TPS782xxEVM

This user's guide describes the characteristics, operation, and use of the TPS782xxEVM-445 where 'xx' is the output voltage. This EVM demonstrates the Texas Instruments TPS782xx, a low dropout linear regulator in a TSOT23-5 package that is capable of 150 mA of output current. This user's guide includes setup instructions, a schematic diagram, thermal guidelines, a bill of materials, and printed-circuit board layout drawings for the evaluation module.

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1 Introduction

The TPS782xxEVM-445 evaluation module (EVM) helps designers evaluate the operation and performance of the TPS78225, TPS78227, TPS78230, and the TPS78233 low dropout linear regulators in the TSOT23-5 package. The TPS782xx is a 150-mA, ultralow, quiescent-current linear regulator.

2 Setup

This section describes the jumpers and connectors on the EVM as well as how to properly connect, set up, and use the TPS782xxEVM.

2.1 Input / Output Connector Descriptions

2.1.1 J1 –VIN

This is the positive input supply voltage. The leads to the input supply must be twisted and kept as short as possible to minimize EMI transmission. Additional bulk capacitance must be added between J1 and J2 if the supply leads are greater than six inches. An additional 47-µF or greater capacitor improves the transient response of the TPS782xx and helps to reduce ringing on the input when long supply wires are used.

2.1.2 J2 –VOUT

This is the positive connection from the output. Connect this pin to the positive input of the load.

2.1.3 J3 – GND

This is the return connection for the input power supply of the regulator.

2.1.4 J4 – GND

This is the return connection for the output.

2.1.5 JP1 – ENABLE

This jumper is used to enable or disable the TPS782xx. Shorting pins 1 and 2 together (ON and the middle pin) enables the regulator. Shorting pins 2 and 3 (middle pin and OFF) disables the regulator. This input must not be left floating.

3 Operation

This section provides information about the operation of the TPS782xxEVM.

3.1 Operating the TPS782xxEVM

Connect the positive input power supply to J1. Connect the input power return (ground) to J3. The TPS782xxEVM has an absolute maximum input voltage of 6 V. The recommended maximum operating voltage is 5.5 V. The actual highest input voltage may be less than 5.5 V due to thermal conditions. See the Thermal Considerations section of this manual to determine if the highest input voltage.

Connect the desired load between J2 (positive lead) and J4 (negative or current return lead). Apply the input power and configure jumper JP1 to enable or disable the regulator.

4 Thermal Guidelines

This section provides guidelines for the thermal management of the TPS782xxEVM-445 board.

4.1 Thermal Considerations

Thermal management is a key component of design of any power converter and is especially important when the power dissipation in the LDO is high. To better help you design the TPS782xx family into your application, use the following formula to approximate the maximum power dissipation at a particular ambient temperature:

$$T_J = T_A + P_d \times \theta_{JA} \quad (1)$$

where T_J is the junction temperature, T_A is the ambient temperature, P_d is the power dissipation in the IC and θ_{JA} is the thermal resistance from junction to ambient. All temperatures are in degrees Celsius.

The thermal resistance from junction to ambient for the TPS782xxEVM has a typically value of 200°C/W. The recommended maximum operating junction temperature specified in the data sheet for the TPS782xx family is 125°C. With these two pieces of information, the maximum power dissipation can be found by using equation (1).

Example Calculation:

For example, what is the maximum input voltage that can be applied to a TPS78225 EVM (2.5-V output) if the ambient temperature is 85°C and the full 150 mA of load current is required?

Given:

$$125°C = 85°C + P_d\ (200°C/W) \quad (2)$$

Using Equation 1, substitute in the preceding given values and find that the maximum power dissipation for the part is P_d =0.20 W.

$$T_J = 125°C,\ T_A = 85°C,\ \theta_{JA} = 200°C/W \quad (3)$$

This means that the total power dissipation of the TPS78225 must be less than 0.20 W. Now, the input voltage can be calculated.

$$P_d = (V_{in} - V_{out}) \times I_{out} = (V_{in} - 2.5\ V) \times 0.15\ A = 0.20\ W \quad (4)$$

So, the input voltage needs to be 3.83 V or less to maintain the junction temperature within the recommended range.

