Texas Instruments

TPS6100x EVM

User's Guide

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Power Management Products

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Preface

Read This First

About This Manual

This user's guide describes the evaluation module (EVM) TPS6100x EVM-156. The TPS6100x family of devices is a single-cell boost converter with start-up into full load. The TPS6100x family is intended for systems with a single or dual-battery cell supply and a required output voltage between1.5 V and 3.3 V.

The guide contains the EVM schematic with an attached bill of material, which shows the components used with their manufacturers. The layout and the component placement of the top and bottom side of the board is shown. The board is assembled on both sides. The following layout considerations point out the most important layout issues, which must be followed to avoid oscillations and instability.

The *Setup of the EVM* section describes how to start working with the board. The next section covers the low-battery feature, which typically works as a battery supervisor.

How to Use This Manual

This document contains the following chapters:

- ❑ Chapter 1 – Introduction
- ❑ Chapter 2 – Schematic and Bill of Material
- ❑ Chapter 3 – Layout
- ❑ Chapter 4 – Setup of the EVM

Related Documentation From Texas Instruments

1) *TPS6100x Single-Cell Boost Converter With Start-Up Into Full Load* – data sheet (literature number SLVS279)
2) *Understanding Boost Power Stages in Switchmode Power Supplies* (literature number SLVA061)
3) *Linear Design Seminar* (literature number SLYD016)

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Chapter 1

Introduction

The Texas Instruments TPS6100x are low-power single-cell boost converters. The TPS61002, TPS61003, and TPS61006 are fixed voltage versions with 1.8-V, 2.5-V and 3.3-V output voltage. The TPS61000 can be adjusted with an external voltage divider to an output voltage between 1.5 V and 3.3 V. Each of these four versions is supported with its own EVM. The EVM with the adjustable output voltage version is adjusted to 3.3-V output voltage.

The maximum output current at an input voltage down to 0.8 V (single battery-cell supply) is 100 mA. If two battery cells are used as supply, output currents up to 200 mA can be drawn at an input voltage down to 1.6 V. The device can be started into a full load with supply voltages down to 0.9 V over the full temperature range.

The high power conversion efficiency of up to 90%, a low quiescent current of less than 50 µA, and a special power-save mode makes this family of devices well-suited for battery-powered applications. These EVMs should help to evaluate the device directly in the application.

The board can be used, for example, to measure the efficiency of different external components and determine the best for the application. The ripple of the output voltage be can easily measured, depending on the output capacitor used. The board is assembled with a 22-µF multilayer ceramic output capacitor from Taiyo Yuden, which has an ultralow ESR to keep the output ripple as low as possible.

If another fixed-voltage version is of interest, the assembled device can be replaced with the desired device. Other fixed voltage versions are TPS61001, TPS61004, and TPS61005 with 1.5-V, 2.8-V and 3-V output voltage. Free samples can be ordered from **http://www.ti.com**. Type in the complete device name in the *quick search* box and select *Check stock or order* under *Availability/Samples*.

To get more detailed information about the device, see the TPS6100x data sheet (literature number SLVS279).

