*User's Guide*

# *TPSM84x24 Power Module Evaluation Module User's Guide*


**ABSTRACT**

The TPSM84824, TPSM84624, and TPSM84424 evaluation module (EVM) is designed as an easy-to-use platform that facilitates an extensive evaluation of the features and performance of the TPSM84x24 power module. This guide provides information on the correct usage of the EVM and an explanation of the numerous test points on the board.


## Table of Contents



## Trademarks

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# 1 Description

This EVM features the TPSM84824/624/424 synchronous buck power module configured for operation with a 4.5-V to 17-V input voltage range. The output voltage can be set to one of six popular values by using a configuration jumper. Similarly, the switching frequency can be set to one of six values with a jumper. Additionally, the RTT resistor value, which selects the TurboTrans feature for improved transient response, is also selectable using a jumper. The full output current rating of the device can be supplied by the EVM. Input and output capacitors are included on the board to accommodate the entire range of input and output voltages. Monitoring test points are provided to allow measurement of efficiency, power dissipation, input ripple, output ripple, line and load regulation, and transient response. Control test points and component footprints are provided for use of the ENABLE, PGOOD, and CLK features of the device. The EVM uses a recommended PCB layout that maximizes thermal performance and minimizes output ripple and noise.

## 2 Getting Started

Figure 2-1 highlights the user interface items associated with the EVM. The *VIN Power* terminal block (J1) is used for connection to the host input supply and the *VOUT Power* terminal block (J2) is used for connection to the load. These terminal blocks can accept up to 16-AWG wire.

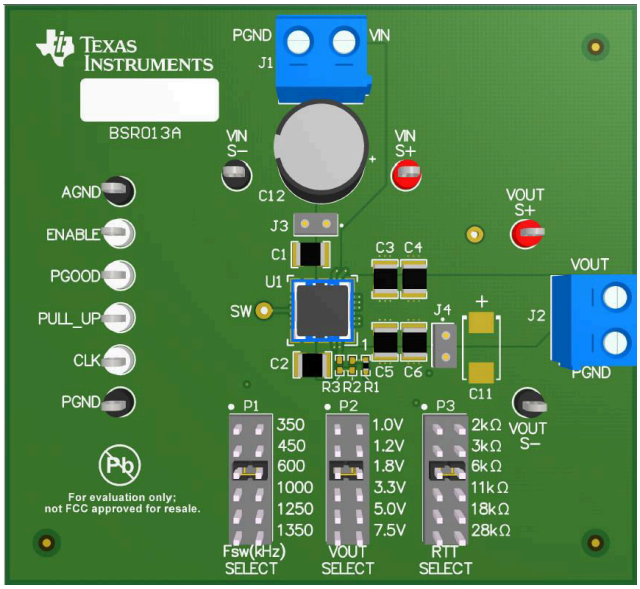


**Figure 2-1. EVM User Interface**

The S+ and S- test points for both VIN and VOUT, located near the power terminal blocks are intended to be used as voltage monitoring points where voltmeters can be connected to measure VIN and VOUT. **Do not use these S+ and S- monitoring test points as the input supply or output load connection points.** The PCB traces connecting to these test points are not designed to support high currents.

The VIN Scope (J3) and VOUT Scope (J4) test points can be used to monitor VIN and VOUT waveforms with an oscilloscope. These test points are intended for use with un-hooded scope probes outfitted with a low-inductance ground lead (ground spring) mounted to the scope probe barrel. The two sockets of each test point are on 0.1 inch centers. The scope probe tip should be inserted into the socket marked with a white dot, and the scope ground lead should be inserted into the other socket.

The control test points located to the left of the device are made available to test the features of the device. The UVLO feature can be adjusted by changing resistors R24 and R25 on the bottom of the board. An external voltage can be applied to the PULL_UP test point for the PGOOD signal. Refer to the *Test Points Descriptions* section of this guide for more information on the individual control test points.

The Fsw SELECT jumper (P1), the VOUT SELECT jumper (P2) and the RTT SELECT jumper (P3) are provided for selecting the desired output voltage, the appropriate switching frequency and the appropriate TurboTrans resistor value. Before applying power to the EVM, ensure that the jumpers are present and properly positioned for the intended output voltage, switching frequency, and TurboTrans resistor value. Refer to Table 2-1 for the recommended jumper settings. Always remove input power before changing the jumper settings.

