

# High Performance Synchronous Buck EVM Using the TPS53124

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## 1 Description

The TPS53124 is a dual, adaptive on-time D-CAP™ mode synchronous buck controller. TPS53124 enables system designers to cost effectively complete the suite of DTV POL regulator and Digital STB regulator with a low external component count. The main control loop for the TPS53124 uses the D-CAP mode that is optimized for low ESR output capacitors such as POSCAP, SP-CAP, or High Polymer Chemistry and provides fast transient response with no external compensation. TPS53124 provides conversion voltages (Drain voltage for the synchronous high-side MOSFET) from 4.5 V to 24 V and output voltages from 0.76 V to 5.5 V.

HPA332 (TPS53124EVM) evaluation module is a high efficiency, dual synchronous buck converter providing 1.05 V at 4 A and 1.8 V at 4 A from 5 V to 22 V input. This user's guide describes the HPA332 performance.

## 2 Electrical Performance

**Table 1. Electrical Performance**

| SPECIFICATIONS            |                       | TEST CONDITIONS         | MIN | TYP  | MAX | UNIT  |
|---------------------------|-----------------------|-------------------------|-----|------|-----|-------|
| Input voltage range (VIN) |                       |                         | 5   | 12   | 22  | V     |
| CH1                       | Output voltage        |                         |     | 1.05 |     | V     |
|                           | Operating frequency   | VIN = 12 V, Iout1 = 1 A |     | 280  |     | kHz   |
|                           | Output current        |                         |     | 4    |     | A     |
|                           | Over current limit    | VIN = 12 V              |     | 5    |     | A     |
|                           | Output ripple voltage | VIN = 12 V, Iout1 = 4 A |     | 29   |     | mVp-p |
| CH2                       | Output voltage        |                         |     | 1.8  |     | V     |
|                           | Operating frequency   | VIN = 12 V, Iout2 = 1 A |     | 360  |     | kHz   |
|                           | Output current        |                         |     | 4    |     | A     |
|                           | Over current limit    | VIN = 12 V              |     | 5    |     | A     |
|                           | Output ripple voltage | VIN = 12 V, Iout2 = 4 A |     | 33   |     | mVp-p |

### Figure 1. TPS53124 EVM Schematic Diagram

## 4 Test Setup and Results

### 4.1 Test Setup

Connect test equipment and HPA332 EVM board as shown in Figure 2.

