User's Guide

SLVU365–March 2010

TPS63020EVM-487

This user's guide describes the characteristics, operation, and use of the TPS63020EVM evaluation module (EVM). The EVM is designed to help the user easily evaluate and test the operation and functionality of the TPS63020. This user's guide includes setup instructions for the hardware, a schematic diagram, a bill of materials, and printed-circuit board layout drawings for the evaluation module.

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1 Introduction

The Texas Instruments TPS63020 is a highly efficient, single-inductor, buck-boost converter in a 14-pin, 3-mm × 4-mm QFN package. Both fixed and adjustable output voltage units are available.

1.1 Background

The TPS63020EVM-487 uses the TPS63020 adjustable version and is set to 3.3-V output. The EVM operates with full-rated performance with an input voltage between 1.8 V and 5.5 V.

1.2 Performance Specification

Table 1 provides a summary of the TPS63020EVM-487 performance specifications. All specifications are given for an ambient temperature of 25°C.

Table 1. Performance Specification Summary

Specification	Test Conditions	Min	Typ	Max	Unit
Input voltage	Iout = 1000 mA	2.0	3.6	5.5	V
Output voltage	Iout = 0 mA to 1000 mA	3.2	3.3	3.4	V
Output current	3.6 V in	0	1000	2500	mA
Operating frequency			2400		kHz
Efficiency	3.6 V in at 1000-mA load		90%		
Output ripple	3.6 V in at 500-mA load		25		mV

1.3 Modifications

The printed-circuit board (PCB) for this EVM is designed to accommodate both the fixed and adjustable versions of this integrated circuit (IC). If the fixed version is installed, R1 is replaced with a 0-Ω resistor and R2 is open. Extra positions are available for additional input and output capacitors.

1.3.1 Adjustable Output IC U1 Operation

U1 is configured for evaluation of the adjustable output version. This unit is set to 3.3 V. Resistors R1 and R2 are used to set the output voltage between 1.2 V and 5.5 V. See the data sheet for recommended values.

1.3.2 Fixed Output Operation

U1 can be replaced with the fixed version for evaluation. With the fixed version, R1 needs to be replaced with a 0-Ω resistor; R2 position is open.

2 Setup and Results

This section describes how to properly use the TPS63020EVM-487.

2.1 Input/Output Connector and Header Descriptions

2.1.1 J1 – VIN

Positive input connection from the input supply for U1.

2.1.2 J2 – Sense

Vin Sense and GND Sense, low current sense lines for sampling input voltage at input capacitor.

2.1.3 J3 – GND

Vin GND return connection from the input supply for U1, common with J6.

2.1.4 J4 – VOUT

Output voltage connection.

2.1.5 J5 – Sense

Vout Sense and GND Sense low current sense lines for sampling output voltage at output capacitor.

2.1.6 J6 – GND

Vout GND return connection for output voltage, common with J3.

2.1.7 J7 – PG GND

Power Good (PG) test point and GND connection.

2.1.8 JP1 – ENABLE

Shorting jumper between the center pin and ON turns on the unit. Installing a shorting jumper between the center pin and OFF turns the unit off.

2.1.9 JP2 –PWR Save

Installing a shorting jumper between the center pin and OFF disables power-saving mode; jumper between center pin and ON enables power-saving mode. The center pin can be used to synchronize the unit with an external clock; see data sheet for additional details.

2.2 Setup

To operate the EVM, connect an input supply to the appropriate pins, and connect a load to the appropriate pins.

2.3 Power-Up

The soft-start circuit is controlled by a ramp to the current limit comparator that starts the switch current limit low and increases to maximum value. Output voltage is monitored during this time and must increase for switch current to increase.

