AN-1449 LM2747 Evaluation Board

1 Introduction

This document describes the LM2747 printed circuit board (PCB) design and provides an example typical application circuit. The demo board allows component design flexibility in order to demonstrate the versatility of the LM2747 IC.

The demo board contains a voltage-mode, high-speed synchronous buck regulator controller. Though the control sections of the IC are rated for 3 V to 6 V (V_{CC}), the driver sections are designed to accept input supply rails (V_{IN}) as high as 14 V.

The demo board design regulates to an output voltage of 1.2 V at 3.5A with a switching frequency of 1MHz from a 1 MHz clock source that has an amplitude from 0 V to V_{CC}. Note, the demo board is optimized for a 1MHz, 14 V input voltage compensation design with V_{CC} = 3.3 V. If a slower switching frequency and input voltage is desired, please consult the device data sheet for control loop compensation procedures. For additional design modifications, see the *Design Consideration* section of the *LM2747 Synchronous Buck Controller With Pre-Bias Startup, and Optional Clock Synchronization Data Sheet* (SNVS370).

The demo board accommodates the use of banana clips to clip onto pads on the board, if preferred, the pads inner diameters are 100mils, for which a solder terminal can be placed (Newark 40F6004). The PCB is designed on two layers with 1oz. copper on a 62mil FR4 laminate.

2 Additional Footprints

An additional footprint D1 is available for a Schottky diode to be placed in parallel with the low side MOSFET. This component can improve efficiency, due to the lower forward drop than the low side MOSFET body diode conducting during the anti-shoot through period. Select a Schottky diode that maintains a forward drop around 0.4 to 0.6 V at the maximum load current (consult the I-V curve). In addition select the reverse breakdown voltage to have sufficient margin above the maximum input voltage.

Footprint C13 is available for a multilayer ceramic capacitor (MLCC) connected flush to the source of the low side MOSFET and drain of the high side MOSFET, in order to provide low supply impedance. For example, component C13 is used in combination with aluminum electrolytic input filter capacitors, placed in designators C12 and C14. If MLCCs are used in designators C12 and C14 component C13 is not necessary.

3 Typical Application Circuit

The typical application circuit in Figure 1 provides the component designators used on the demo board.