**Table 2-1. Output Voltage and Switching Frequency Jumper Settings**

| VOUT Select | Fsw Select | RTT Select |
|---|---|---|
| 1 V | 350 kHz | 2 kΩ |
| 1.2 V | 450 kHz | 3 kΩ |
| 1.8 V | 600 kHz | 6 kΩ |
| 3.3 V | 1000 kHz | 11 kΩ |
| 5 V | 1250 kHz | 18 kΩ |
| 7.5 V | 1350 kHz | 28 kΩ |

# 3 Test Point Descriptions

Wire-loop test points and two scope probe test points have been provided as convenient connection points for digital voltmeters (DVM) or oscilloscope probes to aid in the evaluation of the device. A description of each test point follows:

**Table 3-1. Test Point Descriptions**(1)

| | |
|---|---|
| **VIN S+** | Input voltage monitor. Connect the positive lead of a DVM to this point for measuring efficiency. |
| **VIN S–** | Input voltage monitor. Connect the negative lead of a DVM to this point for measuring efficiency. |
| **VOUT S+** | Output voltage monitor. Connect the positive lead of a DVM to this point for measuring efficiency, line regulation, and load regulation. |
| **VOUT S–** | Output voltage monitor. Connect the negative lead of a DVM to this point for measuring efficiency, line regulation, and load regulation. |
| **AGND** | Analog ground test point. |
| **PGND** | Power ground test point. |
| **VIN Scope (J3)** | Input voltage scope monitor. Connect an oscilloscope to this set of points to measure input ripple voltage. |
| **VOUT Scope (J4)** | Output voltage scope monitor. Connect an oscilloscope to this set of points to measure output ripple voltage and transient response. |
| **ENABLE** | Enable test point. Connect this test point to AGND to disable the device. Leave this test point open to enable the device.The UVLO resistor divider (R24 and R25) is connected at this point. |
| **PGOOD** | Monitors the power good signal of the device. This is an open drain signal. |
| **PULL_UP** | Test point provided for applying a pull-up voltage for the PGOOD signal. A 100-kΩ pull-up resistor (R26) is present on the EVM between this test point and the PGOOD signal. |
| **CLK** | Synchronization clock input test point. An AC coupling capacitor (C13) is present on the EVM between this test point and the SYNC pin of the device. Pads for a termination resistor (R27) are present between this test point and PGND. An external clock signal can be applied to this point to synchronize the device to an appropriate frequency. |

(1) Refer to the product datasheet for absolute maximum ratings associated with above features.

# 4 Performance Data

Figure 4-1 through Figure 4-4 demonstrate the TPSM84824EVM performance. For more data regarding the TPSM84824, TPSM84624, or the TPSM84424, please see the product data sheet.

