k $\Omega$	0805	Panasonic	ERJ-6ENF6812V	1
$R_{FBT}$	3.32 k $\Omega$	0805	Vishay-Dale	CRCW08053K32FKEA	1
$R_{FBB}$	1.07 k $\Omega$	0805	Panasonic	CRCW080534K8FKEA	1
$R_{ON}$	61.9 k $\Omega$	0805	Panasonic	ERJ-6ENF6192V	1

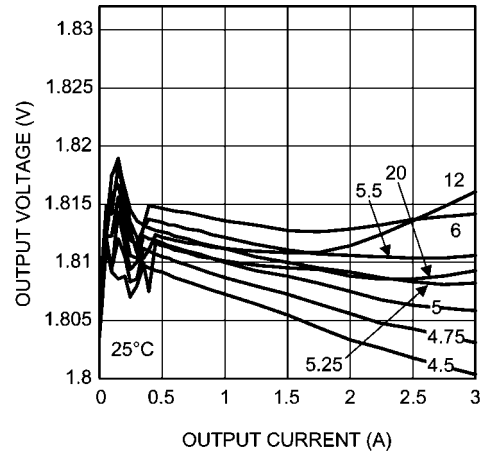
**TABLE 2. LMZ1200xEXT Bill of Materials,  $V_{IN} = 4.5$  to  $20V$ ,  $V_{OUT} = 1.8V$ ,  $I_{OUT(MAX)} = 3A / 2A / 1A$** 

Designator	Description	Case Size	Manufacturer	Manufacturer P/N	Quantity
U1	SIMPLE SWITCHER®	TO-PMOD-7	National Semiconductor	LMZ12003EXTTZ or LMZ12002EXTTZ or LMZ12001EXTTZ	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
$C_{O2}$	100 $\mu F$ , X5R, 6.3V	1210	Taiyo Yuden	JMK325BJ107MM-T	1
$C_{SS}, C_{FF}$	0.022 $\mu F$ , X7R, 100V	0805	AVX	08051C223JAT2A	2
$R_{ENB}$	11.8k	0805	Panasonic	ERJ-6ENF1182V	1
$R_{ENT}$	32.4K $\Omega$	0805	Panasonic	ERJ-6ENF3242V	1
$R_{FBT}$	1.87 k $\Omega$	0805	Vishay-Dale	CRCW08051K87FKEA	1
$R_{FBB}$	1.50 k $\Omega$	0805	Panasonic	CRCW08051K50FKEA	1
$R_{ON}$	32.4K $\Omega$	0805	Panasonic	ERJ-6ENF3242V	1

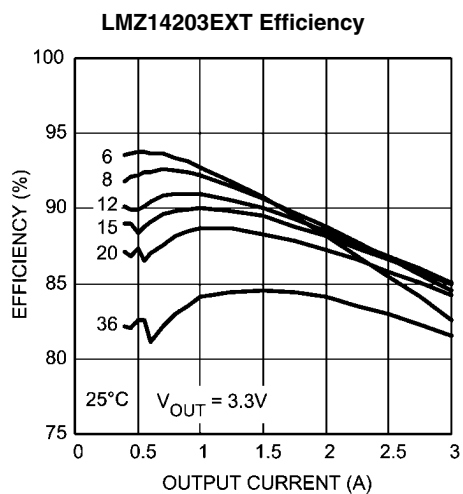
## Performance Characteristics

**LMZ14203EXT Load and Line Regulation**

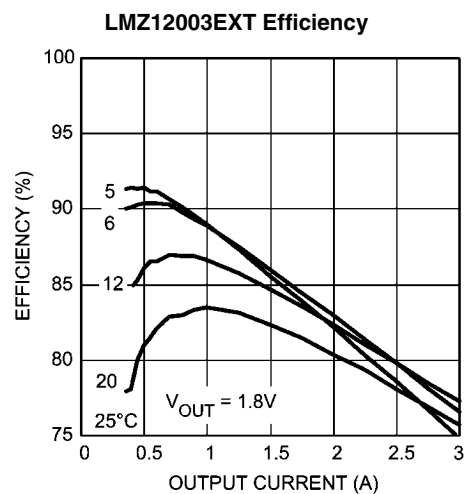
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**LMZ12003EXT Load and Line Regulation**

