

TPS51124 Buck Controller Evaluation Module User's Guide



Table of Contents

1 Description	2
2 Electrical Performance	2
3 Schematic	3
4 Test Setup and Results	4
4.1 Test Setup.....	4
4.2 Test Procedure.....	4
4.3 Start-Up Performance.....	5
4.4 Transient Performance.....	5
5 Configuration	6
5.1 Switching Frequency Selection.....	6
5.2 Bootstrap Diode Selection.....	6
6 EVM Assembly Drawing and PCB Layout	7
7 List of Materials	10
8 References	11
9 Revision History	11

Trademarks

D-CAP™ is a trademark of Texas Instruments.

All trademarks are the property of their respective owners.

1 Description

The TPS51124 is a dual, adaptive on-time D-CAP™ mode synchronous buck controller. The part enables system designers to cost-effectively complete the suite of notebook power bus regulators with the absolute lowest external component count and lowest standby consumption. The fixed frequency emulated adaptive on-time control supports seamless operation between PWM mode at heavy load condition and reduced frequency operation at light load for high efficiency down to milli-ampere range. The main control loop for the TPS51124 uses D-CAP mode that is optimized for low-ESR output capacitors such as POSCAP or SP-CAP promises fast transient response with no external compensation. Simple and separate power-good signals for each channel allow flexibility of power sequencing. The part provides a convenient and efficient operation with supply input voltages (V5IN, V5FILT) ranging from 4.5 V to 5.5 V, conversion voltages (drain voltage for the synchronous high-side MOSFET) from 3 V to 28 V, and output voltages from 0.76 V to 5.5 V.

The HPA178 (TPS51124EVM) evaluation module is a high efficiency, dual synchronous buck converter providing 1.05 V at 10 A and 1.5 V at 10 A from 5-V to 25-V input. This user's guide describes the HPA178 performance in medium switching frequency.

2 Electrical Performance

SPECIFICATIONS		TEST CONDITIONS	MIN	TYP	MAX	UNIT
Input voltage range (V5IN)			4.5	5.0	5.5	V
Input voltage range (VIN)			5	12	25	V
CH1	Output voltage			1.05		V
	Operating frequency	TONSEL: Float VIN = 12 V, IOU1 = 10 A		300		kHz
	Output current			10		A
	Overcurrent limit	VIN = 12 V		13		A
	Output ripple voltage	VIN = 12 V, IOU1 = 10 A		35		mVp-p
CH2	Output voltage			1.5		V
	Operating frequency	TONSEL: Float VIN = 12 V, IOU2 = 10 A		360		kHz
	Output current			10		A
	Overcurrent limit	VIN = 12 V		13		A
	Output ripple voltage	VIN = 12 V, IOU2 = 10 A		35		mVp-p

