

## **TPS61085EVM**

This user's guide describes the characteristics, operation, and use of the TPS61085EVM evaluation module (EVM). This EVM contains the Texas Instruments 650 kHz/1.2 MHz, 18.5 V step-up DC-DC converter TPS61085 with a switch current of 2 A min. The user's guide includes EVM specifications, recommended test setup, the schematic diagram, bill of materials, and the board layout.

### **Contents**

1	Introduction .....	1
	1.1 Background .....	1
	1.2 Performance Specification Summary .....	1
2	Setup and Test Results .....	2
	2.1 Input/Output Connections .....	2
	2.2 EVM Operation .....	3
	2.3 Compensation (R3, C5) .....	3
3	Schematic, Bill of Materials, and Board Layout .....	4
	3.1 Schematic .....	4
	3.2 Bill of Materials .....	5
	3.3 Board Layout .....	5

### **List of Figures**

1	TPS61085EVM Schematic .....	4
2	Top Assembly Layer .....	6
3	Top Layer Routing .....	7
4	Bottom View of EVM Layer Routing .....	8

### **List of Tables**

1	Performance Specification Summary.....	2
2	Recommended Compensation Network Values at High/Low Frequency.....	3
3	HPA355A Bill of Materials .....	5

## **1 Introduction**

This section contains background information for the TPS61085EVM evaluation module.

### **1.1 Background**

This TPS61085EVM uses a TPS61085 boost converter to step up 2.3 V to 6 V input voltages to 12 V. The goal of the EVM is to facilitate evaluation of the TPS61085 power supply solution. The EVM uses the TPS61085 adjustable output boost converter and the appropriate feedback components to provide 12 V.

### **1.2 Performance Specification Summary**

[Table 1](#) provides a summary of the TPS61085EVM performance specifications. All specifications are given for an ambient temperature of 25°C.

**Table 1. Performance Specification Summary**

SPECIFICATION	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$V_{IN}$		2.3		6	V
$V_{OUT}$ <sup>(1)</sup>	TPS61085EVM, $V_{IN} = 3.3\text{ V} \pm 2\%$ , $I_{OUT} < 300\text{ mA}$ , $f_{SW} = 1.2\text{ MHz}$	11.6	12	12.4	V

<sup>(1)</sup> Min and Max values include 1% resistor tolerance as well as IC reference tolerance.

## 2 Setup and Test Results

This section describes how to properly connect, set up, and use the TPS61085EVM.

### 2.1 Input/Output Connections

The connection points are described in the following paragraphs.

#### 2.1.1 J1-VIN

This header is the positive connection to the input power supply. The power supply must be connected between J1 and J3 (GND). The leads to the input supply should be twisted and kept as short as possible. The input voltage has to be between 2.3 V and 6 V.

#### 2.1.2 J2-VIN Sense Connector

This header is not populated, but is planned to be used to measure the input voltage directly on the input capacitor. Therefore a 4-wire power & sense supply can be connected. The leads to the sensing connector should also be twisted.

#### 2.1.3 J3-GND

This header is the return connection to the input power supply. Connect the power supply between these pins and J1 (VIN). The leads to the input supply should be twisted and kept as short as possible. The input voltage has to be between 2.3 V and 6 V.

#### 2.1.4 J4-Vs

This header is the positive connection of the output voltage. The load has to be connected between J4 and J6 (GND).

#### 2.1.5 J5-Vs Sense Connector

This header is not populated, but is planned to be used to measure the output voltage directly on the output capacitors.

#### 2.1.6 J6-GND

This header is the return connection of the output voltage. Connect the load between these pins and J4 (Vs).

#### 2.1.7 JP1-EN

Placing a jumper across pins 1 and 2 ties the EN pin to VIN, thereby enabling the device. Placing a jumper across pins 2 and 3 ties the EN pin to GND, which disables the device.

#### 2.1.8 JP2-FREQ

The middle pin of this jumper connects to the FREQ pin of the IC. Placing this jumper across pins 1 and 2 ties the FREQ pin to  $V_{IN}$ , thereby implementing a 1.2 MHz switching frequency. Placing this jumper across pins 2 and 3 ties the FREQ pin to ground, thereby implementing a 650 kHz switching frequency.

