TLV71733PEVM-072 Evaluation Module

This user's guide describes operational use of the TLV71733PEVM-072 evaluation module as a reference design for engineering demonstration and evaluation of the TLV717xxP, low-dropout linear regulator. Included in this user's guide are setup instructions, a schematic diagram, layout and thermal guidelines, a bill of materials, and test results.

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1 Introduction

The Texas Instruments TLV71733PEVM-072 evaluation module (EVM) helps design engineers to evaluate the operation and performance of the TLV717xxP family of linear regulators for use in their own circuit applications. This particular EVM configuration contains a single linear regulator with internal thermal and current-limit shutdowns. The TLV717xxP linear regulator offers current foldback, which throttles back the output current as the load resistance decreases. The TLV717xxP also has enable (disable) circuitry and provides an active pulldown circuit to quickly discharge output loads. It is available as an extremely small DQN package. The regulator, including external components, is capable of delivering up to 150 mA to the load depending on the input/output power dissipation across the part. The TLV717xxP does not require an input capacitor, and the output capacitor only needs to be ≥ 0.1 μF (effective minimum) for stability; however, for conservative design practice accounting for widely varying noise environments and dynamic line/load conditions, a 1-μF input and output capacitor has been used in the design.

2 Setup

This section describes the jumpers and connectors on the EVM as well as how to properly connect, set up, and use the TLV717xxPEVM.

2.1 Input/Output Connectors and Jumper Descriptions

2.1.1 J1 – VIN

J1 is the input power supply voltage connector. Twist the positive input lead and ground return lead from the input power supply, and keep them as short as possible to minimize EMI transmission. Add additional bulk capacitance between J1 and J2 if the supply leads are greater than 6 inches. For example, an additional 47-μF electrolytic capacitor connected from J1 to ground can improve the transient response of the TLV717xxP, while eliminating unwanted ringing on the input due to long-wire connections.

2.1.2 J2 – GND

J2 is the ground-return connector for the input power supply.

2.1.3 J3 – VOUT

J3 is the regulated output voltage connector.

2.1.4 J4 – GND

J4 is the output ground-return connector.

2.1.5 JP1 – EN

JP1 is the output enable. To enable the output, connect a jumper to short the ON pin 1 to the EN center pin 2. To disable the output, connect a jumper to short EN pin 2 to OFF pin 3.

2.2 Equipment Setup

- Turn off the input power supply after verifying that its output voltage is set to greater than 3.2 V (5.5 V maximum). Connect the positive voltage lead from input power supply to VIN at the J1 connector of the EVM. Connect the ground lead from the input power supply to GND at the J2 connector of the EVM.
- Connect a 0-mA to 150-mA load between an OUT pin at connector J4 and a GND pin at connector J3.
- Disable the output by connecting the jumper on JP1 from the EN pin to the OFF pin.

3 Operation

- Turn on the input power supply. For the initial operation, set the input power supply, VIN – J1, to 5 V.
- Enable the output by reconnecting the jumper on JP1 from the EN pin to the ON pin.
- Vary the respective loads and VIN voltages as necessary for test purposes.

4 Test Results

This section provides typical performance waveforms for the TLV71733PEVM-072 printed-circuit board (PCB).

4.1 Turnon Sequence

Figure 1 shows the turnon/off characteristic where VIN is preset to 5 V, the output drives a 100-mA load, and the EN turnon is stepped to 5 V (C2, red). The output (C3, blue) shows a monotonic rise time of approximately 50 µs. The output voltage start-up ramp is not load dependant.

