User's Guide
SLVU262–February 2009

TPS65053EVM-389

Contents

List of Figures

List of Tables

1 Introduction

The Texas Instruments TPS65053EVM-389 evaluation module (EVM) enables designers to evaluate the operation and performance of the TPS65053 Power Management Integrate Circuit (PMIC) for applications that require multiple power rails and are powered from a single Lithium Ion or Lithium Polymer cell. The TPS65053 contains two efficient step-down switching converters, three low dropout (LDO) linear regulators and a voltage monitor RESET output.

The TPS65053EVM-389 is setup according to the power requirements of the Freescale™ i.MX27 processor.

2 Setup

This chapter describes the jumpers and connectors on the EVM, as well as how to properly connect, setup, and use the TPS65053EVM-389.

2.1 Input/Output Connector Descriptions

J1 - VLDO1

This header is the positive output of LDO1 linear regulator. This output is externally adjustable for the TPS65053 and is programmed to a value of 1.8 V on the EVM. The VLDO1 output is capable of supplying up to 400-mA. A load can be connected between J1 and J2 (GND). Applications using Freescale™ i.MX27 can utilize J1-VLDO1 to power the NVDD_DDR, analog, and FUSEVDD rails of the i.MX27 processor.

J2 - GND

J2 is the return connection of VLDO1 output rail. A load can be connected between J2 and J1 (VLDO1).

J3 - VLDO2

This header is the positive output of LDO2 linear regulator. This output is externally adjustable for the TPS65053 and is programmed to a value of 1.4 V on the EVM. The VLDO2 output is capable of supplying up to 200 mA. A load can be connected between J3 and J4 (GND). Applications using Freescale™ i.MX27 can utilize J3-VLDO2 to power the RTCVDD and OSC32VDD rails of the i.MX27 processor.

J4 - GND

J4 is the return connection of VLDO2 output rail. A load can be connected between J4 and J3 (VLDO2).

J5 - VLDO3

This header is the positive output of LDO3 linear regulator. This output is fixed at 1.3 V for the TPS65053. The VLDO3 output is capable of supplying up to 200-mA. A load can be connected between J5 and J6 (GND).

J6 - GND

J6 is the return connection of VLDO3 output rail. A load can be connected between J6 and J5 (VLDO3).

J7 - RESET

This header allows the user to monitor the RESET output. The RESET output goes high 100-ms after the THRESHOLD input exceeds 1.0-V. RESET goes low when the THRESHOLD input falls below 1.0-V. On the EVM, the RESET circuitry monitors the outputs VOUT DCDC1 and VOUT DCDC2.

J8 - VOUT DCDC1

This header is the positive output of VDCDC1 step-down converter. This output is externally adjustable for the TPS65053 and is programmed to a value of 2.7-V on the EVM. VDCDC1 is capable of sourcing up to 1.0-A. A load can be connected between J8 and J9 (GND). Applications using Freescale™ i.MX27 can utilize J8-VOUT DCDC1 to power NVDD_FAST, NVDD_SLOW, and OSC26VDD of the i.MX27 processor.

J9 - GND

J9 is the return connection of VOUT VDCDC1 output rail. A load can be connected between J9 and J8 (VOUT DCDC1).

J10 - VIN

This header is the positive connection to the input power supply. The power supply must be connected between J10 and J11 (GND). The leads to the input supply should be twisted and kept as short as possible. The input voltage has to be between 2.5-V and 6-V.

J11 - GND

This header is the return connection to the input power supply. Connect the power supply between J11 and J10 (VIN). The leads to the input supply should be twisted and kept as short as possible. The input voltage has to be between 2.5-V and 6-V.

J12 - VOUT DCDC2

This header is the positive output of VDCDC2 step-down converter. This output is externally adjustable for the TPS65053 and is programmed to a value of 1.8-V on the EVM. VDCDC2 is capable of sourcing up to 600-mA. A load can be connected between J12 and J13 (GND). Applications using Freescale™ i.MX27 can can utilize J12-VOUT DCDC2 to power the QVDD rail of the i.MX27 processor.

J13 - GND

J13 is the return connection of VOUT VDCDC2 output rail. A load can be connected between J13 and J12 (VOUT DCDC2).

JP1 - VIN_LDO1

JP1 selects the input voltage source for LDO1.