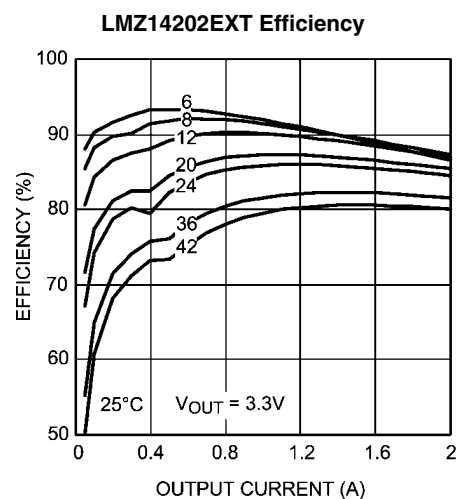
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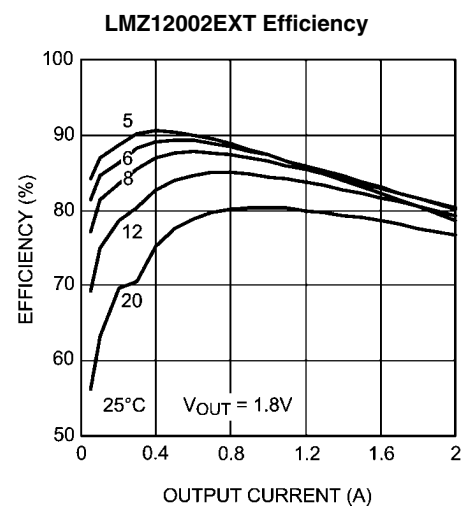
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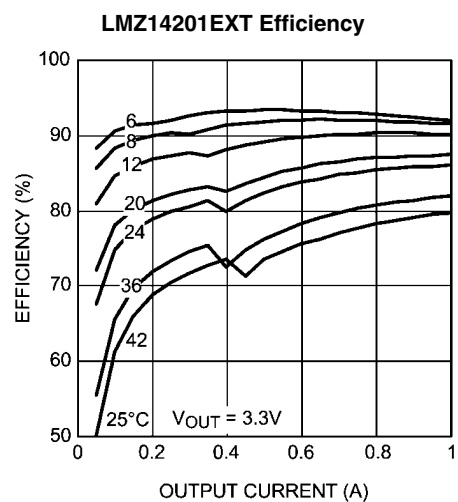
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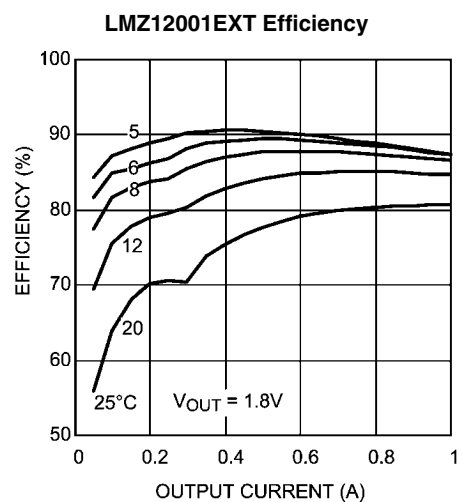
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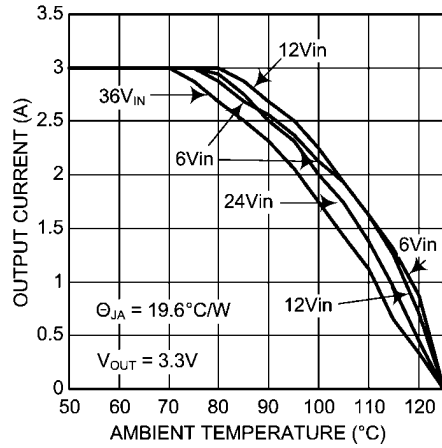
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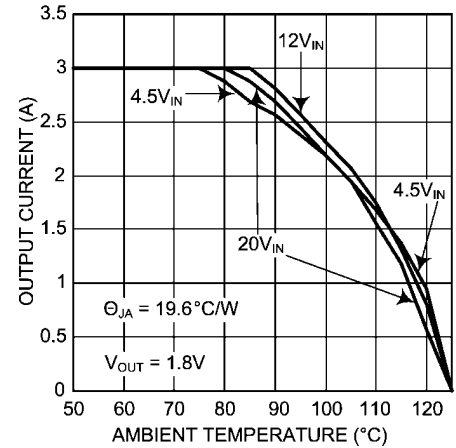
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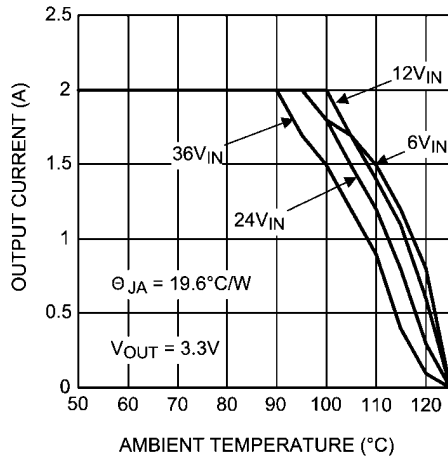
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**LMZ14203EXT Thermal Derating**