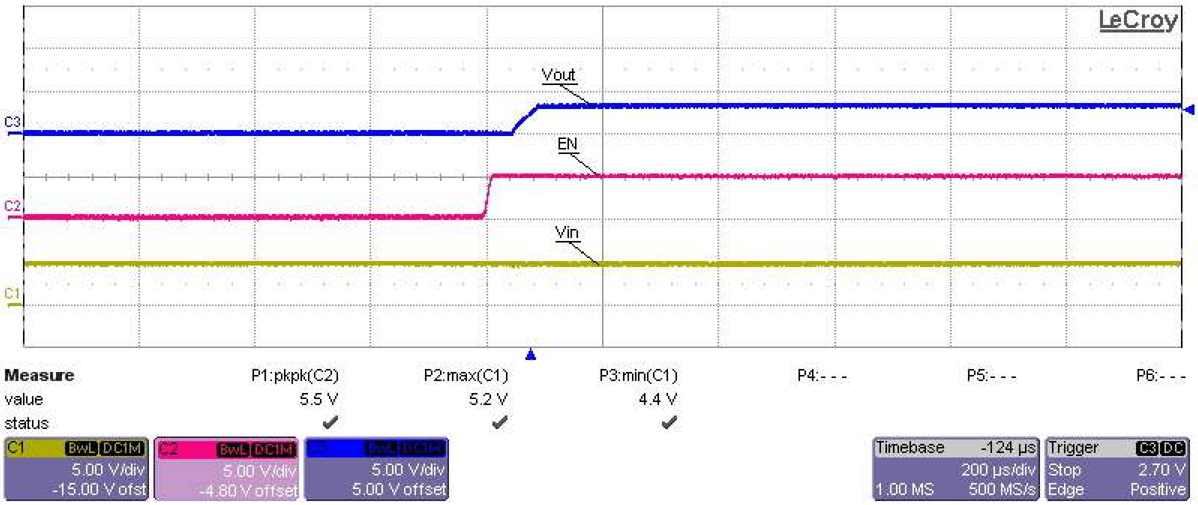

Figure 1. Turnon Sequence

4.2 Output Load Transient

Figure 2 shows the load transient response (VOUT - C3, blue) for a full-load step transient from 20 mA to 150 mA (C4, green). VIN is set at 5 V.