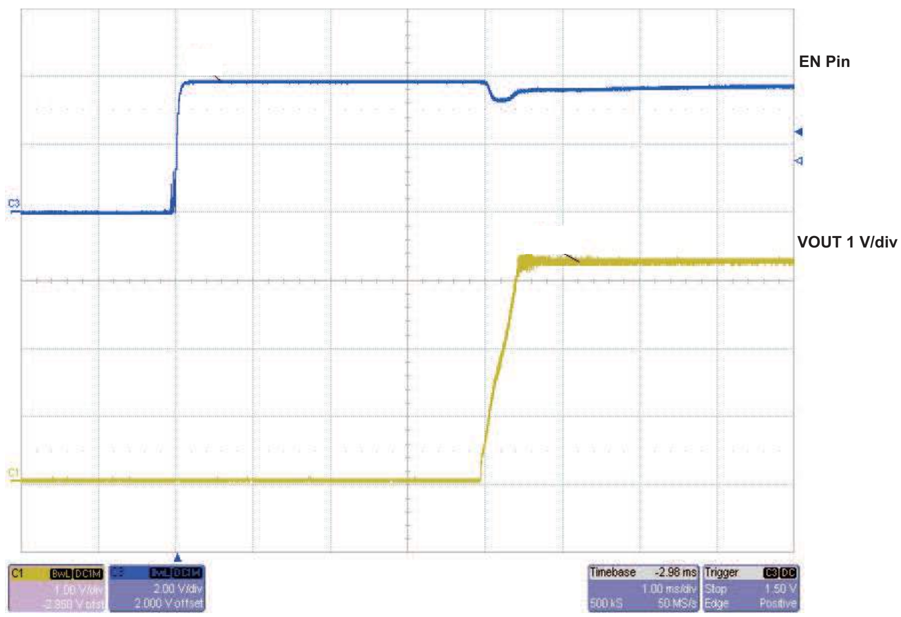

Figure 1. Turn ON Into Electronic Load

2.4 Output Ripple

Output ripple occurs at the switching frequency of 2.4 MHz, and with the recommended L and output C, is low. Amplitude of the ripple varies, depending on load current and input voltage. Ensure that the oscilloscope probe is connected as close as possible to the output capacitor, with a short ground lead, for accurate measurements. Resistance in trace and leads adds to output ripple, and ground lead length increases the amplitude of switching spikes.

