TPS7A8101EVM Evaluation Module

This user's guide describes the characteristics, operation, and use of the TPS7A8101EVM. This evaluation module (EVM) demonstrates the Texas Instruments TPS7A8101 low-dropout (LDO) linear regulator in a 3-mm x 3-mm, SON-8 package, which is capable of a 1-A 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 evaluation module.

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1 Introduction

The TPS7A8101EVM evaluation module helps designers evaluate the operation and performance of the TPS7A8101 adjustable-output LDO. Because the TPS7A8101 is adjustable, the EVM has been designed to provide several common output voltages which can be selected using an onboard jumper. The EVM can provide output voltages of 1.8 V, 2.5 V, 2.8 V or 3.3 V using the jumper. Other output voltages can be evaluated but require changing the feedback resistors.

2 Setup

This section describes the jumpers and connectors on the EVM as well as how to properly connect, set up, and use the TPS7A8101EVM.

2.1 Input/Output Connector Descriptions

2.1.1 J1 – VIN

This is the positive input supply voltage. The connector for J1 is not populated on the TPS7A8101EVM. This footprint allows the mounting of an SMA-style connector for more accurate PSRR measurements. See the bill of materials (BOM) for the manufacturer and part number of the corresponding connector.

2.1.2 J2 – VOUT

This is the output voltage. The connector for J2 is not populated on the TPS7A8101EVM. This footprint allows the mounting of an SMA-style connector for more accurate PSRR measurements. See the BOM for the manufacturer and part number of the corresponding connector.

2.1.3 J3 – VIN

This is the positive connection to the input power supply. The power supply must be connected between J1 and J8 (GND). Twist the leads to the input supply, and keep them as short as possible. The input voltage must be between 2.2 V and 6.5 V.

2.1.4 J4 – VOUT

This is the positive output voltage of the LDO. The output voltage of the TPS7A8101 is adjustable with feedback resistors. On the EVM, the output voltage is set using J6.

2.1.5 J5 – ENABLE

This jumper is used to enable or disable the output of the TPS7A8101. Placing a shorting jumper between pins 1 and 2 (*ON* position) enables the TPS7A8101. Placing the shorting jumper between pins 2 and 3 (*OFF* position) disables the TPS7A8101.

2.1.6 J6 – Output Voltage Select

This jumper is used to set the desired output voltage from the TPS7A8101. Placing a shorting jumper between the appropriate pins gives the corresponding outputs. The output voltage of the TPS7A8101EVM must only be changed when the TPS7A8101EVM is not powered. Installing and removing the jumper with the board powered can lead to undesired or unregulated output voltage

Short Pins	VOUT (V)
1 and 2	3.3
3 and 4	2.8
5 and 6	2.5
7 and 8	1.8

2.1.7 J7 and J8 – GND

This is the return connection to the input power supply. Connect the power supply between J7 or J8 and J3 (VIN). Twist the leads to the input supply, and keep them as short as possible. The input voltage must be between 2.2 V and 6.5 V.

3 TPS7A8101 Device Operation

This section provides information about the operation of the TPS7A8101EVM.

3.1 Test Procedure

Ensure that the input power supply is off. Connect the positive input power supply to J3. Connect the input power return (ground) to J7. The TPS7A8101 has an absolute maximum input voltage of 7 V. The recommended maximum operating voltage is 6.5 V. The actual highest input voltage may be less than 6.5 V due to thermal conditions. See the Thermal Considerations Section 4 of this manual to determine the highest input voltage.

Connect the desired load between J4 (positive lead) and J8 (negative or return lead). Configure jumper J6 for the desired output voltage. Turn on the input power supply.

3.2 Test Data

Figure 1 through Figure 5 present typical performance curves for the TPS62060EVM. Actual performance data can be affected by measurement techniques and environmental variables; therefore, these curves are presented for reference and may differ from actual results obtained by some users.

3.2.1 PSRR

Figure 1 and Figure 2 show the typical PSRR performance for the TPS7A8101EVM.

