TPS23753AEVM-001 Evaluation Module for TPS23753A

This user's guide describes the TPS23753A evaluation module (TPS23753AEVM-001). TPS23753AEVM-001 contains evaluation and reference circuitry for the TPS23753A. The TPS23753A device is an IEEE 802.3-2005 compliant, powered-device (PD) controller and power supply controller optimized for isolated converter topologies. TPS23753AEVM-001 is targeted at low-cost, simple, 7-W flyback converter applications.

Contents

1 Description 2
1.1 Features 2
1.2 Applications 2
2 Electrical Specifications 2
3 Schematic 3
4 General Configuration and Description 4
4.1 Physical Access 4
5 Test Setup 5
6 TPS23753AEVM-001 Typical Performance Data 5
6.1 3.3-V Efficiency 5
6.2 5-V DC/DC Efficiency 6
6.3 TPS23753AEVM-001 Conducted Emissions 7
7 EVM Assembly Drawings and Layout Guidelines 7
8 Bill of Materials 10

List of Figures

1 TPS23753AEVM-001 Schematic 3
2 Typical TPS23753AEVM-001 Test Setup 5
3 TPS23753AEVM-002 Efficiency With 3.3-V Output 6
4 TPS23753AEVM-001 Efficiency With 5-V Output 6
5 TPS23753AEVM-001 Conducted Emissions 7
6 Top-Side Placement 7
7 Top-Side Routing 8
8 Bottom-Side Routing 8
9 Bottom-Side Placement 9

List of Tables

1 TPS23753AEVM-001 and -002 Electrical and Performance Specifications at T=25°C 2
2 Connector Functionality 4
3 Test Points 4
4 TPS23753AEVM-001 and -002 Bill of Materials 10

1 Description

The TPS23753AEVM-001 allows reference circuitry evaluation of the TPS23753A. It contains input and output power connectors and an array of onboard test points for circuit evaluation. TPS23753AEVM-002 (3.3-V output) can be configured with simple bill of materials (BOM) changes.

1.1 Features

- Low-cost, basic design
  - Simple gate drive, Shottky diode rectified secondary
  - 7-W output power from power over ethernet (PoE), 48-V or 24-V adapter and 4-W output power from a 12-V adapter
  - 3.3-V output voltage with simple BOM changes

1.2 Applications

- Voice over Internet protocol – IP telephones
- Wireless LAN – wireless access points
- Security – wired IP cameras

2 Electrical Specifications

Table 1. TPS23753AEVM-001 and -002 Electrical and Performance Specifications at T=25°C

PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
POWER INTERFACE						
Input voltage	Applied to the power pins of connectors J2 or J4		0		57	V
Operating voltage	After start-up		30		57	V
Input UVLO	Rising input voltage				36	V
	Falling input voltage		30			
Detection voltage	At device terminals		3		10	mA
Classification voltage	At device terminals		10		23	mA
Classification current	Rclass = 1270 Ω		1.8		2.4	mA
Inrush current-limit			90		190	mA
Operating current-limit			405		495	mA
DC/DC CONVERTER						
Output voltage	20 V ≤ Vin ≤ 57 V, ILOAD ≤ ILOAD (max) 10.8 V ≤ Vin ≤ 13.2 V, ILOAD ≤ ILOAD (max)	3.3-V output (-002)	3.13	3.3	3.47	V
		5-V output (-001)	4.75	5	5.25	
Output current	20 V ≤ Vin ≤ 57 V	3.3-V output			2	A
					1.4	
	10.8 V ≤ Vin ≤ 13.2 V	5-V output			1.2	A
					0.8	
Output ripple voltage, peak-to-peak	Vin = 44 V, ILOAD = 2 A	3.3-V output		65		mV
	Vin = 44 V, ILOAD = 1.4A	5-V output		50		
Efficiency, end-to-end	Vin = 44 V, ILOAD = 2 A	3.3-V output		77		%
	Vin = 44 V, ILOAD = 1.4 A	5-V output		80		%
Switching frequency			225		270	kHz

