TPS7A7x00EVM-718 Evaluation Module

This user's guide describes the functional operation of theTPS7A7200EVM-718 evaluation module (EVM) for use as a reference design and as general engineering demonstration for the TPS7A7100, TPS7A7200, and TPS7A7300 low-dropout (LDO) linear regulators. EVMs containing these other regulator integrated circuits of the same family, and using the same printed-circuit board and circuitry are available and orderable. 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

Each of Texas Instruments EVMs, the TPS7A7100EVM-718, the TPS7A7200EVM-718, and the TPS7A7300EVM-718, is designed with identical circuitry, excluding the LDO regulator itself, to help engineers evaluate the operation and performance of the TPS7A7x00 linear regulator for possible use in their own circuit application. Notable features of these LDO regulators include thermal and current- limit shutdown protection, a Power Good function, pin-selectable output voltage, low dropout, and wideband performance. The EVM contains a single linear regulator in a 5-mm x 5-mm, QFN (RGW), thermally enhanced, PowerPad™ package. This regulator, including external components, is capable of delivering up to 3 A (depending on the LDO regulator) to a dynamic load across the full recommended input and output voltage range of the LDO regulator. A multipin header with jumpers is provided to enable easy manual selection of the output voltage.

2 Setup

This section describes the connectors and headers on the EVM as well as how to properly connect, set up and use the TPS7A7x00EVM-718. See the Assembly Layer diagram, Figure 4, for the location and orientation of referenced components.

2.1 Input/Output Connector-Headers and Jumper Descriptions

- **J1-VIN** – Positive (+) input power supply voltage test and measurement header.
- **J2 – VOUT** – Output voltage test and measurement header.
- **J3 (pin 1) – VOUT** – Regulator output to a high-current load (up to 6 A).
- **J3 (pin 2) – GND** – Ground return from the load (up to 6 A)
- **J4 (pin 1) – VIN** – Positive (+) input power supply connector.

NOTE: Twist the positive input lead and ground return lead from the input power supply, and keep them as short as possible to minimize EMI and source inductance. Additional bulk capacitance, 68 µF at C5, was added to the EVM to counter source inductances that may cause ringing on the load transient waveform during high-current transients. This bulk capacitance is unnecessary in a typical application circuit.

- **J4 (pin 2) – GND** – Negative (–) input power supply return connector. See preceding J4 –VIN (pin 1) note.
- **J5** - Header for setting the output voltage.

  Output Voltage Set: The output voltage is set by jumpering J5 header pins, each assigned to a given voltage level, to ground where VOUT = Vref + (sum of jumper-voltages). J5 header pins are numbered sequentially, *odd* pins (1,3,5, …, 13) ascending leftward of pin 1 on the top row. All odd pins are connected to ground. Each *even* pin is numbered right to left sequentially (2,4,6,…,14) on the bottom row; and each even pin is assigned a unique voltage level. See the pin-to-pin output voltage assignments in the following table.

VOUT = Vref + (Sum of Voltage Levels)		
Voltage Level	**Voltage Set Pins**	**Ground Pins**
50 mV	2	1
100 mV	4	3
200 mV	6	5
400 mV	8	7
800 mV	10	9
1.6 V	12	11
unused	14	13

  Example: Set VOUT to 1.8 V. Connect shorting jumper from pins 10 to 9, 8 to 7, and 4 to 3. VOUT = Vref + 800 mV + 400 mV + 100 mV = 1.8 V
- **J6 – GND** – Ground header for test and measurement of VIN.
- **J7 – GND** – Ground header for test and measurement of VOUT.
- **JP1 – EN** – Enable (Disable) header. Enable the LDO output by shorting EN (pin 2) to ON (pin 1). Disable the LDO output by shorting EN (pin 2) to OFF (pin 3).
- **TP1** – Power Good (PG) test point.
- **TP4** – VIN test point for most accurate measurement of the input voltage characteristics.
- **TP2** – Ground test point to be used with TP4.
- **TP5** – VOUT test point for most accurate measurement of the output voltage.
- **TP3** – Ground test point to be used with TP5.

2.2 Soldering Guidelines

Any solder rework 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 especially.