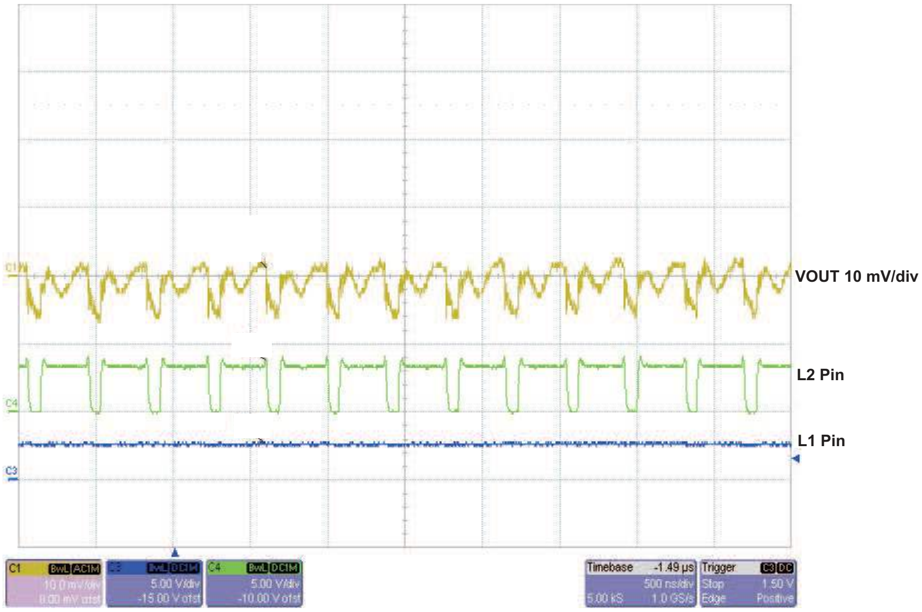

Figure 2. Output Ripple Vin 3 V

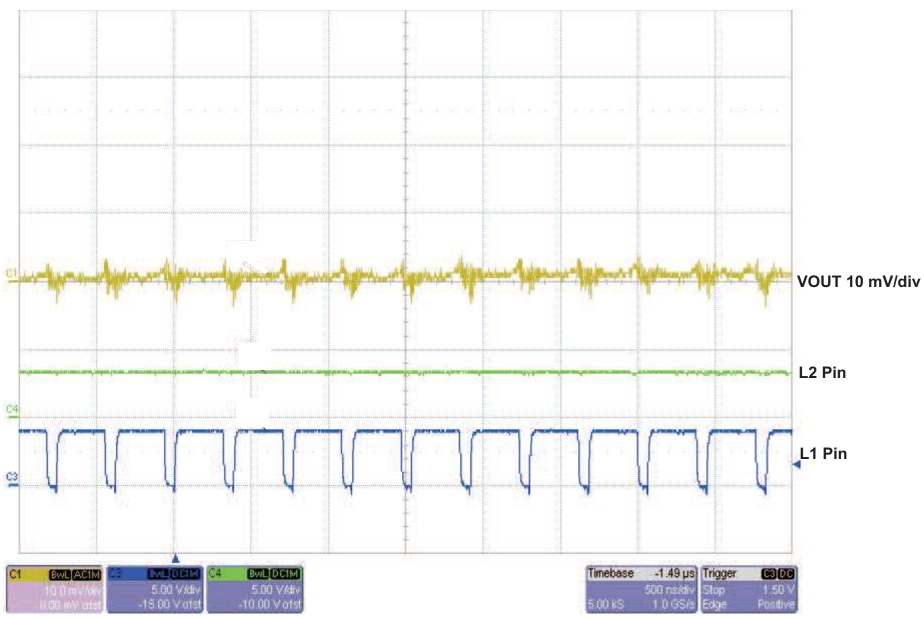

Figure 3. Output Ripple Vin 4 V

2.5 Efficiency

Efficiency of over 90% is common at mid-to-high loads. With power-save mode enabled, efficiency is greater than 80% at light loads of 1 mA to 100 mA.

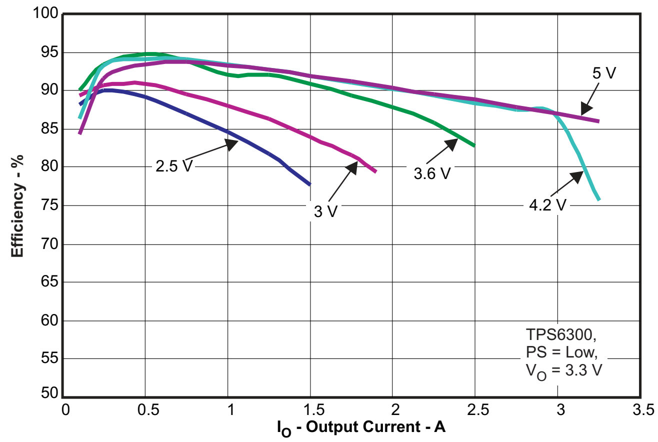

Figure 4. Efficiency Over Li-Ion Cell Range

2.6 Power Dissipation

With high efficiency, the power to be dissipated is low. Also, the QFN package with a solder pad is very efficient at removing heat. Care must be taken, however, to not overheat the device.

2.7 Load Transients

Load transient response is well regulated. Additional output capacitance reduces voltage overshoot and undershoot.