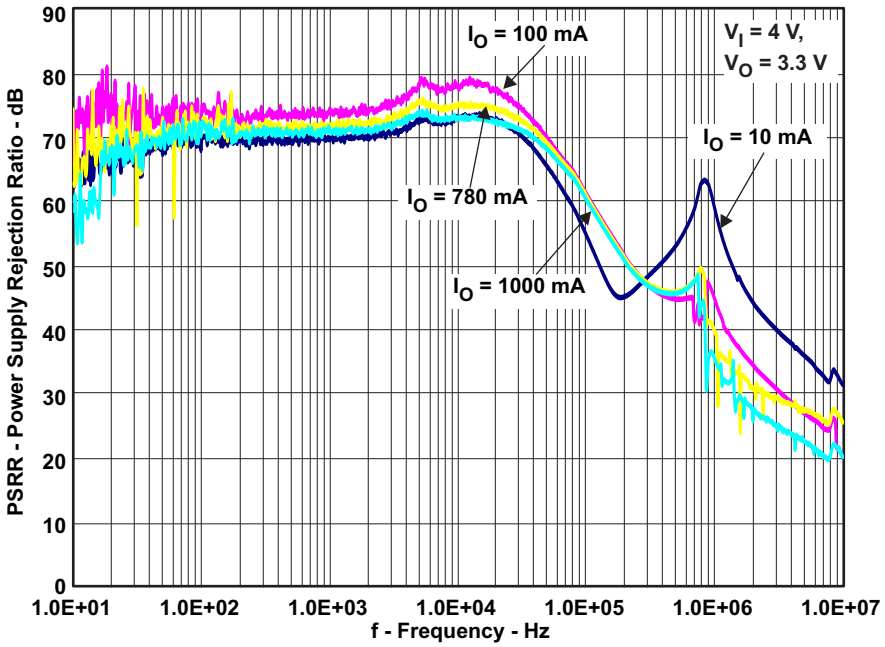

Figure 1. TPS7A8101 PSRR for Variable Output Currents, VDO=0.7 V

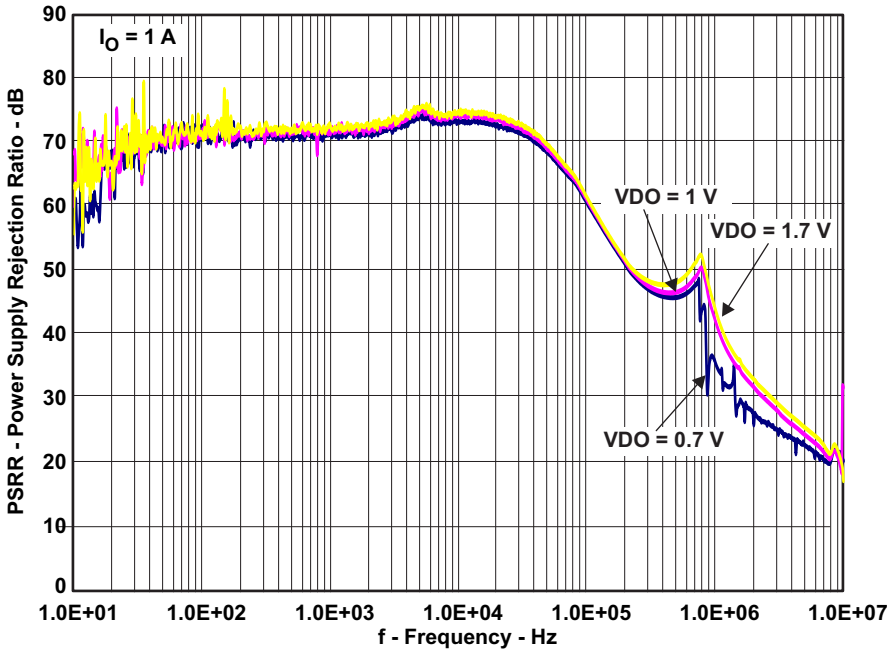

Figure 2. TPS7A8101 PSRR for Variable Dropout Voltage, Iout=1 A

3.2.2 Start-up

Figure 3 shows the typical start-up performance for the TPS7A8101EVM.

