TPS65251 High Current, Synchronous Step Down Three Buck Switcher Evaluation Module

User's Guide

Literature Number: SLVU399A
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1 Introduction

This document presents the information required to power the TPS65251 PMIC as well as the support documentation including schematic and bill of materials.

2 Background

The TPS65251 PMIC is designed to provide 3-A and 2-A continuous outputs with an operational range of 4.5 V to 18 V and an externally set switching frequency ranging from 300 kHz to 2.2 MHz. When the PMIC is not fully loaded, Buck1 can be loaded to 3.5 A and Buck2 and Buck3 to 2.5 A.

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

EVM	TEST CONDITIONS	OUTPUT CURRENT RANGE
TPS65251EVM	V_{IN} = 4.5 V to 13 V f_{sw} = 500 kHz	Buck1, 1.2 V, 3 A Buck2, 1.8 V, 2 A Buck3, 3.3 V, 2 A (25°C ambient)

This evaluation module is designed to provide access to the features of the TPS65251. 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.

3 Schematic

See next page.

The resistor and capacitor values have been chosen according to the guidelines presented on the TPS65251 spec available at http://focus.ti.com/docs/prod/folders/print/tps65251.html.

Note that for the purpose of gains-phase measurements R10, R19 and R21 (0 Ω on the EVM) need to be replaced by suitable low value resistors as per the network analyzer setup required. Test points are provided on either end of the resistors to allow for easy measurement.

