

# TPS62400EVM

This user's guide describes the characteristics, operation, and use of the TPS62400EVM-167 evaluation module (EVM). This EVM demonstrates the Texas Instruments TPS62400 family of 2.25-MHz, dual step-down converters. The EVM is available in three different dash-numbered assemblies:

- -001 : Configured for the TPS62400
- -002: Configured for the TPS62401
- -003: Configured for the TPS62420

Each dash number is assembled with a different member of the TPS62400 family of ICs. This user's guide includes setup instructions, a schematic diagram, a bill of materials, and PCB layout drawings for all versions of the evaluation module.

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## 1 Introduction

### 1.1 Requirements

To operate this EVM properly, connect and properly configure the following components:

A personal computer (PC) with a USB port is required to operate this EVM. The TPS62400 interface software runs on the PC and communicates with the EVM via the PC's USB port. Commands can be sent to the internal registers of the TPS62400 through the USB port.

#### Personal Computer Requirements

- Windows™ 2000 or Windows™ XP operating system
- USB port
- Minimum of 30 MB of free hard disk space (100 MB recommended)
- Minimum of 256 MB or RAM

EasyScale is a trademark of Texas Instruments.  
Windows is a trademark of Microsoft Corporation.

### Printed-Circuit Board Assembly

The TPS62400EVM-167 PCB contains the TPS62400 IC and its required external components. This board contains several jumpers and connectors that enable the user to customize the board for specific operating conditions.

### USB Interface Adapter

The USB interface adapter is the link that allows the PC and the EVM to communicate. One end of the USB interface adapter connects to the PC with the supplied USB cable; the other side of the USB interface adapter connects to the EVM with the supplied ribbon cable.

When a command is written to the EVM, the interface program running on the PC sends the commands to the PC USB port. The USB interface adapter receives the USB command, converts the signal to an EasyScale™ protocol, and then sends the converted signal to the TPS62400EVM board

### Software

Texas Instruments has provided software to assist in evaluating this EVM. The software can be installed from the supplied CD or downloaded from the Texas Instruments Web site at [www.ti.com](http://www.ti.com).

## 2 Setup

This section describes the jumpers and connectors on the EVM as well as how to properly connect, set up, and use the TPS62400EVM-167.

### 2.1 *Input/Output Connector Descriptions*

#### 2.1.1 J1 – VIN

This is the positive input supply voltage. The leads to the input supply should be twisted and kept as short as possible to minimize EMI transmission.

#### 2.1.2 J2 – GND

This is the return connection for the input power supply.

#### 2.1.3 J3 – EasyScale™ Input

This connector is the EasyScale™ input. Pin 6 is ground, and pin 10 is the mode pin of the TPS624xx.

#### 2.1.4 J4 – VOUT2

This is the positive connection from the output of converter 2. Connect this pin to the positive input of the load to be powered by the second output of the converter.

#### 2.1.5 J5 – GND

This is the return connection for VOUT2. Connect this pin to the negative input of the load.

#### 2.1.6 J6 – VOUT1

This is the positive connection from the output of converter 1. Connect this pin to the positive input of the load to be powered by the first output of the converter.

#### 2.1.7 J7 – GND

This is the return connection for VOUT1. Connect this pin to the negative input of the load.

### 2.1.8 JP2 – EN1

This jumper enables or disables converter 1. Connect the shorting jumper from the center EN pin to either the ON or OFF position. Never leave this pin floating .

### 2.1.9 JP3 – EN2

This jumper enables or disables converter 2. Connect the shorting jumper from the center EN pin to either the ON or OFF position. Never leave this pin floating .

### 2.1.10 JP1 – Mode

This jumper is connected to the MODE/DATA pin of the TPS62400 and is used to select the operating mode of TPS62400. Place a jumper between pins 1 and 2 (PU and MODE) when using the EasyScale™ interface to provide a pullup resistor for EasyScale™ communications. If the EasyScale™ interface is not used, then JP4 is used to select between fixed PWM mode or PWM mode with PFM. The converter operates in a fixed-frequency PWM mode when a jumper is installed between pins 1 and 2 (PU and MODE). Shorting pins 2 and 3 (MODE and GND) allows the controller to use a power-saving PFM mode at low output currents.

### 2.1.11 JP4 – DEF1

This jumper is used to configure the DEF1 pin of the TPS62401. A shorting jumper should only be installed when evaluating the TPS62401 on the -001 assembly version of the EVM. Installing a jumper with other versions of the IC produces incorrect output voltages. The TPS62401 output voltage of converter 1 is defined by the internal register REG\_DEF\_1\_LOW when a shunt is placed across pins 2 and 3 of JP4 (DEF1 and GND). With a shunt across pins 1 and 2 of JP4 (DEF1 and VIN), the output voltage of converter 1 is defined by the internal register REG\_DEF\_1\_HIGH.