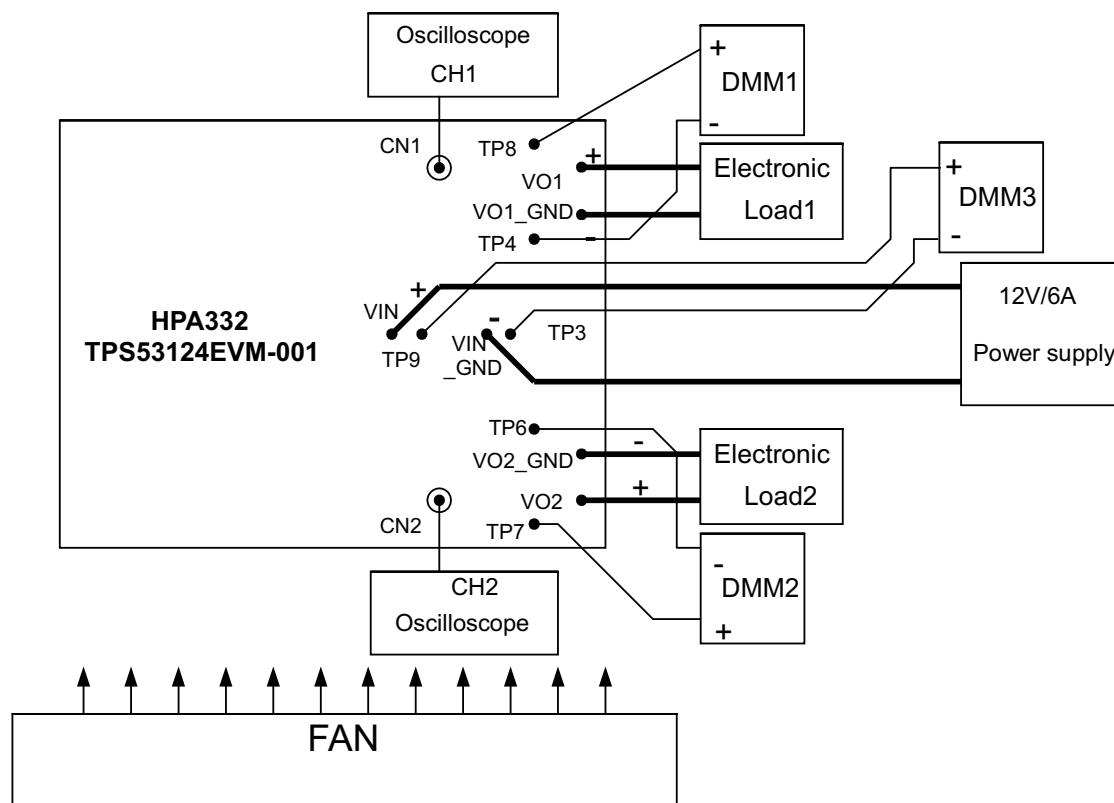


Figure 2. Equipment Setup for HPA332 EVM Board

### 4.2 Test Procedure

1. Make sure the switches SW1 (EN1), SW2 (EN2) are in *OFF* position.
2. Apply appropriate VIN voltage to VIN and VIN\_GND terminals
3. Turn on SW1 (EN1), CH1-output will start up.
4. Turn on SW2 (EN2), CH2-output will start up.

