TEXAS INSTRUMENTS

TPS65010EVM-230

User's Guide

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Following are URLs where you can obtain information on other Texas Instruments products & application solutions:

Products		**Applications**	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Secruity	www.ti.com/security
		Telephony	www.ti.com/telephony
		Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

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

Copyright © 2003, Texas Instruments Incorporated

EVM IMPORTANT NOTICE

Texas Instruments (TI) provides the enclosed product(s) under the following conditions:

This evaluation kit being sold by TI is intended for use for **ENGINEERING DEVELOPMENT OR EVALUATION PURPOSES ONLY** and is not considered by TI to be fit for commercial use. As such, the goods being provided may not be complete in terms of required design–, marketing–, and/or manufacturing–related protective considerations, including product safety measures typically found in the end product incorporating the goods. As a prototype, this product does not fall within the scope of the European Union directive on electromagnetic compatibility and therefore may not meet the technical requirements of the directive.

Should this evaluation kit not meet the specifications indicated in the EVM User's Guide, the kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods. Please be aware that the products received may not be regulatory compliant or agency certified (FCC, UL, CE, etc.). Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge.

EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

TI currently deals with a variety of customers for products, and therefore our arrangement with the user **is not exclusive**.

TI assumes **no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein**.

Please read the EVM User's Guide and, specifically, the EVM Warnings and Restrictions notice in the EVM User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For further safety concerns, please contact the TI application engineer.

Persons handling the product must have electronics training and observe good laboratory practice standards.

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used.

Mailing Address:

Texas Instruments
Post Office Box 655303
Dallas, Texas 75265

Copyright © 2003, Texas Instruments Incorporated

EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the specified input and output ranges described in the EVM User's Guide.

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.

Mailing Address:

Texas Instruments
Post Office Box 655303
Dallas, Texas 75265

Copyright© 2003, Texas Instruments Incorporated

Read This First

About This Manual

This User's Guide describes the characteristics, operation, and use of the TPS65010EVM-230 evaluation module (EVM), which helps you evaluate and test the various operating modes of the TPS65010. The guide includes setup instructions for the hardware and software, a schematic diagram, a bill of materials (BOM), and PCB layout drawings for the evaluation module.

How to Use This Manual

This document contains the following chapters:

- Chapter 1 – Introduction
- Chapter 2 – Setup
- Chapter 3 – Board Layout
- Chapter 4 – Schematic and Bill of Materials

Related Documentation From Texas Instruments

TPS65010 Data Sheet (SLVS149)

If You Need Assistance

Please contact your local TI sales representative.

FCC Warning

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.

Contents

Read This First ..... **v**
About This Manual v
How to Use This Manual v
Related Documentation From Texas Instruments v
If You Need Assistance v
FCC Warning v
Contents ..... **vii**
Figures ..... **vii**
Tables ..... **vii**
Introduction **1-1**
1.1 Requirements 1-2
Setup **2-1**
2.1 Input/Output Connectors 2-2
2.2 Setup 2-3
Board Layout **3-1**
3.1 Layout 3-2
Schematic and Bill of Materials **4-1**
4.1 Schematic 4-2
4.2 Bill of Materials 4-3

Figures

Figure 3-1. Assembly Layer. **3-2**
Figure 3-2. Top Layer Routing **3-3**
Figure 3-3. Layer 2 Routing **3-3**
Figure 3-4. Layer 3 Routing **3-4**
Figure 3-5. Bottom Layer Routing **3-4**
Figure 4-1. TPS65010EVM-230 Schematic **4-2**

Tables

Table 2-1. Input/Output Connectors **2-2**
Table 4-1. Bill of Materials. **4-3**

Chapter 1

Introduction

The Texas Instruments TPS65010EVM-230 is an integrated power and battery management integrated circuit for applications that are powered with one Li-Ion or Li-Polymer cell and require multiple power rails. The TPS65010 contains two highly efficient switching step-down converters, two LDOs, a battery charger, and additional status and I/O pins. You control the device via an I^2C interface.

