TPS65023EVM

This user's guide describes the characteristics, operation, and use of the TPS65023EVM-205 evaluation module (EVM). This EVM is designed to help the user evaluate and test the various operating modes of the TPS65023. This user's guide includes setup instructions for the hardware and software, a schematic diagram, a bill of materials, and PCB layout drawings for the evaluation module.

Related Documentation From Texas Instruments

TPS65023, Power Management IC For Li-Ion Powered Systems data sheet (SLVS670)

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1 Introduction

The Texas Instruments TPS65023EVM 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 TPS65023 contains three highly efficient switching step-down converters, two LDOs, and additional status and I/O pins. The device is controlled via an I^2C interface (HPA172).

1.1 Requirements

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

1.1.1 Personal Computer

A computer with a USB port is required to operate this EVM. The TPS65023 interface software, which is run on the personal computer (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 TPS65023 internal registers through the USB port.

1.1.2 Printed Circuit Board Assembly

The TPS65023EVM-205 PCB contains the TPS65023 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.

1.1.3 USB to I^{2}C Adapter

The HPA172 is the link that allows the PC and the EVM to communicate. The adapter connects to the PC with the supplied USB cable on one side and to the EVM though the supplied ribbon cable on the other. 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 adapter receives the USB command and converts the signal to an I^{2}C protocol. It then sends the I2C signal to the TPS65023 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 adapter receives the information on the I2C interface, converts it to a USB protocol, and sends it to the PC.

1.1.4 Software

Texas Instruments provides 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, go to <Start>, <Run>, and type *D:\setup.exe*, and click <OK> (assuming that D: is your CD drive). Check the TPS65023 product folder on the TI Web site for the latest version 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 TPS65023EVM-205.

2.1 Input/Output Connector Descriptions

J1 – VIN

Input voltage from external power supply, recommended maximum 5.5 V. Input current depends on load but typically is less than 2 A.

J2 – GND

This is the return connection for VIN.

J3 – VINLDO/GND

Input voltage and return for LDO1 and LDO2C. Resistor R20 connects this pin to VDCDC1. If an external power supply is used, remove R20. 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 R21 can be used to connect this input to VDCDC1. If an external power supply is used, remove R21. Recommended maximum input voltage is 4 V.

J5 – VBACKUP/GND

Input voltage and return for VBACKUP, one of the input voltages for RTC. There are no onboard connections to a voltage input. Recommended maximum input voltage is 4 V.

J6 – VRTC/GND

Output voltage from RTC circuit.

J7 – Fault Outputs

Four fault outputs are available on this connector:

$\overline{\text{PWRFAIL}}$– Fault occurs when input voltage is less than 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; acts as a sum fail. Pulled up to VIN when safe; low for fail.

$\overline{\text{RESPWRON}}$– Low reset signal controlled by SW1, 144 ms. Pulled up to VIN normally.

$\overline{\text{LOWBAT}}$– Fault occurs when input voltage is less than 3.6 V. Pulled up to VIN when safe; low for fail.

J8 – USB

This header duplicates the signals from the J20 interface connector.

J9 – VDCDC1

Output from DCDC1 switching regulator maximum output current 1.2 A; default voltage setting is 3.3 V.

J10 – GND

Return for VDCDC1.

J11 – VDCDC2

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

J12 – GND

Return for VDCDC2

J13 – VLDO1

Output from low dropout regulator VLDO1; maximum output current 200 mA, default value 1.1 V.

J14 – GND

Return for VLDO1

J15 – VLDO2

Output from low dropout regulator VLDO2; maximum output current 200 mA, default value 1.3 V.

J16 – GND

Return for VLDO2.

J17 – VDCDC3

Output from switching regulator DCDC3; maximum output current 800 mA, default value 1.55 V.

J18– GND

Return for VDCDC3.

J19 – USB

USB interface connector..

JP1 – DEF1

Sets default voltage for DCDC1, 1.2 V or 1.6 V.

