

TPS65021EVM-110 User's Guide

This User's Guide describes the characteristics, operation, and use of the TPS65021EVM-110 evaluation module (EVM). This EVM is designed to help the user evaluate and test the various operating modes of the TPS65021. This document includes setup instructions for the hardware and software, a schematic diagram, a bill of materials (BOM), and PCB layout drawings for the evaluation module.

Contents

1	Introduction	1
2	Setup	2
3	Board Layout	3
4	Schematic and Bill of Materials	8
5	Related Documentation	10

List of Figures

1	Assembly Layer	4
2	Top Layer	5
3	Routing, GND Plane.....	6
4	Routing, VIN Plane	7
5	Routing, Bottom Layer	8
6	TPS65021EVM-110 Schematic.....	9

List of Tables

1	HPA110B BOM.....	10
---	------------------	----

1 Introduction

The Texas Instruments TPS65021EVM is an integrated power management IC for applications that are powered with one Li-Ion or Li-polymer cell, and require multiple power rails. The TPS65021 contains three highly efficient switching step-down converters, two LDOs, and additional status and I/O pins. The device is controlled via an I²C™ interface.

1.1 Requirements

In order for this EVM to operate properly, the following components must be connected and properly configured.

1.2 Personal Computer

A personal computer (PC) with a USB port is required to operate this EVM. The TPS65021 interface software, which is run on the PC, communicates with the EVM via the PC USB port. The user sends commands to the EVM as well as reads the contents of the TPS65021 internal registers through the USB port.

I²C is a trademark of Philips Electronics.

1.3 Printed-Circuit Board Assembly

The TPS65021EVM-110 printed-circuit board (PCB) contains the TPS65021 IC and its required external components. This PCB has several jumpers and connectors that allow the user to customize the board for specific operating conditions.

1.4 USB to I²C Interface Board (EV2300)

The Texas Instruments EV2300 board 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, and the other end of the EV2300 connects to the EVM with the supplied Molex cable. When the user writes a command to the EVM, the interface program, which is run from the PC, sends the command to the PC USB port. The EV2300 receives the USB command and converts the signal to an I²C protocol. It then sends the I²C signal to the TPS65021 board. When the user reads 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 I²C interface. The EV2300 receives the information on the I²C interface, converts it to a USB protocol, and sends it to the PC.

1.5 Software

Texas Instruments has provided software to assist the user in evaluating this EVM. To install the software, insert the CD provided with the EVM into your computer. The software should start automatically. If it does not, simply go to <Start>, <Run>, and type "D:\SLVU138.exe", and click <OK> (assuming that D: is your CD drive). The program should run without errors. If any problems occur that result in the program not being installed, view the readme.txt file on the CD for further information. Check the TPS65021 product folder on the TI Web site for the latest revision of the software.

2 Setup

This section describes the jumpers and connectors on the EVM as well as how to properly connect, set up, and use the TPS65021EVM-110.

2.1 Input / Output Connector Descriptions

INPUT / OUTPUT	DESCRIPTION
J1 – VIN	Input voltage from external power supply, recommended maximum 5.5 V. Input current is dependent on load but is typically below 2 A.
J2 – GND	This is the return connection for V _I .
J3 – VINLDO/GND	Input voltage and return for LDO1 and LDO2C. Resistor R23 connects this pin to VDCDC1. If an external power supply is used, remove R23. Recommended maximum input voltage is 5.5 V
J4 – VSYSIN/GND	Input voltage and return for VSYSIN, one of the input voltages for RTC. Resistor R24 connects this input to VDCDC1. If an external power supply is used, remove R24. Recommended maximum input voltage is 4 V
J5 – VBACKUP/GND	Input voltage and return for VBACKUP, one of the input voltages for RTC. There is no onboard connections to a voltage input. Recommended maximum input voltage is 4 V.
J7 – VRTC/GND	Output voltage from the RTC circuit.
J8 – Fault Outputs	Four fault outputs are available on this connector: $\overline{\text{PWRFAIL}}$ - Fault occurs when input voltage is below 3 V. Pulled up to VRTC when safe, low for fail. $\overline{\text{INT}}$ - Fault occurs when there is a fail on an input or output voltage. It acts as a sum fail. Pulled up to V _I when safe, low for fail. $\overline{\text{RESPWRON}}$ - Low reset signal controlled by SW2, 300 ms. Pulled up to V _I normally. $\overline{\text{LOWBAT}}$ - Fault occurs when input voltage is below 3.6 V. Pulled up to V _I when safe, low for fail.
J9 – USB	This header duplicates the signals from the J20 interface connector.
J10 – VDCDC1	Output from DCDC1 switching regulator, maximum output current is 1.2 A, default voltage setting is 3.3 V.
J11 – GND	Return for VDCDC1