3 Schematic

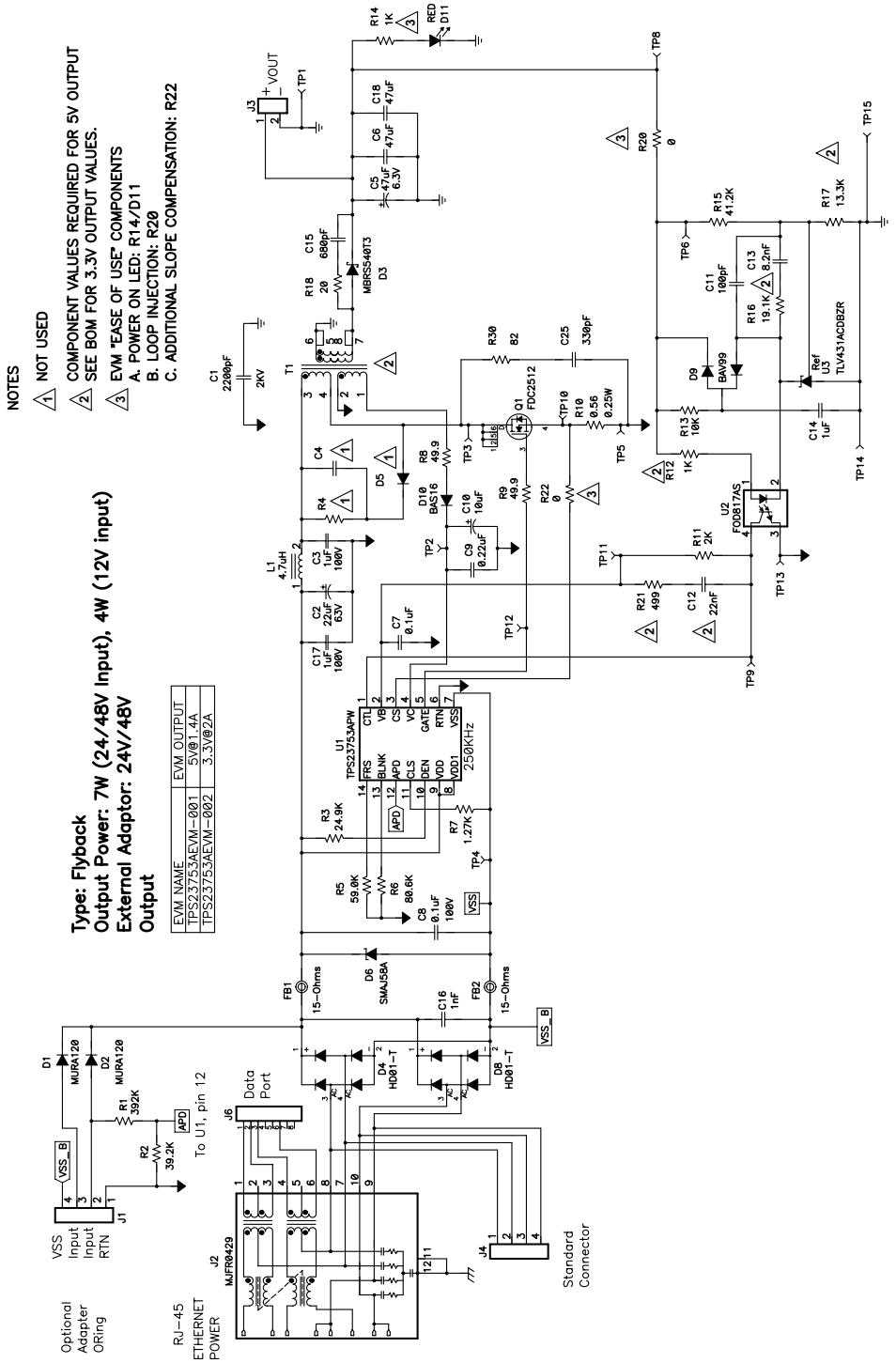

Figure 1. TPS23753AEVM-001 Schematic

4 General Configuration and Description

4.1 Physical Access

Table 2 lists the TPS23753AEVM-001 connector functionality and Table 3 describes the test point availability.

Table 2. Connector Functionality

Connector	Label	Description
J1	RTN Input Input VSS	External adapter input connector. J1-1/J1-2 are used with DC/DC converter adapter input (RTN) and J1-3/J1-4 are used with a PD adapter input (VSS)
J2	ETHERNET POWER	Ethernet power input connector. Contains Ethernet transformer and cable terminations
J3	VOUT	Output voltage connector
J4	12 36 45 78	PD side diode bridge input. Used to apply 48-V input voltage to the diode bridges as would power application from the J2 connector. J4-1/J4-2 and J4-3/J4-4 are used together.
J6	DATA PORT	Ethernet data port connector

Table 3. Test Points

Test Point	Color	Label	Description
TP1, TP14, TP15	BLK	GND	Secondary-side (output) grounds (GND)
TP2	RED	VC	DC/DC converter bias supply
TP3	ORG	DRAIN	Drain terminal of the primary-side switching MOSFET
TP4	BLK	VSS	PoE input, low side
TP5, TP13	BLK	RTN	DC/DC converter return
TP6	ORG	LOOP	Can be used with TP8 for feedback loop measurements.
TP8	RED	VOUT	DC/DC converter output voltage.
TP9	RED	CTL	Control loop input to the pulse width modulator
TP10	WHT	CS	DC/DC converter primary-side switching MOSFET current-sense input
TP11	RED	VB	Bias voltage regulator
TP12	WHT	GATE	Gate drive for the primary-side switching MOSFET
D11	RED	POWER ON	Output power indicator

5 Test Setup

Figure 2 shows a typical test setup for TPS23753AEVM-001. Input voltage can be applied as described in Table 2.

