TPS6261x/TPS6262x/TPS6266xEVM

This user's guide describes the characteristics, operation, and use of the TPS6261x/2x/6xEVM-419 evaluation module (EVM). The TPS626xxEVM-419 is a fully assembled and tested platform for evaluating the performance of the TPS6261x/2x/6x high-frequency, synchronous, step-down dc-dc converters optimized for battery-powered portable applications. This document includes schematic diagrams, a printed circuit board (PCB) layout, bill of materials, and test data. Throughout this document, the abbreviations *EVM*, *TPS626xxEVM*, *TPS6261x/2x/6xEVM*, and the term *evaluation module* are synonymous with the TPS6261x/2x/6xEVM-419 unless otherwise noted.

Contents

List of Figures

1 Introduction

The TPS6261x, TPS6262x, and TPS6266x devices are series of high-frequency, synchronous, step-down dc-dc converters optimized for battery-powered portable applications. Intended for low-power applications, the TPS6261x, TPS6262x, and TPS6266x support up to 350-mA load current, and allow the use of low-cost chip inductors and capacitors. With a wide input voltage range of 2.3 V to 5.5 V, the devices support applications powered by lithium-ion (Li-Ion) batteries with extended voltage ranges. Different fixed voltage output versions of the TPS6261x, TPS6262x, and TPS6266x are available from 1.2 V to 2.3 V. These converters operate at a regulated 6-MHz switching frequency and enter a power-save mode operation under light load currents in order to maintain high efficiency over the entire load current range. A PFM mode extends the battery life by reducing the quiescent current to 31 µA (typ) during light load operation.

1.1 Features

- Input voltage range: 2.3 V up to 5.5 V
- Fixed output voltages
- Up to 2.0-A output current
- 6-MHz regulated frequency operation
- Output capacitor discharge (optional)
- Total solution size: < 12 mm^2

1.2 Applications

- Cell phones, smart phones
- WLAN, GPS, and Bluetooth® applications
- DTV tuners
- DC/DC micro-modules

1.3 EVM Ordering Options

Table 1 provides the ordering information for the various EVM options.

Table 1. Ordering Information

Orderable EVM Number	Device Part Number	Output Voltage	Maximum Output Current	Device Specific Feature
TPS62615EVM-419	TPS62615	1.2 V	350 mA	
TPS62621EVM-419	TPS62621	1.8 V	600 mA	
TPS62622EVM-419	TPS62622	1.5 V	600 mA	
TPS62624EVM-419	TPS62624	1.2 V	600 mA	Output capacitor discharge
TPS62625EVM-419	TPS62625	1.2 V	600 mA	
TPS62660EVM-419	TPS62660	1.8 V	1000 mA	

2 TPS6261x/2x/6xEVM Electrical Performance Specifications

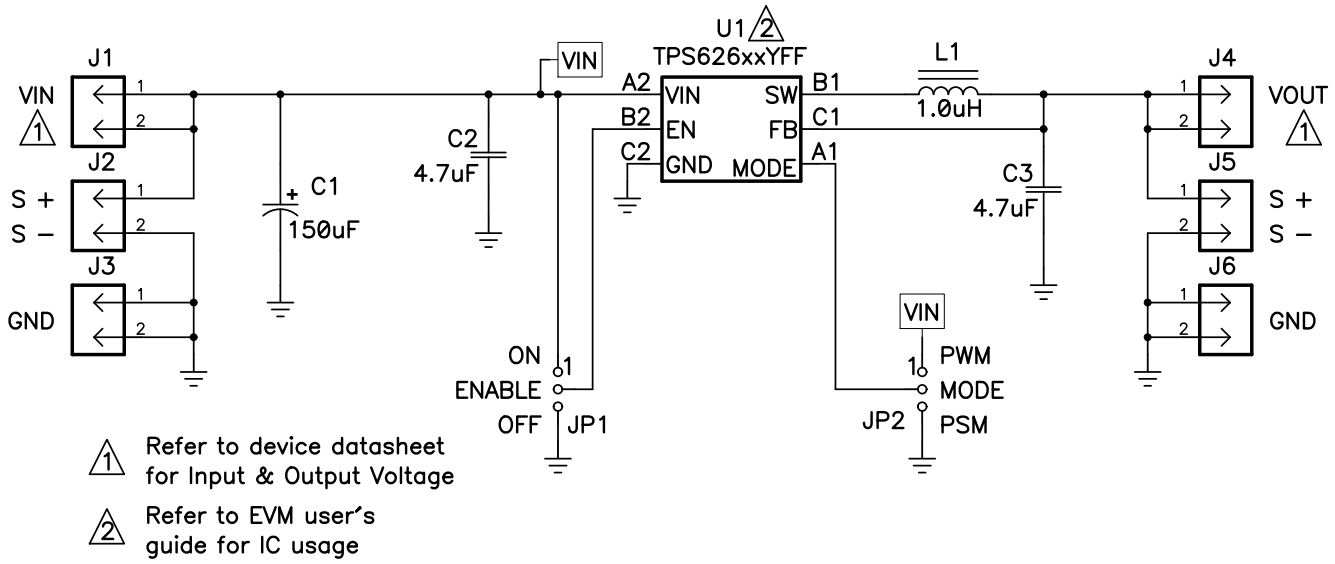
Table 2 summarizes the TPS6261x/2x/6xEVM-419 performance specifications.