INPUT / OUTPUT	DESCRIPTION
J12 – VDCDC2	Output from DCDC2 switching regulator, maximum output current 1 A, default voltage setting 2.5 V.
J13 – GND	Return for VDCDC2
J14 – VLDO1	Output from the low dropout regulator VLDO1, maximum current out is 50 mA, default value 1.1 V.
J15 – GND	Return for VLDO1
J16 –VLDO2	Output from the low dropout regulator, VLDO2 maximum current out is 50 mA, default value 1.3 V.
J17 – GND	Return for VLDO2
J18 – VDCDC3	Output from the switching regulator DCDC3, maximum current is 800 mA, default value 1.55 A
J19 – GND	Return for VDCDC3
J20 – USB	USB interface connector
JP1 – DEF 1	Sets voltage for DCDC1 to 3 V or 3.3 V.
JP2 – DEF 2	Sets voltage for DCDC2 to 2.5 V or 1.8 V.
JP3 – DEF 3	Sets voltage for DCDC3 to 1.55 V or 1.3 V.
JP4 – DCDC1 ON/OFF	EN for regulator DCDC1, default setting is ON.
JP5 – DCDC2 ON/OFF	EN for regulator DCDC2, default setting is ON.
JP6 – DCDC3 ON/OFF	EN for regulator DCDC3, default setting is ON.
JP7 – LDO ON/OFF	EN for both LDO1 and LDO2 regulators, default setting is ON.
JP8 – DEFLDO1	LDO1 and LDO2 definition bit 1.
JP9 – DEFLDO2	LDO1 and LDO2 definition bit 2.
S2 – $\overline{\text{HOT_RST}}$	S2 is a normally open momentary push-button switch that, when pressed, connects the $\overline{\text{HOT_RST}}$ input of the TPS65021 to GND generating the Hot_Reset pulse. The $\overline{\text{HOT_RST}}$ pin is externally pulled up.

2.2 Setup

The following steps must be followed before the EVM is operated.

1. Install the TPS65020EVM software.
2. Connect input voltages and loads to the EVM.
3. Configure all EVM jumpers to factory setting.
 - JP4—ON
 - JP1—3.3 V
 - JP3—1.55 V
 - JP2—2.5 V
 - JP5—ON
 - JP6—ON
 - JP7—ON
 - JP8—ON
 - JP9—ON
4. Connect the Molex cable between the EVM and the EV2300. Note that the Molex cable must connect to the I²C 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 TPS65020EVM software, and select TPS65021 when device selection form screen appears .

3 Board Layout

This section provides the TPS65021EVM-110 board layout and illustrations.

3.1 Layout

Board layout is critical for all switch-mode power supplies. Figure 1 through Figure 5 show the board layout for the TPS65021EVM-110 printed-wiring board. 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 data sheet for specific layout guidelines.