JP2 – DEF2

Sets default voltage for DCDC2, 3.3 V or 1.8 V.

JP3 – DEF3

Sets default voltage for DCDC3, 3.3 V or 1.8 V.

JP4 – DCDC1 ON/OFF

EN for DCDC1 converter; default setting is ON

JP5 – DCDC2 ON/OFF

EN for DCDC2 converter; default setting is ON.

JP6 – DCDC3 ON/OFF

EN for DCDC3 converter; default setting is ON.

JP7 – LDO ON/OFF

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

JP8 – DEFLDO1

Sets default voltage for LDO1 and LDO2 in combination with DEFLDO2. (See SLVS670, Table 3.)

JP9 – DEFLDO2

Sets default voltage for LDO1 and LDO2 in combination with DEFLDO1. (See SLVS670, Table 3.)

S1 –$\overline{\text{HOT\_RST}}$

S1 is a normally open, momentary pushbutton switch that, when pressed, connects the $\overline{\text{HOT\_RST}}$ input of the TPS65023 to GND, generating the $\overline{\text{HOT\_RESET}}$ pulse. $\overline{\text{HOT\_RESET}}$ pin is pulled up externally.

2.2 Setup

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

1. Install the TPS65023EVM software.
2. Connect input voltages and loads to the EVM.
3. Configure all EVM jumpers to factory setting.

JP4–ON	JP1–1.6V	JP3–1.8V
JP2–1.8V	JP5–ON	JP6–ON
JP7–ON	JP9–High	JP8–High

4. Connect the ribbon cable between the EVM and the USB-TO-GPIO (HPA172) adapter.
5. Connect the USB cable between the computer and the HPA172EVM.
6. Turn on all supplies.
7. Run the TPS65023EVM software

3 Board Layout

This section provides the TPS65023EVM-205 board layout and illustrations.

3.1 Layout

Board layout is critical for all switch mode power supplies. Figure 1 through Figure 5show the board layout for the TPS65023EVM-205 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 for specific layout guidelines.

