This user’s guide describes the characteristics, operation, and use of the TPS92691 boost and boost-to-battery evaluation module (EVM). A complete schematic diagram, printed-circuit board layouts, and bill of materials are included in this document.

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1 Introduction

The TPS92691EVM-752 evaluation module (EVM) helps designers evaluate the operation and performance of the TPS92691-Q1 and TPS92691, a multi-topology controller designed for automotive lighting and general illumination applications. The TPS92691EVM-752 uses the TPS92691-Q1 (AEC Q100) IC; however, for general illumination and other non-automotive applications, the TPS92691 is available in the same package and pin configuration and with identical performance characteristics. The TPS92691-Q1 device implements fixed-frequency peak current mode control technique with programmable switching frequency, slope compensation, and startup timing. It incorporates a low offset rail-to-rail current sense amplifier that can directly measure LED current over an output voltage range of 0 V to 65 V. Additional features include wide input voltage range (0 V to 65 V), PWM dimming capability, analog dimming capability, adjustable and syncable switching frequency, input undervoltage protection, output overvoltage protection, and switch cycle-by-cycle current limit. The controller can be used to implement a range of LED driver topologies including Boost, Buck-Boost (Boost-to-Battery), SEPIC, Cuk, and Flyback, based on the output LED stack voltage.

2 Description

The TPS92691EVM-752 is a fully assembled and tested boost and boost-to-battery LED driver designed to power a single string of series-connected LEDs. Accurate closed-loop LED current regulation is achieved using a low-offset current sense amplifier that is compatible with either high- or low-side current-sensing implementations. The DC current set point can be varied over a 15:1 ratio using the high-impedance analog adjust (IADJ) input. An integrated gate-driver circuit and proprietary PWM dimming logic is incorporated to enable external series FET PWM dimming with greater than 100:1 dimming ratio. LED short-circuit failure and other cable harness fault detection is facilitated by current monitor output (IMON), which reports the instantaneous status of LED current measured by the rail-to-rail current sense amplifier. The current monitor output is used in conjunction with microcontroller or discrete circuitry to implement customized fault protection schemes.

2.1 Typical Applications

This converter design describes an application of the TPS92691-Q1 device as a boost and boost-to-battery LED driver with the specifications described in Table 1. For applications with a different input voltage range or different output voltage range, refer to the TPS92691-Q1 datasheet.

2.2 Features

- Versatile LED driver capable of either a Boost or Boost-to-Battery topology by simply changing the LED string connections
- Wide input voltage range (4.5 V to 20 V)
- Wide output voltage range (21 V to 60 V for the Boost, 3 V to 36 V for the Boost-to-Battery)
- Capable of series FET PWM dimming
- Capable of analog dimming
- Instantaneous current monitor output to facilitate LED fault detection and mitigation
- Output overvoltage protection and input undervoltage lockout
3 Connector Description

This section describes the connectors and test points on the EVM and how to properly connect, setup, and use the TPS92691EVM-752.

Figure 1. Connection Diagram

3.1 Configuring for Boost or Boost-to-Battery (J1, J3)

The TPS92691EVM-752 can be configured as a boost regulator or a boost-to-battery regulator simply by connecting the LED load to either connector J1 or to connector J3 as described in this section. Do not attempt to use J1 and J3 simultaneously.

3.1.1 J1, VIN, LED+ (Boost-to-Battery)

The screw-down connector, J1, marked LED+ and VIN is for connecting the LED load to the board in the Boost-to-Battery (Buck-Boost) configuration. The positive terminal of the LED load connects to LED+ while the negative terminal connects to VIN. The leads to the LED load should be twisted and kept as short as possible to minimize voltage drop, inductance, and EMI transmission. The Boost-to-Battery design is for approximately 1 to 12 white LEDs.

