TPS720xxDRVEVM Evaluation Module

This user's guide describes the characteristics, operation, and use of the TPS720xxDRVEVM evaluation module (EVM). This EVM demonstrates the Texas Instruments TPS720xx, an ultralow input voltage low-drop out (LDO) linear regulator in a 2-mm x 2-mm SON-6 package that is capable of 350 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 EVM.

Contents

List of Figures

List of Tables

1 Introduction

The TPS720xxDRVEVM evaluation module helps designers evaluate the operation and performance of the TPS720xx LDO in the SON-6 package. The TPS720xx is a 350-mA, ultralow input voltage linear regulator with a bias pin.

1.1 Related Documentation from Texas Instruments

TPS720xx, 350mA, Ultra-Low V_{IN}, RF Low-Dropout Linear Regulator With Bias Pin data sheet (SBVS100)

2 Setup

This section describes the jumpers and connectors on the EVM as well as how to properly connect, set up, and use the TPS720xxDRVEVM.

2.1 Input / Output Connector Descriptions

2.1.1 J1 – VIN

This is the positive input supply voltage. Twist the leads to the input supply and keep them as short as possible to minimize EMI transmission. If the supply leads are greater than six inches, add more bulk capacitance between J1 and J3 . An additional 47-µF or greater capacitor improves the transient response of the TPS720xx and helps to reduce ringing on the input when long supply wires are used. The maximum input voltage is the smaller of 4.5 V or the value of voltage on pin 1 of J5 (Vbias).

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 J5 – Bias Supply

This connector is used to provide a bias voltage supply to the TPS720xx. Pin 1 is the positive voltage of the bias supply, and pin 2 of J5 is the ground connection of the bias supply. If an external bias supply is used, its voltage must be between 2.5 V and 5.5 V

2.1.6 JP1 – ENABLE

This 3-pin jumper is used to enable or disable the converter. Placing a jumper between pins 1 and 2 of JP1 enables the converter to be on. Moving the jumper between pin 2 and 3 disables the converter to be off'. Terminate the enable pin using a jumper or external signal generator, and leave it floating.

2.1.7 JP1 – Jumper

This 2-pin jumper is used to tie VBIAS to VIN for situations where a bias voltage supply is not used. Installing a jumper across the two pins shorts VBIAS to VIN. Remove the jumper isolated VBIAS from VIN so that an external bias voltage can be used.

3 Operation

This section provides information about the operation of the TPS720xxEVM.

3.1 Operation

Connect the positive input power supply to J1. Connect the input power return (ground) to J3. Connect the positive VBIAS voltage to pin 1 of J5 and the VBIAS return (GND) to pin 2 of J5. Connect the load across J2 (positive output voltage) and J4 (GND). Configure jumpers JP1 and JP2 for the desired operation based on the functions described in and .

The recommended maximum operating input voltage is the lower of 4.5 V or the voltage on VBIAS. The actual highest input voltage may be less due to thermal conditions. To determine the highest input voltage, see .

4 Thermal Guidelines

This section provides guidelines for the thermal management of the TPS720xxDRVEVM 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 help you design the TPS720xx 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 measured thermal resistance from junction to ambient for the TPS720xxEVM board has a typical value of 48.35°C/W. The recommended maximum operating junction temperature specified in the data sheet for the TPS720xx family is 125°C. With this 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 TPS720105 with the output voltage of 1.05 V, if the ambient temperature is 85°C and the full 350 mA of load current is required?

Given: T_J = 125°C, T_A = 85°C, θ_{JA} = 48.35°C/W

Using Equation 2, substitute in the preceding given values and find that the maximum power dissipation for the part is P_d =0.827 W.

$$125°C = 85°C + P_d\ (48.35°C/W) \quad (2)$$

This means that the total power dissipation of the TPS720105 must be less than 0.827 W. The input voltage now can be calculated.

$$P_d = (V_{in} - V_{out}) \times I_{out} = (Vin - 1.05V) \times 0.350\ A = 0.827\ W \quad (3)$$

So, the maximum input voltage needs to be 3.412 V or less in order to maintain a safe junction temperature.

5 Board Layout

This section provides the TPS720xxDRVEVM board layout and illustrations.