Topic **Page**

1.1 Requirements **1-2**

1.1 Requirements

To operate this EVM properly, you must connect and properly configure the following components:

- Personal computer

  A computer with a USB port is required to operate this EVM. The TPS65010 interface software runs on the PC and communicates with the EVM via the PC USB port. You can send commands to the EVM and read the contents of the TPS65010 internal registers through the USB port.

- Printed circuit board assembly

  The TPS65010EVM-230 PCB contains the TPS65010 IC and its required external components. This board contains several jumpers and connectors that enable you to customize the board for specific operating conditions.

- USB to I^2C interface board (EV2300)

  The EV2300 is the link that allows the PC and the EVM to communicate. One end of the EV2300 connects to the PC with the supplied USB cable; the other end of the EV2300 connects to the EVM with the supplied Molex cable.

  - When you write a command to the EVM, the interface program run from the PC sends the command to the PC USB port. The EV2300 receives the USB command, converts the signal to an I^2C protocol, and sends the I^2C signal to the TPS65010 board.
  - When you read a status register from the EVM, the PC sends a command to read a register on the EVM. When the EVM receives the command, it reports the status of the register via the I^2C interface. The EV2300 receives the information on the I^2C interface, converts it to a USB protocol, and sends it to the PC.

- Software

  Texas Instruments has provided software to assist you in evaluating this EVM. When downloading software from TI's website:

  1) Download the master installation file (SLVC021.zip).
  2) Unzip the files to a temporary directory.
  3) Run the *START.bat* to start the installation menu.
  4) Install the TPS65010EVM controller program first.
  5) Install the USB drivers next. (Be sure that the EV2300 board is not connected to your computer).

  Note: Additional manual installation instructions are in the drivers\readme.txt file.

  Please see the application report *Understanding the TPS65010 Software* (SLVA154) for a detailed description of the software and how it works.

When installing from a CD:

1) Insert the CD, it should start up automatically. If not, run the *Start.bat* file on the CD.

2) Install the TPS65010EVM controller program from the main menu first.

3) Install the USB drivers next. (Be sure the EV2300 board is not connected to your computer).

Additional manual installation instructions are in the drivers\readme.txt file.

Chapter 2

Setup

This chapter describes the jumpers and connectors on the EVM and how to properly connect, setup, and use the TPS65010EVM-230.

Topic	Page
2.1 Input/Output Connectors	2-2
2.2 Setup	2-3

2.1 Input/Output Connectors

Table 2-1 lists the input/output connectors

Table 2-1. Input/Output Connectors

Setup Connection	Description
J1-USB	USB charger input/output header can be used as either an input or an output. If R6 is opened, then J1 can be used as an input. An external 5 V can be supplied to the EVM to simulate the USB 5-V bus. If R6 is shorted, J1 may be used as an output. The USB 5-V bus from the PC gets routed through the EV2300 to J5. Shorting R6 connects the USB 5-V bus to J1.
J2-GND	Return connection for USB charger input/output.
J3-AC	AC charger input
J4-GND	Return connection for AC charger input/output
J5-Interface connector	Connect one end of supplied Molex cable to this connector. The other end attaches to USB connector on EV2300.
J6-Vibrator	Header that connects optional vibrator to EVM
J7-GPIO	Header that contains four GPIO signals that connect directly to TPS65010
J8-Interface header	Header that duplicates the signals from J5 interface connector
J9-VBAT-VINMAIN	VBAT output and VINMAIN and VINCORE inputs of the TPS65010 are connected to this header. Short these two pins together to run the TPS65010 main and core converters from the battery. To easily evaluate the performance of the TPS65010 when running from different battery voltages, remove the jumper and connect an auxiliary supply to the VINMAIN pin.
J10-GND	Return connection for auxiliary VINMAIN supply
J11-Battery	Connect a user-supplied Li-Ion battery to this header. If the battery has a temperature sensor, connect it to the TS pin. See the datasheet for a description of how to setup the EVM for a battery with a temperature sensor. The EVM default configuration is for a battery with no temperature sensor. R22 simulates a 10-kΩ battery thermistor.
J12-VCORE	Output voltage of the core converter
J13- GND	Return connection for core converter
J14-VMAIN	Output voltage of main converter
J15-GND	Return connection for main converter
J16-Input/Output BIT	Header that contains the /MPU_RST, /RESPWRON, /PWRFAIL, /INT, and LOW_PWR inputs and outputs of the EVM

