TPS7A8300EVM-209 Evaluation Module

This user's guide describes the operational use of the TPS7A8300EVM-209 Evaluation Module (EVM) as a reference design for engineering demonstration and evaluation of the TPS7A8300, low dropout linear regulator (LDO). Included in this user's guide are setup instructions, a schematic diagram, layout, thermal guidelines, and bill of materials (BOM).

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1 Introduction

The Texas Instruments TPS7A8300EVM-209 EVM helps design engineers to evaluate the operation and performance of the TPS7A8300 family of linear regulators for possible use in their own circuit application. This particular EVM configuration contains a single linear regulator for high-speed communication systems. The regulator is capable of delivering up to 2 A to the load, depending on the input-output power dissipation across the part which can be minimized because of the low dropout voltage. The output capacitor for the TPS7A8300 must be 10 µF (effective minimum) for stability.

2 Setup

This section describes the jumpers and connectors on the EVM as well as how to properly connect, setup, and use the TPS7A8300EVM-209.

2.1 Input/Output Connectors and Jumper Descriptions

2.1.1 J1 – VIN

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 six inches. For example, an additional 47-µF electrolytic capacitor connected from J1 to ground can improve the transient response of the TPS7A8300 while eliminating unwanted ringing on the input due to long wire connections.

2.1.2 J2 – GND

Return connector for the input power supply.

2.1.3 J3 – VOUT

Regulated output voltage connector.

2.1.4 J4 – GND

Output ground return connector.

2.1.5 J5 – Input Connector

For output currents greater than 1 A, it is advisable to use a higher current rated connector. Pin1 connects to the input power supply. Pin 2 connects to the return connector for the input power supply.

2.1.6 J6 – Output Connector

For output currents greater than 1 A, it is advisable to use a higher current rated connector. Pin1 connects to the input power supply. Pin 2 connects to the return connector for the input power supply.

2.1.7 JP1 – EN

Output enable. To enable the output, connect a jumper to short the VIN pin 1 or VBIAS pin 3 to the EN center pin 2. To disable the output, leave JP1 floating. EN is pulled down to GND through resistor R5 when JP1 is not connected.

2.1.8 JP2 – AnyOut

The output voltage of the TPS7A8300 is selectable in accordance with the names given to the output voltage setting pins: 50 mV, 100 mV, 200 mV, 400 mV, 800 mV, and 1.6 V. For each pin connected to the ground, the output voltage setting increases by the value associated with that pin name, starting from the value of the reference voltage of 0.8 V; floating the pin(s) has no effect on the output voltage.

2.2 Soldering Guidelines

Any solder re-work to modify the EVM for the purpose of repair or other application reasons must be performed using a hot-air system to avoid damaging the integrated circuit (IC).

2.3 Equipment Interconnect

- Set the input and bias power supply to 6.5 V(max). Turn the power supply off. 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- to 2-A load between OUT and GND. The connector used depends on the desired output current.
- Disable the output by floating JP1.

3 Operation

- Turn on the power supplies.
- Enable the output by jumping JP1, the EN pin, to VIN or VBIAS.
- Vary the respective load and input voltage as necessary for test purposes.

4 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 is high. Use the following formulas to approximate the maximum power dissipation for the particular ambient temperature:

$$T_J = T_A + P_D \times \theta_{JA} \quad (1)$$

$$P_D = (V_{IN} - V_{OUT1}) \times I_{OUT1} + (V_{IN} - V_{OUT2}) \times I_{OUT2} \quad (2)$$

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 be allowed to exceed 125°C. The layout design must be copper trace and plane areas smartly, 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.

Table 1 repeats information from the Dissipation Ratings Table of the TLV7163318 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 loads 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 Dissipation (T_A = 25°C)	Max Dissipation @2A (T_A = 70°C)
TPS7A8300	High-K	RGW	35.7°C/W	2.80 W	1.54 W

5 Board Layout

Figure 1 to Figure 3 illustrate the PCB layout for this EVM.

