AN-1450 LM3743 Evaluation Board

1 Introduction

The LM3743 is a voltage mode PWM buck controller that implements synchronous rectification. It provides a low cost, fault tolerant, and efficient point of load solution. To reduce component count several parameters are fixed, such as switching frequency and the short circuit protection level. In steady state operation the LM3743 is always synchronous, even at no load, thus simplifying the compensation design. The LM3743 ensures a smooth and controlled start-up when the output is pre-biased. Two levels of current limit protection enhance the robustness of the power supply and requires no current sense resistor in the power path. The primary level of protection is the low side current limit and is achieved by sensing the voltage V_{DS} across the low side MOSFET. The second level of protection is the high side current limit, which protects power components from extremely high currents caused by switch node short-circuit to ground.

2 Specifics Of The Board

The input voltage to the power components (V_{IN}) and the input voltage on the control section (V_{CC}) must be in the range of 3.0V to 5.5V. The 300 kHz demo board design regulates to an output voltage of 1.2V and up to 13A. The 1 MHz demo board design regulates to an output voltage of 1.5V and up to 9A. For additional design modifications, see the *Design Consideration* section of the *LM3743 High-Performance Synchronous Buck Controller with Comprehensive Fault Protection Features Data Sheet* (SNVS427). The PCB is designed on four layers, the top and bottom layers are 2oz. copper and the two inner layers are 1oz. copper. The board measures 2.4 in. x 1.36 in. (6.1 cm x 3.44 cm) and is 62mil (.062") thick on a FR4 laminate.

3 Additional Footprints

When the tracking feature of the LM3743 is used, remove the soft-start capacitor C4 and use a resistor divider on designators R7 and C4. The ground and track post have been provided for your connecting convenience.

4 MOSFET Footprints

The LM3743 demo board accommodates footprints for single N-MOSFETs with standard SOIC-8 packages and with exposed drain pads. The MOSFET footprint has the pinout as shown in Figure 1. Some examples of MOSFET packages with exposed drain pads are also illustrated.