3.1.2 J3, LED+, LED– (Boost)

The screw-down connector, J3, marked LED+ and LED– is for connecting the LED load to the board in the Boost configuration. The leads to the LED load should be twisted and kept as short as possible to minimize voltage drop, inductance, and EMI transmission. The Boost design is for approximately 6 to 20 white LEDs.

3.2 J2, POS(+) , NEG(–)

The screw-down connector, J1, marked POS(+) and NEG(–) is for connecting the EVM to the DC input voltage supply. One other POS(+) and NEG(–) test turret is provided on the board that can also be used.
3.3 **J4, IADJ DRIVE SELECT**

The three-pin header marked J4 is used to select the method of setting the LED current using the IADJ pin of the device. The default setting is a shunt placed between pins 2 and 3 of J4. This sets the IADJ voltage using a resistor divider from VCC for a constant LED current. PWM to analog dimming can be achieved by placing the shunt between pins 1 and 2 of J4 and applying a PWM signal to the IADJ test point, TP4. Direct analog dimming can be achieved by connecting an analog voltage to TP4 in this configuration or by removing the shunt and applying an analog voltage directly to pin 2 of J4.

3.4 **TP2, IMON**

The IMON test point connects directly to the IMON pin of the TPS92691-Q1 device. The IMON voltage, corresponding to measured LED current by integrated rail-to-rail current sense amplifier, can be monitored with this test point. The pin can be connected to an external comparator or microcontroller to detect LED short-circuit, LED+ to VIN, and LED+ to GND fault conditions.

3.5 **TP4, IADJ**

The IADJ test point connects through a two-pole, low-pass filter to the IADJ pin of the TPS92691-Q1 device. The default reference is set to 777 mV through a resistor divider network connected to VCC (shunt connecting pins 2 and 3 of J4) resulting in output current of 350 mA. The voltage on IADJ can be externally set (shunt connecting pins 1 and 2 of J4) using either a pulse width modulated signal from function generator or a DC power supply between 140 mV to over 2.4 V. For more details on setting analog adjust voltage, refer to Section 6.4.

3.6 **TP6, SHUTDOWN**

The test point SHUTDOWN connects through a 1-kΩ resistor to the SS pin of the TPS92691-Q1 device. The voltage range is from 0 V to 5 V, if driven externally. The SS voltage can be monitored with this test point. Pulling SHUTDOWN to GND will also serve to disable the part and put it into STANDBY mode.

3.7 **TP7, SYNC**

The SYNC test point is AC-coupled to the RT/SYNC pin of the TPS92691-Q1 device through a 100-pF capacitor. Apply a square wave with pulse width greater than 200 ns and logic-low level of GND and a high level between 3 V and 5 V to synchronize the switching frequency to the applied frequency. The frequency range of SYNC is from 332 kHz to 449 kHz (±15%) for the nominal set point of 390-kHz switching frequency.

3.8 **TP8, PWM**

The PWM test point connects through a 1-kΩ resistor to the PWM pin of the TPS92691-Q1 device. Leave open for normal operation. If PWM dimming is used, apply a square wave with a low level of GND and a high level of between 3 V and 5 V. The dimming frequency range is 100 Hz to 1 kHz.
## Electrical Performance Specifications