Place a shorting bar in the VOUT_DCDC1 position to select the output of VDCDC1 converter as input voltage source for LDO1.

Place a shorting bar in the VIN position to select the input voltage as input source for LDO1.

JP2 - VIN_LDO2/3

JP2 selects the input voltage source for LDO2 and LDO3.

Place a shorting bar in the VOUT_DCDC1 position to select the output of VDCDC1 converter as input voltage source for LDO2 and LDO3.

Place a shorting bar in the VIN position to select the input voltage as input source for LDO2 and LDO3.

JP3 - EN_LDO1

Placing a shorting bar between EN LDO1 and ON ties the EN pin of LDO1 to VIN, thereby enabling LDO1. Placing a shorting bar between EN LDO1 and OFF ties the EN pin of LDO1 to GND, thereby disabling LDO1.

JP4 - EN_DCDC2

Placing a shorting bar between EN_DCDC2 and ON ties the EN pin of DCDC2 to VIN, thereby enabling DCDC2. Placing a shorting bar between EN_DCDC2 and OFF ties the EN pin of DCDC2 to GND, thereby disabling DCDC2.

JP5 - EN_DCDC1

Placing a shorting bar between EN_DCDC1 and ON ties the EN pin of DCDC1 to VIN, thereby enabling DCDC1. Placing a shorting bar between EN_DCDC1 and OFF ties the EN pin of DCDC1 to GND, thereby disabling DCDC1.

JP6 - MODE Input

JP6 selects the forced PWM or Power Save Mode (PSM) operation for the switching converters DCDC1 and DCDC2.

Placing a shorting bar between MODE and PWM ties the MODE pin of TPS65053 to VIN, thereby selecting forced PWM operating mode for the DCDC converters. Placing a shorting bar between MODE and PSM (Power Save Mode) ties the MODE pin of TPS65053 to GND, thereby selecting Power Save Mode operating mode for the DCDC converters at light-load conditions. If Power Save Mode is selected the DCDC converters will automatically switch to PWM mode at havier load conditions.

JP7 - EN_LDO2

Placing a shorting bar between EN LDO2 and ON ties the EN pin of LDO2 to VIN, thereby enabling LDO2. Placing a shorting bar between EN LDO2 and OFF ties the EN pin of LDO2 to GND, thereby disabling LDO2.

JP8 - EN_LDO3

Placing a shorting bar between EN LDO3 and ON ties the EN pin of LDO3 to VIN, thereby enabling LDO3. Placing a shorting bar between EN LDO3 and OFF ties the EN pin of LDO3 to GND, thereby disabling LDO3.

2.2 EVM Setup

2.2.1 EVM Factory Configuration

The EVM is configured to provide the following nominal operating conditions:

- Input Voltage: 2.5-V to 6.0-V
- Output Voltage: See Table 1
- Maximum Load Current: See Table 2

Table 1. EVM Preset Output Voltage

Preset Output Voltage	TPS65053EVM
VDCDC1	2.7 V
VDCDC2	1.4 V
VLD01	1.8 V
VLD02	1.4 V
VLD03	1.3 V

Table 2. Maximum Load Current

Maximum Load Current	TPS65053EVM
VDCDC1	1 A
VDCDC2	600 mA
VLD01	400 mA
VLD02	200 mA
VLD03	200 mA

2.3 Power Up Sequence

The TPS65053EVM-389 is set up to meet the Power Up requirements of the Freescale™ i.MX27 processor.

The step down converters DCDC1 and DCDC2 start up first, followed by the low drop out (LDO) regulators LDO1, LDO2 and LDO3 as shown in Figure 1.