### 4.3 Start Up Performance

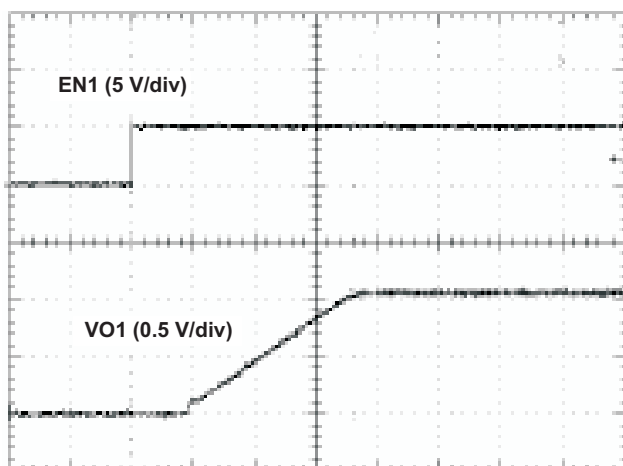


Figure 3. 1.05V Startup Waveforms

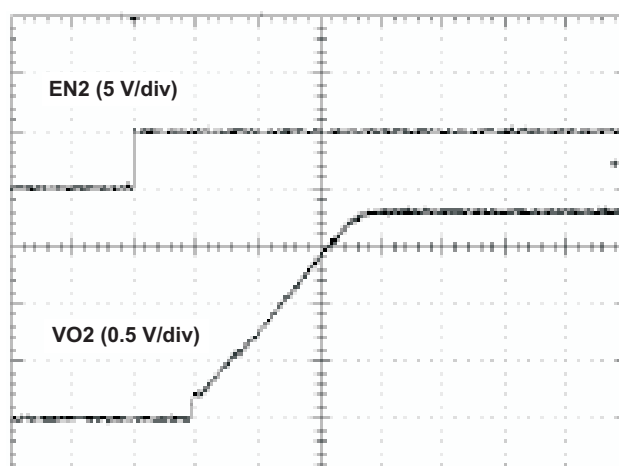


Figure 4. 1.8V Startup Waveform

### 4.4 Transient Response

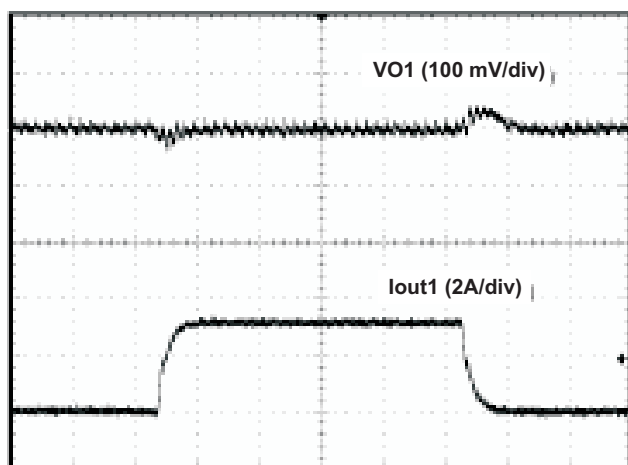


Figure 5. 1.05V Load Transient Response

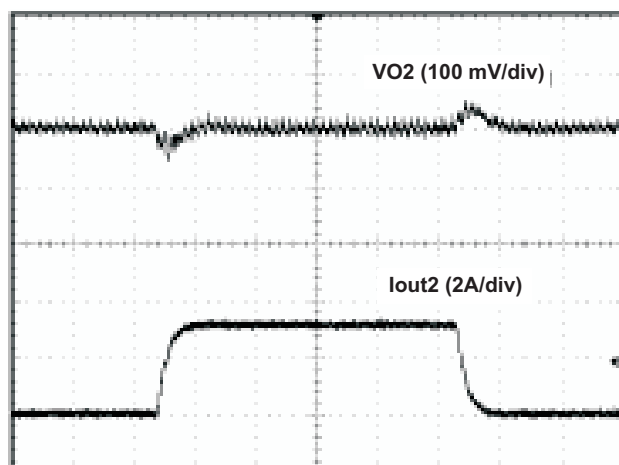


Figure 6. 1.8V Load Transient Response

## 5 Configuration

This EVM can be set at desired configurations. Refer to the following specific setting configuration sections.

### 5.1 Bootstrap Diode Selection

Bootstrap diodes are not populated on this EVM since TPS53124 has them built-in. External Schottky diodes can be added to improve efficiency.