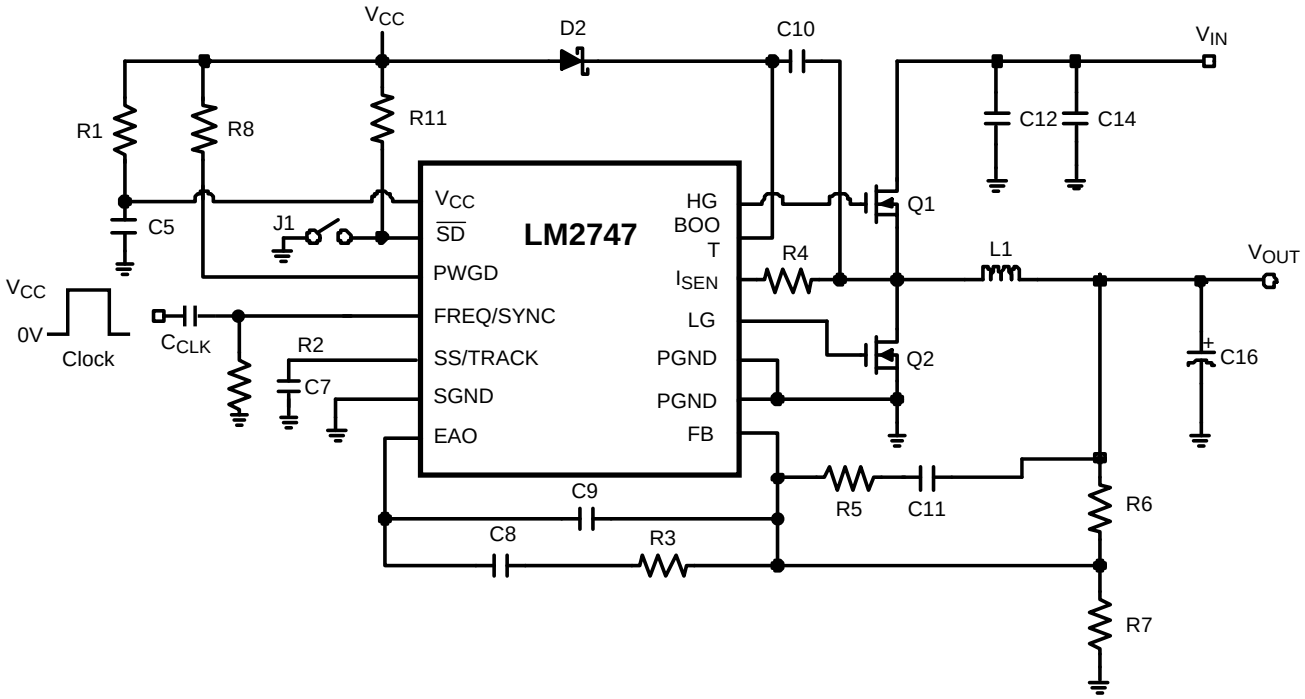

Figure 1. Typical Application

4 Performance Characteristics (Output Ripple Voltage and Switch Node Voltage)

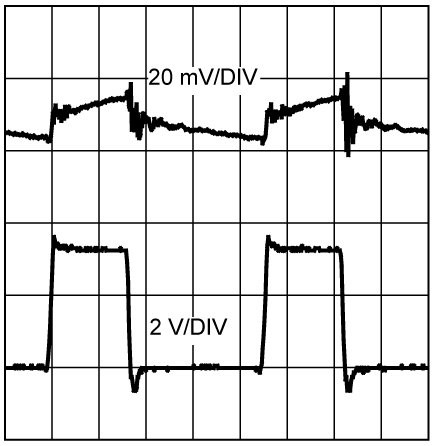

Figure 2. V_{IN} = V_{CC} = 3.3 V, V_{OUT} = 1.2 V, I_{LOAD} = 0A, f_{SW} = 1MHz 20 MHz Bandwidth Limit

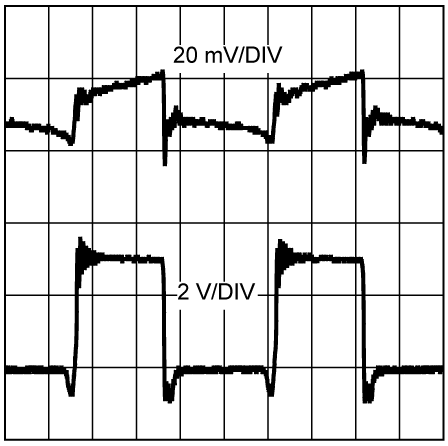

Figure 3. V_{IN} = V_{CC} = 3.3 V, V_{OUT} = 1.2 V, I_{LOAD} = 3.5A, f_{SW} = 1MHz. 20 MHz Bandwidth Limit

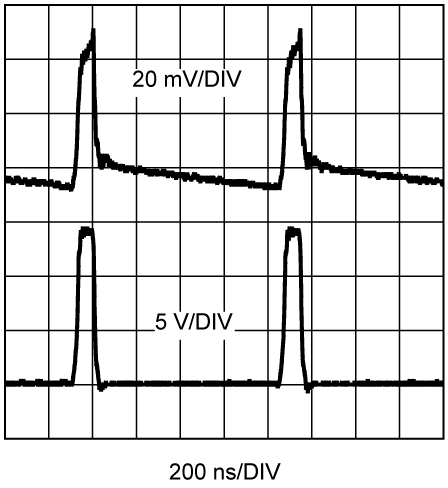

Figure 4. V_{IN} = 14 V, V_{CC} = 5 V, V_{OUT} = 1.2 V, I_{LOAD} = 0A, f_{SW} = 1MHz. 20 MHz Bandwidth Limit