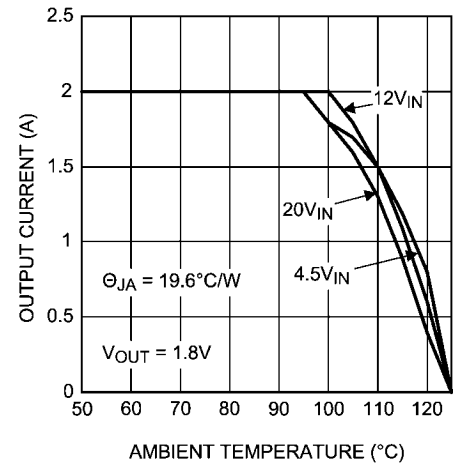
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**LMZ12003EXT Thermal Derating**

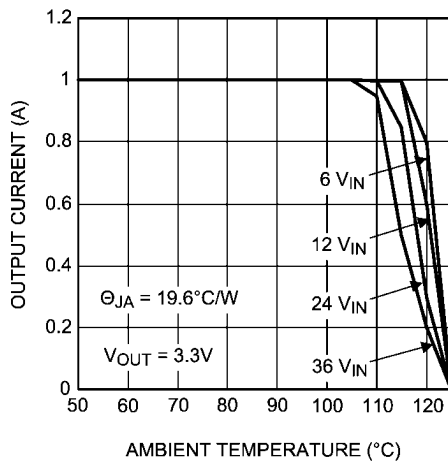
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**LMZ14202EXT Thermal Derating**

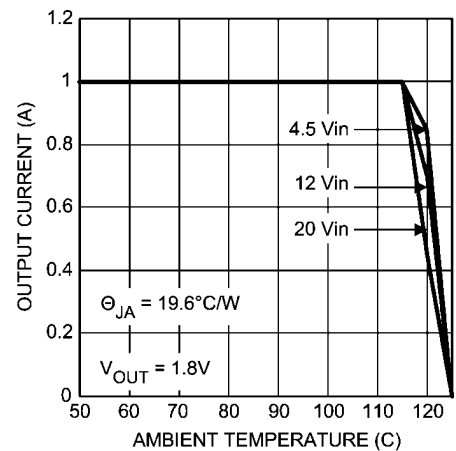
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**LMZ12002EXT Thermal Derating**

