TPS63060EVM-619

This user's guide describes the characteristics, operation, and use of the TPS63060EVM evaluation module (EVM). The EVM is designed to help the user easily evaluate and test the operation and functionality of the TPS63060. This user's guide includes setup instructions for the hardware, a schematic diagram, test results of the EVM, a bill of materials, and printed-circuit board layout drawings for the evaluation module.

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1 Introduction

The Texas Instruments TPS63060 is a highly efficient, single-inductor, internally compensated, buck-boost converter in a 10-pin, 3-mm × 3-mm SON package. Both fixed and adjustable output voltage units are available.

1.1 Background

The TPS63060EVM-619 uses the TPS63060 adjustable-output voltage version of the integrated circuit (IC) and is set to a 5-V output. The fixed-output version(s) can be evaluated on this EVM with minor modification as stated in section titled, *Fixed Output Operation*. The EVM operates with an input voltage between 2.5 V and 12 V.

1.2 Performance Specification

Table 1 provides a summary of the TPS63060EVM-619 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		2.5		12	V
Output voltage	I_{OUT} = 0 mA to 1000 mA	2.5	5	8	V
Output current	VIN = 10 V to 12 V	0		1000	mA
	VIN = 5 V to 10 V, VOUT = 5 V	0		2000	mA
	VIN = 2.5 V to 10 V, VOUT = 2.5 V	0		2000	mA
Operating frequency			2400		kHz
Efficiency	5 V in at 1000-mA load		93%		
Output ripple	5 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 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 5 V. Resistors R1 and R2 can be used to set the output voltage between 2.5 V and 8 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 TPS63060EVM-619.

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 the input voltage at the 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 the output voltage at the output capacitor.

2.1.6 J6 – GND

Vout GND return connection for the 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 the power-saving mode; the jumper between the center pin and ON enables automatic transition to power-saving mode at light-load currents as described in the data sheet. The center pin can be used to synchronize the unit with an external clock; see the data sheet for additional details.

2.2 Setup

To operate the EVM, connect an input supply with the positive lead to J1 and negative lead to J3; connect a load with the positive lead to J4 and the negative lead to J6; short EN to ON (pins 1 and 2) of JP1 with a shorting jumper.

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 the switch current to increase. The following data was taken with a 13-Ω load under multiple VIN conditions.