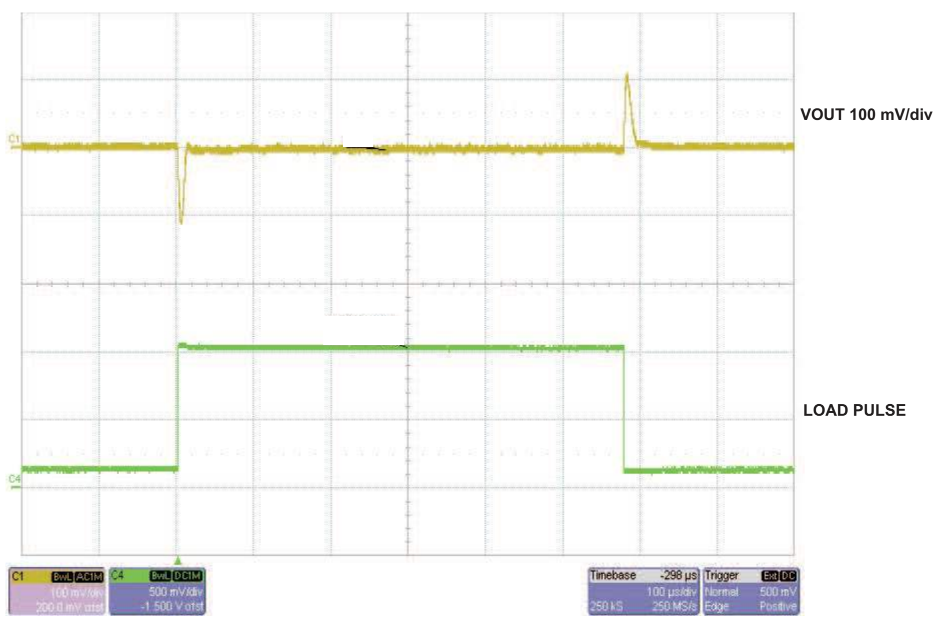

Figure 5. Load Step 100 mA to 500 mA

3 Board Layout

This section provides the TPS63020EVM-487 board layout and illustrations.

3.1 Layout

Figure 6 through Figure 8 show the board layout for the TPS63020EVM-487 PCB.