Table 2. TPS6261x/2x/6xEVM Performance Characteristics

Parameter		Notes and Conditions	Min	Typ	Max	Unit
INPUT CHARACTERISTICS						
V_{IN}	Input voltage		2.2		5.5	V
V_{IN_UVLO}	Input UVLO			2.05	2.1	V
I_Q	Operating quiescent current	I_O = 0 mA, device not switching		31	55	µA
		I_O = 0 mA, PWM mode		7.6		mA
OUTPUT CHARACTERISTICS						
TPS6261x TPS6262x TPS6266x	Regulated dc output voltage	2.3 V < V_{IN} < 4.8 V , 0 mA < I_{OUT} < 600 mA (PFM/PWM)	0.98 x V_{NOM}	V_{NOM}	1.03 x V_{NOM}	V
		2.3 V < V_{IN} < 5.5 V , 0 mA < I_{OUT} < 600 mA (PFM/PWM)	0.98 x V_{NOM}	V_{NOM}	1.04 x V_{NOM}	V
		2.3 V < V_{IN} < 5.5 V , 0 mA < I_{OUT} < 600 mA (PWM)	0.98 x V_{NOM}	V_{NOM}	1.02 x V_{NOM}	V
	Line regulation			0.13		%/V
	Load regulation			–0.0003		%/A
I_{OUT}	Output current	TPS6261x			350	mA
		TPS6262x			600	mA
		TPS6266x			1000	mA
SYSTEM CHARACTERISTICS						
f_{SW}	Switching frequency		5400	6000	6600	kHz
ηpk	Peak efficiency	V_{IN} = Nom			91	%

3 TPS626xxEVM Schematic

Figure 1 illustrates the TPS626xxEVM-419 schematic.



NOTE: For reference only; see Table 3 for specific values.

Figure 1. TPS626xxEVM Schematic

4 Connector and Test Point Descriptions

4.1 Input / Output Connectors: TPS626xxEVM

4.1.1 J1 VIN

This header is the positive connection to the input power supply. The power supply must be connected between J1 and J3 (GND). The leads to the input supply should be twisted and kept as short as possible. The input voltage must be between 2.3 V and 5.5 V.

4.1.2 J2 S+/S–

J2 S+/S– are the sense connection for the input of the converter. Connect a voltmeter, sense connection of a power supply, or oscilloscope to this header.

4.1.3 J3 GND

This header is the return connection to the input power supply. Connect the power supply between J3 and J1 (VIN). The leads to the input supply should be twisted and kept as short as possible. The input voltage must be between 2.3 V and 5.5 V.

Capacitor C1 compensates for parasitic inductance as a result of the wires from the dc power supply to the EVM. It is not required in an actual application circuit.

4.1.4 J4 VOUT

This header is the positive output of the step-down converter. The output voltage of the devices in the TPS6261x/TPS6262x/TPS6266x families have fixed output voltages; refer to the specific device data sheet for detailed information on the device output voltage.

4.1.5 J5 S+/S–

J5 S+/S– are the sense connection for the output of the converter. Connect a voltmeter, sense connection of an electronic load, or oscilloscope to this header.

4.1.6 J6 GND

J6 is the return connection of the converter. A load can be connected between J6 and J4 (VOUT).

4.2 Jumpers and Switches

4.2.1 JP1 ENABLE

This jumper enables/disables the converter on the EVM. Placing a shorting bar between ENABLE and ON turns on the converter. Placing a shorting bar between ENABLE and OFF disables the converter.

4.2.2 JP2 MODE

This jumper enables/disables the power-saving mode under light loads. Placing a shorting bar between MODE and PWM disables the power-saving mode. If the power-save mode is disabled, the converter operates in forced PWM mode over the entire load current range.

Placing a shorting bar between MODE and PSM enables the power-saving mode. The device operates in power-saving mode under light load conditions. See the specific device data sheet for detailed information.

5 Test Configuration

5.1 Hardware Setup

Figure 2 illustrates a typical hardware test configuration.

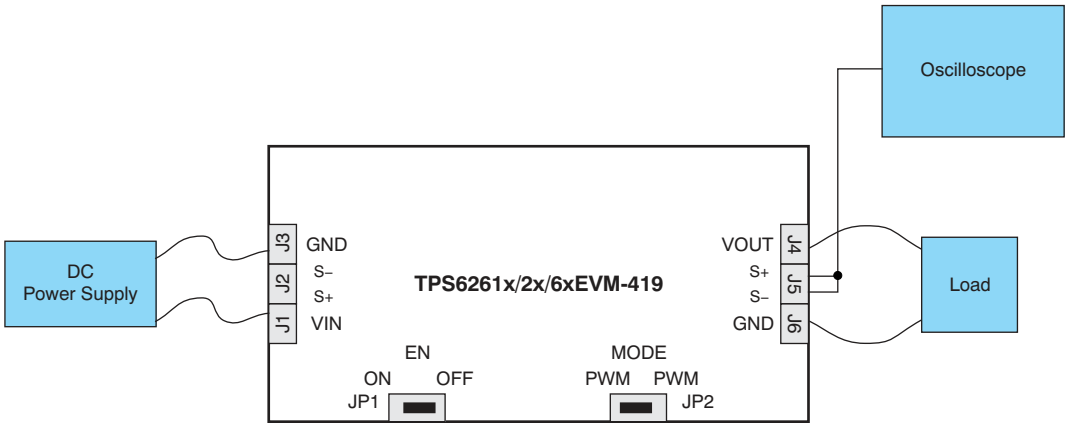


Figure 2. Hardware Board Connection

5.2 Procedure

Follow these procedures when configuring the EVM for testing.

