TEXAS INSTRUMENTS

TPS6110XEVM-216

For Dual Output, Single-Cell Boost Converter

User's Guide

November 2002

Power Management Products

SLVU078

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EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 0 V to 3.6 V and the output voltage range of 1.5 V to 5.5 V at the dc-dc output and 0.9 V to 3.6 V at the LDO output.

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 100°C. The EVM is designed to operate properly with certain components above 100°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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Chapter 1

Introduction

The Texas Instruments TPS61100 to TPS61107 evaluation modules (EVM) for high-efficiency boost converters help designers to evaluate the different operating modes and the performance of the device. Refer to Table 1–1 for the various EVMs available in this family.

If any other output voltage configuration is to be evaluated, the TPS61100 adjustable output voltage version can be set up to provide an output voltage between 1.5 V and 5.5 V at the output of the boost converter and between 0.9 V and 3.3 V at the LDO. Only the appropriate feedback resistor divider has to be adjusted. Also, other fixed output voltage versions of the devices can be easily evaluated using the EVM. Refer to the data sheet (SLVS411) for the various fixed output voltage options available in the TPS6110x device family. The TPS6110x has an input voltage range between 0.9 V and 3.6 V. For proper operation the maximum input voltage should not exceed the output voltage. The maximum output current is at least 100 mA depending on the input voltage.

Table 1–1. Orderable EVM's

EVM Number	Description	
TPS61100EVM-216	Adjustable boost output voltage, set to 3.3 V	Adjustable LDO output voltage, set to 1.5 V
TPS61103EVM-216	Boost output voltage fixed at 3.3 V	Adjustable LDO output voltage, set to 1.5 V
TPS61106EVM-216	Boost output voltage fixed at 3.3 V	LDO output voltage fixed at 1.5 V
TPS61107EVM-216	Boost output voltage fixed at 3.3 V	LDO output voltage fixed at 1.8 V

Chapter 2

Setup of the EVMs

It is important to establish all connections to the EVM before the power supply for the EVM is turned on.

- ❑ Connect a power supply (0.9 V to V_{OUT}, depending on the output voltage of the EVM) to the INPUT header
- ❑ Connect a voltmeter to the OUTPUT header
- ❑ Verify that all jumper s are set to their desired value (EN, ENPB, SKIPEN, ADEN, LDOEN). Default setting is EN, SKIPEN, ADEN and LDOEN to V_{BAT} and ENPB to GND.
- ❑ Turn on the power supply and verify the output voltage

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2.1 Evaluation With the TPS6110x EVM

This chapter details the evaluation process and features of the EVM. For this evaluation, a load is connected to the output terminal in order to adjust the load current between 0 mA and 250 mA.

For accurate output voltage and input voltage measurements, it is important to measure the voltage on the input and output voltage terminals with Kelvin contacts or with a voltmeter connected directly to the input voltage or output voltage terminals. This will eliminate any measurement errors related to voltage drops along the input and output terminal wires connected to the power supply or load.

2.1.1 Enable (EN) and Enable Pushbutton (ENPB) Jumper

These jumpers are used to enable the device. Connecting the enable pin (EN) to V_{BAT} or connecting the enable pushbutton (ENPB) to GND enables the part. The device is only disabled when ENPB is set to V_{BAT} and EN is set to GND. Both enable pins are used to implement enable with a pushbutton and a static signal for example from a microcontroller. For more details refer to the data sheet.

2.1.2 LDO Enable (LDOEN) Jumper

This jumper is used to enable the integrated LDO of the device. Connecting the LDO enable pin (LDOEN) to V_{BAT} enables the LDO section of the part. Disabling the integrated LDO can be done by setting this jumper to GND.

2.1.3 Auto Discharge Enable (ADEN) Jumper

This jumper enables the device to discharge the output capacitor after the device is disabled by setting EN to GND. If ADEN is set to V_{BAT}, the capacitors connected to V_{OUT} is discharged by an internal switch with a resistance of about 400 Ω. The discharge time depends on the total output capacitance. The residual output voltage is less than 0.4V after auto discharge.

When disabling the auto discharge function by setting the jumper to GND, the output capacitors will only be discharged by the load and/or by the leakage currents in every connected part.

2.1.4 Power Save Mode Enable (SKIPEN) Jumper

This jumper enables the device to enter in power save mode at light load, when it is set to V_{BAT}. The device automatically stops switching when the output voltage reached its upper threshold, and starts switching again, when the lower threshold of the output voltage is reached.

When disabling the power save function by setting the jumper to GND, the device stays operating in fixed frequency mode, regardless of the load current value. In this mode, however reverse current will flow back to the input during light load operation increasing power losses. The operating frequency stays constant, which implies low output voltage ripple.

