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.

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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.

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Table 1. Performance Specification Summary

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

(1) 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.

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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:

$$R3 = \frac{125 \times V_{IN} \times V_S \times Cout}{L \times Iout\_max} \qquad C5 = \frac{V_S \times Cout}{5 \times Iout\_max \times R3} \tag{1}$$

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

FREQUENCY	L (µH)	V_S (V)	V_{IN} ± 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 conservatives 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.

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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

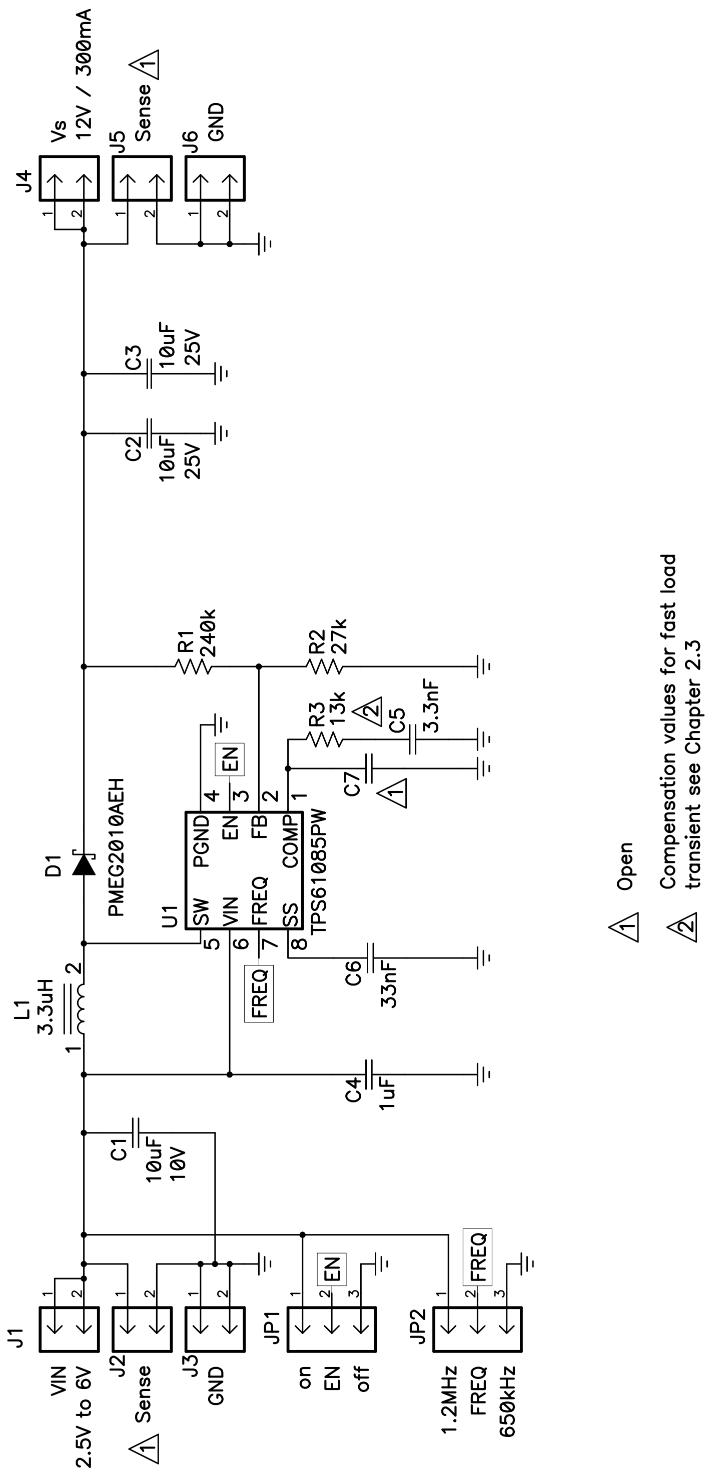

Figure 1. TPS61085EVM Schematic

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3.2 Bill of Materials

Table 3. HPA355A Bill of Materials

Count	RefDes	Value	Description	Size	Part Number	MFR
1	C1	10 µF	Capacitor, Ceramic, 10V, X7R or X5R, 10%	0805	GRM21BR71A106KE51	Murata
2	C2, C3	10 µF	Capacitor, Ceramic, 25V, X7R, 20%	1210	TMK325BJ106MN	Taiyo Yuden
1	C4	1 µF	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 µH	Inductor, 3.3A, 30 mΩ	0.276 x 02.87 inch	7447789003	Wurth 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.