## 6 EVM Assembly Drawing and PCB Layout

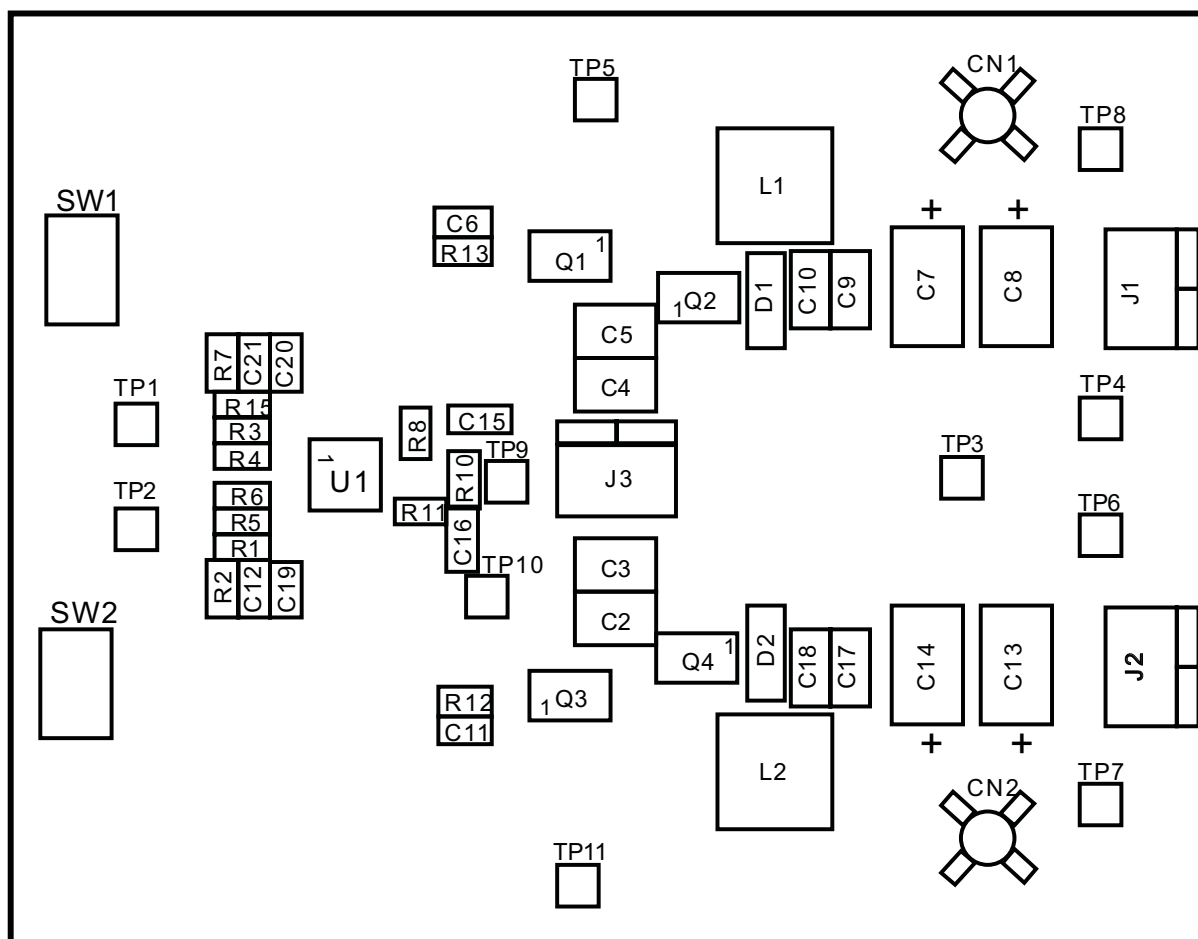