## 2.2 Setup

The TPS624xx needs an input voltage between 2.5 V and 6 V. The input voltage must be higher than the highest output voltage in order to maintain voltage regulation.

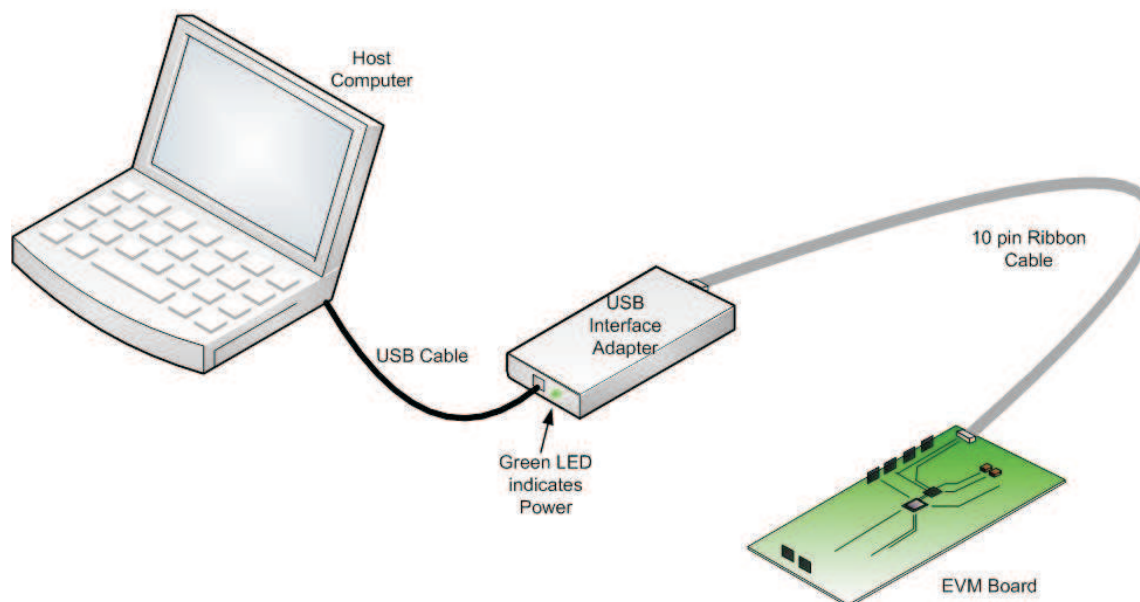
Configure JP4 as needed using a shorting block. For the TPS62400 (-001 board) and the TPS62420 (-003 board) do not install a jumper on JP4. For the TPS62401 (-002) board, this jumper is used to set the DEF\_1 pin of the IC to a logic high or a logic low to define the output voltage at power up. For proper operation, do not leave this pin floating.

Configure the jumper on JP1 to the desired setting. This jumper configures the MODE pin of the TPS624xx. Normally, a shorting block is placed between pin 1 and pin 2 (PU and MODE) which provides a pullup resistor for the MODE pin. Short pins 1 and 2 when using the USB interface adaptor for EasyScale™ communications. When the USB interface adapter is not used, then JP1 can be used to drive the MODE pin to a logic high (short pins 1 and 2) or low (short pins 2 and 3).

Configure JP3 and JP4 as desired. Shorting between ENx and ON (pin 1 and 2) enables the corresponding converter. Shorting between ENx and OFF (pin 2 and 3) disables the corresponding converter of the TPS624xx.

Connect the USB interface adapter to your PC using the supplied USB cable. Connect the TPS62400EVM board to the USB interface adapter using the supplied 10-pin ribbon cable. The connectors on the ribbon cable are keyed to prevent incorrect installation.