Table 1. TPS92691EVM-752 Electrical Performance Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Conditions</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>Unit</th>
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<tbody>
<tr>
<td><strong>Input Characteristics</strong></td>
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<td></td>
<td></td>
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<tr>
<td>Input voltage range</td>
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<td>7</td>
<td>14</td>
<td>20</td>
<td>V</td>
</tr>
<tr>
<td>Input UVLO setting</td>
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<td></td>
<td></td>
<td>V</td>
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<td>Maximum switch node voltage</td>
<td></td>
<td></td>
<td></td>
<td>100</td>
<td>V</td>
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<tr>
<td><strong>Output Characteristics</strong></td>
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<td></td>
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<tr>
<td>Output voltage, VOUT</td>
<td>LED+ to LED– (Boost)</td>
<td>21</td>
<td>60</td>
<td></td>
<td>V</td>
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<td></td>
<td>LED+ to VIN (Boost-to-Battery)</td>
<td>3</td>
<td>36</td>
<td></td>
<td>mA</td>
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<td>Output current</td>
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<td>62.5</td>
<td>350</td>
<td>1070</td>
<td>mA</td>
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<td>Maximum output power</td>
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<td></td>
<td>25</td>
<td>W</td>
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<td>Analog dimming range</td>
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<td></td>
<td>17:1</td>
<td></td>
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<td>PWM dimming range</td>
<td>240-Hz PWM frequency</td>
<td></td>
<td></td>
<td>100:1</td>
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<td><strong>Systems Characteristics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Efficiency</td>
<td>Boost. Input voltage = 14 V, 13 LEDs,</td>
<td></td>
<td></td>
<td>92</td>
<td>%</td>
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<td></td>
<td>I_{LED} = 350 mA</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Switching frequency</td>
<td></td>
<td></td>
<td></td>
<td>390</td>
<td>kHz</td>
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</table>
5  Schematic

Figure 2 illustrates the EVM schematic.
6 Performance Data and Typical Characteristic Curves

The following performance curves are presented for the EVM configured in boost configuration (LED load connected to J3).

6.1 Efficiency

![Figure 3. Efficiency vs Input Voltage (350-mA LED Current)](image)

6.2 Line Regulation

![Figure 4. Output LED Current vs Input Voltage](image)
6.3 Temperature Characteristics

![Figure 5. LED Current vs Ambient Temperature (VIN = 14 V, Number of LEDs in series = 18)](image)

6.4 Analog Adjust Settings

LED current can be varied from 62.5 mA to 1.07 A by varying the voltage at the analog adjust, IADJ pin from 140 mV to 2.4 V, respectively. The EVM is configured with the IADJ voltage, \( V_{\text{IADJ}} \), set to 777 mV using resistor divider network, R13 and R21 between VCC and GND with a shunt placed between pins 2 and 3 on the header J4. The resulting LED current is 350 mA for a current sense resistor, \( R_{\text{CS}} = R_1 \), of 160 mΩ. Calculation is based on:

\[
I_{\text{LED}} = \frac{V_{\text{IADJ}}}{14} \frac{1}{R_{\text{CS}}}
\]

The desired LED current can be achieved by setting the corresponding voltage, \( V_{\text{IADJ}} \), and reconfiguring the resistor divider network, R13 and R21. The internal reference clamp of 2.4 V can be activated by depopulating resistor R21 and connecting IADJ to VCC through pull-up resistor R13.

External control via IADJ test point, TP4 can be enabled by changing the shunt position to connect pins 1 and 2 of J4 together. The IADJ voltage, and hence the LED current, can be modulated over the entire operating range by connecting a DC power supply or a function generator across TP4 to GND. Analog dimming can also be achieved by removing the shunt and connecting an analog voltage directly to pin 2 of J4. To ensure proper operation and limit temperature rise, the maximum output power should be limited to 25 W for any given LED stack voltage and LED current combination.
6.5 PWM Dimming

To enable EVM at power-up, the PWM pin of the TPS92691-Q1 is tied to VCC through a 100-kΩ pullup resistor, R10. The PWM pin can be over-driven by connecting an external digital signal, generated through a microcontroller or function generator, to PWM test point, TP8. The PWM pin can be pulled to ground to disable switching under fault conditions.
6.6 Typical Waveforms (Boost Configuration, VIN = 14 V, 18 LEDs)

Figure 8. LED Current vs. PWM Duty Cycle (Boost, VIN = 14 V, Number of LEDs in Series = 18)

Figure 9. Nominal Operation
- Ch1: Q2 Drain voltage
- Ch2: Switch current sense (R1) voltage
- Ch4: LED current
  Time: 1 µs/div

