

TPS650241EVM

This user's guide describes the characteristics, operation, and use of the TPS650241EVM-234 evaluation module (EVM). This EVM is designed to help the user evaluate and test the various operating modes of the TPS650241. This User's Guide includes setup instructions for the hardware, 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	4
4	Schematic and Bill of Materials	9

List of Figures

1	Assembly Layer	5
2	Top Layer Routing	6
3	Layer 2, GND Plane	7
4	Layer 3 Routing	8
5	Bottom Layer Routing	9
6	TPS650241EVM-234 Schematic	10

List of Tables

1	Jumper Settings	4
2	TPS650241EVM-234 Bill of Materials	11

1 Introduction

The Texas Instruments TPS650241EVM 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 TPS650241 contains three highly efficient switching step-down converters, three LDOs, and additional status and I/O pins.

1.1 Requirements

No additional components other than the external power supply are needed. See [Section 2 – Setup](#).

1.2 Printed Circuit Board Assembly

The TPS650241EVM-234 PCB contains the TPS650241 IC and its required external components. This board contains several jumpers and connectors that allow the user to customize the board for specific operating conditions.

2 Setup

This section describes the jumpers and connectors on the EVM as well as how to properly connect, setup, and use the TPS650241EVM-234.

2.1 *Input/Output Connector Descriptions*

2.1.1 J2 — VIN

Input voltage from the external power supply, recommended maximum is 5.5V. The input current is dependent on the load, but is typically below 2A.

2.1.2 J5 — GND

This is the return connection for VIN

2.1.3 J1 — VDCDC1

Output from the DCDC1 switching regulator, maximum output current is 1.6A. The default voltage setting is 3.3V.

2.1.4 J3 — GND

Return for VDCDC1.

2.1.5 J4 — VDCDC2

Output from the DCDC2 switching regulator, maximum output current is 1A. The default voltage setting is 2.5V

2.1.6 J6 — GND

Return for VDCDC2.

2.1.7 J7 — VDCDC3

Output from the switching regulator DCDC3, maximum output current is 800mA. The default value is 1.375V.

2.1.8 J8 — GND

Return for VDCDC3.

2.1.9 J9 — VLD01

Output from the low drop out regulator VLDO1, maximum output current is 200mA. The default value is 1.5V.

2.1.10 J10 — GND

Return for VLDO1.

2.1.11 J11 — VLD02

Output from the low drop out regulator VLDO2, maximum output current is 200mA. The default value is 1.5V.

2.1.12 J12 — GND

Return for VLDO2.

2.1.13 J13 — VINLDO/GND

Input voltage from the external power supply, recommended maximum 5.5V. The input current is dependent on the load but is typically below 2A.

The EVM has this input connected to the VDCDC1 output via R11.

2.1.14 J14 — VDD_ALIVE/GND

Output from the low drop out regulator VLDO3, maximum output current is 30mA. The default value is 1.2V.

2.1.15 J5 — $\overline{\text{PWRFAIL}}$

$\overline{\text{PWRFAIL}}$ – Fault occurs when the input voltage is below 3V. It is pulled up to VIN when safe, low for fail.

2.1.16 JP1 — DEF1

Sets the default voltage for DCDC1, 2.8V or 3.3V.

2.1.17 JP2 — DEF2

Sets the default voltage for DCDC2, 1.8V or 2.5V.

2.1.18 JP5 — DEF3

Sets the default voltage for DCDC3, 0.9V or 1.375V.

2.1.19 JP3 — DCDC1 ON/OFF

EN for the DCDC1 converter. The default setting is ON.

2.1.20 JP4 — DCDC2 ON/OFF

EN for the DCDC2 converter. The default setting is ON.

2.1.21 JP6 — DCDC3 ON/OFF

EN for the DCDC3 converter. The default setting is ON.

2.1.22 JP7 — PWM/PFM MODE

PWM or PFM Mode jumper. The default setting is PWM.

2.1.23 JP8 — LDO ON/OFF

EN for both the LDO1 and LDO2 regulators. The default setting is ON.