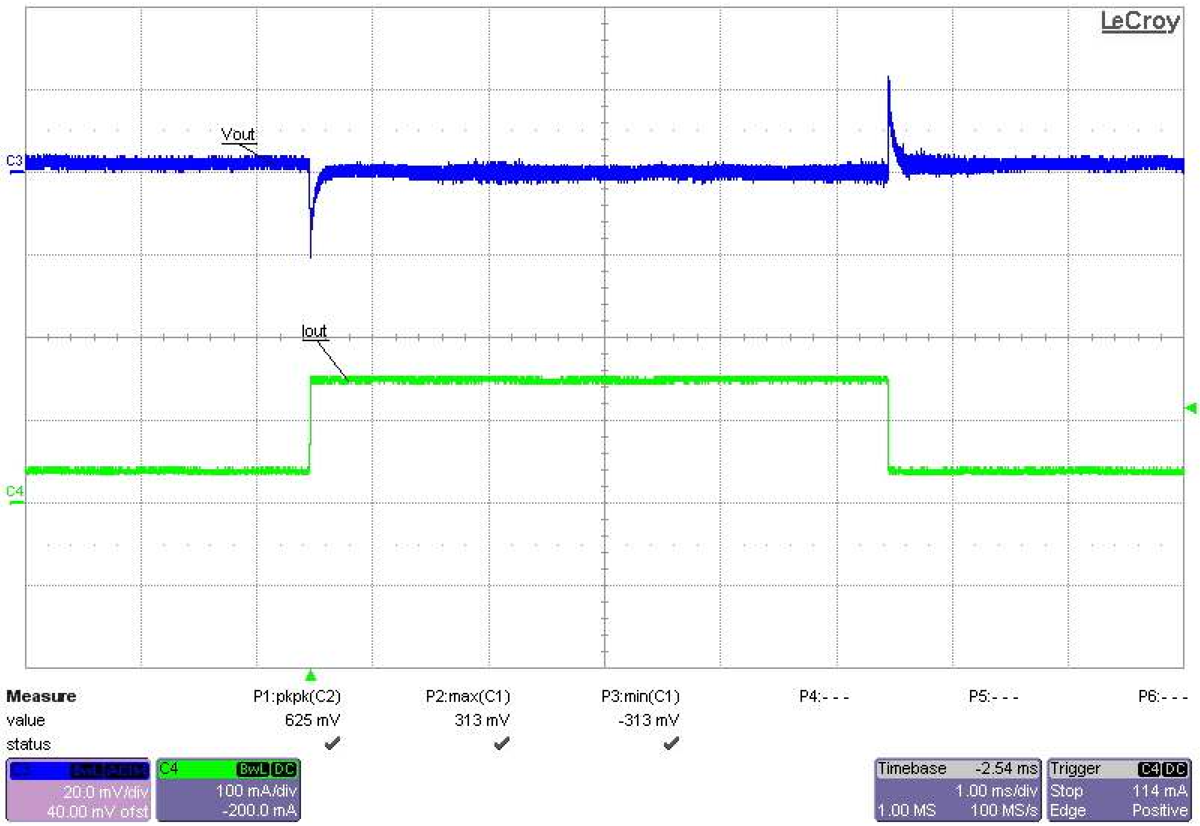

Figure 2. Load Step and Transient Response

5 Thermal Guidelines and Layout Recommendations

Thermal management is a key component of design of any power converter and is especially important when the power dissipation in the low-dropout (LDO) linear regulator is high. Use the following formula to approximate the maximum power dissipation for the particular ambient temperature:

$$T_J = T_A + P_D \times \theta_{JA}$$

Where T_J is the junction temperature, T_A is the ambient temperature, P_D is the power dissipation in the device (W), and θ_{JA} is the thermal resistance from junction to ambient. All temperatures are in degrees Celsius. The maximum silicon junction temperature, T_J, must not be allowed to exceed 150°C. The layout design must use copper trace and plane areas effectively, as thermal sinks, in order not to allow T_J to exceed the absolute maximum rating under all temperature conditions and voltage conditions across the part.

The designer must carefully consider the thermal design of the PCB for optimal performance over temperature. The actual allowable power dissipation on your PCB is a strong function of your layout.