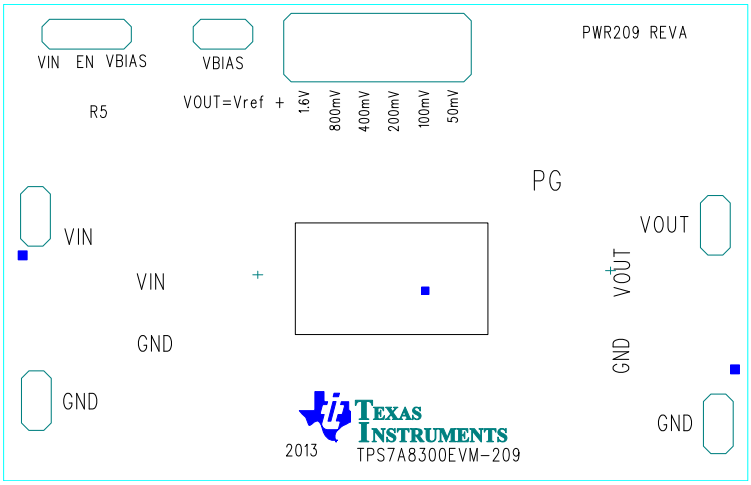

Figure 1. Assembly Layer

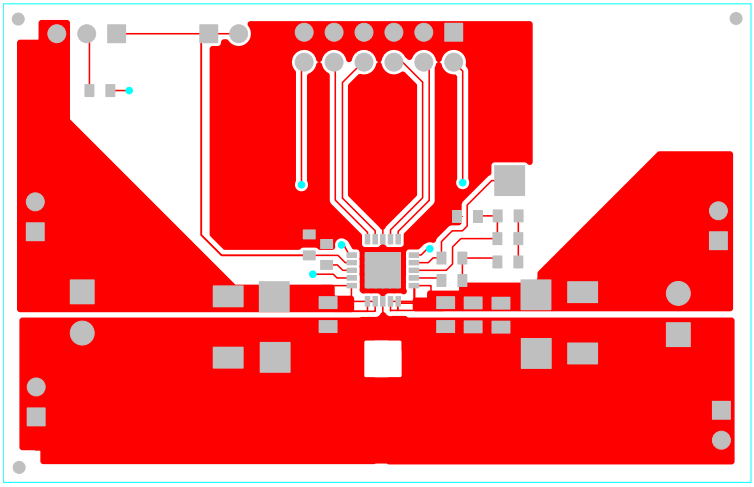

Figure 2. Top Layer Routing

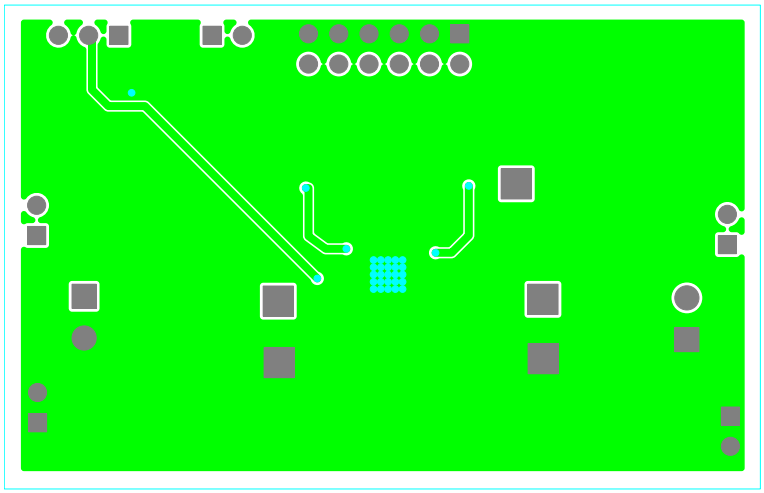

Figure 3. Bottom Layer Routing

6 Schematic

Figure 4 is the schematic for this EVM.