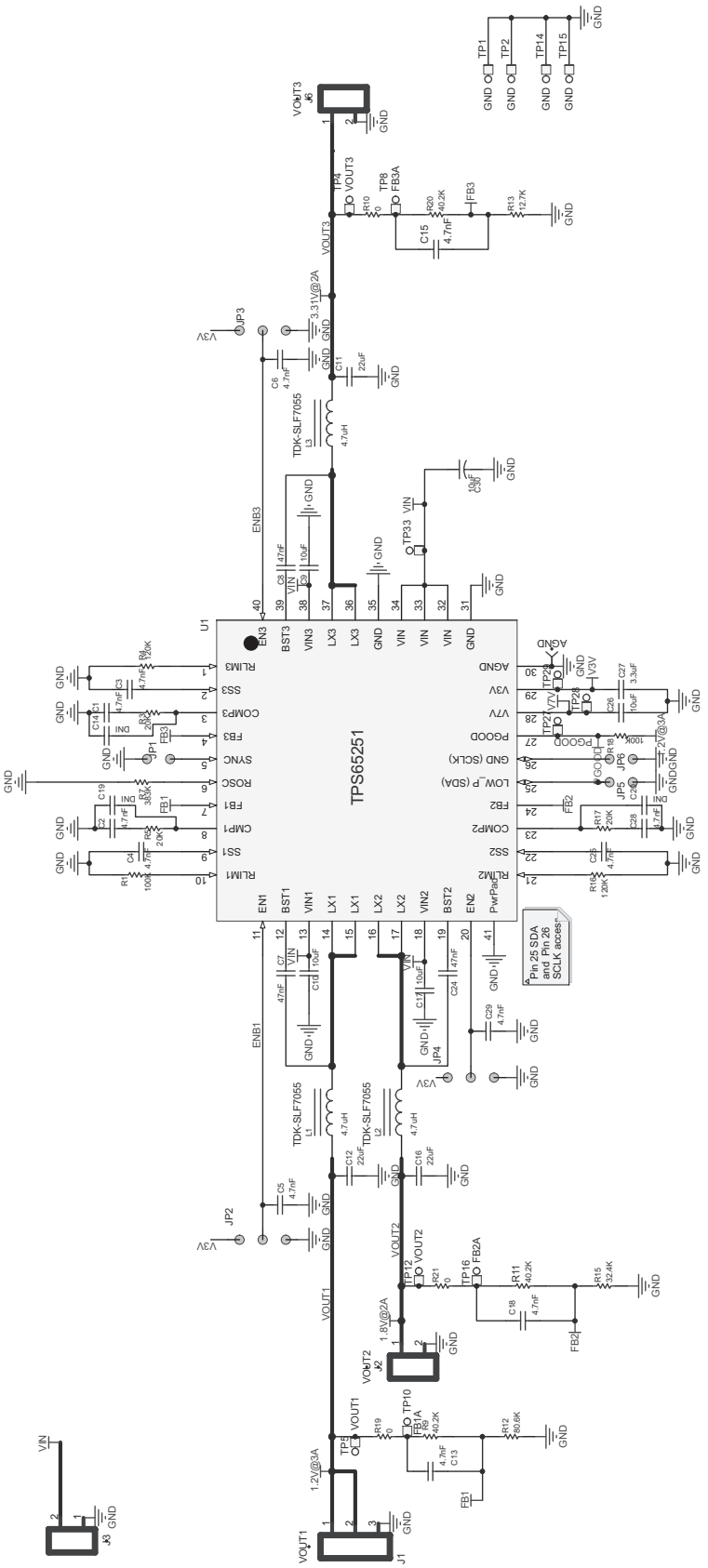

Figure 1. TPS65251 Schematic

4 Placement (Top Layer)

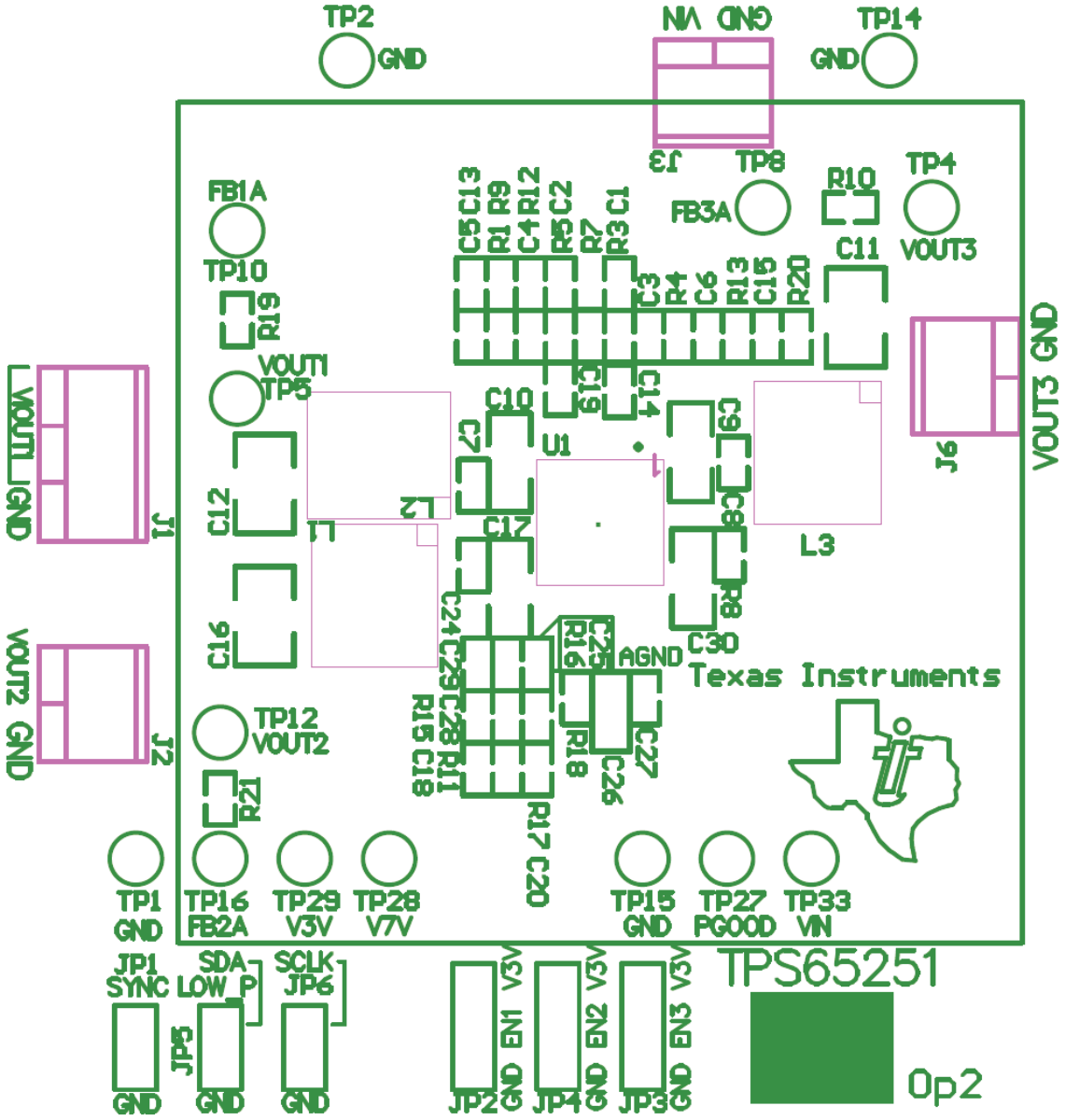

Figure 2. Placement (Top Layer)