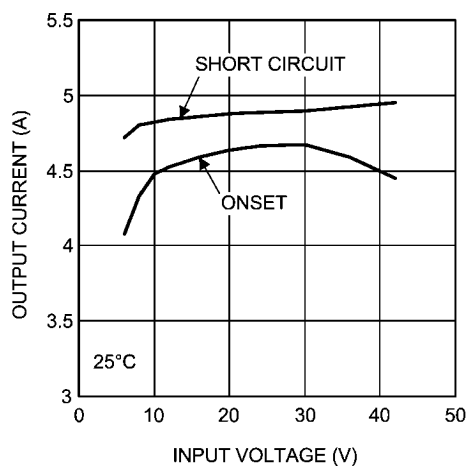
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**LMZ14201EXT Thermal Derating**

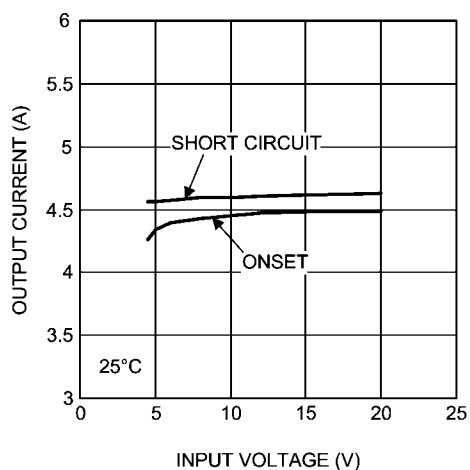
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**LMZ12001EXT Thermal Derating**

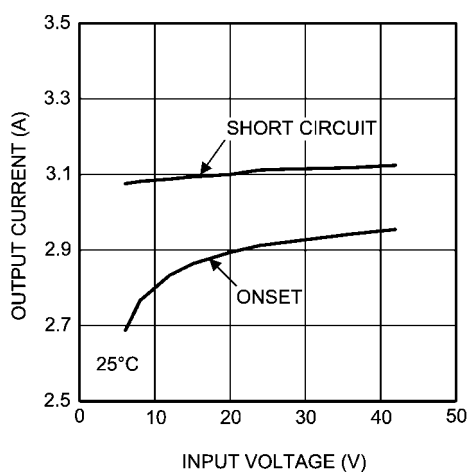
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**LMZ14203EXT Current Limit  $V_{OUT} = 3.3V$** 

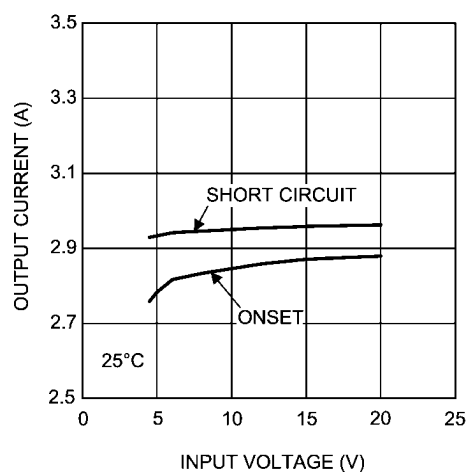
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**LMZ12003EXT Current Limit  $V_{OUT} = 1.8V$** 

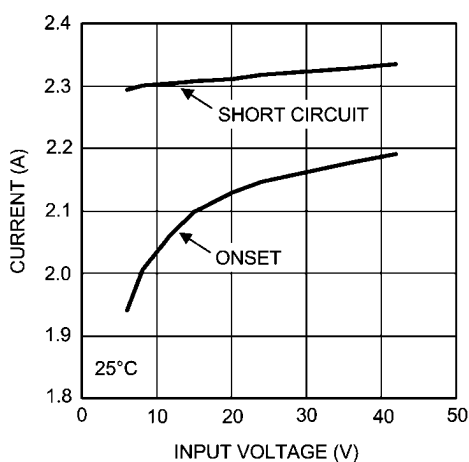
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**LMZ14202EXT Current Limit  $V_{OUT} = 3.3V$** 