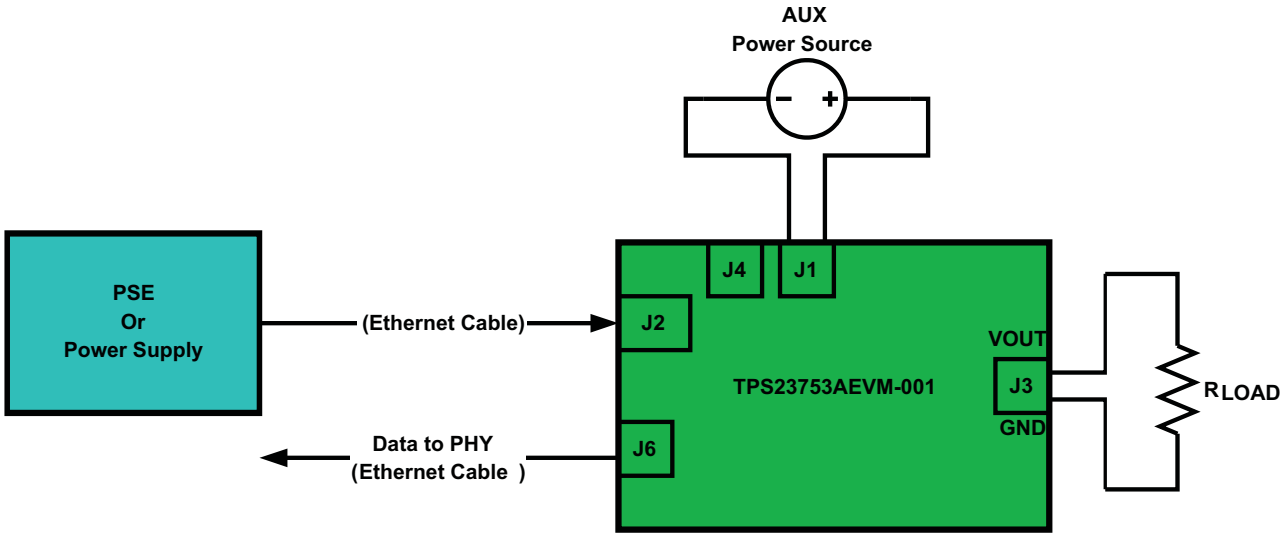

Figure 2. Typical TPS23753AEVM-001 Test Setup

6 TPS23753AEVM-001 Typical Performance Data

6.1 3.3-V Efficiency

Figure 3 illustrates the efficiency at three different input voltage levels: 1) PoE 48 V from J2, 2) 48 V RTN-based adapter, and 3) 24-V RTN-based adapter.

Note: TPS23753AEVM-001 contains options for two different type primary switch snubbers. An RC slew rate snubber is included by default but if additional efficiency is demanded by the application, the RC snubber may be removed and the clamp type snubber may be populated. The RC snubber is best for applications requiring low conducted emissions via the power lines.

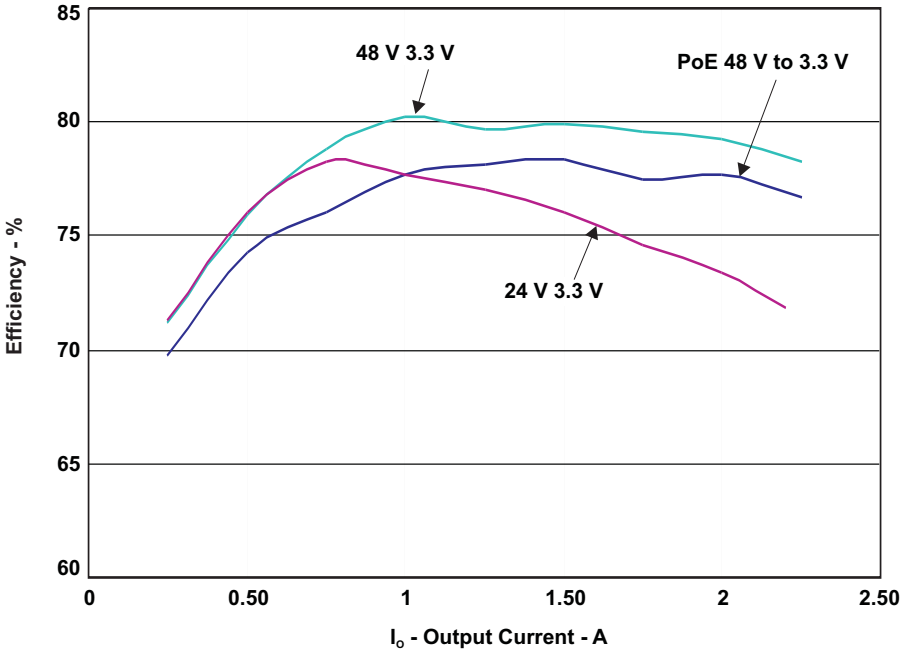

Figure 3. TPS23753AEVM-002 Efficiency With 3.3-V Output

6.2 5-V DC/DC Efficiency

Figure 4 illustrates the efficiency at three different input voltage levels: 1) PoE 48 V from J2, 2) 48 V RTN-based adapter, and 3) 24-V RTN-based adapter.