3 Schematic

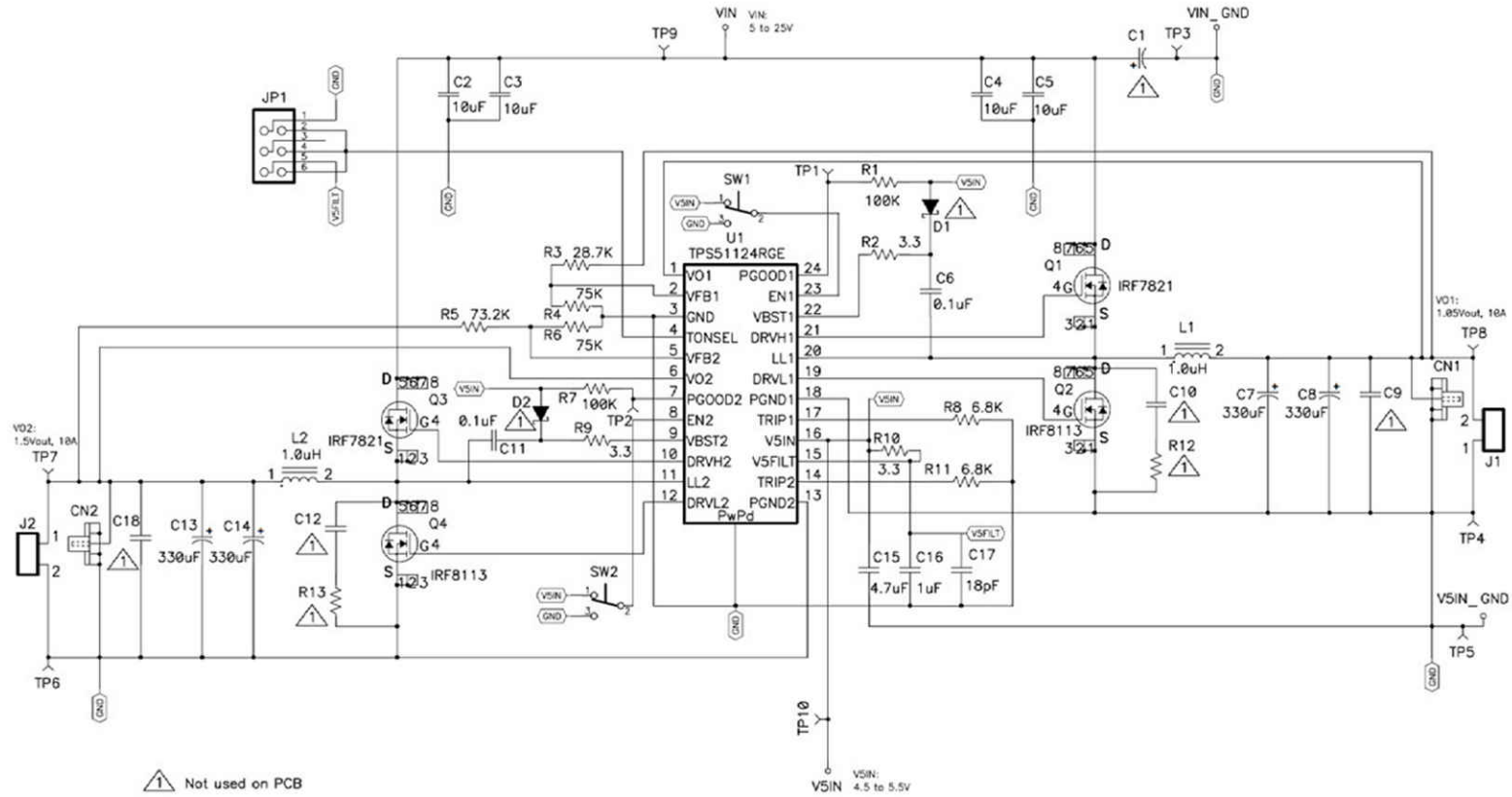


Figure 3-1. TPS51124 EVM Schematic Diagram

4 Test Setup and Results

4.1 Test Setup

Connect the test equipment and HPA178 EVM board as shown in [Figure 4-1](#).