2.3 Initial Setup and Equipment Interconnect

- VOUT Select. Program the desired output voltage per instruction 2.1, bullet J5. Use the shorting jumpers provided with the EVM to jumper the header pins. Note that the EVM is preset for VOUT equal to 1.8 V. The jumper across J5 pins 13 to 14 is no-connect and unused.
- Disable the EVM. Add a shorting jumper to JP1 from EN (pin 2) to OFF (pin3)
- Input Power Supply connection. Before connecting the input power supply to the EVM, verify that its output voltage is set to the desired supply voltage (less than 6.5 V) and that its current limit is set to approximately 4 A. Now turn off the power supply. Connect the positive voltage lead (+) from input power supply to VIN (J4, pin 1) of the EVM. Connect the ground lead (–) from the input power supply to GND (J4, pin 2). Note that for the recommended best thermal and ac performance, ensure that the input voltage at TP4 is 0.5 V to 1 V above VOUT.
- Connect a 0-A to 2-A load between VOUT (J3, pin 1) and GND (J3, pin 2).

3 Operation

- Turn on the input power supply. Verify that the output voltage, VOUT, is near 0 V.
- Enable the output by reconnecting the jumper on JP1 to short the EN (pin 2) to the ON (pin 1).
- Vary the load current and VIN voltage as necessary for test purposes.

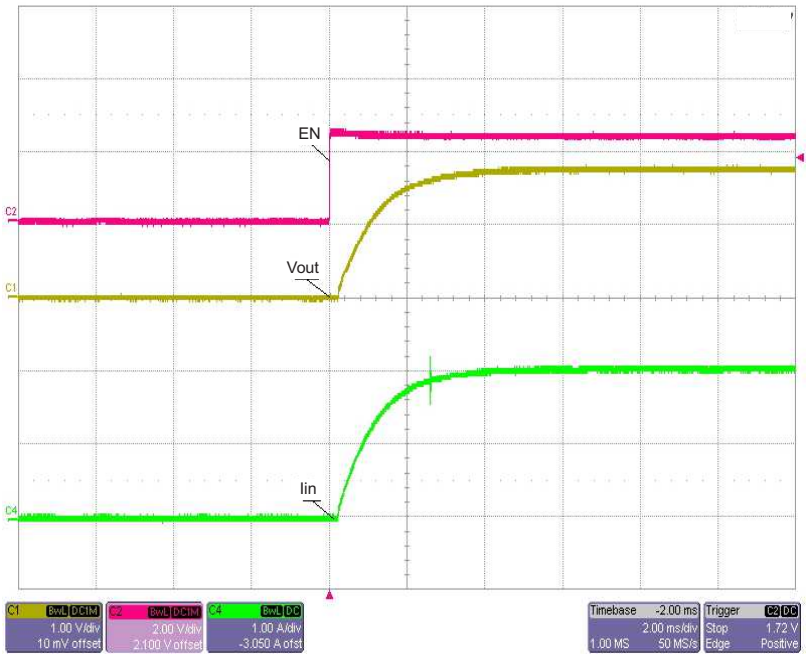
  Note that power dissipation (P_{disp}) across the TPS7A7X00 itself depends on the VIN-to-VOUT voltage drop and the output load current, I_{Load} (P_{disp} = (VIN – VOUT)×I_{Load}). If the power dissipation is high, then the customer may see the output voltage transitioning on-off-on due to the shutdown effect of the thermal-limit shutdown circuit.

4 Test Results

This section provides typical performance waveforms for the TPS7A4001EVM-709 characteristic of this EVM design.

4.1 Turnon Characteristic

Figure 1 shows the VOUT ramp-up waveform at turnon (ENable) as well as the input surge current into the IN pin of the LDO itself when the LDO starts up into a fully loaded output.

