

TLV70130EVM-077

This user's guide describes operational use of the TLV70130EVM-077 evaluation module (EVM) as a reference design for engineering demonstration and evaluation of the TLV70130, low-dropout (LDO) 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.

Contents

1	Introduction	2		
2	Setup			
	2.1 Input/Output Connectors and Jumper Descriptions	2		
	2.2 Equipment Setup	2		
3	Operation	2		
4	Test Results			
	4.1 Turnon Sequence	3		
	4.2 Output Load Transient	3		
5	Thermal Guidelines and Layout Recommendations	4		
6	Board Layout			
7	Schematic and Bill of Materials	7		
	7.1 Schematic	7		
	7.2 Bill of Materials	8		
	List of Figures			
1	Start-Up Sequence	3		
2	Load Step and Transient Response	4		
3	Top-Layer Silkscreen	6		
4	Top-Layer Routing	6		
5	Bottom-Layer Routing	7		
6	TLV70130EVM-077 Schematic	7		
	List of Tables			
1	Thermal Dissipation Rating	5		
2	TLV70130EVM-077 Bill of Materials	8		



Introduction www.ti.com

1 Introduction

The Texas Instruments TLV70130EVM-077 EVM helps design engineers to evaluate the operation and performance of the TLV701xx family of linear regulators for possible use in their own circuit applications. This particular EVM configuration contains a single linear regulator with internal current limit. The TLV701xx series of LDO regulators exhibit ultralow quiescent current that is virtually constant over the complete range of load and thermal specifications. The TLV701xx series is available in a 3-mm x 3-mm SOT23-5 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 TLV701xx is stable with any capacitor > 0.47 μ F; however, for conservative design practice accounting for widely varying noise environments, and dynamic line/load conditions, a 1- μ F input and output capacitor have 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 TLV70130EVM.

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 J3 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 TLV70130, while eliminating unwanted ringing on the input due to long-wire connections.

2.1.2 J2 - VOUT

J2 is the regulated output voltage connector.

2.1.3 J3 - GND

J3 is the ground-return connector for the input power supply.

2.1.4 J4 – GND

J4 is the output ground-return connector

2.2 Equipment Setup

- Turn off the input power supply after verifying that its output voltage is set to greater than 3.2 V (24 V maximum). Connect the positive voltage lead from the 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 J3 connector of the EVM.
- Connect desired load (≤ 150 mA) between an OUT pin at connector J2 and a GND pin at connector J4.

3 Operation

- Turn on the input power supply. For initial operation, set the input power supply, VIN J1, to 5 V.
- Vary the respective loads and VIN voltages as necessary for test purposes.

4 Test Results

This section provides typical performance waveforms for the TLV70130EVM-077 printed-circuit board (PCB).



www.ti.com Test Results

4.1 Turnon Sequence

Figure 1 shows the turnon characteristic where VIN is switched on to 5 V and the output drives a 100-mA load. The output (C1, red) shows a fairly monotonic rise time of approximately 120 ms.

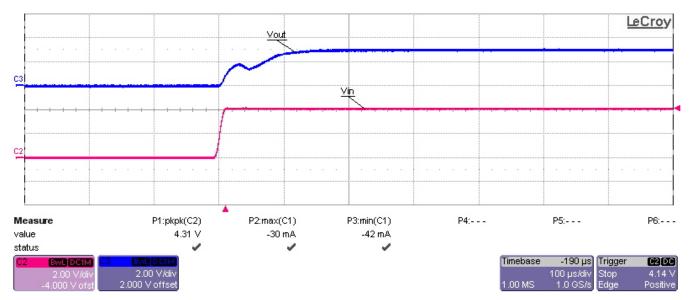


Figure 1. Start-Up Sequence

4.2 Output Load Transient

Figure 2 shows the load transient response (OUT - C1, yellow) for a full-load step transient from 0 mA to 150 mA (C4, green). VIN is set at 5 V.



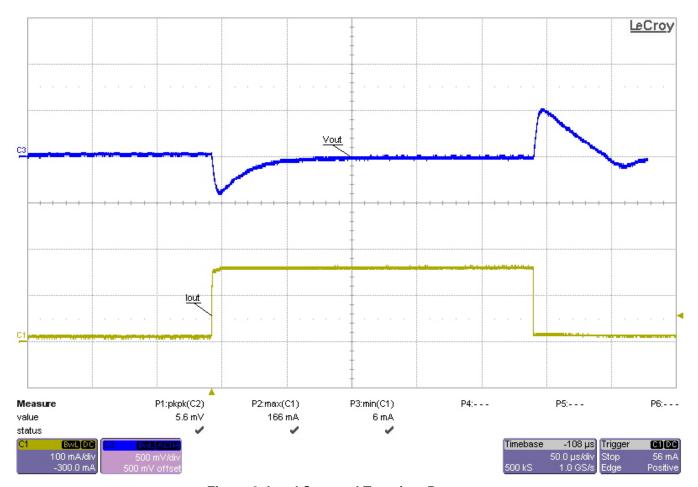


Figure 2. Load Step and Transient Response

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 LDO regulator is high. Use the following formula to approximate the maximum power dissipation for the particular ambient temperature: courtesy

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

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 consider carefully the thermal design of the PCB for optimal performance over temperature. For this EVM, Figure 4 shows the PCB top GND plane has six, 6-mil, thermal via connections to the bottom-side copper GND plane to dissipate heat. The PCB is a two-layer board with 2-oz copper on top and bottom layers. The YFF package drawing can be found at the Texas Instruments Web site in the product folder for the TLV701xx LDO regulator.