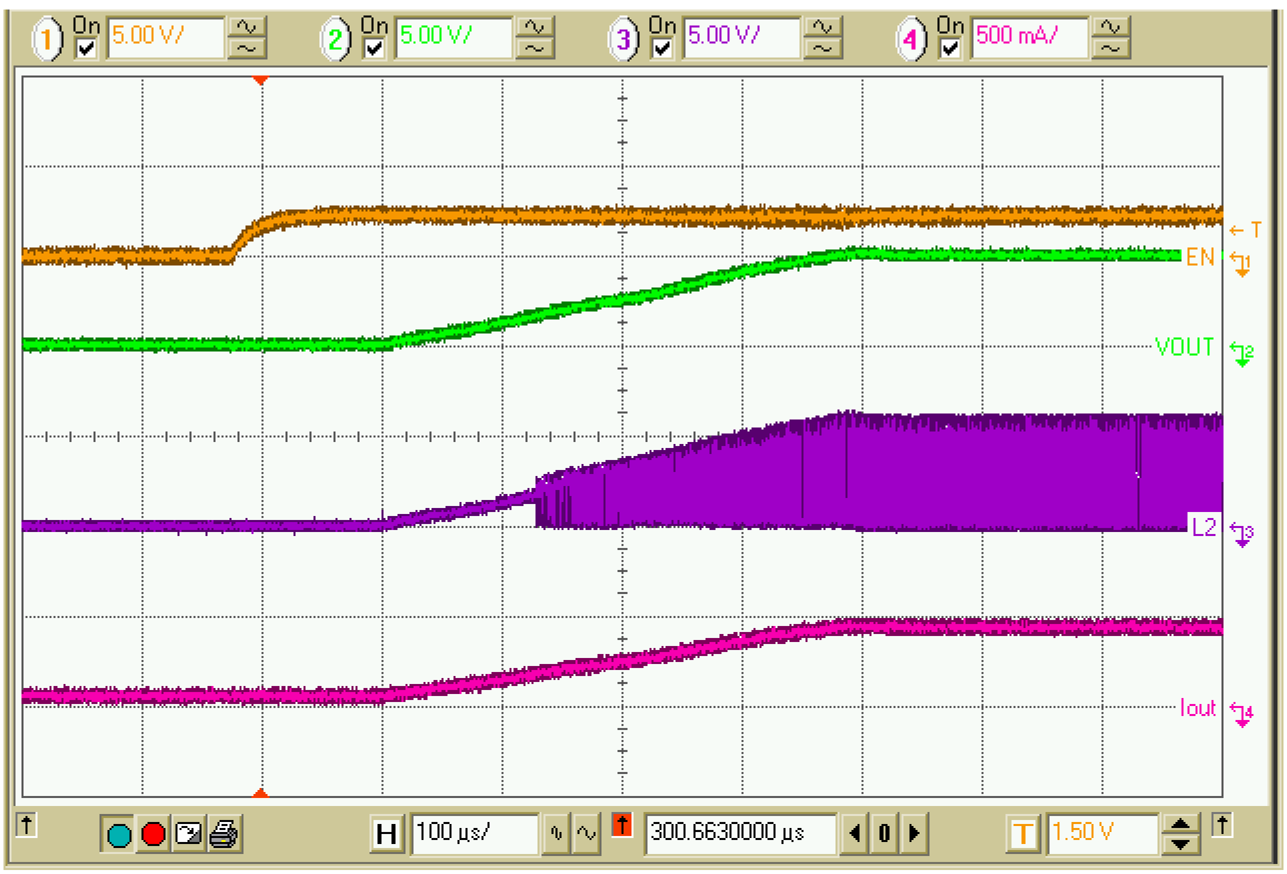

Figure 1. Start-Up With Enable, VIN = 2.5 V

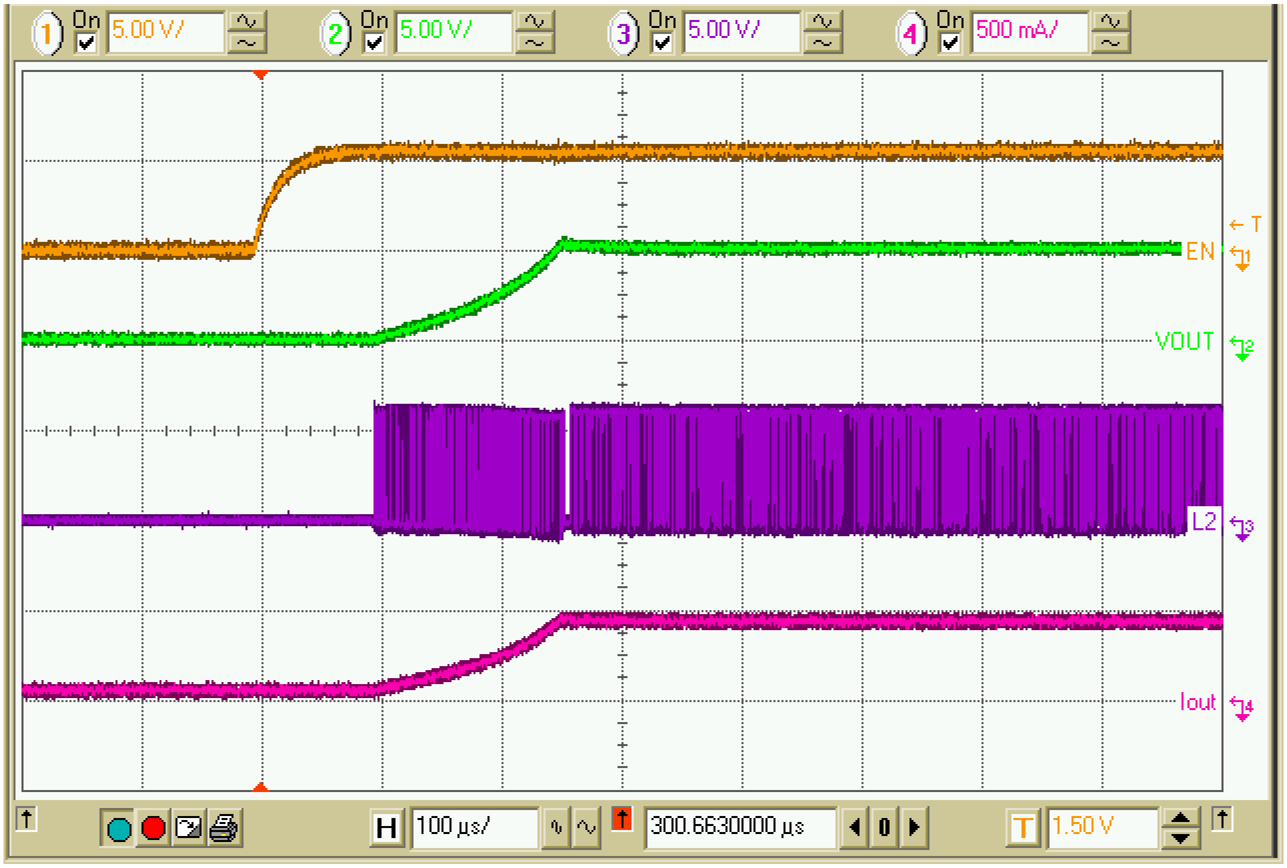

Figure 2. Start-Up With Enable, VIN = 6 V

2.4 Output Ripple

Output ripple occurs at the switching frequency of 2.4 MHz, and with the recommended L and output C, is of low amplitude. The 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. Impedance in trace and probe lead add to output ripple, and ground loop length increases the amplitude of switching spikes. The following dataset was taken with a 250-mA load over multiple input voltages.

