

## **TPS61185EVM-335**

This user's guide describes the characteristics, operation, and use of the TPS61185 evaluation module (EVM). This EVM contains the Texas Instruments TPS61185, a WLED power solution providing up to eight independently regulated current outputs using a single inductor step-up (boost) converter. The current outputs are ideal for driving a WLED backlight in notebook/laptop computers. This user's guide includes EVM specifications, recommended test setup, bill of materials, and a schematic diagram.

### **Contents**

|     |                                                             |   |
|-----|-------------------------------------------------------------|---|
| 1   | Applications .....                                          | 2 |
| 2   | TPS61185EVM-335 Electrical Performance Specifications ..... | 2 |
| 3   | Modifications .....                                         | 2 |
| 4   | Schematic and Bill of Materials .....                       | 3 |
| 5   | Connector and Test Point Descriptions .....                 | 4 |
| 5.1 | Input/Output Connections .....                              | 4 |
| 6   | Test Requirements and Setup .....                           | 5 |
| 6.1 | Hardware Requirements .....                                 | 5 |
| 6.2 | Hardware Setup .....                                        | 5 |
| 7   | TPS61185EVM-335 Assembly Drawings and Layout .....          | 6 |

### **List of Figures**

|   |                                                            |   |
|---|------------------------------------------------------------|---|
| 1 | HPA335EVM Schematic .....                                  | 3 |
| 2 | TPS61185EVM-335 Component Placement, Viewed From Top ..... | 6 |
| 3 | TPS61185EVM-335 Top Copper, Viewed From Top .....          | 7 |
| 4 | TPS61185EVM-335 Bottom Copper, Viewed From Bottom .....    | 7 |

### **List of Tables**

|   |                                                                |   |
|---|----------------------------------------------------------------|---|
| 1 | TPS61185EVM-335 Electrical and Performance Specifications..... | 2 |
| 2 | Bill of Materials .....                                        | 4 |

## 1 Applications

The TPS61185 is an excellent solution for computer notebook and monitor LCD display backlighting.

## 2 TPS61185EVM-335 Electrical Performance Specifications

Table 1 provides a summary of the TPS61185EVM-335 performance specifications. All specifications are given for an ambient temperature of 25°C.

**Table 1. TPS61185EVM-335 Electrical and Performance Specifications**

| Parameter              |                         | Notes and Conditions <sup>(1)</sup>                                                                | Min | Typ | Max | Unit |
|------------------------|-------------------------|----------------------------------------------------------------------------------------------------|-----|-----|-----|------|
| Input Characteristics  |                         |                                                                                                    |     |     |     |      |
| V <sub>IN</sub>        | Input Voltage           |                                                                                                    | 7   |     | 24  | V    |
| En                     | EN Logic high           |                                                                                                    | 2.1 |     | 20  | V    |
| PWM                    | PWM Logic high          |                                                                                                    | 2.1 |     | 20  | V    |
| I <sub>Q_VIN</sub>     | Input Quiescent Current | Device enable, switching, f <sub>S</sub> = 1 MHz, V <sub>IN</sub> = 24 V; No load                  | 0.5 |     | 3   | mA   |
| V <sub>IN_UVLO</sub>   | Input UVLO              | V <sub>IN</sub> ramp down                                                                          | 3.6 | 3.9 | 4.0 | V    |
|                        |                         | V ramp up                                                                                          | 3.8 |     | 4.2 |      |
| Output Characteristics |                         |                                                                                                    |     |     |     |      |
| V <sub>OUT</sub>       | V(TP1)                  | J6 connected to 10 WLED configured WLEDEVM-260, JP1 shorted, JP5-12 pins 1-2 shorted, EN/PWM = VDD |     | 31  | 35  | V    |
|                        |                         | J6 connected to 10 WLED configured WLEDEVM-260, JP1 open, JP5-12 shorted, EN/PWM = VDD, OVP active | 36  | 38  | 40  | V    |
| I <sub>OUT</sub>       | I(JP1) = 8 X IFBx       | V <sub>IN</sub> = 12 V, R <sub>ISET</sub> = 62 kΩ, PWM=VDD                                         |     | 155 |     | mA   |
| System Characteristics |                         |                                                                                                    |     |     |     |      |
| f <sub>S</sub>         | Oscillator Frequency    | R <sub>FSW</sub> = 604 kΩ                                                                          | 0.8 | 1.0 | 1.2 | MHz  |