Figure 10. Overvoltage Protection
- Ch1: Output voltage
- Ch2: SS pin voltage
  Time: 400 ms/div
Figure 11. PWM Dimming (Duty Cycle = 4%, Frequency = 240 Hz)

Figure 12. PWM Dimming (Duty cycle = 50%, Frequency = 240 Hz)

Figure 13. PWM Dimming (Duty cycle = 96%, Frequency = 240 Hz)

Figure 14. Start-Stop (Warm-Crank) Transient Response
6.7 EMI

Figure 15. Conducted EMI Based on CISPR 25 Class 3 Limits
Boost, 32 V Output, R6 = 47 Ω
7 Optimizing EVM Performance Based on LED String Voltage and Current

The default EVM schematic is configured to operate over a wide range of LED currents (62.5 mA to 1.07 A) and string configurations (1 to 20 LEDs). The driver operation, efficiency and transient response can be improved by reconfiguring the schematic for a given LED current and LED string forward voltage drop.

The LED current sense resistor, \( R_{CS} = R_1 \) value can be calculated based on the maximum allowable differential voltage of 172 mV which is achieved by pulling the IADJ pin to VCC through an external resistor. The slope compensation voltage can be adjusted by changing the switch current sense resistor, \( R_{IS} = R_{11} \), based on the maximum expected LED stack voltage. The proportional integral compensation network can be tuned to achieve high bandwidth and desired phase margin for a specified range of input and output voltages. For more details and design procedure refer to the TPS92691-Q1 datasheet (SLVSD68).

8 TPS92691EVM-752 Assembly Drawing and PCB Layout

Figure 16, Figure 17, and Figure 18 show the design and assembly of the TPS92691EVM-752 printed circuit board. The EVM dimensions are \( x = 3.05 \text{ in} \) and \( y = 2.7 \text{ in} \).

![Assembly Drawing](image)
Figure 17. Top Layer and Top Overlay (Top View)

Figure 18. Bottom Layer and Bottom Overlay (Bottom View)
### Table 2. Bill of Materials

<table>
<thead>
<tr>
<th>Designator</th>
<th>Qty</th>
<th>Value</th>
<th>Description</th>
<th>Package</th>
<th>PartNumber</th>
<th>Manufacturer</th>
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<tr>
<td>U1</td>
<td>1</td>
<td>Multi-Topology LED Driver with Rail-to-Rail Current Sense Amplifier</td>
<td>PWP0016J</td>
<td>TPS92691QPWPRQ1</td>
<td>Texas Instruments</td>
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<td>C1, C3, C11</td>
<td>3</td>
<td>0.1uF</td>
<td>CAP, CERM, 0.1 µF, 100 V, +/- 10%, X7R</td>
<td>1206</td>
<td>C3216X7R2A104K</td>
<td>TDK</td>
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<td>C2</td>
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<td>TDK</td>
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<td>C5, C6</td>
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<td>CAP, CERM, 0.1 µF, 100 V, +/- 10%, X7R</td>
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<td>TDK</td>
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<td>IHL-P4040DZER220M8A</td>
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<td>2</td>
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<td>Ferrite Bead, 160 ohm @ 100 MHz, 6 A</td>
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<td>HI1206T161R-10</td>
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<td>R1</td>
<td>1</td>
<td>0.16</td>
<td>RES, 0.16, %, 0.5 W</td>
<td>1210</td>
<td>MCR25J2HF4816</td>
<td>Rohm</td>
</tr>
<tr>
<td>R2</td>
<td>1</td>
<td>2.00k</td>
<td>RES, 2.00 k, %, 0.1 W</td>
<td>0603</td>
<td>CRCW06032K00K0E</td>
<td>Vishay-Dale</td>
</tr>
<tr>
<td>R3</td>
<td>1</td>
<td>10.0</td>
<td>RES, 10.0, %, 0.25 W</td>
<td>1206</td>
<td>CRCW120610R00K0E</td>
<td>Vishay-Dale</td>
</tr>
<tr>
<td>R4</td>
<td>1</td>
<td>487k</td>
<td>RES, 487 k, %, 0.1 W</td>
<td>0603</td>
<td>CRCW0603487KFKEA</td>
<td>Vishay-Dale</td>
</tr>
</tbody>
</table>