2.1.24 JP9 — VDD_ALIVE/GND

EN for the VDD_ALIVE low dropout regulator. The default setting is ON.

2.2 Factory Setup

The EVM comes from the factory with the following default settings on the jumpers.

Table 1. Jumper Settings

Jumper	Shunt Location
JP1	Between V-Hi and DEF1
JP2	Between V-Hi and DEF2
JP3	Between ON and DCDC1
JP4	Between ON and DCDC2
JP5	Between V-Hi and DEF3
JP6	Between ON and DCDC3
JP7	Between PWM and MODE
JP8	Between ON and LDO
JP9	Between ON and VDD_ALIVE

3 Board Layout

This section provides the TPS650241EVM-234 board layout and illustrations.

3.1 Layout

Board layout is critical for all switch mode power supplies. [Figure 1](#) through [Figure 5](#) shows the board layout for the TPS650241EVM-234 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 data sheet ([SLVS774](#)) for specific layout guidelines.

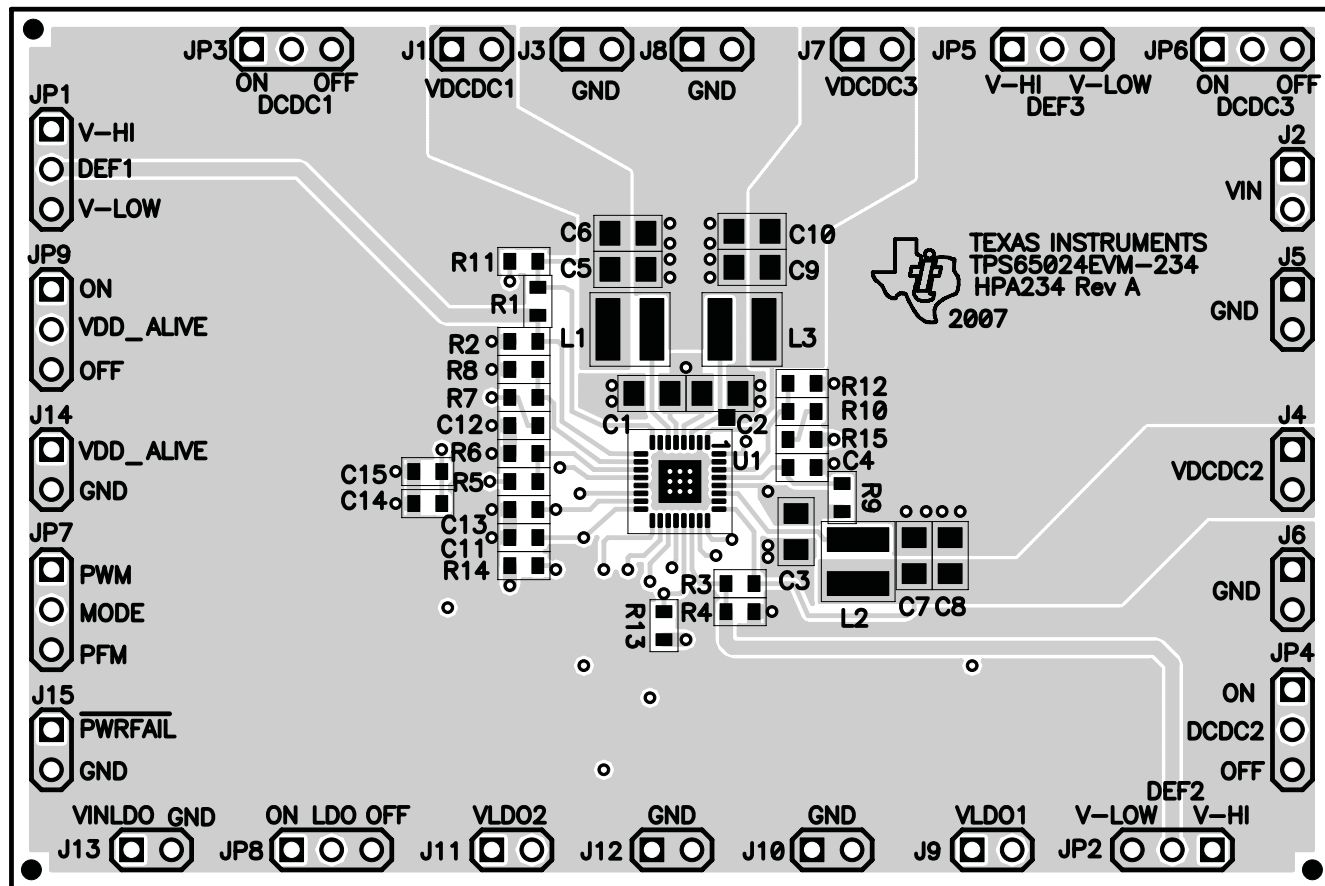


Figure 1. Assembly Layer

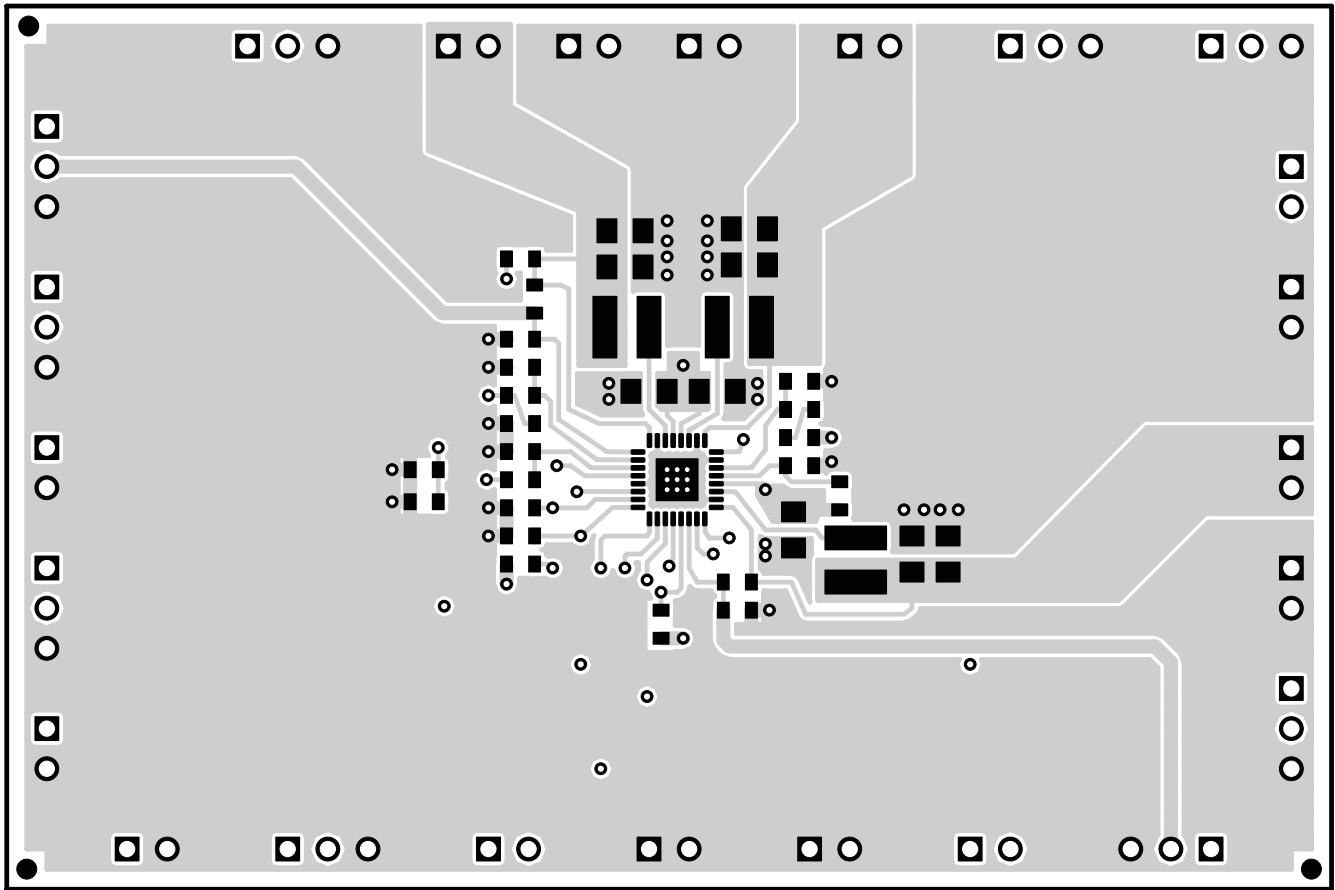


Figure 2. Top Layer Routing

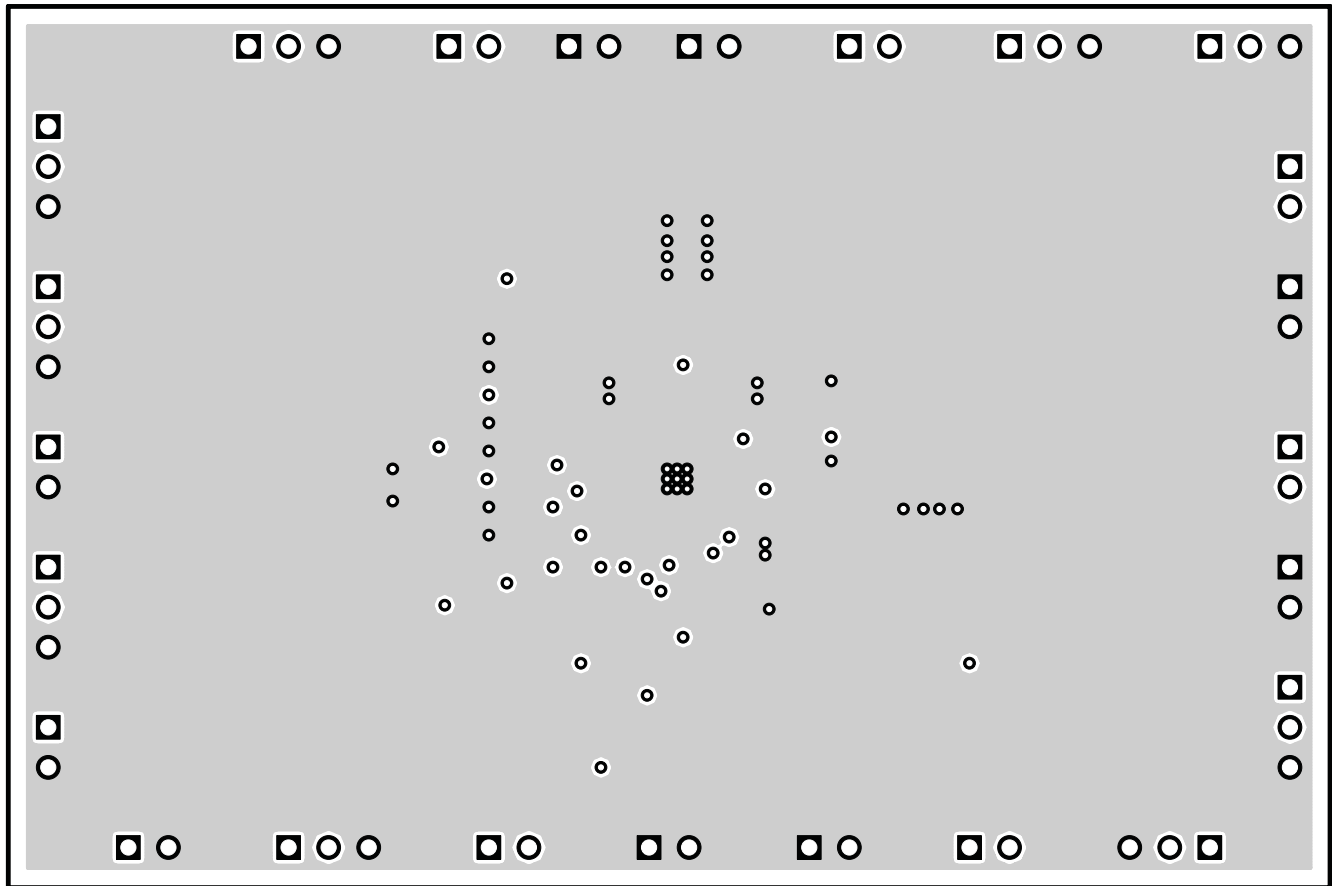


Figure 3. Layer 2, GND Plane

