TPS82130EVM-720, TPS82140EVM-720, and TPS82150EVM-720 Evaluation Modules

The PWR720 evaluation module (EVM) facilitates the evaluation of the TPS82130/40/50 MicroSiP™ power modules. The device outputs a 1.8-V output voltage at up to 3-A of output current from input voltages between 3 V and 17 V.

Contents
1 Introduction .............................................................................................................. 1
2 Setup .................................................................................................................... 3
3 PWR720 EVM Test Results .................................................................................. 3
4 Board Layout ....................................................................................................... 4
5 Schematic and Bill of Materials ............................................................................ 7

List of Figures
1 Top Assembly ..................................................................................................... 4
2 Top Overlay ......................................................................................................... 4
3 Top Layer ............................................................................................................. 5
4 Internal Layer 1 .................................................................................................. 5
5 Internal Layer 2 .................................................................................................. 6
6 Bottom Layer ..................................................................................................... 6
7 PWR720 EVM Schematic .................................................................................... 7

List of Tables
1 PWR720 EVM Options ........................................................................................ 1
2 Performance Specification Summary .................................................................... 2
3 PWR720 EVM Thermal Data ................................................................................. 2
4 PWR720 EVM Bill of Materials ............................................................................ 7

1 Introduction
The TPS82130 is a 3-A, synchronous, step-down module in a 2.8- × 3.0- × 1.53-mm package. The inductor and IC are included in the device. The TPS82140 and TPS82150 are pin-to-pin compatible power modules supporting lower output currents. See Table 1 for a summary of the PWR720 EVMs.

Table 1. PWR720 EVM Options

<table>
<thead>
<tr>
<th>Orderable EVM Number</th>
<th>IC Part Number</th>
<th>Maximum Output Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>TPS82130EVM-720 (PWR720-001)</td>
<td>TPS82130</td>
<td>3000 mA</td>
</tr>
<tr>
<td>TPS82140EVM-720 (PWR720-002)</td>
<td>TPS82140</td>
<td>2000 mA</td>
</tr>
<tr>
<td>TPS82150EVM-720 (PWR720-003)</td>
<td>TPS82150</td>
<td>1000 mA</td>
</tr>
</tbody>
</table>
1.1 Performance Specification

Table 2 provides a summary of the PWR720 EVM performance specifications.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Test Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage</td>
<td></td>
<td>3</td>
<td>17</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Output Voltage Setpoint</td>
<td></td>
<td></td>
<td>1.8</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Output Current (TPS82130EVM-720)</td>
<td></td>
<td>0</td>
<td>3000</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>Output Current (TPS82140EVM-720)</td>
<td></td>
<td>0</td>
<td>2000</td>
<td></td>
<td>mA</td>
</tr>
<tr>
<td>Output Current (TPS82150EVM-720)</td>
<td></td>
<td>0</td>
<td>1000</td>
<td></td>
<td>mA</td>
</tr>
</tbody>
</table>

1.2 Thermal Data

Table 3 shows the PWR720 EVM thermal data after considering the printed-circuit board (PCB) design of real applications. Compared to the JEDEC values listed in the data sheet, the PWR720 EVM design uses thicker copper on the 2 internal layers, has bigger planes connecting to the IC, and uses a thinner PCB. These improve the thermal performance. But the PCB is smaller than the standard JEDEC PCB, and this decreases the thermal performance. Overall, these differences improve the thermal performance and more closely match a real end application.

<table>
<thead>
<tr>
<th>Thermal Metric(1)</th>
<th>TPS821x0EVM-720</th>
<th>TPS821x0 Data Sheet (JEDEC 51-5)</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_{JAK}$ (Junction-to-ambient thermal resistance)</td>
<td>46.1</td>
<td>58.2</td>
<td>°C/W</td>
</tr>
<tr>
<td>$R_{JC(top)}$ (Junction-to-case (top) thermal resistance)</td>
<td>9.4</td>
<td>9.4</td>
<td></td>
</tr>
<tr>
<td>$R_{JB}$ (Junction-to-board thermal resistance)</td>
<td>14.4</td>
<td>14.4</td>
<td></td>
</tr>
<tr>
<td>$\psi_{JT}$ (Junction-to-top characterization parameter)</td>
<td>0.9</td>
<td>0.9</td>
<td></td>
</tr>
<tr>
<td>$\psi_{JB}$ (Junction-to-board characterization parameter)</td>
<td>14.0</td>
<td>14.2</td>
<td></td>
</tr>
<tr>
<td>$R_{JC(bot)}$ (Junction-to-case (bottom) thermal resistance)</td>
<td>21.3</td>
<td>21.3</td>
<td></td>
</tr>
</tbody>
</table>

