AN-1573 LM2745-19A Demonstration Board

1 Introduction

This application notes describes the LM2745 printed circuit board (PCB) design and provides an example typical application circuit. The LM2745 is a voltage mode PWM buck controller which implements synchronous rectification. It provides a low cost, high power density, and efficient point of load solution. In steady state operation the LM2745 is always synchronous, even at no load, thus simplifying the compensation design. The LM2745 ensures a smooth and controlled start-up when the output is pre-biased. The current limit protection does not require a current limit resistor in the power path, but is achieved by sensing the voltage V_{DS} across the low side MOSFET. Though the control sections of the IC are rated for 3 to 6V (V_{CC}), the driver sections are designed to accept input supply rails (V_{IN}) as high as 14V.

2 Specifics Of The Board

This demo board targets the fixed and mobile telecommunications, industrial electronics, and distributed power markets. The demo board has a V_{IN} range of 8V to 14V and a LDO regulator, the LP2937, powers V_{CC} by regulating a 5V output voltage. The LM2745 regulates to an output range of 1.2V to 3.3V at 19A with a switching frequency of 300 kHz. Note, the demo board is optimized for the above parameters, thus for additional design modifications refer to the Design Consideration section of the LM2745 data sheet. 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 2.19 in. x 1.03 in. x 0.41 in. (56 mm x 26.2 mm x 10.3 mm) (l, w, h) on a FR4 laminate.

3 Feature Options

When the tracking feature of the LM2745 is required for use, remove the jumper that connects the soft-start capacitor C10 and connect the resistor divider, on designators R13 and R14 (see Figure 1). The Track terminal has been provided for your connecting convenience. The demo board is synchronize ready, just connect an external clock to the SYNC terminal. **Note:** increasing the switching frequency results in a lower inductor current ripple and input and output voltage ripple (if the component values are kept the same). Monitor the MOSFET junction temperature since switching losses will increase, and do not exceed the maximum junction temperature of the MOSFET. Refer to the MOSFET manufacturer datasheet for maximum junction temperature specification and heat sinking guidelines.

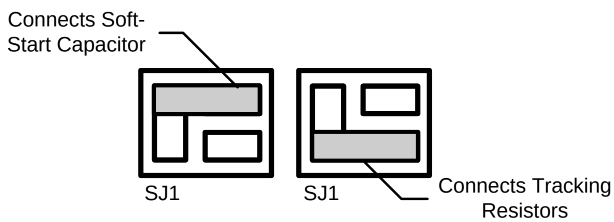

Figure 1. Soft-Start and Tracking Jumper

All trademarks are the property of their respective owners.

4 Specification Summary

- Space saving footprint
- Wide ambient temperature range: -40 ºC to 65 ºC
- Input voltage range: 8V to 14V
- Adjustable output voltage: 1.2V to 3.3V
- No minimum load requirement
- Remote ON/OFF
- Power good signal
- Fixed switching frequency: 300 kHz
- Switching frequency synchronize range 250 kHz to 1 MHz
- Current Limit Protection
- Master power supply start-up tracking function
- Start-up with a pre-biased output load
- Adjustable soft-start
- Small size 2.19 in. x 1.03 in. x 0.41 in. (56 mm x 26.2 mm x 10.3 mm)