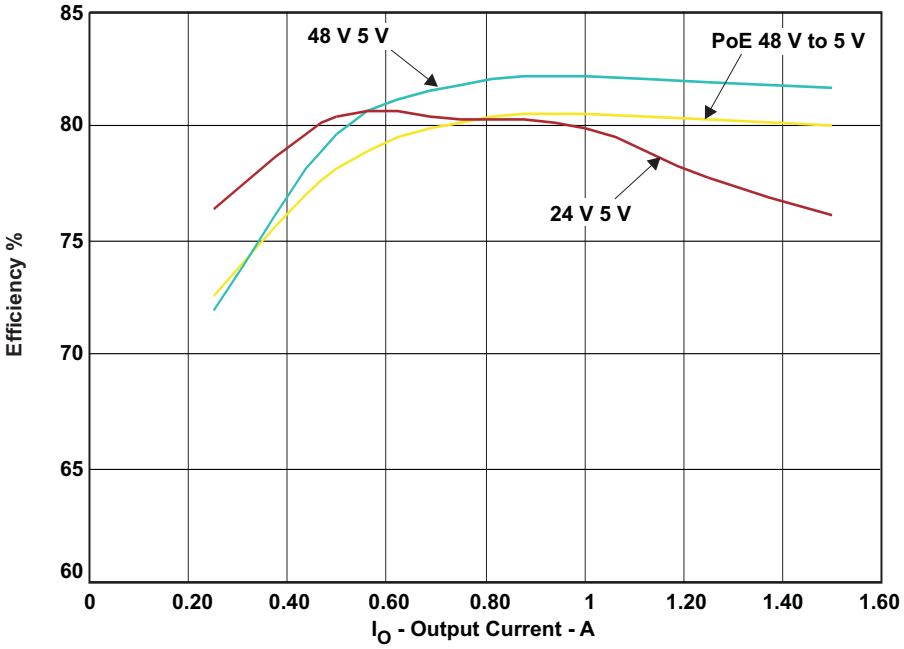

Figure 4. TPS23753AEVM-001 Efficiency With 5-V Output

6.3 TPS23753AEVM-001 Conducted Emissions

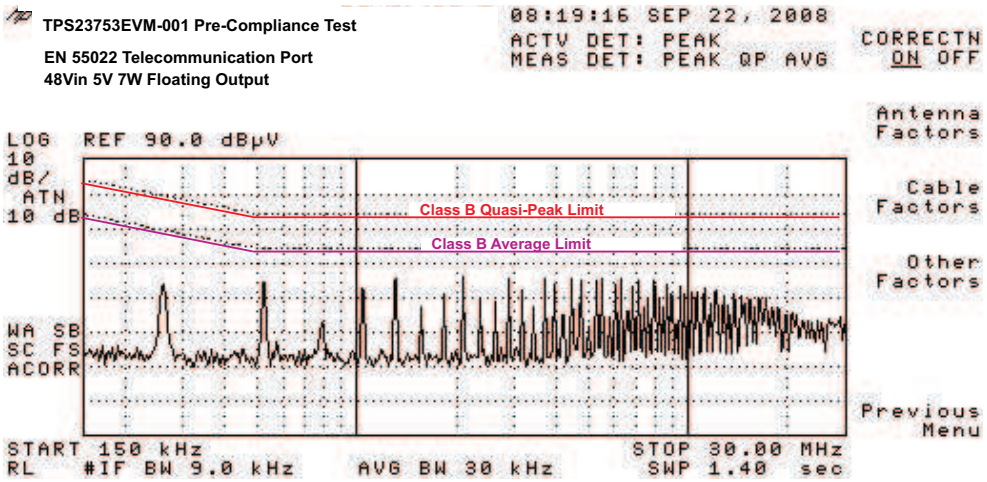

Figure 5. TPS23753AEVM-001 Conducted Emissions

7 EVM Assembly Drawings and Layout Guidelines

Figure 6 through Figure 9 show component placement and layout.