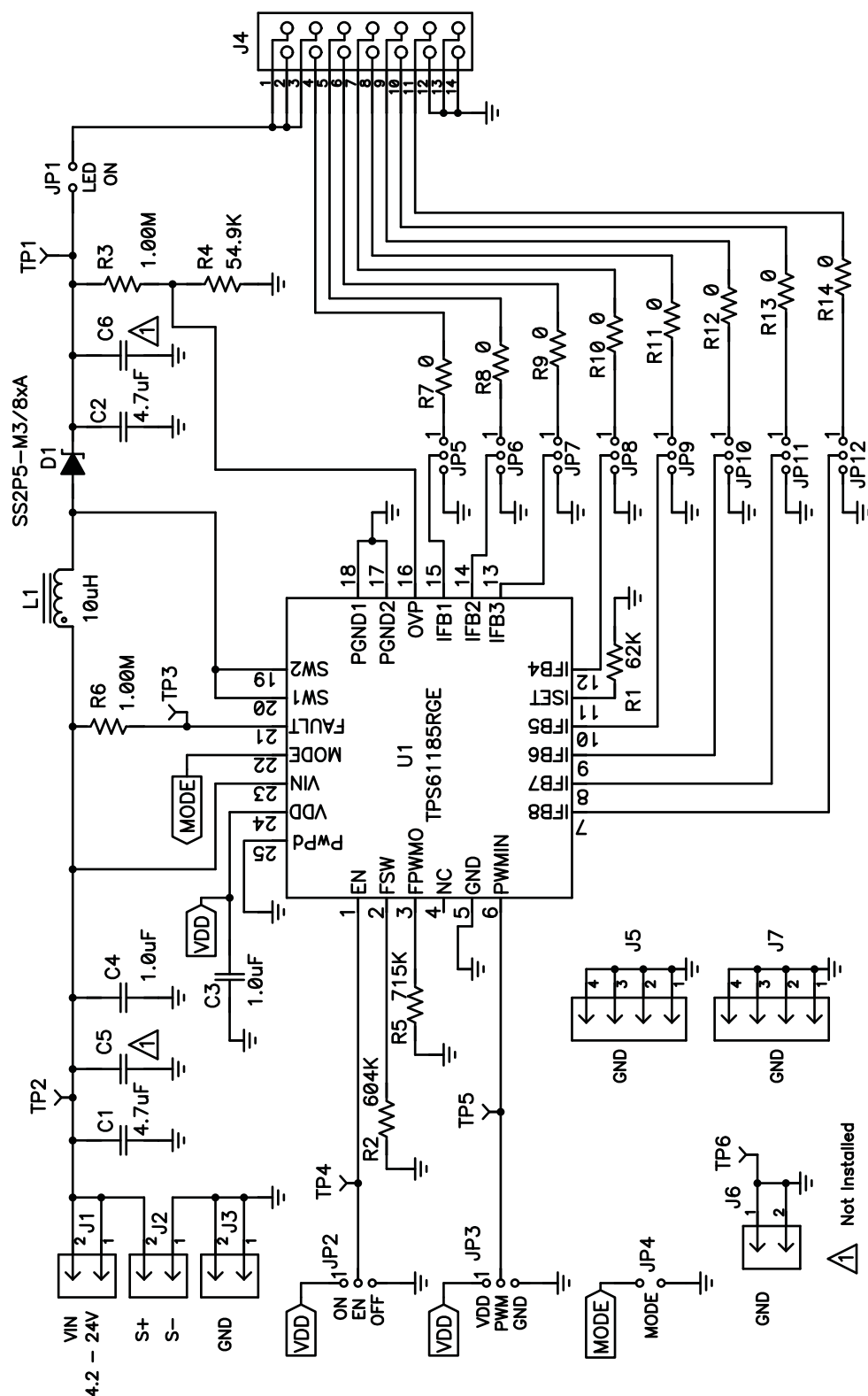
<sup>(1)</sup> The user can estimate the input current by solving the power balance equation,  $\text{eff} = P_{\text{OUT}}/P_{\text{IN}} = (V_O \times I_O)/(V_{\text{IN}} \times I_{\text{IN}})$ , for I<sub>IN</sub> and estimating the efficiency to be a conservative 85%. For example, for V<sub>O</sub> = 32 V, V<sub>IN</sub> = 7 V and I<sub>O</sub> = 8 × 20 mA = 160 mA, I<sub>IN</sub> = (31 V × 160 mA)/(7 V × 0.85) = 0.83 A