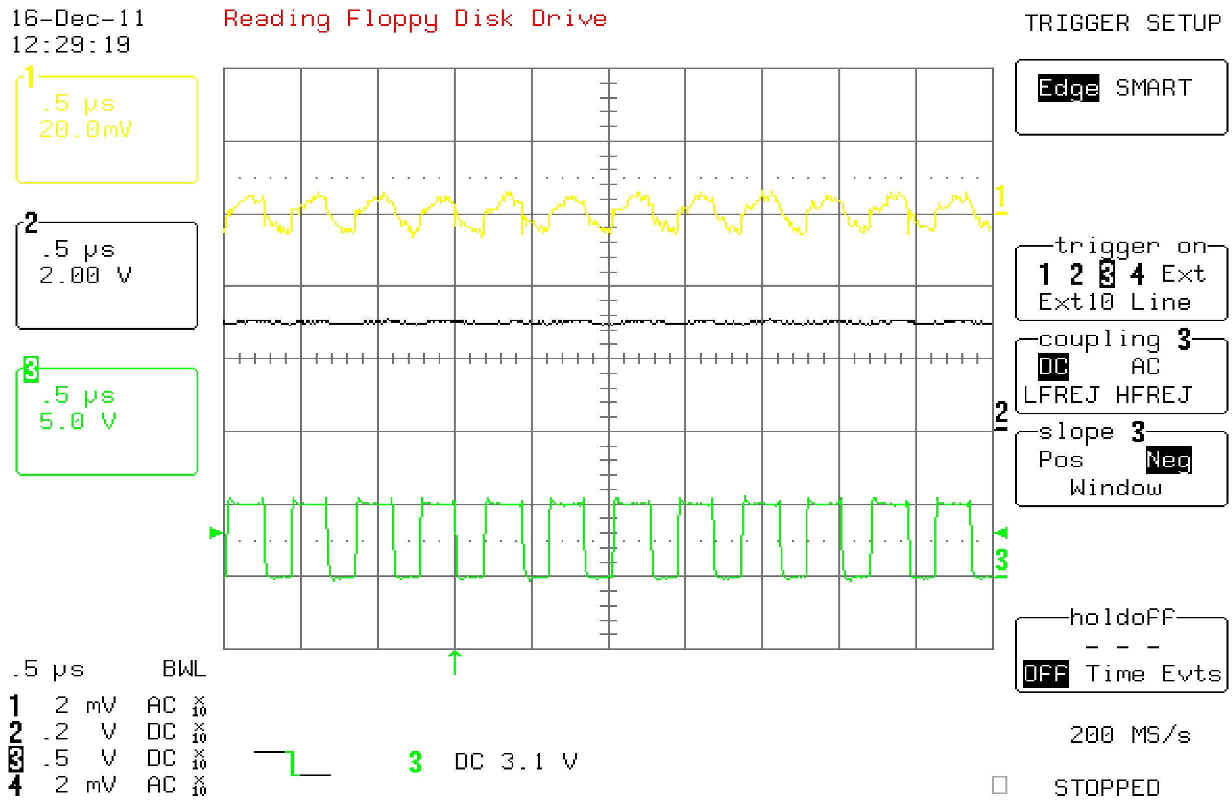

Figure 3. Output Ripple VIN = 3 V

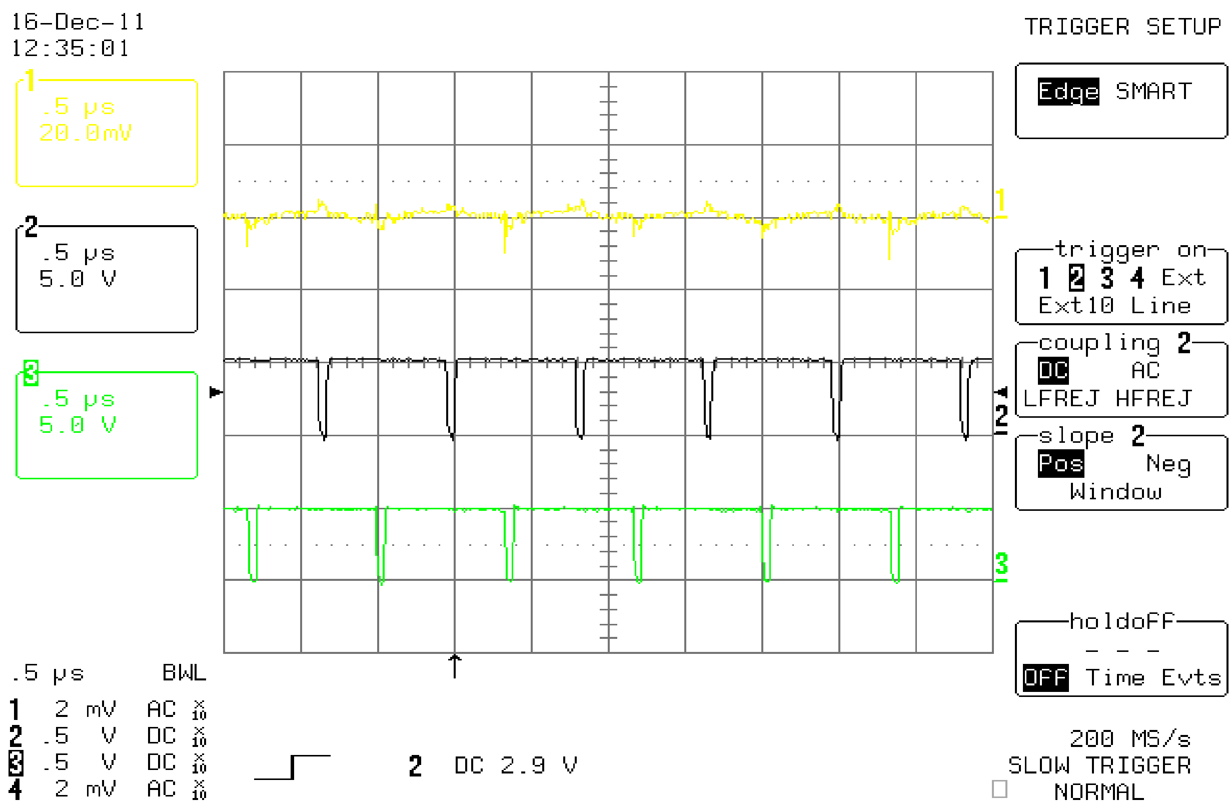

Figure 4. Output Ripple VIN = 5 V

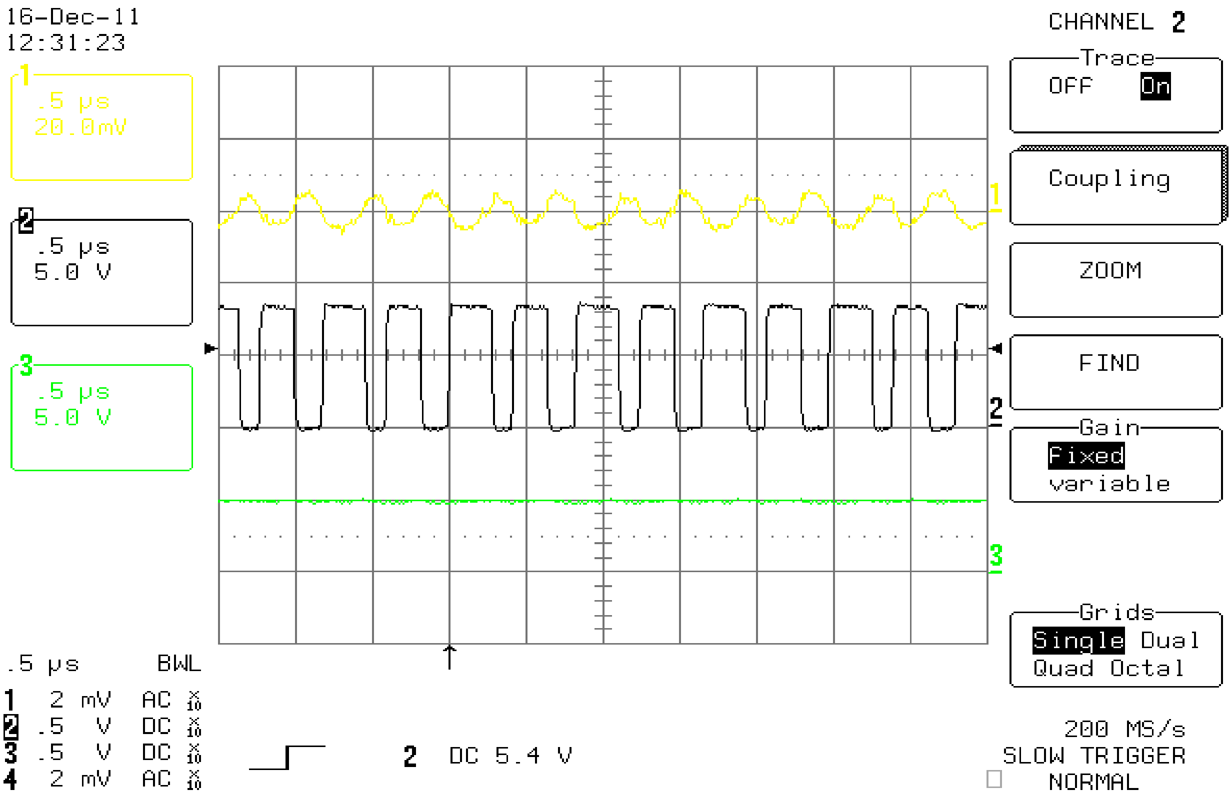

Figure 5. Output Ripple VIN = 8 V

