

TPS2475XEVM-546 EVM: Evaluation Module for TPS2475X

This user's guide describes the evaluation module (EVM) for the TPS24750 and TPS24751 (TPS2475XEVM-546). The TPS2475X is a 2.5-V to 18-V power-limiting, hot-swap controller with an integrated MOSFET cable of high-current operation.

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1 Introduction

The TPS2475XEVM allows reference circuit evaluation of TI's TPS24750 and TPS24751 hot-swap controllers with integrated 10-A MOSFET. The TPS2475X is available with both latching and auto-retry operation.

1.1 Features

- General TPS2475X Features
 - 2.5-V to 18.0-V (TYP) bus operation
 - Programmable current limit
 - Programmable undervoltage lockout
 - Programmable overvoltage
 - Programmable V_{OUT} slew rate
 - Programmable power limit
 - Latched-off TPS24750RUV
 - Auto-Retry TPS24751RUV
- External blocking FET
- Push button RESET signal
- Copper pour with vias to the internal ground takes advantage of the power pad package
- On-board transorb is for overvoltage input protection
- Common diode at output prevents negative spike when load is removed while powered on

1.2 Applications

- Server
 - Plug-in circuit boards
 - Redundant array of independent disks (RAID)
 - Disk drives
- Telecom
 - ATCA
 - Micro-ATCA
- General hot plug

2 Description

The TPS2475XEVM-546 enables full evaluation of the TPS2475X devices, refer to the schematic shown in [Figure 1](#). Input power is applied at T1/T3 while T2/T4 provides the output connection to the load. D4/C1/C7 provides input protection for the TPS2475X (U1) while D5/C3/C4 provides output protection. S1 allows U1 to be RESET or disabled. A power good (PG) indicator is provided by D2 and circuit faults can be observed with D3.

Table 1. TPS2475X EVM Options

Part Number	Vin Range	UVLO/OVP	Current Limit (TYP)	Power Limit (TYP)	Fault Response
TPS24751RUV (-001)	2.5 V – 18 V	8.4 V/14 V	11 A	21 W	Auto-Retry
TPS24750RUV (-002)	2.5 V – 18 V	8.4 V/14 V	11 A	21 W	Latched

Turn on or inrush slew rate control can be enabled by installing a shunt on J2 and observed at TP3. The PG and FAULT LED's (D2 and D3 respectively) can be enabled by installing a shunt on J1. Scaled channel current can be monitored at TP16 with a scale factor of 16.17 A/V.

3 Schematic

The schematic for the EVM is shown in [Figure 1](#)