## Quick Connection Diagram USB Interface Adapter



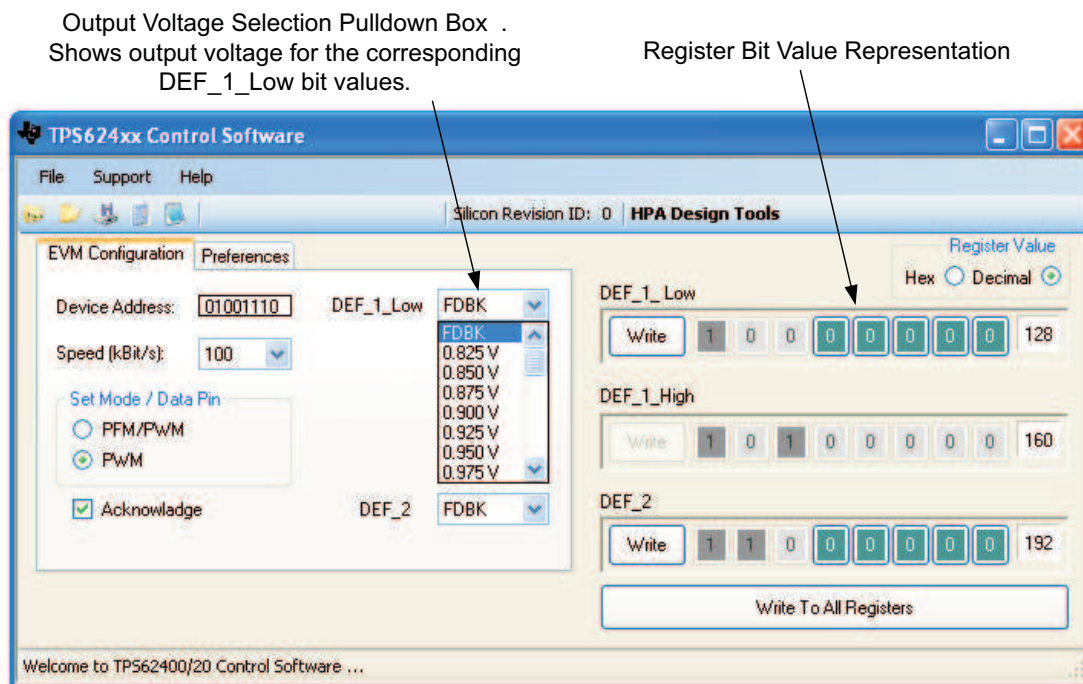
Connect an input voltage supply to the TPS62400EVM board. The TPS62400 uses an input voltage between 2.5 V and 6 V. Connect the positive input voltage to J1. Connect the input voltage return (ground) connection to J2.

### 2.3 Operation

Once connected, turn on the input voltage source to the EVM board. Find the icon for the TPS62400 Evaluation Software on the desktop of the host computer. If no icon is present, then use the *start* menu to find the folder containing the evaluation software. Some computers install the software in hidden folders that make it difficult to find using the Microsoft Internet Explorer browser. Software installed in hidden folders is visible when using the *start* menu.

The software displays the *Controller Selection* screen. Check the box that matches the device on the EVM board. The software then displays the *EVM Configuration* screen. This screen allows the user to read and change the values of the internal registers of the TPS624xx. The software only displays the registers that are available for the controller that was selected in the *Controller Selection* screen. The *EVM Configuration* screen provides pulldown boxes for easy selection of the output voltage. The software also displays the bit representation of each register. Bits can be toggled on and off by clicking on them.

The output voltage pulldown boxes show the target output voltage based on the 31 combinations of bits. The voltages in the pulldown boxes are preprogrammed to match the TPS624xx device on the EVM board. [Figure 1](#) shows the *EVM Configuration* screen for the TPS62400 or TPS62420.



**Figure 1. EVM Configuration Screen for the TPS62400**

Figure 1 shows the DEF\_1\_Low register selections. The first value *FDBK* corresponds to the binary data 00000 which sets the output voltage based on the feedback resistors tied to the DEF\_1 pin of the TPS62400. The output voltages shown are based on the nominal output voltage, by device, while in PFM mode. All TPS624xx devices dynamically adjust the nominal output voltage in PFM mode so the pulldown boxes do not exactly match the actual output voltage in PFM mode.