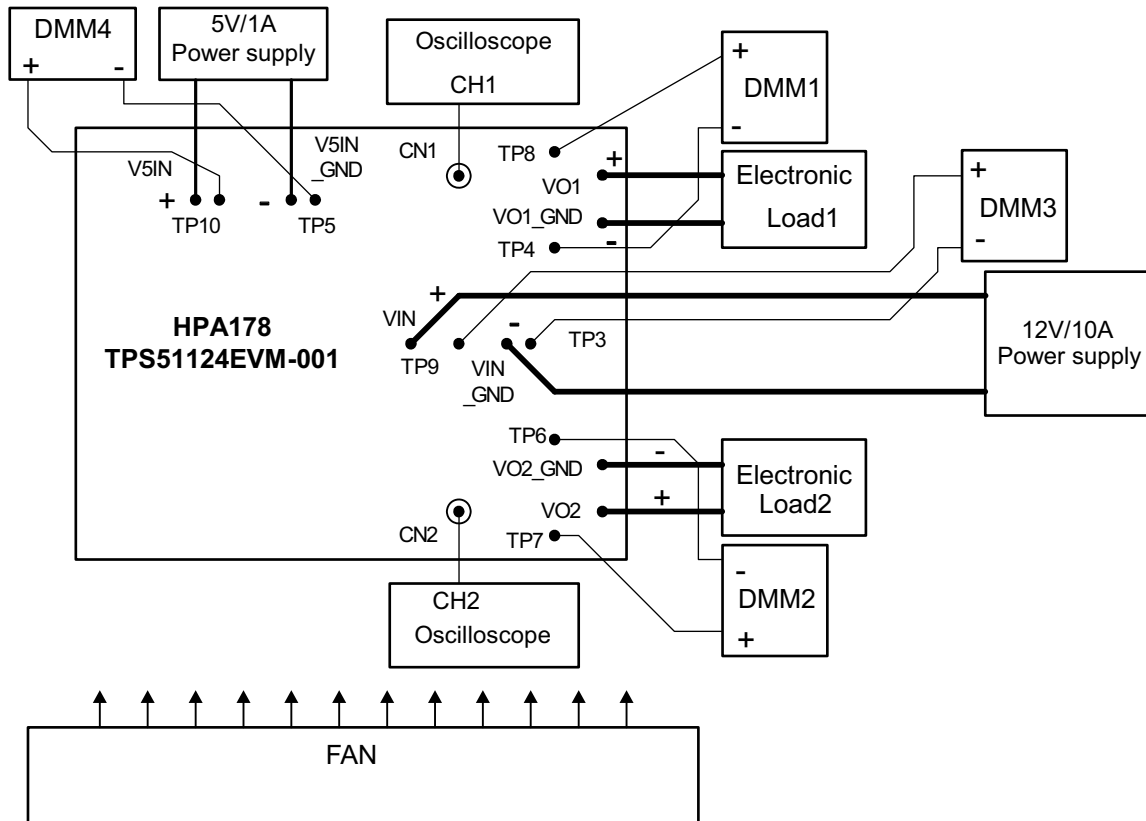


Figure 4-1. Equipment Setup for HPA178 EVM Board

4.2 Test Procedure

1. Ensure the switches SW1 (EN1) and SW2 (EN2) are in the "OFF" position.
2. Ensure the shunt jumper for JP1 is set 3-pin to 4-pin (Med).
3. Apply appropriate V5IN voltage to V5IN and V5IN_GND terminals.
4. Apply appropriate VIN voltage to VIN and VIN_GND terminals.
5. Turn on SW1 (EN1). The CH1-output will start up.
6. Turn on SW2 (EN2). The CH2-output will start up.