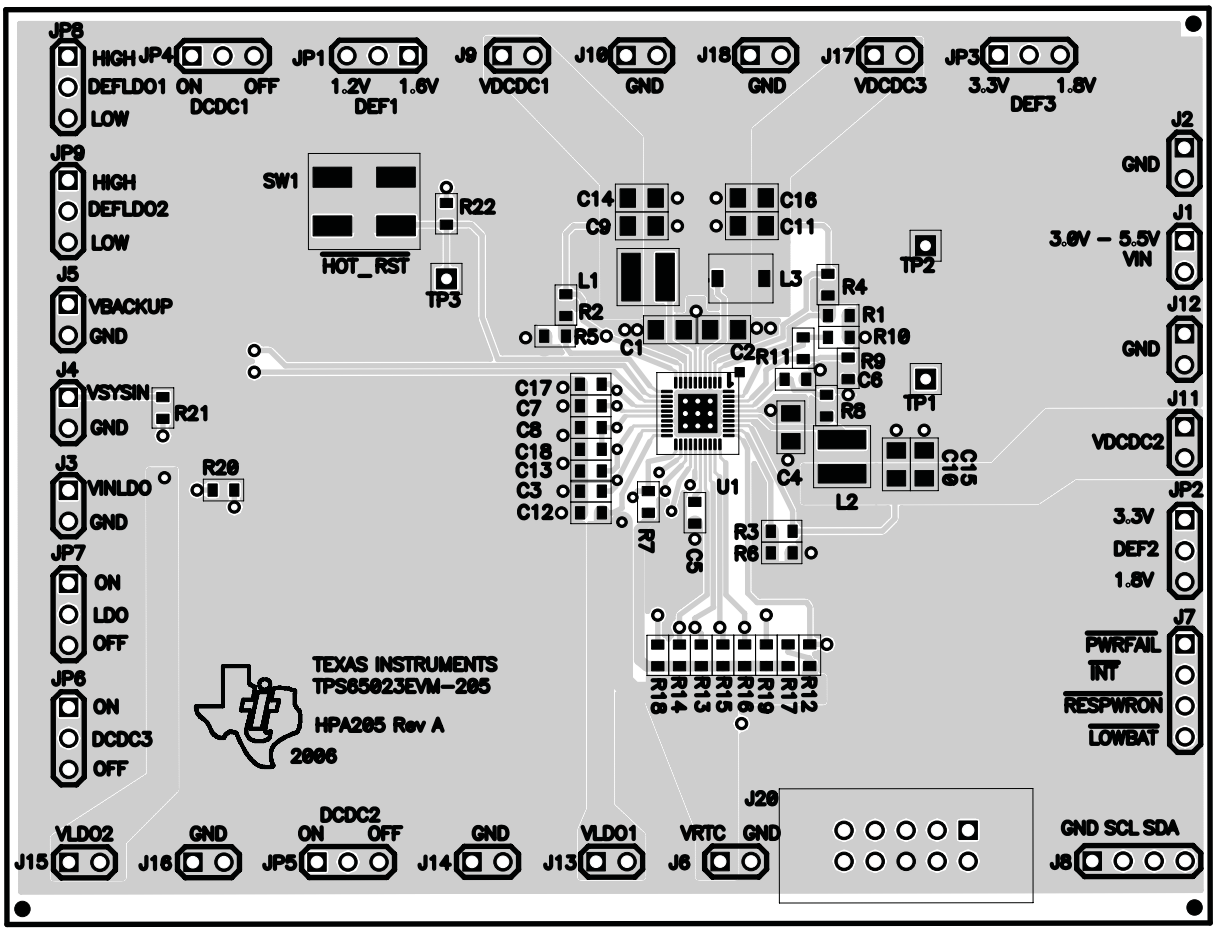

Figure 1. Assembly Layer

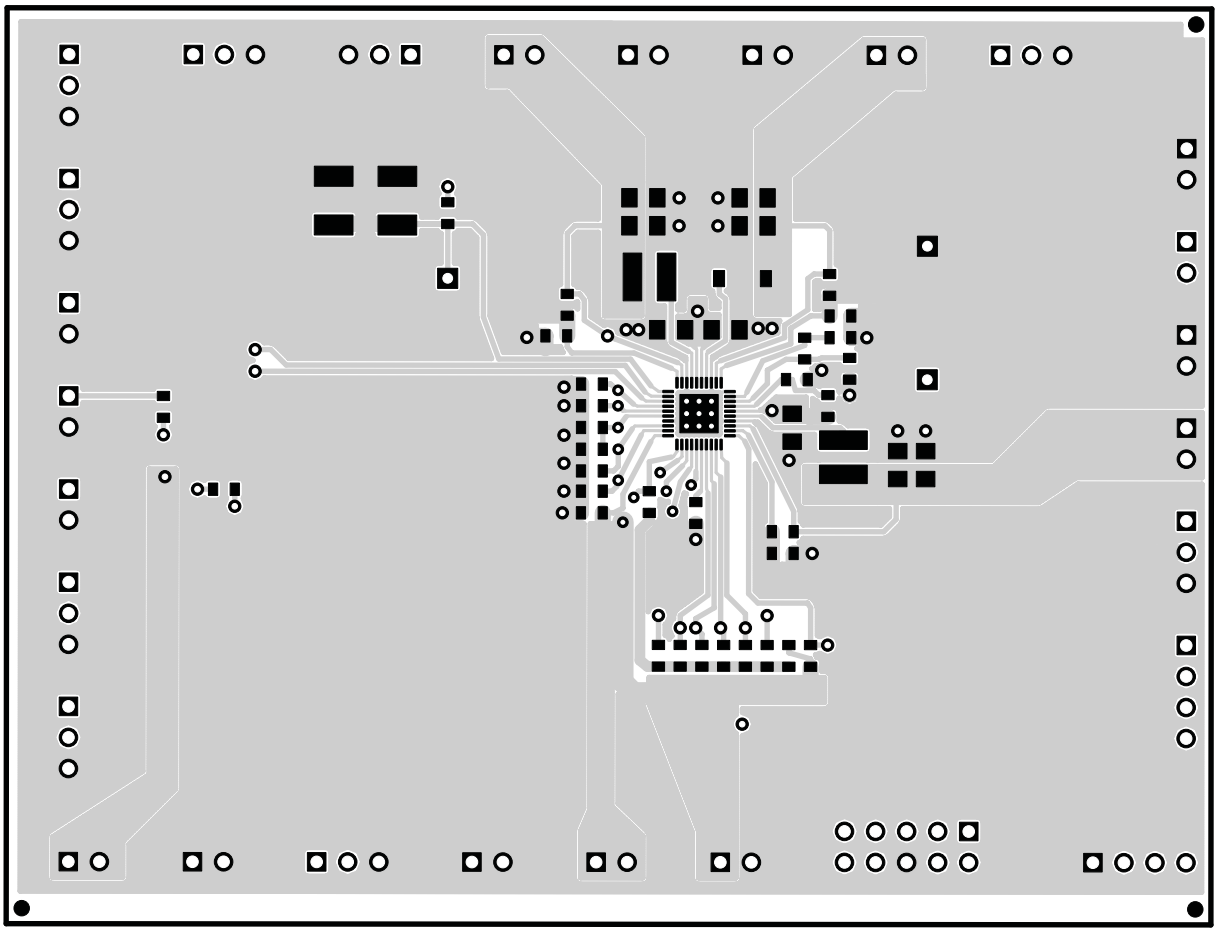