Table 2 lists the TPS92691EVM-752 components list according to the schematic shown in Figure 2.
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<tr>
<th>Designator</th>
<th>Qty</th>
<th>Value</th>
<th>Description</th>
<th>Package</th>
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<tr>
<td>R5</td>
<td>1</td>
<td>1.00k</td>
<td>RES, 1.00 k, 1%, 0.25 W</td>
<td>1206</td>
<td>CRCW12061K00FKEA</td>
<td>Vishay-Dale</td>
</tr>
<tr>
<td>R6</td>
<td>1</td>
<td>0</td>
<td>RES, 0, 5%, 0.1 W</td>
<td>0603</td>
<td>CRCW06030000Z0EA</td>
<td>Vishay-Dale</td>
</tr>
<tr>
<td>R7</td>
<td>1</td>
<td>100</td>
<td>RES, 100, 1%, 0.1 W</td>
<td>0603</td>
<td>CRCW06031000RFKEA</td>
<td>Vishay-Dale</td>
</tr>
<tr>
<td>R8, R9</td>
<td>2</td>
<td>1.0k</td>
<td>RES, 1.0 k, 5%, 0.1 W</td>
<td>0603</td>
<td>CRCW06031001JNEA</td>
<td>Vishay-Dale</td>
</tr>
<tr>
<td>R10, R16, R17</td>
<td>3</td>
<td>100k</td>
<td>RES, 100 k, 1%, 0.1 W</td>
<td>0603</td>
<td>CRCW06031000KFKEA</td>
<td>Vishay-Dale</td>
</tr>
<tr>
<td>R11</td>
<td>1</td>
<td>0.06</td>
<td>RES, 0.06, 1%, 1 W</td>
<td>1210</td>
<td>CSRN2010FK60L0</td>
<td>Stackpole Electronics Inc</td>
</tr>
<tr>
<td>R12</td>
<td>1</td>
<td>10.0k</td>
<td>RES, 10.0 k, 1%, 0.1 W</td>
<td>0603</td>
<td>CRCW06031000KFKEA</td>
<td>Vishay-Dale</td>
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<tr>
<td>R13</td>
<td>1</td>
<td>102k</td>
<td>RES, 102 k, 1%, 0.1 W</td>
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<td>CRCW06031020KFKEA</td>
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<tr>
<td>R14, R15</td>
<td>2</td>
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<td>RES, 10.0, 1%, 0.1 W</td>
<td>0603</td>
<td>CRCW06031001R0FKEA</td>
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<td>R18</td>
<td>1</td>
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<td>RES, 20.0 k, 1%, 0.1 W</td>
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<td>R19</td>
<td>1</td>
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<td>RES, 1.43 k, 1%, 0.1 W</td>
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<td>R21</td>
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<td>RES, 11.8 k, 1%, 0.1 W</td>
<td>0603</td>
<td>CRCW060311K8FKEA</td>
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3 Regulatory Notices:

3.1 United States

3.1.1 Notice applicable to EVMs not FCC-Approved:
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.

3.1.2 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
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

Concerning EVMs Including Radio Transmitters:
This device complies with Industry Canada license-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.

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.

3.3 Japan

3.3.1 Notice for EVMs delivered in Japan: Please see http://www.tij.co.jp/lsds/taja/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、次のとところをご覧ください。

http://www.tij.co.jp/lsds/taja/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 by Radio Law of Japan to follow the instructions below with respect to EVMs:

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

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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:
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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.

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<td><a href="http://www.ti.com/omap">www.ti.com/omap</a></td>
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<td>e2e.ti.com</td>
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