4.3 Start-Up Performance

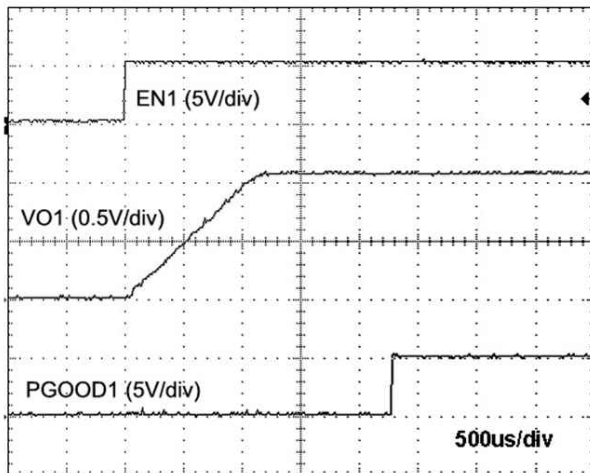


Figure 4-2. 1.05-V Start-Up Performance

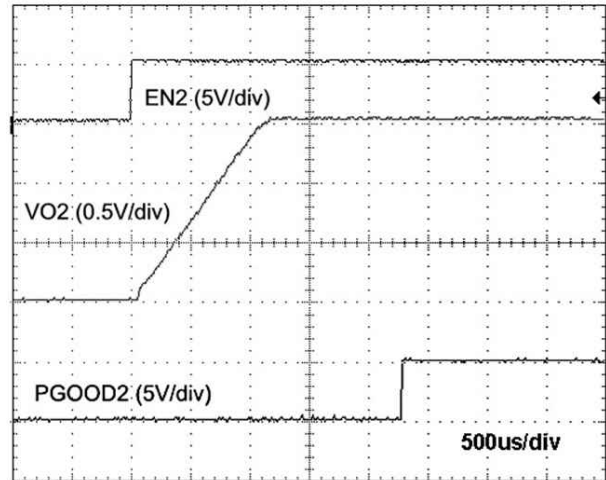


Figure 4-3. 1.5-V Start-Up Performance

4.4 Transient Performance

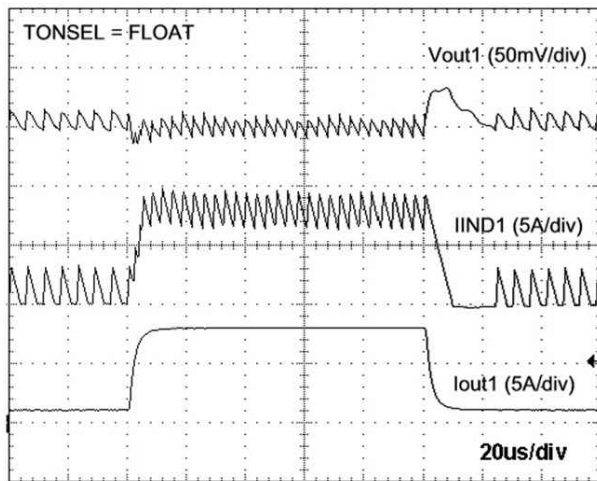


Figure 4-4. 1.05-V Load Transient Performance

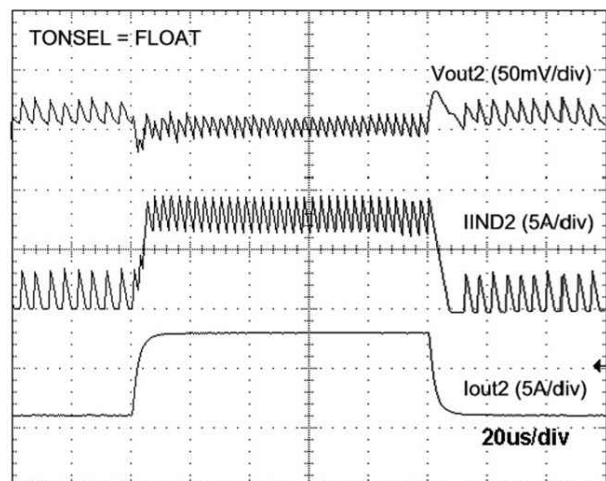


Figure 4-5. 1.5-V Load Transient Performance

5 Configuration

This EVM could be set to the desired configurations of the user.

Please refer to the following specific configuration setting sections.

5.1 Switching Frequency Selection

Switching frequency can be set by the TONSEL pin using JP1 on the EVM. The default setting is medium.

Table 5-1. Switching Frequency Selection

Jumper (JP1) Set to	TONSEL	Frequency ⁽¹⁾		
		Typ	CH1	CH2
Top(1-2 pin shorted)	GND	Slow	240 kHz	300 kHz
CENTER(3-4 pin shorted)	Float	Medium	300 kHz	360 kHz
Bottom(5-6 pin shorted)	V5FILT	Fast	360 kHz	420 kHz

(1) Frequencies are approximate.

5.2 Bootstrap Diode Selection

Bootstrap diodes (D1, D2) are not populated on this EVM since the TPS51124 has them built in. External Schottky diodes can be added in order to further improve the efficiency.