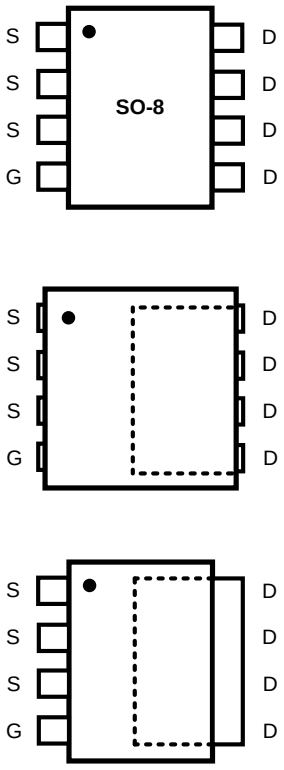

Figure 1. SOIC-8 Footprint

5 Performance Characteristics

Efficiency

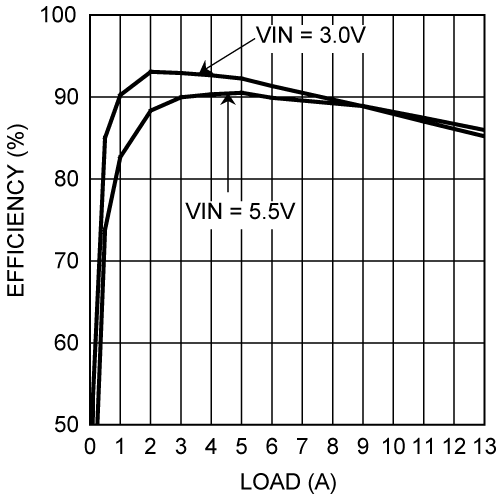

Figure 2. Efficiency vs. Load Current
V_{OUT} = 1.2V, f_{SW} = 300 kHz

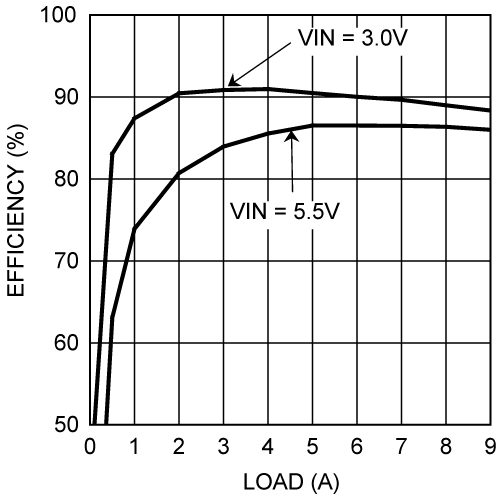

Figure 3. Efficiency vs. Load Current
V_{OUT} = 1.5V, f_{SW} = 1MHz

Switch Node Voltage and Output Voltage Ripple

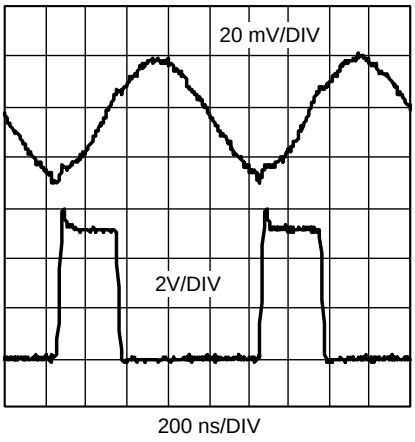

Figure 4. V_{IN} = 5V, V_{OUT} = 1.5V, I_{LOAD} = 0A, f_{SW} = 1MHz 20 MHz Bandwidth Limit

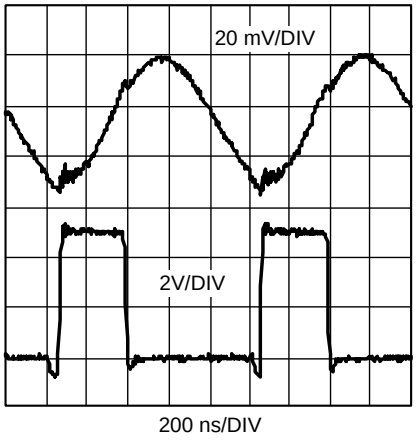

Figure 5. V_{IN} = 5V, V_{OUT} = 1.5V, I_{LOAD} = 9A, f_{SW} = 1MHz 20 MHz Bandwidth Limit

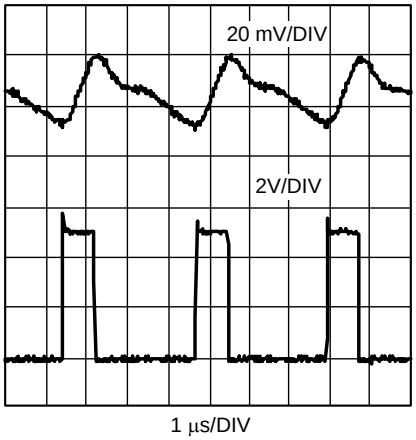

Figure 6. V_{IN} = 5V, V_{OUT} = 1.2V, I_{LOAD} = 0A, f_{SW} = 300kHz 20 MHz Bandwidth Limit

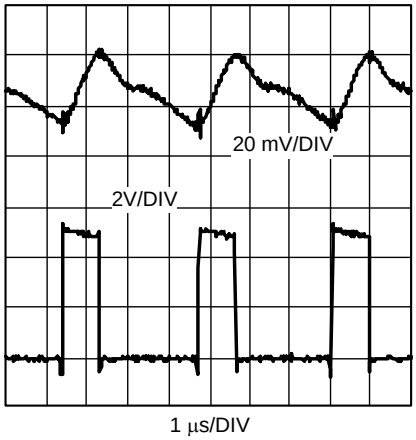

Figure 7. V_{IN} = 5V, V_{OUT} = 1.2V, I_{LOAD} = 13A, f_{SW} = 300kHz 20 MHz Bandwidth Limit

Table 1. 300 kHz Bill of Materials (BOM)