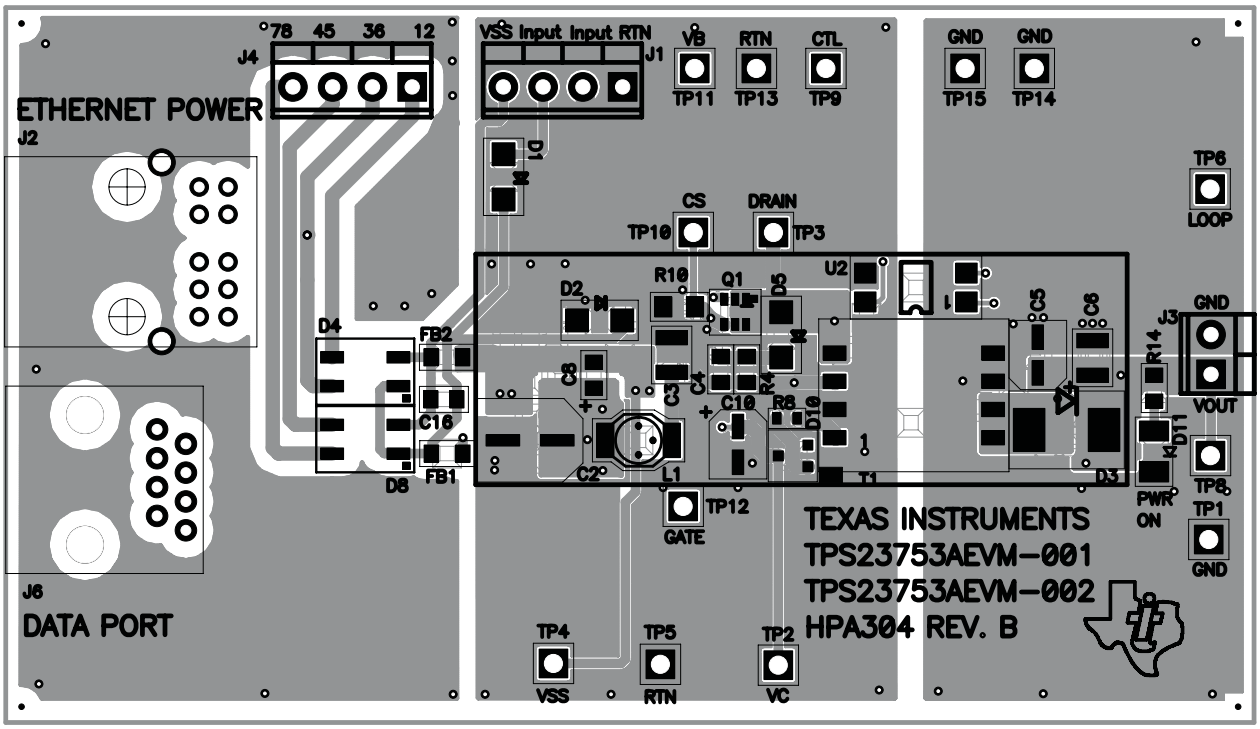

Figure 6. Top-Side Placement

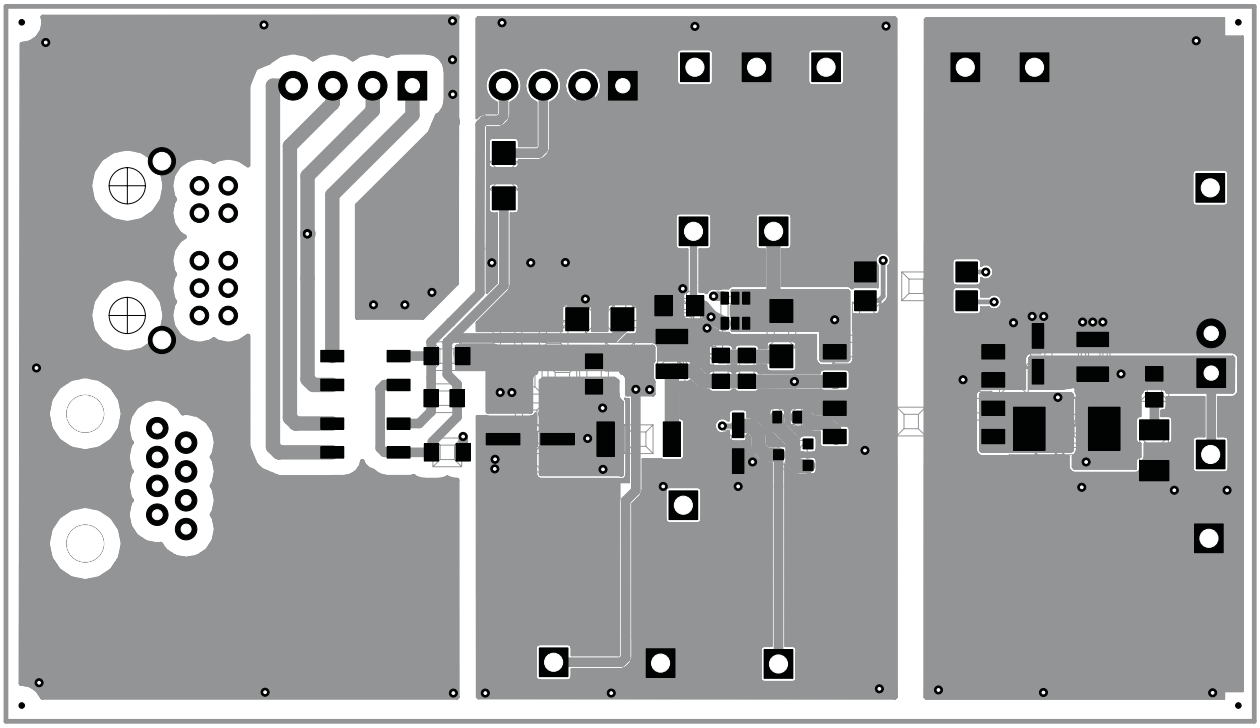

Figure 7. Top-Side Routing

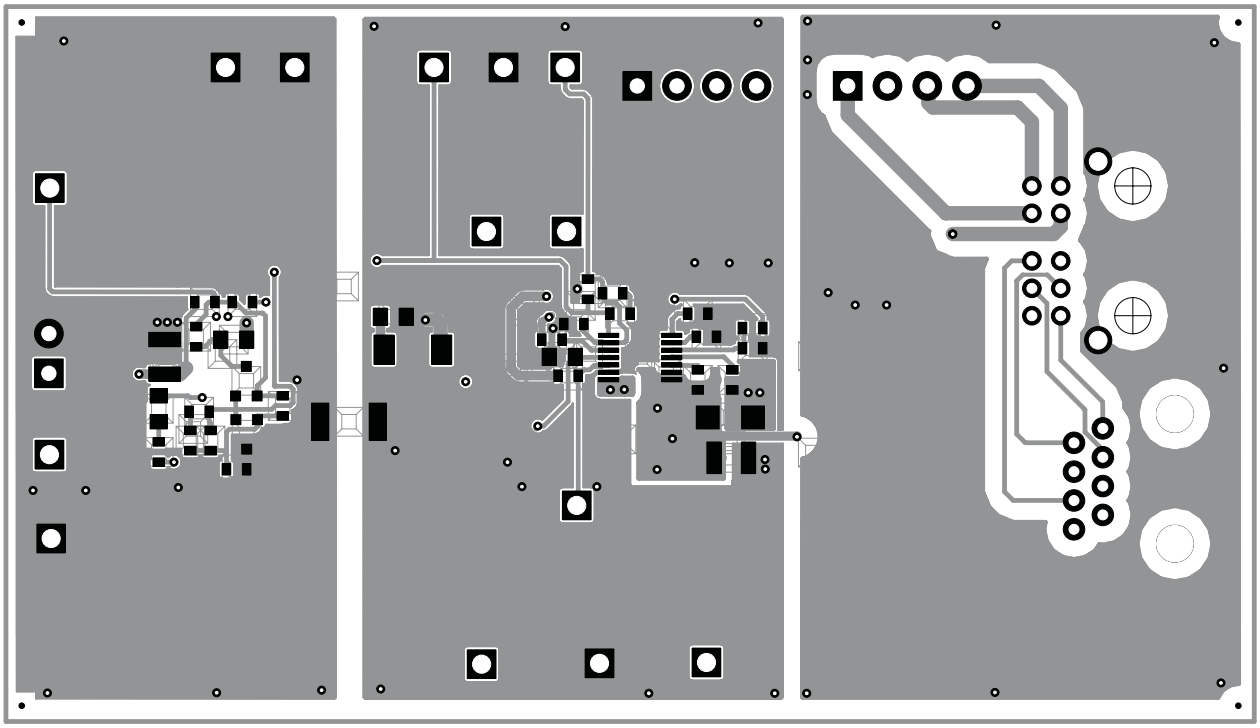

Figure 8. Bottom-Side Routing

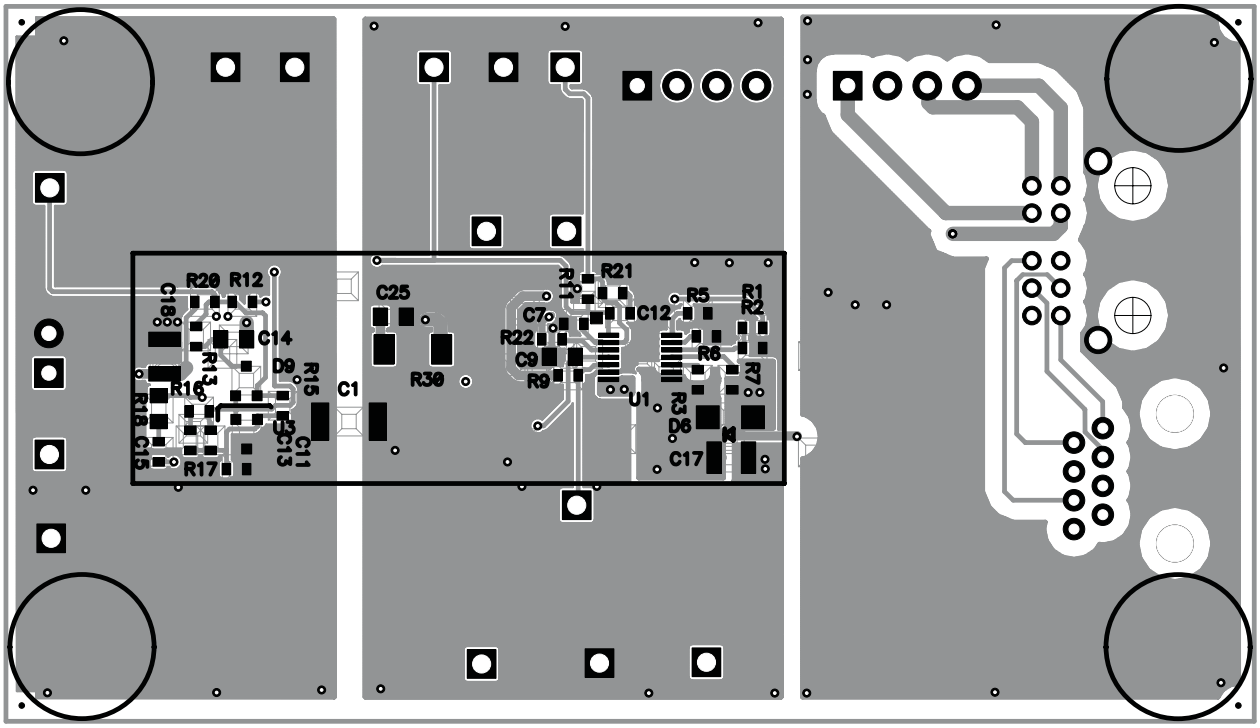

Figure 9. Bottom-Side Placement

8 Bill of Materials

Table 4. TPS23753AEVM-001 and -002 Bill of Materials

TPS23753AEVM-X		RefDes	Value	Description	Size	Part Number	MFR
Outputs (V)							
3.3	5						
Count							
X=002	X=001						
1	1	C1	2200pF	Capacitor, Ceramic, 2KV, X7R, 10%	1812	C4532X7R3D222K	TDK
1	1	C10	10uF	Capacitor, Aluminum, 16V, ±20%	0.200 × 0.210 in	EEVFK1E100R	Panasonic
1	1	C11	100pF	Capacitor, Ceramic, 50V, C0G, 5%	0603	Std	Std
0	1	C12	22nF	Capacitor, Ceramic, 50V, X7R, 10%	0603	Std	Std
1	0	C12	47nF	Capacitor, Ceramic, 50V, X7R, 10%	0603	Std	Std
0	1	C13	8.2nF	Capacitor, Ceramic, 50V, X7R, 10%	0603	Std	Std
1	0	C13	6.8nF	Capacitor, Ceramic, 50V, X7R, 10%	0603	Std	Std
1	1	C14	1uF	Capacitor, Ceramic, 16V, X7R, 10%	0805	Std	Std
1	1	C15	680pF	Capacitor, Ceramic, 25V, X7R, 10%	0603	Std	Std
1	1	C16	1nF	Capacitor, Ceramic, 100V, X7R, 10%	0805	Std	Std