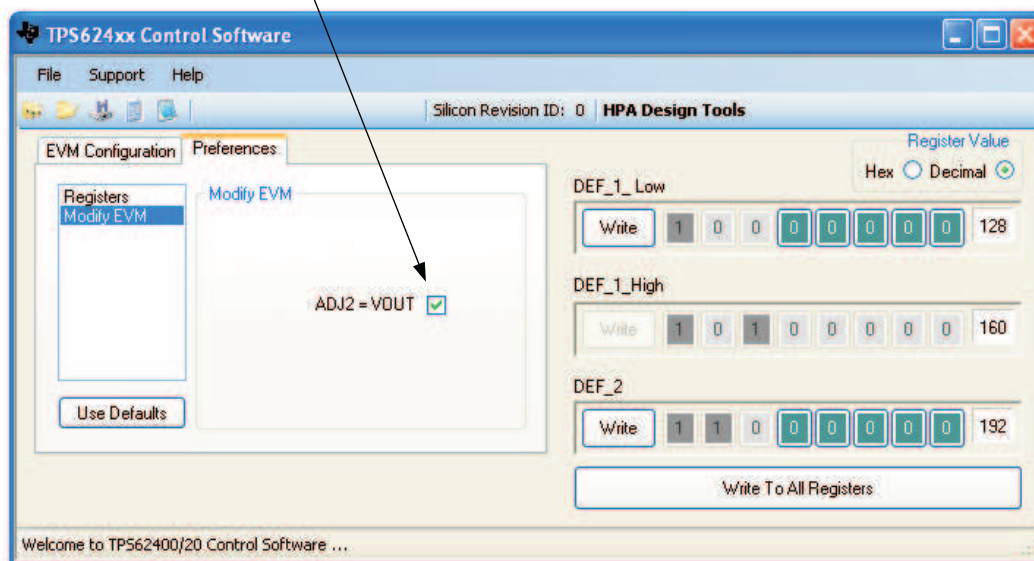
The register bit representation panel on the right side of the screen allows the register values to be altered bit by bit. Clicking on the colored boxes changes the sense of the bit. The actual TPS624xx register is not updated with the new value until the *Write* or *Write To All Register* buttons is pushed. This allows the user to change all of the bits before updating the register.

## 2.4 Other Output Voltages on TPS62400 and TPS62420

The output voltage of the TPS62400 and TPS62420 is set by an external feedback resistor network. The power-up output voltage can be modified by changing the feedback resistors as shown in the data sheet for the device. This output voltages in the pulldown boxes do not change because the only entry in the box that would be effected is for the binary bit value 00000. The pulldown box is labeled as *FDBK* for this register value to cover this situation.

It is possible to tie the DEF\_1 pin to VOUT1 or to tie the ADJ\_2 pin to VOUT2 with no other resistors being used. In this special case, the output voltage for a binary bit value of 00000 corresponds to the reference voltage of the device which is typically 0.6 V. The output voltages shown in the pulldown boxes can be selected to show the new values.

Check box to change the output voltage values shown in the pulldown boxes for the case where the feedback pin is directly tied to the output voltage. Applies to the TPS62400 and TPS62420 only.



**Figure 2. Preferences Screen Showing Check Box to Configure Pulldown Boxes**

Figure 2 shows the *Modify EVM* panel of the *Preferences* Screen. Check the box if the adjustable versions of the EVM (TPS62400 and TPS62420) have been modified to have the feedback pin of the converter tied directly to the output voltage of the converter. This changes the output voltage values shown in the pulldown boxes on the *EVM Configuration* screen.

### 3 Board Layout

This section provides the TPS62400EVM-167 board layout and illustrations.

#### 3.1 Layout

Board layout is critical for all high-frequency, switch-mode power supplies. Figure 3, Figure 4, and Figure 5 show the board layout for the TPS62400EVM-167 PCB. The nodes with high-switching frequencies and currents are kept as short as possible to minimize trace inductance. Careful attention has been given to the routing of high-frequency current loops and a single-point grounding scheme is used. See the data sheet for specific layout guidelines.