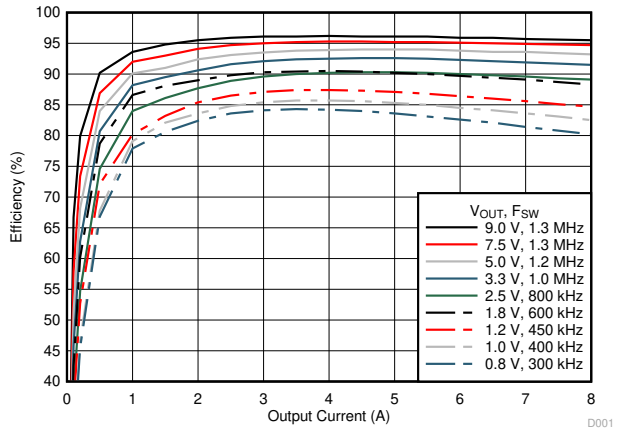


**Figure 4-1. Efficiency ($V_{IN}$ = 12 V)**

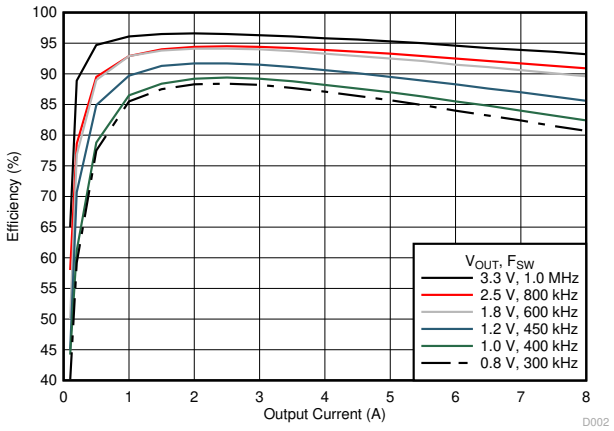


**Figure 4-2. Efficiency ($V_{IN}$ = 5 V)**

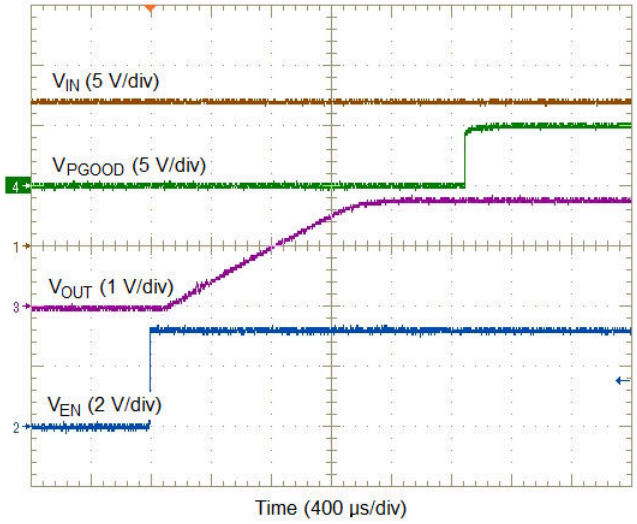


**Figure 4-3. EN Start-up Waveforms**

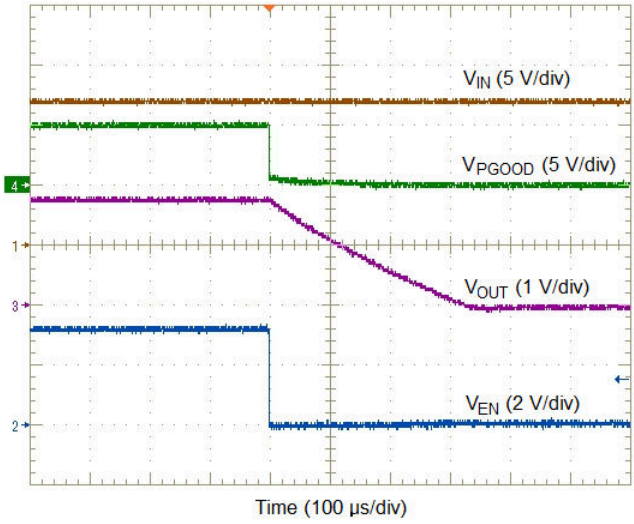


**Figure 4-4. EN Shutdown Waveforms**

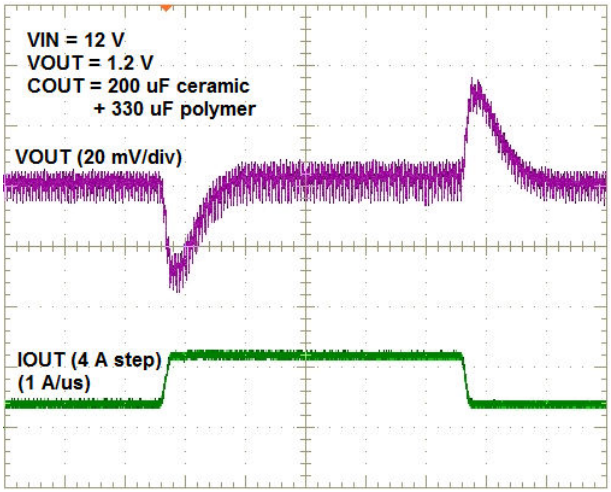


**Figure 4-5. Transient Performance**

# 5 Bill of Materials (BOM)

See Table 5-1 for the TPSM84824EVM, TPSM84624EVM, or TPSM84424 bill of materials.