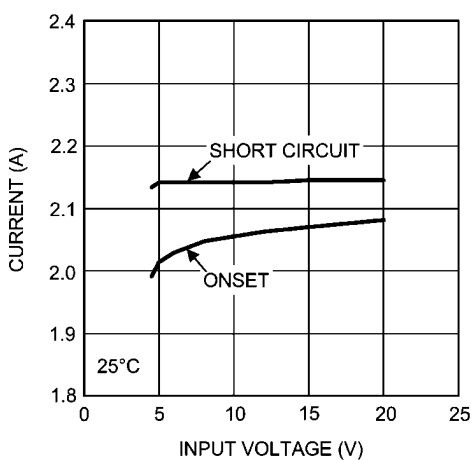
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**LMZ12002EXT Current Limit  $V_{OUT} = 1.8V$** 

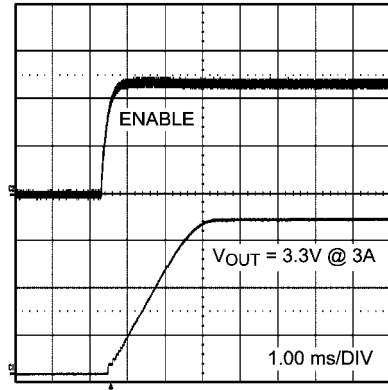
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**LMZ14201EXT Current Limit  $V_{OUT} = 3.3V$** 

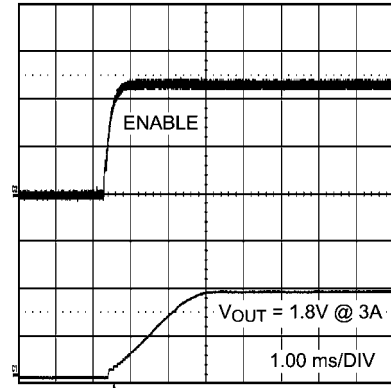
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**LMZ12001EXT Current Limit  $V_{OUT} = 1.8V$** 

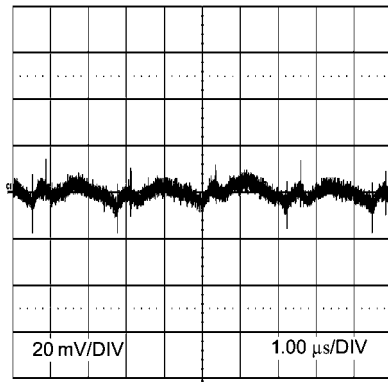
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LMZ14203EXT Startup  $V_{IN} = 12V$ 

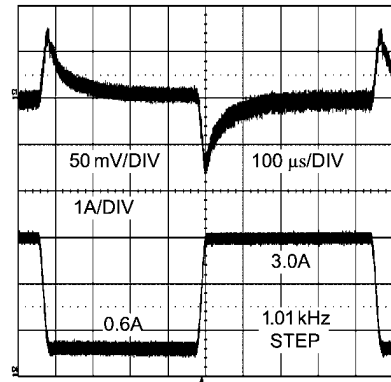
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LMZ12003EXT Startup  $V_{IN} = 12V$ 

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LMZ14203EXT Output Ripple  $V_{OUT} = 3.3V$   
 $I_{OUT} = 3A$ , BW = 200 MHz

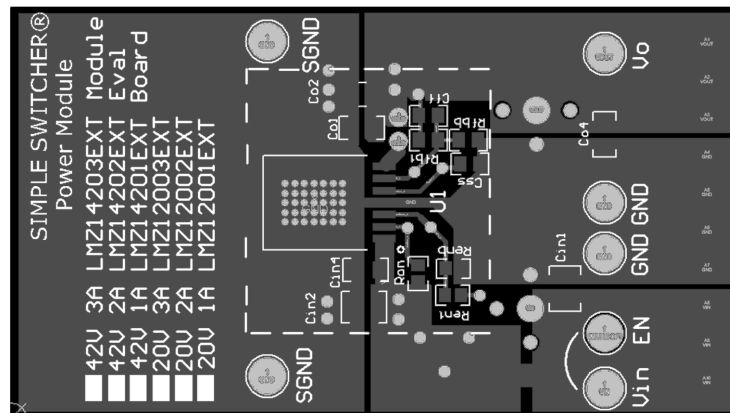
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LMZ14203EXT Transient Response  $V_{IN} = 24V$   
 $V_{OUT} = 3.3V$ , 0.6 A to 3A Step