Chapter 2

Schematic and Bill of Material

Figure 2–1. Schematic of the EVM

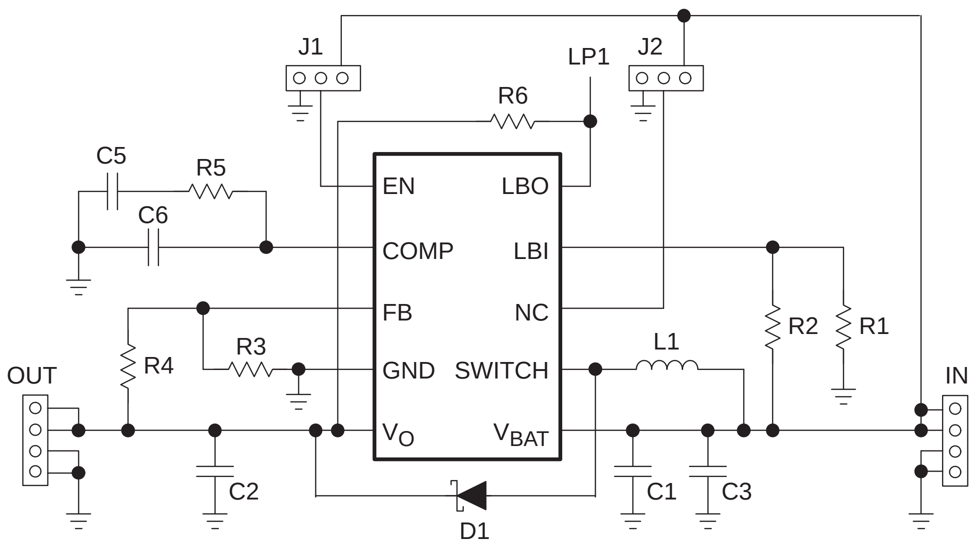

Table 2–1. Bill of Material

Component	Value	Functionality
IC1	Texas Instruments: TPS6100x 10-pin MSOP package	Controller-IC in the boost-converter stage
L1	10 µH, Coilcraft: DS1608C-103	Inductor for storing energy during on-state of the power transistor
D1	Motorola: MBRM120LT3	Schottky diode for rectifying current flow, works as a free-wheeling diode
R1	1 MΩ, 1%	Resistor to adjust the threshold voltage, supervised by the low-battery function
R2	909 kΩ, 1%	Resistor to adjust the threshold voltage, supervised by the low-battery function
R3	178 kΩ, 1% (only TPS61000-ADA)	Resistor to adjust the output voltage for the adjustable version
R4	1 MΩ, 1% (only TPS61000-ADA)	Resistor to adjust the output voltage at the adjustable version
R5	33 kΩ, 5%	Resistor to compensate the control loop
R6	470 kΩ, 5%	Pullup resistor for the open-drain output of the low-battery output
C1	10 µF, Taiyo Yuden: JMK316BJ106ML-T	Input capacitor to stabilize input voltage
C2	22 µF, Taiyo Yuden: LMK432BJ226MM-T	Output capacitor to supply the load during on state of the power transistor
C3	100 nF, 10 V	Input capacitor for filtering spikes
C5	10 nF, 10 V	Capacitor to compensate the control loop
C6	47 pF, 10 V	Capacitor to compensate the control loop
J1	3-pin	To enable (connect to V_{BATT}) or disable (to GND) the device
J2	3-pin	Not used for this family of devices
IN	4-pin	To connect the device to the battery and GND → Input
OUT	4-pin	To connect the device to the load and GND → Output