CAUTION

Many of the components on the TPS6261x/2x/6xEVM-419 are susceptible to damage by electrostatic discharge (ESD). Customers are advised to observe proper ESD handling precautions when unpacking and handling the EVM, including the use of a grounded wrist strap, bootstraps, or mats at an approved ESD workstation. An electrostatic smock and safety glasses should also be worn.

1. Work at an ESD workstation. Make sure that any wrist straps, bootstraps, or mats are connected and reference the user to earth ground before power is applied to the EVM. Electrostatic smock and safety glasses should also be worn.
2. Connect a dc power supply between J1 and J2 on the TPS626xxEVM. Note that the input voltage should range from 2.3 V to 5.5 V. Keep the wires from the input power supply to EVM as short as possible and twisted.
3. Connect a dc voltmeter or oscilloscope to the output sense connection of the EVM.
4. A load can be connected between J4 and J6 on the TPS626xxEVM.
5. To enable the converter, connect the shorting bar on JP1 between ENABLE and ON on the TPS626xxEVM.
6. The TPS626xxEVM has a feature that allows users to switch between Power-Save Mode under light loads and forced PWM mode, with jumper JP2.

6 TPS626xxEVM Test Data

Figure 5 through Figure 11 present typical performance graphs for the TPS626xxEVM. Actual performance data can be affected by measurement techniques and environmental variables; therefore, these curves are presented for reference and may differ from actual results obtained by some users.

6.1 Efficiency

Figure 3 through Figure 8 show the typical efficiency performance for the TPS626xxEVM.

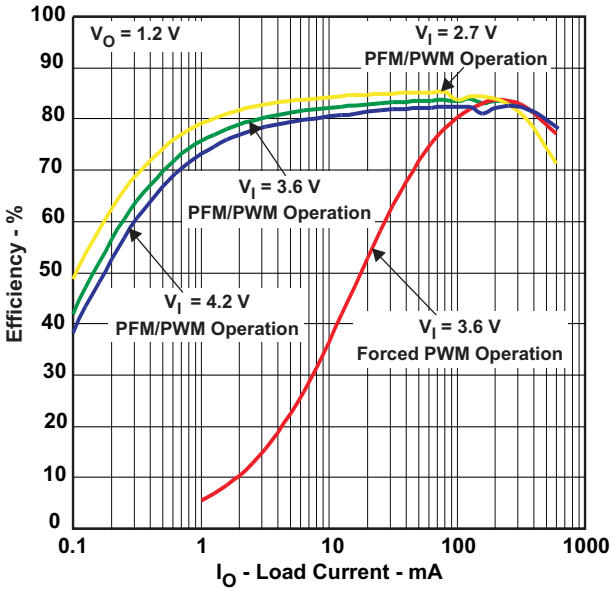


Figure 3. TPS6262xEVM Efficiency versus Load Current (VIN = 2.7 V)

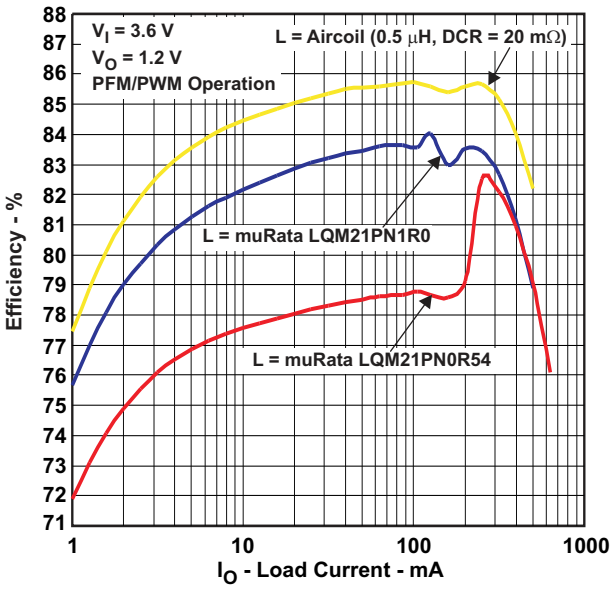


Figure 4. TPS6262x and TPS6262xEVM Efficiency versus Load Current (VIN = 3.6 V)

