Using the TLV700xxEVM-503

User's Guide

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This user's guide describes the characteristics, operation, and use of the TLV700xxEVM-503 evaluation module (EVM). This EVM demonstrates the Texas Instruments TLV700xx a low dropout (LDO) linear regulator that is capable of 200 mA at both fixed and adjustable output voltage levels. 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.

1 Introduction

The TLV700xxEVM-503 evaluation module (EVM) helps designers evaluate the operation and performance of the TLV700xx family. The TLV700xx is a 200-mA, low quiescent current, low noise, high PSRR, fast start-up LDO linear regulator with excellent line and load transient response.

2 Setup

This section describes the jumpers and connectors on the EVM as well as how to properly connect, setup, and use the TLV700xxEVM.

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 TLV700xx and helps to reduce ringing on the input when long supply wires are used.

2.1.2 J2 –GND

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

2.1.3 J3 –VOUT

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

2.1.4 J4 –GND

This is the return connection for the output.

2.1.5 JP1 –ENABLE

This jumper enables or disables the regulator. Connecting the shorting jumper between pin 1 and pin 2 (ENABLE and VIN) enables the converter. Connecting the shorting jumper between pin 2 and pin 3 (ENABLE and GND) disables the converter. Never leave this pin floating.

2.2 Soldering Guidelines

Any soldering work on the TLV700xxEVM must be performed using a hot air system to avoid damaging the integrated circuit (IC). A hot air system must be used when soldering or de-soldering any external components such as the feedback network as well as the IC. A hot air system heats all of the traces on the board equally, which equalizes the thermal expansion of the traces on the board and thus reduces stress. Heating only one trace, such as with a soldering iron, allows one trace to expand more than the others and to cause shear stress on the pins of the QFN package. The shear stress on a single pin can be enough to break the pin of the IC, thus causing an IC failure.

3 Operation

This section provides information about the operation of the TLV700xxEVM.

3.1 Operation

Connect the positive input power supply to J1. Connect the input power return (ground) to J2. The TLV700xxEVM 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 J3 (positive lead) and J4 (negative lead). Configure jumper JP1 as required. The function of JP1 is described in the Setup section (2.1.5) of this manual.

4 Thermal Guidelines

This section provides guidelines for the thermal management of the TLV700xxEVM-503 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 TLV700xx 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 device, 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 TLV700xxEVM has a typically value of 200°C/W. The recommended maximum operating junction temperature specified in the data sheet for the TLV700xx 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 TLV70025 (fixed 2.5-V output) if the ambient temperature is 85°C and the full 200 mA of load current is required?

$$T_J = 125°C,\ TA = 85°C,\ \theta_{JA} = 200°C/W \quad (2)$$

Using Equation 1, substitute in the preceding given values and find that the maximum power dissipation for the part is P_d = 0.2 W.

$$125°C = 85°C + P_d\,(200°C/W) \quad (3)$$

This means that the total power dissipation of the TLV70025 must be less than 0.2 W. Now, the input voltage can be calculated.

$$P_d = (V_{IN} - V_{OUT}) \times I_{OUT} = (V_{IN} - 2.5) \times 0.2\,A = 0.2\,W \quad (4)$$

So, the maximum input voltage needs to be 3.5 V or less in order to maintain a safe junction temperature.

Similar analysis can be performed to determine the maximum ambient temperature over a range of operation. For an input voltage of 3.3 V you can calculate the highest ambient temperature allowed and still provide full output current.

Using Equation 1 and Equation 3 again, T_A is 93.0°C.

5 Board Layout

This section provides the TLV700xxEVM-503 board layout and illustrations

5.1 Layout

When laying out the board for the TLV700xx, TI recommends that the board be designed with separate ground planes for Vin and Vout which are only connected at the GND pin of the device. Also, the ground connection for the bypass capacitor must be connected directly to the GND pin of the device. By following the foregoing two guidelines, you can improve the PSRR performance of the TLV700xx. See the TLV700xx data sheet for specific layout guidelines.