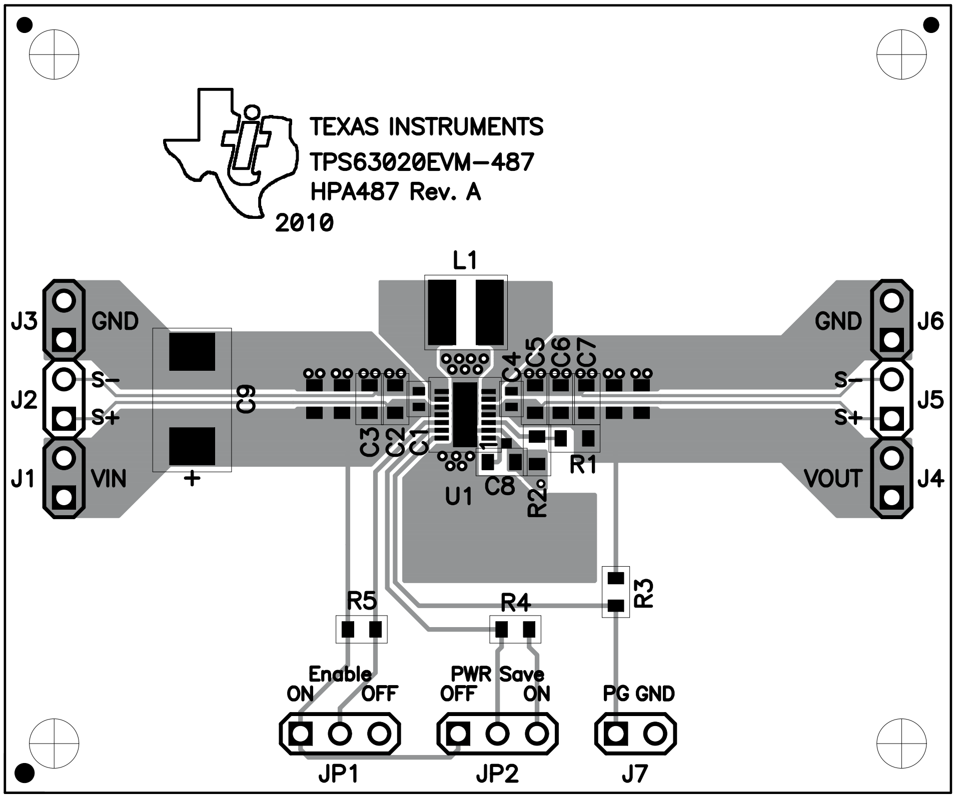

Figure 6. Assembly Layer

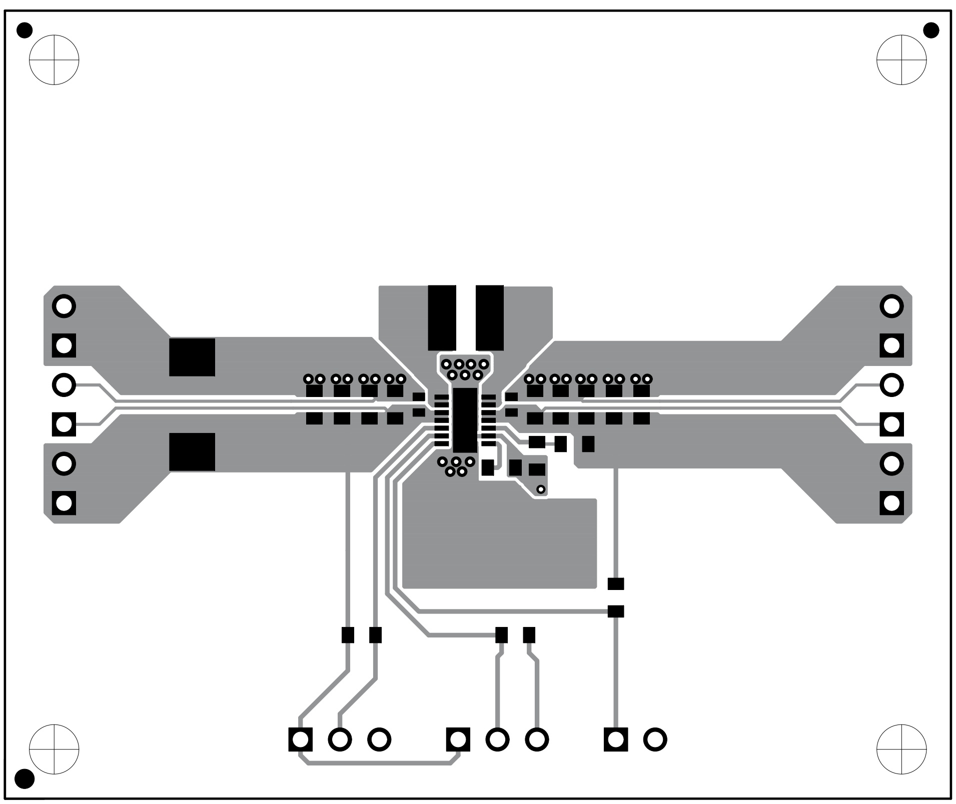

Figure 7. Top Layer Routing

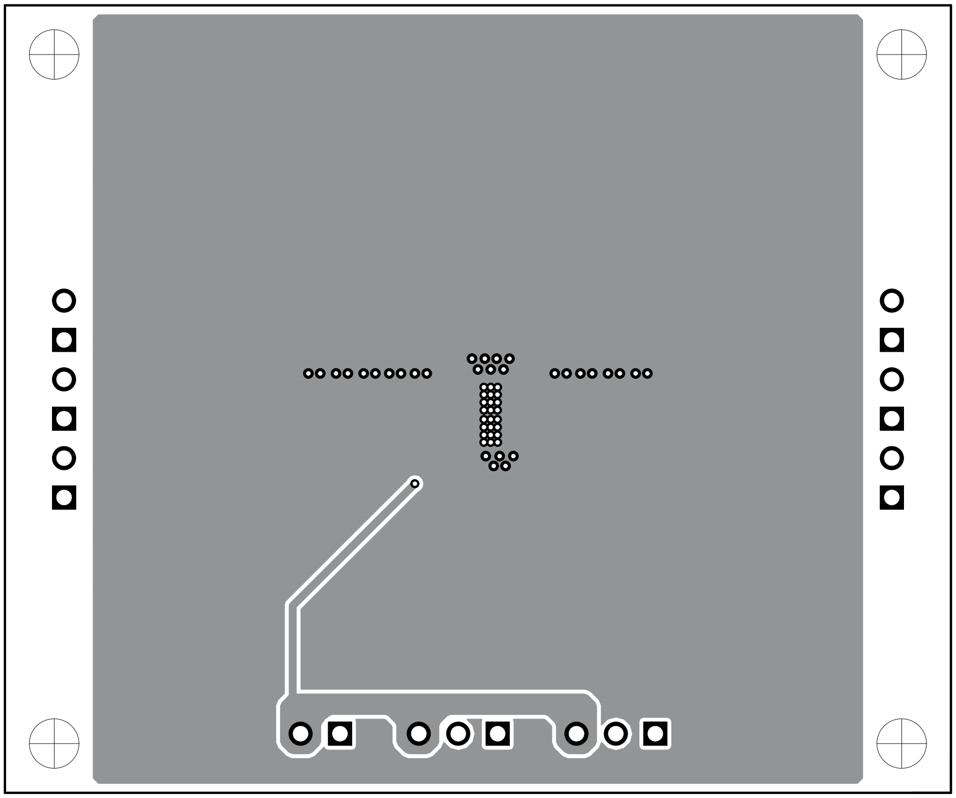

Figure 8. Bottom Layer Routing

4 Schematic and Bill of Materials

This section provides the TPS63020EVM-487 schematic and bill of materials.