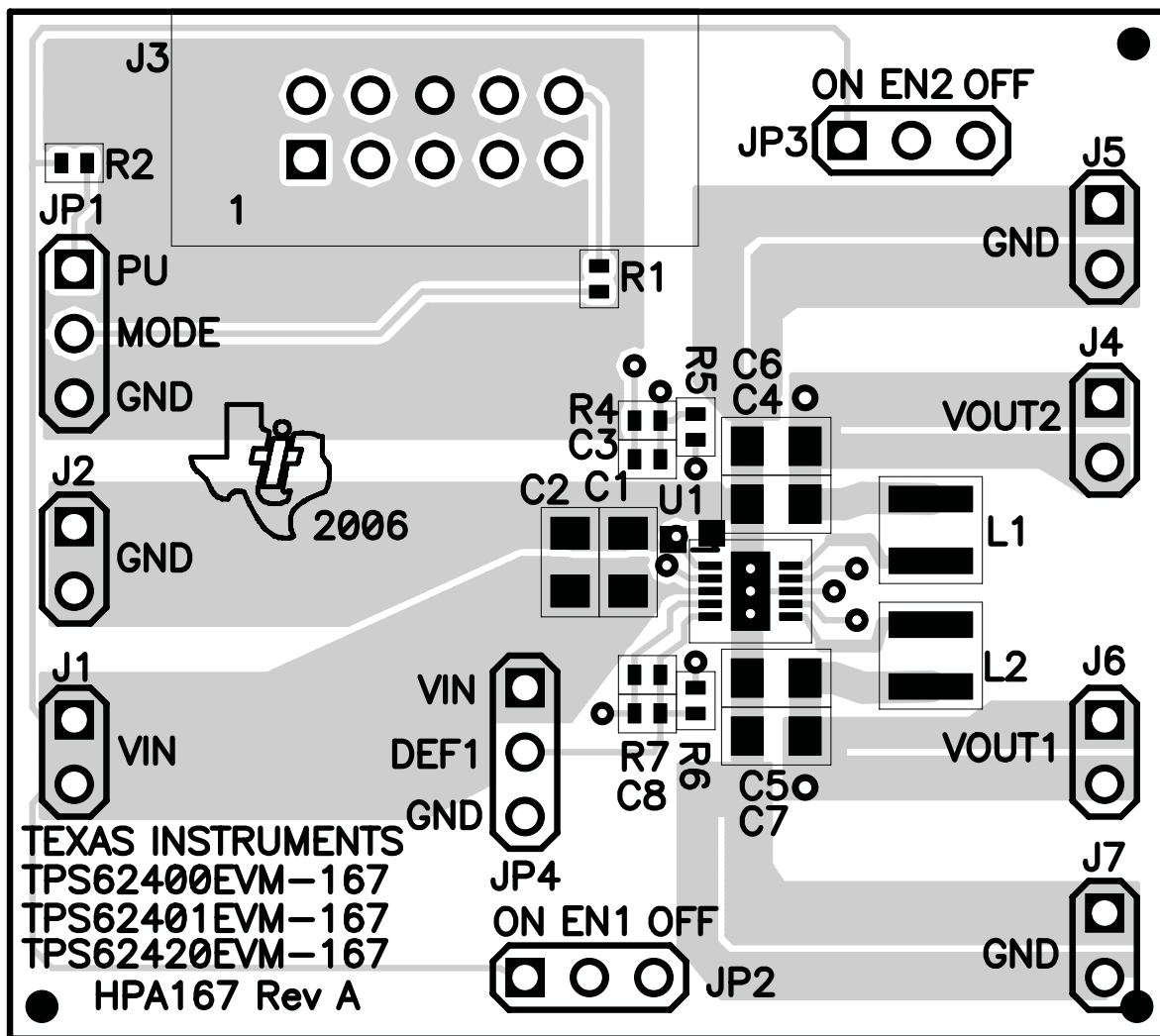


Figure 3. Assembly Layer

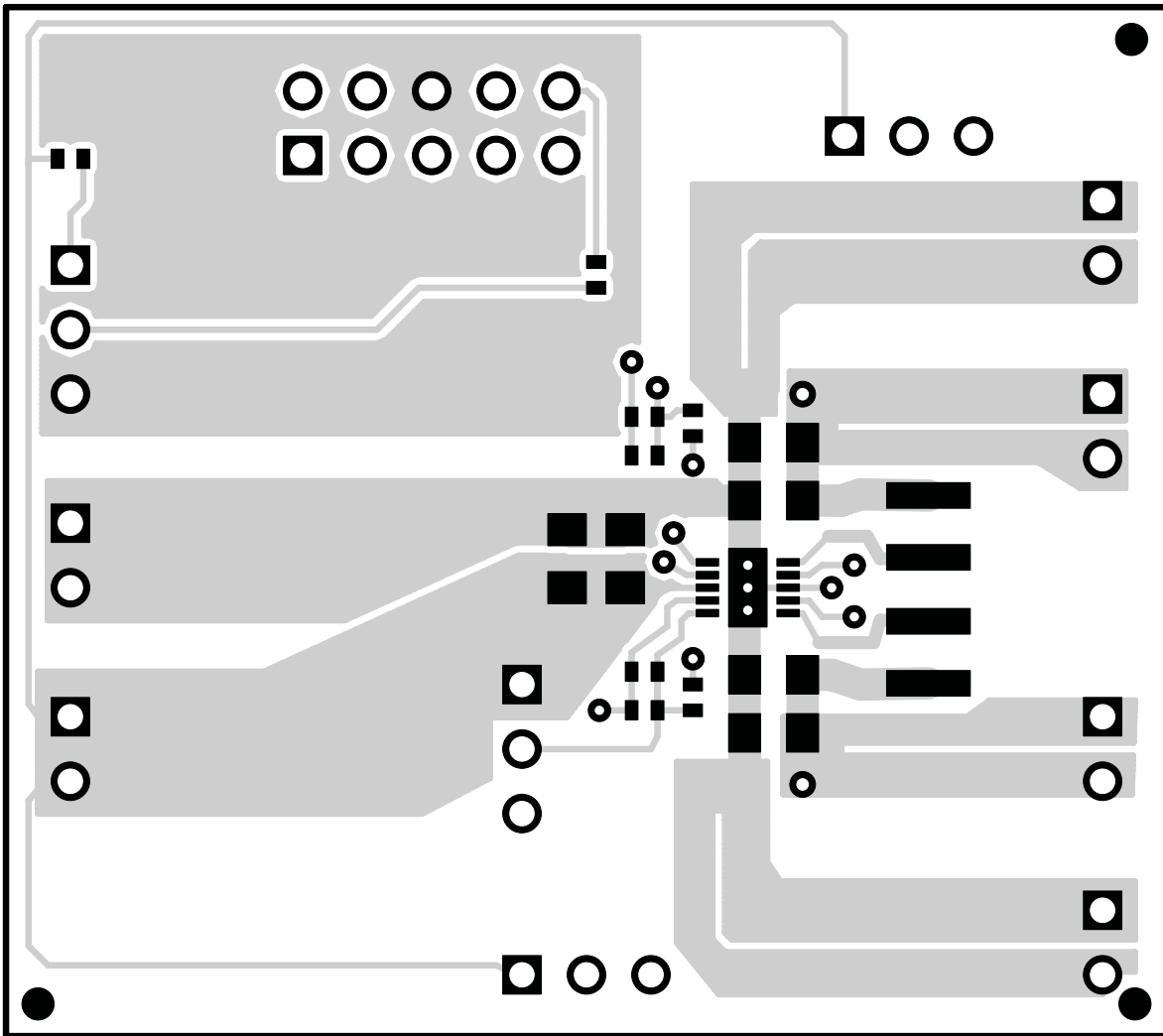


Figure 4. Top Layer Routing



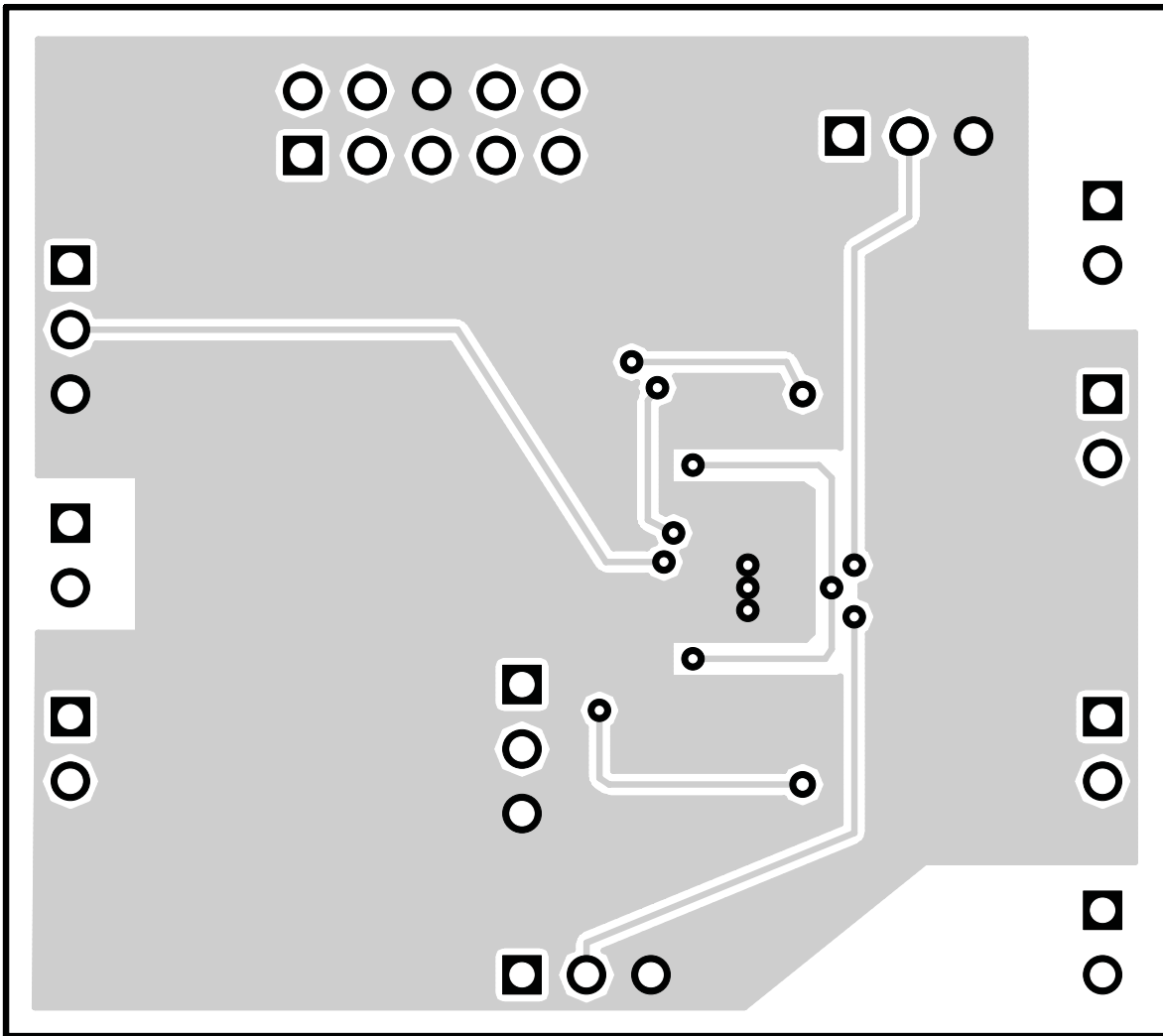


Figure 5. Bottom Layer Routing

#### 4 Schematic and Bill of Materials

This section provides the TPS62400EVM-167 schematic and bill of materials.