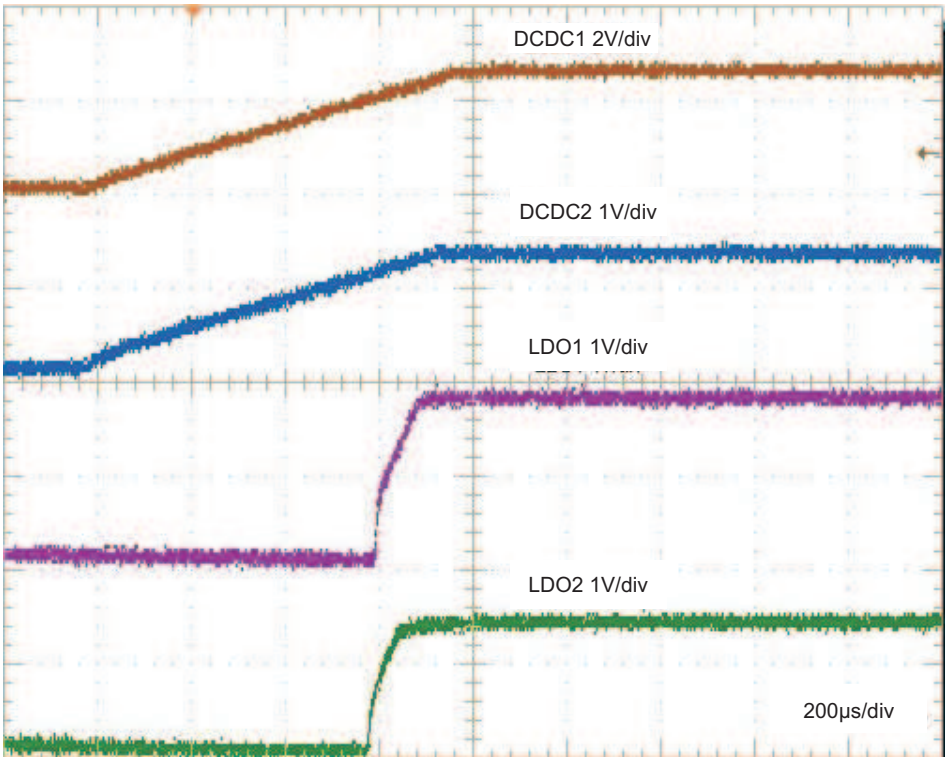

Figure 1.

2.4 Operation

1. Configure all EVM jumpers to factory settings shown in Table 3.
2. Connect the input voltage return to J11.
3. Connect the positive input voltage to J10.
4. Connect all loads to the outputs.
5. Turn on input voltage.

Table 3. Factory EVM Jumper Settings

Jumper	Shunt Location
	TPS65053EVM
JP1	Between VOUT_DCDC1 and VIN_LDO1
JP2	Between VOUT_DCDC1 and VIN_LDO2
JP3	Between ON and EN_LDO1
JP4	Between ON and EN_DCDC2
JP5	Between ON and EN_DCDC1
JP6	Between PWM and MODE
JP7	Between ON and EN_LDO2
JP8	Between ON and EN_LDO3

3 Board Layout

This chapter provides the TPS65053EVM-389 board layout and illustrations.

3.1 Layout

Figure 2 and Figure 3 show the board layout for the TPS65053EVM-389 PWB.