6 EVM Assembly Drawing and PCB Layout

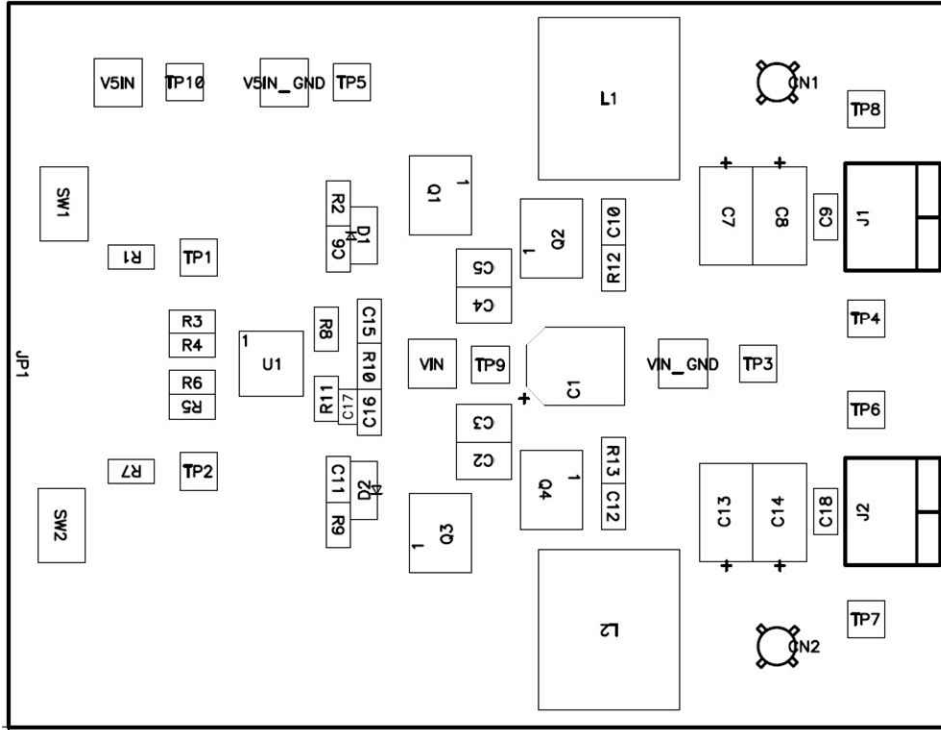


Figure 6-1. Top Assembly

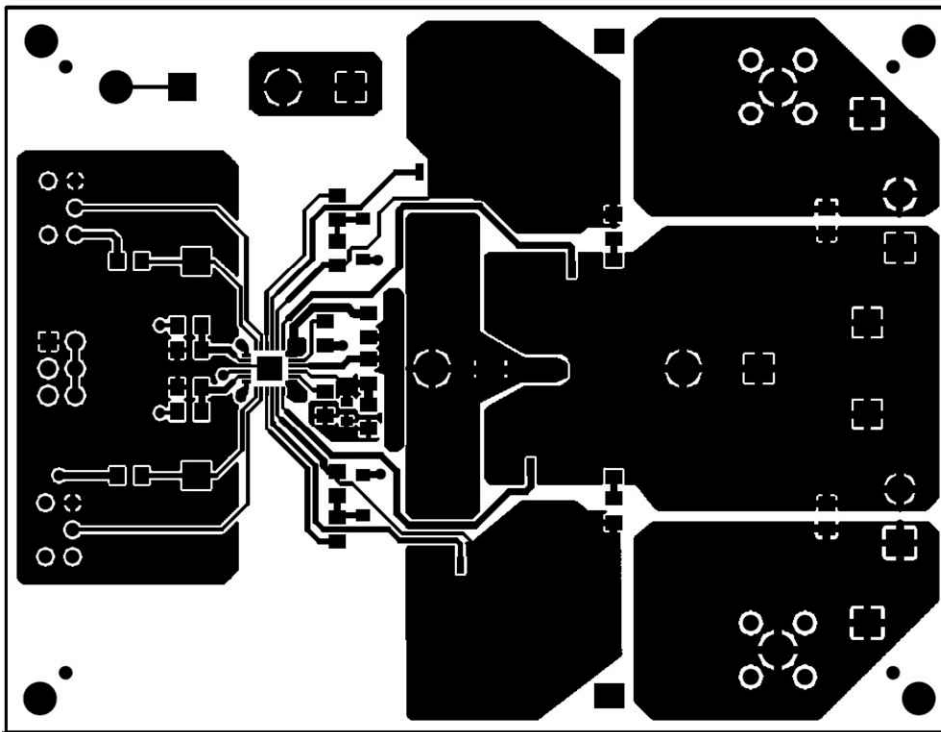


Figure 6-2. Top Layer

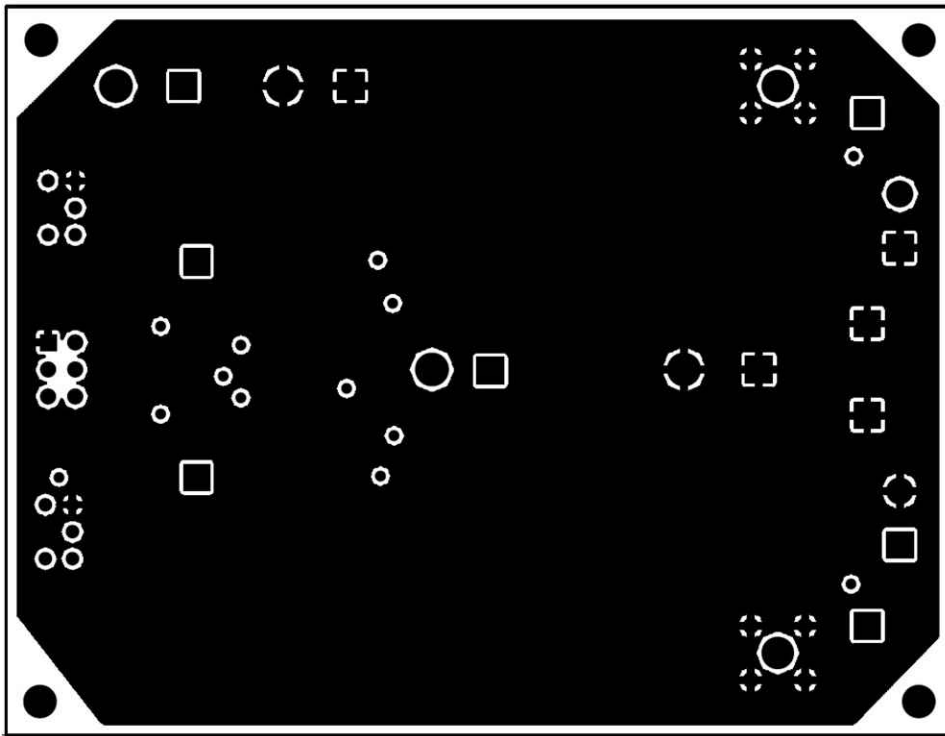


Figure 6-3. Inner Layer 1

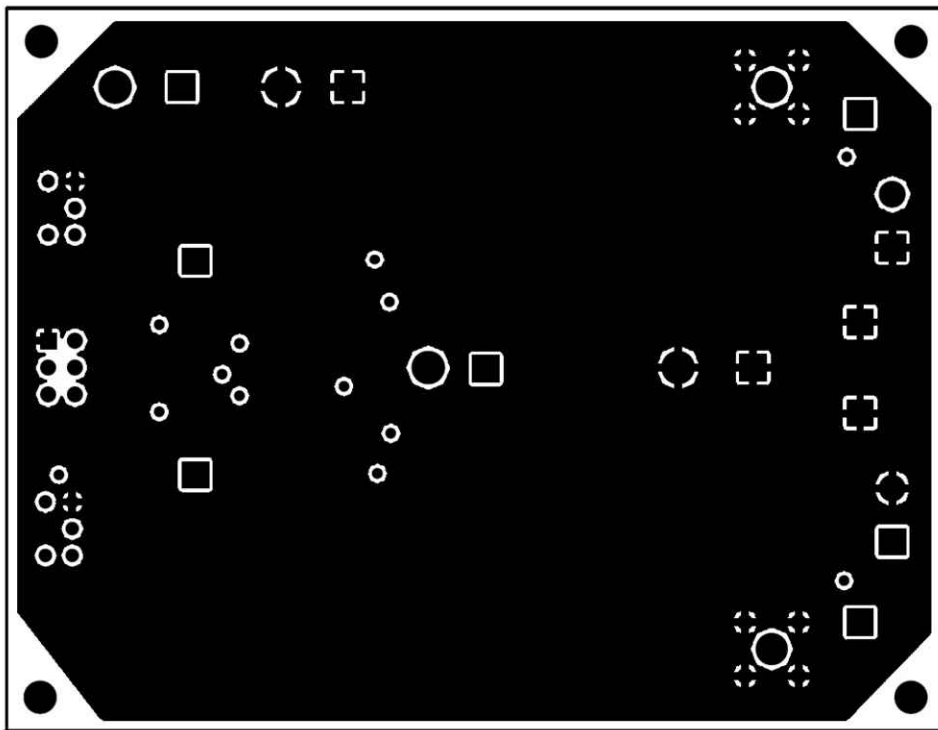


Figure 6-4. Inner Layer 2

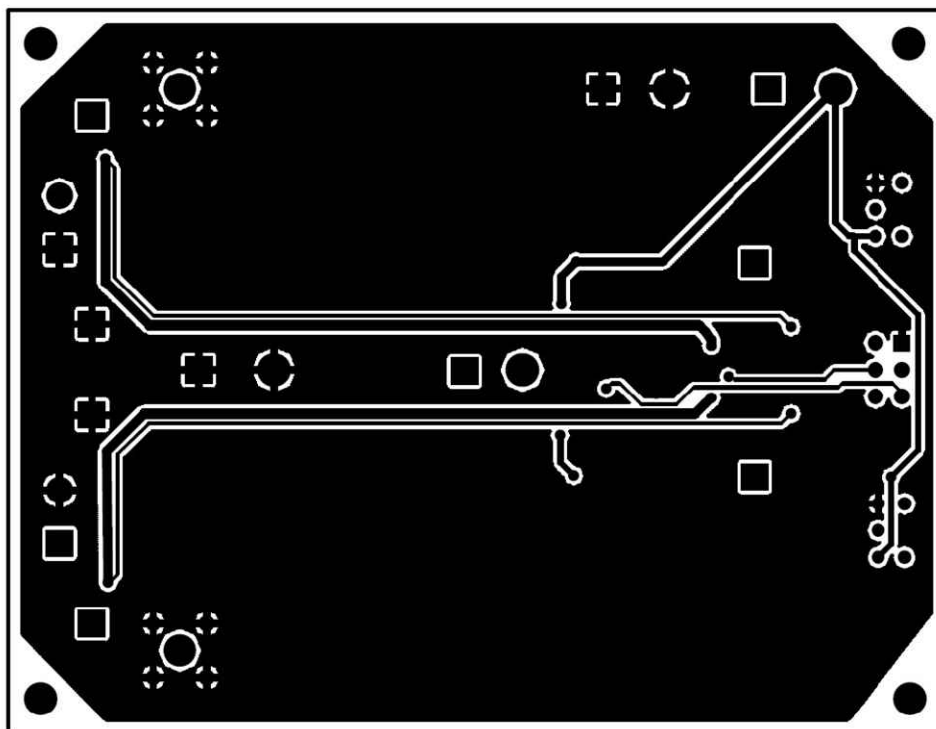


Figure 6-5. Bottom Layer

7 List of Materials

Reference Designator	QTY	Description	Size	Mfr	Part Number
—	1	Shunt,100-mil, Black	0.100	3M	929950-00
C1	0	Capacitor,Aluminum	0.26 × 0.26 inch	Any	Any
C13, C14	2	Capacitor, POSCAP, 330 mF, 2.5-V18-mW, 20%	7343	SANYO	2R5TPE330MI
C15	1	Capacitor,Ceramic, 4.7 mF,6.3 V, BJ, 20%	0805	TDK	C2012X5R0J475K
C16	1	Capacitor,Ceramic, 1 mF,6.3 V, BJ, 20%	0805	TDK	C2012X5R0J105K
