TPS65020EVM-110 User's Guide

This User's Guide describes the characteristics, operation, and use of the TPS65020EVM-110 evaluation module (EVM). This EVM is designed to help the user evaluate and test the various operating modes of the TPS65020. This User's 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.

Contents

List of Figures

List of Tables

1 Introduction

The Texas Instruments TPS65020EVM 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 TPS65020 contains three highly efficient switching step-down converters, two LDOs, and additional status and I/O pins. The device is controlled via an I^{2}C™ 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 (PC)

A computer with a USB port is required to operate this EVM. The TPS65020 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 TPS65020 internal registers through the USB port.

I^{2}C is a trademark of Philips Electronics.

1.3 Printed Circuit Board Assembly

The TPS65020EVM-110 PCB contains the TPS65020 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.

1.4 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, 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 I^2C protocol. It then sends the I^2C signal to the TPS65020 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 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.

1.5 Software

Texas Instruments has provided software to assist the user in evaluating this EVM. To install the software, insert the enclosed CD 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 TPS65020 product folder on the TI website 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, setup, and use the TPS65020EVM-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 on board connections to a voltage input. Recommended maximum input voltage is 4 V.
J6 – GPIO1/GPIO2	Direct connection to the GPIO1 and GPIO2 pins. For this EVM, GPIO1 is configured as a push-button input, and GPIO2 is configured as an LED output.
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.

INPUT / OUTPUT	DESCRIPTION
J11 – GND	Return for VDCDC1
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 drop out regulator VLDO1, maximun current out is 50 mA, default value 1.1 V.
J15 – GND	Return for VLDO1
J16 –VLDO2	Output from the low drop out 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.
S1 – GPIO1	S1 is a normally open momentary push-button switch that, when pressed, connects V_I to GPIO1. The GPIO1 input is configured on the TPS65020 as a debounced push button that drives an ON/OFF circuit with output at GPIO2.
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 TPS65020 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
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 TPS65020EVM software.

3 Board Layout

This section provides the TPS65020EVM-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 TPS65020EVM-110 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 to the datasheet for specific layout guidelines.