6 Board Layout

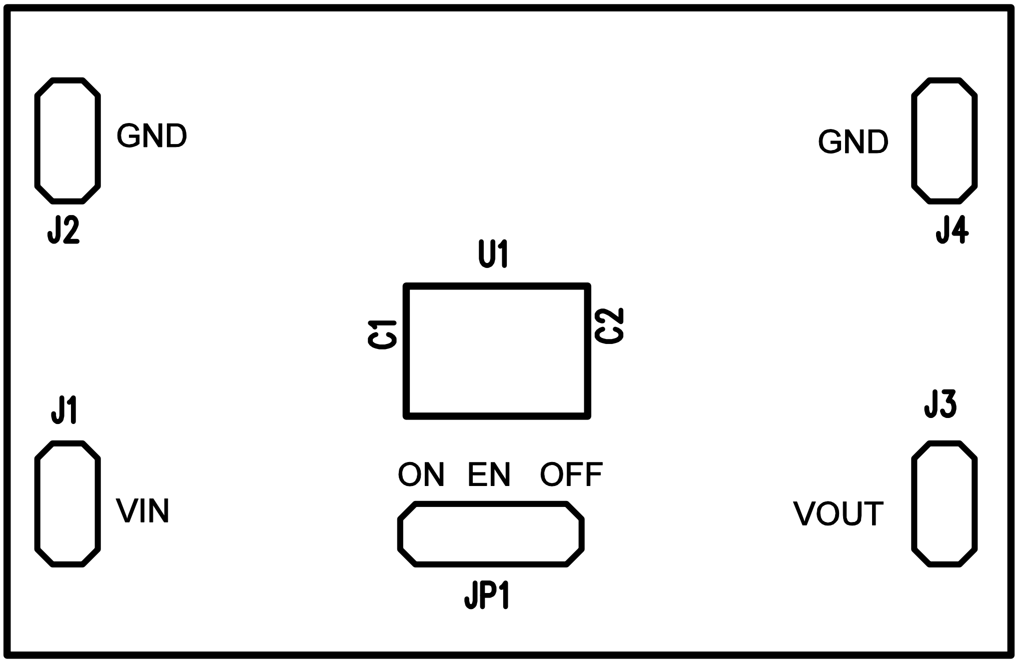

Figure 3. Top-Layer Silkscreen

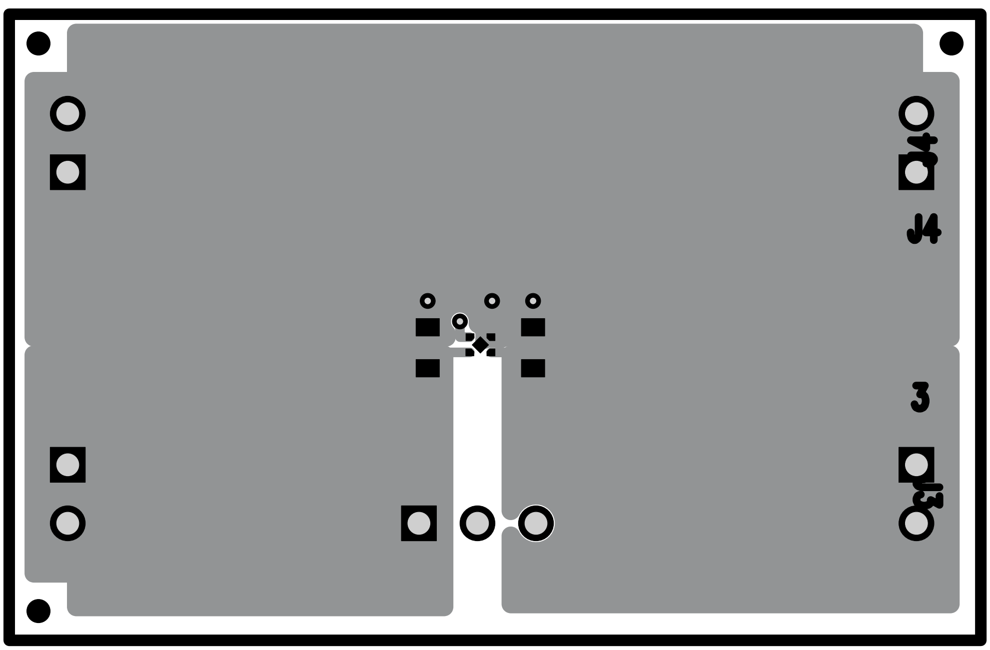

Figure 4. Top-Layer Routing

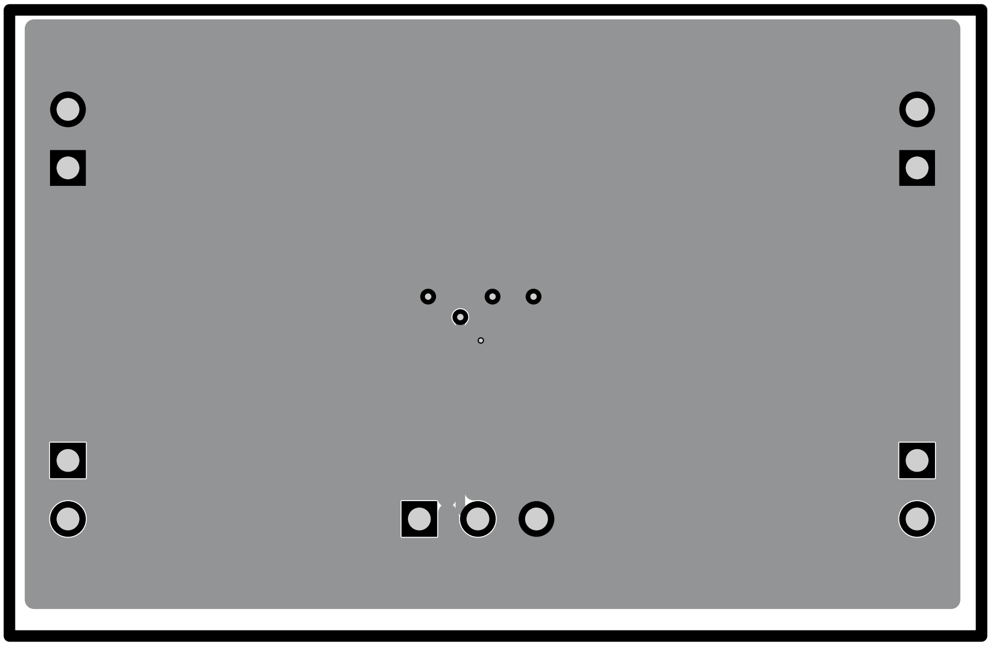

Figure 5. Bottom-Layer Routing

7 Schematic and Bill of Materials

7.1 Schematic

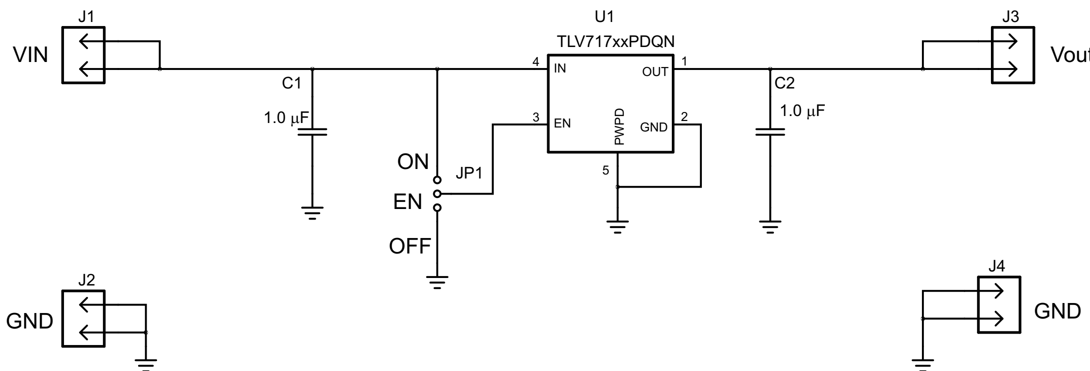

Figure 6. TLV71733PEVM-072 Schematic

7.2 Bill of Materials

Table 1. TLV71733PEVM-072 Bill of Materials

Count	RefDes	Value	Description	Size	Part Number	MFR
2	C1, C2	1.0μF	Capacitor, Ceramic, Low Inductance, 10V, [X7R], [10%]	0603	STD	STD
4	J1-4	PTC36SAAN	Header, 2-pin, 100mil spacing	0.100 inch x 2	PEC36SAAN	Sullins
1	JP1		Header, 3-pin, 100mil spacing	0.100 inch x 3		Sullins
1	U1	TLV71733PDQN	IC, 200mA, Low IQ, LDO Regulator for Portables	uDFN	TLV71733PDQN	TI
1	—		PCB, 1 In x 1 In x 1 In		PWR072	Any

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It is important to operate this EVM within the input voltage range of 1.7 V to 5.5 V and the output voltage range of 1.2 V to 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 125° C. The EVM is designed to operate properly with certain components above 125° 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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General Statement for EVMs including a radio

User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant

Caution

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

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Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concerning EVMs including detachable antennas

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

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Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

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Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

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2. Use this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
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