TEXAS INSTRUMENTS

TPS65011EVM-049

User's Guide

January 2004 *PMP Portable Power*

SLVU103

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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.

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Read This First

About This Manual

This User's Guide describes the characteristics, operation, and use of the TPS65011EVM-049 evaluation module (EVM), which helps you evaluate and test the various operating modes of the TPS65011. 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

TPS65011 Data Sheet (SLVS501)

If You Need Assistance

Please contact your local TI sales representative.

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Chapter 1

Introduction

The Texas Instruments TPS65011EVM-049 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 TPS65011 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.

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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 TPS65011 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 TPS65011 internal registers through the USB port.

- Printed circuit board assembly

  The TPS65011EVM-049 PCB contains the TPS65011 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 TPS65011 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. Note that the TPS65010EVM controller program is used for both the TPS65010 and TPS65011 EVMs.
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, set up, and use the TPS65011EVM-049.

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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 TPS65011
J8-Interface header	Header that duplicates the signals from J5 interface connector
J9-VBAT-VINMAIN	VBAT output and VINMAIN and VINCORE inputs of the TPS65011 are connected to this header. Short these two pins together to run the TPS65011 main and core converters from the battery. To easily evaluate the performance of the TPS65011 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 1.8 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 3.3 V. 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 de-assert LOW_POWER signal. The ENABLE LP BIT must be set in VDCDC1 register before low-power mode is activated. If an input voltage is applied to either AC or USB, the TPS65011 will not enter low-power mode unless the internal register CHGCONFIG BIT 7 is set to 1.
JP6-BATT_COVER	Connect BATT_COVER to VBAT to assert BATT_COVER signal.
JP7_TPOR	Connect TPOR to GND to set the power on reset delay time, /RESPWRON to 100 ms. Connect TPOR to VBAT to set the power on reset delay time, /RESPWRON to 1 s.
S1-PB_ONOFF	Normally open momentary pushbutton switch that, when pressed, connects VBAT to PB_ONOFF input of TPS65011
S2-/HOT_RST	Normally open momentary pushbutton switch that, when pressed, connects /HOT_RST input of TPS65011 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 TPS65011EVM-049 board layout and illustrations.

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3.1 Layout

Board layout is critical for all switch mode power supplies. Figures 1-5 show the board layout for the TPS65011EVM-049 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