2.5 Power Dissipation

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

2.6 Load Transients

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

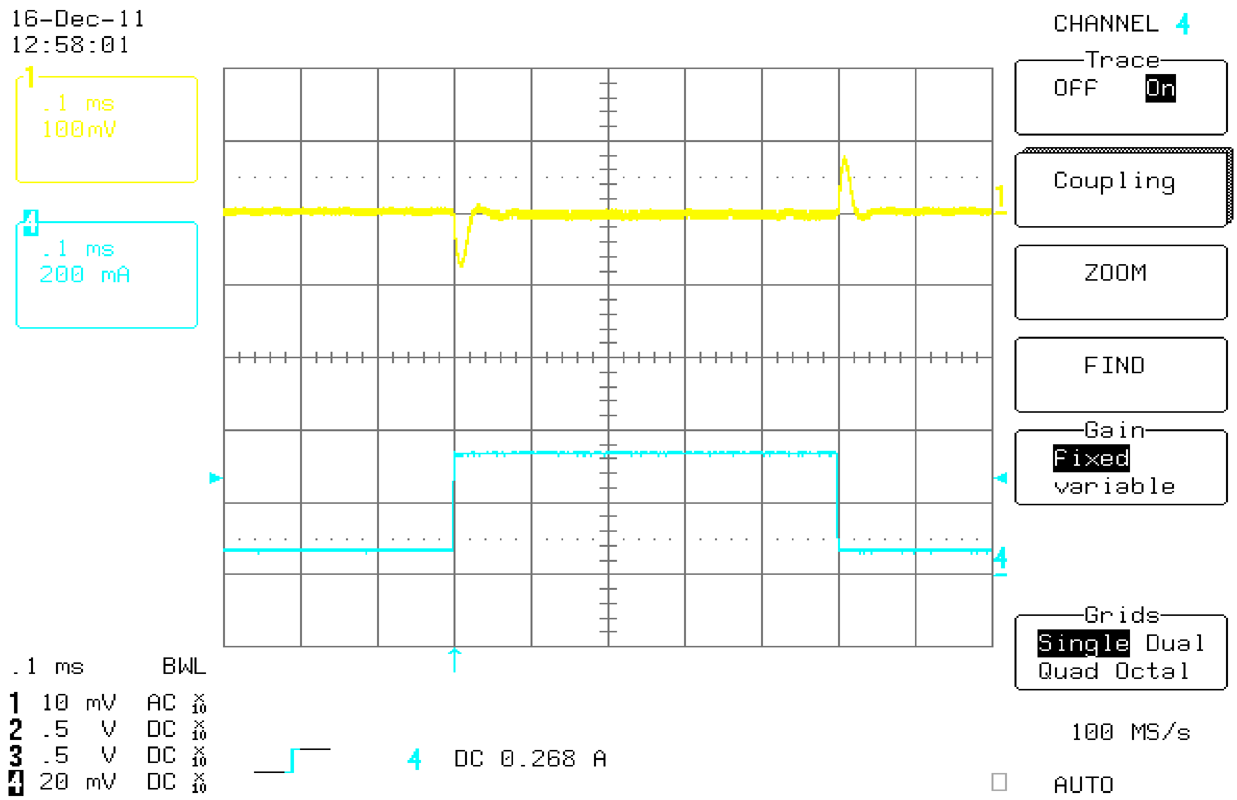

Figure 6. Load Step 100 mA to 500 mA, VIN = 8 V

3 Board Layout

This section provides the TPS63060EVM-619 board layout and illustrations.

3.1 Layout

Figure 7 through Figure 9 show the board layout for the TPS63060EVM-619 PCB.