**Table 5-1. EVM Bill of Materials**

| Designator | Qty | Value | Description | Package Reference | Part Number | Manufacturer |
|---|---|---|---|---|---|---|
| C1, C2 | 2 | 10µF | CAP, CERM, 10 µF, 25 V,+/- 10%, X7R, 1210 | 1210 | GRM32DR71E106KA12L | MuRata |
| C3, C4, C5, C6 | 4 | 47µF | CAP, CERM, 47 µF, 10 V,+/- 10%, X7R, 1210 | 1210 | GRM32ER71A476KE15L | MuRata |
| C12 | 1 | 100µF | CAP, AL, 100 µF, 50 V, +/- 20%, 0.162 ohm, TH | | EEUFC1H101B | Panasonic |
| C13 | 1 | 47pF | CAP, CERM, 47 pF, 50 V,+/- 1%, C0G/NP0, 0603 | 0603 | GRM1885C1H470FA01J | MuRata |
| J1, J2 | 2 | | Terminal Block, 5.08 mm, 2x1, Brass, TH | 2x1 5.08 mm Terminal Block | ED120/2DS | On-Shore Technology |
| J3, J4 | 2 | | Socket Strip, 2x1, 100mil, Black, Tin, TH | Socket Strip, 100mil, 2pin | 310-43-102-41-001000 | Mill-Max |
| P1, P2, P3 | 3 | | Header, 100mil, 6x2, Tin, TH | Header, 6x2, 100mil, Tin | PEC06DAAN | Sullins Connector Solutions |
| R1 | 1 | 10.0k | RES, 10.0 k, 1%, 0.063 W, 0402 | 0402 | CRCW040210K0FKED | Vishay-Dale |
| R5 | 1 | 15.0k | RES, 15.0 k, 1%, 0.1 W, 0603 | 0603 | CRCW060315K0FKEA | Vishay-Dale |
| R6 | 1 | 10.0k | RES, 10.0 k, 1%, 0.1 W, 0603 | 0603 | CRCW060310K0FKEA | Vishay-Dale |
| R7 | 1 | 4.99k | RES, 4.99 k, 1%, 0.1 W, 0603 | 0603 | CRCW06034K99FKEA | Vishay-Dale |
| R8 | 1 | 2.21k | RES, 2.21 k, 1%, 0.1 W, 0603 | 0603 | CRCW06032K21FKEA | Vishay-Dale |
| R9 | 1 | 1.37k | RES, 1.37 k, 1%, 0.1 W, 0603 | 0603 | CRCW06031K37FKEA | Vishay-Dale |
| R10 | 1 | 866 | RES, 866, 1%, 0.063 W, 0603 | 0603 | CRCW0603866RFKEA | Vishay-Dale |
| R11 | 1 | 143k | RES, 143 k, 1%, 0.1 W, 0603 | 0603 | CRCW0603143KFKEA | Vishay-Dale |
| R12 | 1 | 110k | RES, 110 k, 1%, 0.1 W, 0603 | 0603 | CRCW0603110KFKEA | Vishay-Dale |
| R13 | 1 | 82.5k | RES, 82.5 k, 1%, 0.1 W, 0603 | 0603 | CRCW060382K5FKEA | Vishay-Dale |
| R14 | 1 | 48.7k | RES, 48.7 k, 1%, 0.1 W, 0603 | 0603 | CRCW060348K7FKEA | Vishay-Dale |
| R15 | 1 | 38.3k | RES, 38.3 k, 1%, 0.1 W, 0603 | 0603 | CRCW060338K3FKEA | Vishay-Dale |
| R16 | 1 | 35.7k | RES, 35.7 k, 1%, 0.1 W, 0603 | 0603 | CRCW060335K7FKEA | Vishay-Dale |
| R17, R28 | 2 | 2.00k | RES, 2.00 k, 1%, 0.1 W, 0603 | 0603 | CRCW06032K00FKEA | Vishay-Dale |
| R18 | 1 | 3.01k | RES, 3.01 k, 1%, 0.1 W, 0603 | 0603 | CRCW06033K01FKEA | Vishay-Dale |
| R19 | 1 | 6.04k | RES, 6.04 k, 1%, 0.1 W, 0603 | 0603 | CRCW06036K04FKEA | Vishay-Dale |
| R20 | 1 | 11.3k | RES, 11.3 k, 1%, 0.1 W, 0603 | 0603 | CRCW060311K3FKEA | Vishay-Dale |
| R21 | 1 | 18.2k | RES, 18.2 k, 1%, 0.1 W, 0603 | 0603 | CRCW060318K2FKEA | Vishay-Dale |
| R22 | 1 | 28.0k | RES, 28.0 k, 1%, 0.1 W, 0603 | 0603 | CRCW060328K0FKEA | Vishay-Dale |
| R23 | 1 | 0 | RES, 0, 5%, 0.1 W, 0603 | 0603 | ERJ-3GEY0R00V | Vishay-Dale |
| R24 | 1 | 86.6k | RES, 86.6 k, 1%, 0.1 W, 0603 | 0603 | CRCW060386K6FKEA | Vishay-Dale |