Setup Connection	Description
J17-LDO1	Input/output connection for LDO1. VINLDO1 can be connected to an external supply or connected to another output voltage on the EVM. The EVM default configuration connects VMAIN to VINLDO1. Remove R25 if a voltage other than VMAIN is used as input to VINLDO1.
J18-GND	Return connection for LDO1 and LDO2 low dropout linear regulators
J19-LDO2	Input/output connection for LDO2. VINLDO2 can be connected to an external supply or connected to another output voltage on the EVM. The EVM default configuration connects VMAIN to VINLDO2. Remove R26 if a voltage other than VMAIN will be used as input to VINLDO2.
JP1-DEFCORE	Jumper allows you to select default core voltage at startup. Connect DEFCORE to VBAT to select default as 1.6 V. Connect DEFCORE to GND to select default as 1.5 V.
JP2-DEFMAIN	Jumper allows you to select the default main voltage at startup. Connect DEFMAIN to VBAT to select default as 3.3V. Connect DEFMAIN to GND to select default as 3.0 V.
JP3- PS_SEQ	Jumper selects power supply turn-on/ turn-off sequence. Connect PS_SEQ to VCC to power the main converter up first and down last. Connect PS_SEQ to GND power the core converter up first and down last.
JP4- GPIO PULLUP	Jumper to select between VBAT and VMAIN for GPIO pull-up voltage on EVM
JP5-LOW_POWER	Connect LOW_POWER to VBAT to assert LOW_POWER signal. Remove jumper to deassert LOW_POWER signal. The ENABLE LP BIT must be set in VDCDC1 register before low-power mode is activated.
JP6-BATT_COVER	Connect BATT_COVER to VBAT to assert BATT_COVER signal.
S1-PB_ONOFF	Normally open momentary pushbutton switch that, when pressed, connects VBAT to PB_ONOFF input of TPS65010
S2-/HOT_RST	Normally open momentary pushbutton switch that, when pressed, connects /HOT_RST input of TPS65010 to GND

2.2 Setup

Perform the following procedure before operating the EVM:

1) Install the TPS65010EVM software.

2) Connect input voltages and loads to the EVM.

3) Configure all EVM jumpers.

4) Connect the Molex cable between the EVM and the EV2300. Note that the Molex cable must connect to the I^2C connector on the EV2300.

5) Connect the USB cable between the computer and the EVM.

6) Turn on all supplies and loads.

7) Run the TPS65010EVM software.

Chapter 3

Board Layout

This chapter provides the TPS65010EVM-230 board layout and illustrations.

Topic	Page
3.1 Layout	3-2

3.1 Layout

Board layout is critical for all switch mode power supplies. Figures 1-5 show the board layout for the TPS65010EVM-230 PWB. The nodes with high switching frequencies and currents are short and are isolated from the noise sensitive feedback circuitry. Careful attention has been given to the routing of high frequency current loops. See the datasheet for specific layout guidelines.

Figure 3-1. Assembly Layer.

