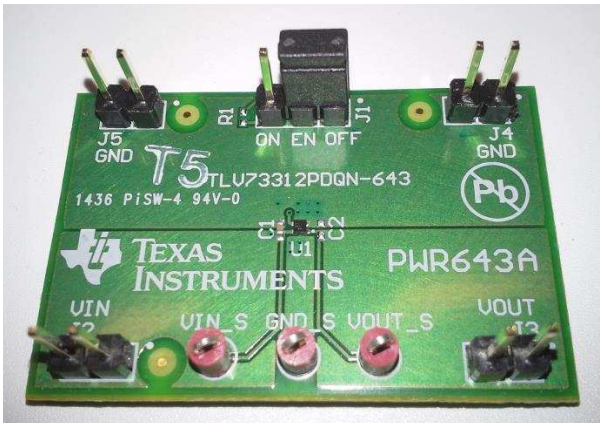
TLV73312PDQN-643 Evaluation Module



This user's guide describes the operational use of the TLV73312PDQN-643 evaluation module (EVM) as a reference design for engineering demonstration and evaluation of the TLV73312PDQN, an ultra-small, low-quiescent current, low-dropout regulator (LDO). Included in this user's guide are setup instructions, a schematic diagram, printed circuit board (PCB) layout drawings, and a bill of materials for the EVM.

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1 Introduction

The Texas Instruments TLV73312PDQN-643 EVM helps design engineers evaluate the operation and performance of the TLV733 series of LDOs for possible use in their own circuit applications. This particular EVM configuration contains the TLV73312PDQN LDO configured with a single 1-µF input capacitor and no output capacitor. The TLV733 series are ultra-small, low quiescent current LDOs capable of operating capacitor-free with good load and line transient performance in a 4-pin DQN (X2SON) package. This document describes the configuration and setup of the TLV73312PDQN-643 EVM board.

2 Hardware

This section describes the connectors on the EVM, as well as how to properly connect, set up, and use the TLV73312PDQN-643.

2.1 Input and Output Connectors

2.1.1 J1—ON, EN, OFF

J1 allows a jumper to connect the enable pin (pin 2 of J1) to VIN (pin 3 of J1) or to GND (pin 1 of J1). The board is shipped with the jumper connecting the EN pin to GND, and must be moved to connect the enable pin to VIN for normal regulation.

2.1.2 J2—VIN

Connect the input power supply (1.4 V to 5.5 V) positive terminal to J2. Two pins are provided to allow space for multiple connections.

2.1.3 J3—VOUT

Connect the output load positive terminal to J3. Two pins are provided to allow space for multiple connections.

2.1.4 J4—GND

Connect the output load negative terminal to J4. Two pins are provided to allow space for multiple connections.

2.1.5 J5—GND

Connect the input supply negative terminal to J5. Two pins are provided to allow space for multiple connections.

2.1.6 VIN_S

VIN_S allows for a Kelvin measurement directly to the IN pin of the TLV73312PDQN. Use this test post for voltage measurements to a high-impedance digital voltmeter (DVM).

2.1.7 VOUT_S

VOUT_S allows for a Kelvin measurement directly to the OUT pin of the TLV73312PDQN. Use this test post for voltage measurements to a high-impedance DVM.

2.1.8 GND_S

GND_S allows for a Kelvin measurement directly to the GND pin of the TLV73312PDQN. Use this test post for the negative connection of the VIN_S and VOUT_S DVM measurements.

2.2 Components

2.2.1 C1

C1 is the input capacitor for the TLV73312PDQN but is not necessary for stability. However, C1 can help the device output transient response when the impedance between the input supply and the LDO is inductive. An input capacitor of 1 µF is recommended for applications where the input impedance is unknown.

2.2.2 C2

C2 is the output capacitor and is not populated on this board. If improved transient response is required, a ceramic capacitor of any value less than or equal to 100 µF can be populated for C2. A 1-µF capacitor is a good choice for a balance of size and cost versus transient performance.

2.2.3 R1

R1 allows for a resistor to connect the EN pin to the VIN voltage. The EN pin must be pulled above 0.9 V to enable the device. If a resistive connection to VIN is necessary (in the case that an external open-drain enable signal is used), R1 can be populated with an appropriate pull-up resistor. If a direct short to VIN is desired, the jumper provided on J1 can be used to short EN to VIN.

3 Setup and Test

- Set the input power-supply voltage to 0 V. Connect the positive voltage lead from the power supply to J2 (VIN). Connect the ground lead from the power supply to J5 (GND).
- Short EN to VIN by connecting the jumper on J1 to the header pins marked ON and EN.
- Connect a voltmeter across VOUT_S and GND_S.
- Add the required load from J3 (VOUT) to J4 (GND).
- Vary the input power-supply voltage as necessary for test purposes.