5 Performance Characteristics

Efficiency

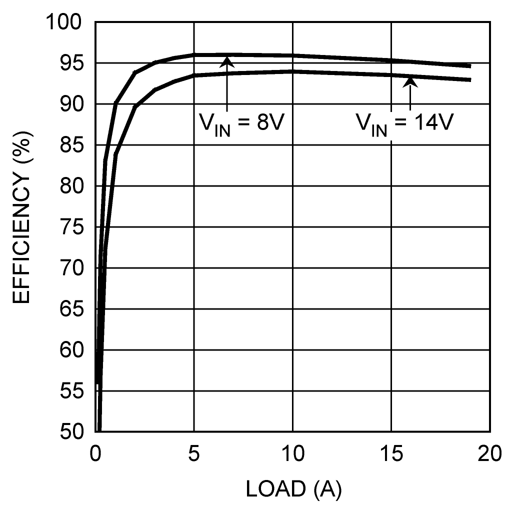

Figure 2. Efficiency vs. Load Current
V_{OUT} = 3.3V, f_{SW} = 300 kHz

6 Switch Node Voltage and Output Voltage Ripple

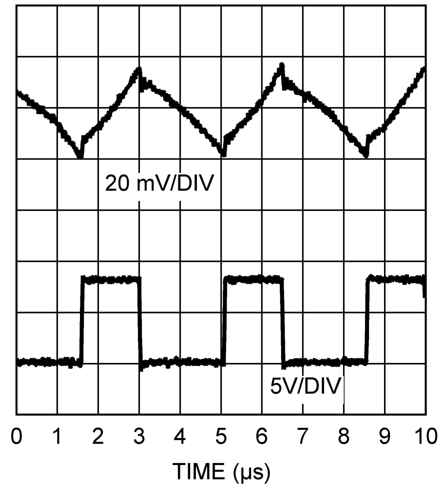

Figure 3. V_{IN} = 8V, V_{OUT} = 3.3V, I_{LOAD} = 100 mA, f_{SW} = 300 kHz 20 MHz Bandwidth Limit

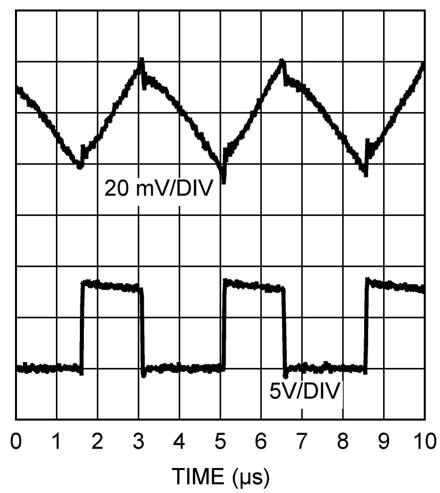

Figure 4. V_{IN} = 8V, V_{OUT} = 3.3V, I_{LOAD} = 19A, f_{SW} = 300 kHz 20 MHz Bandwidth Limit

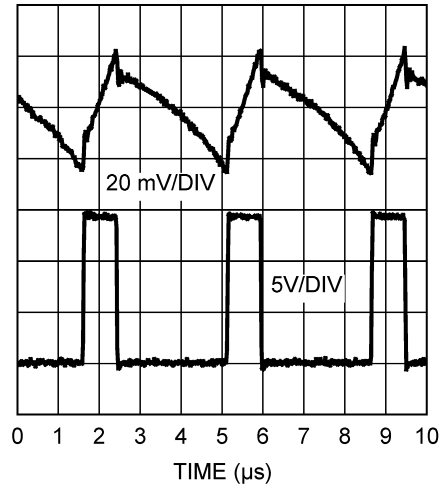

Figure 5. V_{IN} = 14V, V_{OUT} = 3.3V, I_{LOAD} = 100 mA, f_{SW} = 300 kHz 20 MHz Bandwidth Limit

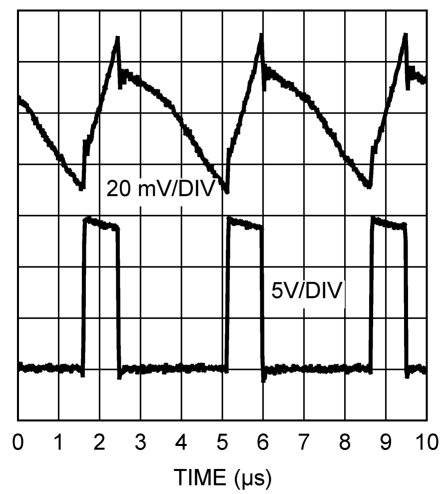

Figure 6. V_{IN} = 14V, V_{OUT} = 3.3V, I_{LOAD} = 19A, f_{SW} = 300 kHz 20 MHz Bandwidth Limit