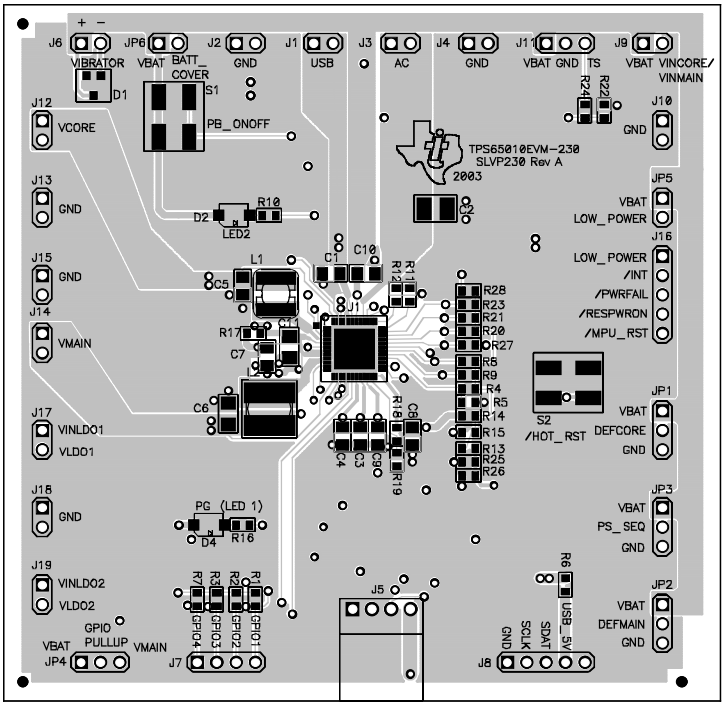


Figure 3-2. Top Layer Routing

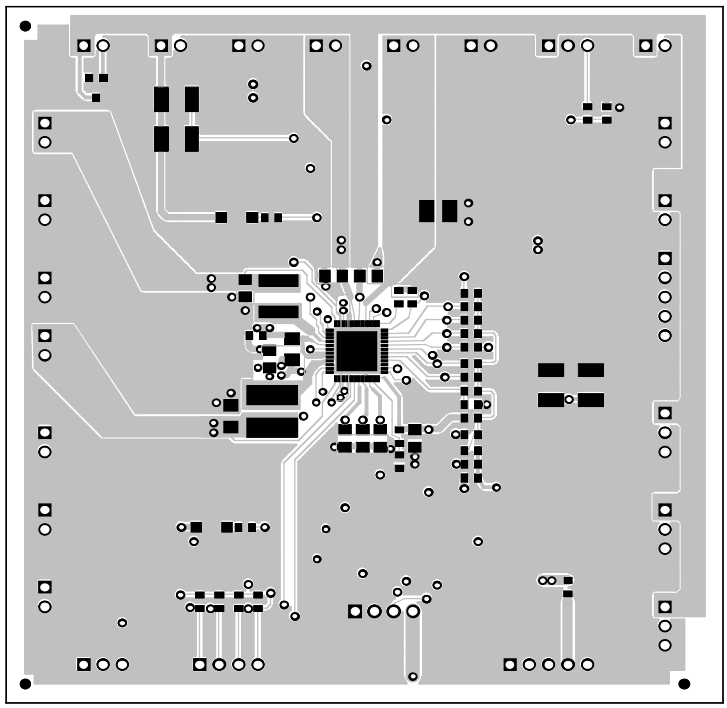


Figure 3-3. Layer 2 Routing