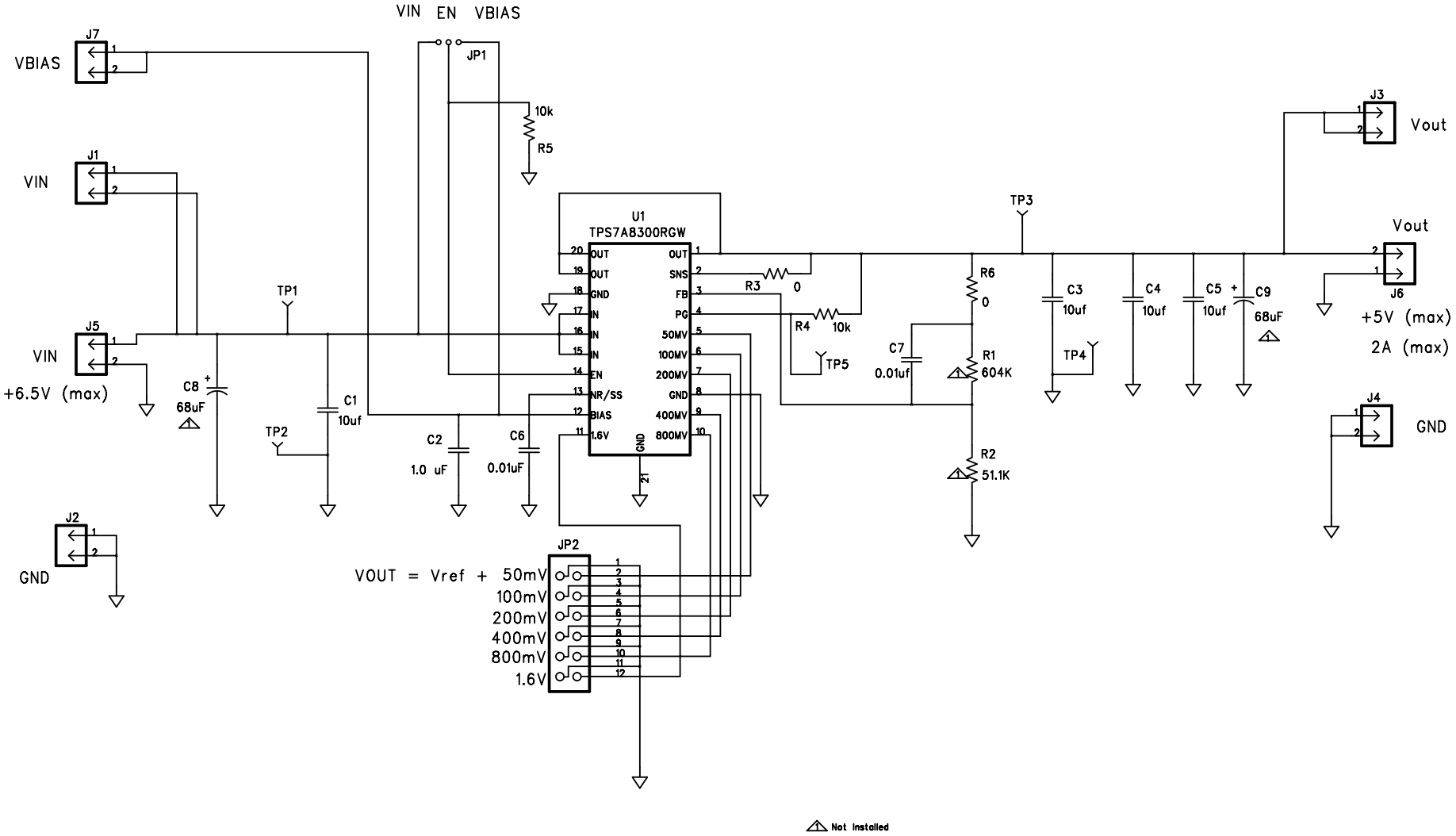

Figure 4. TPS7A8300EVM-209 Schematic

7 Bill of Material

The BOM for this EVM is shown in Table 2

Table 2. Table 2. TPS7A8300EVM-209 BOM

RefDes	Value	Description	Size	Part Number	MFR
C6, C7	0.01uF	Capacitor, Ceramic Chip, 50V, ±10%, X7R	603	GRM188R71H103KA01D	Murata
C2	1.0 uF	Capacitor, Ceramic, Low Inductance, 16V,X7R,10%	603	GRM188R71C105KA12D	Murata
C1, C3, C4, C5	10uf	Capacitor, Ceramic, 16V, [X5R], [10%l]	805	GRM21BR61C106KE15L	Murata
C8, C9	68uF	Capacitor, Tantalum 16V,	6032	TPSC686K016R0200	AVX
J5,J6	ED555/2DS	Connector, Male 2 Pole 3.5 mm, 6A, 150V	6.5x6.5 mm	ED555/2DS	On Shore Tech
J1, J2, J3, J4, J7	PEC02SAAN	Header, Male 2-pin, 100mil spacing, (36-pin strip)	0.100 inch x 2	PECO2SAAN	Sullins
JP2	PEC06DAAN	Header, Male 2x6 pin, 100mil spacing	0.100 inch x 2X6	PEC06DAAN	Sullins
JP1	PEC03SAAN	Header, Male 3-pin, 100mil spacing,	0.100 inch x 3	PEC03SAAN	Sullins
R3, R6	0	Resistor, Chip, 1/10W, 1%	603	CRCW06030000Z0EA	Vishay
R4, R5	10k	Resistor, Chip, 1/10W, 1%	603	CRCW060310K0FKEA	Vishay
R2	51.1K	Resistor, Chip, 1/10W, 1%	603	CRCW060351K1FKEA	STD
R1	604K	Resistor, Chip, 1/10W, 1%	603	CRCW0603604KFKEA	STD
TP1. TP2, TP3, TP4, TP5	5010	Test Point, Red, Thru Hole	0.125 x 0.125 inch	5010	Keystone
U1	TPS7A8300RGW	IC, 2 A, LDO Voltage Regulator for High Speed Communication Systems	QFN-20	TPS7A8300RGW	TI
--		PCB, 2.5 In x 1.6 In x 0.062 In		PWR209A	Any
JP1, JP2		Shunt, Black	100-mil	929950-00	3M
1. These assemblies are ESD sensitive, observe ESD precautions.					
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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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.

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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.

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