C17	1	Capacitor,Ceramic, 18 pF, 50 V, BJ, 20%	0805	Std	Std
C2, C3, C4, C5	4	Capacitor,Ceramic, 10 mF,25 V, BJ , 20%	1210	TDK / TaiyoYuden	C3225JB1E106 / TMK325BJ106MM
C6, C11	2	Capacitor,Ceramic, 0.1 mF,50 V, BJ, 20%	0805	Std	Std
C7, C8	2	Capacitor, POSCAP, 330 mF, 2.5-V15-mW, 20%	7343	SANYO	2R5TPE330MF
C9, C10, C12, C18	0	Capacitor,Ceramic	0805	Any	Any
CN1, CN2	2	Adaptor, 3.5-mm probe clip (or 131-5031-00)	0.2	Tektronix	131-4244-00
D1, D2	0	Diode,Schottky, 0.5 A, 30 V	SOD-123	Any	Any
J1, J2	2	TerminalBlock, 2-pin, 15 A, 5.1 mm	0.40 × 0.35 inch	OST	ED1609
JP1	1	Header, 2×3-pin,100mil spacing (36-pin strip)	0.20 × 0.30 inch	Sullins	PTC36DAAN
L1, L2	2	Inductor,1.0 μH, 20.5 A, 2 mW	0.496 × 0.532 inch	TOKO	FDA1254-1R0M
Q1, Q3	2	MOSFET,N-ch, 30 V, 11 A, 12.5 mW	SO8	IR	IRF7821