Designator	Function	Description	Part Number	Vendor
U1	Controller	Buck Controller	LM3743	Texas Instruments
C1	Input Filter	22 µF,10 V, X7R, 1812	GRM43ER71A226KE01B	Murata
C2	Input Filter	Al-elec, 10 V, 470 µF	10ME470WX	Sanyo
C3	Decoupling	1 µF, 10 V, X7R, 0805	0805ZC105KAT	AVX
C4	Soft Start Cap	180 nF, 25 V, X7R	VJ0805Y184KXXA	Vishay
C5	Output Filter	470 µF, 4 V, 15mΩ	4TPE470MFL	Sanyo
C6	Output Filter	10 µF, 6.3 V, 0805	0805D106MAT	AVX
C7	Comp Cap	56 pF, 25 V, 0805	VJ0805A560KXAA	Vishay
C8	Comp Cap	2.2 nF, 25 V, 0805	VJ0805A222KXAA	Vishay
C9	Comp Cap	1.5 nF, 25 V, 0805	VJ0805Y152KXXA	Vishay
C10	Bootstrap Cap	.47 µF, 25 V, 0805	VJ0805Y474KXXA	Vishay
R1	Current Limit Res	1.78 kΩ, 0805	CRCW08051781F	Vishay
R2	Top FB Resistor	10 kΩ, 0805	CRCW08051002F	Vishay
R3	Bottom FB Resistor	20 kΩ, 0805	CRCW08052002F	Vishay
R4	Comp Resistor	22.6 kΩ, 0805	CRCW08052262F	Vishay
R5	Comp Resistor	3.57 kΩ, 0805	CRCW08053571F	Vishay
R6	V_{CC} Filter Resistor	2 Ω, 0805	CRCW08052R00F	Vishay
L1	Output Filter	1.5 µH, 13.8A, 2.9 mΩ	DR125-1R5	Cooper
D1	Bootstrap Diode	500 mA, 20 V, V_F =.3 V	MBR0520LT1	Onsemi
Q1	Top FET	4.5 mΩ @V_{GS} = 4.5 V, 21 nC	Si7882DP	Vishay
Q2	Bottom FET	4.5 mΩ @V_{GS} = 4.5 V, 21 nC	Si7882DP	Vishay