Chapter 3

Layout

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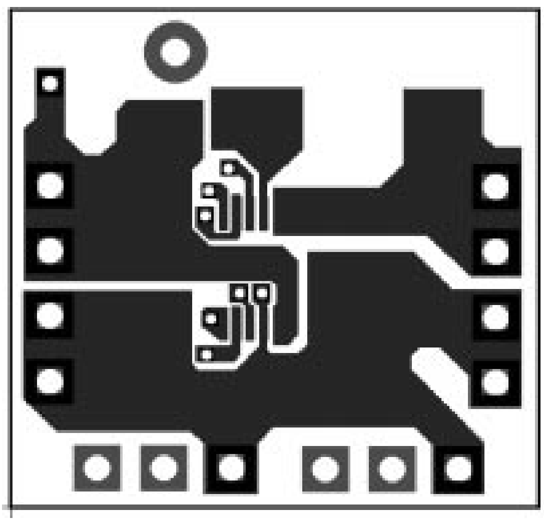
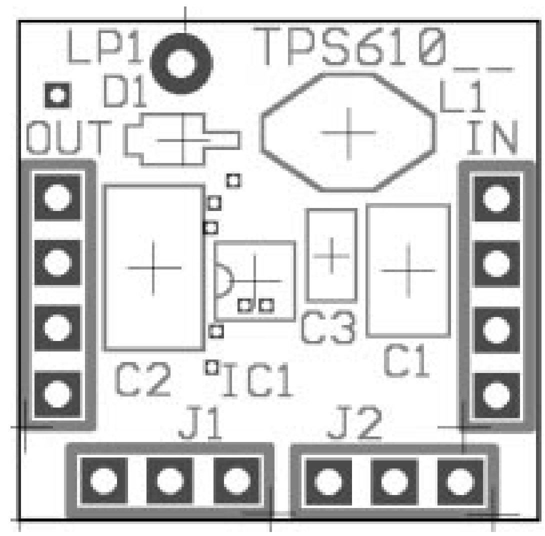
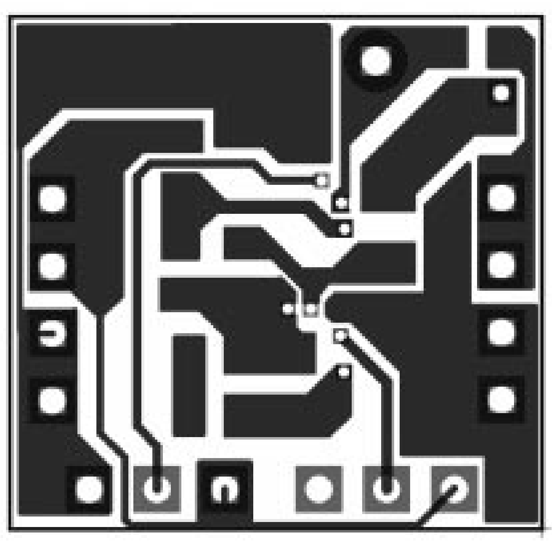
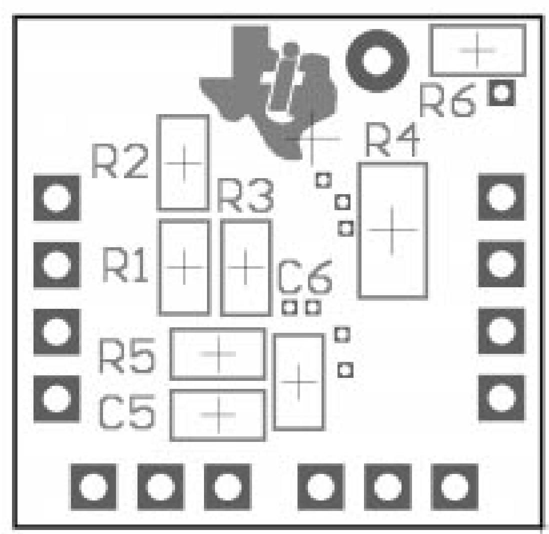
3.1 Top-Side Layout and Component Placement





3.2 Bottom-Side Layout and Component Placement



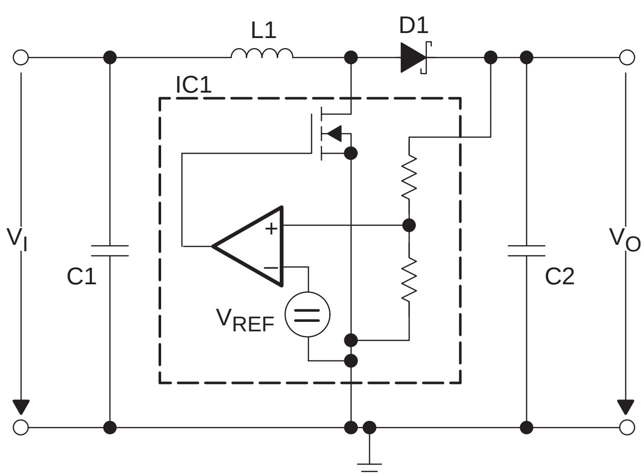


3.3 Layout Considerations

The basic components of a boost converter topology (as shown in Figure 3–1) are placed on the top side of the EVM. These are the components which carry the high currents. The ground plane is divided into two parts that are connected to the ground pin of the device. The ground plane on the top side carries the inductor current and the load current back to the ground terminal of the power supply. The ground plane on the bottom side of the EVM is for connecting the sensitive parts to ground. These are the compensation network and the voltage divider for the low-battery function and for fixing the output voltage on the adjustable version. It is very important to keep noisy and high current traces away from sensitive lines or to separate them by using additional ground traces between them**,** otherwise instability or oscillation can occur. The resistive divider for fixing the output voltage should be placed as close as possible to the FB pin.

Since the device has a high switching frequency of 500 kHz and large peak currents, the layout is an extemely important part of the design. All power components like the input and output capacitors, the inductor, the diode, and the device should be kept as close together as possible. The traces should be kept short, wide, and direct.