7 Load Transient Response

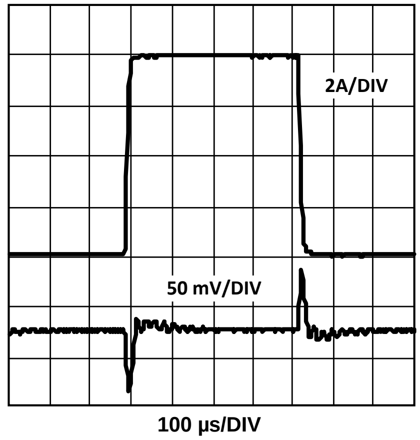

Figure 7. V_{IN} = 14V, V_{OUT} = 3.3V
I_{LOAD} = 2A to 10A
CH1: V_{OUT}, CH2: I_{LOAD}

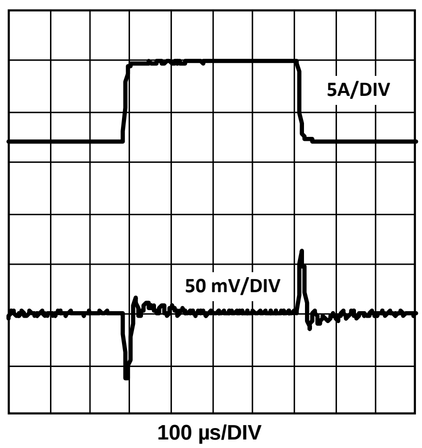

Figure 8. V_{IN} = 14V, V_{OUT} = 3.3V
I_{LOAD} = 11A to 19A
CH1: V_{OUT}, CH2: I_{LOAD}

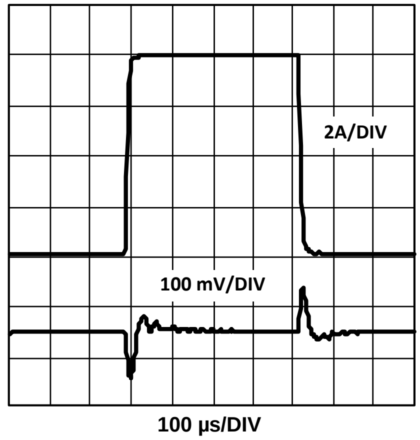

Figure 9. V_{IN} = 8V, V_{OUT} = 3.3V
I_{LOAD} = 2A to 10A
CH1: V_{OUT}, CH2: I_{LOAD}

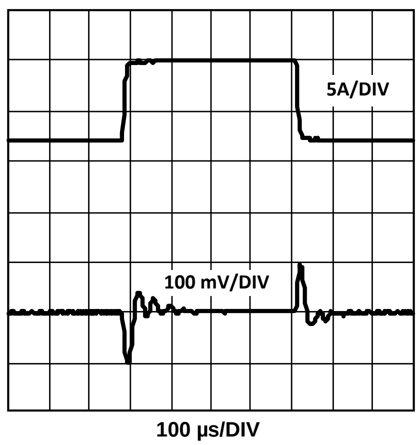

Figure 10. V_{IN} = 8V, V_{OUT} = 3.3V
I_{LOAD} = 11A to 19A
CH1: V_{OUT}, CH2: I_{LOAD}

8 Bill of Materials

Table 1. Bill of Materials for LM2745 POL EVB (Vin: 8V to 14V, Vout:3.3V, 19A)