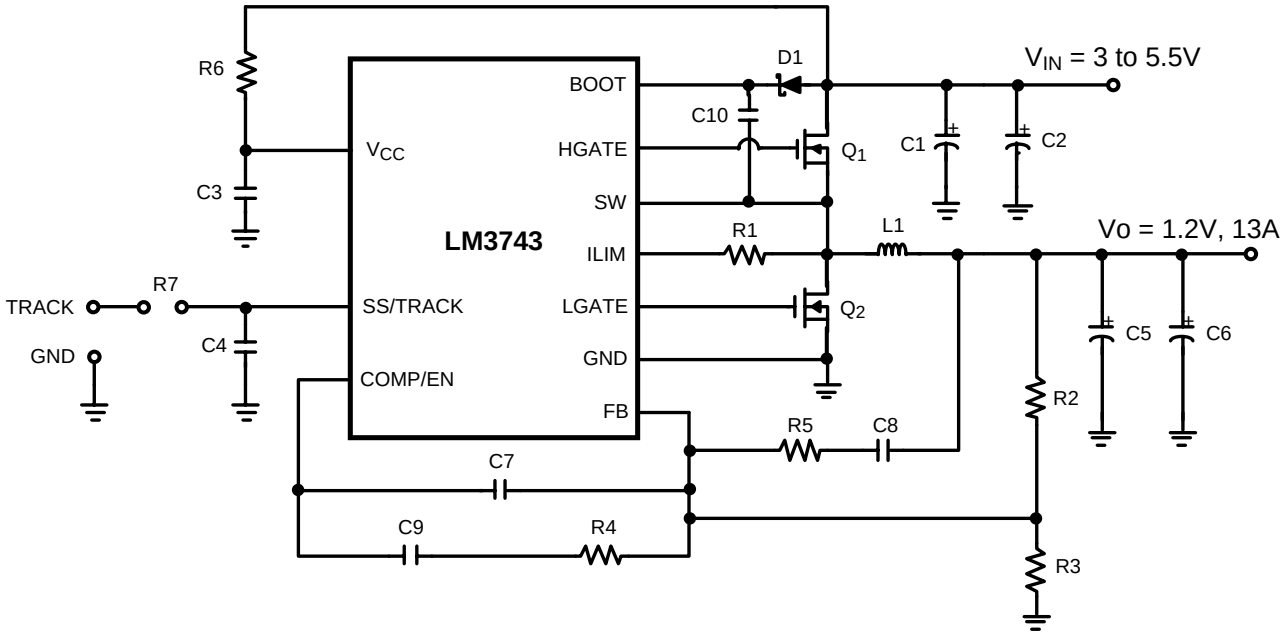

Figure 8. 300 kHz Demo Board Schematic

Table 2. 1 MHz Bill of Materials

Designator	Function	Description	Part Number	Vendor
U1	Controller	Buck Controller	LM3743	Texas Instruments
C1	Input Filter	22 µF, 10 V, X7R, 1812	GRM43ER71A226KE01B	Murata
C2	Input Filter	Al-elec, 10 V, 470 µF	10ME470WX	Sanyo
C3	Decoupling	1 µF, 10 V, X7R, 0805	0805ZC105KAT	AVX
C4	Soft Start Cap	180 nF, 25 V, X7R	VJ0805Y184KXXA	Vishay
C5	Output Filter	470 µF, 4 V, 15mΩ	4TPE470MFL	Sanyo
C6	Output Filter	10 µF, 6.3 V, 0805	0805D106MAT	AVX
C7	Comp Cap	8.2 pF, 25 V, 0805	VJ0805A8R2KXAA	Vishay
C8	Comp Cap	820 pF, 25 V, 0805	VJ0805A821KXAA	Vishay
C9	Comp Cap	470 pF, 25 V, 0805	VJ0805Y471KXXA	Vishay
C10	Bootstrap Cap	.1 µF, 25 V, 0805	VJ0805Y104KXXA	Vishay
R1	Current Limit Res	1.1 kΩ, 0805	CRCW08051101F	Vishay
R2	Top FB Resistor	10 kΩ, 0805	CRCW08051002F	Vishay
R3	Bottom FB Resistor	11.3 kΩ, 0805	CRCW08057871F	Vishay
R4	Comp Resistor	35.7 kΩ, 0805	CRCW08053572F	Vishay
R5	Comp Resistor	8.87 kΩ, 0805	CRCW08058871F	Vishay
R6	V_{CC} Filter Resistor	2 Ω, 0805	CRCW08052R00F	Vishay
L1	Output Filter	.47 µH, 11.6A, 3.6 mΩ	FP3-R47	Cooper
D1	Bootstrap Diode	500 mA, 20 V, V_F =.3 V	MBR0520LT1	Onsemi
Q1	Top FET	4.5 mΩ @ V_{GS} = 4.5 V, 21 nC	Si7882DP	Vishay
Q2	Bottom FET	4.5 mΩ @ V_{GS} = 4.5 V, 21 nC	Si7882DP	Vishay