(1) For more information about traditional and new thermal metrics, see the IC Package Thermal Metrics application report, SPRA953.

1.3 Modifications

The PCB for this EVM is designed to accommodate some modifications by the user. Additional input and output capacitors can be added.

1.3.1 Input and Output Capacitors

C5 is provided for an additional input capacitor. This capacitor is not required for proper operation but can be used to reduce the input voltage ripple.

C6, C7, and C8 are provided for additional output capacitors. These capacitors are not required for proper operation but can be used to reduce the output voltage ripple and to improve the load transient response. The total output capacitance must remain within the recommended range in the data sheet for proper operation.
2 **Setup**

This section describes how to properly use the PWR720 EVM.

### 2.1 Input/Output Connector Descriptions

- **J1 – VIN**: Positive input connection from the input supply for the EVM
- **J2 – S+/S-**: Input voltage sense connections. Measure the input voltage at this point.
- **J3 – GND**: Return connection from the input supply for the EVM
- **J4 – VOUT**: Output voltage connection
- **J5 – S+/S-**: Output voltage sense connections. Measure the output voltage at this point.
- **J6 – GND**: Output return connection
- **J7 – PG/GND**: The PG output appears on pin 1 of this header with a convenient ground on pin 2.
- **J8 – SS/TR & GND**: The SS/TR input appears on pin 1 of this header with a convenient ground on pin 2.
- **JP1 – EN**: EN pin input jumper. Place the supplied jumper across ON and EN to turn on the IC. Place the jumper across OFF and EN to turn off the IC.
- **JP2 – PG Pullup Voltage**: PG pin pullup voltage jumper. Place the supplied jumper on JP2 to connect the PG pin pullup resistor to Vout. Alternatively, the jumper can be removed and a different voltage can be supplied on pin 2 to pull up the PG pin to a different level. This externally applied voltage should remain below 6 V.

### 2.2 Setup

To operate the EVM, set jumpers JP1 and JP2 to the desired position per Section 2.1. Connect the input supply to J1 and J3 and connect the load to J4 and J6.

3 **PWR720 EVM Test Results**

The PWR720 EVM was used to take all the data in the TPS821x0 data sheet (SLVSCY5, SLVSDN3, or SLVSDN4). See the device data sheet for the performance of this EVM.

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**WARNING**

Hot surface. Contact may cause burns. Do not touch!
This section provides the PWR720 EVM board layout and illustrations in Figure 1 through Figure 6. The Gerbers are available on the EVM product page: TPS82130EVM-720, TPS82140EVM-720, or TPS82150EVM-720. Rev B of the PCB just corrected typographical errors in the A version.

**Figure 1. Top Assembly**

**Figure 2. Top Overlay**
5 Schematic and Bill of Materials

This section provides the PWR720 EVM schematic and bill of materials (BOM).

5.1 Schematic

Figure 7 illustrates the EVM schematic.

![Schematic Diagram]

Figure 7. PWR720 EVM Schematic

5.2 Bill of Materials

Table 4 lists the BOM for this EVM.