Table 1 repeats information from the Dissipation Ratings Table of the TLV701xx data sheet for comparison with the thermal resistance, θ_{JA} , calculated for this EVM layout to show the wide variation in thermal resistances for given copper areas. The High-K value is determined using a standard JEDEC High-K (2s2p) board having dimensions of 3-inch x 3-inch with 1-ounce internal power and ground planes and 2-oz copper traces on top and bottom of the board.



Table 1. Thermal Dissipation Rating

Board	Package	R _{eJA}	T _A ≤ 25°C Power Rating	T _A = 70°C Power Rating	(T _A = 85°C) Power Rating
High-K ⁽¹⁾	DBV	213.1°C/W	470 mW	258 mW	188 mW

⁽¹⁾ The JEDEC High-K (2s2p) board design used to derive this data was 3-inch × 3-inch, multilayer board with 1-ounce internal power and ground planes and 2-ounce copper traces on top and bottom of the board.

The thermal resistance for the TLV70130EVM-077, $R_{\scriptscriptstyle \theta JA}$, is the measured value for this particular layout scheme. The actual allowable power dissipation on your PCB is a strong function of your layout.



Board Layout www.ti.com

6 Board Layout

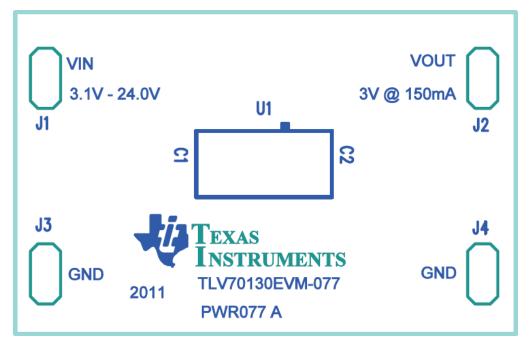


Figure 3. Top-Layer Silkscreen

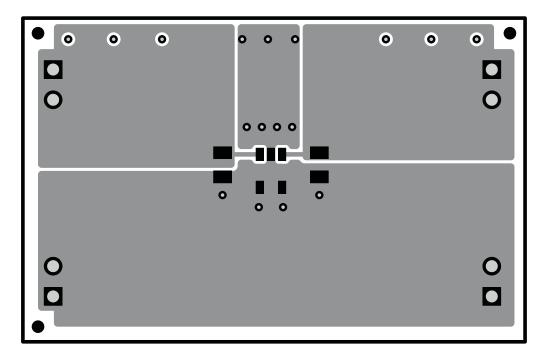


Figure 4. Top-Layer Routing



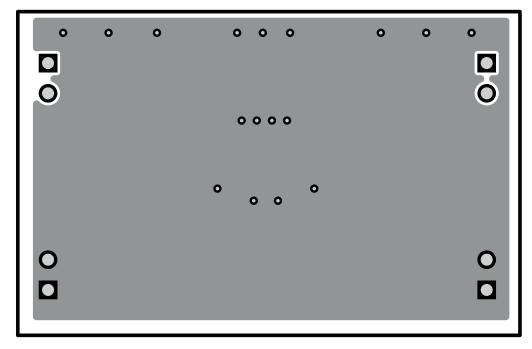


Figure 5. Bottom-Layer Routing

7 Schematic and Bill of Materials

7.1 Schematic

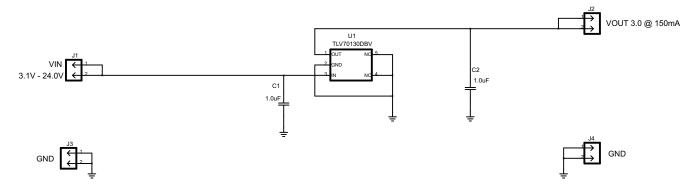


Figure 6. TLV70130EVM-077 Schematic



7.2 Bill of Materials

Table 2. TLV70130EVM-077 Bill of Materials

Count	RefDes	Value	Description	Size	Part Number	MFR
1	C1	1.0uF	Capacitor, Ceramic, 35V, X7R, 10%	0805	STD	STD
1	C2	1.0uF	Capacitor, Ceramic, 10V, X7R, 10%	0805	STD	STD
4	J1-4	PEC02SAAN	Header, 2-pin, 100mil spacing	0.100 in x 2	PEC02SAAN	Sullins
1	U1	TLV71730DBV	IC, 24-V Input Voltage, 150-mA, Ultralow IQ Low-Dropout Regulators	SOT-23	TLV71730DBV	TI
1	_		PCB, 1.660 ln x 1.070 ln x 0.062 ln		PWR077	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 -3.1 V to 24 V and the output voltage range of 3 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.

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
----------	--------------

Audio www.ti.com/audio Communications and Telecom www.ti.com/communications **Amplifiers** amplifier.ti.com Computers and Peripherals www.ti.com/computers dataconverter.ti.com Consumer Electronics www.ti.com/consumer-apps **Data Converters DLP® Products** www.dlp.com **Energy and Lighting** www.ti.com/energy DSP dsp.ti.com Industrial www.ti.com/industrial Clocks and Timers www.ti.com/clocks Medical www.ti.com/medical Interface interface.ti.com Security www.ti.com/security

Logic logic.ti.com Space, Avionics and Defense www.ti.com/space-avionics-defense

Power Mgmt power.ti.com Transportation and Automotive www.ti.com/automotive
Microcontrollers microcontroller.ti.com Video and Imaging www.ti.com/video

RFID <u>www.ti-rfid.com</u>
OMAP Mobile Processors www.ti.com/omap

Wireless Connectivity <u>www.ti.com/wirelessconnectivity</u>

TI E2E Community Home Page <u>e2e.ti.com</u>