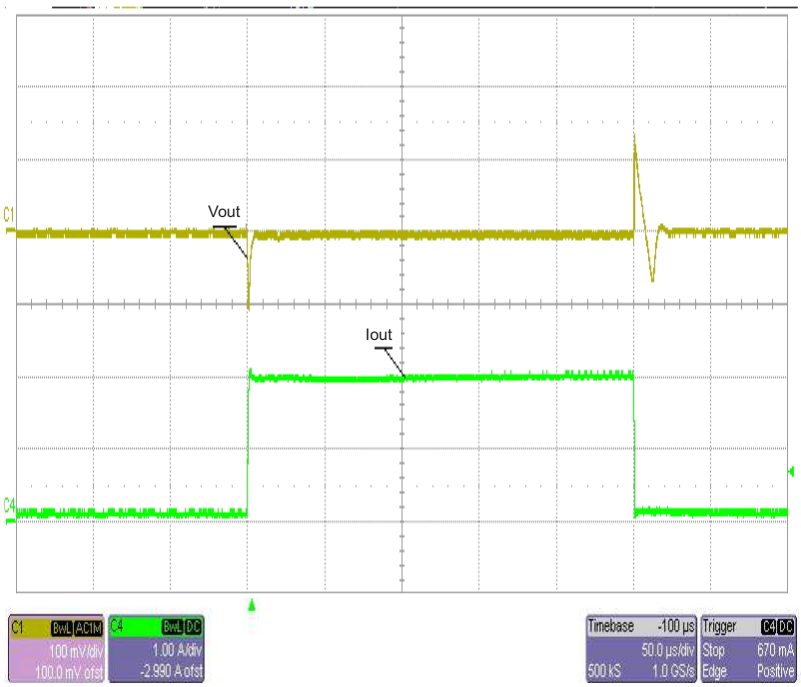


NOTE: C1 (yellow) VOUT - Turnon Ramp to 1.8V, C2 (red) I_{IN} – Surge Current for a Fully Loaded output.

Figure 1. Turnon Sequence

4.2 Output Load Transient

Figure 2 shows the VOUT transient response (C1, yellow) for a load-step transition from 100 mA to 2 A (C4, green).



NOTE: C4 – Load Current Step (100mA – 2.A), C1 VOUT – Output voltage transient response.

Figure 2. Step-Load and Output Voltage Transient Response

5 Thermal Guidelines and Layout Recommendations

Thermal management is a key consideration in the design of any dc-dc converter but is especially important for an LDO regulator when the power dissipation is high. Use Equation 1 to approximate the worst-case junction temperature for the application:

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

where T_J is the junction temperature (°C), TA is the ambient temperature (°C), P_d is the power dissipation in the device (W), and θ_{JA} is the thermal resistance from junction to ambient (°C/W). The maximum silicon junction temperature must not be allowed to exceed 125°C for reliable operation. The layout design must use copper trace and plane areas smartly, as thermal sinks, so as to not allow T_J to exceed the absolute maximum rating under all load, voltage, and temperature conditions for a given application.

The designer must carefully consider the thermal design of the printed-circuit board (PCB) for optimal performance over temperature. For this EVM, Figure 6 shows that the RGW package footprint employs a square thermal pad, centered under the device, for conducting heat to the copper-spreading layers of the PCB. The thermal pad is soldered directly to a pad on the PCB containing a 5x5 pattern of 10-mil vias for conducting heat to the bottom-side ground plane copper. Approximately 4 in^2 of 2-oz copper is used on the bottom side of the EVM for dissipating heat generated by the LDO regulator.

Table 1 is based on thermal resistance information from the Thermal Information Table of the TPS7A7x00 data sheet for comparison with the approximate thermal resistance, θ_{JA}, calculated for this EVM layout to show the variation in junction-ambient thermal resistances for varying copper areas. The High-K thermal resistance, θ_{JA}, is determined using a standard JEDEC High-K (2s2p) board having dimensions of 3-inch x 3-inch with two 1-oz internal power and ground planes and one 2-oz copper bottom plane for spreading/sinking heat from the IC component.

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

Board	Package	Θ_{JA}	Maximum Dissipation Without Derating (T_A = 25°C)	Max Dissipation Without Derating (T_A = 70°C)
High-K	RGW	30.5°C/W	3.27 W	1.8 W
TPS7A7X00EVM-718	RGW	24°C/W	4 W	2.3 W

The thermal resistance for the TPS7A7A00EVM-718 is the measured value for this particular layout scheme. The maximum power dissipation is proportional to the volume of copper volume connected to the package.