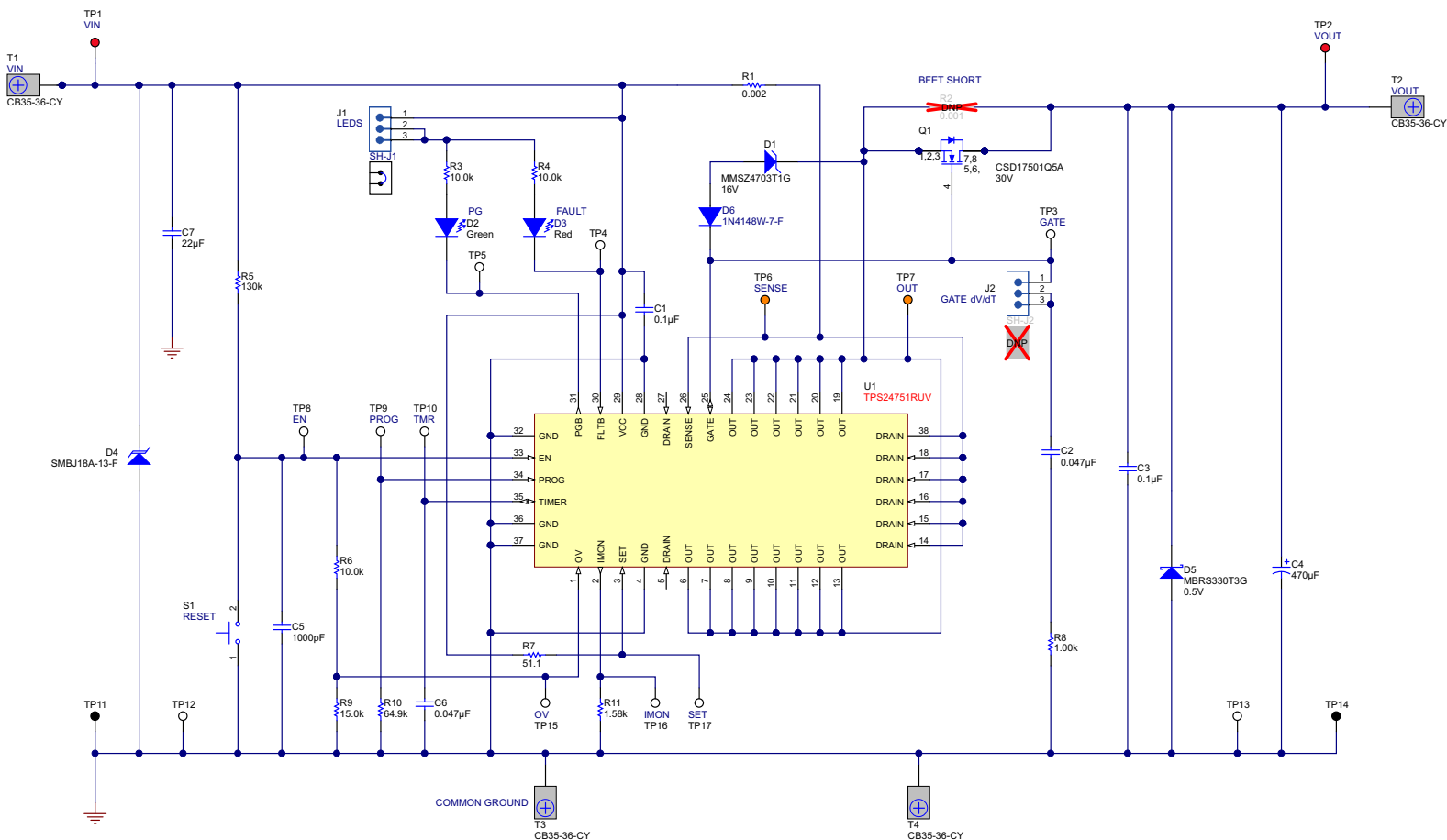


Figure 1. TPS2475XEVm Schematic

4 General Configuration and Description

4.1 Physical Access

Table 2 lists the TPS2475XEVM connector functionality, Table 3 describes the test point availability and Table 4 describes the jumper functionality.

Table 2. Connector Functionality

Connector	Label	Description
T1/T3	VIN/GND	2.5 V–18 V input to the EVM
T2/T4	VOUT/GND	2.5 V–18 V output from the EVM

Table 3. Test Points

Test Point	Color	Label	Description
TP1/TP11/TP12	RED/BLK/SM	VIN/GND	2.5 V–18 V input to the EVM
TP2/TP14/TP13	RED/BLK/SM	VOUT/GND	2.5 V–18 V output from the EVM
TP8	WHT	EN	Active high enable input
TP15	WHT	OV	Active high overvoltage input
TP3	WHT	GATE	Blocking FET GATE control and slew rate control
TP5	WHT	PG	Power good test point
TP4	WHT	FAULT	Fault test point
TP6	ORG	SNS	Sense amplifier inverting input connection
TP7	ORG	OUT	TPS2475X internal MOSFET DRAIN connection (before blocking FET)
TP9	WHT	PROG	Power limiting engine programming connection
TP10	WHT	TMR	Fault timer programming connection
TP17	WHT	SET	Sense amplifier non-inverting input connection
TP16	WHT	IMON	Current monitor. Load current = $16.17 \times$ voltage on TP16.