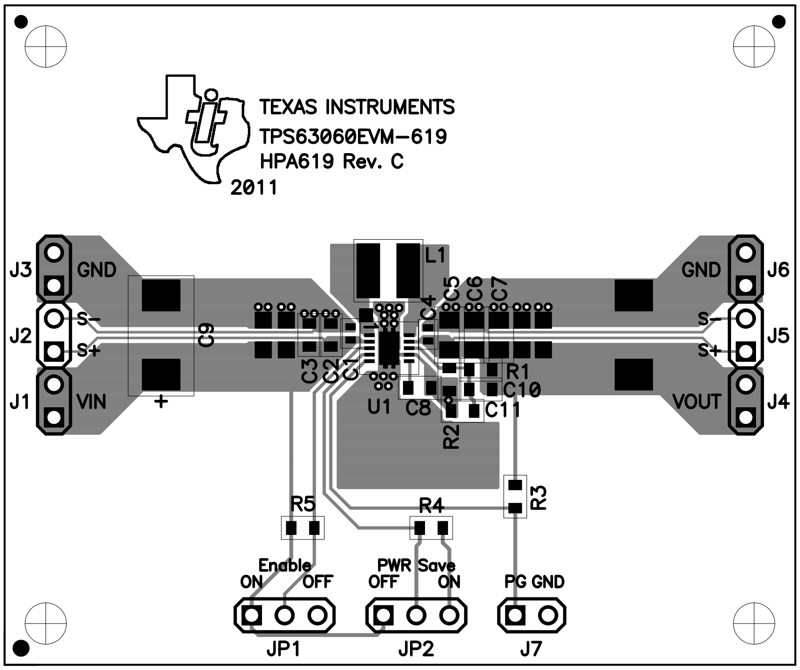

Figure 7. Assembly Layer

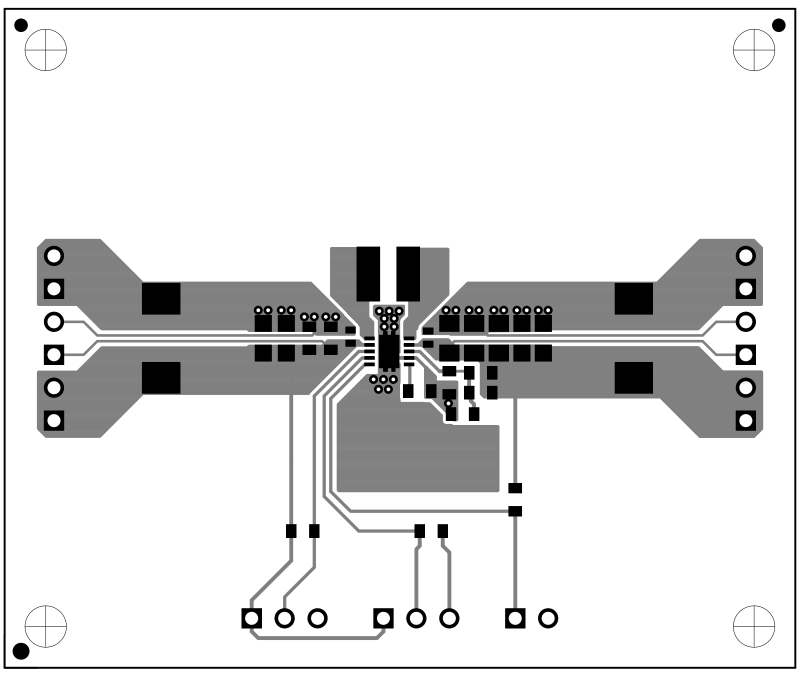

Figure 8. Top Layer Routing

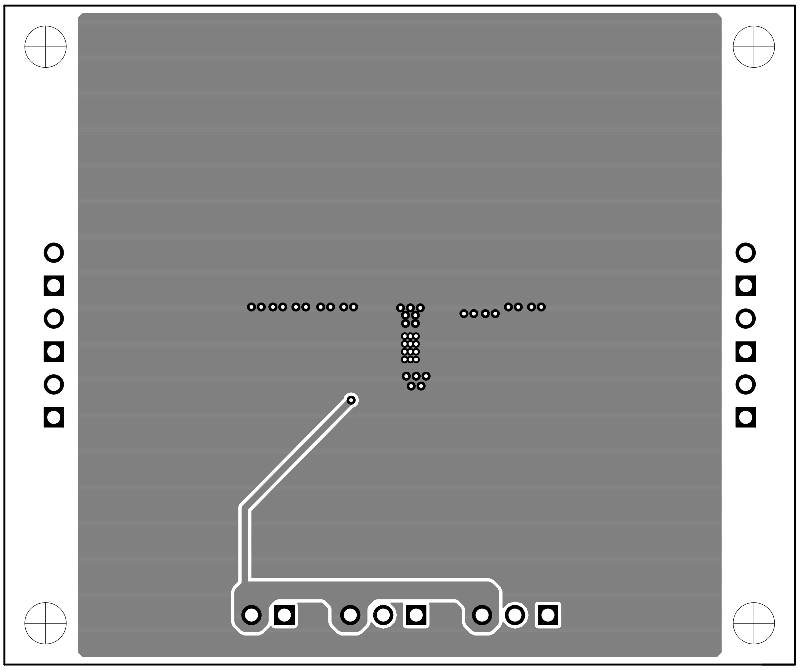

Figure 9. Bottom Layer Routing

4 Schematic and Bill of Materials

This section provides the TPS63060EVM-619 schematic and bill of materials.