2.1.5 LBI/LBO Comparator

The LBO1 and LBO2 terminals are open drain outputs and have pullup resistors, R7 and R8, connected to the output. The signal on these pins can go low as soon as the input voltage at LBI falls below the threshold of 500 mV. Refer to the more detailed description and the truth table in the datasheet. Both LBO outputs stay at high-impedance when the input voltage at LBI is above the appropriate thresholds. A resistor divider (R1, R2) is used on the EVM to monitor the supply voltage.

More details about setting the low battery threshold voltage can be found in the data sheet (literature number SLVS411).

2.1.6 Power Good Output

The PG pin is an open drain output with a pullup resistor, R9, connected to the output. The signal on this pin goes high as soon as the output voltage is greater than typically 92% of the nominal voltage. The signal goes low as soon as the output voltage falls below this typical threshold. There is an implemented delay time of 30 μs to prevent the power good output from ringing.

Chapter 3

Bill of Materials, PCB Layout and Schematic

This chapter contains bill of materials, PCB layout of the EVM, and schematic.

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3.1 Bill of Materials

The bill of materials for the TPS6110x EVM is shown in Table 3–1 with adjustable and fixed output voltage versions.

More details about the design and component selection for the dc-dc converter can be found in the data sheet.

Table 3–1. Bill of Materials

Reference	Description	Manufacturer	Comments
C4	100 µF 10 V, Low ESR Tantalum size D	Vishay	Vishay 591D–107X0010U2T
C3	10 µF X5R 6.3 V, capacitor SMD1206	TDK	TDK C3216X5R0J106M
C5, C6	2.2 µF X5R 6.3 V, capacitor SMD0805	TDK	TDK C2012X5R1A225M
L1	10 µH, WE-PD Type S	Wurth Elektronik	Wurth Elektronik: 744 778 10 Also possible: Sumida CDRH73-100 or Coiltronics DR73-100
R10	0 Ω, resistor SMD0805		
R4	180 kΩ,1%, resistor SMD0805		TPS61100EVM and TPS61103EVM
R6	180 kΩ,1%, resistor SMD0805		TPS61100EVM
R3	1 MΩ,1%, resistor SMD0805		TPS61100EVM
R7, R8, R9	1 MΩ, 1%, resistor SMD0805		
R1	390 kΩ, 1%, resistor SMD0805		
R5	390 kΩ, 1%, resistor SMD0805		TPS61100EVM and TPS61103EVM
R5	0 Ω, resistor SMD0805		TPS61106EVM and TPS61107EVM
R2	470 kΩ, 1%, resistor SMD0805		
R11			Not assembled
LDOOUT	Header 1×4, 0.1″ pitch		
OUTPUT	Header 1×4, 0.1″ pitch		
INPUT	Header 1×4, 0.1″ pitch		
J6	Header 1×3, 0.1″ pitch		
EN	Header 1×3, 0.1″ pitch		With Jumper set to VBAT
ENPB	Header 1×3, 0.1″ pitch		With Jumper set to GND
LDOEN	Header 1×3, 0.1″ pitch		With Jumper set to VBAT
ADEN	Header 1×3, 0.1″ pitch		With Jumper set to VBAT
SKIPEN	Header 1×3, 0.1″ pitch		With Jumper set to VBAT
GND	Header 1×2, 0.1″ pitch		
U1	TPS61100PW, RGE24	TI	TPS61100EVM-216
	TPS61103PW, RGE24	TI	TPS61103EVM-216
	TPS61106PW, RGE24	TI	TPS61106EVM-216
	TPS61107PW, RGE24	TI	TPS61107EVM-216

3.2 PCB Layout

As for all switch mode power supplies the PCB layout is a critical step in the power supply design process. The figures below show the layout for the adjustable and fixed output voltage EVMs. Please refer to the data sheet for further layout guidelines. The required board area for the complete dc-to-dc converter solution takes up less than 320 mm^2 (16 mm $\times$ 20 mm) on a double sided PCB, as it is indicated by the rectangular on the component placement plot.