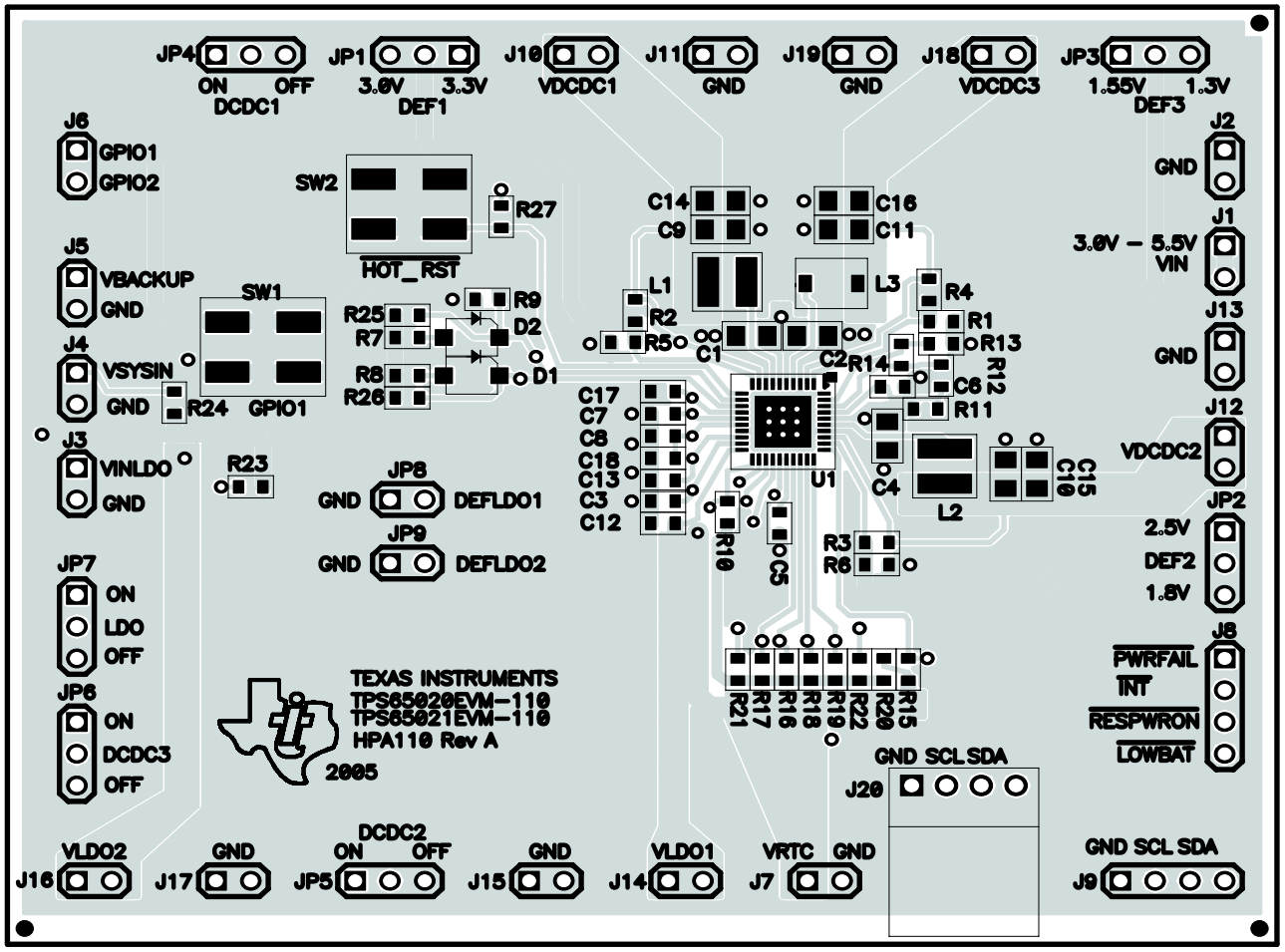

Figure 1. Assembly Layer

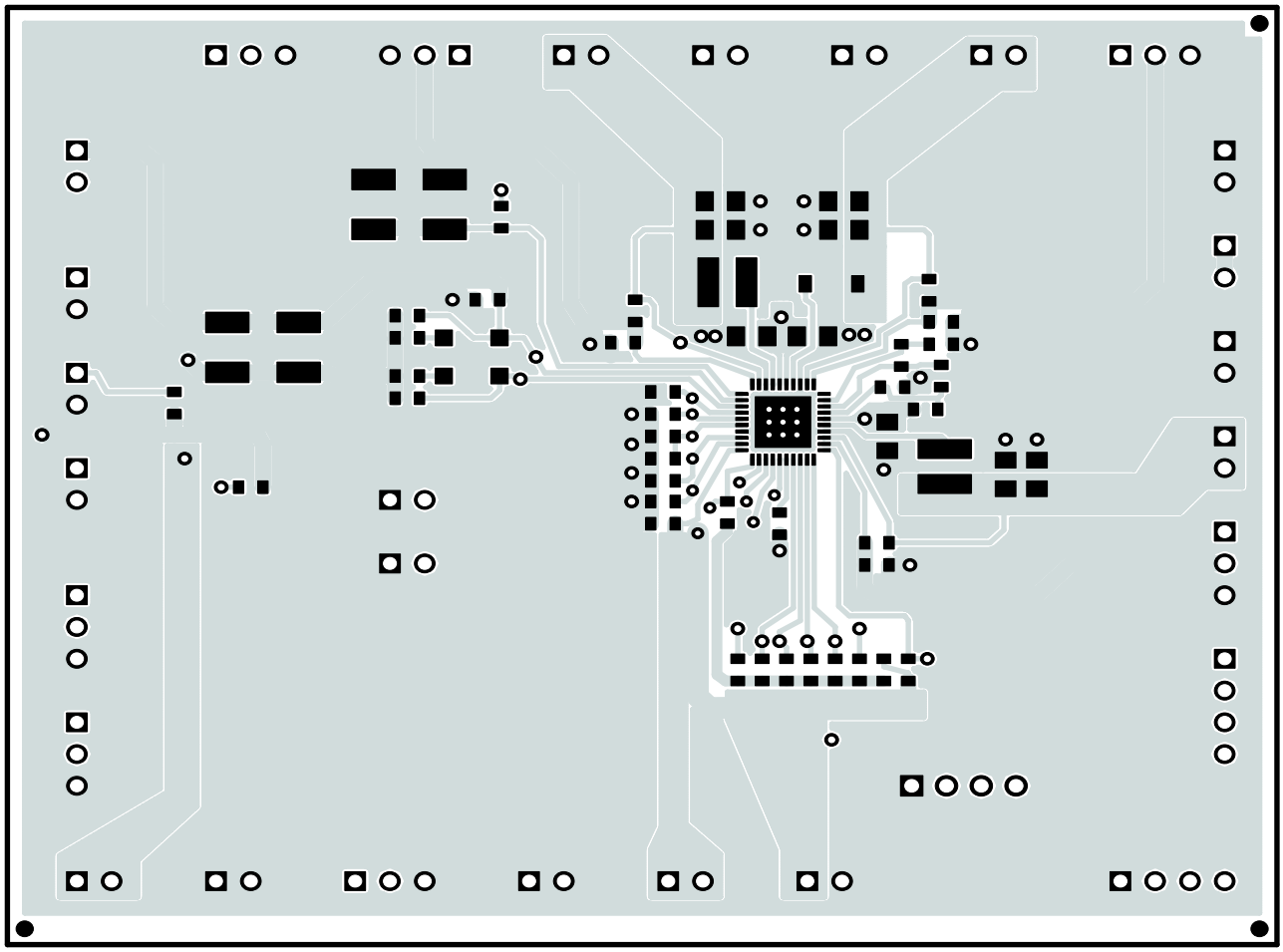