Figure 2. Top Layer Routing

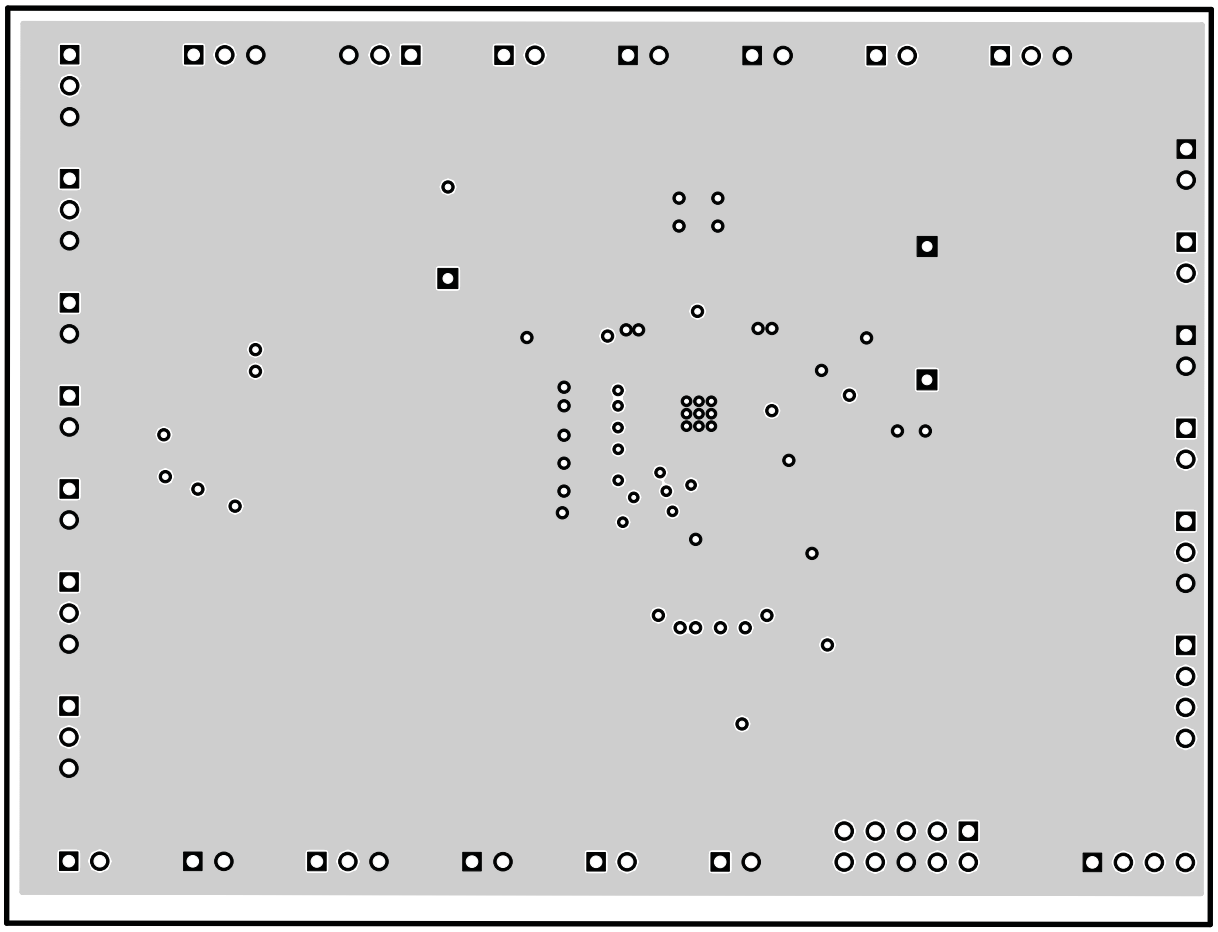