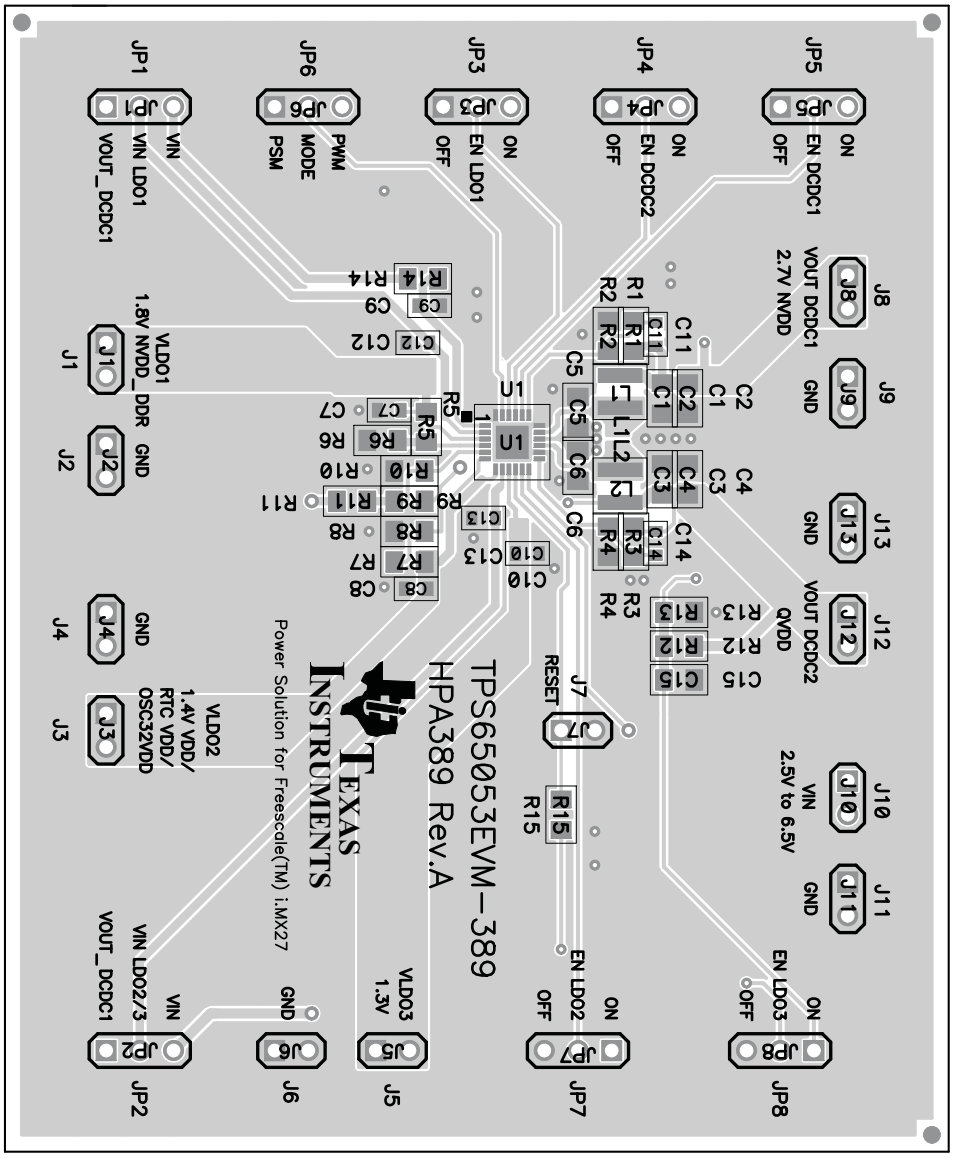

Figure 2. Assembly Layer

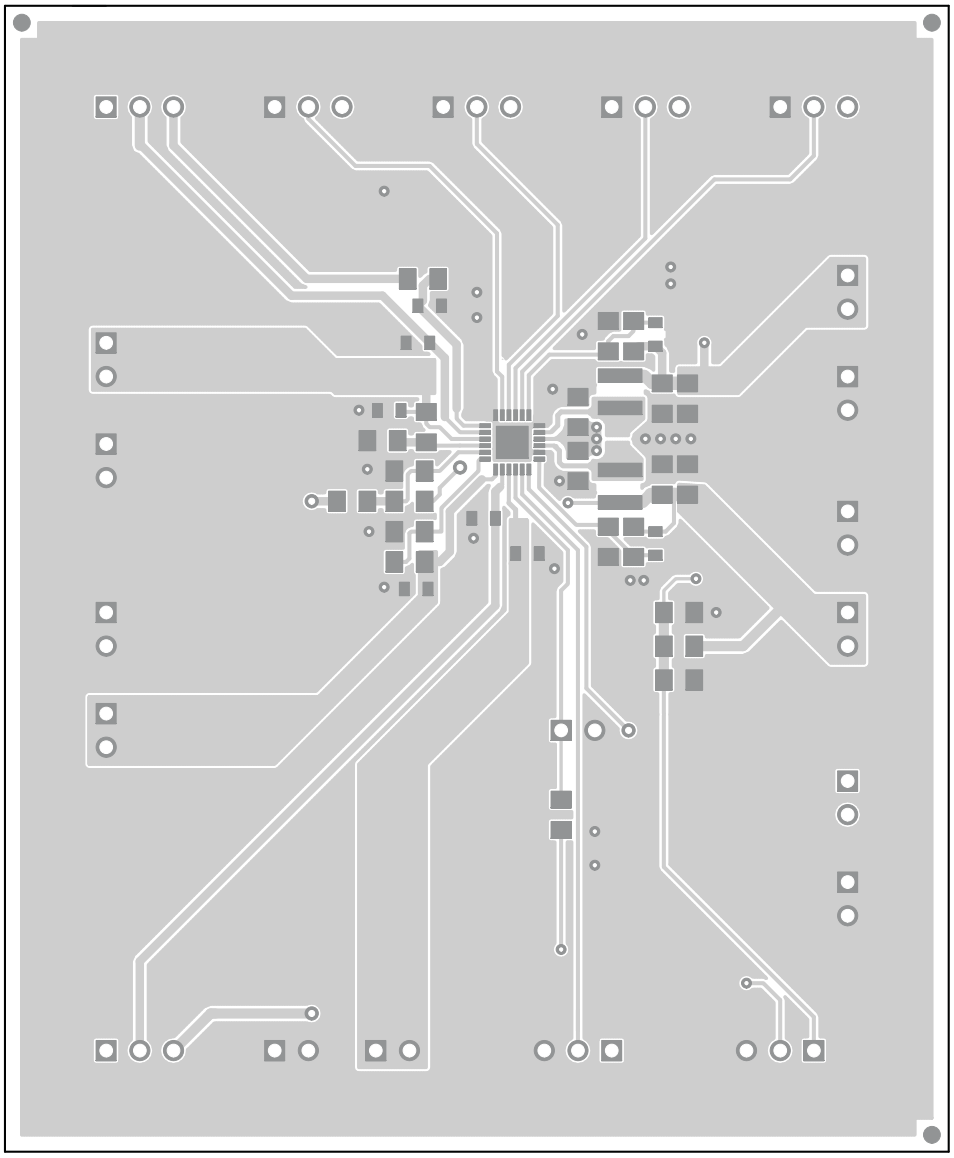

Figure 3. Top Layer Routing

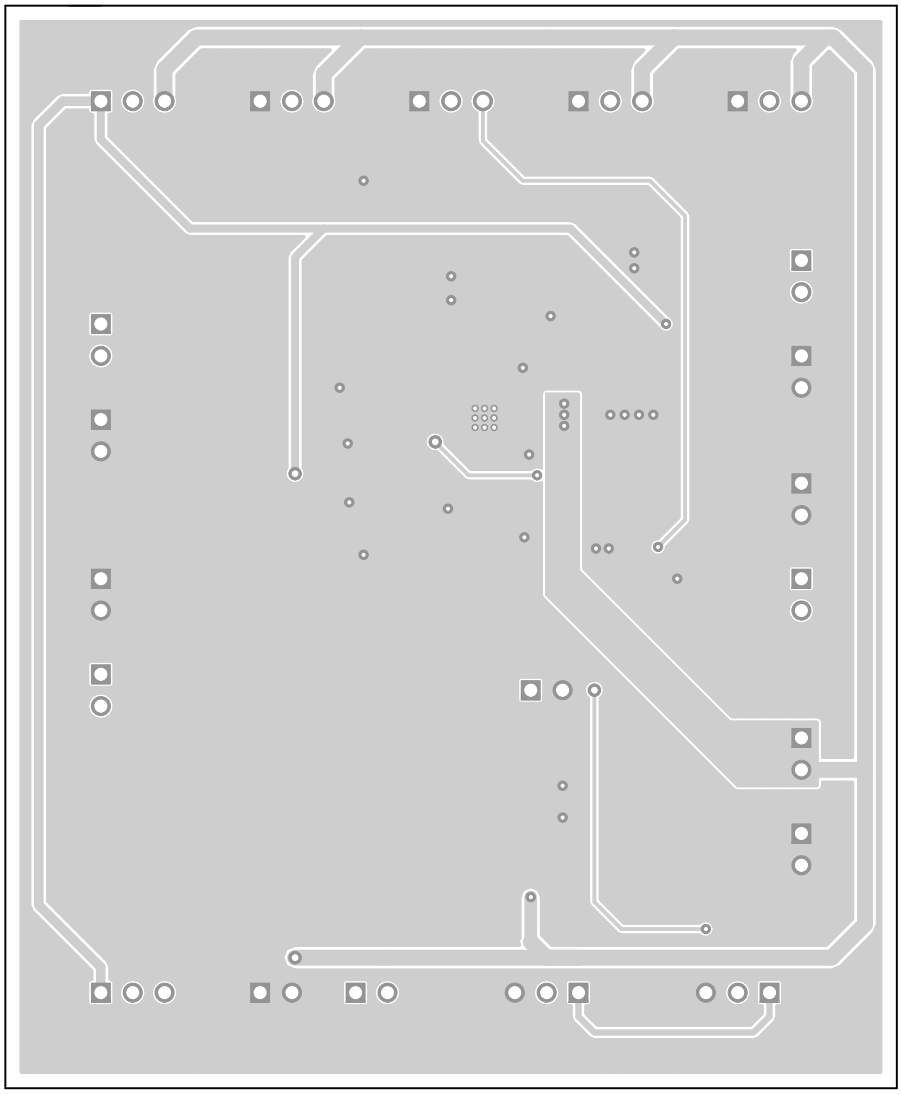

Figure 4. Bottom Layer Routing

4 Schematic and Bill of Materials

This chapter provides the TPS65053EVM-389 schematic and bill of materials.