### 4.1 Schematic

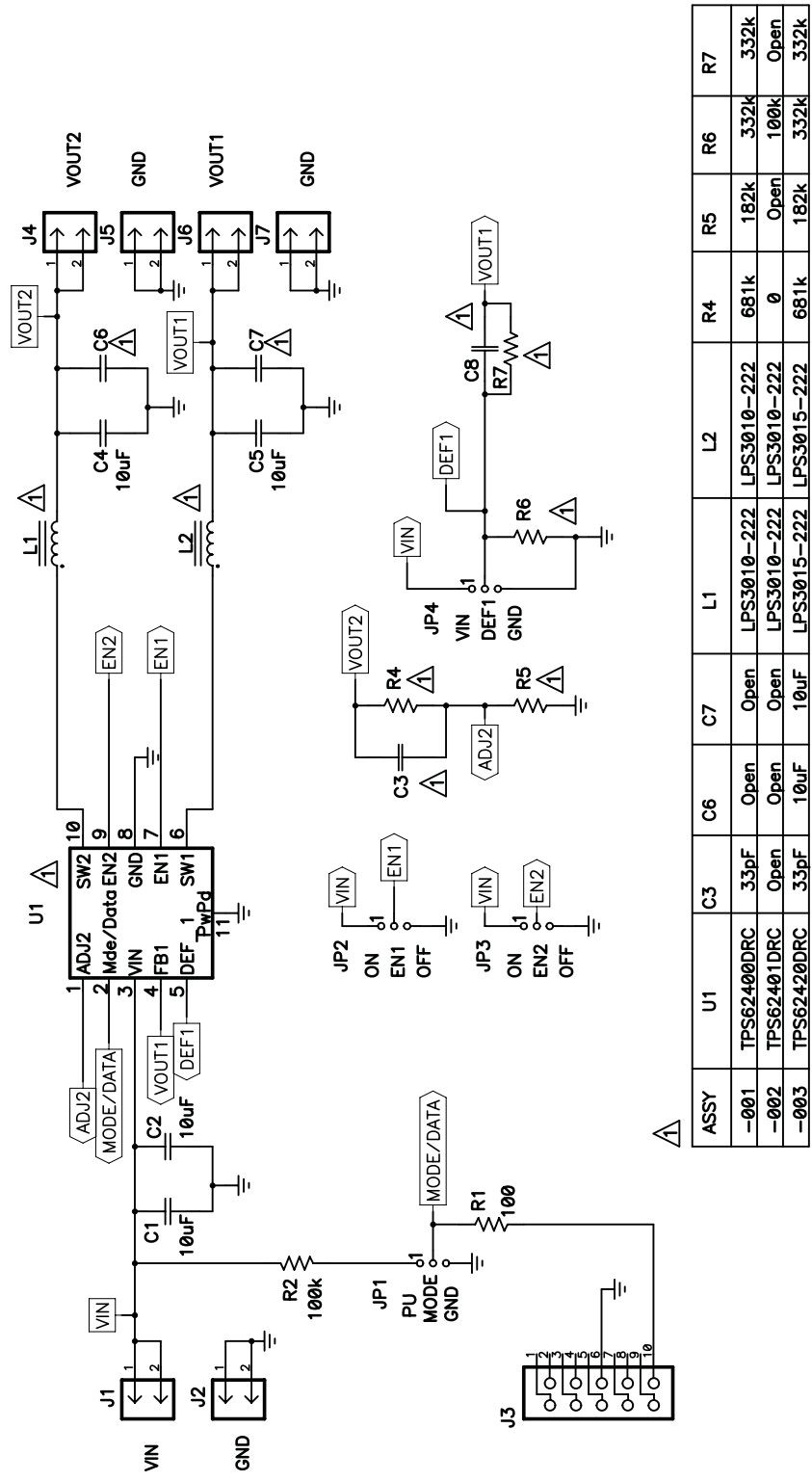


Figure 6. TPS62400EVM-167 Schematic

## 4.2 Bill of Materials

**Table 1. HPA167A Bill of Materials**

Count			Ref Des	Value	Description	Size	Part Number	MFR
-001	-002	-003						
4	4	4	C1, C2, C4, C5	10µF	Capacitor, ceramic, 10V, X5R, 10%	0805	C2012X5R1A106K	TDK
1	0	1	C3	33pF	Capacitor, ceramic, 50V, C0G, 5%	0402	C1608C0G1H330J	TDK
0	0	2	C6, C7	10µF	Capacitor, ceramic, 10V, X5R, 10%	0805	C2012X5R1A106K	TDK
0	0	0	C8	Open	Capacitor, ceramic, xxV	0402		
6	6	6	J1, J2, J4–J7		Header, 2 pin, 100 mil spacing, (36-pin strip)	0.100 × 2	PTC36SAAN	Sullins
1	1	1	J3		Connector, male straight 2×10 pin, 100 mil spacing, 4 Wall	0.338 × 0.788	2510-6002UB	3M
4	4	4	JP1–JP4		Header, 3 pin, 100mil spacing, (36-pin strip)	0.100 × 3	PTC36SAAN	Sullins
2	2	0	L1, L2	2.2µH	Inductor, SMT, 1.2A, 90mΩ	0.118 × 0.188	LPS3010-222ML	Coilcraft
0	0	2		2.2µH	Inductor, SMT, 1.5A, 110mΩ	0.118 × 0.188	LPS3015-222ML	Coilcraft
1	1	1	R1	100	Resistor, Chip, 1.16W, 1%	0402	Std	Std
1	1	1	R2	100k	Resistor, Chip, 1.16W, 1%	0402	Std	Std
0	1	0	R4	0	Resistor, Chip, 1.16W, 1%	0402	Std	Std
1	0	1		681k	Resistor, Chip, 1.16W, 1%	0402	Std	Std
1	0	1	R5	182k	Resistor, Chip, 1.16W, 1%	0402	Std	Std
1	0	1	R6	332k	Resistor, Chip, 1.16W, 1%	0402	Std	Std
0	1	0		100k	Resistor, Chip, 1.16W, 1%	0402	Std	Std
1	0	1	R7	332k	Resistor, Chip, 1.16W, 1%	0402	Std	Std
1	0	0	U1		IC, 2.25MHz dual step down converter	QFN10	TPS62400DRC	TI