Location	Part Number	Type	Size	Parameters	Qty	Vendor
U1	LM2745	Syn. Buck Controller	TSSOP-14	Vin: 4.5V - 5.5V	1	NSC
U2	LM27937IMP-5.0	Linear Regulator 5V,500mA	SOT-223	5V, 500mA	1	NSC
L1	SER2010-202ML	Inductor		2uH, 27A, 0.852mohm	1	Coilcraft
Q1-2	IRF6633	N-MOSFET	DirectFET-MP	20V, 16A, 4.1mohm, 11nC	2	Vishay
Q3	IRF6609	N-MOSFET	DirectFET-MT	20V, 150A, 2mohm, 46nC	1	Vishay
D1	SL22-E3/2C	Schottky Diode	SMB	20V, 2A	1	Vishay
D2	MBRS0520	Schottky Diode	SOD123	20V, 0.5A	1	Vishay
C1, 2	GRM32ER61C226KE20L	Ceramic Capacitor	1210	22µF, 25V, X7R, 5%	2	Murata
C3, 11	GRM319R71H104KA01B	Ceramic Capacitor	1206	100nF, 25V, X7R, 10%	2	Murata
C14	GRM319R71H474KA01B	Ceramic Capacitor	1206	470nF, 25V, X7R, 10%	1	Murata
C9	GRM1885C1H1210JA01	Ceramic Capacitor	0603	120pF, 50V, C0G, 5%	1	Murata
C6	GRM188R71H222KA01	Ceramic Capacitor	0603	2.2nF, 50V, X7R, 10%	1	Murata
C7	GRM1885C1H101JA01	Ceramic Capacitor	0603	100pF, 50V, C0G, 5%	1	Murata
C8	GRM188R71H332KA01	Ceramic Capacitor	0603	3.3nF, 50V, X7R, 10%	1	Murata
C10	GRM188R71H153KA01	Ceramic Capacitor	0603	15nF, 50V, X7R, 10%	1	Murata
C12	GRM40X7R472K25	Ceramic Capacitor	0805	470nF, 25V, X7R, 10%	1	Murata
C13	12066D226MAT	Ceramic Capacitor	1206	22µF, 6.3V, X5R, 20%	1	AVX
C4, 5	6SVPC220M	OS-CON	C6	220µF, 6.3V, 20%	2	Sanyo
R1,18	CRCW06030R00F	Chip Resistor	0603	0ohm	2	Vishay
R2	CRCW06032151F	Chip Resistor	0603	2.15k, 1%	1	Vishay
R3, R17	CRCW06031002F	Chip Resistor	0603	10k, 1%	2	Vishay
R4	CRCW06032211F	Chip Resistor	0603	2.21k, 1%	1	Vishay
R10, 11	CRCW06031003F	Chip Resistor	0603	100k, 1%	2	Vishay
R5, 6, 8	CRCW06032R21F	Chip Resistor	0603	2.21ohm, 1%	3	Vishay
R7, 9	CRCW06034702F	Chip Resistor	0603	47k, 1%	2	Vishay
R12	CRCW06038451F	Chip Resistor	0603	8.45k, 1%	1	Vishay
R15	CRCW06031821F	Chip Resistor	0603	1.82k, 1%	1	Vishay
R16	CRCW060310R0F	Chip Resistor	0603	10ohm, 1%	1	Vishay
-	-	F-Pin			8	
-	-	Pin 90 deg., SIP, 6 way	Pitch: 2.54mm		1	