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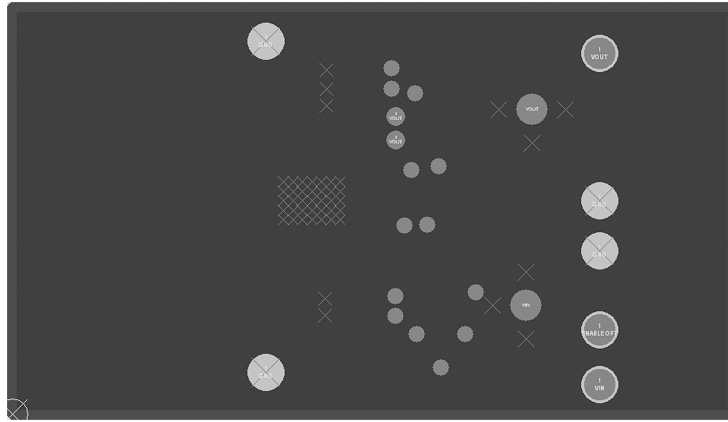
## PCB Layout Diagrams

Gerber and CAD files can be download from the LMZ14203EXT product folder.



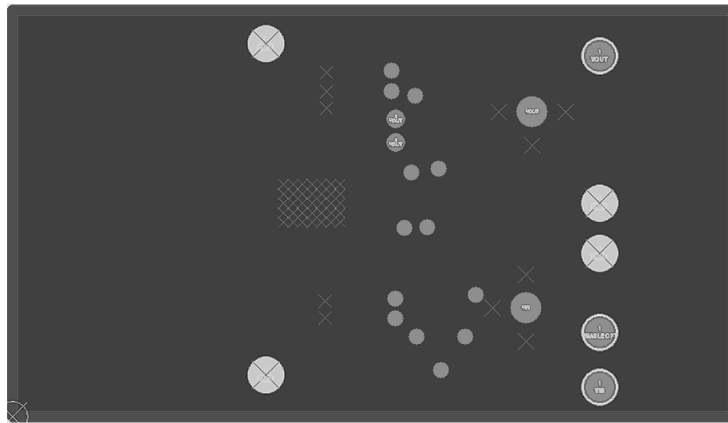
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FIGURE 2. Top Layer



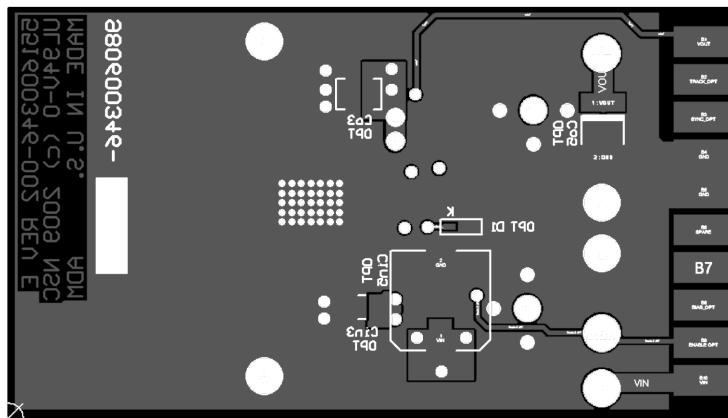
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**FIGURE 3. Internal Layer I (Ground)  
Heat Sinking Layer**