5.1 Layout

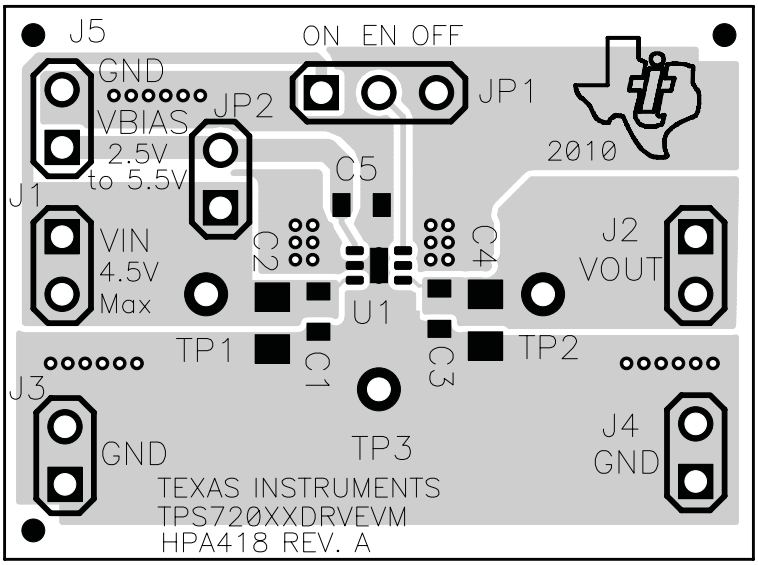

Figure 1. Assembly Layer

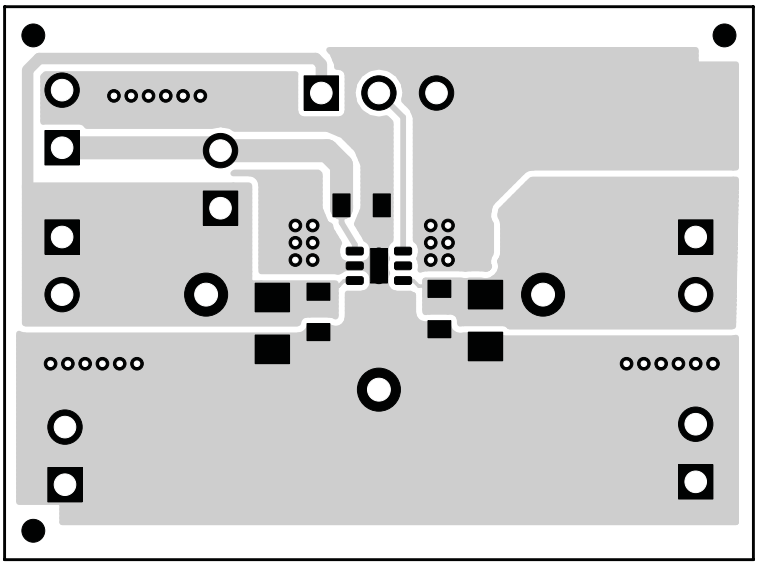

Figure 2. Top Layer Routing

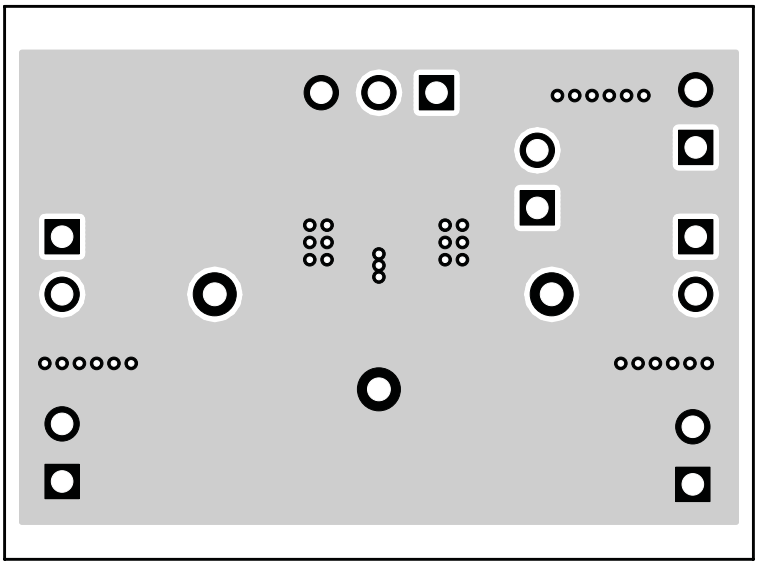

Figure 3. Bottom Layer Routing

6 Schematic and Bill of Materials

This section provides the TPS720xxDRVEVM schematic and bill of materials.

