

TPS652510 High Current, Synchronous Step Down Three Buck Switcher Evaluation Module

This document presents the information required to power the TPS652510 PMIC as well as the support documentation including schematic and bill of materials.

Contents

	Contents					
1	Background and EVM Limitations	2				
2	Power-up Procedure					
3	TPS652510EVM Schematic					
4	EVM Layout					
5	Bench Test Setup Conditions					
	5.1 Headers Description	7				
	5.2 Test Points and Placement	7				
	List of Figures					
1	TPS652510EVM Schematic	3				
2	Composite Layer	4				
3	Top Layer	5				
4	Middle Layer (2nd), Solid Cu Ground					
5	Middle (3rd) Layer	5				
6	Bottom Layer	5				
	List of Tables					
1	Input Voltage and Output Current Summary	2				
2	Bill of Materials	8				



1 Background and EVM Limitations

The TPS652510 PMIC is designed to provide 3 , 2 and 2 A continuous outputs with an operational range of 4.5 to 16V and a externally set switching frequency ranging from 300kHz to 2.2MHz, with automatic PFM/PWM operation . When the PMIC is not fully loaded, buck1 can be loaded to 3.5A and buck 2 and 3 to 2.5A.

As there are many possible options to set the converters, table 1 presents the performance specification summary for the EVM.

Table 1. Input Voltage and Output Current Summary

Evaluation Module	Test Conditions	Output Current Range
TPS652510EVM	Vin = 4.5 V to 15 V Fsw = 500 KHz	Buck1, 1.2 V, 3A Buck2, 1.8 V, 3A Buck3, 3.3 V, 3A (25°C ambient)

This evaluation module is designed to provide access to the features of the TPS652510. Some modifications can be made to this module to test performance at different input and output voltages, current and frequency operation. Please contact TI Field Applications Group for advice on these matters.

2 Power-up Procedure

- 1. Define which converters are to be enabled or disabled by connecting jumpers to JP3, JP11 and JP20 accordingly, or to wiring external drive signals to the ENx headers.
- 2. If PGOOD signal is required connect JP27 or wire the PGOOD pin to a pull-up supply
- 3. Connect loads to the output connectors.
- 4. Apply a DC voltage to header J3. Polarity is marked on the silk-screen.
- 5. Converters will start according to the setting on JP3, JP11 and JP20. Check the outputs

3 TPS652510EVM Schematic

The resistor and capacitor values have been chosen according to the guidelines presented on the TPS652510 spec that will be available at

http://focus.ti.com/docs/prod/folders/print/TPS652510.html

Note that for the purpose of gains-phase measurements R14, R17 and R37 (zero ohm on the EVM) need to be replaced by suitable low value resistors as per the network analyzer setup required. Test points connections are provided on either end of the resistors to allow for easy measurement.