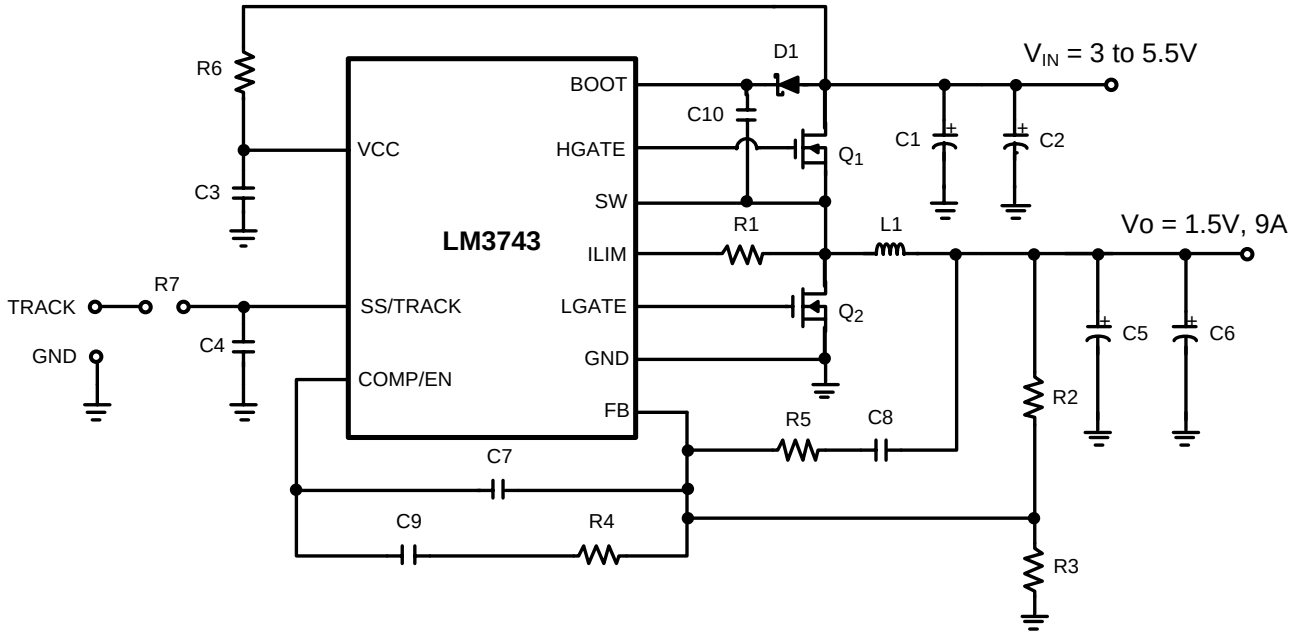

Figure 9. 1 MHz Demo Board Schematic

6 PCB Layout Diagram(s)