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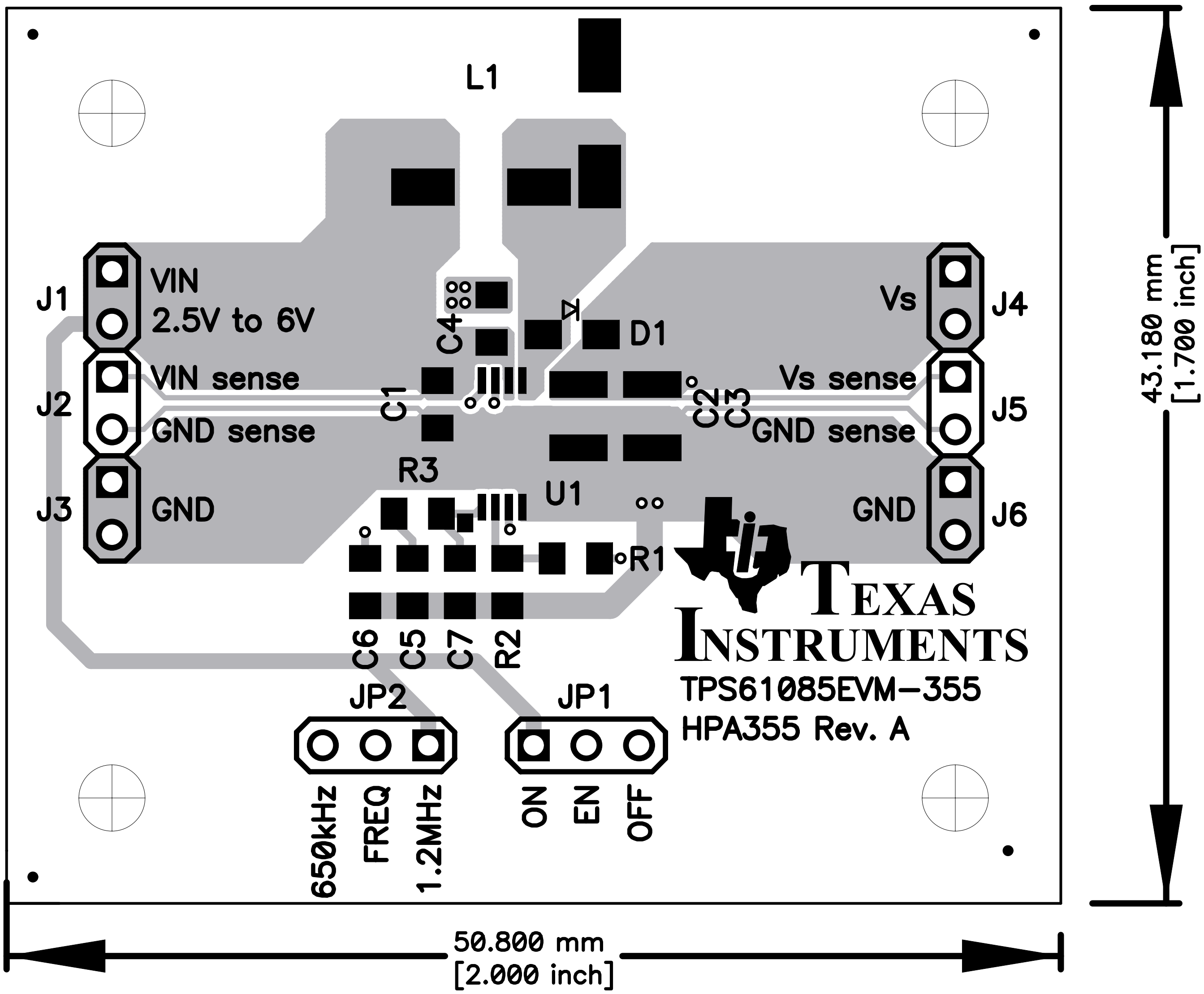