Figure 3–1. Component Placement

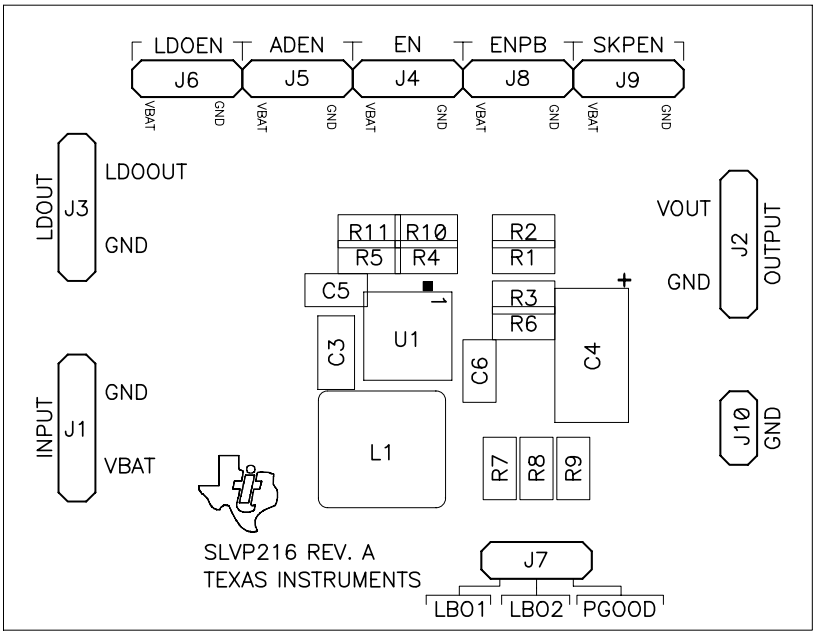


Figure 3–2. Top Layer

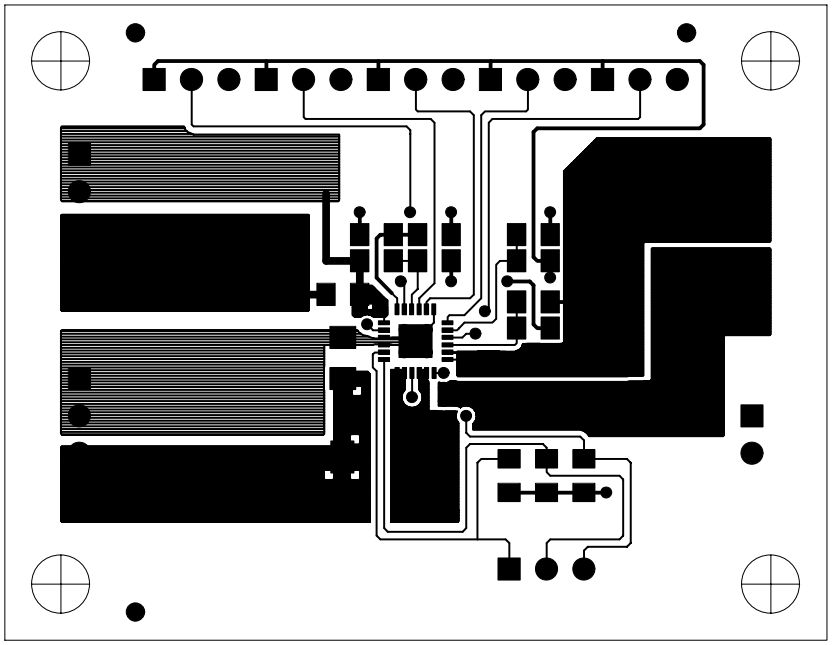
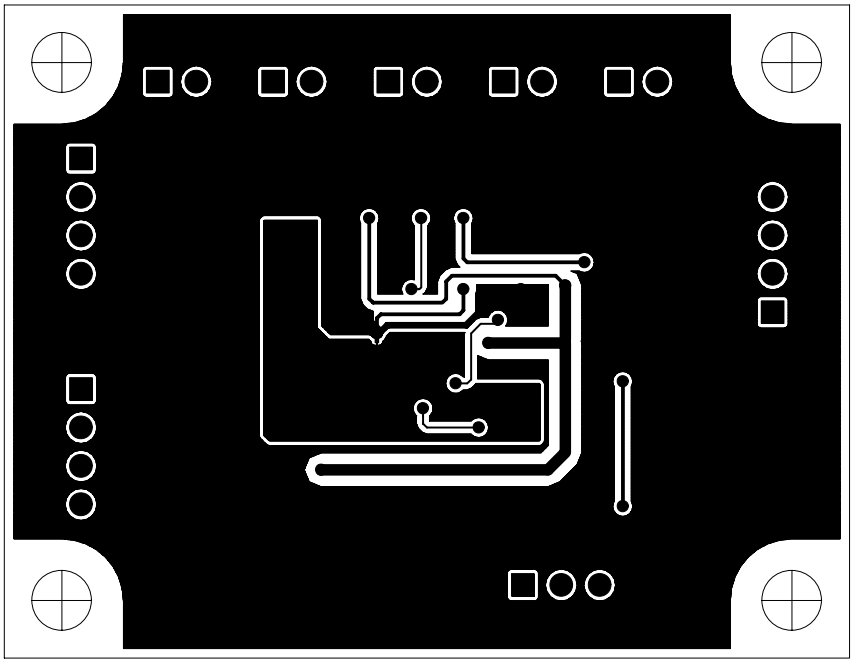


Figure 3–3. Bottom Layer



3.3 Schematic

Figure 3–4. TPS6110x EVM Circuit Diagram