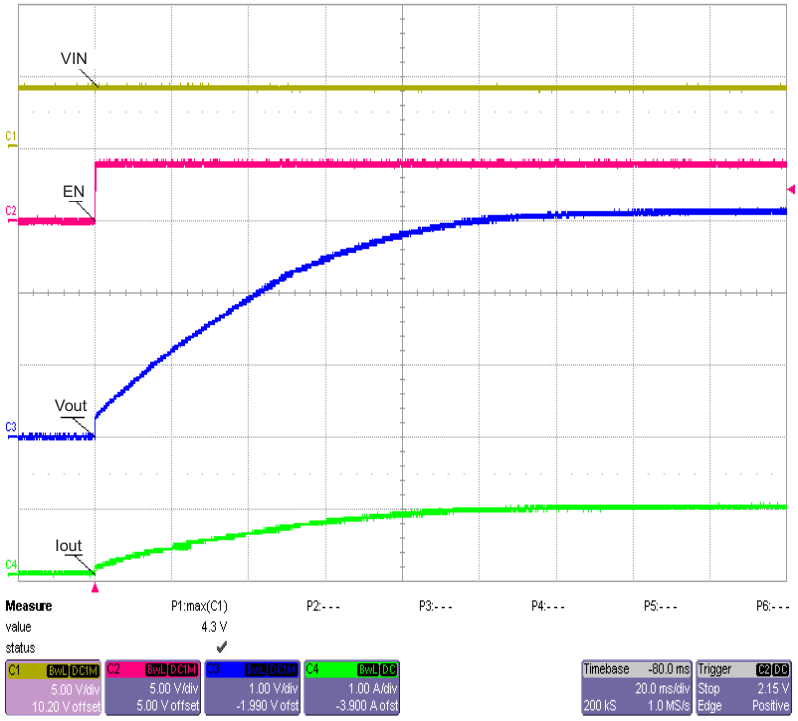

Figure 3. TPS7A8101 Start-Up Into Full Load, 1 A

3.2.3 Shutdown

Figure 4 shows the typical shutdown performance for the TPS7A8101EVM.

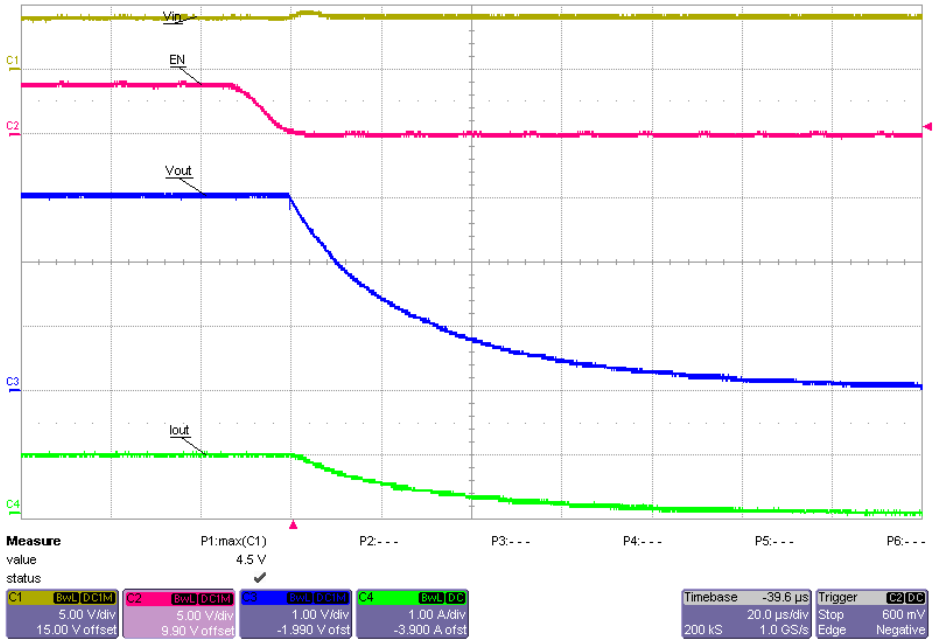

Figure 4. TPS7A8101 Shutdown with 3.3-Ω Load

3.2.4 Transient Performance

Figure 5 shows the load transient response of the TPS7A8101EVM.