Q2, Q4	2	MOSFET,N-ch, 30 V, 13.8 A, 6.8 mW	SO8	IR	IRF8113
R1, R7	2	Resistor,Chip, 100 kW,1/10W, 1%	0805	Std	Std
R12, R13	0	Resistor,Chip	0805	Std	Std
R2, R9, R10	3	Resistor,Chip, 3.3 W,1/10W, 1%	0805	Std	Std
R3	1	Resistor,Chip, 28.7 kW,1/10W, 1%	0805	Std	Std
R4, R6	2	Resistor,Chip, 75 kW,1/10W, 1%	0805	Std	Std
R5	1	Resistor,Chip, 73.2 kW,1/10W, 1%	0805	Std	Std
R8, R11	2	Resistor,Chip, 6.8 kW,1/10W, 1%	0805	Std	Std
SW1, SW2	2	Switch,ON-ON Mini Toggle	0.28 × 0.18 inch	Nikkai	G12AP
TP1, TP2	2	Testpoint, White, Thru hole	0.125× 0.125 inch	Keystone	5012
TP10	1	Testpoint, Orange, Thru hole	0.125× 0.125 inch	Keystone	5013
TP3, TP4, TP5, TP6	4	Testpoint, Black, Thru hole	0.125× 0.125 inch	Keystone	5011
TP7, TP8	2	Testpoint, Yellow, Thru hole	0.125× 0.125 inch	Keystone	5014
TP9	1	Testpoint, Red, Thru hole	0.125× 0.125 inch	Keystone	5010
U1	1	IC, Dual Synchronous Step-Down Controller for Low Voltage Power Rails	QFN32	TI	TPS51124RHB
VIN_GND,VIN, V5IN,V5IN_GND	4	Pin,Wiring Terminal	0.09(D) × 0.31 inch	MillMax	3183-2-00-15-00-00-080

8 References

Texas Instruments, [TPS51124 Dual Synchronous Step-Down Controller for Low Voltage Power Rails Data Sheet](#)

9 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision A (June 2008) to Revision B (March 2022)	Page
• Updated the numbering format for tables, figures, and cross-references throughout the document.	2
• Updated the user's guide title.....	2

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#) or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2022, Texas Instruments Incorporated