Figure 2. Top Assembly Layer

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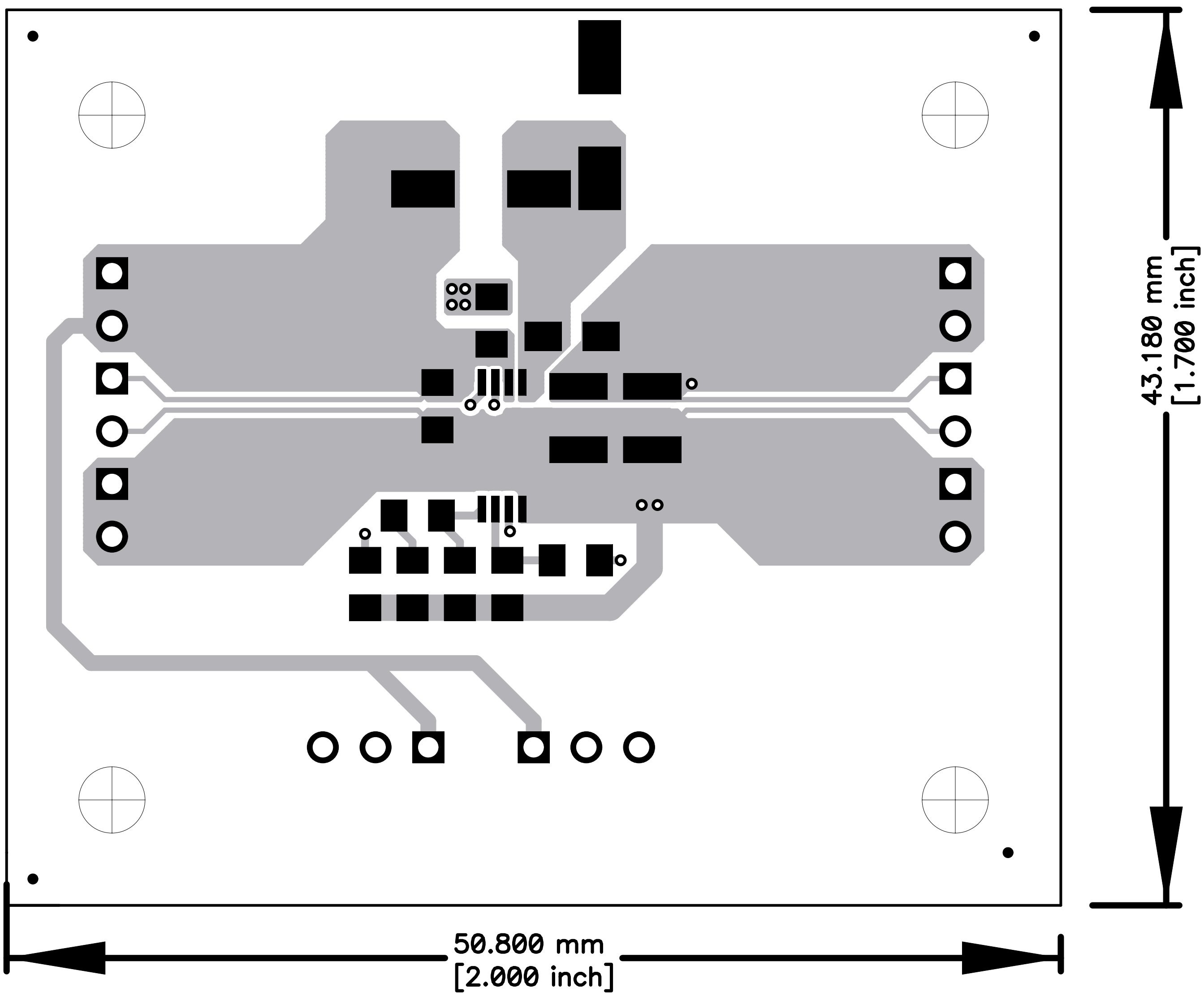