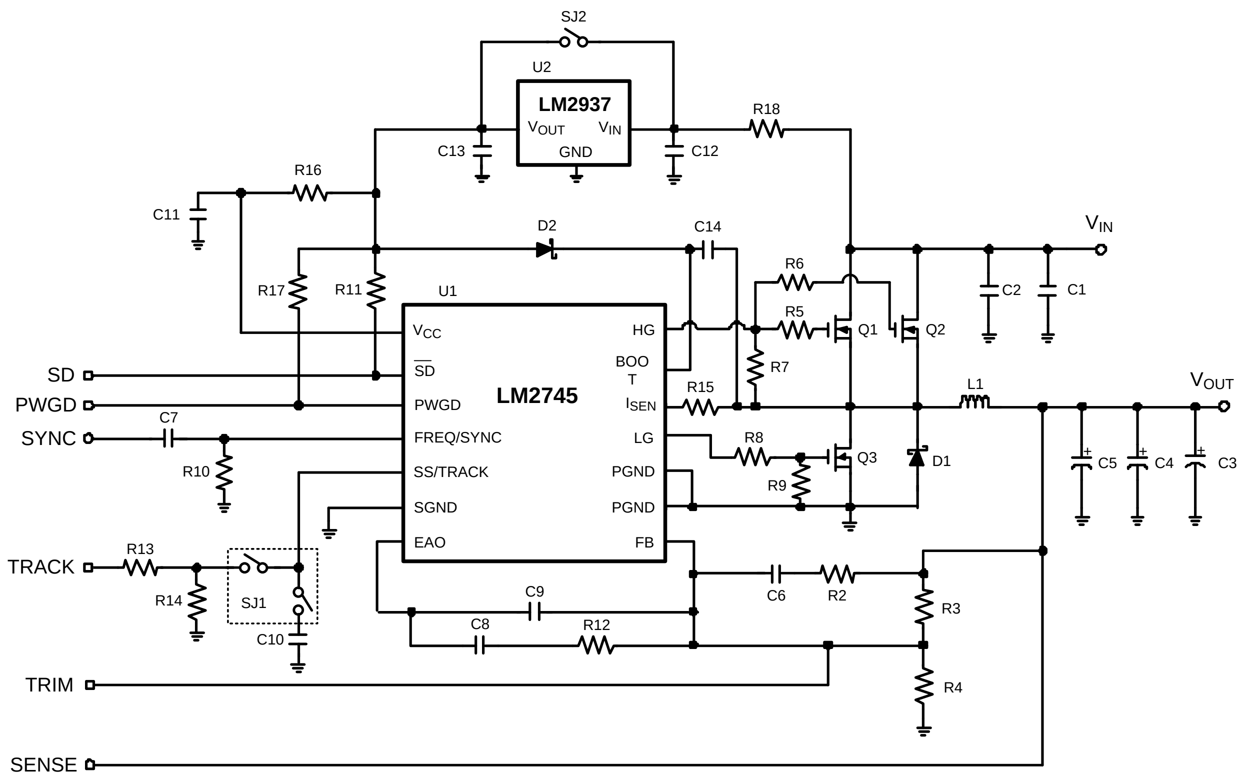

Figure 11. 300 kHz Demo Board Schematic

9 PCB Layout

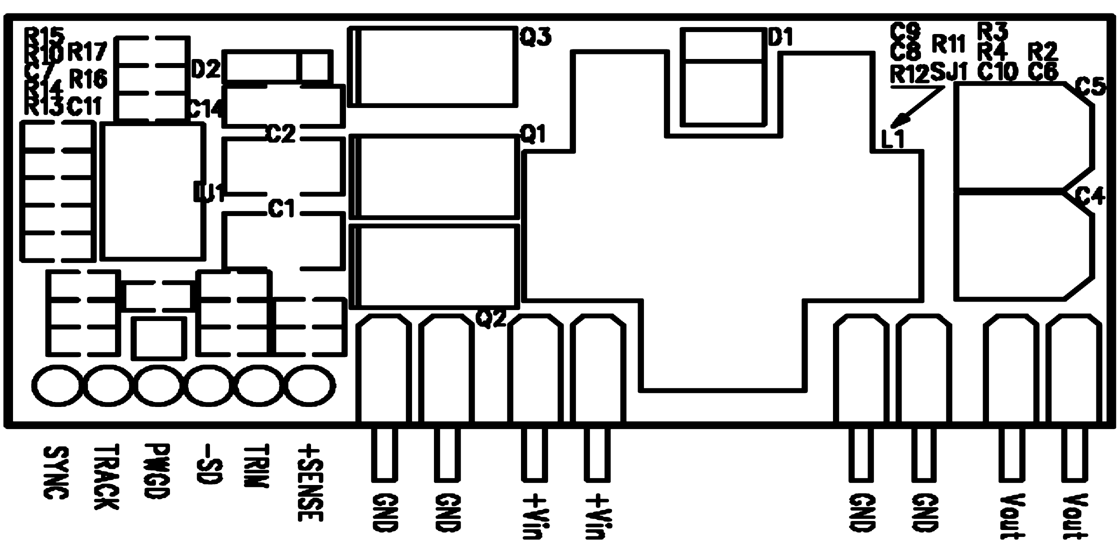

Figure 12. Top Silkscreen

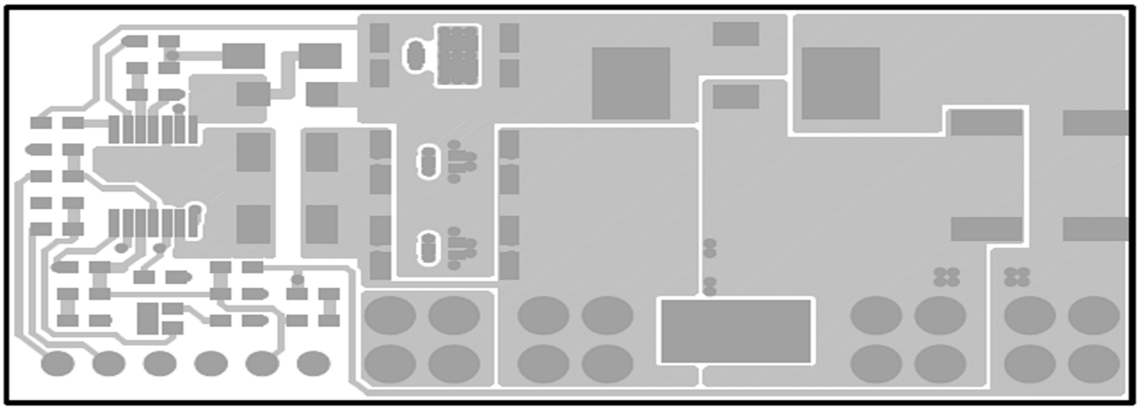