## 3 Modifications

See the data sheet ([SLVSAA1](#)) when changing components such as R1 to set the LED current or R3 and R4 to set the OVP threshold. To aid in such customization of the EVM, the board was designed with devices having 0603 or larger footprints. A real implementation likely occupies less total board space.

Note that changing components can improve or degrade EVM performance. For example, using inductors with larger saturation current rating allows the use of lower input voltages.

## 4 Schematic and Bill of Materials



NOTE: For Reference Only, See [Table 2](#) specific Values

### Figure 1. HPA335EVM Schematic

**Table 2. Bill of Materials**

| Count | RefDes             | Value         | Description                                                          | Size               | Part Number                                                                 |
|-------|--------------------|---------------|----------------------------------------------------------------------|--------------------|-----------------------------------------------------------------------------|
| 1     | C1                 | 4.7 $\mu$ F   | Capacitor, Ceramic, 25V, X7R, 10%                                    | 1206               | Std                                                                         |
| 1     | C2                 | 4.7 $\mu$ F   | Capacitor, Ceramic, 50V, X5R, 10%                                    | 1206               | Std                                                                         |
| 1     | C3                 | 0.1 $\mu$ F   | Capacitor, Ceramic, 25V, X7R, 10%                                    | 0603               | Std                                                                         |
| 1     | C4                 | 1.0 $\mu$ F   | Capacitor, Ceramic, 25V, X5R, 10%                                    | 0805               | Std                                                                         |
| 0     | C5                 | Open          | Capacitor, Ceramic, 25V                                              | 1206               | Std                                                                         |
| 0     | C6                 | Open          | Capacitor, Ceramic, 50V                                              | 1206               | Std                                                                         |
| 1     | D1                 | SS2P5-E3/84A  | Diode, High Current SMD Schottky Rectifier, 2A, 50VDC-P5 or 60VDC-P6 | DO-220AA           | SS2P5-M3/84A or alt. SS2P6-M3/84A or alt. SS2P5-E3/84A or alt. SS2P6-E3/84A |
| 4     | J1–J3, J6          | PEC02SAAN     | Header, Male 2-pin, 100mil spacing                                   | 0.100 inch x 2     | PEC02SAAN                                                                   |
| 1     | J4                 | N2514-6002-RB | Connector, Male Straight 2x7 pin, 100mil spacing, 4 Wall             | 0.100 inch x 2X7   | N2514-6002-RB                                                               |
| 2     | J5, J7             | PEC04SAAN     | Header, Male 4-pin, 100mil spacing                                   | 0.100 inch x 4     | PEC04SAAN                                                                   |
| 2     | JP1, JP4           | PEC02SAAN     | Header, 2-pin, 100mil spacing                                        | 0.100 inch x 2     | PEC02SAAN                                                                   |
| 10    | JP2, JP3, JP5–JP12 | PEC03SAAN     | Header, 3-pin, 100mil spacing                                        | 0.100 inch x 3     | PEC03SAAN                                                                   |
| 1     | L1                 | 10 $\mu$ H    | Inductor, 90.0mohm, 1.49A, $\pm$ 20%                                 | 0.205 x 0.205 inch | #A915AY-100M                                                                |
| 1     | R1                 | 64.9K         | Resistor, Chip, 1/16W, 1%                                            | 0603               | Std                                                                         |
| 1     | R2                 | 604K          | Resistor, Chip, 1/16W, 1%                                            | 0603               | Std                                                                         |
| 2     | R3, R6             | 1.00M         | Resistor, Chip, 1/16W, 1%                                            | 0603               | Std                                                                         |
| 1     | R4                 | 54.9K         | Resistor, Chip, 1/16W, 1%                                            | 0603               | Std                                                                         |
| 1     | R5                 | 715K          | Resistor, Chip, 1/16W, 1%                                            | 0603               | Std                                                                         |
| 8     | R7–R14             | 0             | Resistor, Chip, 1/10W, 1%                                            | 0805               | Std                                                                         |
| 5     | TP1–TP5            | 5000          | Test Point, Red, Thru Hole Color Keyed                               | 0.100 x 0.100 inch | 5000                                                                        |
| 1     | TP6                | 5001          | Test Point, Black, Thru Hole Color Keyed                             | 0.100 x 0.100 inch | 5001                                                                        |
| 1     | U1                 | TPS61185RTW   | IC, WLED Driver for Notebooks                                        | QFN-24             | TPS61185RTW                                                                 |
| 12    | –                  |               | Shunt, 100-mil, Black                                                | 0.100              | 929950-00                                                                   |
| 1     |                    |               | PCB 1.9" x 3.00" x 0.062"                                            |                    | HPA335                                                                      |