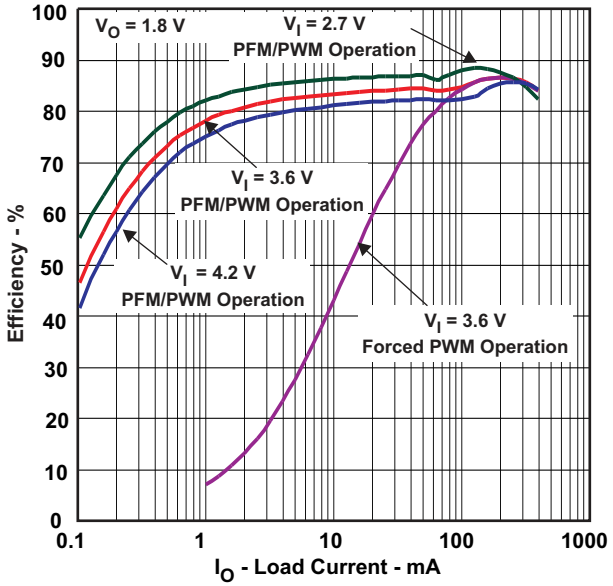


Figure 5. TPS6261xEVM Efficiency versus Load Current (V_{OUT} = 1.8 V)

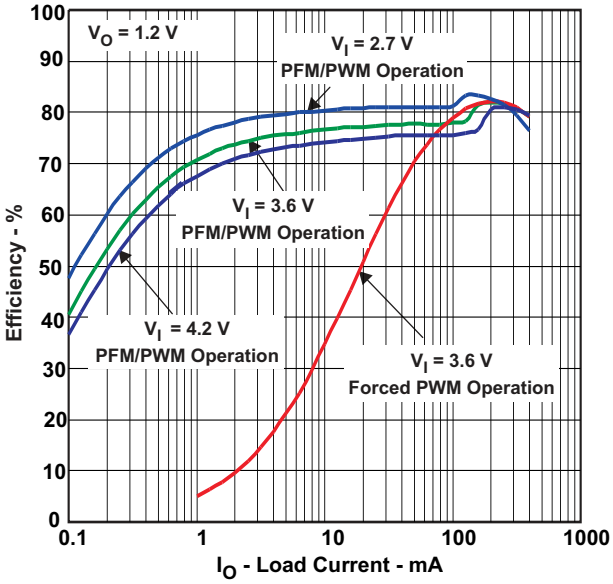


Figure 6. TPS6261xEVM Efficiency versus Load Current (V_{OUT} = 1.2 V)

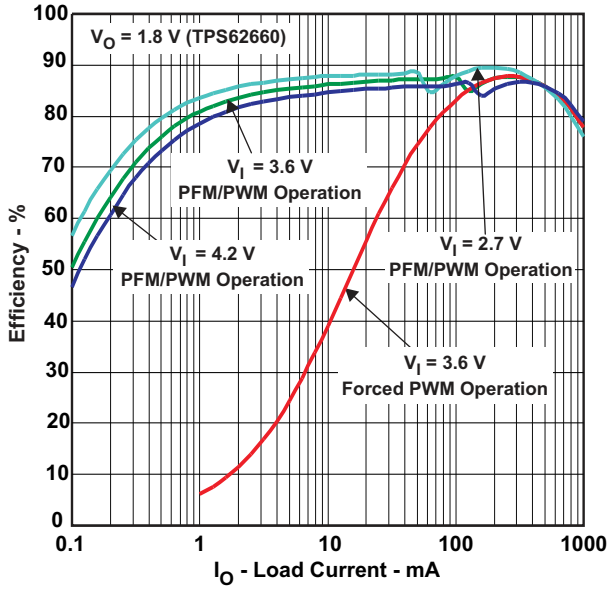


Figure 7. TPS6266xEVM Efficiency versus Load Current (V_{OUT} = 1.8 V)

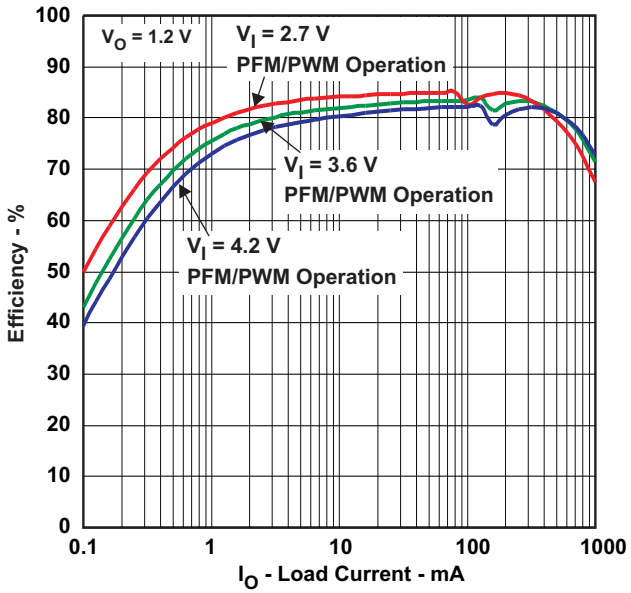


Figure 8. TPS6266xEVM Efficiency versus Load Current (V_{OUT} = 1.2 V)

6.2 Start-Up

Figure 9 through Figure 11 show the typical start-up performance for different TPS626xxEVM boards.