4.1 Schematic

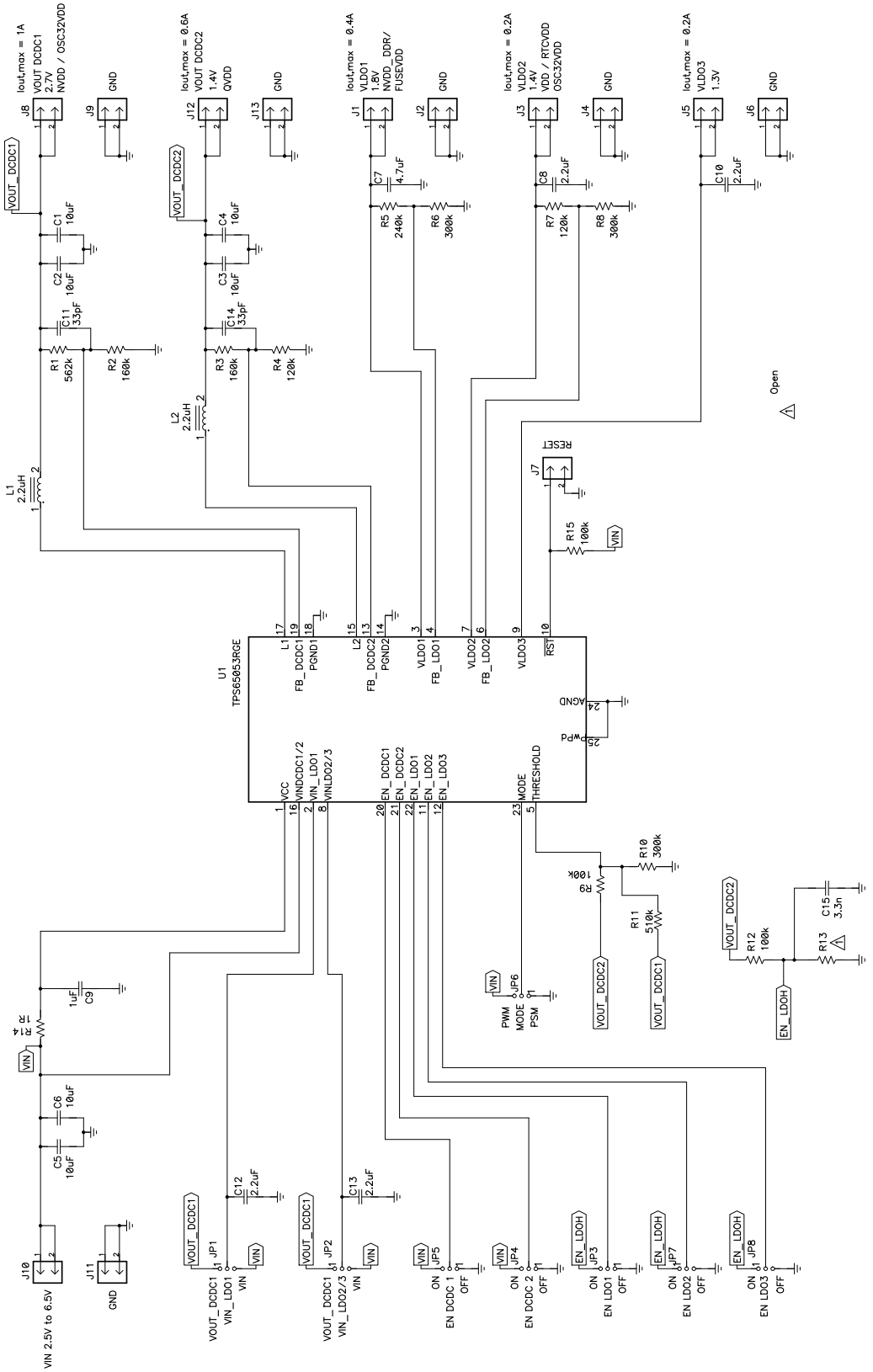

Figure 5. TPS65053EVM-389 Schematic

4.2 Bill of Materials

Table 4. TPS65053EVM-389 Bill of Materials

Count	RefDes	Value	Description	Size	Part Number	MFR
6	C1, C2, C3, C4, C5, C6	10uF	Capacitor, Ceramic, 10V, X5R, 10%	0805	GRM21BR61A106KE19L	muRata
2	C11, C14	33pF	Capacitor, Ceramic, 50V, C0G, 5%	0603	C1608C0G1H330J	TDK
1	C15	3.3nF	Capacitor, Ceramic, 6.3V, X5R, 10%	0805	Std	Std
1	C7	4.7uF	Capacitor, Ceramic, 6.3V, X5R, 20%	0603	GRM188R60J475ME19D	muRata
4	C8, C10, C12, C13	2.2uF	Capacitor, Ceramic, 10V, X5R, 10%	0603	GRM188R61A225KE34D	muRata
1	C9	1uF	Capacitor, Ceramic, 16V, X7R, 10%	0603	C1608X7R1C105K	TDK
12	J1, J2, J3, J4, J5, J6, J8, J9, J10, J11, J12, J13		Header, Male 2-pin, 100mil spacing	0.100 inch x 2		Any
1	J7		Header, 2-pin, 100mil spacing	0.100 inch x 2		Any
8	JP1, JP2, JP3, JP4, JP5, JP6, JP7, JP8		Header, 3-pin, 100mil spacing	0.100 inch x 3		Any
2	L1**, L2**	2.2uH	Inductor, SMT,1.5A, 110milliohm	0.118 x 0.118 inch	LPS3015-222ML	Coilcraft
1	R1	562kΩ	Resistor, Chip, 1/10W, 1%	0805	Std	Std
1	R11	510kΩ	Resistor, Chip, 1/10W, 1%	0805	Std	Std
0	R13	open	Resistor, Chip, 1/10W, 1%	0805	Std	Std
1	R14	1R	Resistor, Chip, 1/10W, 1%	0805	Std	Std
2	R2, R3	160kΩ	Resistor, Chip, 1/10W, 1%	0805	Std	Std
2	R4, R7	120kΩ	Resistor, Chip, 1/10W, 1%	0805	Std	Std