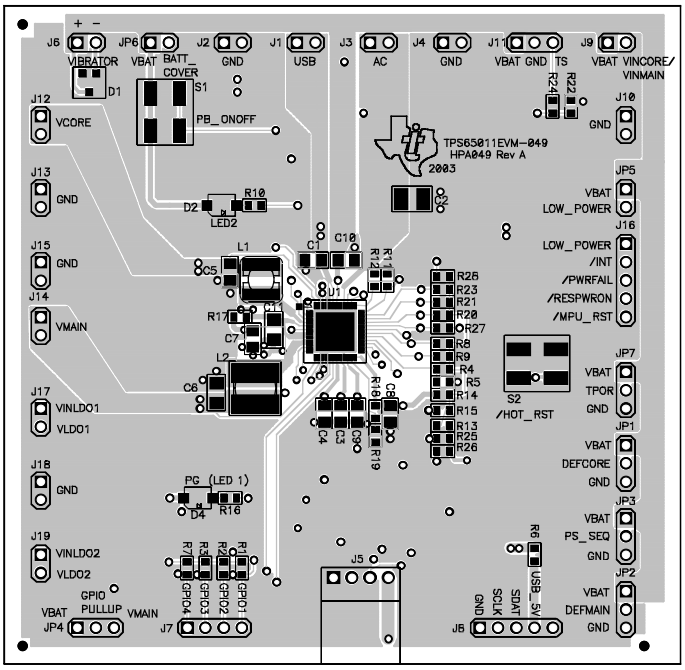


Figure 3-2. Top Layer Routing

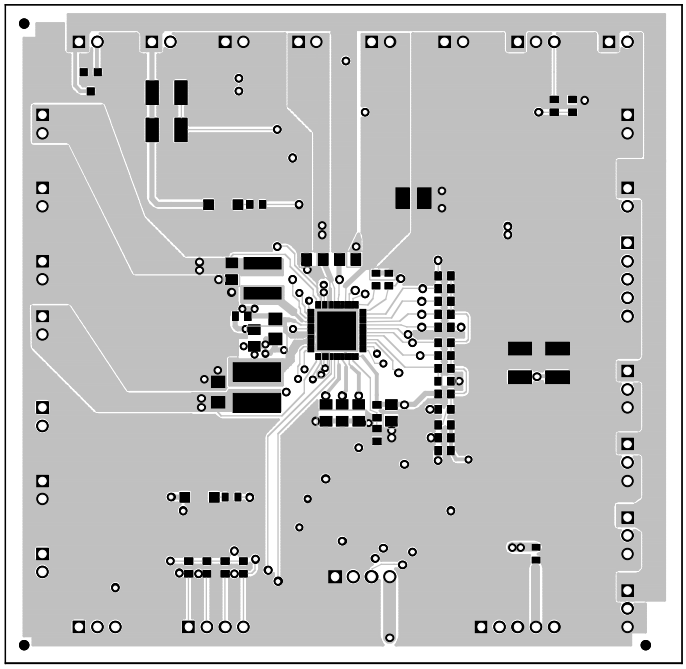


Figure 3-3. Layer 2 Routing

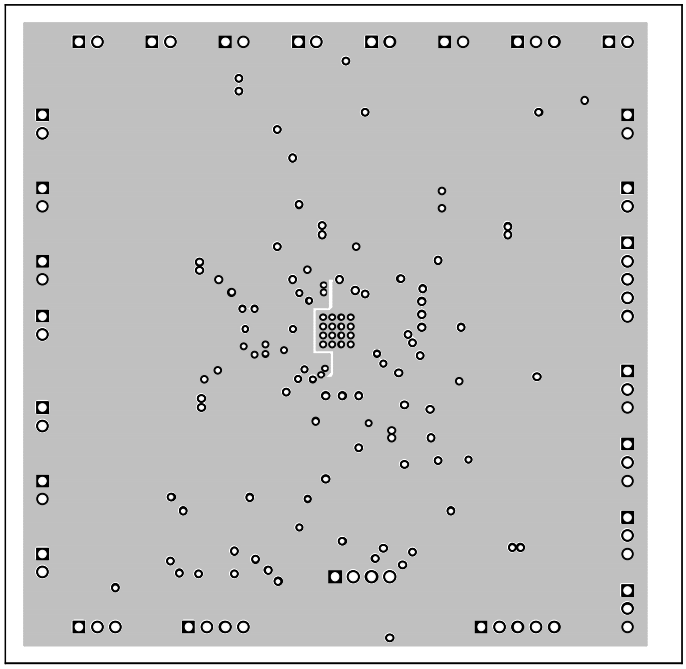


Figure 3-4. Layer 3 Routing

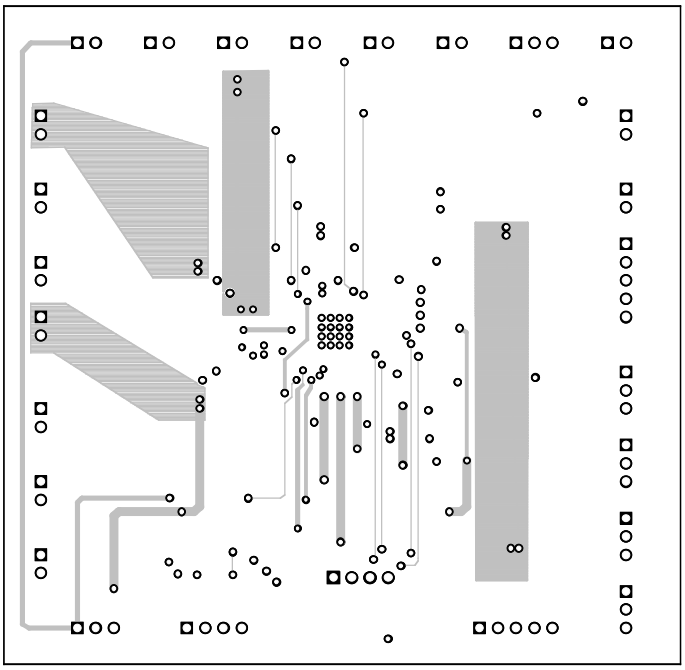
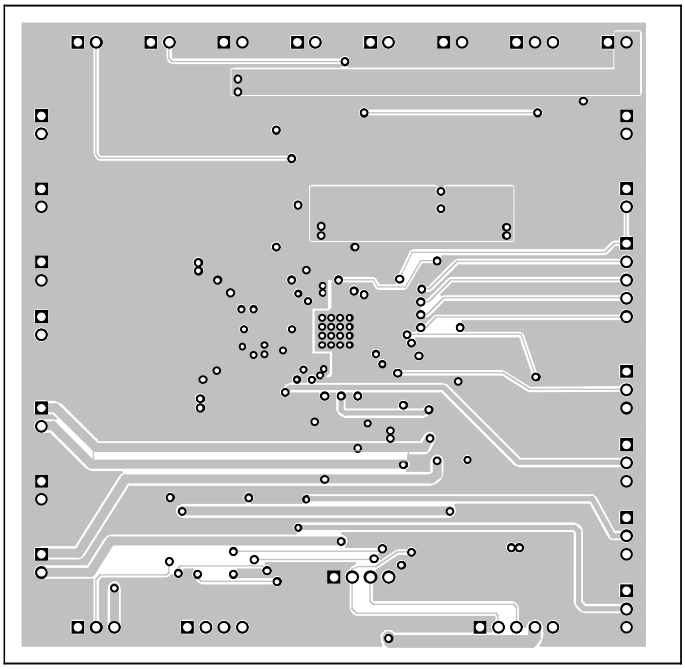