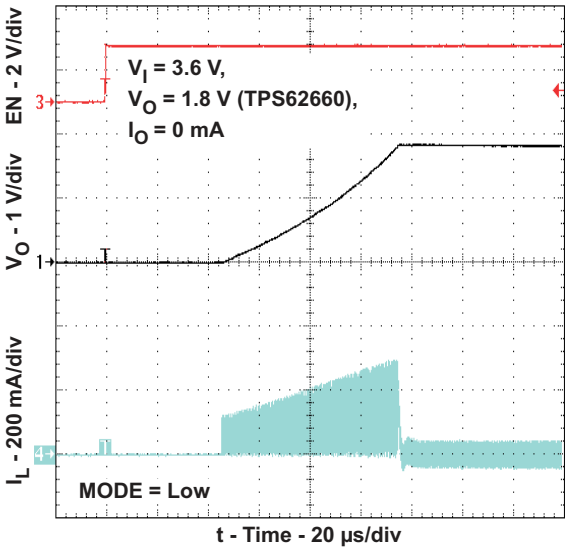


Figure 9. TPS62660EVM Startup

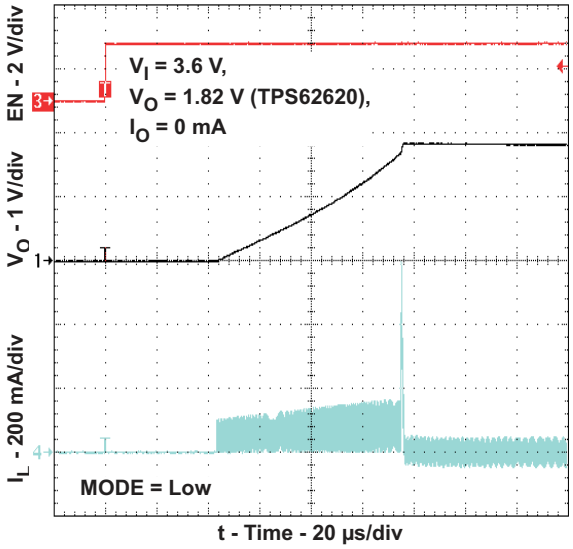


Figure 10. TPS62620EVM Start-Up

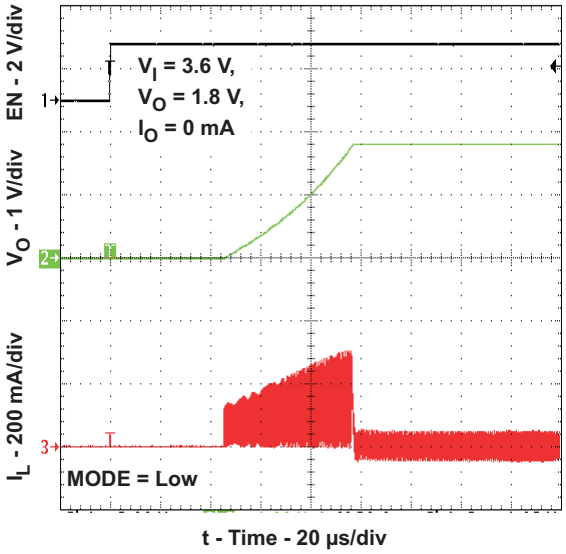


Figure 11. TPS6261xEVM Start-Up

6.3 Output Voltage Ripple (Power-Save Mode)

Figure 12 illustrates the typical output voltage ripple for the TPS626xx in power-save mode.

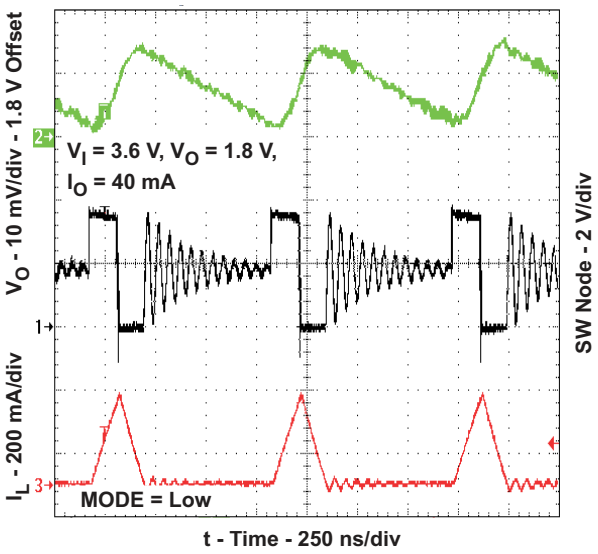


Figure 12. Power-Save Mode Ripple

6.4 Output Voltage Ripple (PWM)

Figure 13 illustrates the typical output voltage ripple for the TPS626xx in PWM mode.