Figure 3–1. Topology of a Boost Converter Stage



Chapter 4

Setup of the EVM

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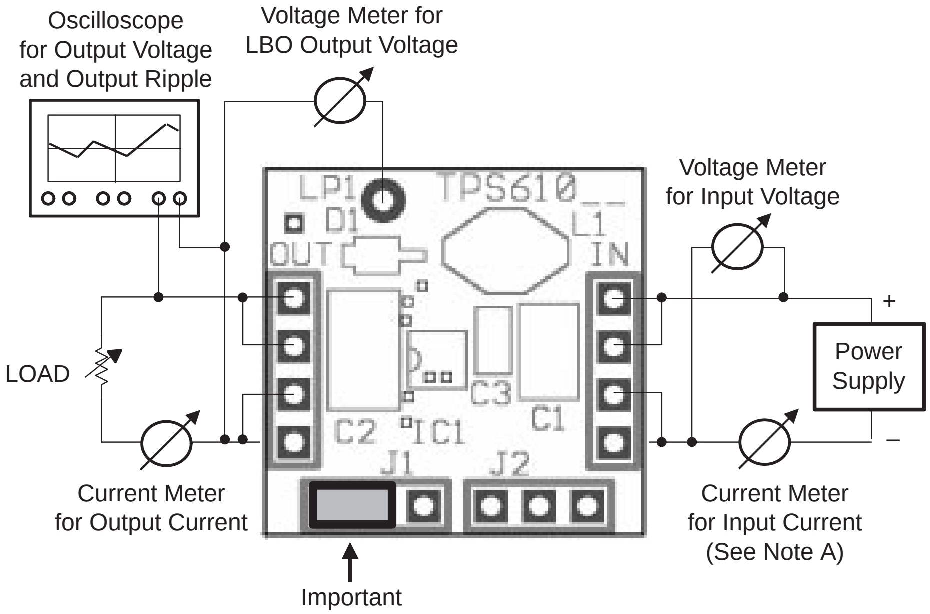
4.1 Setup of the EVM

Figure 4–1. Setup of the EVM



Note A: Use this current meter only if the sense wires of the supply are used.

Follow these steps for proper operation of the EVM:

1) Connect J1, the Enable-pin, with V_{DD} as shown in Figure 4–1.

2) Connect the sense wires of the power supply to the input terminals of the board, or solder the connections of the power supply to the terminals.

3) Connect the input voltage meter between the board on the one side and the power supply and input current meter on the other side.

4) Connect the oscilloscope between the output terminals of the EVM on the one side and the load and output current meter on the other side.

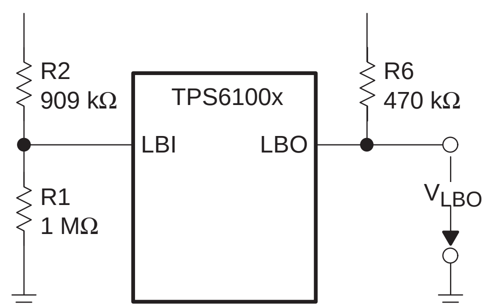
4.2 Low-Battery Function LBI and LBO

The low battery feature is typically used to supervise the battery voltage and to indicate when the voltage goes below an adjustable threshold voltage. The threshold voltage can be adjusted by an external resistive divider connected to the low-battery input (LBI) as shown in Figure 4–2. It can be calculated by using equation 1.

$$V_{threshold} = \left(\frac{R_2}{R_1} + 1\right) \times V_{REF} = \left(\frac{909\ k\Omega}{1\ M\Omega} + 1\right) \times 0.5\ V = 0.955\ V \qquad (1)$$

On the EVM, the threshold voltage is adjusted to about 0.96 V. If the battery voltage goes below 0.96 V, the LBO open-drain output is pulled down to ground. Otherwise, it is in a high-impedance state and the voltage is pulled up via the external resistor R6 to V_O. R1 is a 1-MΩ resistor, so that the current through R1 is about 50 times higher than the typical current into the LBI pin of 10 nA. Therefore, the LBI input current can be neglected in the calculations.

Figure 4–2. Resistive Divider at LBI



Note:

Voltage drops can be found on the input line although there are two input capacitors. These spikes can be the reason for triggering the LBO earlier than expected, since the input voltage decreases the adjusted threshold voltage for short periods of time. Be aware of this.