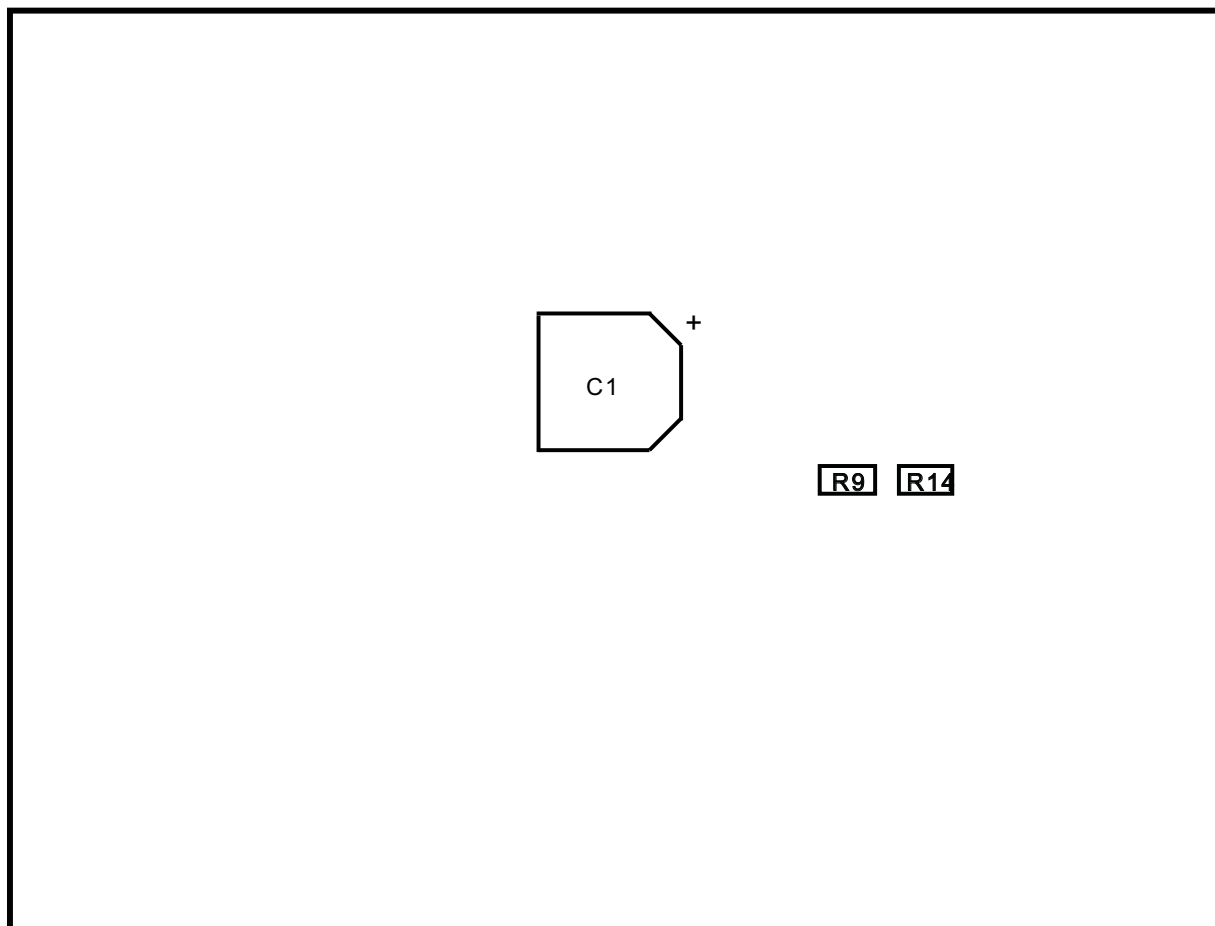