**Table 5-1. EVM Bill of Materials (continued)**

| Designator | Qty | Value | Description | Package Reference | Part Number | Manufacturer |
|---|---|---|---|---|---|---|
| R25 | 1 | 30.9k | RES, 30.9 k, 1%, 0.1 W, 0603 | 0603 | CRCW060330K9FKEA | Vishay-Dale |
| R26 | 1 | 100k | RES, 100 k, 5%, 0.063 W, 0402 | 0402 | CRCW0402100KJNED | Vishay-Dale |
| SH-P1, SH-P2 SH-P3 | 3 | 1x2 | Shunt, 2mm, Gold plated, Black | 2mm Shunt, Closed Top | 2SN-BK-G | Samtec |
| TP1, TP2 | 2 | | Test Point, Multipurpose, Red, TH | Multipurpose Testpoint Red | 5010 | Keystone |
| TP3, TP4, TP9, TP10 | 4 | | Test Point, Multipurpose, Black, TH | Multipurpose Testpoint Black | 5011 | Keystone |
| TP5, TP16, TP7, TP8 | 4 | | Test Point, Multipurpose, White, TH | Multipurpose Testpoint White | 5012 | Keystone |
| U1 | 1 | | TPSM84824 MOL0024A (QFN-24) | MOL0024A | TPSM84824MOL | Texas Instruments |
| | | | TPSM84624 MOL0024A (QFN-24) | | TPSM84624MOL | |
| | | | TPSM84424 MOL0024A (QFN-24) | | TPSM8424MOL | |
| C7, C8, C9, C10 | 0 | | CAP, CERM, 1210 | 1210 | | |
| C11 | 0 | | CAP, Tantalum Polymer, 7343-40 SMD | 7343-40 | | |
| C14 | 0 | | CAP, CERM, 0402 | 0402 | | |
| C15, C16 | 0 | | CAP, CERM, 1210 | 1210 | | |
| D1 | 0 | | Diode, Schottky, 30 V, 0.2 A, SOD-323 | SOD-323 | BAT54WS-7-F | Diodes Inc. |
| R2, R3 | 0 | | RES, 0.1 W, 0603 | 0603 | | |
| R4 | 0 | | RES, 0.063 W, 0402 | 0402 | | |
| R27 | 0 | | RES, 1W, 2512 | 2512 | | |
| TP11 | 0 | | Test Point. No entry in BOM. | N/A | | |

## 6 Schematic

Figure 6-1 is the schematic for the TPSM84824EVM. The schematic for the TPSM84624EVM and TPSM84424EVM is identical with the only difference is the U1 IC.