Similar analysis can be performed to determine the maximum ambient temperature allowed and still operate the TPS782xx over the full output current and input voltage range. Table 1 shows the calculated maximum ambient temperature allowed while keeping the junction temperature at or below 125°C for various output voltages, full output current, and an input voltage of 5.5 V.

Table 1. Calculated Maximum Ambient Temperature

Output Voltage (V)	Maximum Ambient Temperature (°C)
3.3	59
3.0	50
2.7	41
2.5	35

5 Board Layout

This section provides the TPS782xxEVM-445 board layout and illustrations.

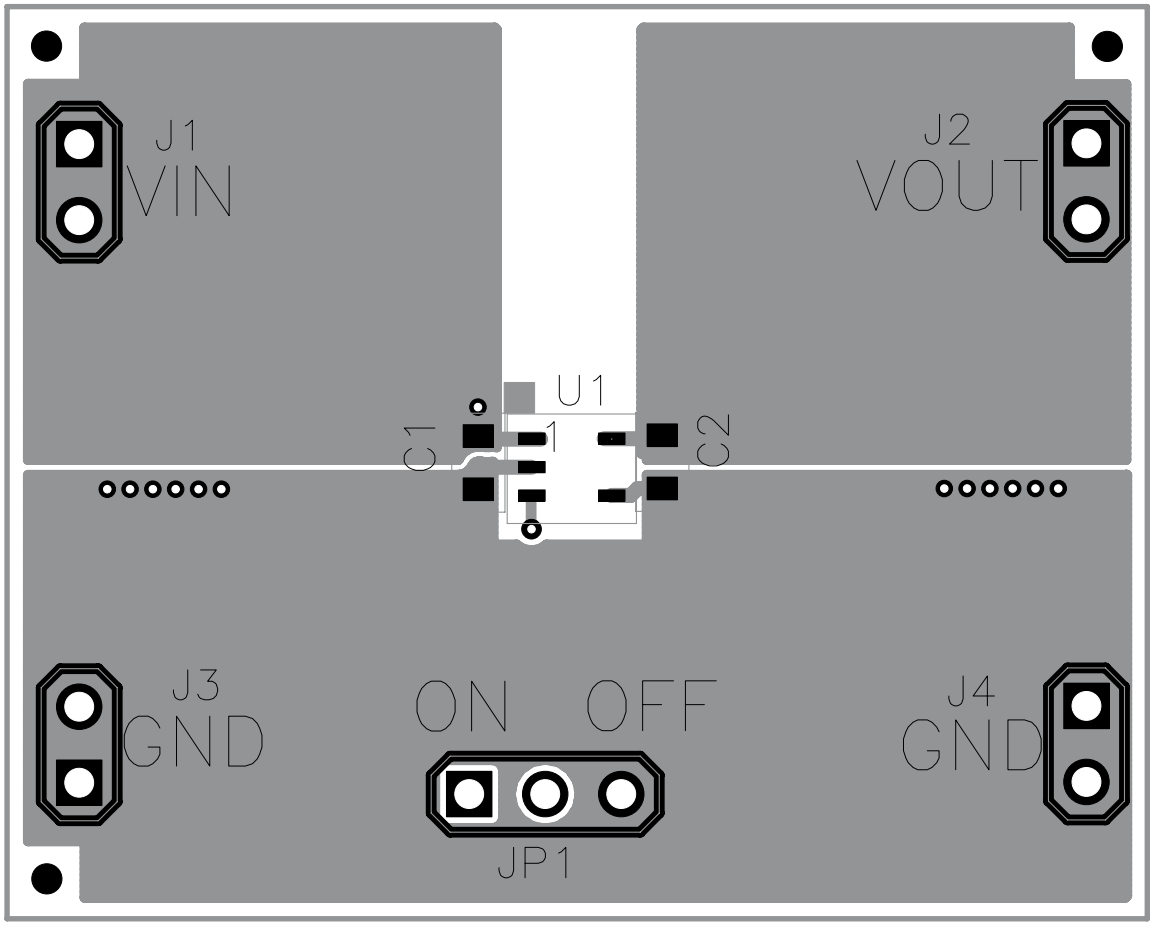


Figure 1. Top Layer Assembly