Figure 2. Top Layer

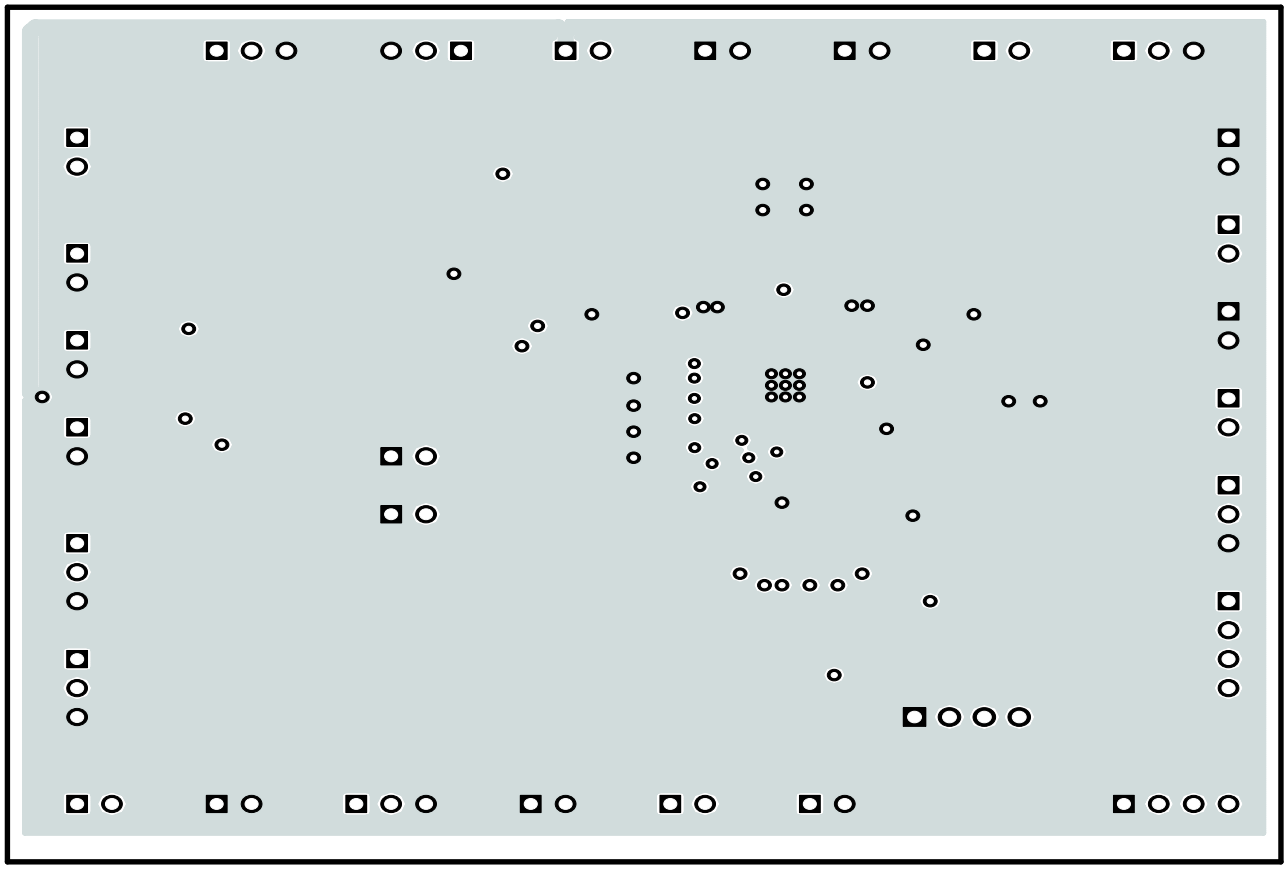