1	R5	240kΩ	Resistor, Chip, 1/10W, 1%	0805	Std	Std
3	R6, R8, R10	300kΩ	Resistor, Chip, 1/10W, 1%	0805	Std	Std
3	R9, R12, R15	100kΩ	Resistor, Chip, 1/10W, 1%	0805	Std	Std
1	U1**	TPS65053RGE	IC, 2.25 MHz Dual Step-down Converter With 3 Low Input Voltage LDOs	QFN24	TPS65053RGE	TI
1	--		PCB, 3.4 In x 2.8 In x 0.062 In		HPA389	Any
8	--		Shunt, 100-mil, Black	0.100		Any

Related Documentation From Texas Instruments

TPS65053 data sheet (SLVS754)

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.

EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 2.5 V to 6 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.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265

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
DLP® Products	www.dlp.com	Broadband	www.ti.com/broadband
DSP	dsp.ti.com	Digital Control	www.ti.com/digitalcontrol
Clocks and Timers	www.ti.com/clocks	Medical	www.ti.com/medical
Interface	interface.ti.com	Military	www.ti.com/military
Logic	logic.ti.com	Optical Networking	www.ti.com/opticalnetwork
Power Mgmt	power.ti.com	Security	www.ti.com/security
Microcontrollers	microcontroller.ti.com	Telephony	www.ti.com/telephony
RFID	www.ti-rfid.com	Video & Imaging	www.ti.com/video
RF/IF and ZigBee® Solutions	www.ti.com/lprf	Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265