## 2.2 EVM Operation

First there should be jumpers connected to JP1 and JP2, to make sure that the part gets the proper signals on the EN and FREQ pins. The user has to connect an input power supply set between 2.3 V and 6 V between headers J1 and J3 in order for the EVM to operate. The absolute maximum input voltage is 7 V. The user can connect a load resistance between J4 and J6. Connect a jumper between pins 1 and 2 of JP1 to enable the device.

## 2.3 Compensation (R3, C5)

The regulator loop can be compensated by adjusting the external components connected to the COMP pin. The COMP pin is the output of the internal transconductance error amplifier. Standard values of R3 = 13 kΩ and C5 = 3.3 nF will work for the majority of the applications.

Please refer to [Table 2](#) for dedicated compensation networks giving an improved load transient response. The following equations can be used to calculate R3 and C5:

$$R3 = \frac{125 \times V_{IN} \times V_S \times C_{out}}{L \times I_{out\_max}} \quad C5 = \frac{V_S \times C_{out}}{5 \times I_{out\_max} \times R3} \quad (1)$$

**Table 2. Recommended Compensation Network Values at High/Low Frequency**

FREQUENCY	L (μH)	V <sub>S</sub> (V)	V <sub>IN</sub> ± 20% (V)	R3(kΩ)	C5
High (1.2 MHz)	3.3	15	5	82	1.1 nF
			3.3	75	1.6 nF
		12	5	51	1.1 nF
			3.3	47	1.6 nF
		9	5	30	1.1 nF
			3.3	27	1.6 nF
Low (650 kHz)	6.8	15	5	43	2.2 nF
			3.3	39	3.3 nF
		12	5	27	2.2 nF
			3.3	24	3.3 nF
		9	5	15	2.2 nF
			3.3	13	3.3 nF

[Table 2](#) gives conservative R3 and C5 values for certain inductors, input and output voltages providing a very stable system. For a faster response time, a higher R3 value can be used to enlarge the bandwidth, as well as a slightly lower value of C5 to keep enough phase margin. These adjustments should be performed in parallel with the load transient response monitoring of TPS61085 to make sure that the system is still stable.

### 3 Schematic, Bill of Materials, and Board Layout

This section provides the TPS61085EVM schematic and bill of materials. Compensation is optimized for stability for different LC output filters. To optimize for fast transient response, see [Section 2.3](#).