Figure 3. Routing, GND Plane

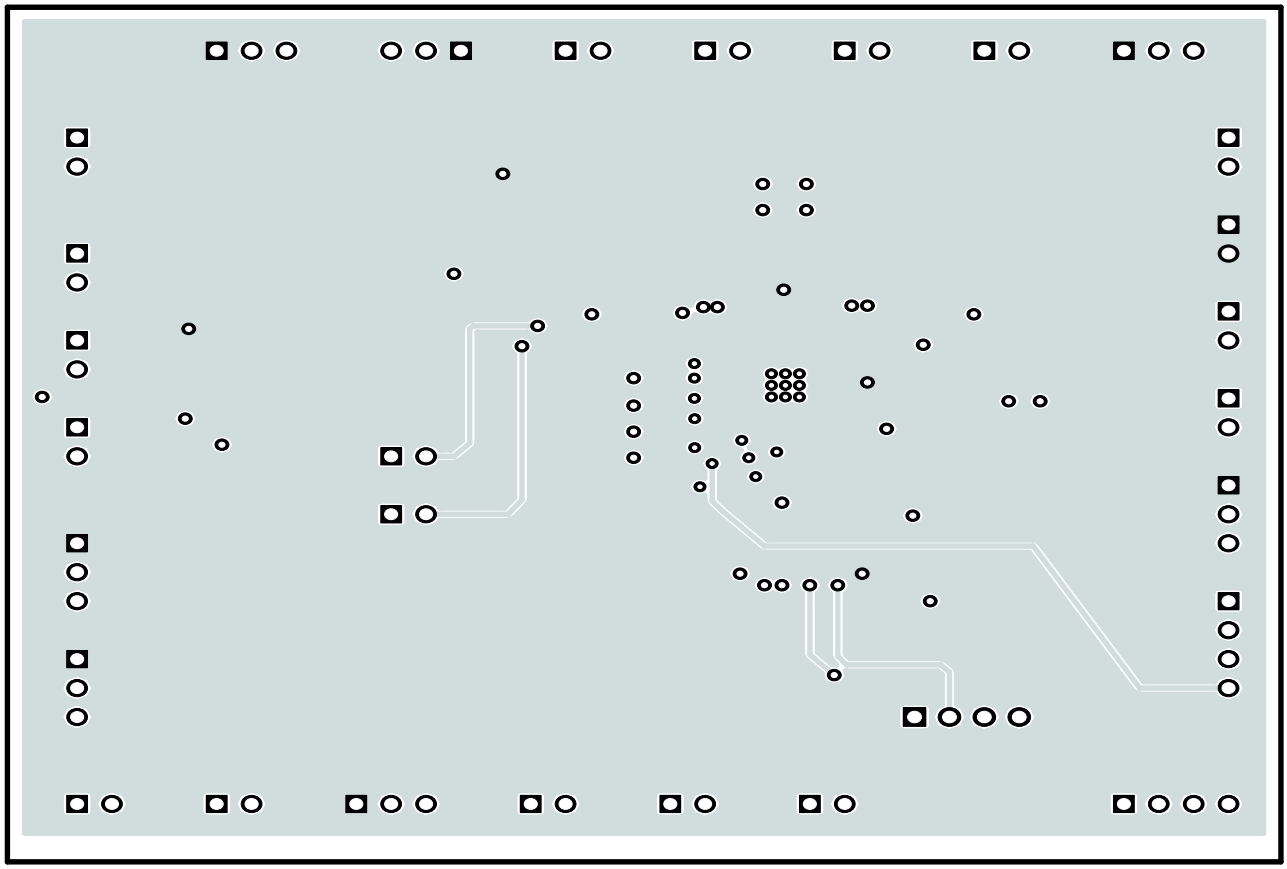

Figure 4. Routing, VIN Plane