Figure 3-5. Bottom Layer Routing



Chapter 4

Schematic and Bill of Materials

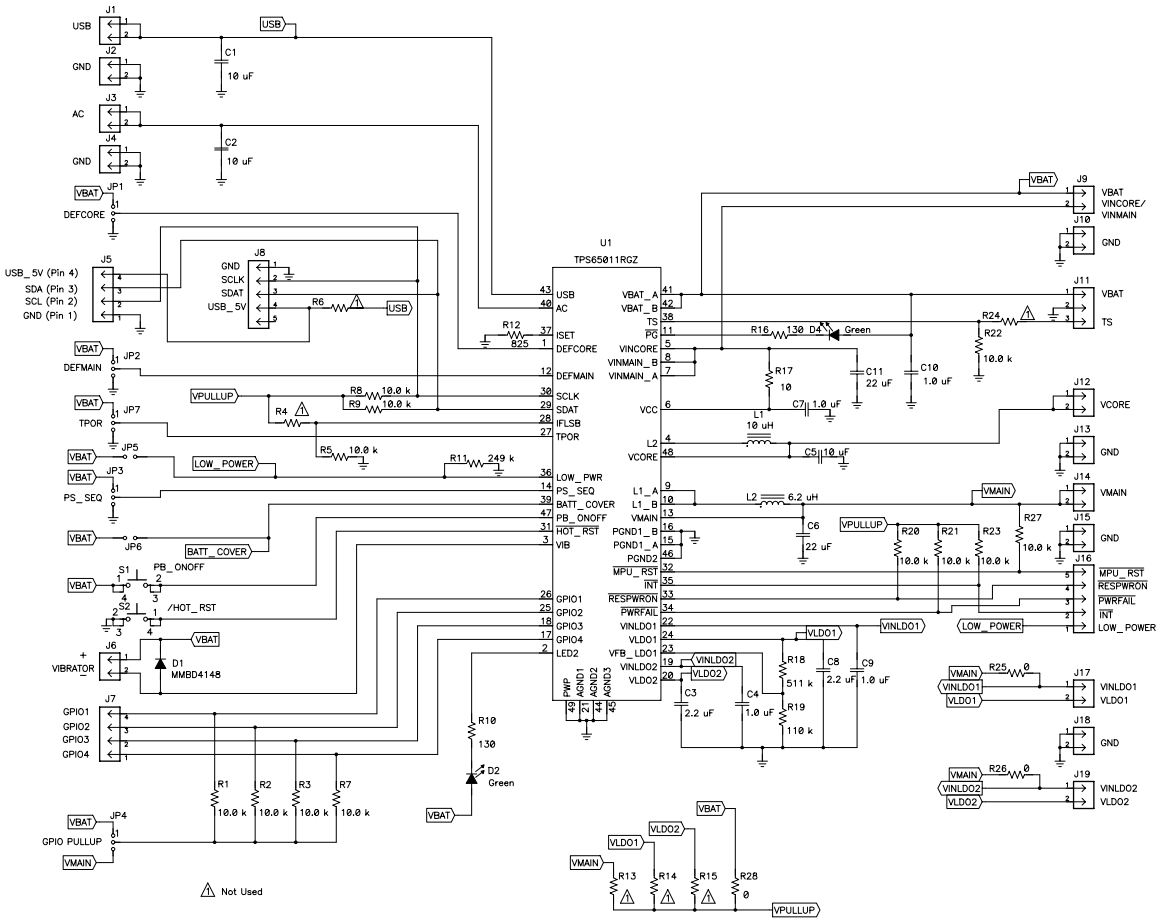
This chapter provides the TPS65011EVM-049 schematic and bill of materials.

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4.1 Schematic

The schematic for the TPS65011EVM-049 is shown in Figure 4-1.

Figure 4-1. TPS65011EVM-049 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,		Panasonic	LNJ361C3UR01

Count	Ref Des	Description	Size	MFR	Part Number
		gull wing, GW Type			
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
5	JP1, JP2, JP3, JP4, JP7	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	R25, R26, R28	Resistor, Chip, 0-Ω, 1/16-W, 1%	603	Std	Std
1	R17	Resistor, Chip, 10-Ω, 1/16-W, 1%	603	Std	Std
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, R13, R14, R15, R24	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	TPS65011RGZ
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		Molex	22-01-3047

Count	Ref Des	Description	Size	MFR	Part Number
		Centers			
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