4.1 Schematic

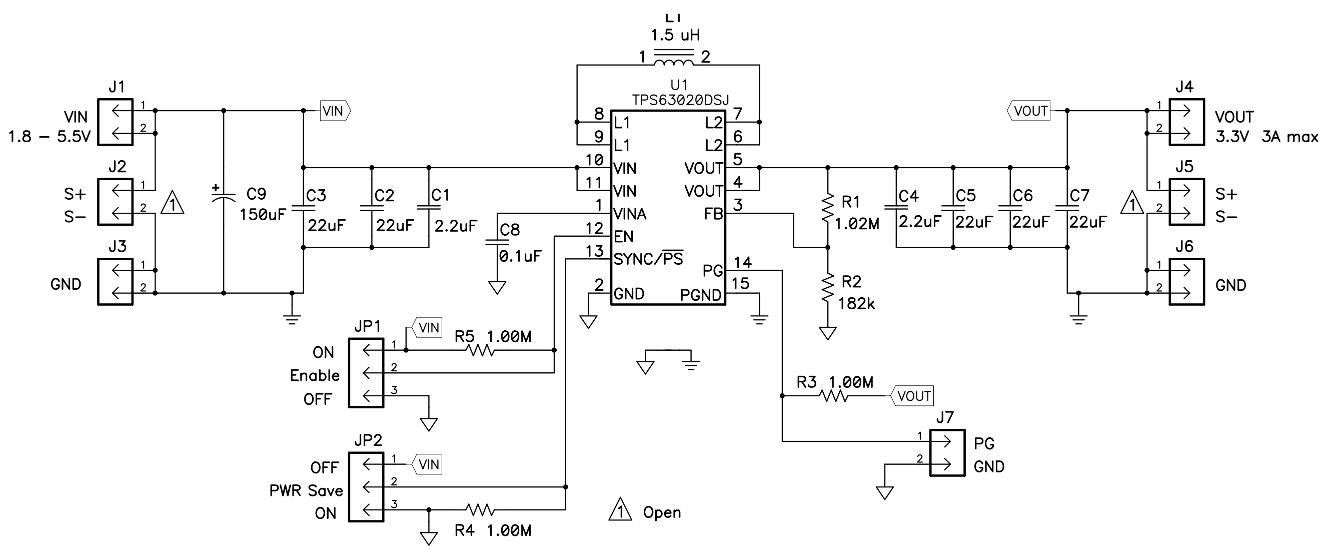

Figure 9. Schematic

4.2 Bill of Materials

Table 2. TPS63020EVM-487 Bill of Materials

Count	RefDes	Value	Description	Size	Part Number	MFR
2	C1, C4	2.2 µF	Capacitor, ceramic, 6.3-V, X5R, 20%	0402	GRM155R60J225ME15D	Murata
5	C2, C3, C5, C6, C7	22 µF	Capacitor, Ceramic, Low Inductance, 6.3V, X5R, 20%	0603	GRM188R60J226MEA0L	Murata
1	C8	0.1 µF	Capacitor, Ceramic, Low Inductance, 25V, X7R, 10%	0603	Std	Std
1	C9	150 µF	Capacitor, Tantalum, SMT, 150uF 10V, 100mOhm	D	B45197A2157K409	Kemet
1	L1	1.5 µH	Inductor, Power, 4.1A, ±20%	0.157 x 0.157 inch	XFL4020-152ME	Coilcraft
1	R1	1.02M	Resistor, chip, 1/16-W, 1%	0603	Std	Std
1	R2	182k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
3	R3, R4, R5	1.00M	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	U1	_	IC, High Efficiency Single Inductor Buck-Boost Converter w/ 4-A Switches	SON-14	TPS63020DSJ	TI

4.3 Related Documentation From Texas Instruments

TPS63020, High-Current, Buck-Boost Converter data sheet (SLVS916)

4.4 If You Need Assistance

Contact your local TI sales representative.

FCC Warnings

This equipment is intended for use in a laboratory test environment only. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to subpart J of part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments 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.

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

EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 3 V to 5.5 V. Maximum recommended output current is 1000 mA with 3.6-V input.

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.

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.

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