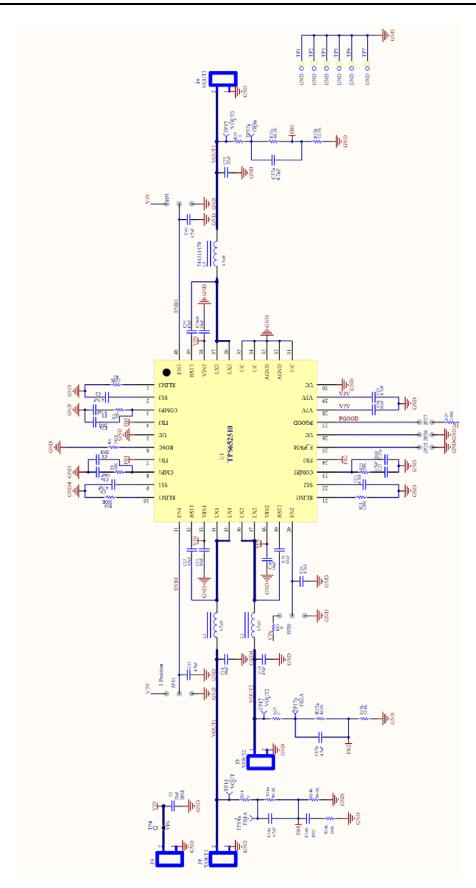


Figure 1. TPS652510EVM Schematic



TPS652510EVM Schematic www.ti.com

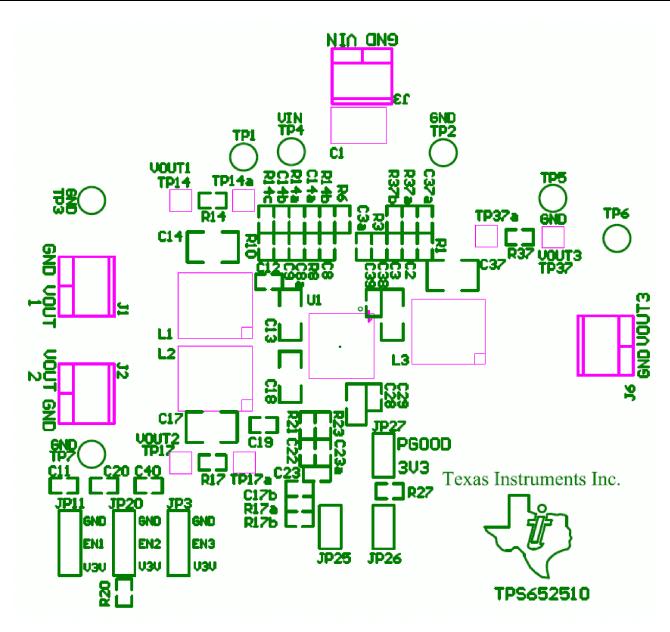


Figure 2. Composite Layer



www.ti.com EVM Layout

4 EVM Layout

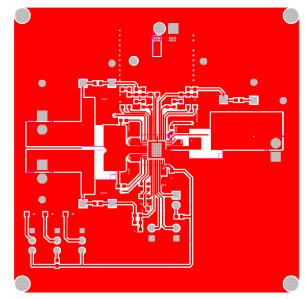


Figure 3. Top Layer

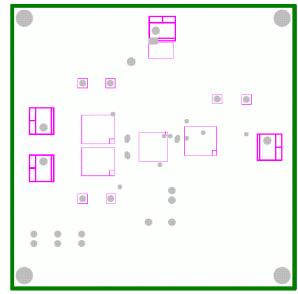


Figure 4. Middle Layer (2nd), Solid Cu Ground

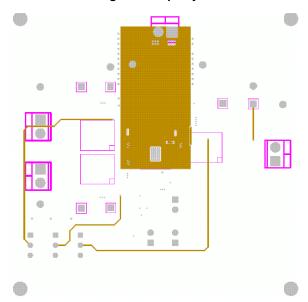


Figure 5. Middle (3rd) Layer

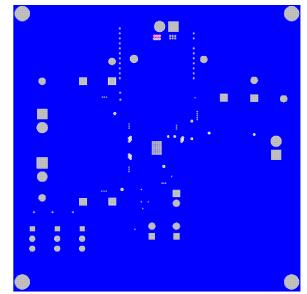
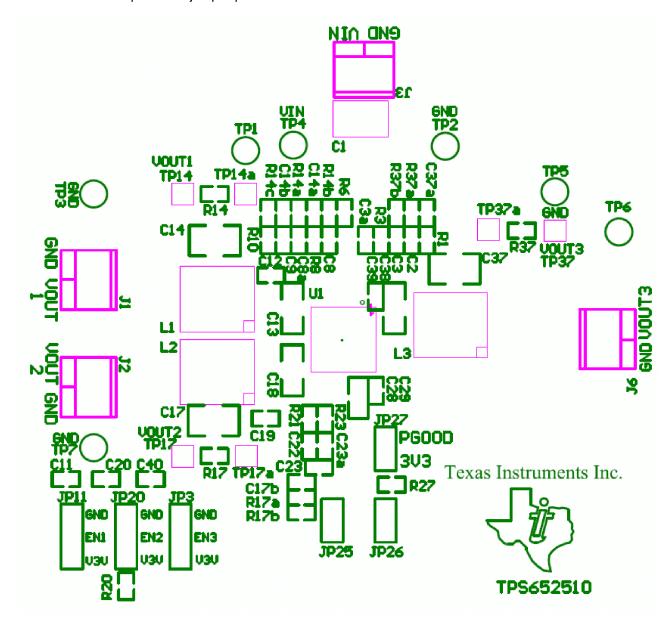