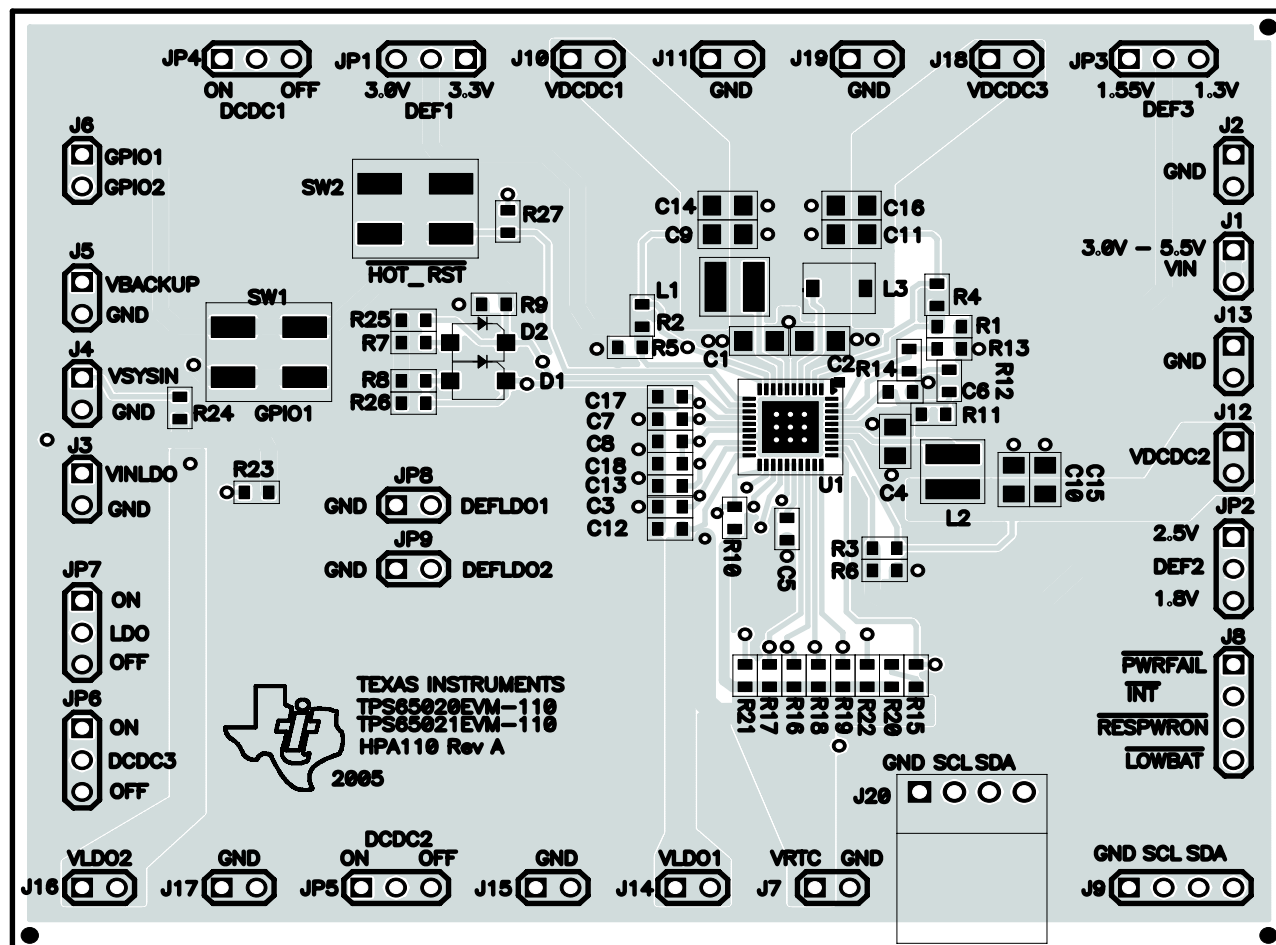


Figure 1. Assembly Layer

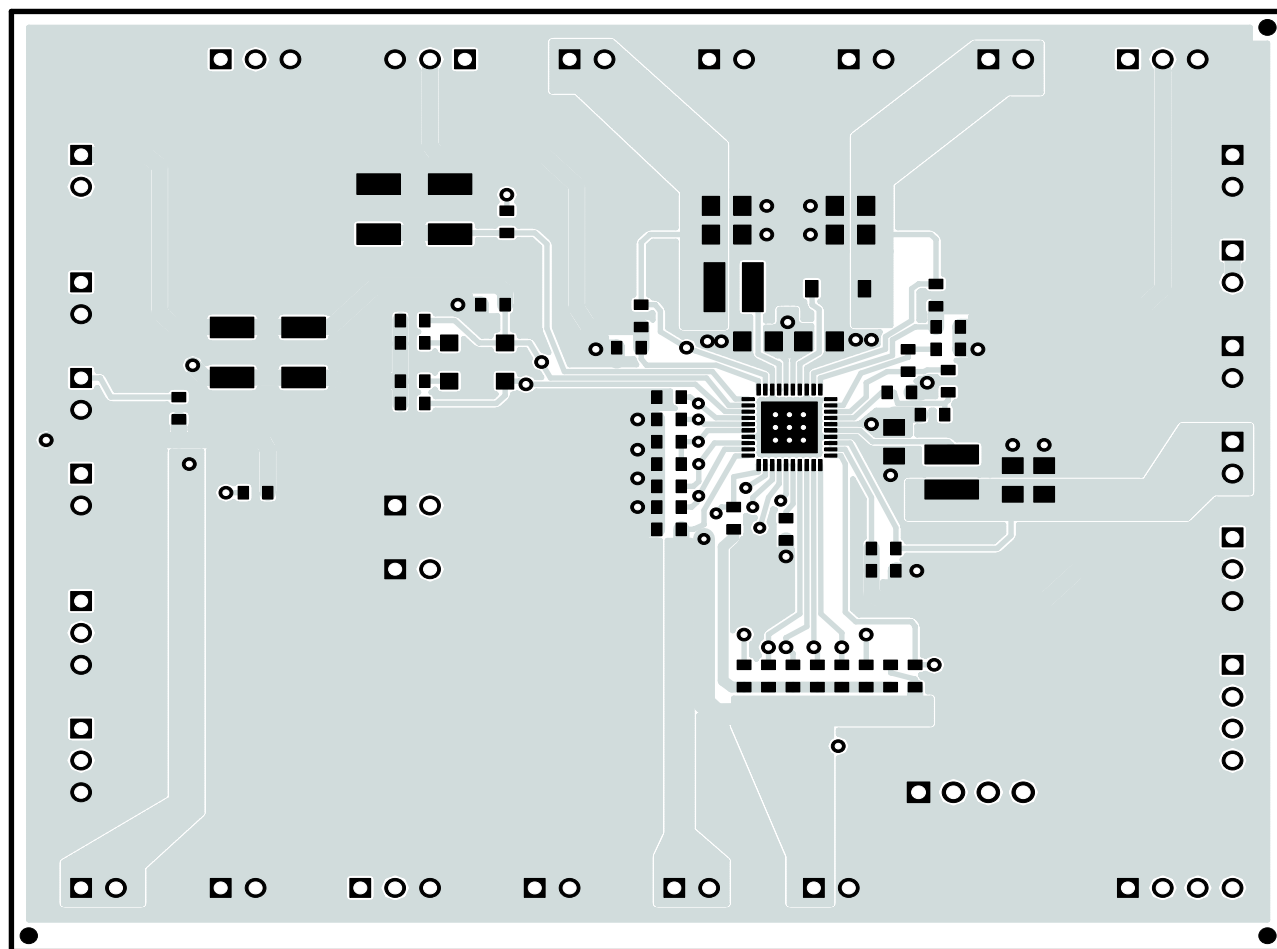