0	1	0				QFN10	TPS62401DRC	TI
0	0	1				QFN10	TPS62420DRC	TI
1	1	1	–		PCB, 1.8 In × 1.596 In × 0.062 In		HPA167	Any
4	4	4	–		Shunt, 100-mil, black	0.100	929950-00	3M

## 5 Related Documentation From Texas Instruments

- A. *TPS62400/TPS62401, 2.25MHz 400mA/600mA Dual Step-Down Converter in Small 3x3mm QFN Package data sheet* ([SLVS681](#))
- B. *TPS62420, 2.25MHz 600mA/1000mA Dual Step Down Converter in Small 3x3mm QFN Package data sheet* ([SLVS676](#))

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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 0.6 V to 6 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 85°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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Interface	<a href="http://interface.ti.com">interface.ti.com</a>	Digital Control	<a href="http://www.ti.com/digitalcontrol">www.ti.com/digitalcontrol</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>	Military	<a href="http://www.ti.com/military">www.ti.com/military</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>	Optical Networking	<a href="http://www.ti.com/opticalnetwork">www.ti.com/opticalnetwork</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>	Telephony	<a href="http://www.ti.com/telephony">www.ti.com/telephony</a>
Low Power Wireless	<a href="http://www.ti.com/lpw">www.ti.com/lpw</a>	Video & Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>
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