Figure 6. Bottom Layer



5 Bench Test Setup Conditions

Headers description and jumper placement.





5.1 Headers Description

Header Number	Function	LOC	Placement	Comment
JP11	BUCK1 enable (EN1)	SW	For immediate start-up fit jumper to V3V For sequencing do not fit jumper To disable converter fit jumper to GND	Fit according to test requirement
JP20	BUCK2 enable (EN2)	SW	For immediate start-up fit jumper to V3V For sequencing do not fit jumper To disable converter fit jumper to GND	Fit according to test requirement
JP3	BUCK3 enable (EN3)	SW	For immediate start-up fit jumper to V3V For sequencing do not fit jumper To disable converter fit jumper to GND	Fit according to test requirement
JP25	Forced PWM (F_PWM)	S	For forced PWM operation fit jumper to V3V For automatic PFM/PWM operation fit jumper to GND	Do not leave this header open. Use a jumper to set either forced PWM mode or automatic PFM/PWM mode
JP26	Test	S	Used for test purposes	Jumper must be fitted
JP27	PGOOD	S	PGOOD indicated pulled to 3V3	Fit according to test requirement

5.2 Test Points and Placement

Buck converter outputs are white and have a label for easy location. Close to any of these test points there are black ground test points to allow for DVM measurement or to use a metal exposed scope probe to reduce common mode noise measurements. All test points are described in the following table:

Test Point	Name	Signal	COLOR	Comment
TP1	GND	GND	Black	
TP2	GND	GND	Black	
TP3	GND	GND	Black	
TP4	Vin	Vin	Black	
TP5	GND	GND	Black	
TP6	GND	GND	Black	
TP7	GND	GND	Black	
TP14	Vout1	Output voltage Buck1	Not fitted	
TP14a		Injection Point gain-phase measurement buck1	Not fitted	Normally not used
TP17	Vout1	Output voltage Buck2	Not fitted	
TP17a		Injection Point gain-phase measurement buck2	Not fitted	Normally not used
TP37	Vout1	Output voltage Buck3	Not fitted	
TP37a		Injection Point gain-phase measurement buck3	Not fitted	Normally not used



Table 2. Bill of Materials (1)