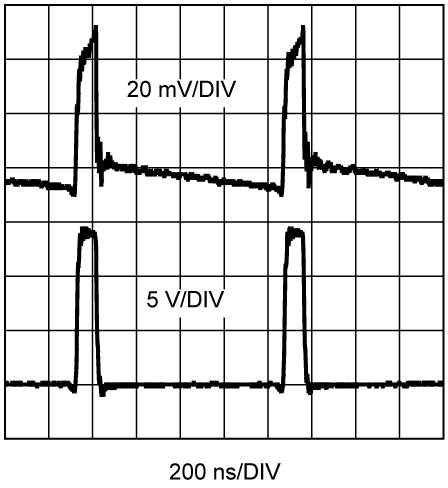

Figure 5. V_{IN} = 14 V, V_{CC} = 5 V, V_{OUT} = 1.2 V, I_{LOAD} = 3.5A, f_{SW} = 1MHz. 20 MHz Bandwidth Limit

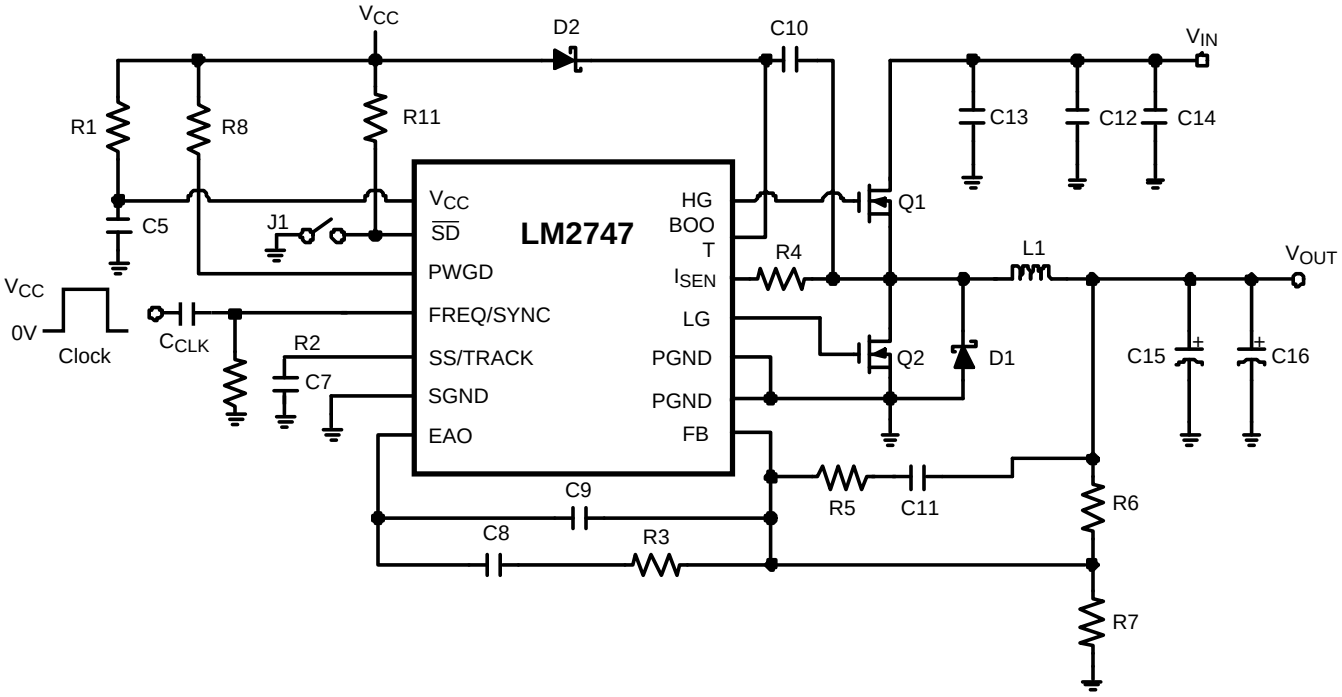

Figure 6. Complete Demo Board Schematic

Table 1. Bill of Materials (BOM)