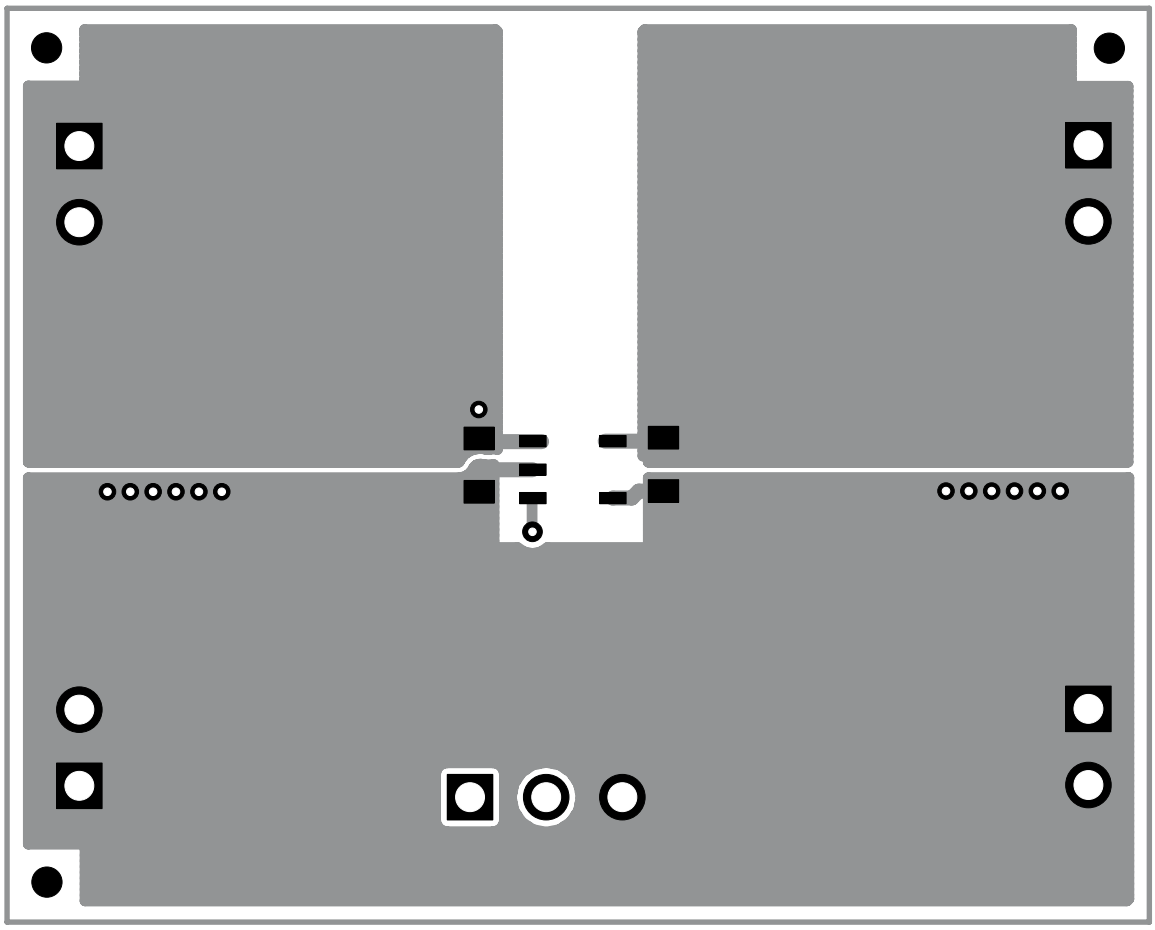


Figure 2. Top Layer Routing

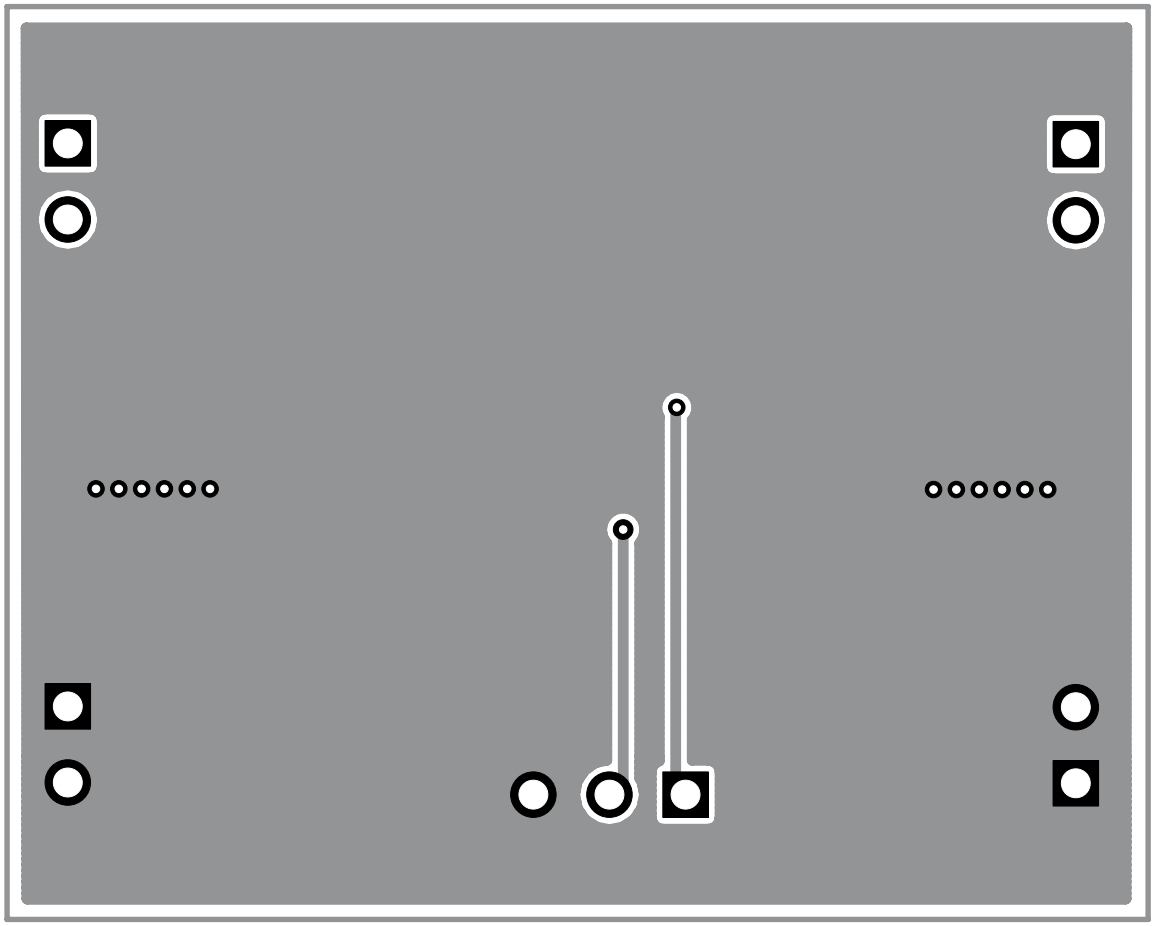


Figure 3. Bottom Layer Routing

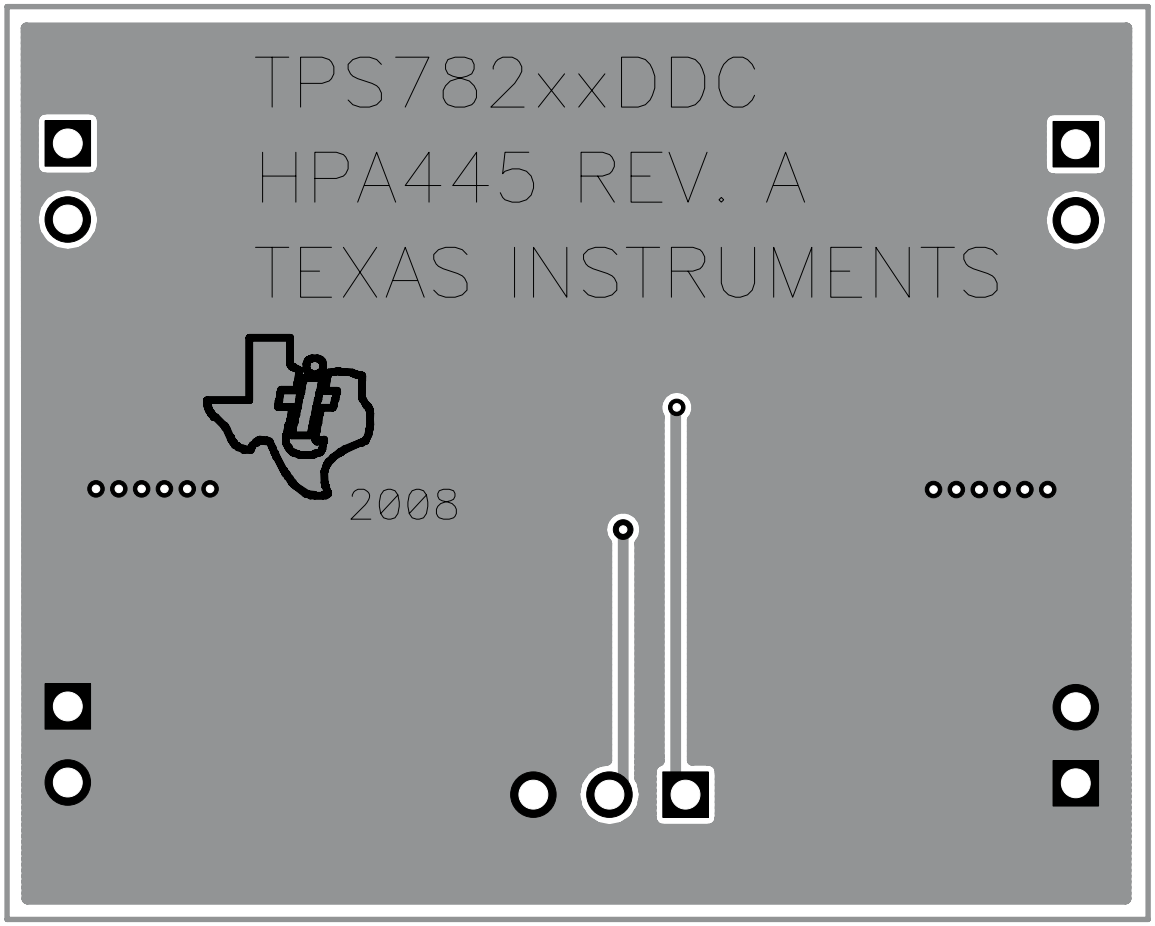
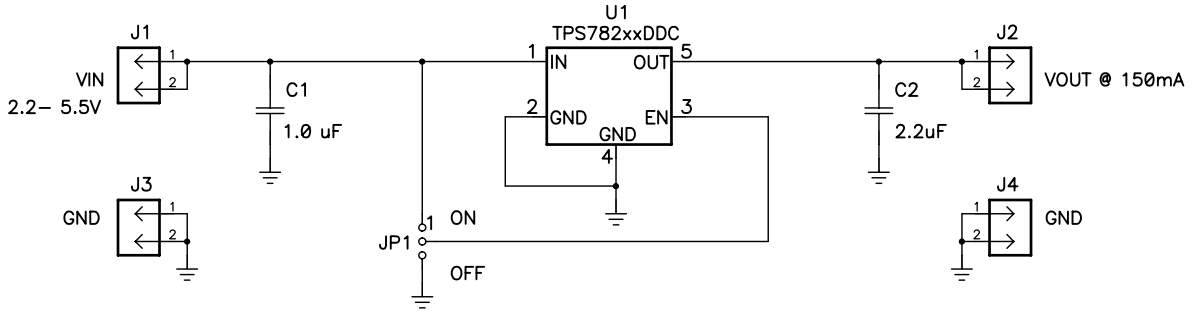