Figure 13. Top Copper Layer

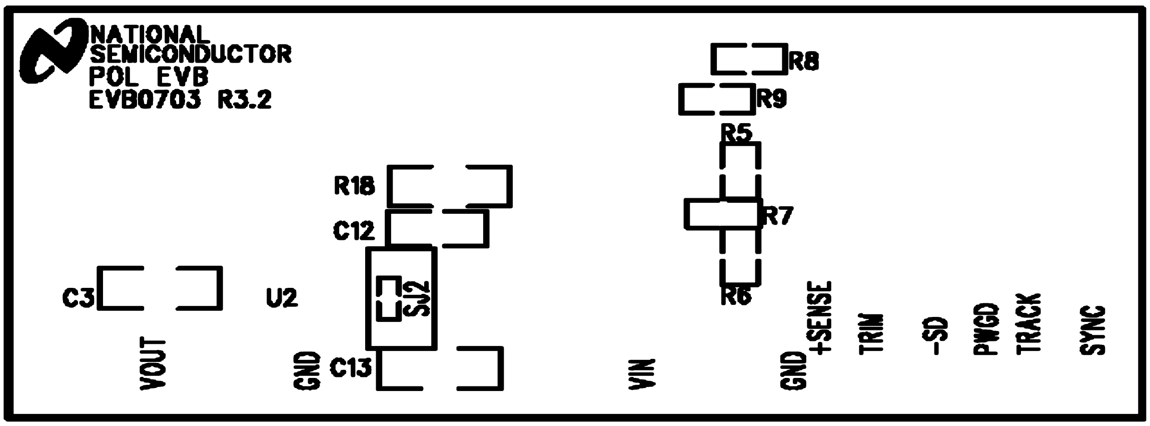

Figure 14. Bottom Silkscreen

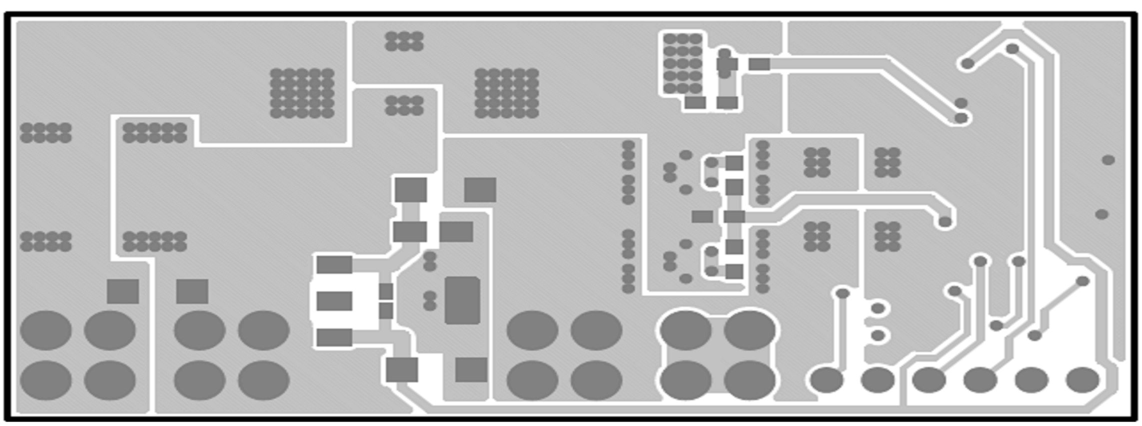

Figure 15. Bottom Copper Layer

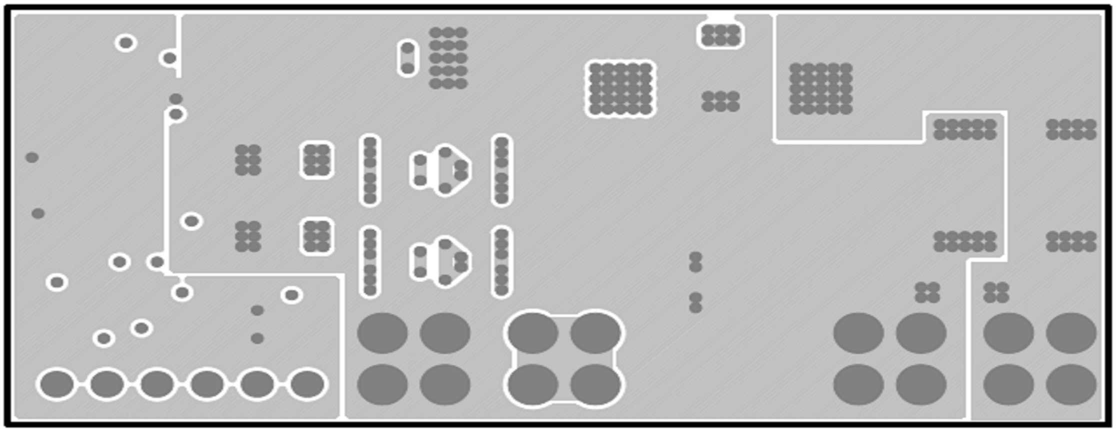

