This user's guide describes the characteristics, operation, and use of the Texas Instruments TPS62160 and TPS62170 evaluation modules (EVM). These EVMs are designed to help the user easily evaluate and test the operation and functionality of the TPS62160 and TPS62170. This user's guide includes setup instructions for the hardware, printed-circuit board layouts for the EVMs, a schematic diagram, a bill of materials, and test results for the EVMs.

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1 Introduction

The TPS62160 is a 1-A, synchronous, step-down converter in a 2x2-mm, 8-pin WSON package. Both fixed and adjustable output voltage units are available.

The TPS62170 is a 0.5-A, synchronous, step-down converter in a 2x2-mm, 8-pin WSON package. Both fixed and adjustable output voltage units are available.

1.1 Background

The TPS62160EVM-627 (HPA627-001) uses the TPS62160 adjustable version and is set to a 3.3-V output. The EVM operates with full-rated performance with an input voltage between 3.7 V and 17 V.

The TPS62170EVM-627 (HPA627-002) uses the TPS62170 adjustable version and is set to a 3.3-V output. The EVM operates with full-rated performance with an input voltage between 3.7 V and 17 V.

1.2 Performance Specification

Table 1 provides a summary of the TPS621x0EVM-627 performance specifications. All specifications are given for an ambient temperature of 25°C.

<table>
<thead>
<tr>
<th>Specification</th>
<th>Test Conditions</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
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<tr>
<td>Input Voltage</td>
<td></td>
<td>3.7</td>
<td></td>
<td>17</td>
<td>V</td>
</tr>
<tr>
<td>Output Voltage</td>
<td>PWM Mode of Operation</td>
<td>3.227</td>
<td>3.327</td>
<td>3.427</td>
<td>V</td>
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<td></td>
<td>TPS62170EVM-627</td>
<td>0</td>
<td>500</td>
<td>mA</td>
<td></td>
</tr>
<tr>
<td>Peak Efficiency</td>
<td></td>
<td></td>
<td></td>
<td>93.1</td>
<td>%</td>
</tr>
<tr>
<td>Soft-Start Time</td>
<td></td>
<td></td>
<td></td>
<td>180</td>
<td>μs</td>
</tr>
</tbody>
</table>

1.3 Modifications

The printed-circuit board (PCB) for this EVM is designed to accommodate both the fixed and adjustable voltage versions of this integrated circuit (IC). Additional input and output capacitors can also be added. Finally, the loop response of the IC can be measured.

1.3.1 Fixed Output Operation

U1 can be replaced with the fixed-voltage version of the IC for evaluation. For fixed-voltage version operation, replace R2 with a 0-Ω resistor and remove R1.

1.3.2 Input and Output Capacitors

C4 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.

C3 is provided for an additional output capacitor. This capacitor is 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.

1.3.3 Loop Response Measurement

The loop response of the TPS621x0EVM-627 can be measured with two simple changes to the circuitry. First, install a 10-Ω resistor across the pads in the middle of the back of the PCB. The pads are spaced to allow installation of 0805- or 0603-sized resistors. Second, cut the short section of trace between the via on the output voltage and the trace that connects to the VOS pin via. These changes are shown in Figure 1. With these changes, an ac signal (10-mV, peak-to-peak amplitude recommended) can be injected into the control loop across the added resistor.
2 Setup

This section describes how to properly use the TPS621x0EVM-627.

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.

- **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 1 to pull up the PG pin to a different level. This externally applied voltage must remain below 7 V.

2.2 Setup

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

3 TPS621x0EVM-627 Test Results

This section provides test results of the TPS621x0EVM-627.
Figure 2. Efficiency

Figure 3. Load Regulation

Figure 4. Line Regulation With $i_{out} = 0.5$ A
Figure 5. Loop Response With Vin = 12 V and Iout = 0.5 A

Figure 6. Input Voltage Ripple With Vin = 12 V and Iout = 1 A
Figure 7. Output Voltage Ripple With Vin = 12 V and Iout = 1 A

Figure 8. Load Transient Response With Vin = 12 V
Figure 9. Start-Up on Vin With 0.5-A Load

Figure 10. Start-Up on EN with 0.5-A Load
Figure 11. Shutdown on EN With 0.5-A Load

Figure 12. Prebias Start-Up and Shutdown on EN With 0.5-A Load
Figure 13. Thermal Performance With Vin = 12 V and Iout = 1 A
4 Board Layout

This section provides the TPS621x0EVM-627 board layout and illustrations.

Figure 14. Assembly Layer

Figure 15. Top Layer Routing
Figure 16. Bottom Layer Routing
5 Schematic and Bill of Materials

This section provides the TPS621x0EVM-627 schematic and bill of materials.

5.1 Schematic

Figure 17. TPS621x0EVM-627 Schematic
### Table 2. TPS621x0EVM-627 Bill of Materials

<table>
<thead>
<tr>
<th>Count</th>
<th>RefDes</th>
<th>Value</th>
<th>Description</th>
<th>Size</th>
<th>Part Number</th>
<th>MFR</th>
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</thead>
<tbody>
<tr>
<td>-001</td>
<td>C1</td>
<td>10 µF</td>
<td>Capacitor, Ceramic, 25V, X5R, 20%</td>
<td>0805 Std</td>
<td>Std</td>
<td></td>
</tr>
<tr>
<td>-002</td>
<td>C2</td>
<td>22 µF</td>
<td>Capacitor, Ceramic, 6.3V, X5R, 20%</td>
<td>0805 Std</td>
<td>Std</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>C5</td>
<td>68 µF</td>
<td>Capacitor, Tantalum, 35V, 68µF, ±20%</td>
<td>7361[V] AVX</td>
<td>TPSV686M035R0150 AVX</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>L1</td>
<td>2.2 µH</td>
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<td></td>
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<tr>
<td>1</td>
<td>R1</td>
<td>1.21M</td>
<td>Resistor, Chip, 1/16W, 1%</td>
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<td>Std</td>
<td></td>
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<td>383k</td>
<td>Resistor, Chip, 1/16W, 1%</td>
<td>0603 Std</td>
<td>Std</td>
<td></td>
</tr>
<tr>
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<td>R3</td>
<td>100k</td>
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<td>U1</td>
<td>TPS62160DSG</td>
<td>IC, 17V 1A Buck Converter</td>
<td>2 x 2 mm WSON TPS62160DSG Ti</td>
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<tr>
<td>1</td>
<td>U1</td>
<td>TPS62170DSG</td>
<td>IC, 17V 0.5A Buck Converter</td>
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EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of 3.6 V to 17 V and the output voltage range of 0.9 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.

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During normal operation, some circuit components may have case temperatures greater than 50°C. The EVM is designed to operate properly with certain components above 50°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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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

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- 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.

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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.

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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 détaçables

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 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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4. You will take care of proper disposal and recycling of the EVM’s electronic components and packing materials.

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