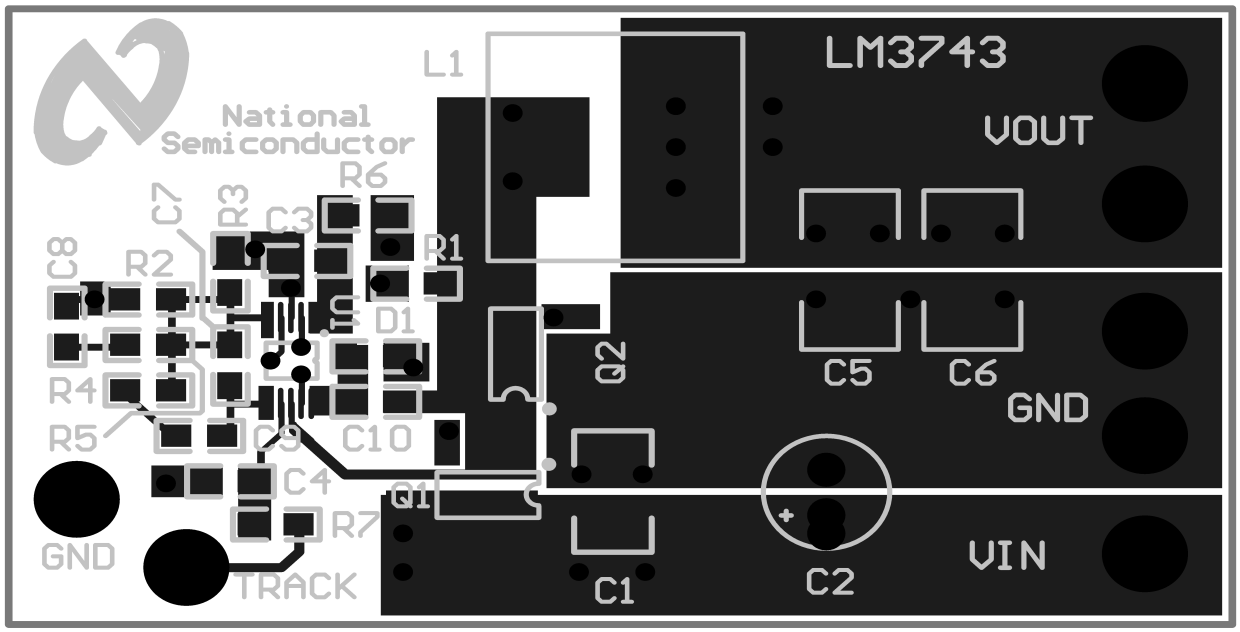

Figure 10. Top Layer

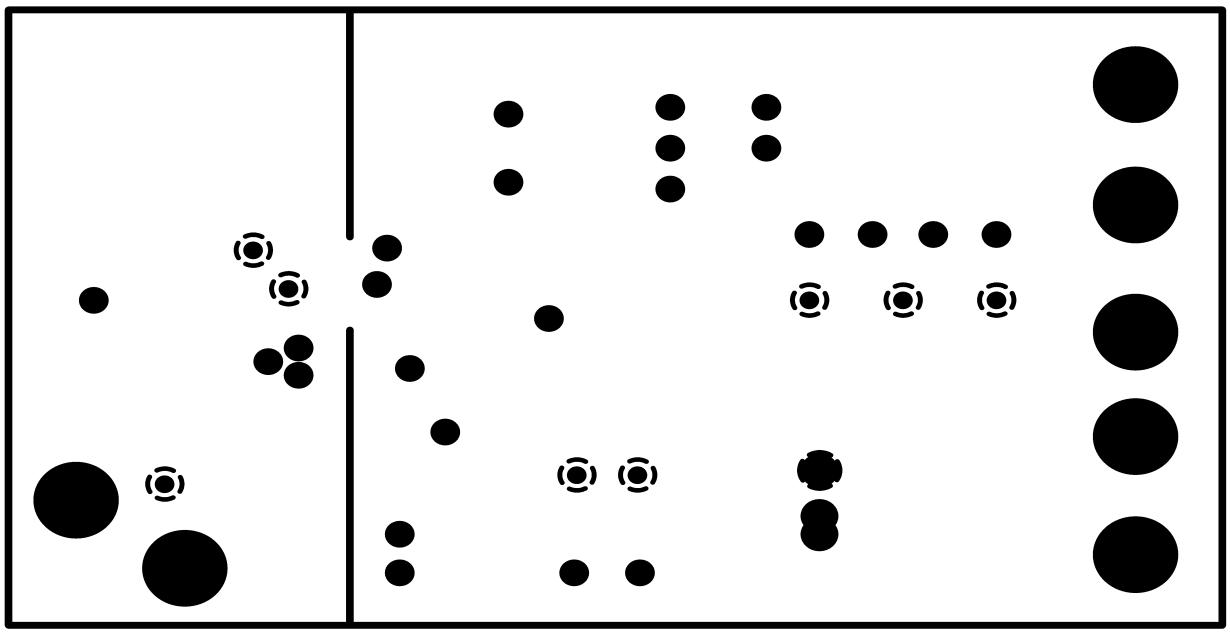

Figure 11. Internal Layer I (Ground)