<table>
<thead>
<tr>
<th>Count</th>
<th>Ref Des</th>
<th>Value</th>
<th>Description</th>
<th>Size</th>
<th>Part Number</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>-001</td>
<td>C1</td>
<td>10 µF</td>
<td>CAP, CERM, 10 µF, 25 V, +/- 20%, X7R</td>
<td>1206</td>
<td>C32167R1E106M160AE</td>
<td>TDK</td>
</tr>
<tr>
<td>-001</td>
<td>C2</td>
<td>22 µF</td>
<td>CAP, CERM, 22 µF, 10 V, +/- 20%, X7S</td>
<td>0805</td>
<td>C2012X7S1A226M125AC</td>
<td>TDK</td>
</tr>
<tr>
<td>-001</td>
<td>C3</td>
<td>3300 pF</td>
<td>CAP, CERM, 3300 pF, 50 V, +/- 5%, COG/NP0, 0603</td>
<td>0603</td>
<td>Std</td>
<td>Std</td>
</tr>
<tr>
<td>-001</td>
<td>C4</td>
<td>68 µF</td>
<td>CAP, TA, 68 µF, 25 V, +/- 20%, 0.125 ohm, SMD</td>
<td>7343-43</td>
<td>TPSE686M025R0125</td>
<td>AVX</td>
</tr>
<tr>
<td>-002</td>
<td>R1</td>
<td>124 k</td>
<td>RES, 124 k, 1%, 0.1 W, 0603</td>
<td>0603</td>
<td>Std</td>
<td>Std</td>
</tr>
<tr>
<td>-002</td>
<td>R2, R3</td>
<td>100 k</td>
<td>RES, 100 k, 1%, 0.1 W, 0603</td>
<td>0603</td>
<td>Std</td>
<td>Std</td>
</tr>
<tr>
<td>-003</td>
<td>U1</td>
<td>TPS82130</td>
<td>3A, High Efficiency Step Down MicroSiP Module with Integrated Inductor</td>
<td>3 x 2.8 mm</td>
<td>TPS82130SIL</td>
<td>Texas Instruments</td>
</tr>
<tr>
<td></td>
<td>U1</td>
<td>TPS82140</td>
<td>2A, High Efficiency Step Down MicroSiP Module with Integrated Inductor</td>
<td>3 x 2.8 mm</td>
<td>TPS82140SIL</td>
<td>Texas Instruments</td>
</tr>
<tr>
<td></td>
<td>U1</td>
<td>TPS82150</td>
<td>1A, High Efficiency Step Down MicroSiP Module with Integrated Inductor</td>
<td>3 x 2.8 mm</td>
<td>TPS82150SIL</td>
<td>Texas Instruments</td>
</tr>
</tbody>
</table>

Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from A Revision (June 2016) to B Revision

- EVM user’s guide revision B supports the addition of TPS82140EVM-720 and TPS82150EVM-720. .................................................. 1
- Added PWR720 EVM Options table. ................................................................................................................................. 1
- Changed Performance Specification Summary table to include TPS82140EVM-720 and TPS82150EVM-720. ................. 2
- Changed schematic to a generic device name - TPS821x0SILR, from TPS82130SILR. .......................................................... 7
- Changed PWR720 EVM Bill of Materials table to include TPS82140EVM-720 and TPS82150EVM-720......................... 7
STANDARD TERMS FOR EVALUATION MODULES

1. **Delivery:** TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an “EVM” or “EVMs”) to the User (“User”) in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.

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1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

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2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

3 **Regulatory Notices:**

3.1 **United States**

3.1.1 Notice applicable to EVMs not FCC-Approved:

**FCC NOTICE:** This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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

**FCC Interference Statement for Class A EVM devices**

**NOTE:** This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.
FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

• Reorient or relocate the receiving antenna.
• Increase the separation between the equipment and receiver.
• Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
• Consult the dealer or an experienced radio/TV technician for help.

3.2 Canada

3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

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3.3.1 Notice for EVMs delivered in Japan: Please see http://www.tij.co.jp/lds/td_ia/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/lds/td_ia/general/eStore/notice_01.page

3.3.2 Notice for Users of EVMs Considered “Radio Frequency Products” in Japan: EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs 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 EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.
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西新宿三井ビル

3.3.3 Notice for EVMs for Power Line Communication: Please see http://www.tij.co.jp/lsts/ti_ja/general/eStore/notice_02.page

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3.4 European Union
3.4.1 For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive):

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

4 EVM Use Restrictions and Warnings:
4.1 EVMs ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.
4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.
4.3 Safety-Related Warnings and Restrictions:
4.3.1 User shall operate the EVM within TI’s recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should 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 also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user 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, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.
4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure 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. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.
4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User’s handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. Accuracy of Information: To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.
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