4.1 Schematic

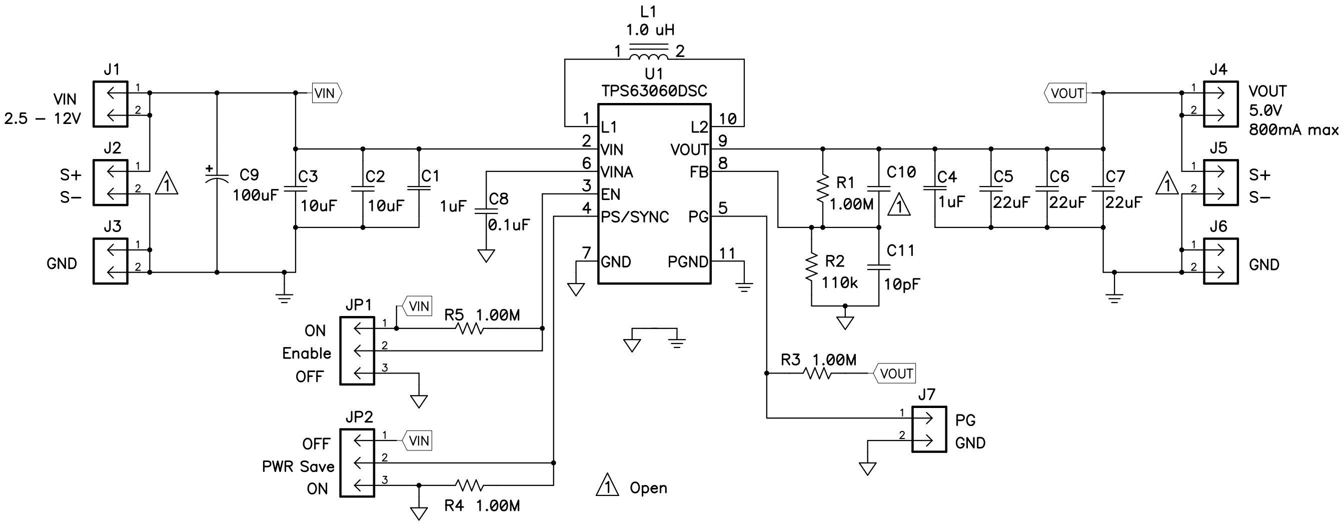

Figure 10. Schematic

4.2 Bill of Materials

Table 2. TPS63060EVM-619 Bill of Materials

Count	RefDes	Value	Description	Size	Part Number	MFR
1	C1	1uF	Capacitor, Ceramic, 16V, X5R, 10%	402	GRM155R61C105KA12D	Murata
1	C4	1uF	Capacitor, Ceramic, 10V, X5R, 10%	402	Std	Std
1	C8	0.1uF	Capacitor, Ceramic, 25V, X7R, 10%	603	Std	Std
0	C10	10pF	Capacitor, Ceramic, 25V, X5R, 20%	603	Std	Std
1	C11	10pF	Capacitor, Ceramic, 6.3V, X5R, 20%	603	Std	Std
5	C12, C13, C5, C6, C7	22uF	Capacitor, Ceramic, 10V, X5R, 20%	805	Std	Std
2	C2, C3	10uF	Capacitor, Ceramic, 25V, X5R, 20%	603	GRM188R61E106MA73	Murata
1	C9	100uF	Capacitor, Tantalum, SMT, 100uF, 25V, 10%	X	T491X107K025AT	Kemet
1	L1	1uH	Inductor, Power, 4.5 A, ±20%	0.157 x 0.157 inch	XFL4020-102ML	Coilcraft
5	R1, R3, R4, R5	1.00M	Resistor, Chip, 1/16W, 1%	603	Std	Std
5	R2	110k	Resistor, Chip, 1/16W, 1%	603	Std	Std
1	U1	TPS63060DSC	IC, High Input Voltage Single Inductor Buck-Boost Converter	SON-1	TPS63060DSC	TI

4.3 Related Documentation From Texas Instruments

TPS63060, High Input Voltage Buck-Boost Converter With 2A Switch Current data sheet (SLVSA92)

4.4 If You Need Assistance

Contact your local TI sales representative.

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EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of 5 V to 24 V and the output voltage range of VIN to 17.4 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.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. 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 25°C. The EVM is designed to operate properly with certain components above 25°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.