Figure 16. Internal Layer-1 (GND Copper)

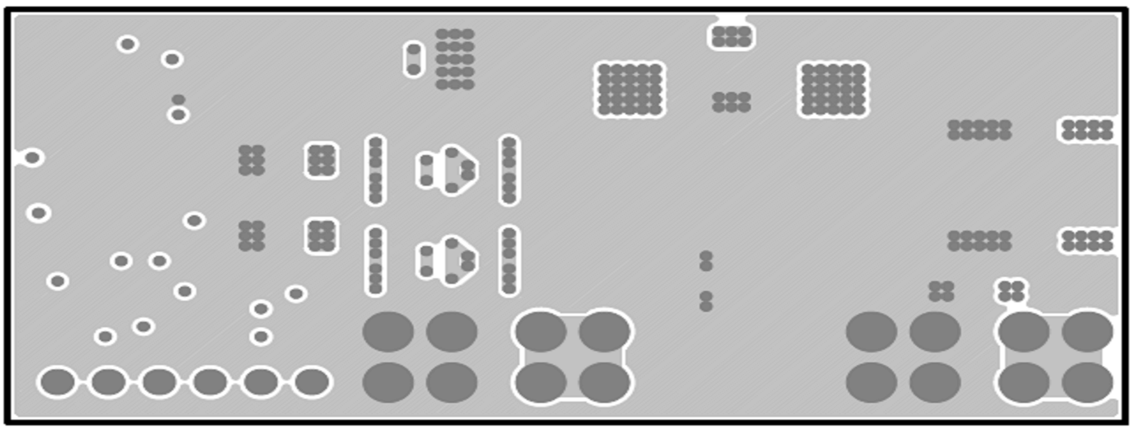

Figure 17. Internal Layer-2 (GND Copper)

Products		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265