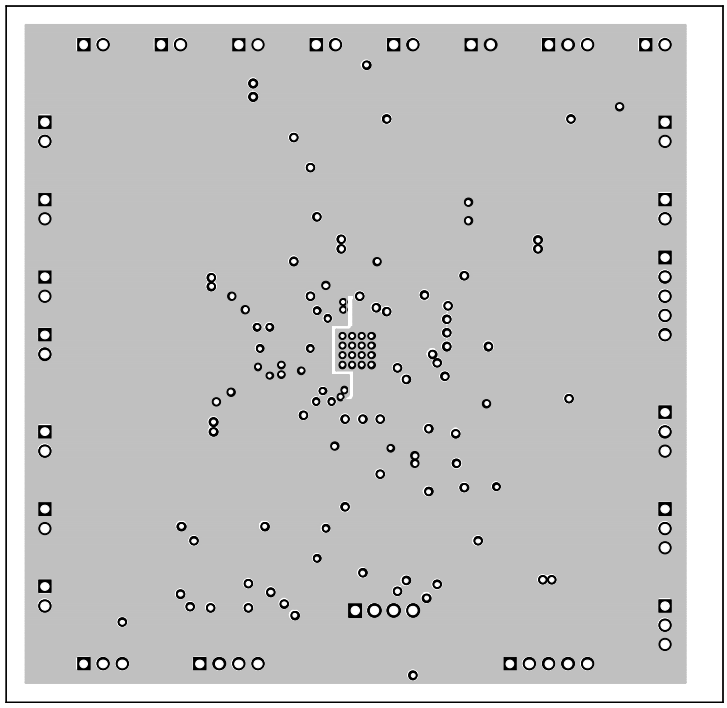


Figure 3-4. Layer 3 Routing

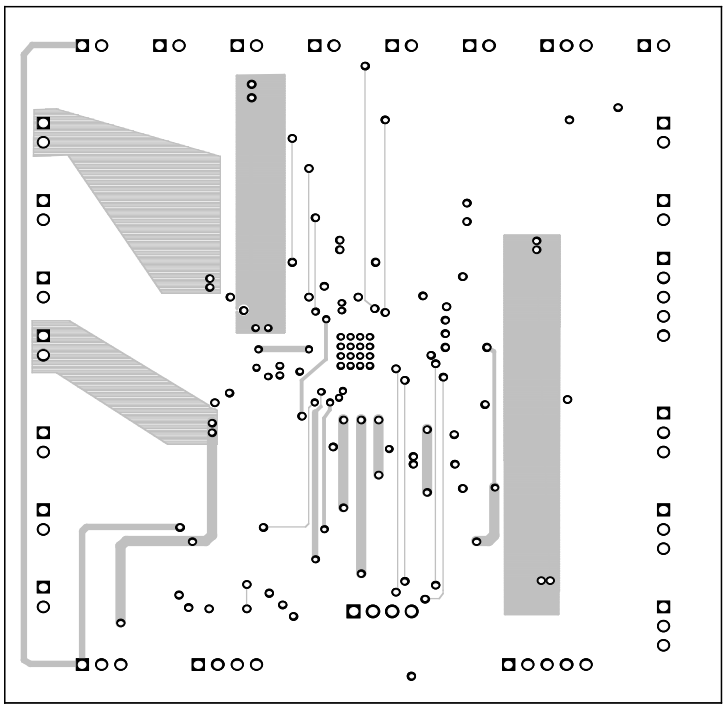
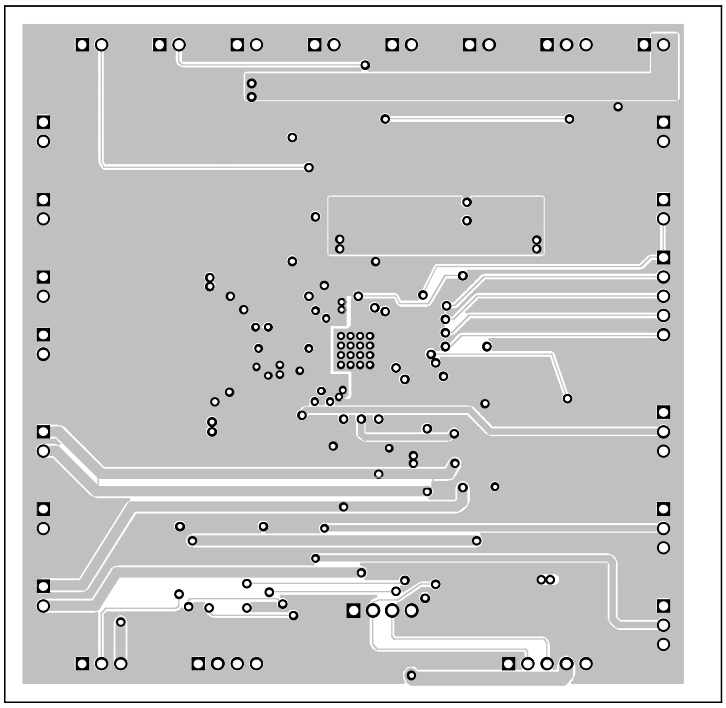