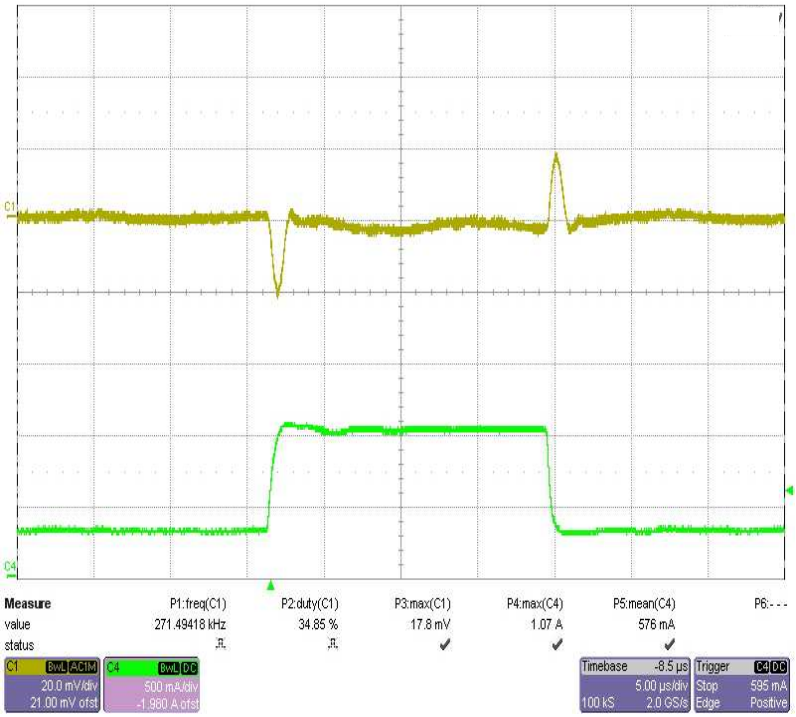

Figure 5. TPS7A8101 Transient Response

4 Thermal Guidelines

This section provides guidelines for the thermal management of the TPS7A81xxDRBEVM board.

4.1 Thermal Considerations

Thermal management is a key design component of any power converter and is especially important when the power dissipation in the LDO is high. To better help you design the TPS7A81xxDRB family into your application, use Equation 1 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 integrated circuit (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 TPS7A8101EVM has a typical value of 45.7°C/W. The recommended maximum operating junction temperature specified in the data sheet for the TPS7A8101 is 125°C. With this information, the maximum power dissipation can be found by using Equation 1.

Table 1 shows the maximum input voltage that can be applied to the input of the TPS7A8101EVM and still provide the full 1 A of output current. Table 1 shows the input voltage versus the output voltage setting and two ambient temperatures (25°C and 85°C). The maximum input voltage shown provides the rated output current while keeping the junction temperature at or below the recommended 125°C.

Table 1. Maximum Input Voltage vs Ambient Temperature and Output Voltage

		Selected Output Voltage (V)			
Ambient Temp	**Iout (A)**	**1.8**	**2.5**	**2.8**	**3.3**
25	1.00	3.98	4.68	4.98	5.48

Table 1. Maximum Input Voltage vs Ambient Temperature and Output Voltage (continued)

		Selected Output Voltage (V)			
Ambient Temp	**Iout (A)**	**1.8**	**2.5**	**2.8**	**3.3**
85	1.00	2.67	3.37	3.67	4.17