6.1 Schematic

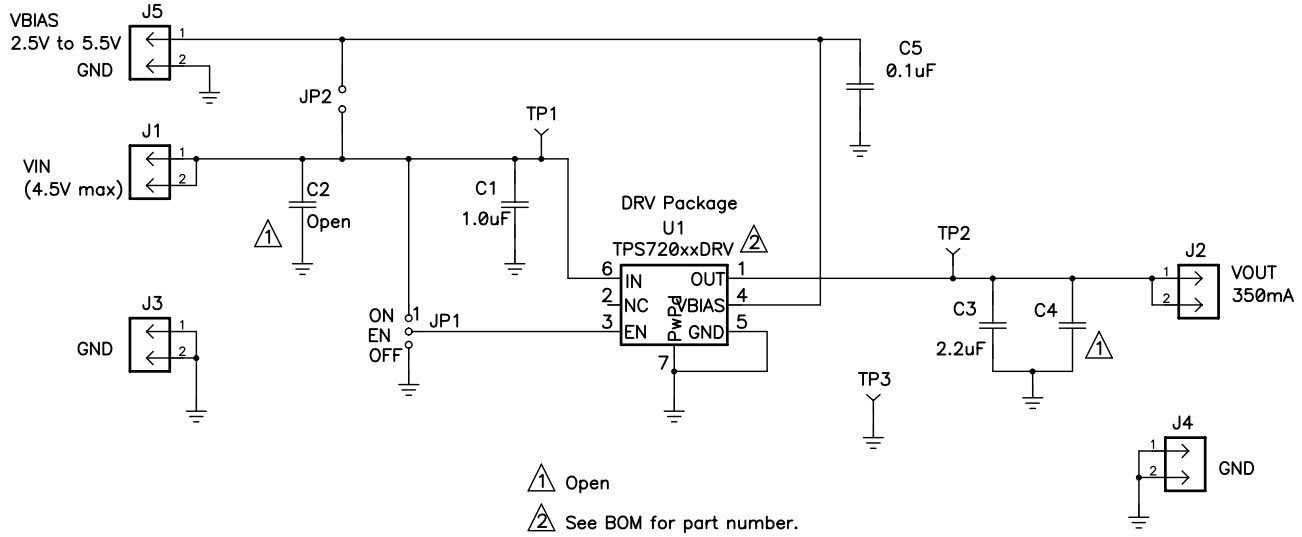

Figure 4. TPS720xxDRVEVM Schematic

6.2 Bill of Materials

Table 1. TPS720xxDRVEVM Bill of Materials

Count	RefDes	Value	Description	Size	Part Number	MFR
1	C1	1.0 µF	Capacitor, Ceramic, 10V, X5R, 20%	0603	Std	Std
0	C2	Open	Capacitor, Ceramic, 10V, X5R, 20%	0805	Std	Std
1	C3	2.2 µF	Capacitor, Ceramic, 6.3V, X5R, 10%	0603	Std	Std
0	C4	Open	Capacitor, Ceramic, 6.3V, X5R, 10%	0805	Std	Std
1	C5	0.1 µF	Capacitor, Ceramic, 6.3V, X5R, 20%	0603	Std	Std
5	J1–J5	PEC02SAAN	Header, 2-pin, 100 mil spacing	0.100 inch x 2	PEC02SAAN	Sullins
1	JP1	PEC03SAAN	Header, 3-pin, 100 mil spacing	0.100 inch x 3	PEC03SAAN	Sullins
1	JP2	PEC02SAAN	Header, 2-pin, 100 mil spacing	0.100 inch x 2	PEC02SAAN	Sullins
3	TP1–TP3	5000	Test Point, Red, Thru Hole Color Keyed	0.100 x 0.100 inch	5000	Keystone
1	U1	TPS720105DRV	IC, LDO Linear Regulator With Bias Pin, 350mA	SON-6	TPS720105DRV	TI
2	N/A		Shunt, Open-top		151-8000	Kobiconn
1	PCB		PCB, 1.300 In x 0.960 In x .062 In		HPA418	Any

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.

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.

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 1.1 V to 4.5 V and the output voltage range of 0.9 V to 3.6 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.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265

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:

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

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265