Figure 3-5. Bottom Layer Routing



Chapter 4

Schematic and Bill of Materials

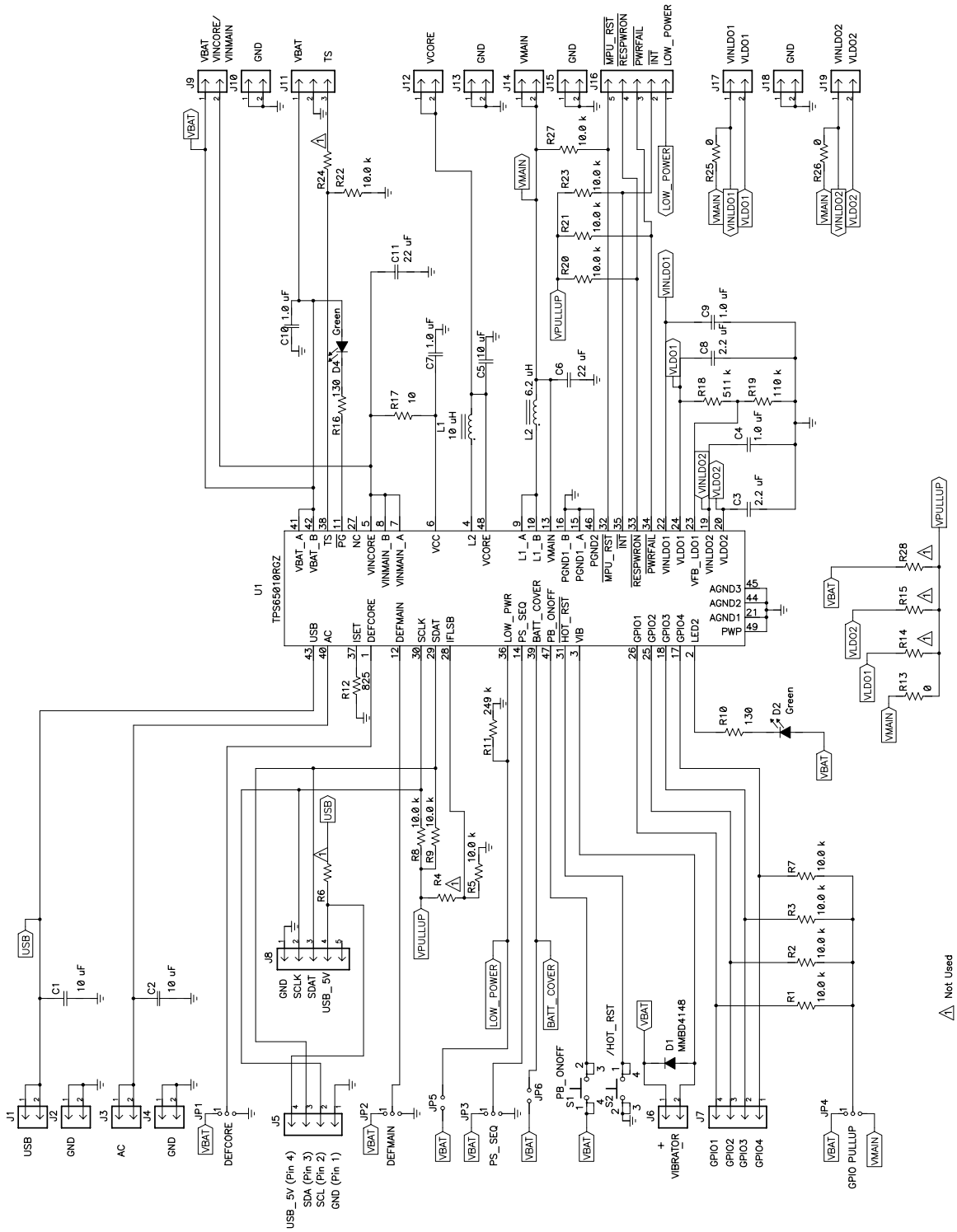
This chapter provides the TPS65010EVM-230 schematic and bill of materials.

Topic	Page
4.1 Schematic	4-2
4.2 Bill of Materials	4-3

4.1 Schematic

Shows the TPS65010EVM-230 schematic

Figure 4-1. TPS65010EVM-230 Schematic



4.2 Bill of Materials

Table 4-1. Bill of Materials.