Designator	Function	Part Description	Part Number
U1	Controller	LM2747 TSSOP14	Texas Instruments
C5	V_{CC} Decoupling	Cer Cap 1 µF 25 V 10% 0805	Murata GRM216R61E105KA12B
C7	Soft Start Cap	Cer Cap 12 nF 25 V 10% 0805	Vishay VJ0805Y123KXX
C8	Comp Cap	Cer Cap 1.5 nF 25 V 10% 0805	Vishay VJ0805Y152KXX
C9	Comp Cap	Cer Cap 18 pF 25 V 10% 0805	Vishay VJ0805A180KAA
C10	Cboot	Cer Cap 0.1 µF 25 V 10% 0805	Vishay VJ0805Y104KXX
C11	Comp Cap	Cer Cap 1.8 nF 25 V 10% 0805	Vishay VJ0805Y182KXX
C12	Input Filter Cap	Cer Cap 10 µF 25 V 10% 1210	AVX 12103D106MAT
C14	Input Filter Cap	Cer Cap 10 µF 25 V 10% 1210	AVX 12103D106MAT
C15	Output Filter Cap	470µF, 6.3 V, 10 mΩ ESR POScap	Sanyo 6TPD470
R1	Filter Resistor	Res 10 Ω .25W 0805	Vishay CRCW08051000F
R2	Frequency Adjust Res	Res18.7 kΩ .25W 0805	Vishay CRCW08052187F
R3	Comp Res	Res 17.4 kΩ .25W 0805	Vishay CRCW08051742F
R4	Current Limit Res	Res 3.16 kΩ .25W 0805	Vishay CRCW08053161F
R5	Comp Res	Res 2.94 kΩ .25W 0805	Vishay CRCW08052941F
R6	Res Divider, upper	Res 10.0 kΩ .25W 0805	Vishay CRCW08051002F
R7	Res Divider, lower	Res 10.0 kΩ .25W 0805	Vishay CRCW08051002F
R8	PWGD Pull-Up	Res 100 kΩ .25W 0805	Vishay CRCW08051003F
R11	Shut Down Pull-Up	Res 100 kΩ .25W 0805	Vishay CRCW080561003F
D2	Bootstrap Diode	Schottky Diode, SOD-123	MBR0530LTI
L1	Output Filter Inductor	Inductor 1 µH, 5.3Arms, 10.2 mΩ	Cooper DR73-1R0
Q1-Q2	Top and Bottom FETs	Dual N-MOSFET, V_{DS} = 20 V, 24 mΩ @ 2.5 V	Vishay 9926BDY
C_{CLK}	Sync AC Coupling Cap	Cer Cap 56 pF 25 V 10% 0805	Vishay VJ0805A560KXAA

5 PCB Layout Diagrams

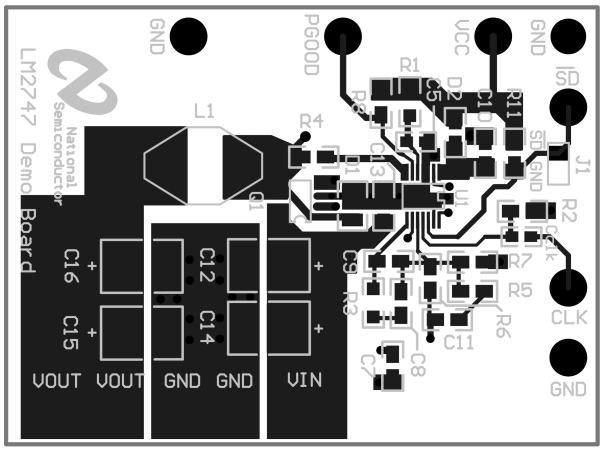

Figure 7. Top Layer and Top Overlay

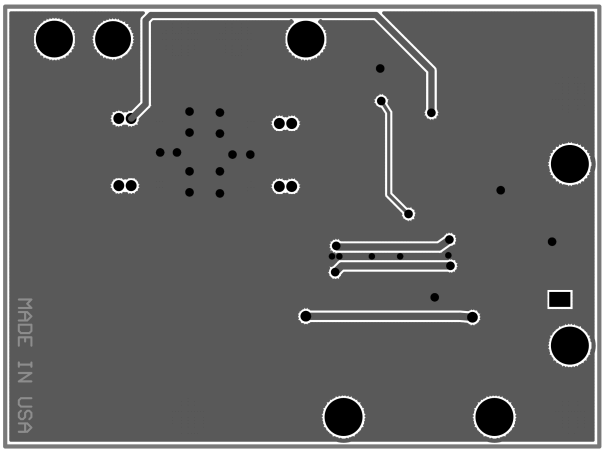

Figure 8. Bottom Layer

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers’ products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers’ products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

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