1	1	C2	22µF	Capacitor, Aluminum, 63V, ±20%	0.260 × 0.276 in	EEVFK1J220XP	Panasonic
1	1	C25	330pF	Capacitor, Ceramic, 200V, X7R, 10%	0805	Std	Std
2	2	C3, C17	1µF	Capacitor, Ceramic, 100V, X7R, 10%	1210	Std	Std
0	0	C4	10nF	Capacitor, Ceramic, 100V, X7R, 10%	0805	Std	Std
1	1	C5	47µF	Capacitor, Aluminum, 6.3V, ±20%	0.200 x 0.210 in	EEVFK0J470UR	Panasonic
2	2	C6, C18	47µF	Capacitor, Ceramic, 10V, X5R, 20%	1210	Std	TDK
1	1	C7	0.1µF	Capacitor, Ceramic, 50V, X7R, 10%	0603	Std	Std
1	1	C8	0.1µF	Capacitor, Ceramic, 100V, X7R, 10%	0805	Std	Std
1	1	C9	0.22µF	Capacitor, Ceramic, 25V, X7R, 10%	0805	Std	Std
2	2	D1, D2	MURA120	Diode, Rectifier, 1A, 200V	SMA	MURA120	On Semi
0	0	D5	MURA120	Diode, Rectifier, 1A, 200V	SMA	MURA120	On Semi
1	1	D10	BAS16	Diode, Switching, 150-mA, 75-V, 350mW	SOT23	BAS16	Fairchild
1	1	D3	MBRS540T3	Diode, Schottky, 5-A, 40-V	SMC	MBRS540T3	On Semi
2	2	D4, D8	HD01-T	Bridge Rectifier, 100V, 0.8A	MINI DIP4	HD01-T	Diodes, Inc
1	1	D6	SMAJ58A	Diode, TVS, 58-V, 1W	SMA	SMAJ58A	Diodes Inc.
1	1	D9	BAV99	Diode, Dual Ultra Fast, Series, 200-mA, 70-V	SOT23	BAV99	Fairchild
2	2	FB1,FB2	15-Ω	Bead, Ferrite, SMT, 15-Ω, 1500mA	0805	MMZ2012R150A	TDK