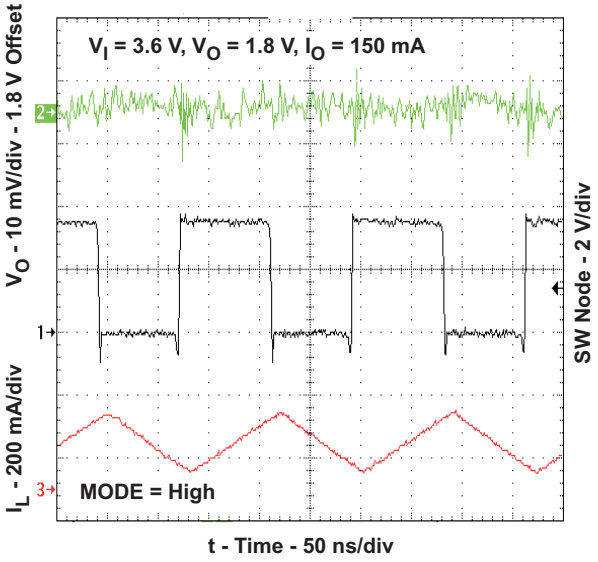


Figure 13. PWM Output Ripple

7 TPS626xxEVM Assembly Drawings and Layout

Figure 14 through Figure 16 show the design of the show the design of the TPS6261x/2x/6xEVM-419 printed circuit boards. The EVM has been designed using a two-layer, 1-ounce copper-clad PCB with all components in an active area on the top side of the board. Moving components to both sides of the PCB or using additional internal layers can offer additional size reduction for space-constrained systems.

NOTE: Board layouts are not to scale. These figures are intended to show how the board is laid out; they are not intended to be used for manufacturing TPS6261x/2x/6xEVM-419 PCBs.

Note the connection of the TPS626xx feedback (FB) pin. It is recommended to connect the FB pin directly to the inductor, not directly on the V_{OUT} connection of the output capacitor. The connection to the inductor is recommended because it provides better transient response performance.

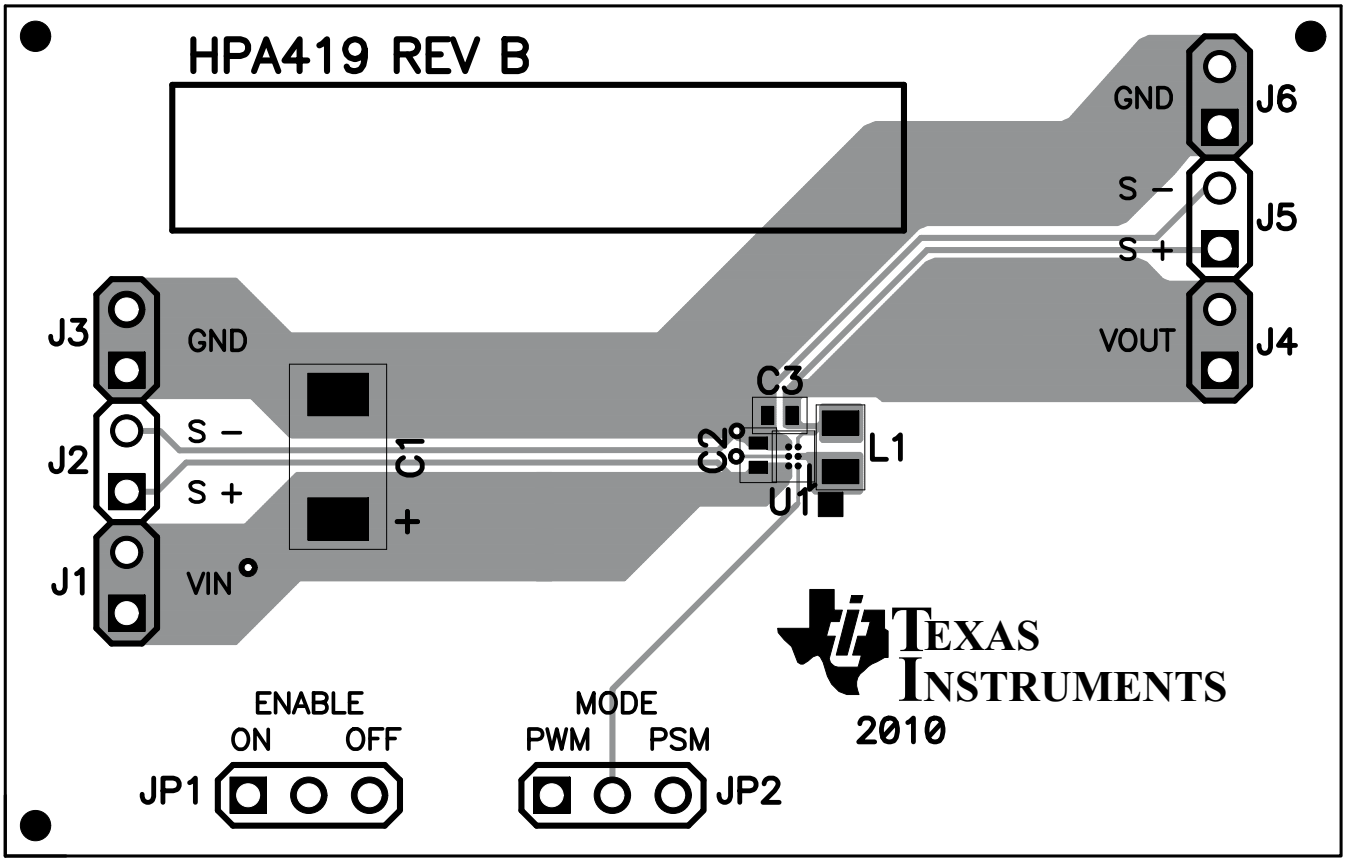


Figure 14. TPS626xxEVM Component Placement (Top View)