Figure 2. Top Layer

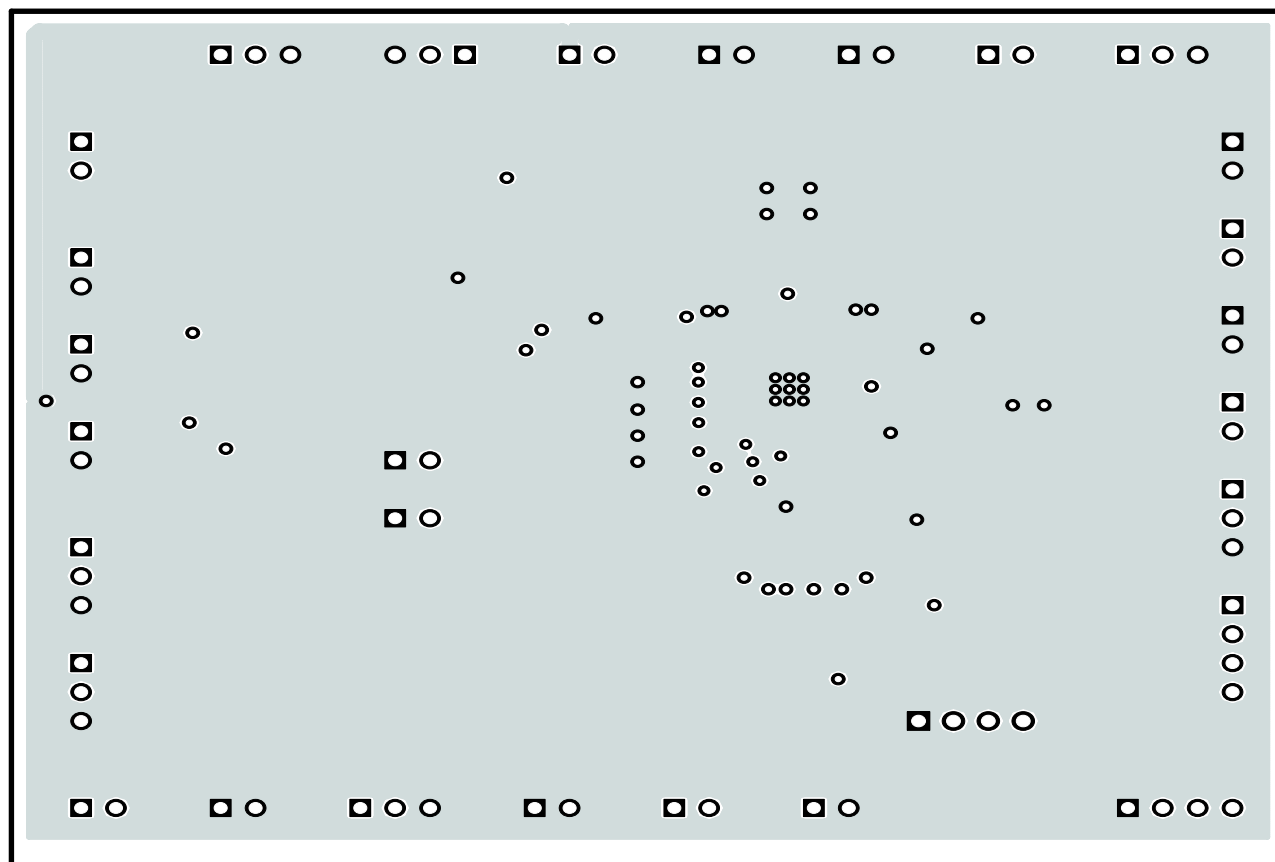


Figure 3. Routing, GND Plane

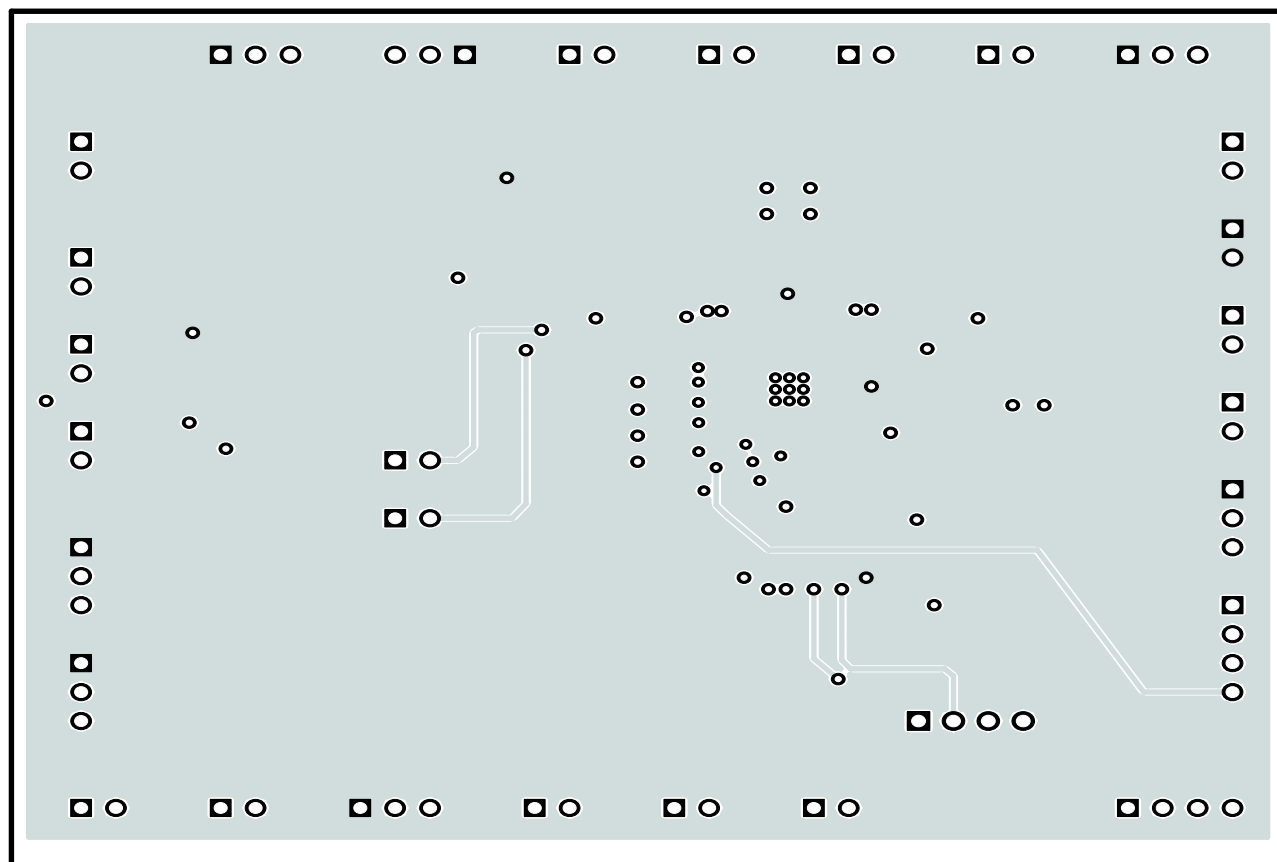