2	2	J1, J4	ED555/4DS	Terminal Block, 4-pin, 6-A, 3,5mm	0.55 × 0.25 in	ED555/4DS	OST
1	1	J2	MJFR0429	Connector, Module, RJ45	0.855 × 0.620	MJFR0429	E&E Magnetic Products
1	1	J3	ED1514	Terminal Block, 2-pin, 6-A, 3,5mm	0.27 × 0.25	ED1514	
1	1	J6	5520252-4	Connector, Jack Modular, Rt. Angle,	0.655 × 0.615 in	5520252-4	AMP
1	1	L1	4.7µH	Inductor, SMT, 1.5A, 90-mΩ	0.26 × 0.09 in	DO1608C-472ML	Coilcraft
1	1	Q1	FDC2512	MOSFET, N-ch, 150-V, 1.4-A, 425-mΩ	SSOT-6	FDC2512	Fairchild
1	1	R1	392K	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	1	R10	0.56	Resistor, Chip, 1/4W, 1%	1206	ERJ-8RQFR56V	Panasonic ECG
1	1	R11	2K	Resistor, Chip, 1/16W, 1%	0603	Std	Std
0	1	R12	1K	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	0	R12	402	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	1	R13	10K	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	1	R15	41.2K	Resistor, Chip, 1/16W, 1%	0603	Std	Std
0	1	R16	19.1K	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	0	R16	7.15K	Resistor, Chip, 1/16W, 1%	0603	Std	Std
0	1	R17	13.3K	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	0	R17	24.3K	Resistor, Chip, 1/16W, 1%	0603	Std	Std