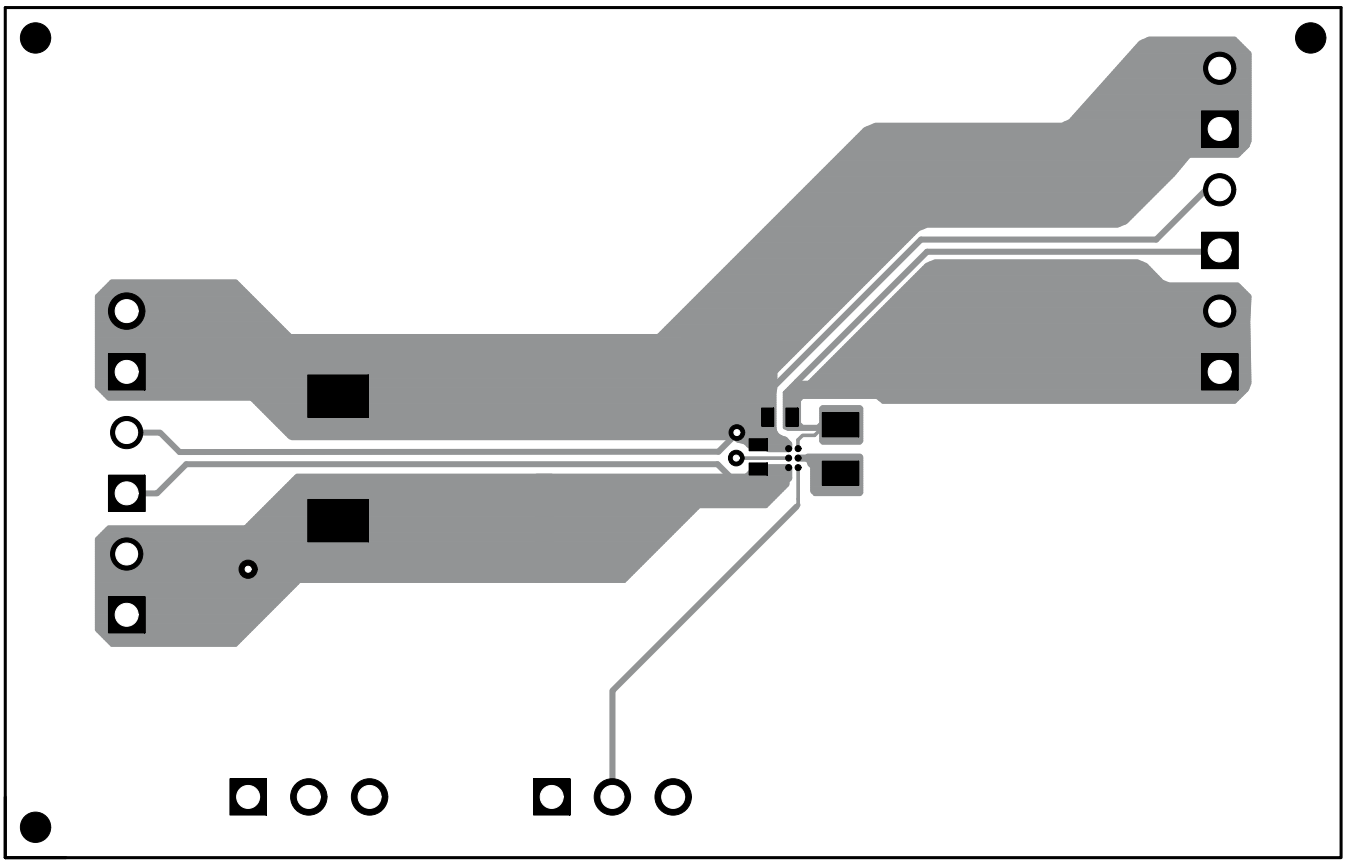


Figure 15. TPS626xxEVM Top-Side Copper (Top View)