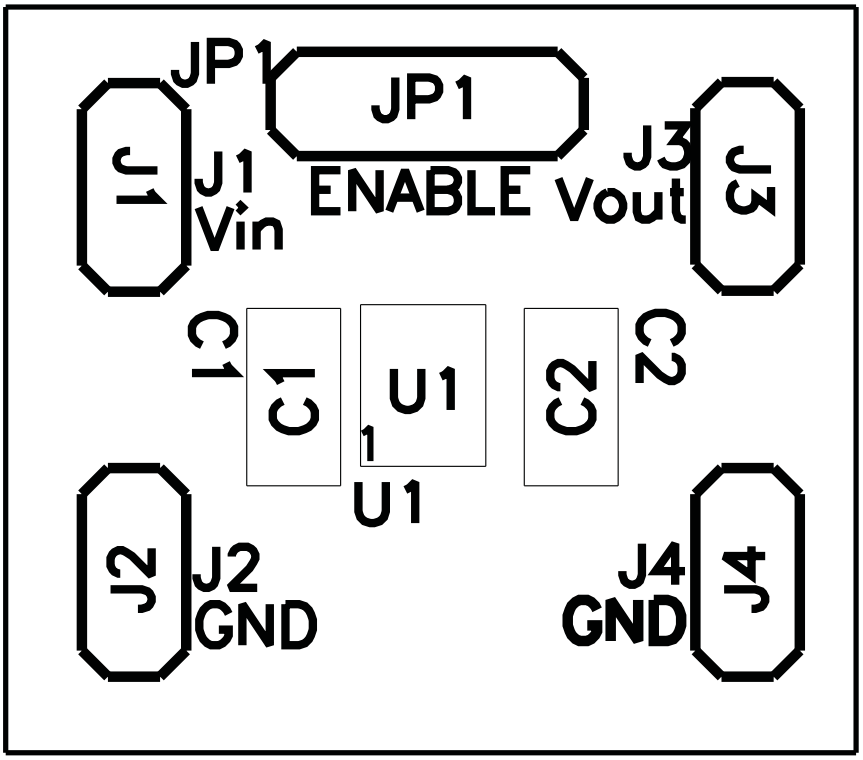


Figure 1. Assembly Layer

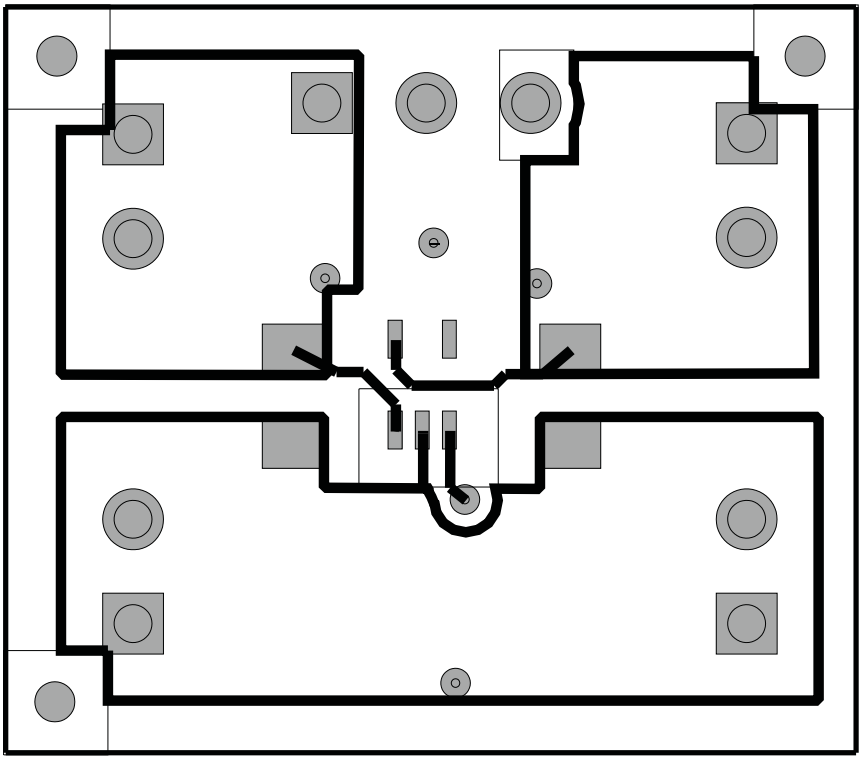


Figure 2. Top Layer Routing

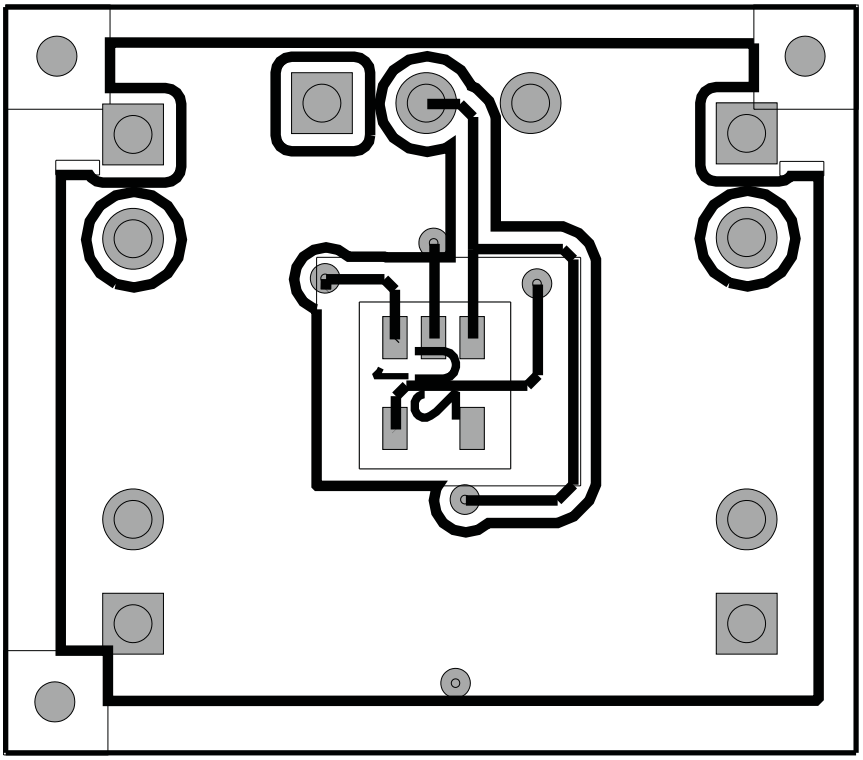
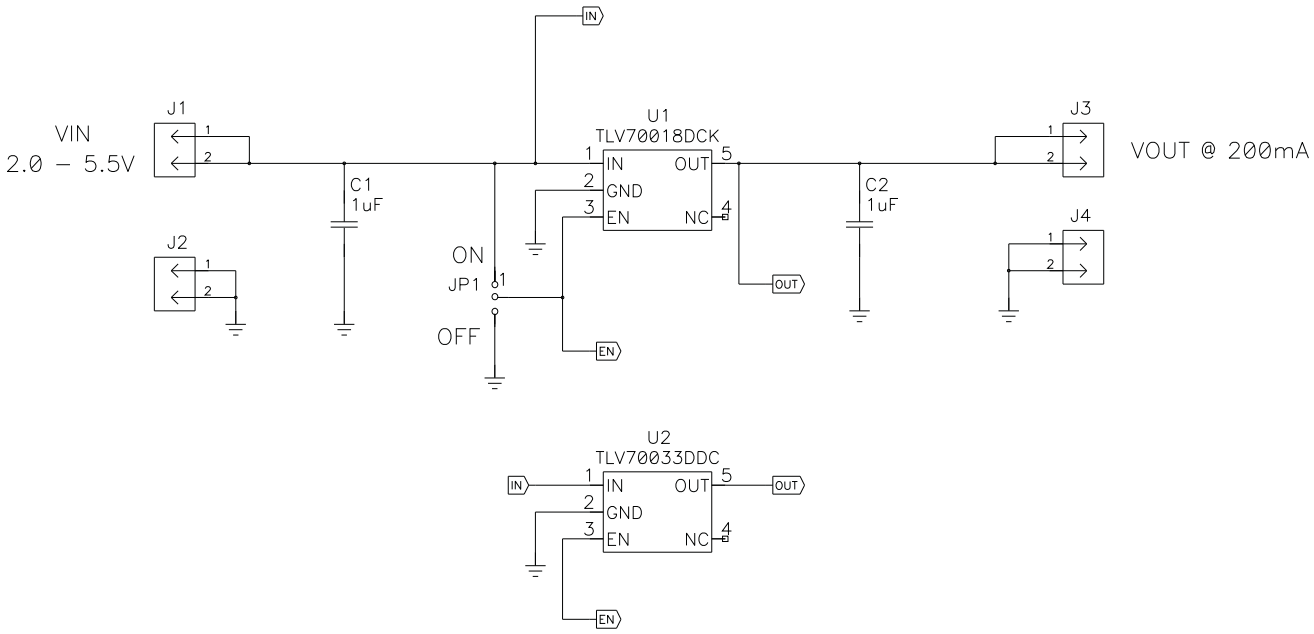


Figure 3. Bottom Layer Routing

6 Schematic and List of Materials

This section provides the TLV700xxEVM-503 schematic and List of Materials.

6.1 Schematic



ASSY	U1	U2	VOUT
–001	TPS70018DCK	–	1.8V
–002	–	TPS70033DDC	3.3V

Figure 4. TLV700xxEVM-503 Schematic

6.2 List of Materials

Table 1. TLV700xxEVM-503 List of Materials

COUNT	REF DES	DESCRIPTION	PART NUMBER	MFR
2	C1, C2	Capacitor, ceramic, 25 V, X5R, 20%, 1 µF, 805	STD	STD
4	J1, J2, J3, J4	Header, 2 pin, 100-mil spacing, 0.100 in x 2 in	PEC02SAAN	Sullins
1	JP1	Header, 3 pin, 100-mil spacing, 0.100 inch x 3 in	PEC03SAAN	Sullins
1	U1	200 mA, low IQ, LDO regulator, SC70-5	TLV70018DCK	TI
1	U2	200 mA, low IQ, LDO regulator, SOT23-5	TLV70033DDC	TI
1	--	Shunt, 100-mil, black, 0.1	929950-00	3M
1		PCB, 0.815 in x 0.725 in x 0.062 in	HPA503	Any

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EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 2.7 V to 5.5 V and the output voltage range of 1.193 V to 5.5 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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