Figure 4. Routing, VIN Plane

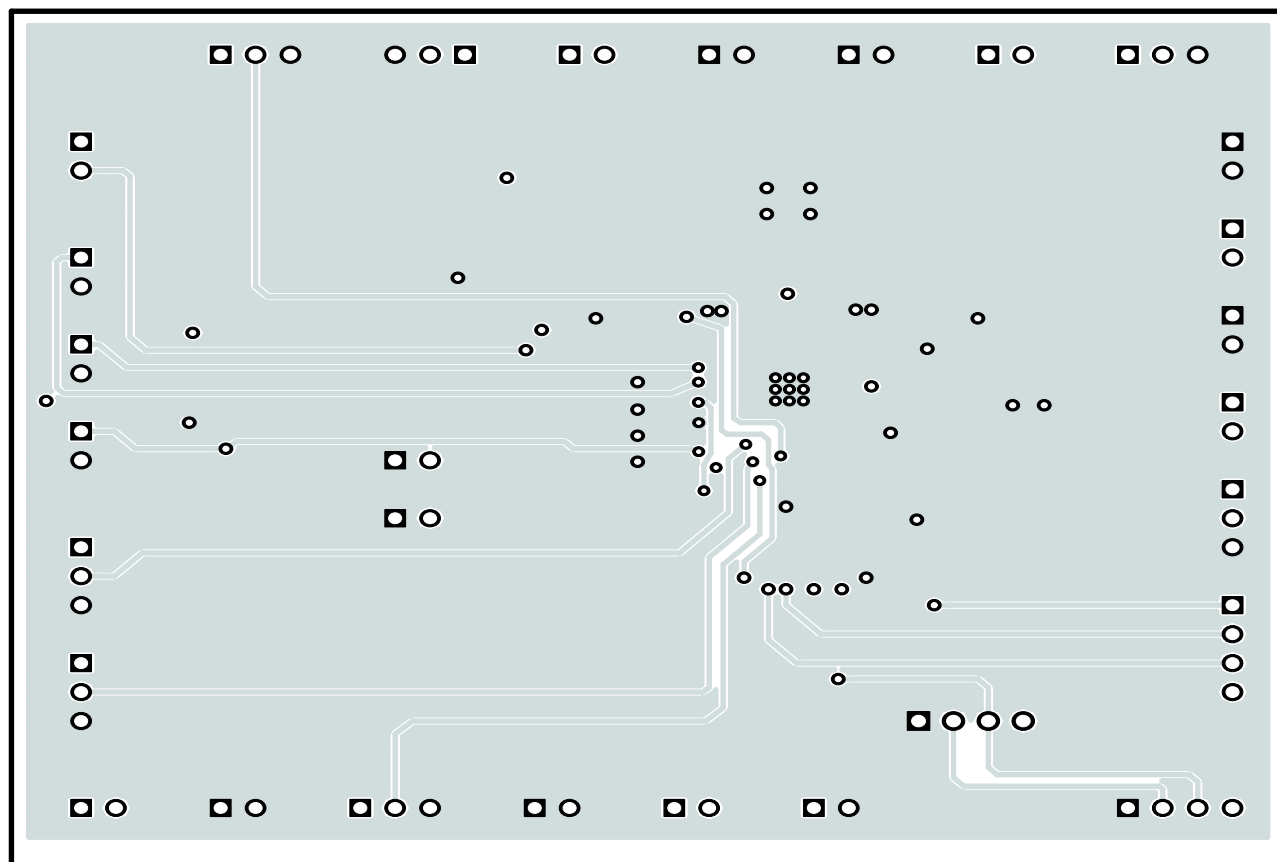


Figure 5. Routing, Bottom Layer

4 Schematic and Bill of Materials

This section provides the TPS65021EVM-110 schematic and bill of materials.