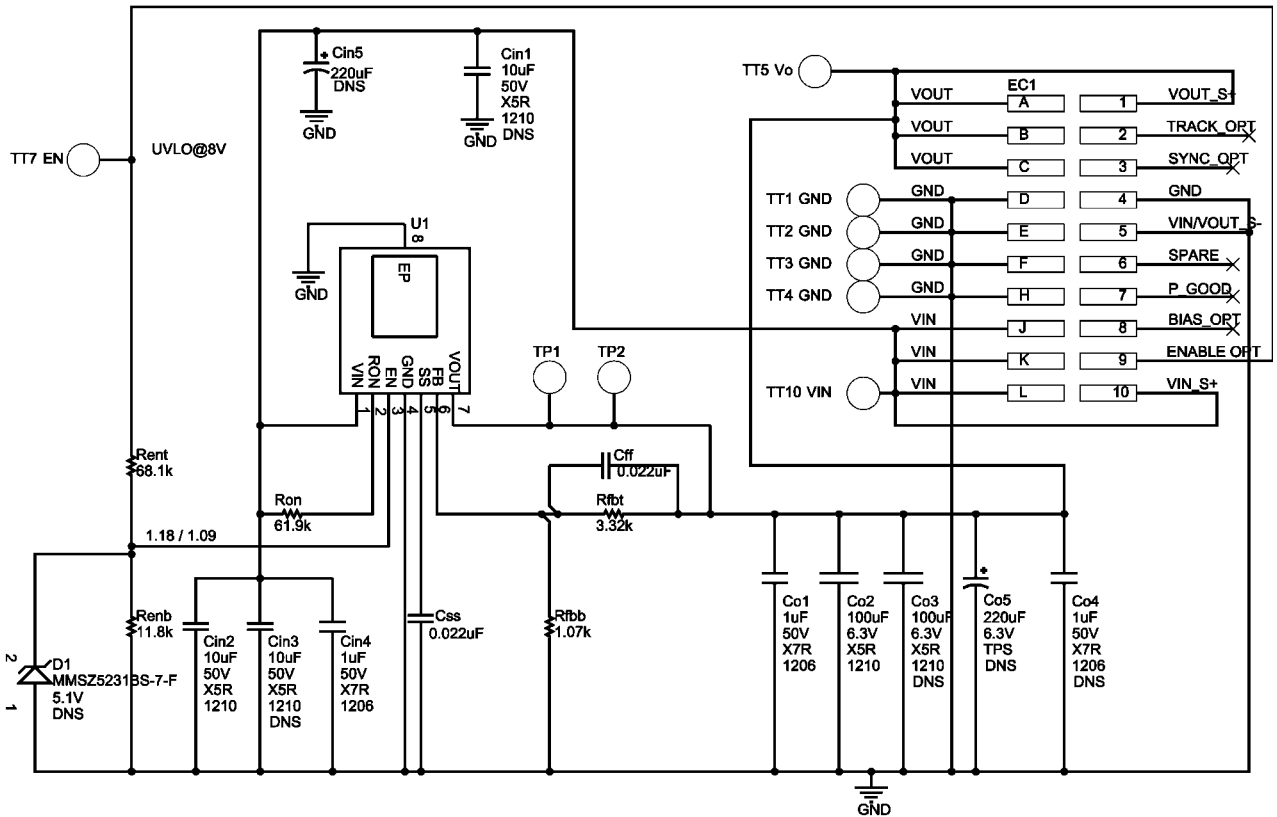
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**FIGURE 4. Internal Layer II (Ground)  
Heat Sinking Layer**



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



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FIGURE 6. LMZ14203EXT PCB CAD package schematic  
DNS = Component not installed



## Notes

## Notes

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Interface	<a href="http://www.national.com/interface">www.national.com/interface</a>	Eval Boards	<a href="http://www.national.com/evalboards">www.national.com/evalboards</a>
LVDS	<a href="http://www.national.com/lvds">www.national.com/lvds</a>	Packaging	<a href="http://www.national.com/packaging">www.national.com/packaging</a>
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>
Switching Regulators	<a href="http://www.national.com/switchers">www.national.com/switchers</a>	Distributors	<a href="http://www.national.com/contacts">www.national.com/contacts</a>
LDOs	<a href="http://www.national.com/ldo">www.national.com/ldo</a>	Quality and Reliability	<a href="http://www.national.com/quality">www.national.com/quality</a>
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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>
Temperature Sensors	<a href="http://www.national.com/tempsensors">www.national.com/tempsensors</a>	SolarMagic™	<a href="http://www.national.com/solarmagic">www.national.com/solarmagic</a>
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