6 Board Layouts

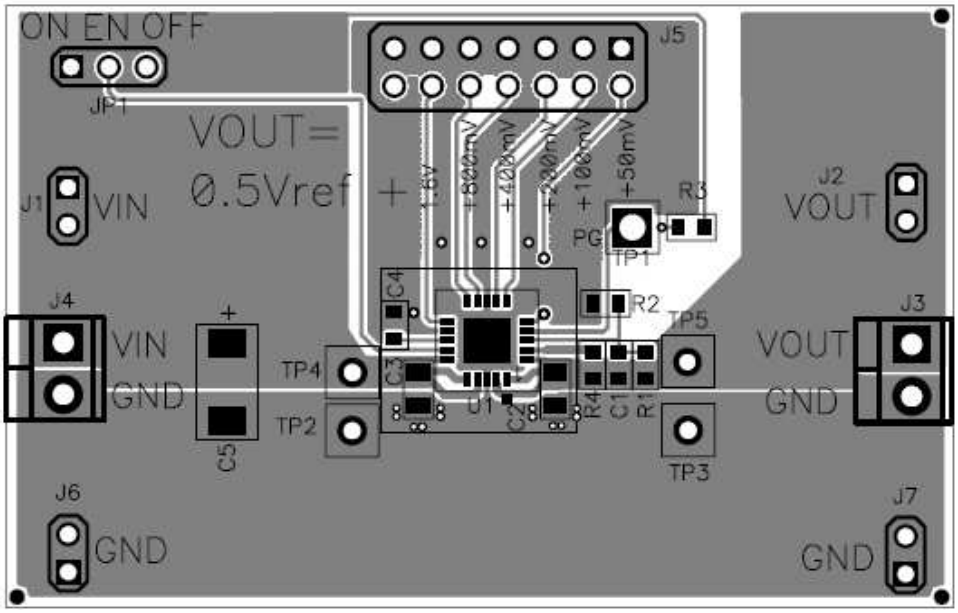


Figure 3. Assembly Layer

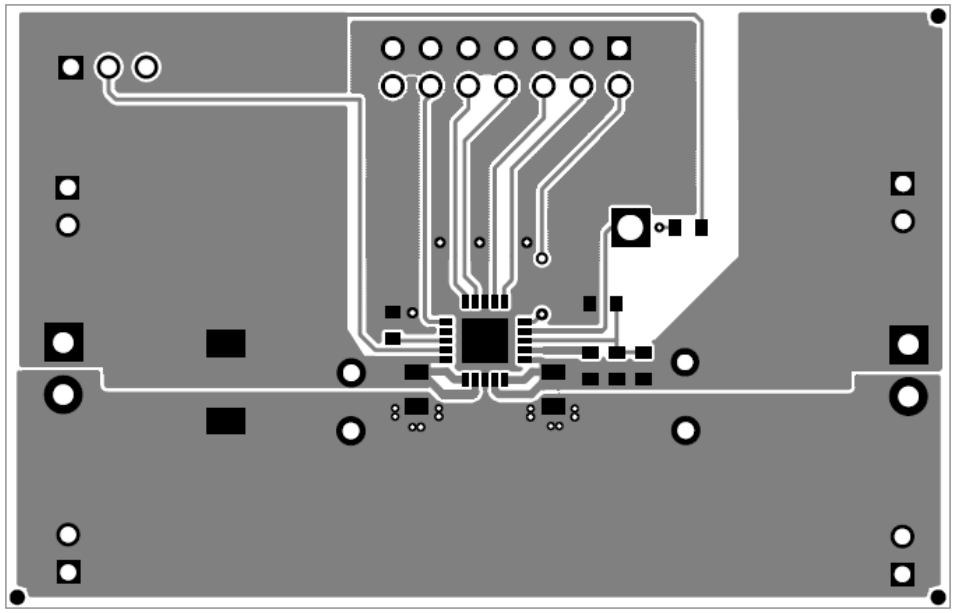