Figure 4. Bottom Layer Assembly

6 Schematic and Bill of Materials

This section provides the TPS782xxEVM-445 schematic and bill of materials.

6.1 Schematic



C1: 1.0uF, 10V, X7R, 10%, 0603
C2: 2.2uF, 6.3V, X7R, 10%, 0603

ASSY	U1	VOUT
–001	TPS78233	3.3
–002	TPS78230	3.0
–003	TPS78227	2.7
–004	TPS78225	2.5

Figure 5. TPS782xxEVM-445 Schematic

6.2 Bill of Materials

Table 2. TPS782xxEVM-445 Bill of Materials

-001	-002	-003	-004	RefDes	Value	Description	Size	Part No.	MFR
1	1	1	1	C1	1.0 µF	Capacitor, Ceramic, 10-V, X7R, 10%	0603	STD	Any
1	1	1	1	C2	2.2 µF	Capacitor, Ceramic, 6.3-V, X7R, 10%	0603	STD	Any
4	4	4	4	J1– J4	PTC36SAAN	Header, 2-pin, 100mil spacing	0.100 × 2	PTC36SAAN	Sullins
1	1	1	1	JP1	PTC36SAAN	Header, 3-pin, 100mil spacing	0.100 inch × 3	PTC36SAAN	Sullins
1	1	1	1	N/A	N/A	PCB, 1.2 In × 1.5 In × 0.062	N/A	HPA445	Any
1	0	0	0	U1	TPS78233DDC	IC, 150mA, Ultra-Low Quiescent Current, IQ 1µA	TSOT23-5	TPS78233DDC	TI
0	1	0	0	U1	TPS78230DDC	IC, 150mA, Ultra-Low Quiescent Current, IQ 1µA	TSOT23-5	TPS78230DDC	TI
0	0	1	0	U1	TPS78227DDC	IC, 150mA, Ultra-Low Quiescent Current, IQ 1µA	TSOT23-5	TPS78227DDC	TI
0	0	0	1	U1	TPS78225DDC	IC, 150mA, Ultra-Low Quiescent Current, IQ 1µA	TSOT23-5	TPS78225DDC	TI
1	1	1	1	N/A	N/A	100 mil 2 Pin Shunt	0.100 × 2	929957-08	3M

Notes:

1. These assemblies are ESD sensitive, ESD precautions shall be observed.
2. These assemblies must be clean and free from flux and all contaminants. Use of no clean flux is not acceptable.
3. These assemblies must comply with workmanship standards IPC-A-610 Class 2.
4. Ref designators marked with an asterisk ('**') cannot be substituted.
   All other components can be substituted with equivalent MFG's components.

6.3 Related Documentation From Texas instruments

TPS782xx, 150mA, Ultra-Low Quiescent Current, IQ 1µA Low Dropout Linear Regulator data sheet (SBVS115)

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EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 2.2 V to 5.5 V and the output voltage range of 1 V to 5.4 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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