Figure 3. Layer 2 Routing, GND Plane

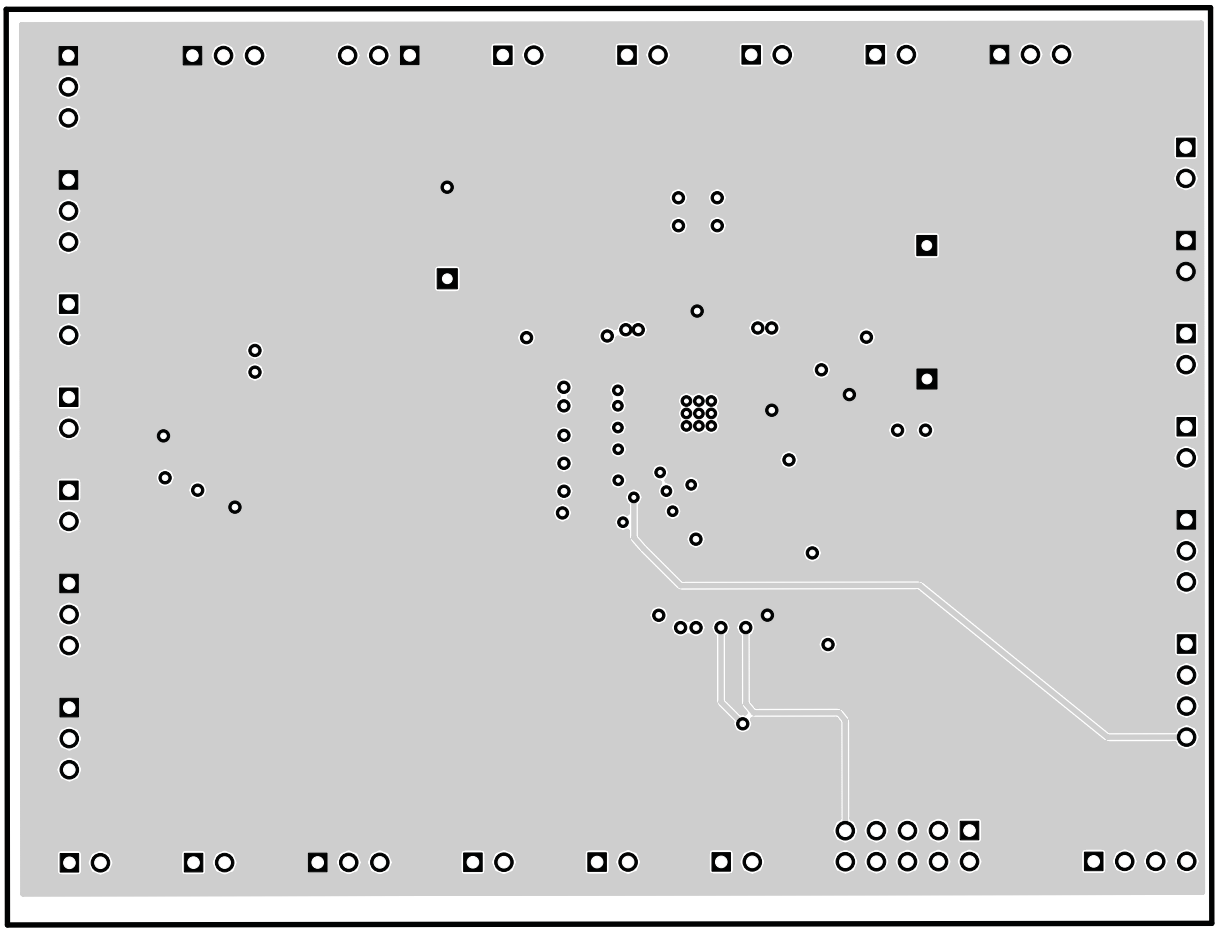

Figure 4. Layer 3 Routing, Vin Plane