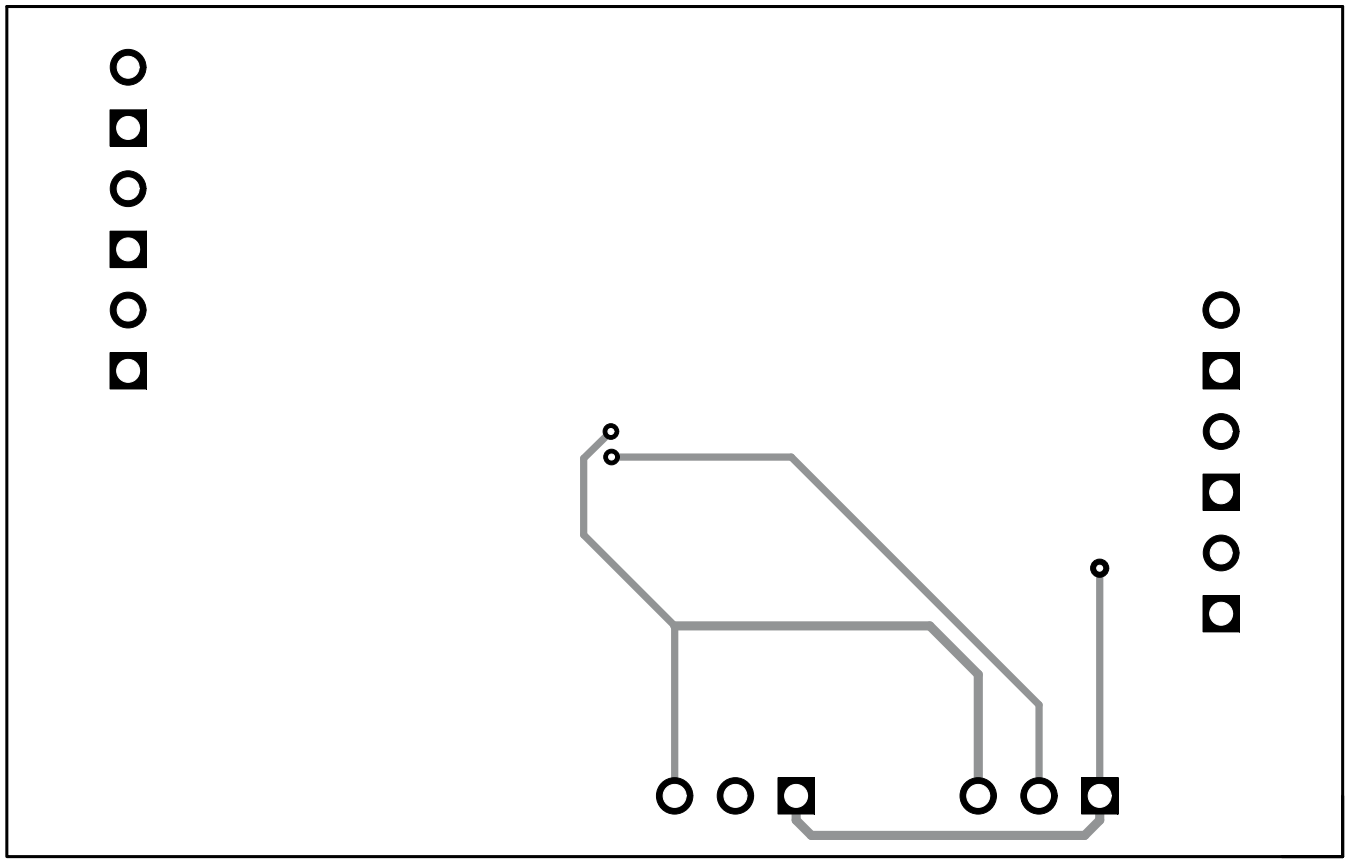


Figure 16. TPS626xxEVM Bottom-Side Copper (Bottom View)

8 Bill of Materials

Table 3 lists the bill of materials for the TPS626xxEVM.

Table 3. TPS626xxEVM-419 Bill of Materials

EVM Device Option: Count						RefDes	Value	Description	Size	Part Number
-001	-002	-003	-004	-005	-006					
1	1	1	1	1	1	C1	150 µF	Capacitor, Tantalum, 6.3 V, 18 mΩ, 20%	6032	6TPE150MIC2
2	2	2	2	2	2	C2, C3*	4.7 µF	Capacitor, Ceramic, 6.3V, X5R, 20%	0402	GRM155R60J475ME87
0	0	0	0	1	0	L1	1.0 µH	Inductor, SMT, 800 mA, 190 mΩ	2012	LQM21PN1R0MC0
1	1	1	1	0	1	L1	1.0 µH	Inductor, SMT, 800 mA, 190 mΩ	2012	LQM21PN1R0NGR
1	0	0	0	0	0	U1	TPS62621YFF	IC, 500mA, 6-MHz Synchronous Step-Down Converter	WCSP-6	TPS62621YFF
0	1	0	0	0	0	U1	TPS62622YFF	IC, 500mA, 6-MHz Synchronous Step-Down Converter	WCSP-6	TPS62622YFF
0	0	1	0	0	0	U1	TPS62624YFF	IC, 500mA, 6-MHz Synchronous Step-Down Converter	WCSP-6	TPS62624YFF
0	0	0	1	0	0	U1	TPS62625YFF	IC, 500mA, 6-MHz Synchronous Step-Down Converter	WCSP-6	TPS62625YFF
0	0	0	0	1	0	U1	TPS62615YFF	IC, 350mA, 6-MHz Synchronous Step-Down Converter	WCSP-6	TPS62615YFF
0	0	0	0	0	1	U1	TPS62660YFF	IC, 1000mA, 6-MHz Synchronous Step-Down Converter	WCSP-6	TPS62660YFF

9 Marking Information

Table 4 provides the marking information for this EVM.

Table 4. Marking Information

Assembly Number	Marking Text
HPA419-001	TPS62621EVM-419
HPA419-002	TPS62622EVM-419
HPA419-003	TPS62624EVM-419
HPA419-004	TPS62625EVM-419
HPA419-005	TPS62615EVM-419
HPA419-006	TPS62660EVM-419

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EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of 2.3 V to 5.5 V and the output voltage range of 1.2 V to 1.8 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 +60°C. The EVM is designed to operate properly with certain components above +60°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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