Figure 7. Top Assembly



**Figure 8. Bottom Assembly**

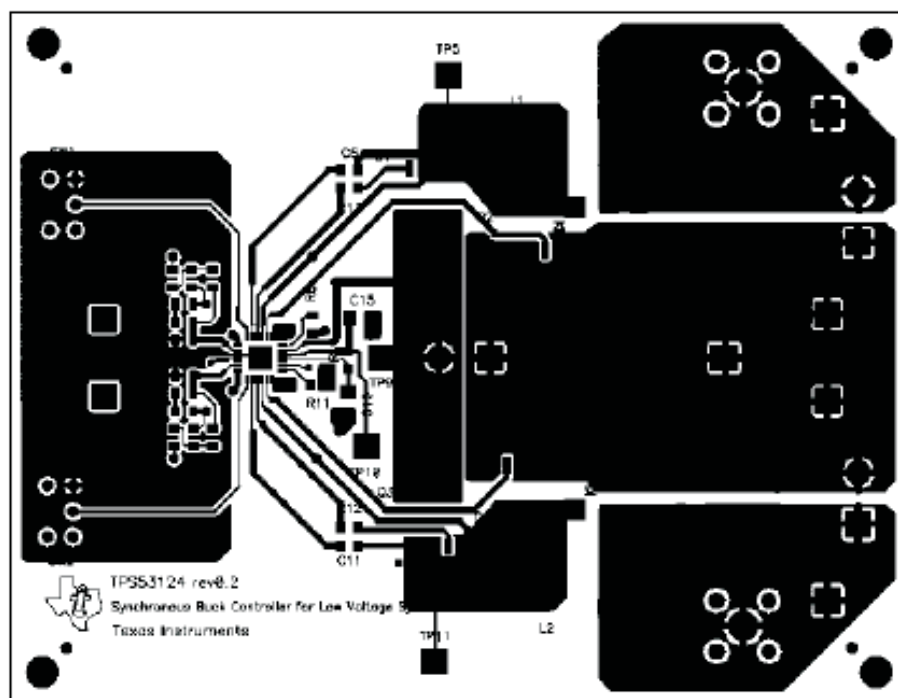


Figure 9. Top Layer

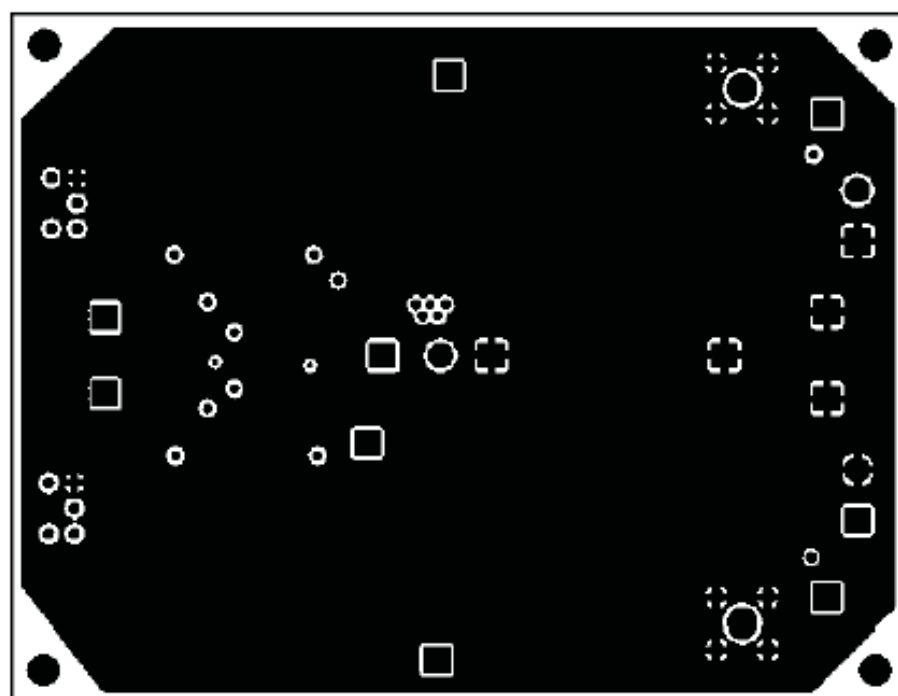


Figure 10. Inner Layer 1



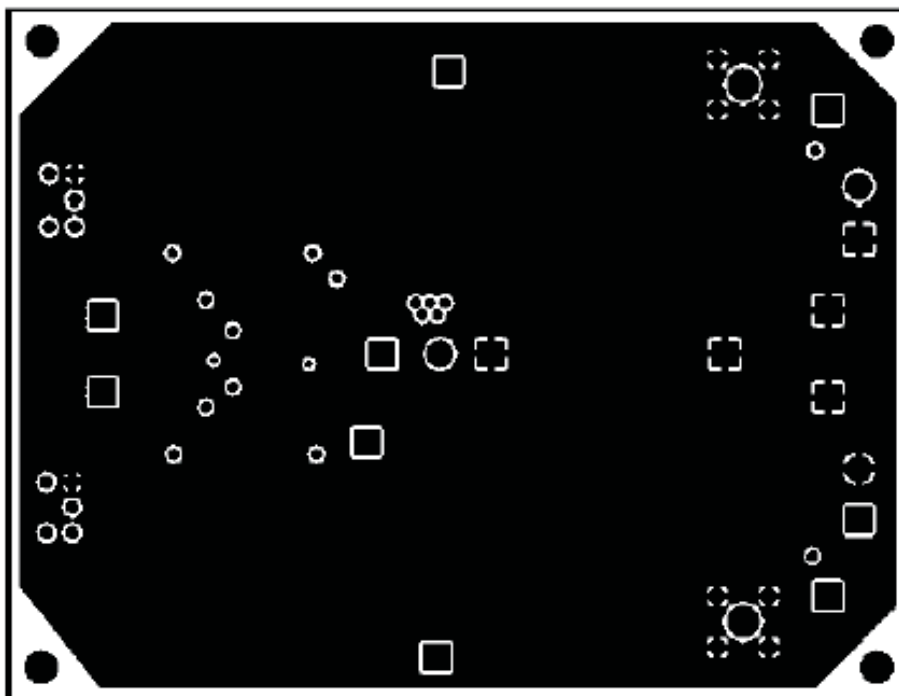


Figure 11. Inner Layer 2

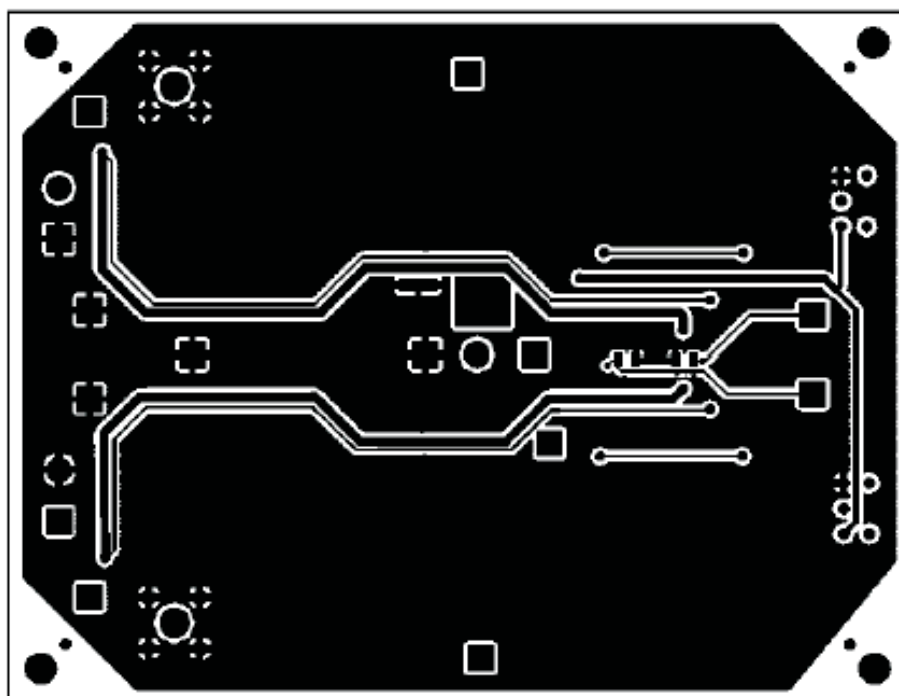


Figure 12. Bottom Layer

## 7 List of Materials

**Table 2. List of Materials**

| Ref Dsg                | QTY | Description                                                           | Size                  | MFR                | Part Number       |
|------------------------|-----|-----------------------------------------------------------------------|-----------------------|--------------------|-------------------|
| C1                     | 0   | Capacitor, Aluminum                                                   | 0.26 × 0.26 inch      | Any                | Any               |
| C8, C13                | 2   | Capacitor, NPCAP, 330 μF, 4.0-V 15-mΩ , 20%                           | 6.6 × 7.2 mm          | NIPPON<br>CHEMICON | APXE4R0ARA331M    |
| C15                    | 1   | Capacitor, Ceramic, 4.7 μF, 10V, BJ, 20%                              | 0805                  | TDK                | C2012JB1A475MN    |
| C16                    | 1   | Capacitor, Ceramic, 1 μF, 16V, BJ, 20%                                | 0805                  | TDK                | C2012JB1C105M75MN |
| C2, C3, C4, C5         | 4   | Capacitor, Ceramic, 10 μF, 25V, BJ , 20%                              | 1210                  | Taiyo Yuden        | TMK325BJ106MN     |
| C6, C11                | 2   | Capacitor, Ceramic, 0.1 μF, 50V, BJ, 20%                              | 0603                  | Std                | Std               |
| C7,C14                 | 0   | not mount                                                             | 6,6 × 7,2 mm          | Any                | Any               |
| C9, C10,<br>C17,C18    | 0   | not mount                                                             | 1206                  | Any                | Any               |