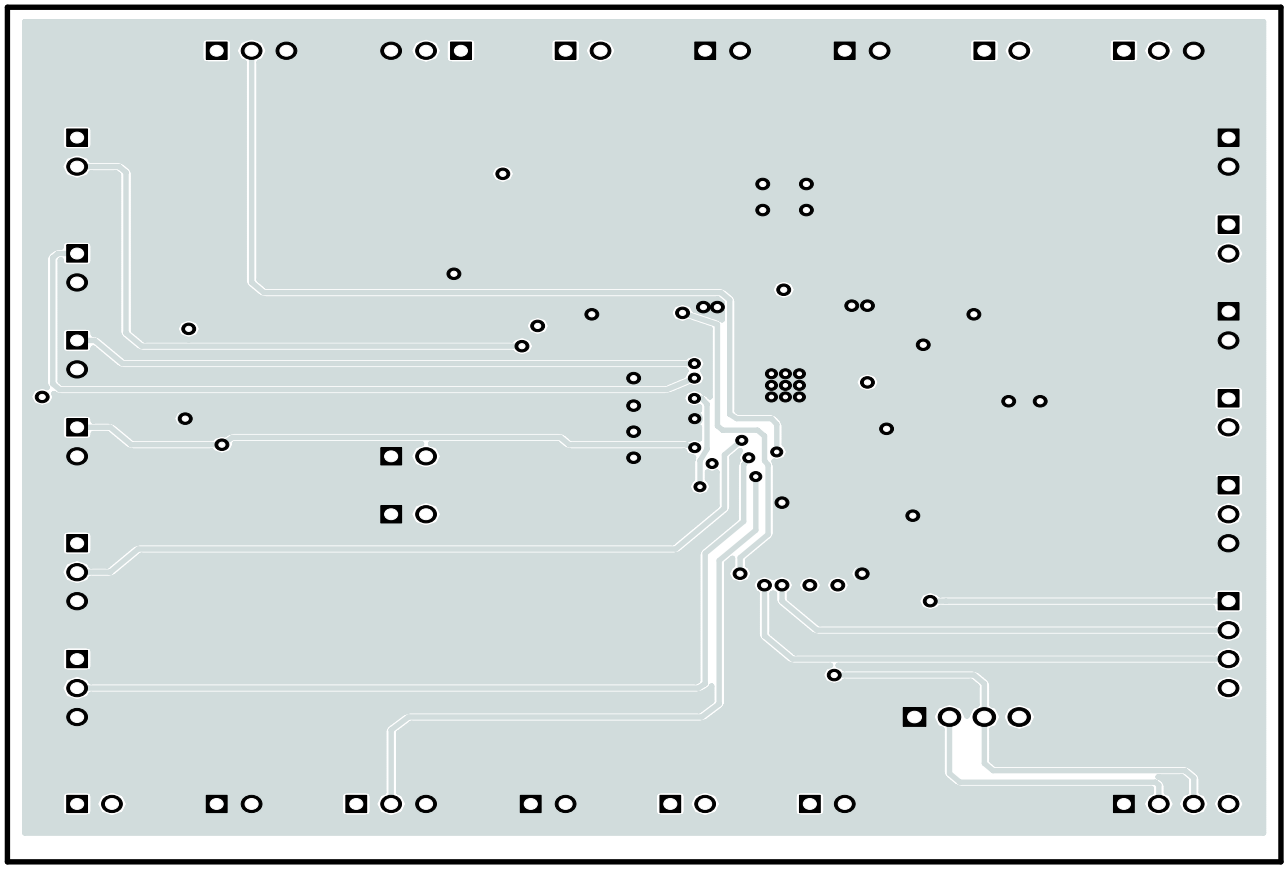

Figure 5. Routing, Bottom Layer

4 Schematic and Bill of Materials

This section provides the TPS65020EVM-110 schematic and bill of materials.