4.1 Schematic

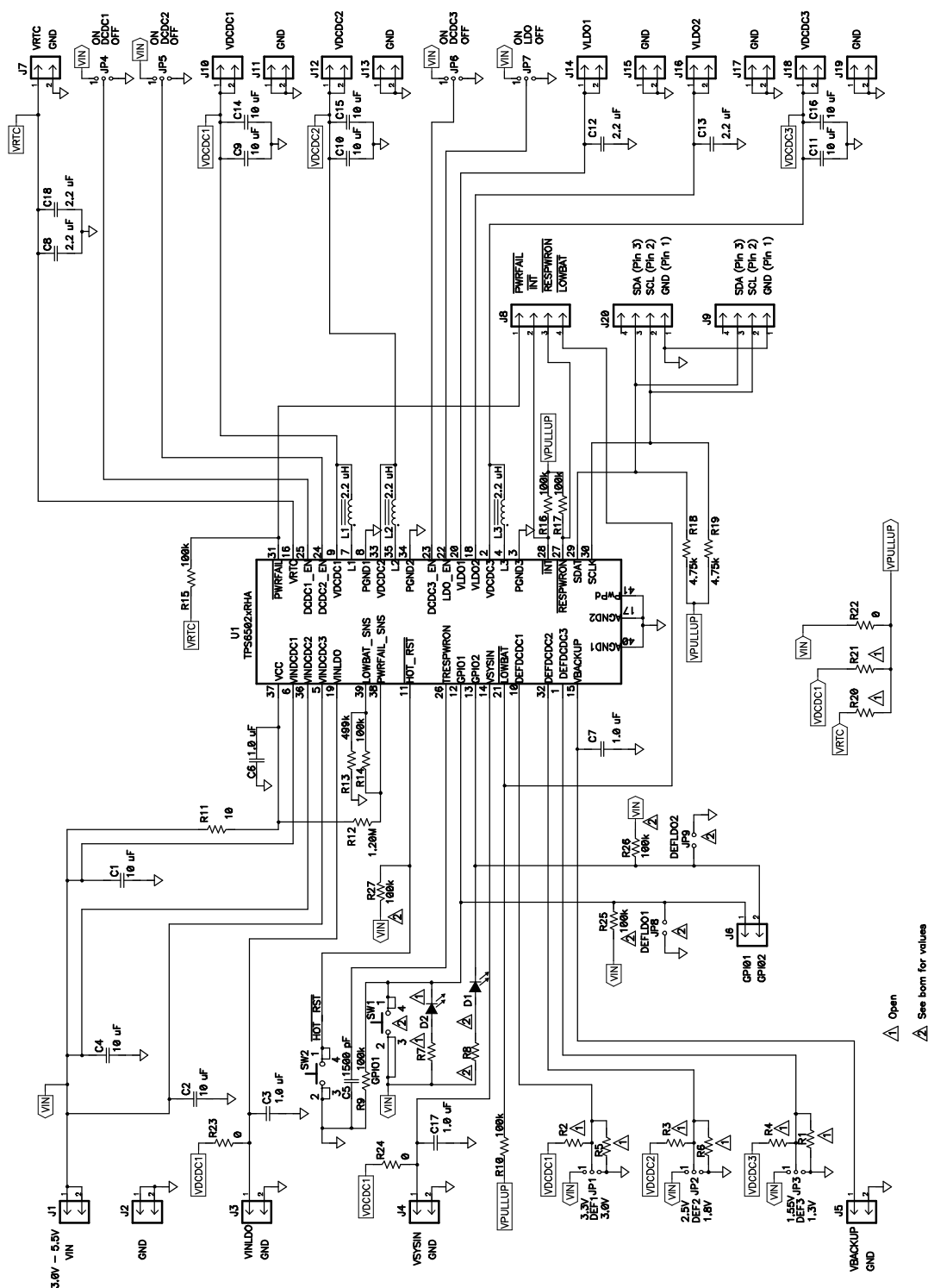


Figure 6. TPS65021EVM-110 Schematic

4.2 Bill of Material

Table 1. HPA110B BOM

Count		Ref Des	Value	Description	Size	Part No.	MFR
-001	-002						
9	9	C1, C2, C4, C9–C11, C14–C16	10 μ F	Capacitor, ceramic, 10 μ F, 6.3 V, X5R, 20%	0805	C2012X5R0J106K	TDK
4	4	C8, C12, C13, C18	2.2 μ F	Capacitor, ceramic, 2.2 μ F, 6.3 V, X5R, 10%	0603	C1608X5R0J225K	TDK
4	4	C3, C6, C7, C17	1.0 μ F	Capacitor, Ceramic, 1.0 μ F, 6.3 V, X5R, 10%	0603	C1608X5R0J105K	TDK
1	1	C5	1500 pF	Capacitor, Ceramic, 1500 pF, 50 V, X7R, 10%	0603	C1608X7R1H152K	TDK
1	0	D1		Diode, LED, Red, Gullwing, GW Type, 20 mA, 1.4 mcd typ	0.087 x 0.120	LN1261CAL	Panasonic
0	0	D2		Diode, LED, Red, Gullwing, GW Type, 20 mA, 1.4 mcd typ.	0.087 x 0.120		
17	17	J1–J7, J10–J19		Header, 2-pin, 100 mil spacing, (36-pin strip)	0.100 x 2	PTC36SAAN	Sullins
1	1	J20		Header, Friction Lock Assembly, 4-pin Right Angle	0.400 x 0.500	22-05-3041	Molex
2	2	J8, J9		Header, 4-pin, 100 mil spacing, (36-pin strip)	0.100 x 4	PTC36SAAN	Sullins
7	7	JP1–JP7		Header, 3-pin, 100 mil spacing, (36-pin strip)	0.100 x 3	PTC36SAAN	Sullins
0	2	JP8, JP9		Header, 2-pin, 100 mil spacing, (36-pin strip)	0.100 x 2	PTC36SAAN	Sullins
2	2	L1, L2	2.2 μ H	Inductor, SMT, 1.72-A, 59-milliohm	0.157 x 0.157	VLCF4020T-2R2N1R7	TDK
1	1	L3	2.2 μ H	Inductor, SMT, 1.5-A, 87-milliohm	0.137 x 0.147	VL4012AT-2R2M1R5	TDK
0	0	R1–R7, R20, R21	Open	Resistor, Chip, xx-Ohms, 1/16-W, 1%	0603		
1	1	R11	10	Resistor, Chip, 10-Ohms, 1/16-W, 1%	0603	Std	Std
1	1	R12	1.20M	Resistor, Chip, 1.20M-Ohms, 1/16-W, 1%	0603	Std	Std
1	1	R13	499k	Resistor, Chip, 499k-Ohms, 1/16-W, 1%	0603	Std	Std
2	2	R18, R19	4.75k	Resistor, Chip, 4.75k-Ohms, 1/16-W, 1%	0603	Std	Std
3	3	R22–R24	0	Resistor, Chip, 0-Ohms, 1/16-W, 1%	0603	Std	Std
1	0	R8	1.0k	Resistor, Chip, 1.0k-Ohms, 1/16-W, 1%	0603	Std	Std
6	6	R9, R10, R14–R17	100k	Resistor, Chip, 100k-Ohms, 1/16-W, 1%	0603	Std	Std
0	3	R25–R27	100k	Resistor, Chip, 100k-Ohms, 1/16-W, 1%	0603	Std	Std
1	0	SW1		Switch, SPST, PB Momentary, Sealed Washable	0.245 X 0.251	KT11P2JM	C & K
1	1	SW2		Switch, SPST, PB Momentary, Sealed Washable	0.245 X 0.251	KT11P2JM	C & K
1	0	U1		IC, Power Management IC for Li-Ion Powered Systems	0.242 x 0.242	TPS65020RHA	TI
0	1			IC, Power Management IC for Li-Ion Powered Systems	0.242 x 0.242	TPS65021RHA	TI
1	1			PCB, 3.65 In x 2.95 In x 0.062 In		HPA110	Any
7	9			Shunt, 100-mil, Black	0.100	929950-00	3M