| C12 ,C19–C21           | 0   | not mount                                                             | 0603                  | Any                | Any               |
| CN1, CN2               | 0   | Adaptor, 3,5-mm probe clip ( or 131-5031-00)                          | 0.2                   | Tektronix          | 131-4244-001      |
| D1, D2                 | 0   | Diode, Schottky, 1-A, 30-V                                            | SMA                   | Any                | Any               |
| J1, J2, J3             | 3   | Terminal Block, 2-pin, 15-A, 5,1mm                                    | 0.40 × 0.35 inch      | Phoenix<br>Contact | MKDSN1.5/2-5.08   |
| L1, L2                 | 2   | Inductor, 3.3 μH, 6.0 A, 29.7 mΩ                                      | 6,5 × 7,1mm           | TDK                | SPM6530T-3R3M     |
| Q1, Q3                 | 2   | MOSFET, N-ch, 30-V, 6.5-A, 38-mΩ                                      | SO8                   | ROHM               | RSS065N032        |
| Q2, Q4                 | 2   | MOSFET, N-ch, 30-V, 10-A, 17.5-mΩ                                     | SO8                   | ROHM               | RSS100N03         |
| R1                     | 1   | Resistor, Chip, 1.8 kΩ , 1/16W, 1%                                    | 0603                  | Std                | Std               |
| R3                     | 1   | Resistor, Chip, 3.3 kΩ , 1/16W, 1%                                    | 0603                  | Std                | Std               |
| R4, R6                 | 2   | Resistor, Chip, 10 kΩ , 1/16W, 1%                                     | 0603                  | Std                | Std               |
| R5                     | 1   | Resistor, Chip, 12 kΩ , 1/16W, 1%                                     | 0603                  | Std                | Std               |
| R8, R11                | 2   | Resistor, Chip, 5.6 kΩ , 1/16W, 1%                                    | 0603                  | Std                | Std               |