5 Board Layout

5.1 Layout

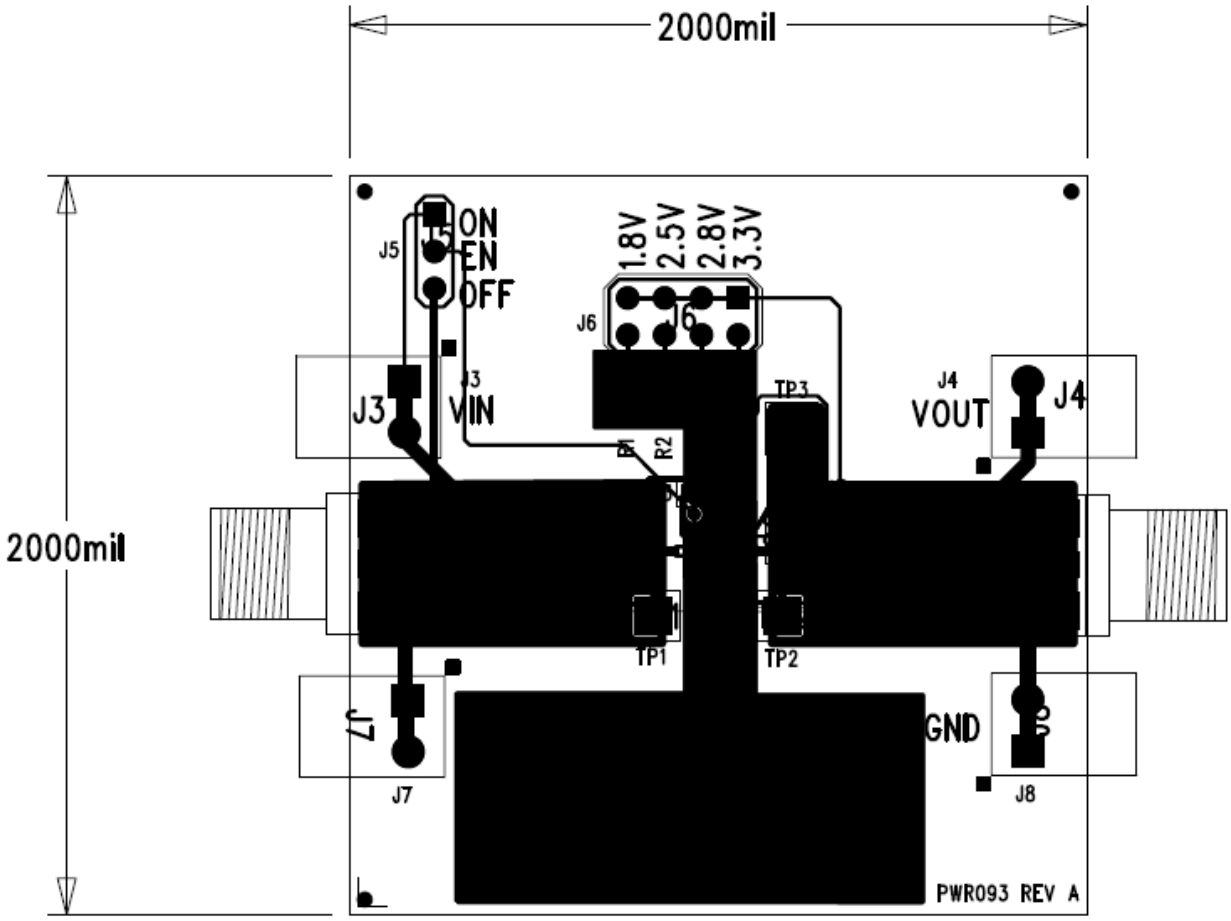

Figure 6. Top Layer Assembly

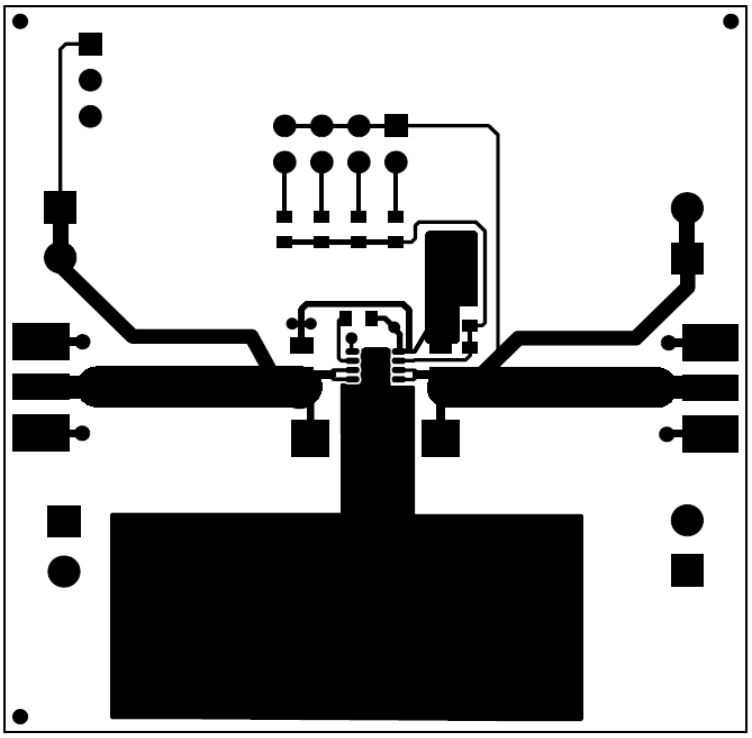

Figure 7. Top Layer Routing