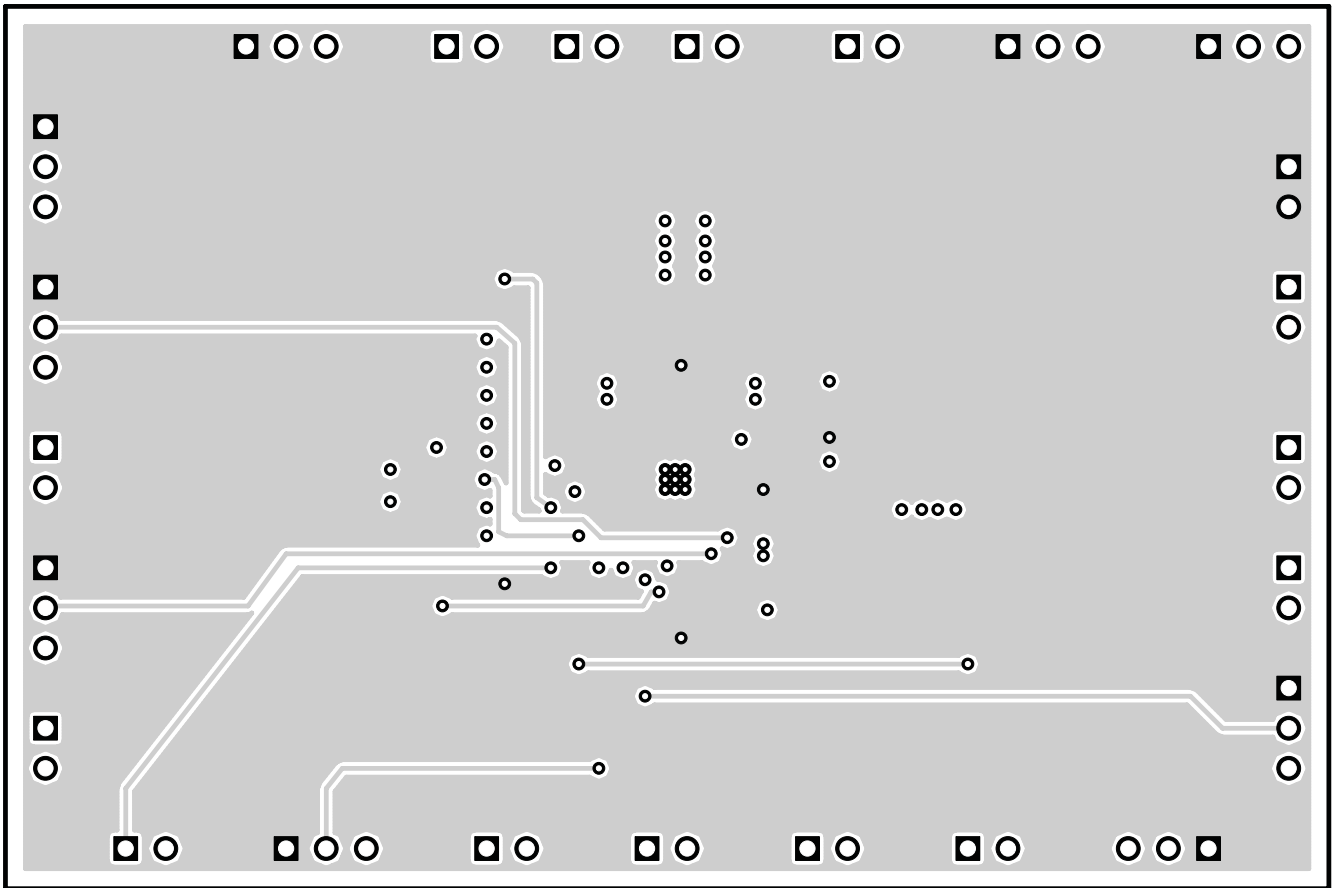


Figure 4. Layer 3 Routing

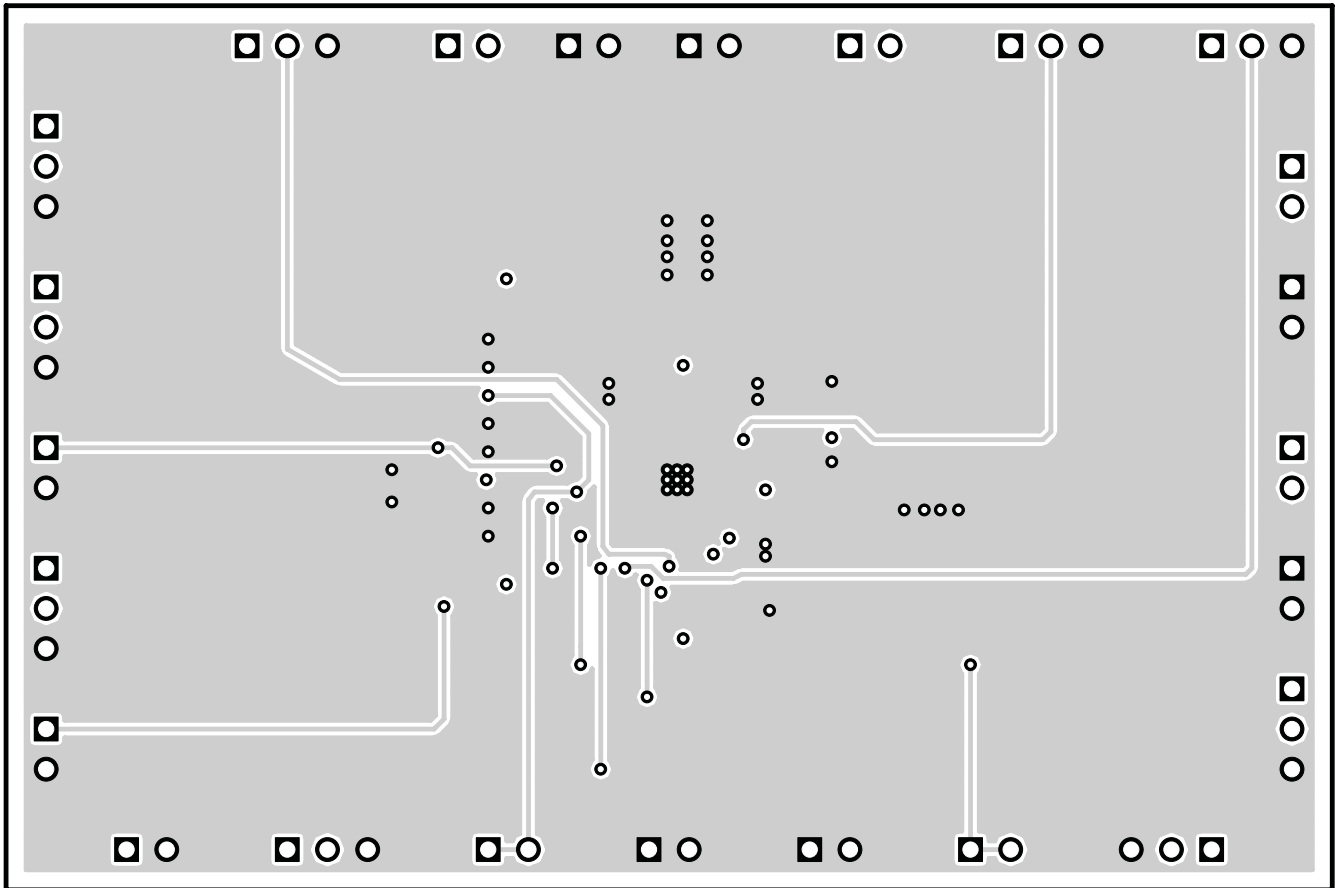


Figure 5. Bottom Layer Routing

4 Schematic and Bill of Materials

This section provides the TPS6650241EVM-234 schematic and bill of materials.