| R9, R14                | 2   | Resistor, Chip, 0 Ω , 1/16W, 1%                                       | 0603                  | Std                | Std               |
| R12, R13               | 2   | Resistor, Chip, 10 Ω , 1/16W, 1%                                      | 0603                  | Std                | Std               |
| R15                    | 1   | Resistor, Chip, 430 Ω , 1/16W, 1%                                     | 0603                  | Std                | Std               |
| R2, R7, R10            | 0   | not mount                                                             | 0603                  | Any                | Any               |
| SW1, SW2               | 2   | Switch, ON-ON Mini Toggle                                             | 0.28 × 0.18 inch      | Nikkai             | G12AP             |
| TP1, TP2, TP5,<br>TP11 | 4   | Test Point, White, Thru Hole                                          | 0.125 × 0.125<br>inch | Keystone           | 5012              |
| TP10                   | 1   | Test Point, Orange, Thru Hole                                         | 0.125 × 0.125<br>inch | Keystone           | 5013              |
| TP3, TP4, TP6          | 3   | Test Point, Black, Thru Hole                                          | 0.125 × 0.125<br>inch | Keystone           | 5011              |
| TP7, TP8               | 2   | Test Point, Yellow, Thru Hole                                         | 0.125 × 0.125<br>inch | Keystone           | 5014              |
| TP9                    | 1   | Test Point, Red, Thru Hole                                            | 0.125 × 0.125<br>inch | Keystone           | 5010              |
| U1                     | 1   | IC, Dual Synchronous Step-Down Controller for Low Voltage Power Rails | QFN24                 | TI                 | TPS53124RGE       |

## 8 Reference

1. TPS53124 Data sheet, *Dual Synchronous Step-Down Controller for Low Voltage Power Rails*, ([SLUS825](#))

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