4.1 Schematic

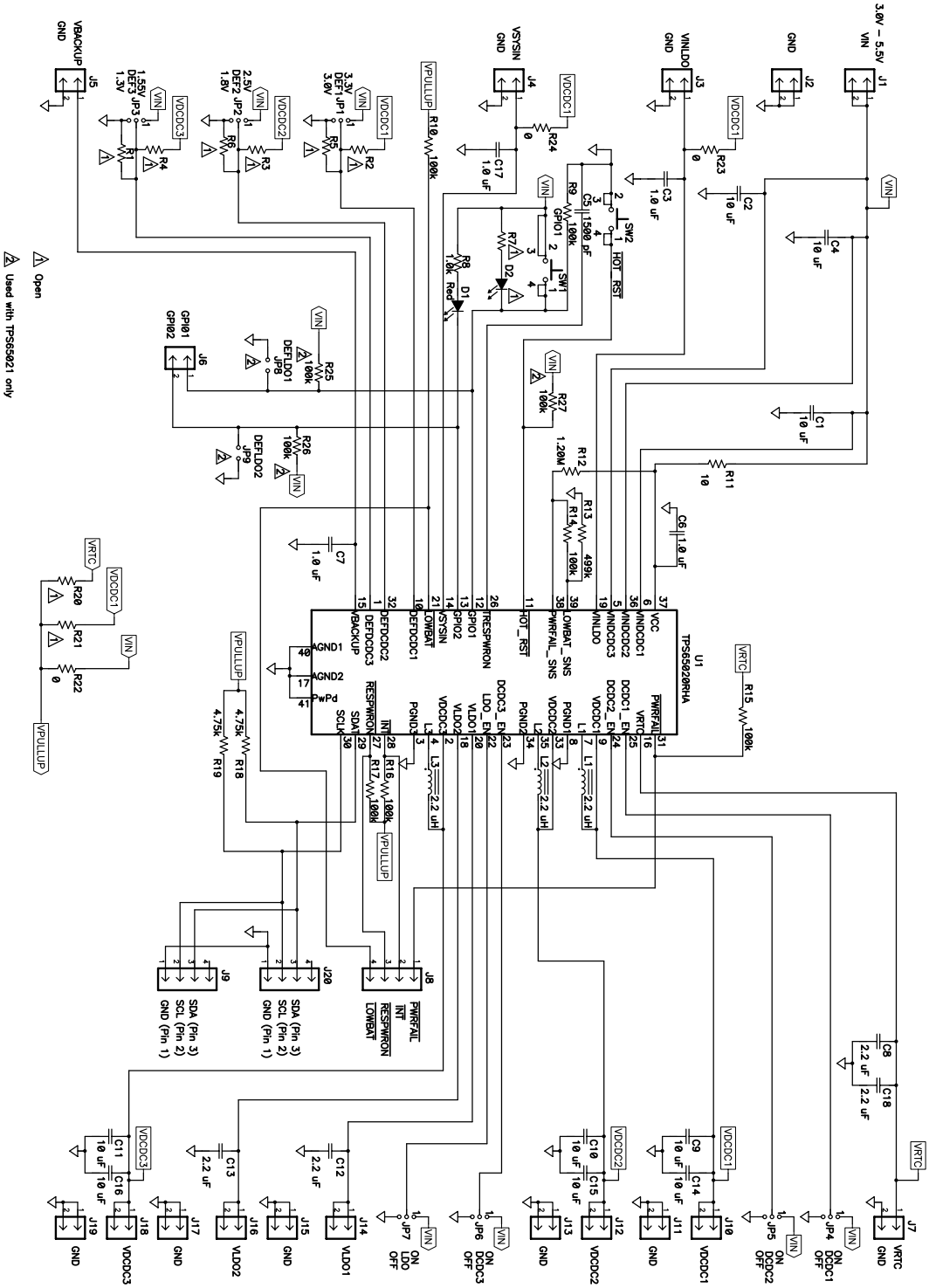

Figure 6. TPS65020EVM-110 Schematic

4.2 Bill of Material

Table 1. HPA110A BOM

Count		Ref Des	Value	Description	Size	Part No.	MFR
–001	–002						
9	9	C1, C2, C4, C9, C10, C11, C14, C15, C16	10 µF	Capacitor, ceramic, 10 µF, 6.3 V, X5R, 20%	0805	C2012X5R0J106K	TDK
4	4	C8, C12, C13, C18	2.2 µF	Capacitor, ceramic, 2.2 µF, 6.3 V, X5R, 10%	0603	C1608X5R0J225K	TDK
4	4	C3, C6, C7, C17	1.0 µF	Capacitor, Ceramic, 1.0 µF, 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	1	D1	Red	Diode, LED, Red, Gullwing, GW Type, 20 ma, 1.4 mcd typ	0.087 x 0.120	LN1261CAL	Panasonic
0	0	D2	Open	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 µH	Inductor, SMT, 1.72-A, 59-milliohm	0.157 x 0.157	VLCF4020T-2R2N1R7	TDK
1	1	L3	2.2 µH	Inductor, SMT, 1.5-A, 87-milliohm	0.137 X 0.147	VLF4012AT-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, R23, R24	0	Resistor, Chip, 0-Ohms, 1/16-W, 1%	0603	Std	Std
1	1	R8	1.0k	Resistor, Chip, 1.0k-Ohms, 1/16-W, 1%	0603	Std	Std
6	6	R9, R10, R14, R15, R16, R17	100k	Resistor, Chip, 100k-Ohms, 1/16-W, 1%	0603	Std	Std
0	3	R25, R26, R27	100k	Resistor, Chip, 100k-Ohms, 1/16-W, 1%	0603	Std	Std
2	2	SW1, 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
	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. *TPS65020, Power Management IC for Li-Ion Powered Systems* data sheet, SLVS607

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.

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EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 0 V to 4 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 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.

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