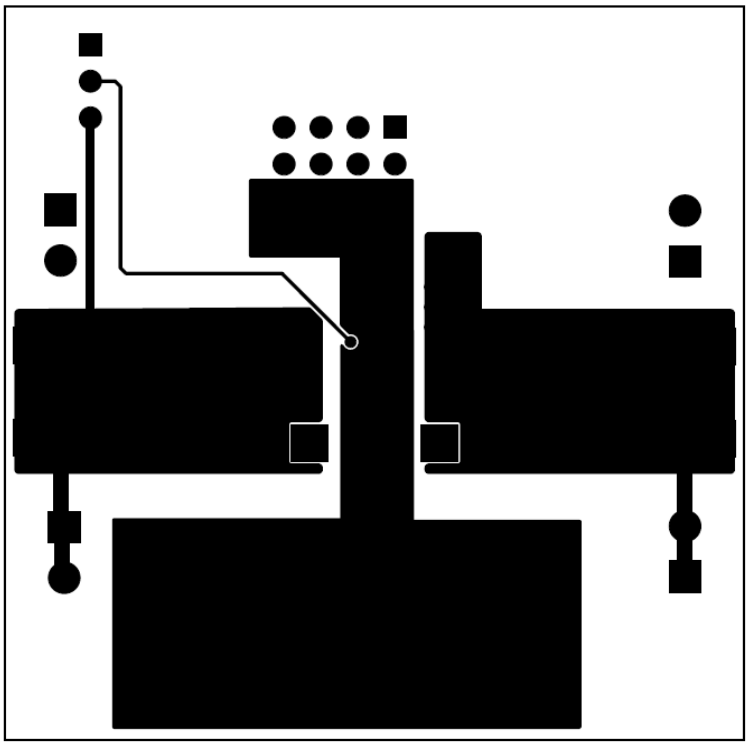

Figure 8. Bottom Layer Routing

6 Schematic and Bill of Materials

This section provides the TPS7A8101EVM board schematic and BOM.