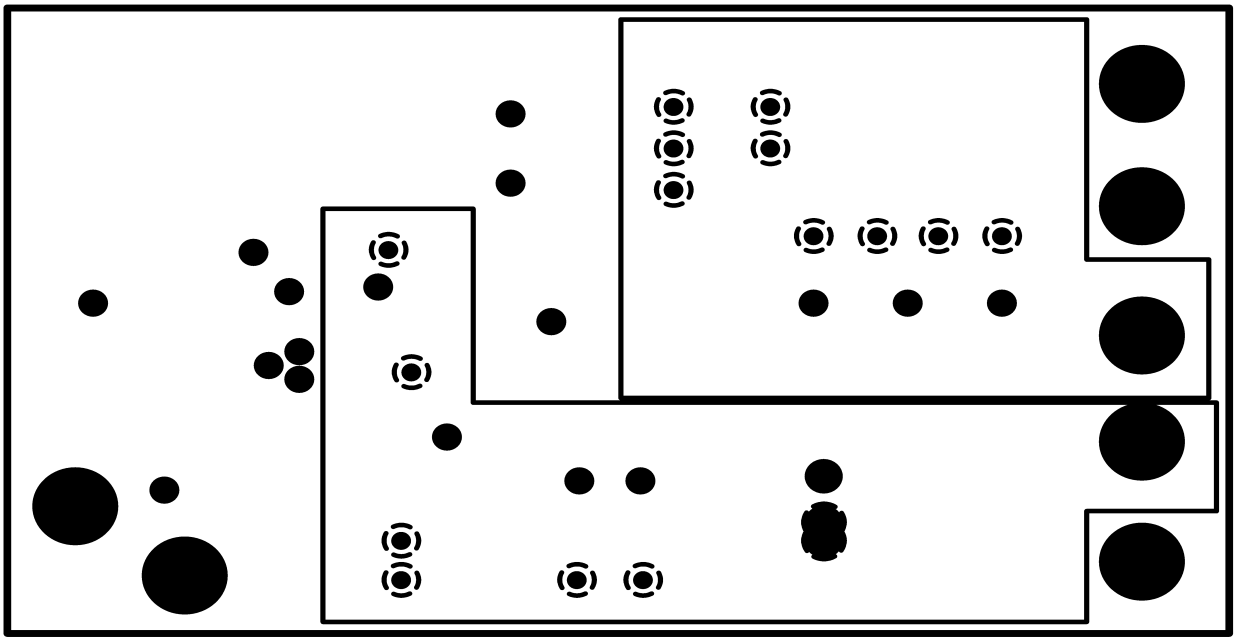

Figure 12. Internal Layer II (V_{IN} and V_{OUT}) Heat Sinking Layer

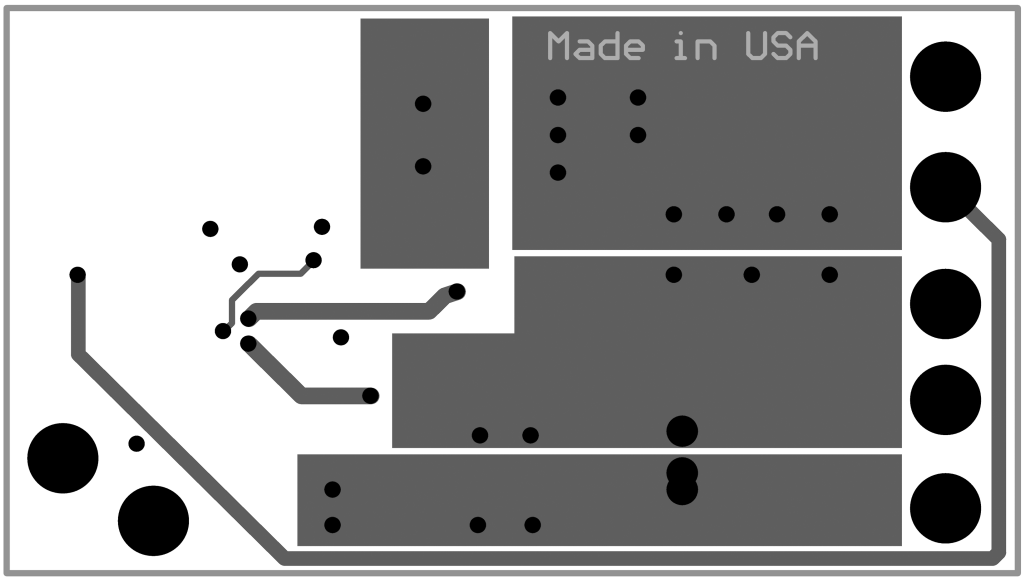

Figure 13. Bottom Layer Heat Sinking Layer and Signal Traces

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