Figure 4. Top Layer Routing

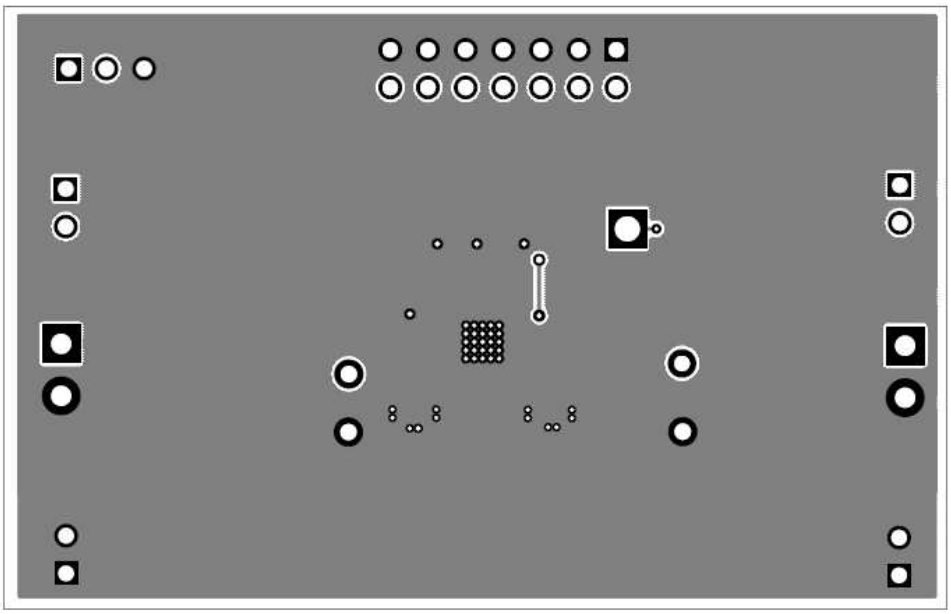
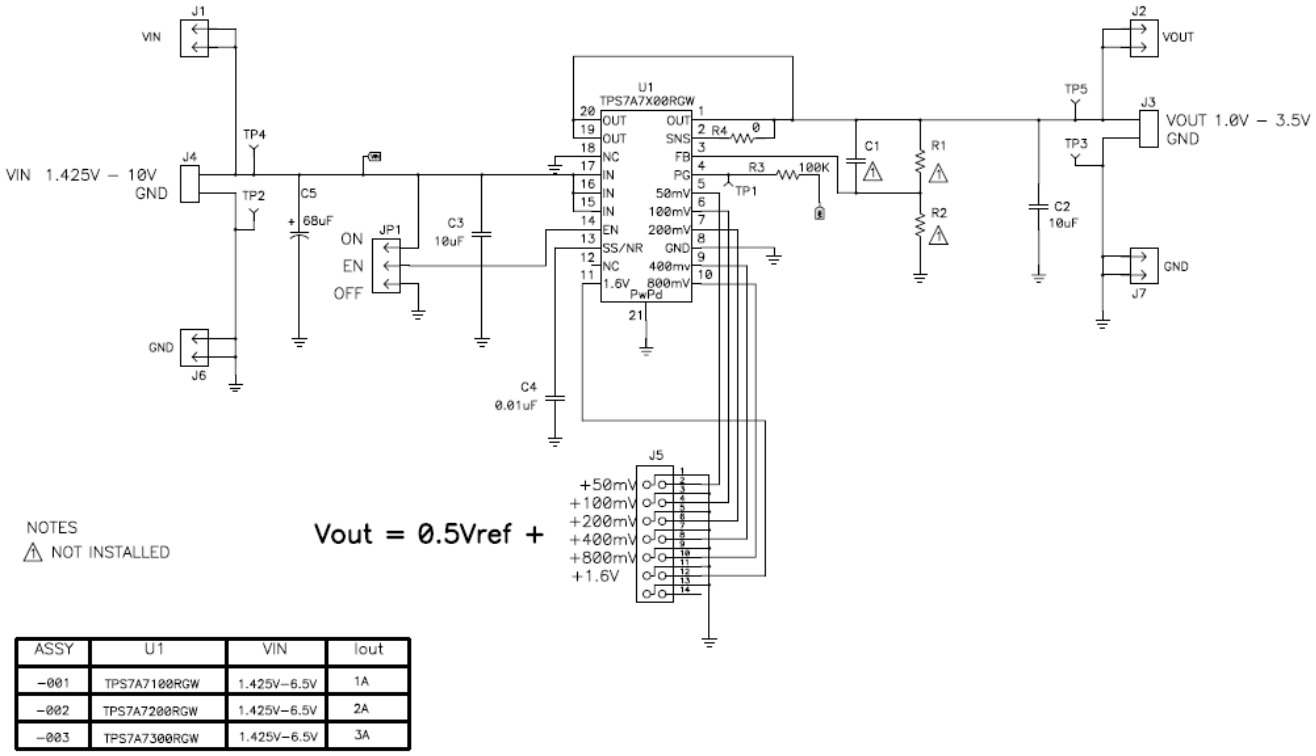