4 Operation

The TLV73312PDQN is a fixed 1.2-V LDO. The device is designed to operate with 1.4 V ≤ VIN ≤ 5.5 V, and 0 ≤ IOUT ≤ 300 mA.

5 Test Results

5.1 Startup Performance

Figure 1 shows the startup performance of the TLV73312PDQN-643 EVM.

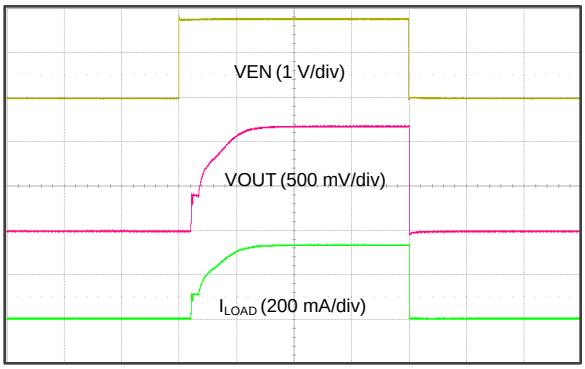

Figure 1. Startup Performance with a 3.7-Ω Load Resistor, VIN = 1.8 V

5.2 Load Transient Performance

Figure 2 shows the load transient performance of the TLV73312PDQN-643 EVM.

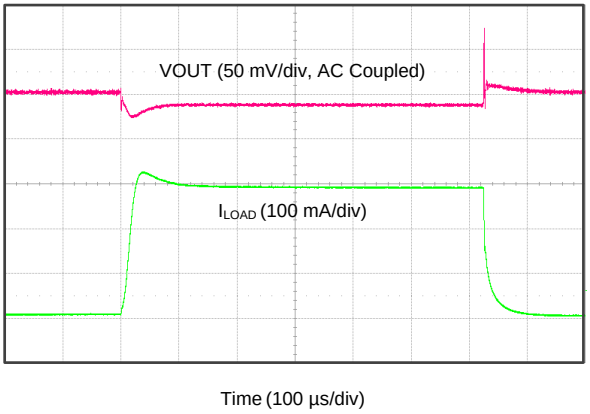

Figure 2. Load Transient Response, 0 mA to 300 mA, VIN = 1.8 V, VEN = VIN

6 Thermal Guidelines and Layout Recommendations

Thermal management is a key design component of any power converter and is especially important when the power dissipation in the LDO is high. Use Equation 1 to approximate the maximum power dissipation for the 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 (Watts),
- and θ_{JA} is the thermal resistance from junction to ambient.
- All temperatures are in degrees Celsius.

The maximum operating junction temperature, T_J, must not to exceed 125°C. The layout must use copper traces and planes as thermal sinks in order to keep T_J below the maximum operating temperature during worst-case conditions.

Table 1 includes information from the Dissipation Ratings Table of the TLV733 series data sheet for comparison with the thermal resistance, θ_{JA}, for High-K JEDEC standard boards. The maximum input voltage can be calculated for full load at different ambient temperatures. The input voltage must be less than these values in order to maintain a safe junction temperature.

Table 1. Thermal Resistance, θ_{JA}, and Maximum Power Dissipation

IC	Board	Package	θ_{JA}	Max VIN at 300 mA (T_A = 25°C)	Max VIN at 300 mA (T_A = 70°C)
TLV73312	High-K	DQN	218.6°C/W	2.724 V	2.03 V