## 5 Connector and Test Point Descriptions

### 5.1 Input/Output Connections

The connections points are described in the following paragraphs.

#### 5.1.1 J1 – VIN

This header is the positive connection to the input power supply. Twist the input supply and GND leads to the input supply and keep them as short as possible.

#### 5.1.2 J2 – S+/S-

This header provides a Kelvin connection across the input capacitor (C1) for more accurate input voltage measurements.

#### 5.1.3 J3 – GND

This header is the return connection to the input power supply.

#### 5.1.4 J4 – 14-Pin Connector

This header facilitates connecting the TPS61185EVM-335 to the WLEDEVM-260 LED EVM board. This boards must be ordered separately from the TPS61185.

#### 5.1.5 J5 and J7 – GND

These headers connect to the board's ground plane.

#### 5.1.6 JP1 – LED ON

The user can remove the shunt on this jumper and connect the high side of external LED strings. When using the WLEDEVM-260 LED EVM, installing the shunt on this jumper connects the output of the boost converter to J4. Removing the jumper removes the WLEDs from the boost converter feedback path and causes the integrated circuit's (IC) overvoltage protection circuitry to activate. Instead of the shunt, the user can place an ammeter across the jumper to measure the total output current (i.e.,  $8 \times \text{IFB\#}$ ).

#### 5.1.7 JP2 – EN

Installing the shunt on this jumper to ON sets the ENABLE pin voltage to VDD, thereby enabling the IC's boost converter. Connecting it to OFF pulls EN to ground, which disables the IC's boost converter.

Note: With  $V_{\text{IN}}$  applied, VDD does not reach full regulation until EN is pulled high. While it is possible to enable the IC by tying the EN pin to the unregulated VDD output for evaluation, it is not recommended in a real application.

#### 5.1.8 JP3 – PWM

Installing the shunt on this jumper to VDD sets the current sinks to 100% current and therefore any attached LEDs to full brightness. The user must connect an external PWM signal or use JP3 to take PWM to a logic high (above 1.2 V but no higher than 6 V) in order to enable the current sinks.

#### 5.1.9 JP4 – MODE

Installing the shunt on this jumper connects the MODE pin to GND causing the frequency at which each current regulator to turn on/off at the same frequency and duty cycle as the input PWM signal on JP3. If the shunt is not installed, the regulators turn on/off at the same duty cycle as the input PWM signal but at the frequency programmed by the resistor connected to the FPWM pin (R5).

#### 5.1.10 JP5 – JP12

The user can remove the shunt and tie the middle pin of this jumper to an external string of LEDs. Alternatively, the user can use the shunt to tie the IFBx pin to JPx and then connect JPx to the WLEDEVM-260 or WLEDEVM-461 boards. For strings that are not used, the user can remove the shunt entirely or tie the applicable IFBx pin to GND.

## 6 Test Requirements and Setup

### 6.1 Hardware Requirements

This EVM requires an external power supply capable of providing up to 24 V at 3 A.

If dimming via an external PWM signal is desired, then a function generator capable of providing at least a 2.1-V amplitude PWM signal between 100 Hz to 20 kHz is required to avoid screen flickering and maintain dimming linearity.