5 Bench Test Setup Conditions

5.1 Headers Description and Jumper Placement

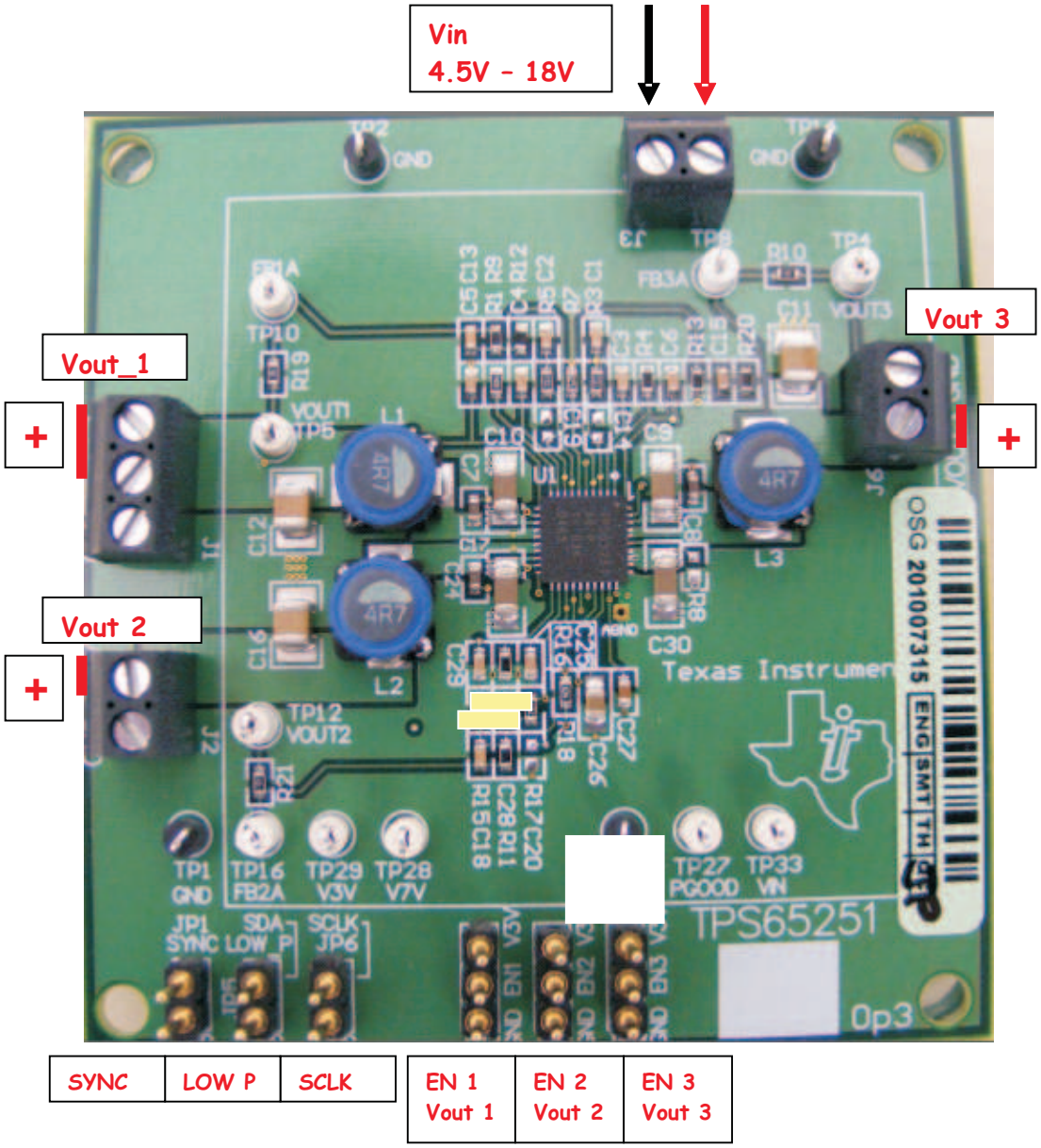

Figure 3. Headers Description and Jumper Placement

Test points:

Black – GND

White – Each output, feed-back, power good and V_{IN}. All marking on PCB.

5.2 Jumpers

Table 2. Jumpers

JUMPER NO.	FUNCTION	PLACEMENT	COMMENT
JP1	SYNC input	For buck internal clock fit jumper. For external SYNC connect as per drawing.	Jumper must be fitted if no external SYNC is used
JP2	Buck1 enable (EN1)	For automatic 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)	For automatic start-up fit jumper to V3V. For sequencing do not fit jumper. To disable converter fit jumper to GND.	Fit according to test requirement
JP4	Buck2 enable (EN2)	For automatic start-up fit jumper to V3V. For sequencing do not fit jumper. To disable converter fit jumper to GND.	Fit according to test requirement
JP5	LOW_P	Low power: Power save mode ON/OFF. If need low power mode test, should connect V3V internal regulator test point (TP29).	Fit according to test requirement. During normal operation jumper must be fitted.
JP6	GND	For normal operation fit jumper (GND)	Fit according to test requirement. During normal operation jumper must be fitted.

5.3 Test Points and Placement

Buck converter outputs are red 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 Table 3.

Table 3. Test Points and Placement

TEST POINT	NAME	SIGNAL	COLOR	COMMENT
TP1	GND	Ground	Black	
TP2	GND	Ground	Black	
TP3	AGND	Ground		Not fitted. Only Via.
TP4	VOUT3	Buck3 output	White	
TP5	VOUT1	Buck1 output	White	
TP8	FB3A	Input for gain-phase measurement Buck3	White	Normally not used
TP10	FB1A	Input for gain-phase measurement Buck1	White	Normally not used
TP12	VOUT2	Buck2 output	White	Normally not used
TP14	GND	Ground	Black	
TP15	GND	Ground	Black	
TP16	FB2A	Input for gain-phase measurement Buck2	White	Normally not used
TP27	PGOOD	Power Good (open drain connected to Buck1 output)	White	
TP28	V7V	V7V pin (internal rail)	White	
TP29	V3V	V3V pin (internal rail)	White	
TP33	VIN	Input supply	White	

6 Power-Up Procedure

1. Define which converters are to be enabled or disabled by connecting the correct jumpers accordingly (enable to V3V, disable to GND for all cases).
2. Apply a DC voltage to jumper J3. Polarity is clearly marked on the silk-screen.
3. Verify that the relevant converters are powered up by the output voltages. The whole start-up process will take around 100 ms. PGOOD will be asserted after 1 s.
4. Apply loads to the output connectors.
5. For low power and SYNC operation remove the jumpers and connect control supplies as indicated in the bench test setup section.