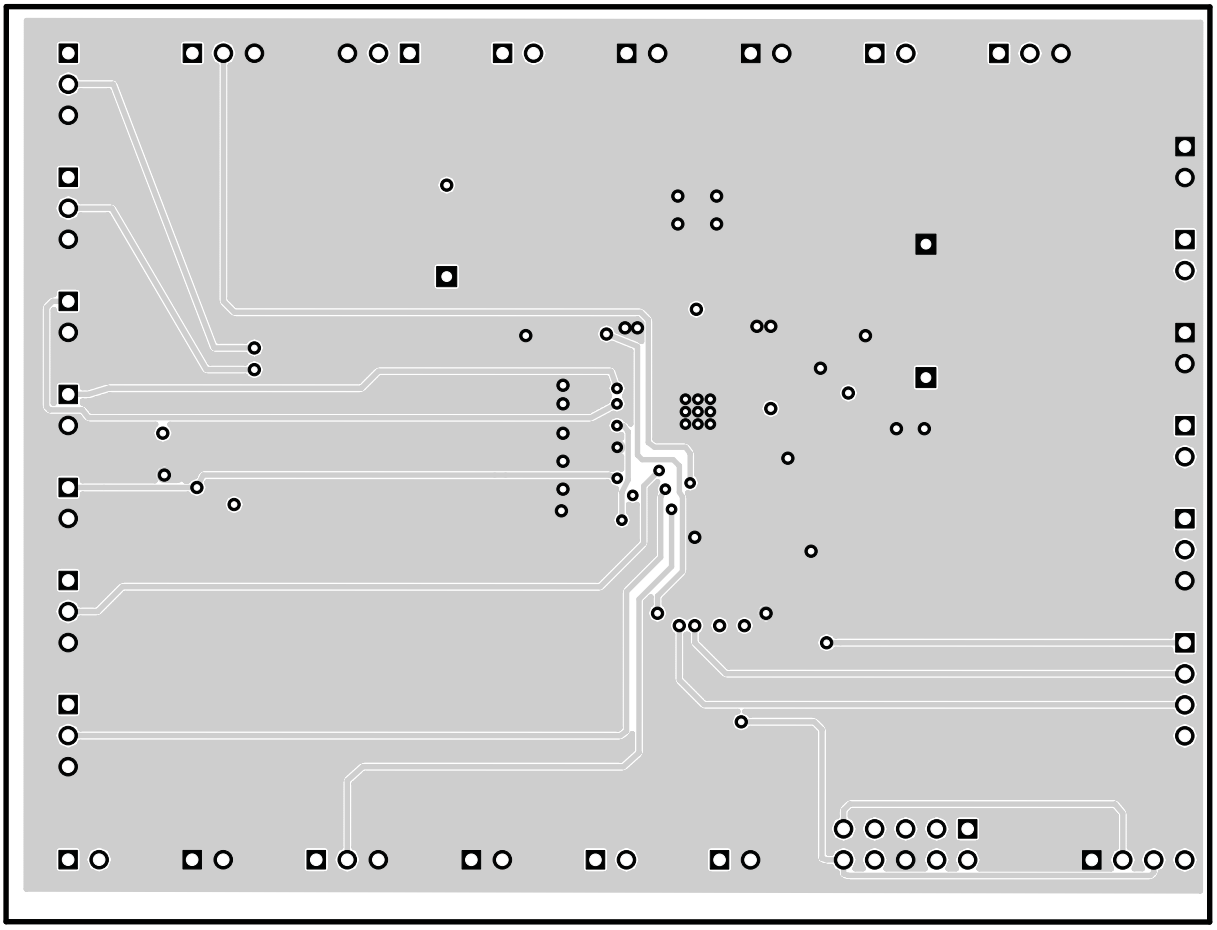

Figure 5. Bottom Layer Routing

4 Schematic and Bill of Materials

This section provides the TPS65023EVM-205 schematic and bill of materials.