### 6.2 Hardware Setup

- Connect a power supply capable of supplying up to 24 V at 3 A between the VIN pin and GND (J1 and J3). Do not turn on the power supply.
- Either set JP2 ON or connect a second logic signal or power supply capable of providing at least 2.1-V voltage to the high-impedance EN pin of JP2.

- JP1 must be connected directly or through an ammeter to the high side of external LED strings. WLEDEV-260 connected to J4 can be used as external LED strings.
- Properly configure JP5-JP12 so that each IFB line either connects directly to an LED string, to the J4 connector, or to GND. Unused IFBx lines must have the appropriate JP5-JP12 jumpers shunted to ground.
- To turn on the LEDs at full LED current and brightness, install JP3's shunt to VDD.
- To dim the LEDs by PWM dimming, connect the function generator to the PWM pin of JP3.

## 7 TPS61185EVM-335 Assembly Drawings and Layout

The following figures (Figure 2 through Figure 4) show the design of the TPS61185EVM-335 printed-circuit board (PCB). The EVM has been designed using a two-layer, 2-oz copper-clad circuit board, 4.83 cm × 7.62 cm, with all components on the top side and all active traces to the top and bottom layers to allow the user to easily view, probe, and evaluate the TPS61185 control IC in a practical, double-sided application. Moving components to both sides of the PCB or using additional internal layers can offer additional size reduction for space-constrained systems.