5 Related Documentation

1. *TPS65021, Power Management IC for Li-Ion Powered Systems* data sheet ([SLVS613](#))

FCC Warnings

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.

EVM TERMS AND CONDITIONS

Texas Instruments (TI) provides the enclosed Evaluation Module and related material (EVM) to you, the user, (you or user) **SUBJECT TO** the terms and conditions set forth below. By accepting and using the EVM, you are indicating that you have read, understand and agree to be bound by these terms and conditions. **IF YOU DO NOT AGREE TO BE BOUND BY THESE TERMS AND CONDITIONS, YOU MUST RETURN THE EVM AND NOT USE IT.**

This EVM is provided to you by TI and is intended for your **INTERNAL ENGINEERING DEVELOPMENT OR EVALUATION PURPOSES ONLY**. It is provided "AS IS" and "WITH ALL FAULTS." It is not considered by TI to be fit for commercial use. As such, the EVM may be incomplete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety measures typically found in the end product. As a prototype, the EVM 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 EVM not meet the specifications indicated in the EVM User's Guide, it may be returned within 30 days from the date of delivery for a full refund of any amount paid by user for the EVM, which user agrees shall be user's sole and exclusive remedy. **THE FOREGOING WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY TI TO USER, AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE OR NON-INFRINGEMENT.**

TI shall have no obligation to defend any claim arising from the EVM, including but not limited to claims that the EVM infringes third party intellectual property. Further, TI shall have no liability to user for any costs, losses or damages resulting from any such claims. User shall indemnify and hold TI harmless against any damages, liabilities or costs resulting from any claim, suit or proceeding arising from user's handling or use of the EVM, including but not limited to, (i) claims that the EVM infringes a third party's intellectual property, and (ii) claims arising from the user's use or handling of the EVM. TI shall have no responsibility to defend any such claim, suit or proceeding.

User assumes all responsibility and liability for proper and safe handling and use of the EVM and the evaluation of the EVM. TI shall have no liability for any costs, losses or damages resulting from the use or handling of the EVM. User acknowledges that the EVM may not be regulatory compliant or agency certified (FCC, UL, CE, etc.). Due to the open construction of the EVM it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge.

EXCEPT TO THE EXTENT OF THE USER'S INDEMNITY OBLIGATIONS SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES WHETHER TI IS NOTIFIED OF THE POSSIBILITY OR NOT.

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**.

User agrees to read the EVM User's Guide and, specifically, the EVM warnings and Restrictions notice in the EVM User's Guide prior to handling the EVM and the product. This notice contains important safety information about temperatures and voltages.

It is user's responsibility to ensure that persons handling the EVM and the product have electronics training and observe good laboratory practice standards.

By providing user with this EVM, product and services, TI is NOT granting user any license in any patent or other intellectual property right.

EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 0 V to 5.5 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.

EVM WARNINGS AND RESTRICTIONS (continued)

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.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2005, Texas Instruments Incorporated

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 and 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	Security	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 © 2005, Texas Instruments Incorporated