#### 3.1 Schematic

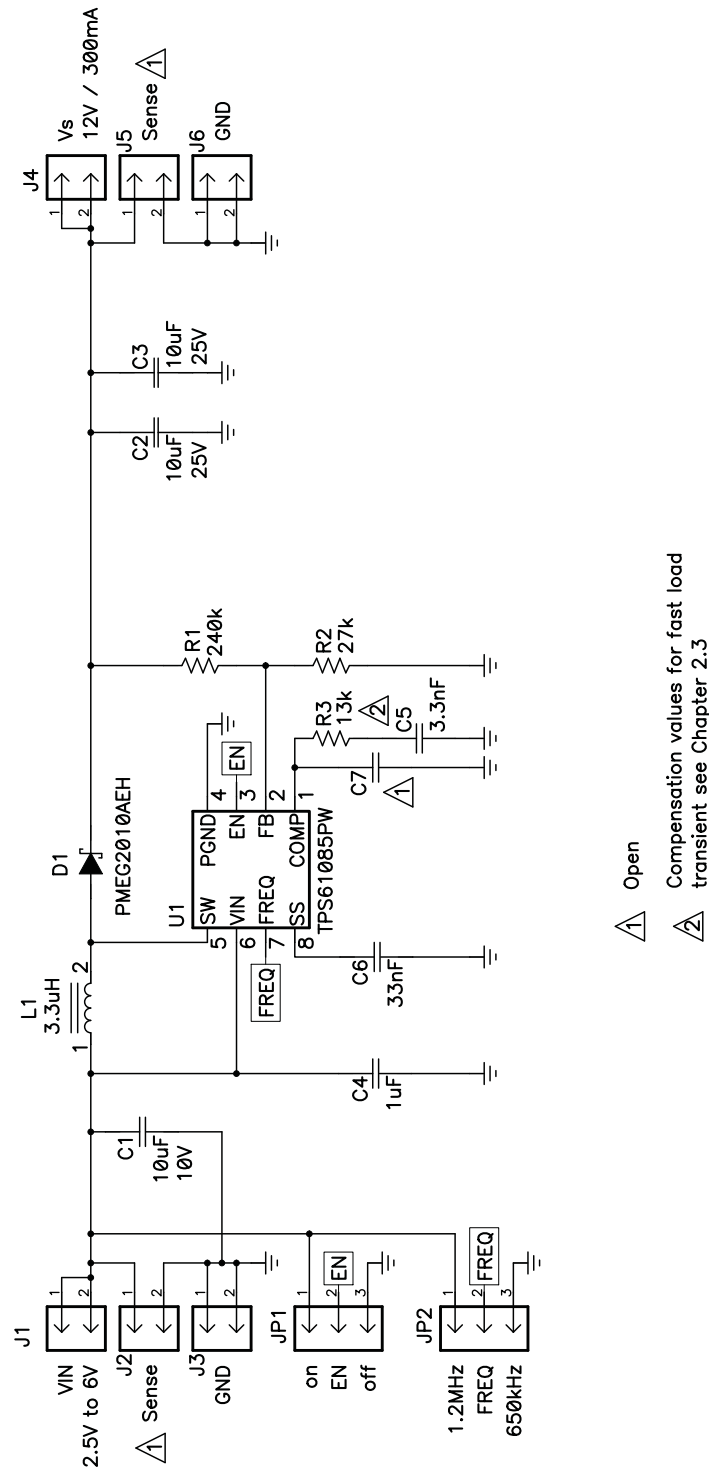


Figure 1. TPS61085EVM Schematic

## 3.2 Bill of Materials

**Table 3. HPA355A Bill of Materials**

Count	RefDes	Value	Description	Size	Part Number	MFR
1	C1	10 $\mu$ F	Capacitor, Ceramic, 10V, X7R or X5R, 10%	0805	GRM21BR71A106KE51	Murata
2	C2, C3	10 $\mu$ F	Capacitor, Ceramic, 25V, X7R, 20%	1210	TMK325BJ106MN	Taiyo Yuden
1	C4	1 $\mu$ F	Capacitor, Ceramic, 10V, X7R, 10%	0805	GRM21BR71A105KA01	Murata
1	C5	3.3 nF	Capacitor, Ceramic, 10V, X7R, 10%	0805	Std	Std
1	C6	33 nF	Capacitor, Ceramic, 10V, X7R, 20%	0805	Std	Std
0	C7	open	Capacitor, Ceramic, 10V, X7R, 20%	0805	Std	Std
1	D1	PMEG2010AEH	Diode, Schottky, 20V, 1A	SOD123	PMEG2010AEH	Vishay
1	L1	3.3 $\mu$ H	Inductor, 3.3A, 30 m $\Omega$	0.276 x 02.87 inch	7447789003	Würth Elektronik
1	R1	2040k (232k)	Resistor, Chip, 1/10W, 1%	0805	Std	Std
1	R2	27k (267k)	Resistor, Chip, 1/10W, 1%	0805	Std	Std
1	R3	13k	Resistor, Chip, 1/10W, 1%	0805	Std	Std
1	U1	TPS61085PW	IC, 600kHz/1.2MHz Step-Up DC-DC Converter	TSSOP-8	TPS61085PW	TI

## 3.3 Board Layout

This section provides the TPS61085EVM board layout and illustrations.

### 3.3.1 Layout

Board layout is critical for all switch-mode power supplies. [Figure 2](#), [Figure 3](#), and [Figure 4](#) show the board layout for the HPA355 PCB. The switching nodes with high-frequency noise are isolated from the noise-sensitive feedback circuitry, and careful attention has been given to the routing of high-frequency current loops. See the data sheet for further layout guidelines.

The empty pads, located to the right of the inductor, allow for easier measurement of the inductor current using a current probe. Desolder the inductor, rotate it by 90° and solder it to the additional pads. Then use a wire from the top pad to the input pad to close the current path again.