6.1 Schematic

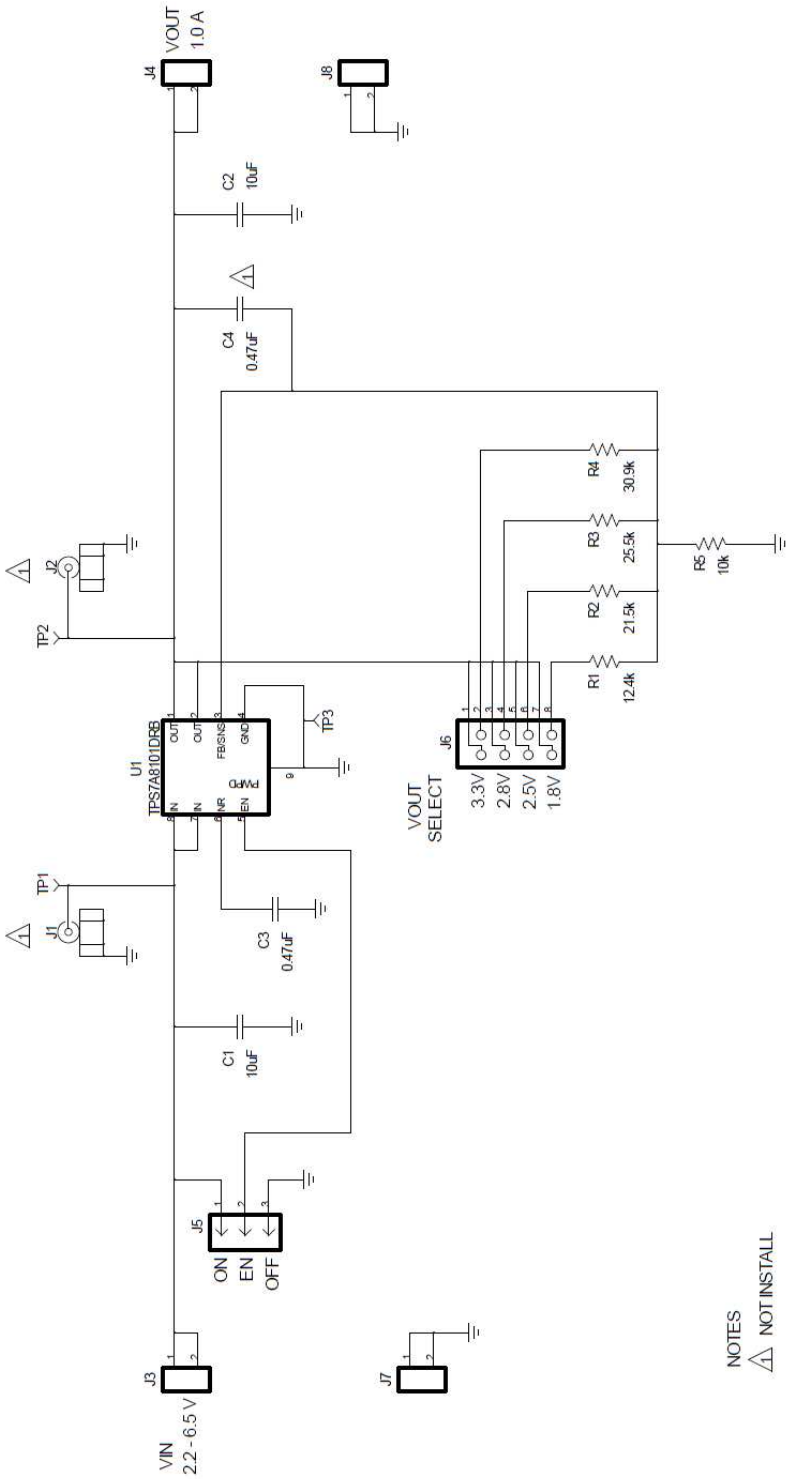

Figure 9. TPS7A8101EVM Schematic

6.2 Bill of Materials

Table 2. Bill of Materials

Count	RefDes	Value	Description	Size	Part No.	MFR
2	C1, C2	10µF	Capacitor, Ceramic, 10V, X7R, 10%	0805	Std	Std
2	C3, C4	0.47µF	Capacitor, Ceramic, 16V, X7R, 10%	0603	Std	Std
0	J1, J2	142-0711-821	CONNECTOR, SHIELDED, END LAUNCH JACK, GOLD PLATED, FOR 0.062 PCB, EDGE MOUNTED	0.250 SQ	142-0711-821	STD
4	J3, J4, J7, J8	ED550/2DS	Terminal Block, RA 2-pin, 6-A, 3.5mm	7.0 x 8.2 mm	ED550/2DS	OST
1	J5	PEC03SAAN	Header, Male 3-pin, 100mil spacing	0.100 inch x 3	PEC03SAAN	Sullins
1	J6	PEC04DAAN	Header, Male 2x4-pin, 100mil spacing	0.20 x 0.40 inch	PEC04DAAN	Sullins
1	R1	12.4k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R2	21.5k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R3	25.5k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R4	30.9k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R5	10k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	TP1	5010	Test Point, Red, Thru Hole	0.125 x 0.125 inch	5010	Keystone
1	TP2	5013	Test Point, Orange, Thru Hole	0.125 x 0.125 inch	5013	Keystone
1	TP3	5011	Test Point, Black, Thru Hole	0.125 x 0.125 inch	5011	Keystone
1	U1	TPS7A8101DRB	IC, Low Noise, High-Bandwidth PSRR LDO 1A Linear Regulator	DRB-8	TPS7A8101DRB	TI
1	–		PCB, 2 In x 2 In x 0.62 In		PWR093	Any
2		15-29-1025	Shunt, 2 pos 0.100 In Gold		15-29-1025	Molex

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.

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EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of 2.2 V to 6.5 V and the output voltage range of 0.8 V to 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.

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For EVMs **not** subject to the above rules, this evaluation board/kit/module 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 or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment 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.

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.

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

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.

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.

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.

【Important Notice for Users of this Product in Japan】

This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
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
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

Texas Instruments Japan Limited
(address) 24-1, Nishi-Shinjuku 6 chome, Shinjuku-ku, Tokyo, Japan

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For Feasibility Evaluation Only, in Laboratory/Development Environments. Unless otherwise indicated, this EVM is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. It should not be used as all or part of a finished end product.

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1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard.
3. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

Certain Instructions. It is important to operate this EVM within TI's recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. 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 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

Agreement to Defend, Indemnify and Hold Harmless. You agree to defend, indemnify and hold TI, its licensors and their representatives harmless from and against any and all claims, damages, losses, expenses, costs and liabilities (collectively, "Claims") arising out of or in connection with any use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

Safety-Critical or Life-Critical Applications. If you intend to evaluate the components for possible 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, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

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