4.1 Schematic

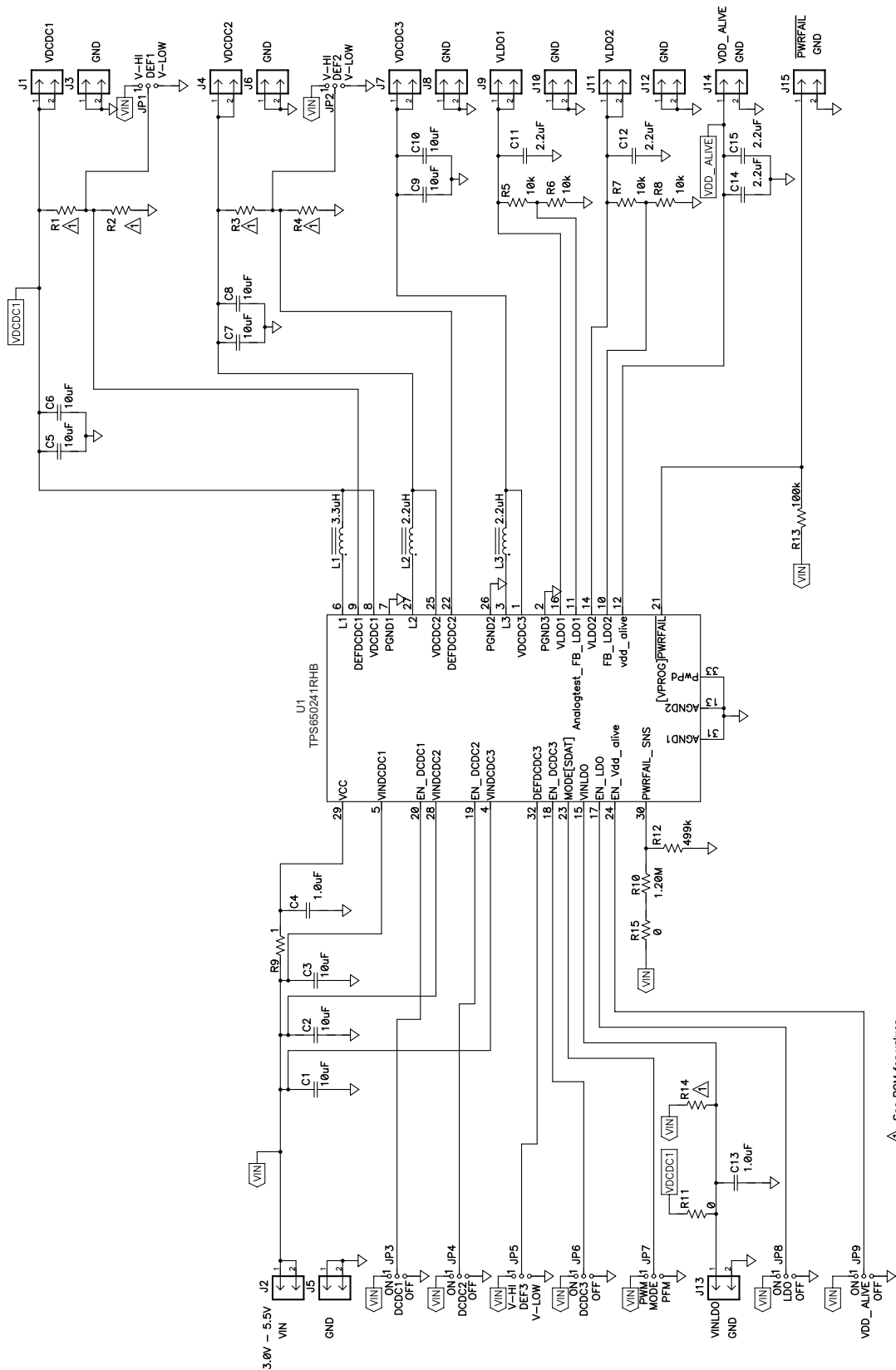


Figure 6. TPS650241EVM-234 Schematic

4.2 Bill of Materials

Table 2. TPS650241EVM-234 Bill of Materials

COUNT	RefDes	Value	Description	Size	Part Number	MFR
9	C1, C2, C3, C5 - C10	10uF	Capacitor, Ceramic, 6.3V, X5R, 10%	0805	C2012X5R0J106K	TDK
2	C11, C12, C14, C15	2.2uF	Capacitor, Ceramic, 6.3V, X5R, 10%	0603	C1608X5R0J225K	TDK
2	C4, C13	1.0uF	Capacitor, Ceramic, 6.3V, X5R, 10%	0603	C1608X5R0J105K	TDK
15	J1 - J15		Header, 2 pin, 100mil spacing, (36-pin strip)	0.100 x 2	PTC36SAAN	Sullins
9	JP1 - JP9		Header, 3 pin, 100mil spacing, (36-pin strip)	0.100 x 3	PTC36SAAN	Sullins
1	L1	3.3uH	Inductor, SMT, 1.52A, 78milliohm	0.157 x 0.157	VLCF4020T-3R5N1R5	TDK
2	L2, L3	2.2uH	Inductor, SMT, 1.72A, 59milliohm	0.157 x 0.157	VLCF4020T-2R2N1R7	TDK
0	R1, R2, R3, R4, R14	Open	Resistor, Chip, 1/16W, 1%	0603		
1	R10	1.20M	Resistor, Chip, 1/16W, 1%	0603	Std	Std
2	R11, R15	0	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R12	499k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R13	100k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
4	R5, R6, R7, R8	10k	Resistor, Chip, 1/16W, 1%	0603	Std	Std
1	R9	1	Resistor, Chip, 1/16W, 5%	0603	Std	Std
1	U1		IC, 3 DC-DC Converters	QFN-32[RTV]	TPS650241RHB	TI
1	--		PCB, 3.3 In x 2.2 In x 0.062 In		HPA234	Any
9	--		Shunt, 100 mil, Black	0.100	929950-00	3M

EVALUATION BOARD/KIT IMPORTANT NOTICE

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

This evaluation board/kit is intended for use for **ENGINEERING DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY** and is not considered by TI to be a finished end-product fit for general consumer use. Persons handling the product(s) must have electronics training and observe good engineering practice standards. As such, the goods being provided are not intended to be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety and environmental measures typically found in end products that incorporate such semiconductor components or circuit boards. This evaluation board/kit does not fall within the scope of the European Union directives regarding electromagnetic compatibility, restricted substances (RoHS), recycling (WEEE), FCC, CE or UL, and therefore may not meet the technical requirements of these directives or other related directives.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/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. 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 User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please contact the TI application engineer or visit www.ti.com/esh.

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.

FCC Warning

This evaluation board/kit is intended for use for **ENGINEERING DEVELOPMENT, DEMONSTRATION, OR EVALUATION PURPOSES ONLY** and is not considered by TI to be a finished end-product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to 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.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2007, Texas Instruments Incorporated

EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 1 V to 5.5 V and the output voltage range of 1 V to 3.3 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.

During normal operation, some circuit components may have case temperatures greater than 85°C. The EVM is designed to operate properly with certain components above 85°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 © 2007, 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 TI 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. Information of third parties may be subject to additional restrictions.

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.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

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
RFID	www.ti-rfid.com	Telephony	www.ti.com/telephony
Low Power Wireless	www.ti.com/lpw	Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2007, Texas Instruments Incorporated

www.BDTIC.com/TI