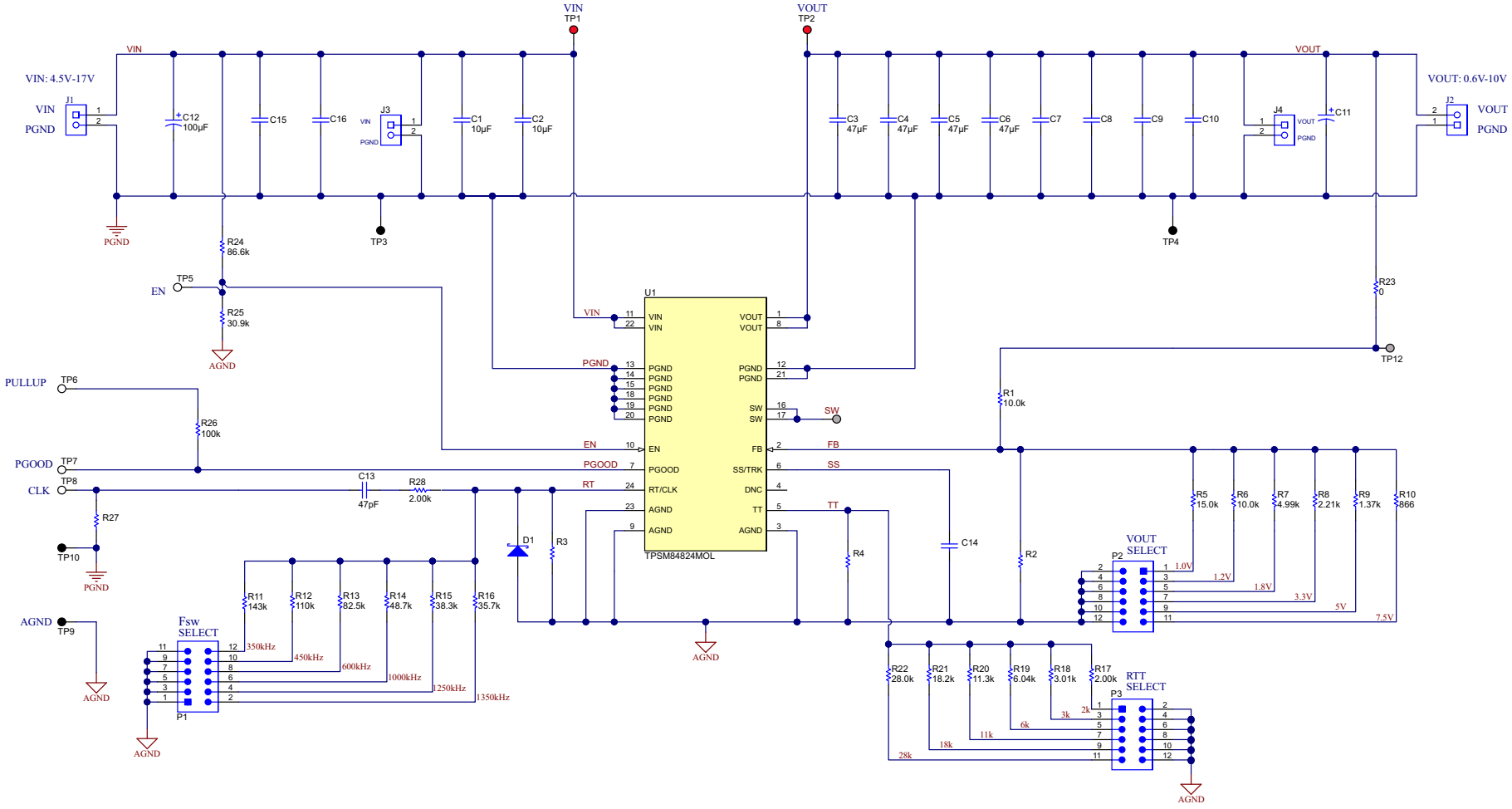




**Figure 6-1. TPSM84824EVM Schematic**

# 7 PCB Layout

Figure 7-1 through Figure 7-6 show the PCB layers of the TPSM84824EVM, TPSM84624EVM and TPSM84424EVM.