Table 4. TPS23753AEVM-001 and -002 Bill of Materials (continued)

TPS23753AEVM-X		RefDes	Value	Description	Size	Part Number	MFR
Outputs (V)							
3.3	5						
Count							
X=002	X=001						
1	1	R18	20	Resistor, Chip, 1/10W, 5%	0805	Std	Std
1	1	R2	39.2K	Resistor, Chip, 1/16W, 1%	0603	Std	Std
2	2	R20, R22	0	Resistor, Chip, 1/16W, 1%	0603	Std	Std
0	1	R21	499	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	0	R21	402	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	1	R3	24.9K	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	1	R30	82	Resistor, Chip, 1/2W, 5%	2010	Std	Std
0	0	R4	49.9K	Resistor, Chip, 1/10W, 1%	0805	Std	Std
1	1	R5	59.0K	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	1	R6	80.6K	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	1	R7	1.27K	Resistor, Chip, 1/16W,1%	0603	Std	Std
2	2	R8, R9	49.9	Resistor, Chip, 1/16W, 1%	0603	Std	Std
0	1	T1	POE70P-50L or 835-01046FC	Transformer, PoE 7W, 155 µH. 5V, 1.4A Output	0.500 × 0.600 in	POE70P-50L or 835-01046FC	Coilcraft or E&E Magnetic Products
1	0	T1	POE70P-33L or 835-01045FC	Transformer, PoE 7W, 155 µH. 3.3V, 2.1A Output	0.500 × 0.600 in	POE70P-33L or 835-01045FC	Coilcraft or E&E Magnetic Products
1	1	U1	TPS23753APW	IC, IEEE 802.3-2005 Integrated Primary Side Controller	TSSOP14	TPS23753APW	TI
1	1	U2	FOD817AS	IC, Optocoupler, 6-V, 80-160% CTR	SMT-4PDIP	FOD817AS	Fairchild
1	1	U3	TLV431ACDBZR	IC, Low-Voltage Adjustable Shunt Regulator	SOT23-3	TLV431ACDBZR	TI
1	1	—	—	PCB, 2.48 In × 4.33 In × 0.062 In	—	HPA304	Any

EVALUATION BOARD/KIT IMPORTANT NOTICE

Texas Instruments (TI) provides the enclosed product(s) under the following conditions:

This evaluation board/kit is intended for use for **ENGINEERING DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY** and is not considered by TI to be a finished end-product fit for general consumer use. Persons handling the product(s) must have electronics training and observe good engineering practice standards. As such, the goods being provided are not intended to be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety and environmental measures typically found in end products that incorporate such semiconductor components or circuit boards. This evaluation board/kit does not fall within the scope of the European Union directives regarding electromagnetic compatibility, restricted substances (RoHS), recycling (WEEE), FCC, CE or UL, and therefore may not meet the technical requirements of these directives or other related directives.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge.

EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

TI currently deals with a variety of customers for products, and therefore our arrangement with the user **is not exclusive.**

TI assumes **no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein.**

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please contact the TI application engineer or visit www.ti.com/esh.

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used.

FCC Warning

This evaluation board/kit is intended for use for **ENGINEERING DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY** and is not considered by TI to be a finished end-product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 0 V to 57 V and the output voltage range of 3 V to 15 V.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative.

During normal operation, some circuit components may have case temperatures greater than 80°C. The EVM is designed to operate properly with certain components above 80°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

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

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI 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 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. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

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

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		**Applications**	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DLP® Products	www.dlp.com	Broadband	www.ti.com/broadband
DSP	dsp.ti.com	Digital Control	www.ti.com/digitalcontrol
Clocks and Timers	www.ti.com/clocks	Medical	www.ti.com/medical
Interface	interface.ti.com	Military	www.ti.com/military
Logic	logic.ti.com	Optical Networking	www.ti.com/opticalnetwork
Power Mgmt	power.ti.com	Security	www.ti.com/security
Microcontrollers	microcontroller.ti.com	Telephony	www.ti.com/telephony
RFID	www.ti-rfid.com	Video & Imaging	www.ti.com/video
RF/IF and ZigBee® Solutions	www.ti.com/lprf	Wireless	www.ti.com/wireless

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