Figure 5. Bottom Layer Routing

7 Schematic and Bill of Materials

7.1 Schematic



ASSY	U1	VIN	Iout
–001	TPS7A7100RGW	1.425V–6.5V	1A
–002	TPS7A7200RGW	1.425V–6.5V	2A
–003	TPS7A7300RGW	1.425V–6.5V	3A

Figure 6. TPS7A7x00EVM-718 Schematic

7.2 Bill of Materials

Table 2. TPS7A7x00EVM-718 Bill of Materials

HPA718A BOM

Count -001	Count -002	Count -003	RefDes	Value	Description	Size	Part Number	MFR
0	0	0	C1	33pF	Capacitor, Ceramic, 10V, X5R, 10%	0603	STD	STD
2	2	2	C2, C3	10uF	Capacitor, Ceramic, 10V, X5R, 10%	0805	STD	STD
1	1	1	C4	0.01uF	Capacitor, Ceramic, 10V, X5R, 10%	0603	STD	STD
1	1	1	C5	68uF	Capacitor, Tant, 10V, Temp - 55 ~ 125 C°, ±20%	2312	T495C686M010ZTE250	Kemet
4	4	4	J1, J2, J6, J7	PEC02SAAN	Header, Male 2-pin, 100mil spacing	0.100 inch x 2	PEC02SAAN	Sullins
1	1	1	JP1	PEC03SAAN	Header, Male 3-pin, 100mil spacing	0.100 inch x 3	PEC03SAAN	Sullins
1	1	1	J5	PEC07DAAN	Header, Male 2x7 pin, 100mil spacing	0.100 inch x 2 x 7	PEC07DAAN	Sullins
2	2	2	J3, J4	ED555/2DS	Terminal Block, 2-pin, 6-A, 3.5mm	0.27 x 0.25 inch	ED555/2DS	OST
0	0	0	R1, R2	DNI	Resistor, Chip, 1/16W, 1%	0603	STD	STD
1	1	1	R3	100K	Resistor, Chip, 1/16W, 1%	0603	STD	STD
1	1	1	R4	0	Resistor, Chip, 1/16W, 1%	0603	STD	STD
1	1	1	TP1	5013	Test Point, Orange, Thru Hole	TH	5013	Keystone
2	2	2	TP2, TP3	5001	Test Point, Black, Thru Hole Color Keyed	TH	5001	Keystone
2	2	2	TP4, TP5	5000	Test Point, Red, Thru Hole Color Keyed	TH	5000	Keystone
1	0	0	U1	TPS7A7100RGW	IC, 2A, Fast Transient, Very Low Dropout Regulator	QFN-20	TPS7A7100RGW	TI
0	1	0	U1	TPS7A7200RGW	IC, 2A, Fast Transient, Very Low Dropout Regulator	QFN-20	TPS7A7200RGW	TI
0	0	1	U1	TPS7A7300RGW	IC, 2A, Fast Transient, Very Low Dropout Regulator	QFN-20	TPS7A7300RGW	TI
1	1	1	--	HPA718	1.600 x 2.500 x 0 .062 inch 2 layer 2oz. PCB	1.600 in. x 2.500 in.	HPA718	Any
5	5	5		Shunt	Shunt, 100-mil, Black	0.1	929950-00	3M
1	1	1	--		Label (See note 5)	1.25 x 0.25 inch	THT-13-457-10	Brady

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.
5. Install label after final wash. Text shall be 8 pt font. Text shall be per Table 1.

Table 1

Assembly number	Text
HPA718-001	TPS7A7100EVM-718
HPA718-002	TPS7A7200EVM-718
HPA718-003	TPS7A7300EVM-718

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As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

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 is 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.

REGULATORY COMPLIANCE INFORMATION (continued)

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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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.

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http://www.tij.co.jp

EVALUATION BOARD/KIT/MODULE (EVM)
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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.

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

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.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265

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Texas Instruments (TI) provides the enclosed Evaluation Board/Kit/Module (EVM) under the following conditions:

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.

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 LIMITED 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. 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.

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 visit www.ti.com/esh or contact TI.

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REGULATORY COMPLIANCE INFORMATION

As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

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.

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http://www.tij.co.jp

EVALUATION BOARD/KIT/MODULE (EVM)
WARNINGS, RESTRICTIONS AND DISCLAIMERS

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.

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

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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Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components which meet ISO/TS16949 requirements, mainly for automotive use. Components which have not been so designated are neither designed nor intended for automotive use; and TI will not be responsible for any failure of such components to meet such requirements.

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