7 Bill of Materials

Table 4. Bill of Materials

ITEM	QUANTITY	DESIGNATOR	VALUE	FOOTPRINT	MANUFACTURER	MANUFACTURER PART NO.	DESCRIPTION	COMMENT
1	9	C1, C2, C3, C4, C5, C6, C25, C28, C29	4.7 nF	603	Panasonic -ECG	ECJ-1VB1H472K	4700PF 50V X7R 0603	Ceramic capacitor
2	3	C7, C8, C24	47 nF	603	Panasonic -ECG	ECJ-1VF1H473Z	47000PF 50V Y5V 0603	Ceramic capacitor
3	3	C9, C10, C17	10 µF	1206	Panasonic -ECG	ECJ-3YB1E106M	10UF 25V X5R 1206	Ceramic capacitor
4	3	C11, C12, C16	22 µF	1210	Panasonic -ECG	ECJ-4YB1E226M	22UF 25V X5R 1210	Ceramic capacitor
5	3	C13, C15, C18	470 pF	603	Panasonic -ECG	ECJ-1VB2A471K	470PF 100V X7R 0603	Ceramic capacitor
6	3	C14, C19, C20	DNI	603				Capacitor
7	1	C26	10 µF	805	Panasonic -ECG	ECJ-2FB1A106K	10UF 10V X5R 0805	Ceramic capacitor
8	1	C27	3.3 µF	603	TDK	C1608X5R1A335K	3.3UF 10V X5R 0603	Ceramic capacitor
9	1	C30	10 µF	1206	Panasonic -ECG	ECJ-3YB1E106M	10UF 25V, X5R 1206	Ceramic capacitor
10	1	J1		TB_3X3.5MM	OnShoreTechnology Inc	ED555/3DS	Terminal, 3 pin, 6 A, 3.5 mm	VOUT1
11	1	J2, J3, J6		TB_2X3.5MM	OnShoreTechnology Inc	ED555/2DS	Terminal, 2 pin, 6 A, 3.5 mm	TBLK_6A_2X3.5MM
12	3	JP1, JP5, JP6		JMP0.2	Mil-Max	800-10-064-10-001000	SIP HEADER STRAIGHT PCB	JUMPER 2 PIN
13	3	JP2, JP3, JP4		JMP0.3	Mil-Max	800-10-064-10-001000	SIP HEADER STRAIGHT PCB	JUMPER 2 PIN
14	3	L1, L2, L3	4.7 µH	IND_SLF7055	TDK Corporation	SLF7055T-4R7N3R1-3PF	Magnetic-Core Inductor	TDK-SLF7055
15	2	R1, R18	100 kΩ	603	Panasonic -ECG	ERA-3AEB104V	RES 100 kΩ 1/10 W .1% 0603 SMD	Resistor
16	3	R3, R5, R17	20 kΩ	603	Panasonic -ECG	ERA-3YEB203V	RES 20 kΩ 1/10 W .1% 0603 SMD	Resistor
17	2	R4, R16	150 kΩ	603	Panasonic -ECG	ERJ-3EKF1503V	RES 150 kΩ 1/10 W 1% 0603 SMD	Resistor
18	1	R7	383 kΩ	603	Panasonic -ECG	ERJ-3EKF3833V	RES 383 kΩ 1/10 W 1% 0603 SMD	Resistor
19	1	R8	DNI	603	Panasonic -ECG	ERJ-3GEY0R00V	RES ZERO Ω 1/10 W 5% 0603 SMD	Resistor

Table 4. Bill of Materials (continued)

ITEM	QUANTITY	DESIGNATOR	VALUE	FOOTPRINT	MANUFACTURER	MANUFACTURER PART NO.	DESCRIPTION	COMMENT
20	3	R9, R11, R20	360 kΩ	603	Panasonic -ECG	ERJ-3EKF3603V	RES 360 kΩ 1/10 W 1% 0603 SMD	Res1
21	3	R10, R19, R21	49.9 Ω	603	Susumu Co Ltd	RR0816Q-49R9-D-68R	RES 49.9 Ω 1/16 W .5% 0603 SMD	Res1
22	1	R12	715 kΩ	603	Panasonic -ECG	ERJ-3EKF7153V	RES 715 kΩ 1/10 W 1% 0603 SMD	Resistor
23	1	R13	115 kΩ	603	Panasonic -ECG	ERJ-3EKF1153V	RES 115 kΩ 1/10 W 1% 0603 SMD	Resistor
24	1	R15	287 kΩ	603	Panasonic -ECG	ERJ-3EKF2873V	RES 287 kΩ 1/10 W 1% 0603 SMD	Resistor
25	4	TP1, TP2, TP14, TP15,	Black	TEST POINT 0.052	Keystone	5001	TEST POINT MINI .040"D BLACK	GND
26	1	TP3	STD	TP-SMALL				Test Point, 0.020 Hole
27	1	TP4, TP5, TP8, TP10, TP12, TP16, TP27, TP28, TP29, TP33		TEST POINT 0.052	Keystone	5002	TEST POINT MINI .040"D WHITE	Glass Beaded Test Point
28	1	U1		QFN-40	TI		TPS65251	

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

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 . The EVM is designed to operate properly with certain components above 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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