Figure 3. Top Layer Routing

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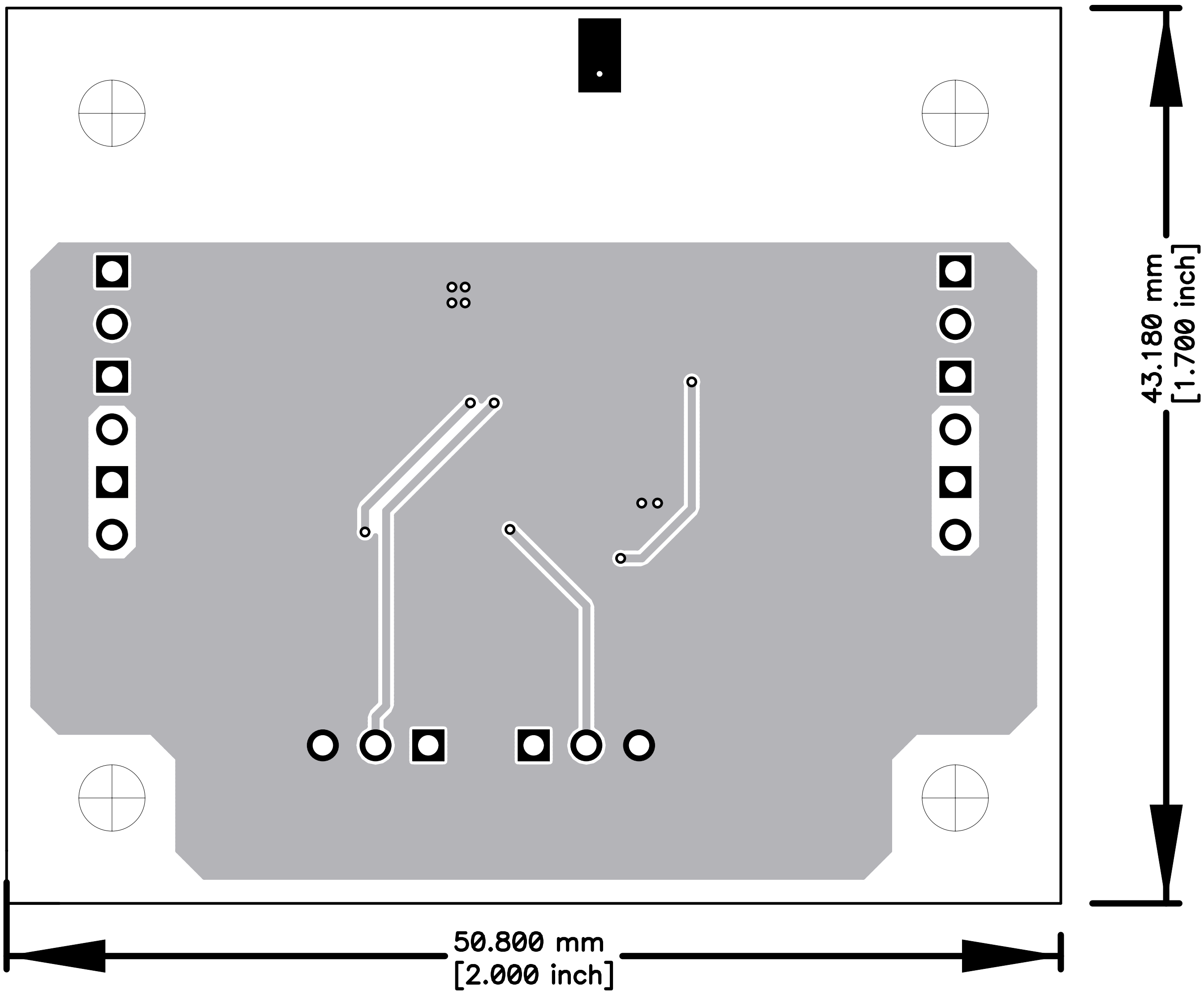

Figure 4. Bottom View of EVM Layer Routing

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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.

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