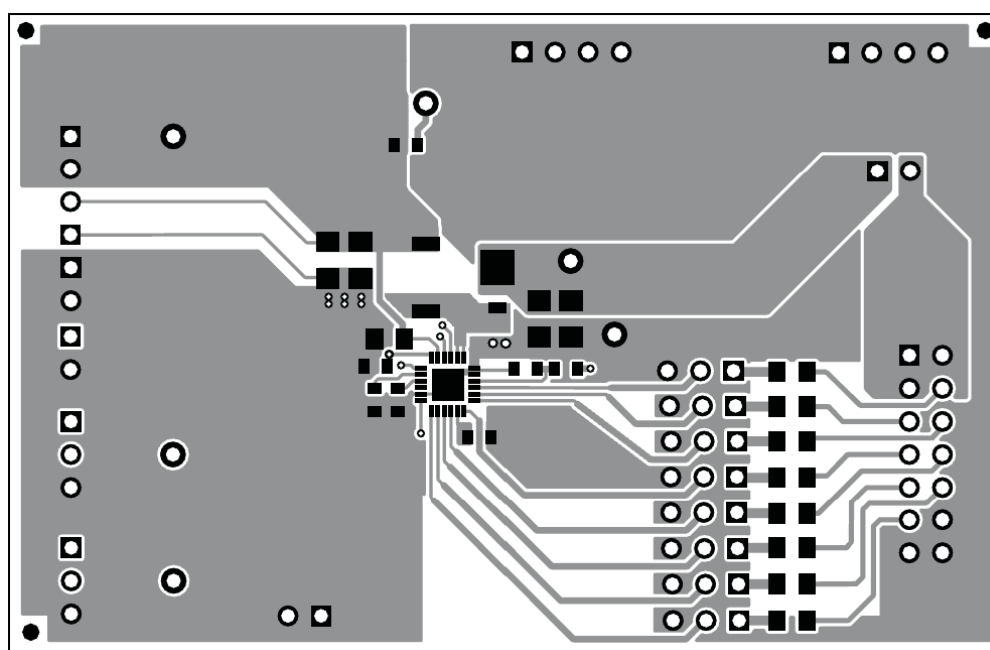


Figure 2. TPS61185EVM-335 Component Placement, Viewed From Top

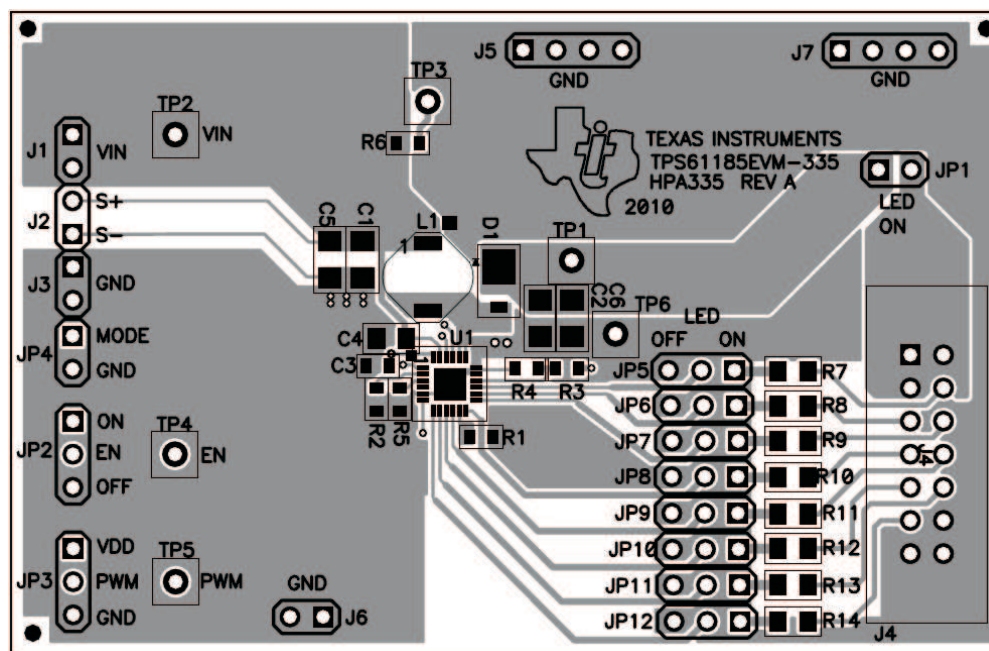


Figure 3. TPS61185EVM-335 Top Copper, Viewed From Top

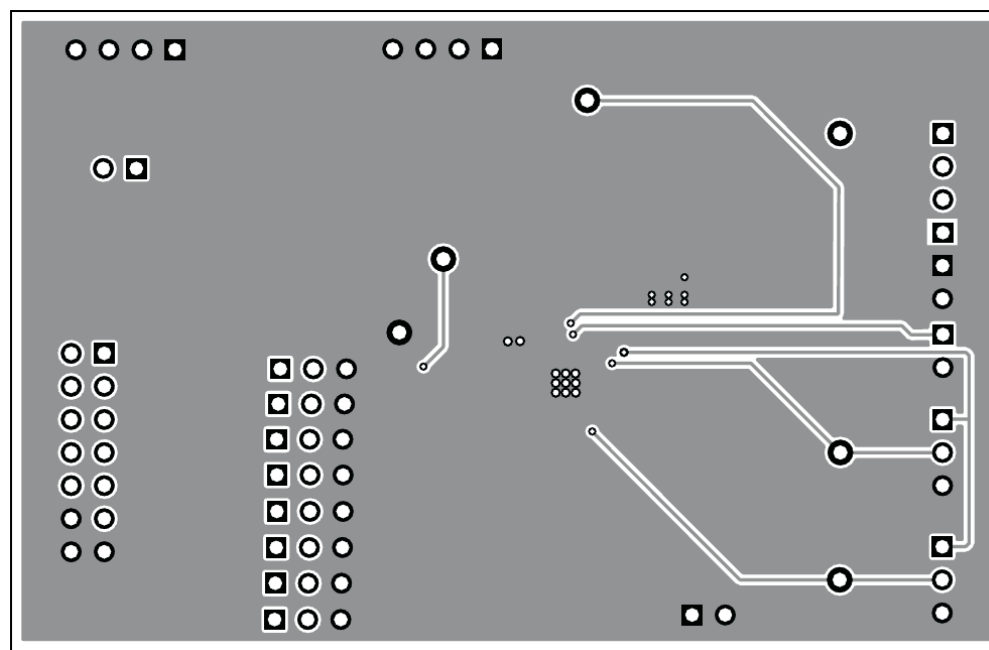


Figure 4. TPS61185EVM-335 Bottom Copper, Viewed From Bottom

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## EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of 4 V to 24 V and the output voltage range of 32 V to 46 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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