Count	RefDes	Value	Description	Size
1	C1	22 µF	CAP CERAMIC 22UF 25V X5R 1210	1812
11	C2, C3, C9, C11, C14a, C17b, C20, C22, C23, C37a, C40	4.7 nF	CAP 4700PF 50V CERAMIC X7R 0603	0603
1	C8a	10 nF		0603
3	C3a, C8, C23a	DNI	CAP 10000PF 50V CERAMIC X7R 0603	0603
3	C12, C19, C39	47 nF	CAP 47000PF 25V CERM X7R 0603	0603
3	C13, C18, C38	10 μF	CAP CERAMIC 10UF 25V X5R 1206	1206
1	C14	68 µF	CAP CERAMIC 22UF 25V X5R 1210	1210
1	C17	47 µF	CAP CERAMIC 22UF 25V X5R 1210	1210
1	C37	22 µF	CAP CERAMIC 22UF 25V X5R 1210	1210
5	C28, C30, C31, C32, C33	10 μF	CAP CER 10UF 10V X7R 0805	0805
1	C29	4.7 µF	CAP CER 4.7UF 10V X5R 0603	0603
1	J1,'J2,'J3,'J6	ED55/2DS	TERMINAL BLOCK 3.5MM 2POS PCB	TB_2X3.5MM
2	J4	ED55/3DS	TERMINAL BLOCK 3.5MM 2POS PCB	TB_3X3.5MM
6	JP3, JP5, JP11, JP20, JP25, JP34		CONN HEADER 50POS .100" SGL GOLD	JMP0.3
3	JP26, JP27, JP35 1		CONN HEADER 50POS .100" SGL GOLD	JMP0.2
3	L1, L2, L3	4.7 µH	Magnetic-Core Inductor	IND_RLF7030
2	R1, R21	120 K	RES 120K OHM 1/10W 5% 0603 SMD	0603
1	R2	10 K	RES 10K OHM 1/10W 5% 0603 SMD	0603
3	R3, R8, R23	20 K	RES 20K OHM 1/10W 5% 0603 SMD	0603
1	R6	383 K	RES 383K OHM 1/10W 1% 0603 SMD	0603
4	R10, R26, R27, R35	100 K	RES 100K OHM 1/10W 5% 0603 SMD	0603
4	R14, R17, R20, R37	0	RES 0.0 OHM 1/10W 5% 0603 SMD	0603
3	R14a, R17a, R37a	40.2 K	RES 40.2K OHM 1/10W 1% 0603 SMD	0603
1	R14b	80.6 K	RES 80.6K OHM 1/10W 1% 0603 SMD	0603
1	R17b	32.4 K	RES 32.4K OHM 1/10W 1% 0603 SMD	0603
1	R37b	12.7 k	RES 12.7K OHM 1/10W 1% 0603 SMD	0603
6	TP1, TP2, TP3, TP5, TP6, TP7		Glass Beaded Test Point	TEST POINT 0.052
1	TP4	STD	Glass Beaded Test Point	TEST POINT 0.052
1	TP14	STD	Test Point, O.032 Hole	TP-032
1	TP14a	STD	Test Point, O.032 Hole	TP-032
1	TP17	STD	Test Point, O.032 Hole	TP-032
1	TP17a		Test Point, O.032 Hole	TP-032
4	TP30, TP31, TP32, TP33	STD	Glass Beaded Test Point	TEST POINT 0.052
1	TP37	STD	Test Point, O.032 Hole	TP-032
1	TP37a		Test Point, O.032 Hole	TP-032
1	U1		TPS652510	QFN-40

 $^{^{\}left(1\right)}$ $\;$ Items with gray backgrounds are optional/not needed for a reference design.

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 $xx \ V$ to $xx \ V$ and the output voltage range of $xx \ V$ to $xx \ V$.

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 55°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.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265 Copyright © 2011, 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:

Applications

interface.ti.com

Audio www.ti.com/audio Communications and Telecom www.ti.com/communications **Amplifiers** amplifier.ti.com Computers and Peripherals www.ti.com/computers dataconverter.ti.com Consumer Electronics www.ti.com/consumer-apps **Data Converters DLP® Products** www.dlp.com **Energy and Lighting** www.ti.com/energy DSP dsp.ti.com Industrial www.ti.com/industrial Clocks and Timers www.ti.com/clocks Medical www.ti.com/medical

Logic logic.ti.com Space, Avionics and Defense www.ti.com/space-avionics-defense

Security

Power Mgmt power.ti.com Transportation and Automotive www.ti.com/automotive

Microcontrollers microcontroller.ti.com Video and Imaging www.ti.com/video

RFID <u>www.ti-rfid.com</u>

OMAP Mobile Processors www.ti.com/omap

Interface

Wireless Connctivity www.ti.com/wirelessconnectivity

TI E2E Community Home Page <u>e2e.ti.com</u>

www.ti.com/security