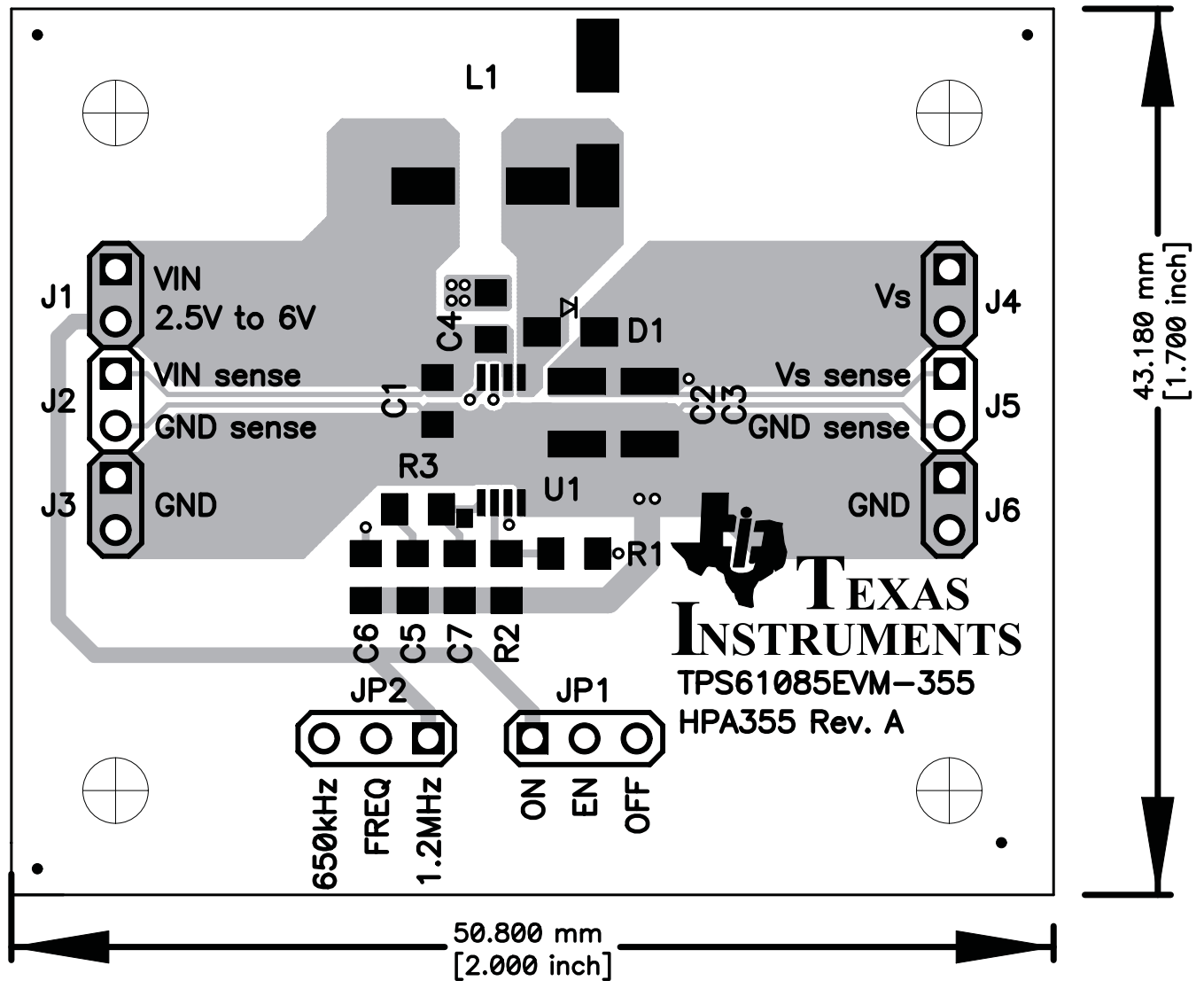


Figure 2. Top Assembly Layer

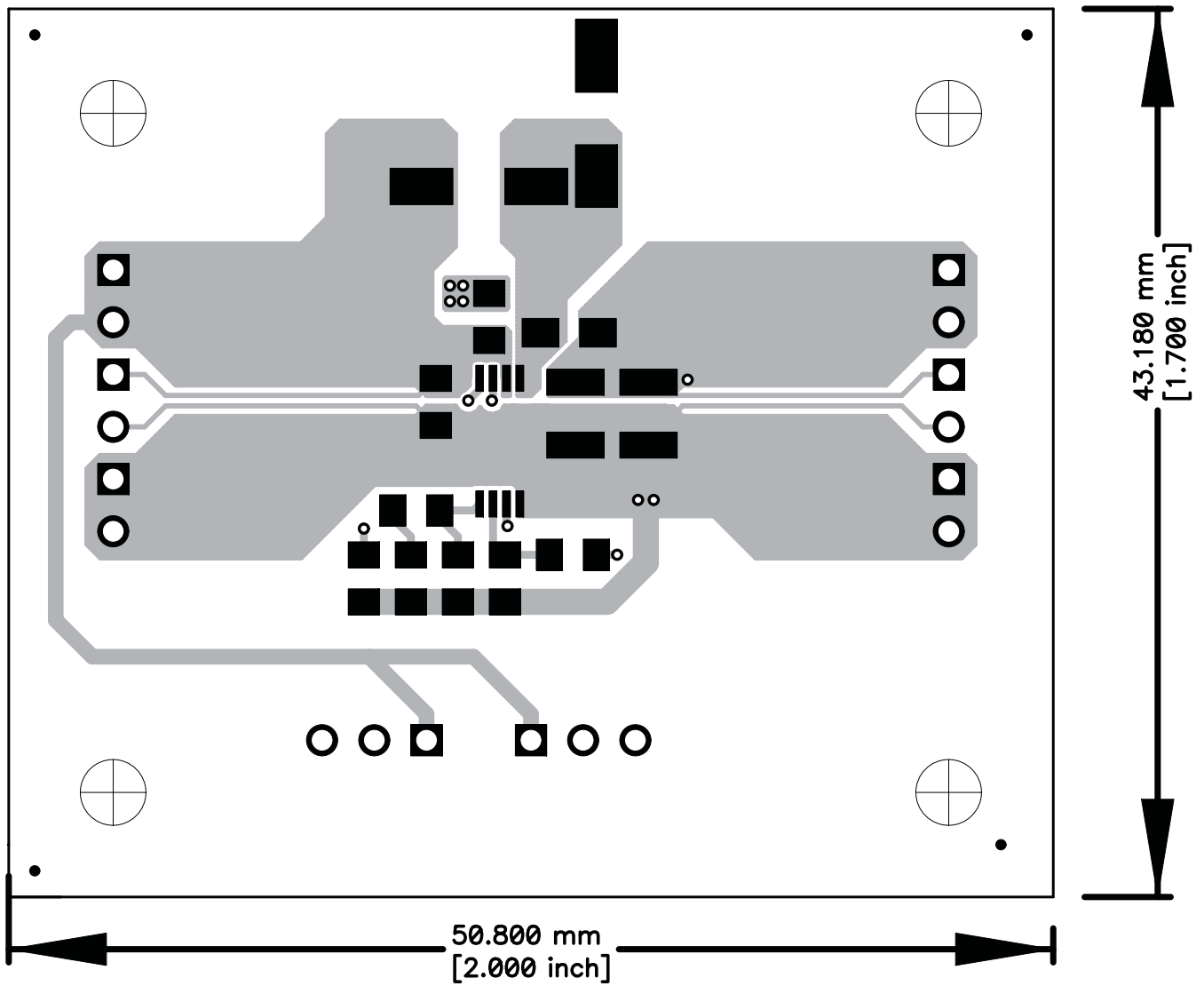


Figure 3. Top Layer Routing

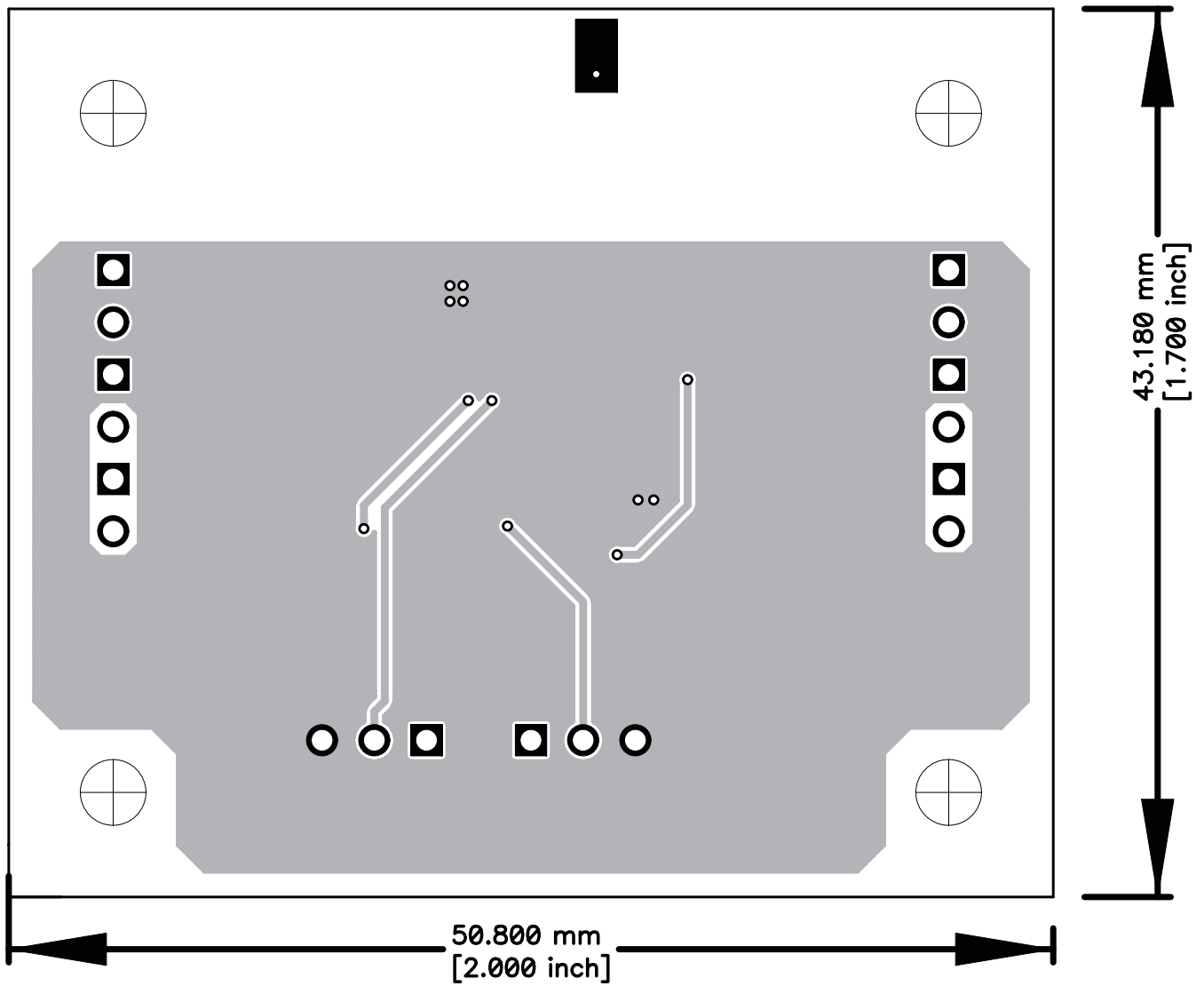


Figure 4. Bottom View of EVM Layer Routing



## 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](http://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 2.5 V to 6 V and the output voltage range of up to 18.5 V, but 12 V as configured.

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 125° C. The EVM is designed to operate properly with certain components above 85° 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  
Copyright © 2010, Texas Instruments Incorporated

## 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:

<b>Products</b>		<b>Applications</b>	
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>	Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>	Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>	Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>	Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>	Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>	Energy	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>	Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>	Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>	Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>	Space, Avionics & Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
RF/IF and ZigBee® Solutions	<a href="http://www.ti.com/lprf">www.ti.com/lprf</a>	Video and Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>
		Wireless	<a href="http://www.ti.com/wireless-apps">www.ti.com/wireless-apps</a>

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265  
Copyright © 2010, Texas Instruments Incorporated