4.1 Schematic

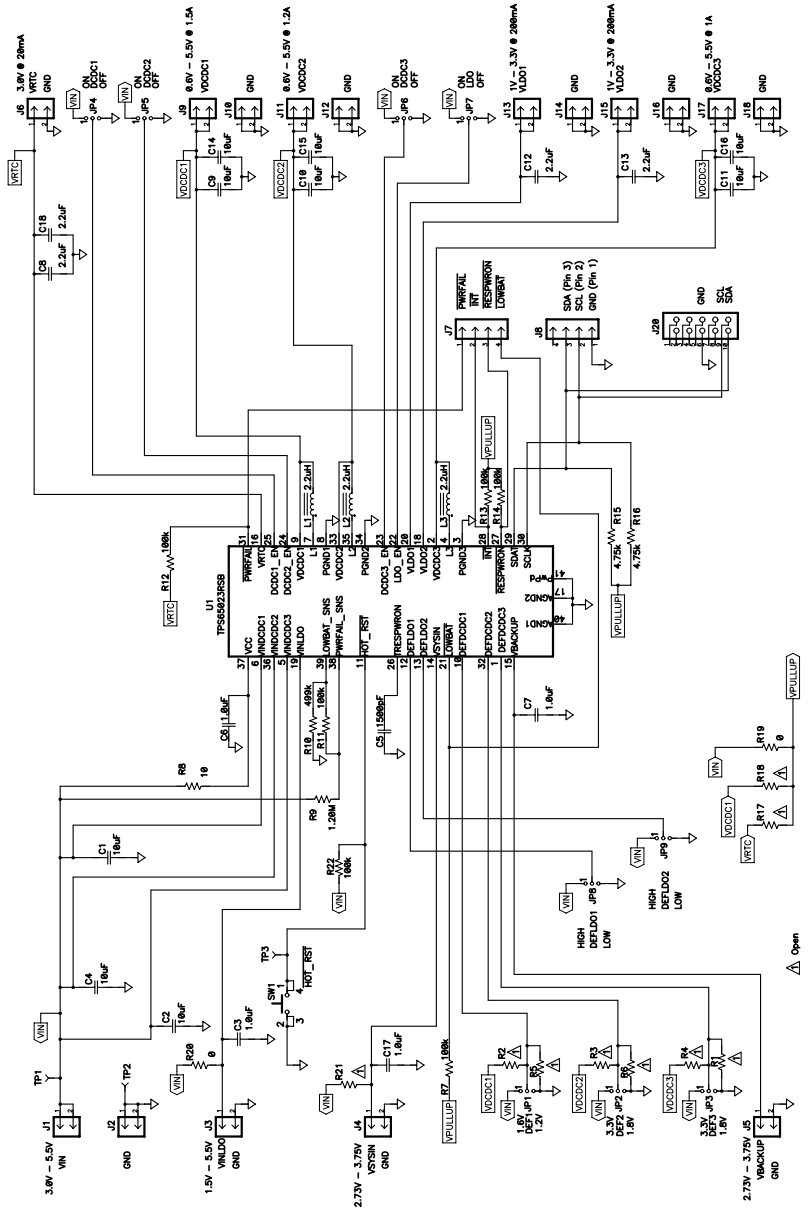

Figure 6. Figure 6. TPS65023EVM-205 Schematic

4.2 Bill of Materials

Table 1. TPS65023EVM-205 Bill of Materials

Count	RefDes	Value	Description	Size	Part Number	MFR
9	C1, C2, C4, C9–C11, C14–C16	10 µF	Capacitor, ceramic, 6.3 V, X5R, 10%	0805	C2012X5R0J106K	TDK
2	C12, C13	2.2 µF	Capacitor, ceramic, 6.3 V, X5R, 10%	0603	C1608X5R0J225K	TDK
4	C3, C6, C7, C17	1.0 µF	Capacitor, ceramic, 6.3 V, X5R, 10%	0603	C1608X5R0J105K	TDK
1	C5	1500 pF	Capacitor, ceramic, 50 V, X7R, 10%	0603	C1608X7R1H152K	TDK

Table 1. TPS65023EVM-205 Bill of Materials (continued)

Count	RefDes	Value	Description	Size	Part Number	MFR
2	C8, C18	2.2 µF	Capacitor, ceramic, 6.3 V, X5R, 10%	0603	C1608X5R0J225K	TDK
16	J1–J6, J9–J18		Header, 2 pin, 100 mil spacing, (36-pin strip)	0.100 × 2	PTC36SAAN	Sullins
1	J20		Connector, Male straight 2c5 pin, 100 mil spacing, 4 wall	0.33 × 0.788	2510-6002UB	3M
2	J7, J8		Header, 4 pin, 100 mil spacing, (36-pin strip)	0.100 × 4	PTC36SAAN	Sullins
9	JP1–JP9		Header, 3 pin, 100 mil spacing, (36-pin strip)	0.100 × 3	PTC36SAAN	Sullins
2	L1, L2	2.2 µH	Inductor, SMT, 1.72A, 59 mΩ	0.157 × 0.157	VLCF4020T-2R2N1R7	TDK
1	L3	2.2 µH	Inductor, SMT, 1.5A, 87 mΩ	0.137 × 0.147	VLF4012AT-2R2M1R5	TDK
0	R1–R6, R17, R18, R21	Open	Resistor, chip, 1.16W, 1%	0603		
1	R10	499k	Resistor, chip, 1.16W, 1%	0603	Std	Std
2	R15, R16	4.75k	Resistor, chip, 1.16W, 1%	0603	Std	Std
2	R19, R20	0	Resistor, chip, 1.16W, 1%	0603	Std	Std
6	R7, R11–R14, R22	100k	Resistor, chip, 1.16W, 1%	0603	Std	Std
1	R8	10	Resistor, chip, 1.16W, 1%	0603	Std	Std
1	R9	1.20M	Resistor, chip, 1.16W, 1%	0603	Std	Std
1	SW1		Switch, SPST, PB Momentary, Sealed washable	0.245 × 0.251	KT11P2JM	C & K
1	U1		IC power management IC for Li-Ion powered systems	QFN	TPS65023RSB	TI
1	—		PCB, 3.88 × 2.95 × 0.062 in		HPA205	Any
9	—		Shunt, 100 mil, Black	0.100	929950-00	3M

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EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 3.3 V to 5.5 V and the output voltage range of 0.8 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 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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