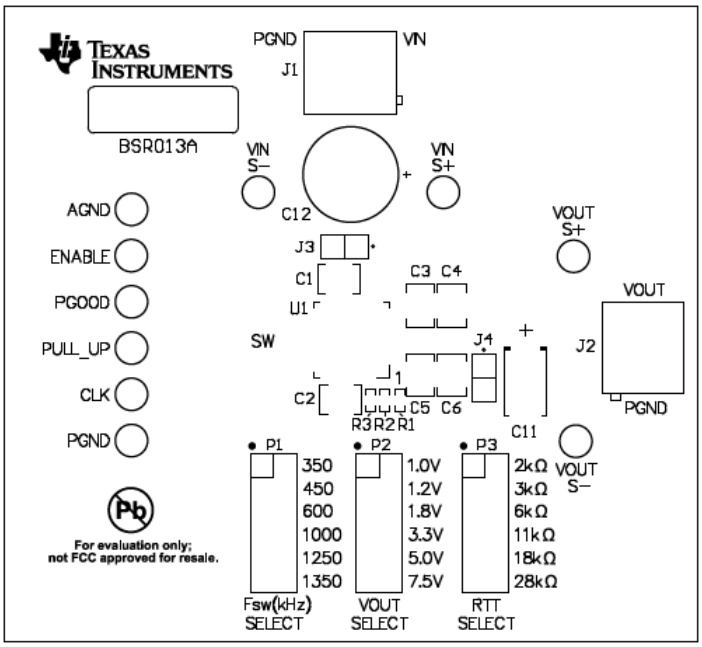


**Figure 7-1. Topside Component Layout (Top View)**

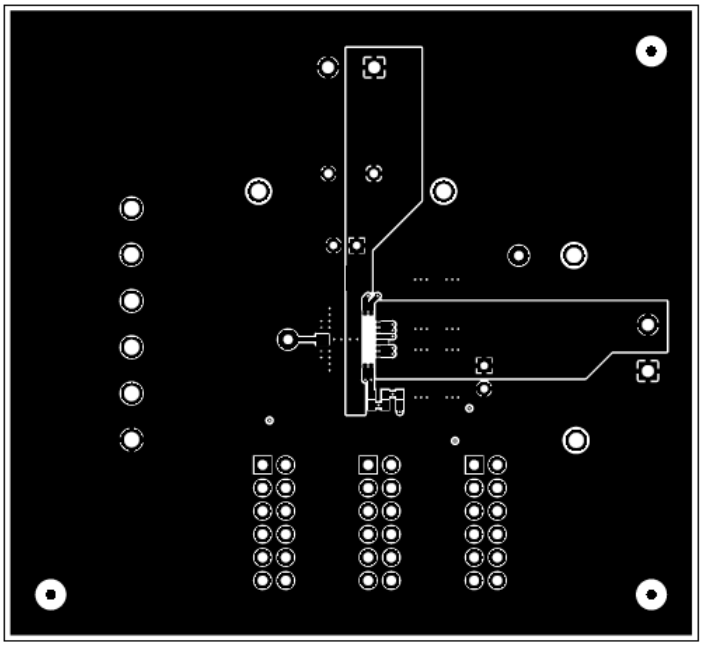

**Figure 7-2. Topside Copper (Top View)**

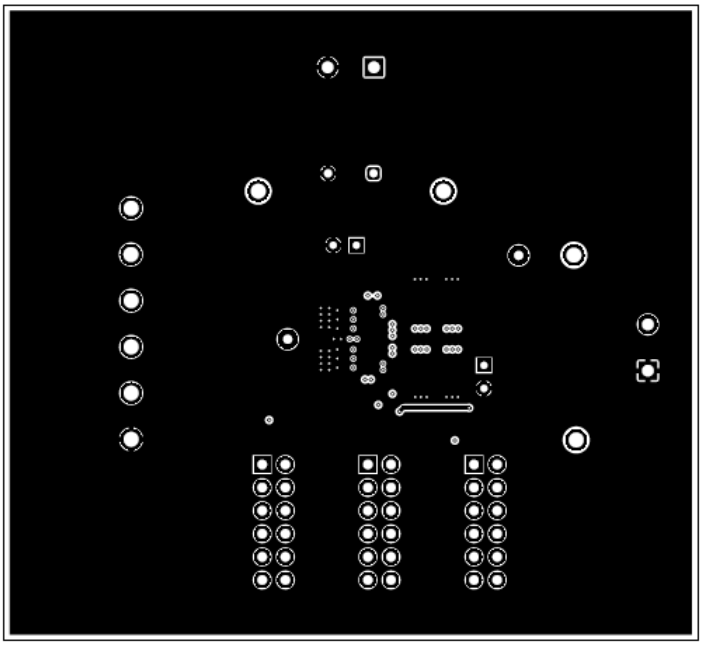

**Figure 7-3. Layer 2 Copper (Top View)**

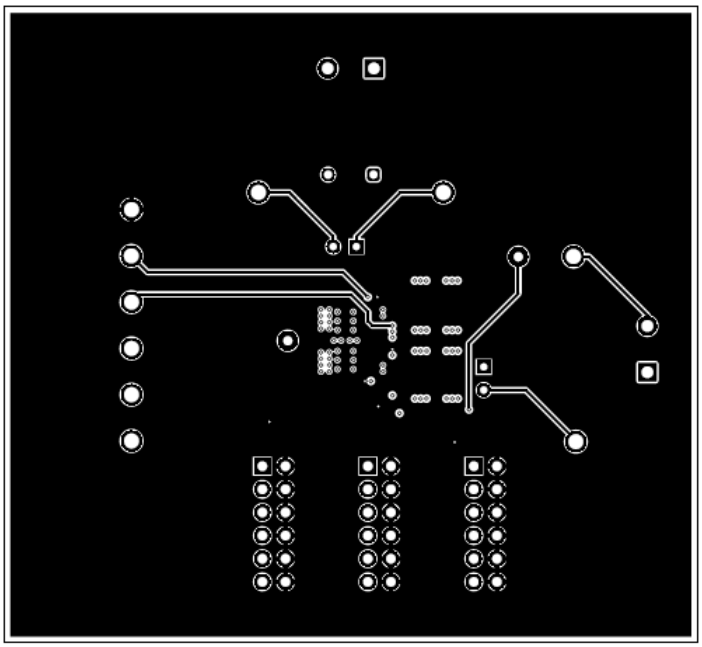

**Figure 7-4. Layer 3 Copper (Top View)**

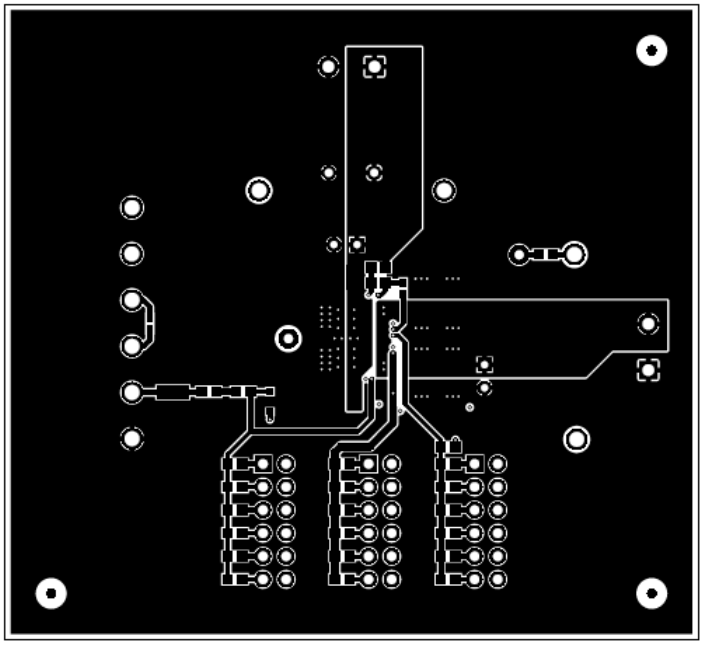

**Figure 7-5. Bottom-Side Copper (Top View)**

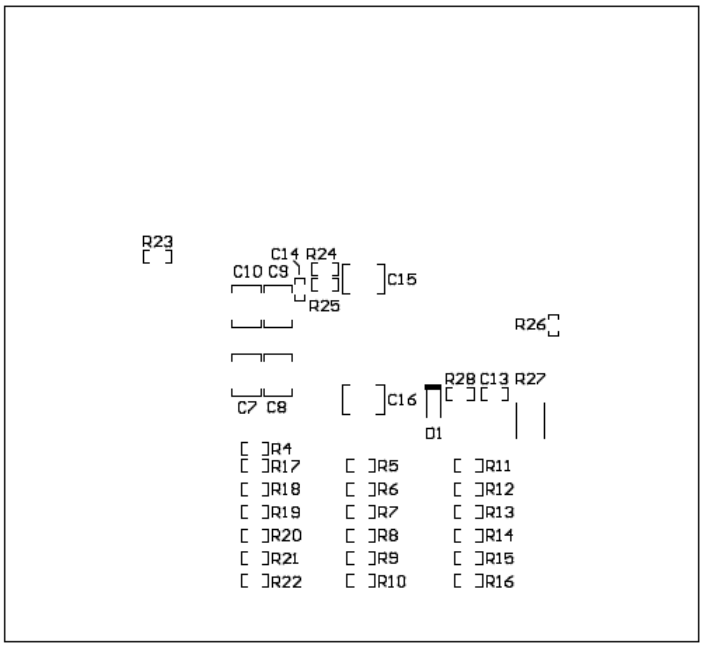


**Figure 7-6. Bottom-Side Component Layout (Bottom View)**

# 8 Revision History

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

| Changes from Revision A (March 2018) to Revision B (June 2021) | Page |
|---|---|
| • Updated user's guide title | 2 |
| • Updated the numbering format for tables, figures, and cross-references throughout the document. | 2 |

| Changes from Revision * (November 2017) to Revision A (March 2018) | Page |
|---|---|
| • Added TPSM84624EVM option to user guide | 1 |

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