Count	Ref Des	Description	Size	MFR	Part Number
2	C1, C5	Capacitor, Ceramic, 10-uF, 6.3-V, X5R, 10%	805	TDK	C2012X5R0J106KT
1	C2	Capacitor, Ceramic, 10-uF, 16-V, X5R, 10%	1210	TDK	C3225X5R1C106KT
2	C3, C8	Capacitor, Ceramic, 2.2-uF, 6.3-V, X5R, 10%	805	TDK	C2012X5R0J225KT
4	C4, C7, C9, C10	Capacitor, Ceramic, 1.0-uF, 10-V, X5R, 10%	805	TDK	C2012X5R1A105KT
2	C6, C11	Capacitor, Ceramic, 22-uF, 6.3-V, X5R, 10%	1206	TDK	C3216X5R0J226MT
1	D1	Diode, Zener, 100-V, 600-mA	SOT23	Fairchild	MMBD4148
2	D2, D4	Diode, LED, green, gullwing, GW Type		Panasonic	LNJ361C3UR01
14	J1, J2, J3, J4, J6, J9, J10, J12, J13, J14, J15, J17, J18, J19	Header, 2-pin, 100mil spacing, (36-pin strip)	0.100 x 2	Sullins	PTC36SAAN
1	J11	Header, 3-pin, 100mil spacing, (36-pin strip)	0.100 x 3	Sullins	PTC36SAAN
1	J5	Header, friction lock ass'y, 4-pin Right Angle	0.4 x 0.5	Molex	22-05-3041
1	J7	Header, 4-pin, 100mil spacing, (36-pin strip)	0.100 x 4	Sullins	PTC36SAAN
2	J8, J16	Header, 5-pin, 100mil spacing, (36-pin strip)	0.100 x 5	Sullins	PTC36SAAN
4	JP1, JP2, JP3, JP4	Header, 3-pin, 100mil spacing, (36-pin strip)	0.100 x 3	Sullins	PTC36SAAN
2	JP5, JP6	Header, 2-pin, 100mil spacing, (36-pin strip)	0.100 x 2	Sullins	PTC36SAAN
1	L1	Inductor, SMT, 10-uH, 1-A, 128.3-milliohm	0.185x0.185	Sumida	CDRH4D28-100
1	L2	Inductor, SM Toroid, 6.2-uH, 1.80-A, 45-milliohms		Sumida	CDRH5D28-6R2
12	R1, R2, R3, R5, R7, R8, R9, R20, R21, R22, R23, R27	Resistor, Chip, 10.0 kΩ, 1/16-W, 1%	603	Std	Std
2	R10, R16	Resistor, Chip, 130-Ω, 1/16-W, 1%	603	Std	Std
1	R11	Resistor, Chip, 249 kΩ, 1/16-W, 1%	603	Std	Std
1	R12	Resistor, Chip, 825-Ω, 1/16-W, 1%	603	Std	Std
3	R13, R25, R26	Resistor, Chip, 0-Ω, 1/16-W, 1%	603	Std	Std
1	R17	Resistor, Chip, 10-Ω, 1/16-W, 1%	603	Std	Std

Count	Ref Des	Description	Size	MFR	Part Number
1	R18	Resistor, Chip, 511 k-Ω, 1/16-W, 1%	603	Std	Std
1	R19	Resistor, Chip, 110k-Ω, 1/16-W, 1%	603	Std	Std
0	R4, R6, R14, R15, R24, R28	Resistor, Chip, xx-Ω, 1/16-W, 1%	603		
2	S1, S2	Switch, SPST, PB Momentary, Sealed Washable	0.245 X 0.251	C & K	KT11P2JM
1	U1	IC, Power & battery management for OMAP systems	0.282 x 0.282	TI	TPS65010RGZ
1	--	PCB, 3.7 In x 3.6 In x .062 In		Any	SLVP230
6	--	Shunt, 100-mil, Black	0.100	3M	929950-00

		Connector			
2	J5 mate	Connector, Female, 0.100 Centers		Molex	22-01-3047
8	N/A	Terminals, Crimp, Tin		Molex	08-50-0114
	N/A	Wire, Insulated 24 Awg, Red, 18 Inches (+/- 3 inches)(USB_5V)		Any	Any
	N/A	Wire, Insulated 24 Awg, White, 18 Inches (+/- 3 inches)(SCL)		Any	Any
	N/A	Wire, Insulated 24 Awg, Black, 18 Inches (+/- 3 inches)(GND)		Any	Any
	N/A	Wire, Insulated 24 Awg, Brown, 18 Inches (+/- 3 inches) (SDA)		Any	Any
1	N/A	Heatshrink 1"		Any	Any