7 Board Layout

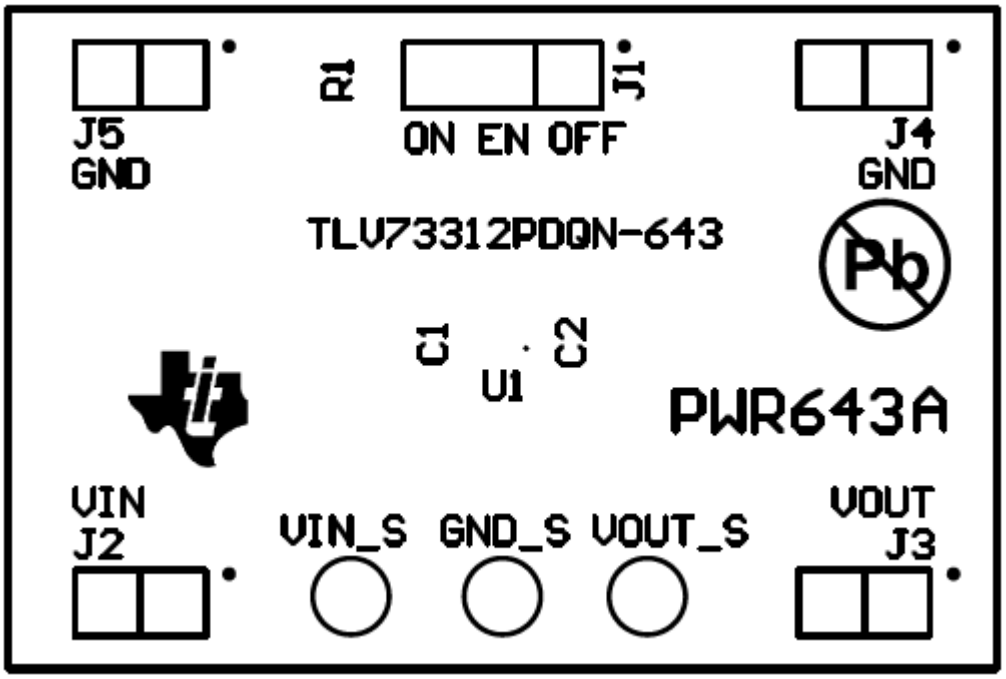

Figure 3. Top Silk Screen

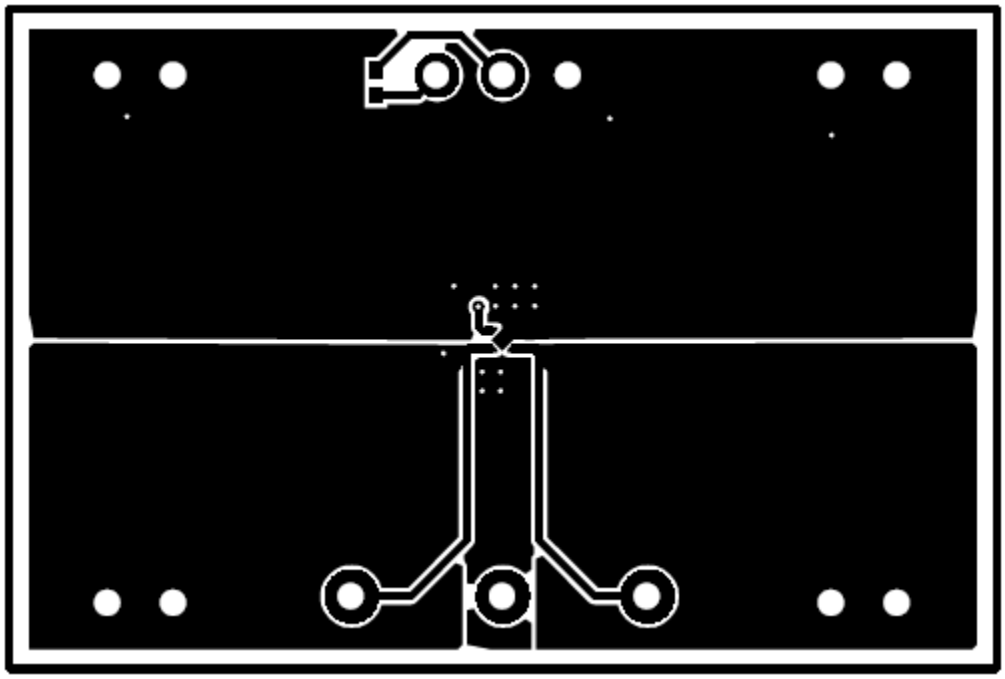

Figure 4. Top Layer Routing

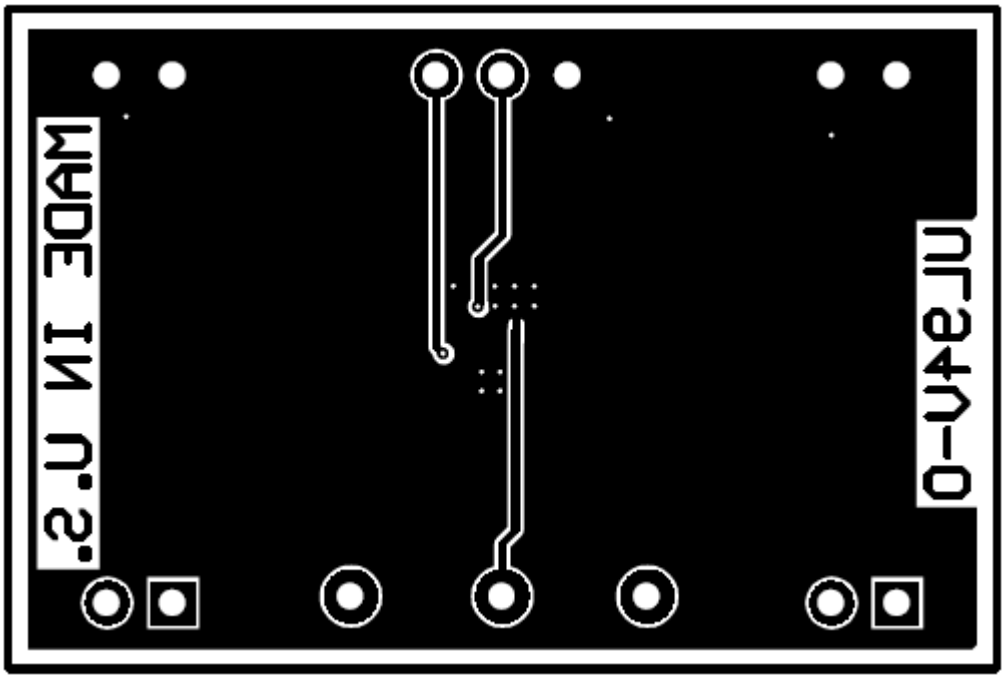

Figure 5. Bottom Layer Routing

8 Schematic

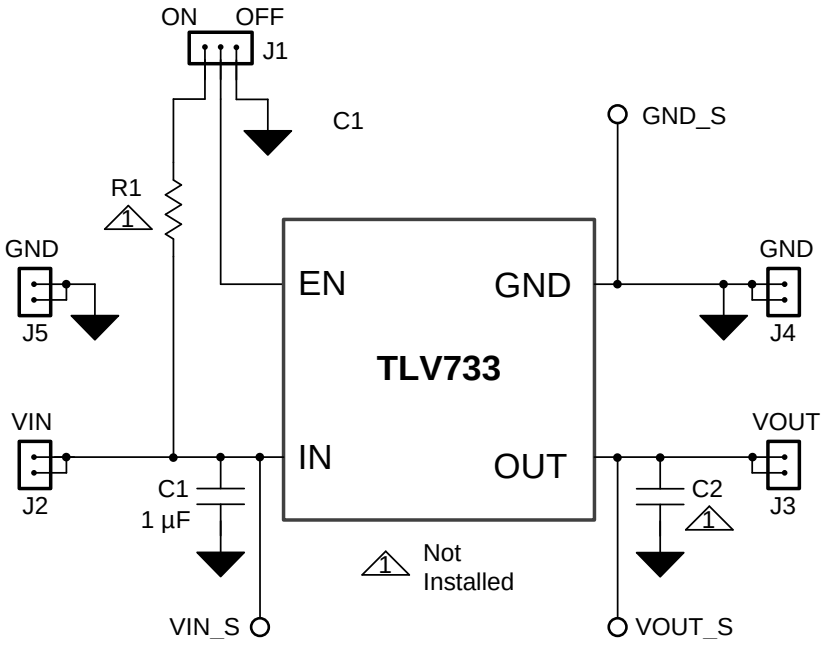

Figure 6. TLV73312PDQN-643 Schematic

9 Bill of Materials

Table 2. TLV73312PDQN-643 Bill of Materials(1)(2)(3)

Qty	Designator	Value	Description	Size	Part Number	Manufacturer
1	C1	1 uF	CAP, CERM, 1uF, 6.3V, +/-20%, X5R, 0402	0402	SC1005X5R0J105M	TDK
0	C2	1 uF	CAP, CERM, 1uF, 6.3V, +/-20%, X5R, 0402	0402	SC1005X5R0J105M	TDK
0	R1	10 kΩ	RES, 10.0k ohm, 1%, 0.063W, 0402	0402	CRCW040210K0FKED	Vishay-Dale
1	J1	3 x 1	Header, TH, 100mil, 3x1, Gold plated, 230 mil above insulator	100 mil.	TSW-103-07-G-S	Samtec
4	J2, J3, J4, J5	2 x 1	Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	100 mil.	TSW-102-07-G-S	Samtec
1	SH-J1	1 x 2	Shunt, 100mil, Gold plated, Black	Shunt	SPC02SYAN	Sullins
1	U1(4)	—	IC, Capacitor-Free, 300-mA, Low-Dropout Regulator with Foldback Current Limit for Portable Devices	1x1 SON	TLV73312PDQN	TI
1	—	—	PCB, 1.0 in x 1.5 in x 0.062 in	1.00 in x 1.50 in x 0.062 in	PWR643	Any

(1) These assemblies are electrostatic-discharge (ESD) sensitive; observe ESD precautions.
(2) These assemblies must be clean and free from flux and all contaminants. Do not use no-clean flux.
(3) These assemblies must comply with workmanship standards IPC-A-610 Class 2.
(4) Cannot be substituted. All other components can be substituted with equivalent manufacturer components.

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      3.1.2 *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

      NOTE: 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.

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NOTE: 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.*

3.2 *Canada*

3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-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.

Concernant les EVMs avec appareils radio:

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.

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.

Concernant les EVMs avec antennes détachables

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. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

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2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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