Table 4. Jumpers and LEDs

Jumper	Label	Description
J1	J1	Install between pins 1 and 2 to enable D2 and D3
J2	RMP	Install between pins 1 and 2 to enable GATE linear ramp control
D2 (GREEN)	PG	Power good indicator. LED turns on when the voltage at TP7 (OUT) gets within 120 mV of the voltage at TP6 (SNS).
D3 (RED)	FAULT	Circuit fault indicator. LED turns on when the internal MOSFET is disabled due to a fault condition.

4.2 Test Setup

Figure 2 shows a typical test setup for the TPS2475XEVM. Connect T1/T3 to the power supply and T2/T4 to the load.

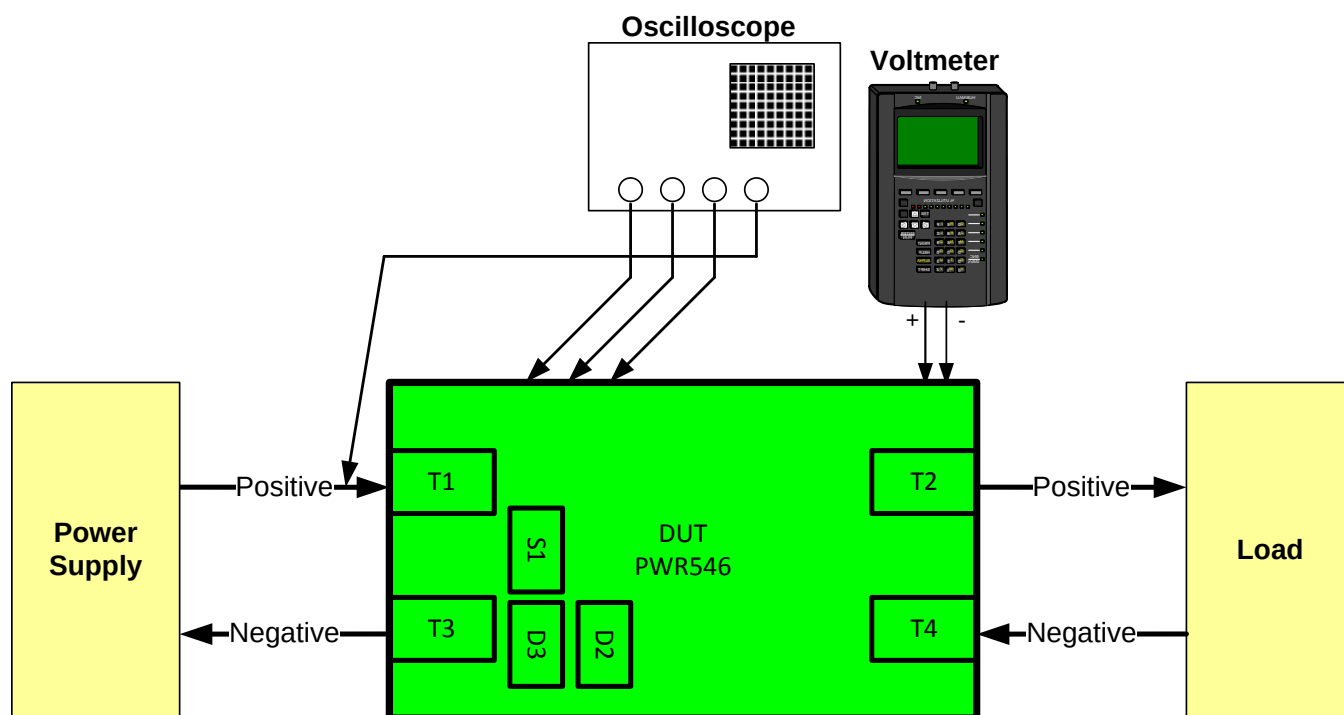


Figure 2. Typical TPS2475XEVM Test Setup

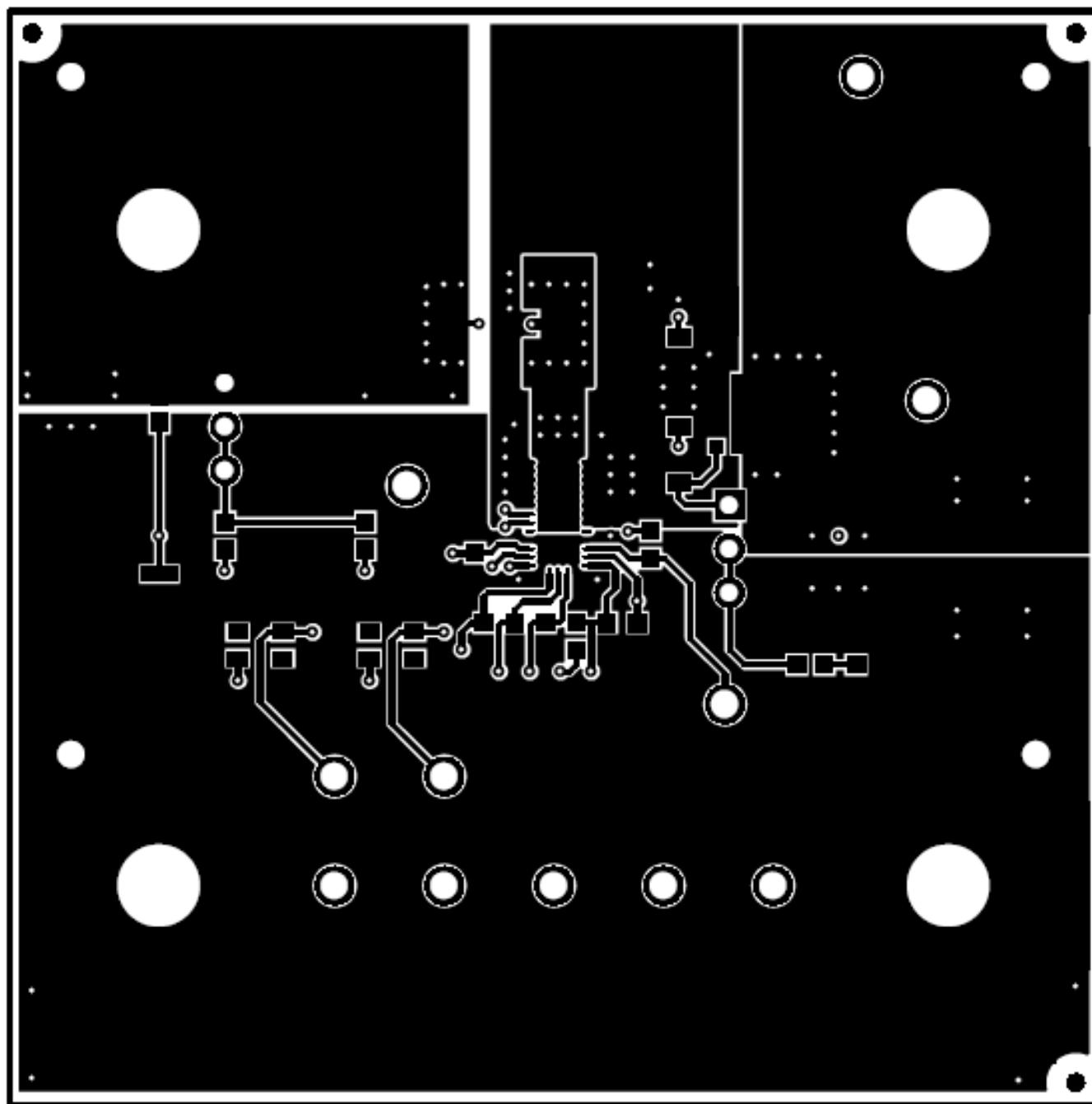


Figure 4. Top Side Routing

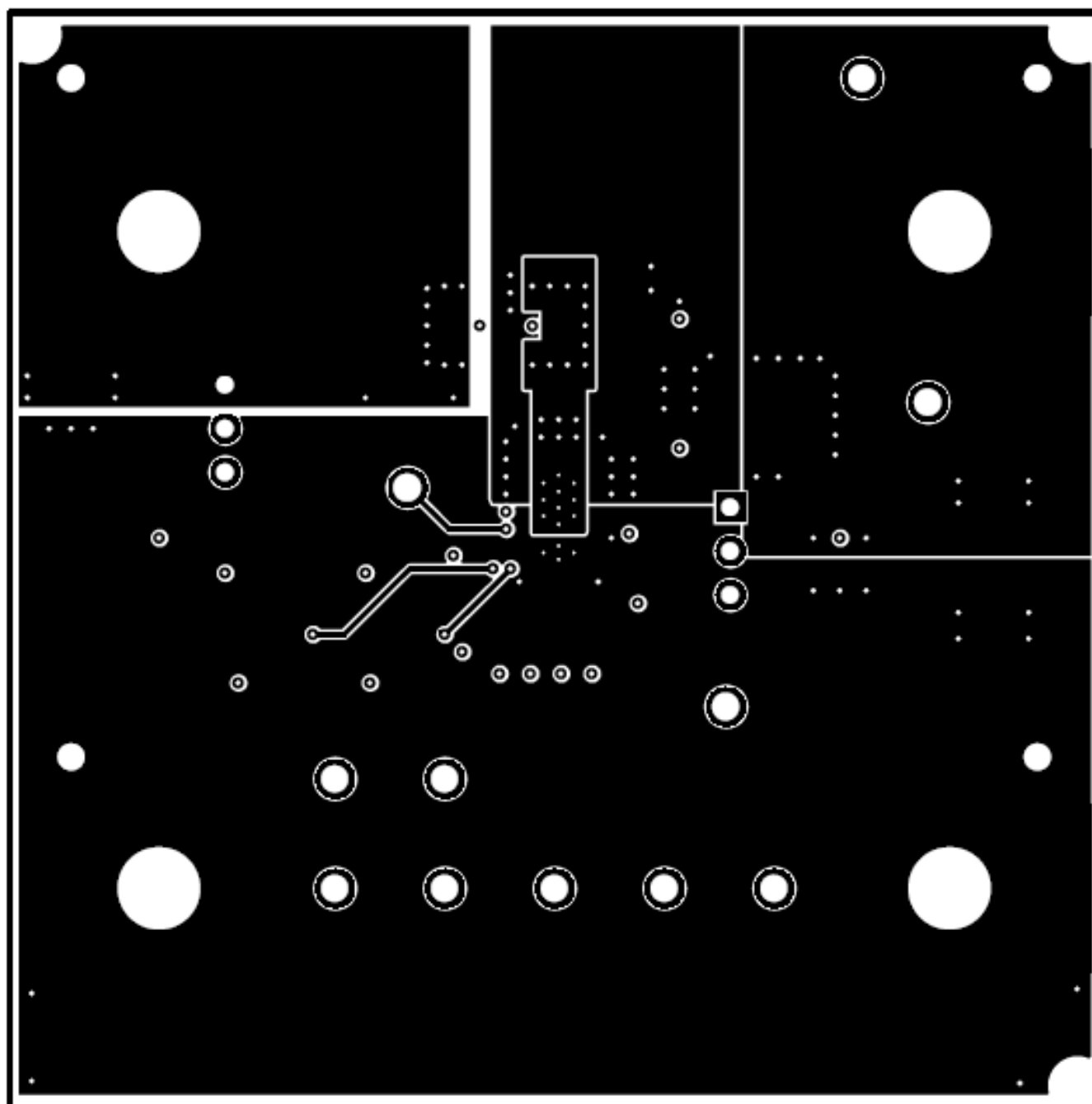


Figure 5. Layer 2 Routing

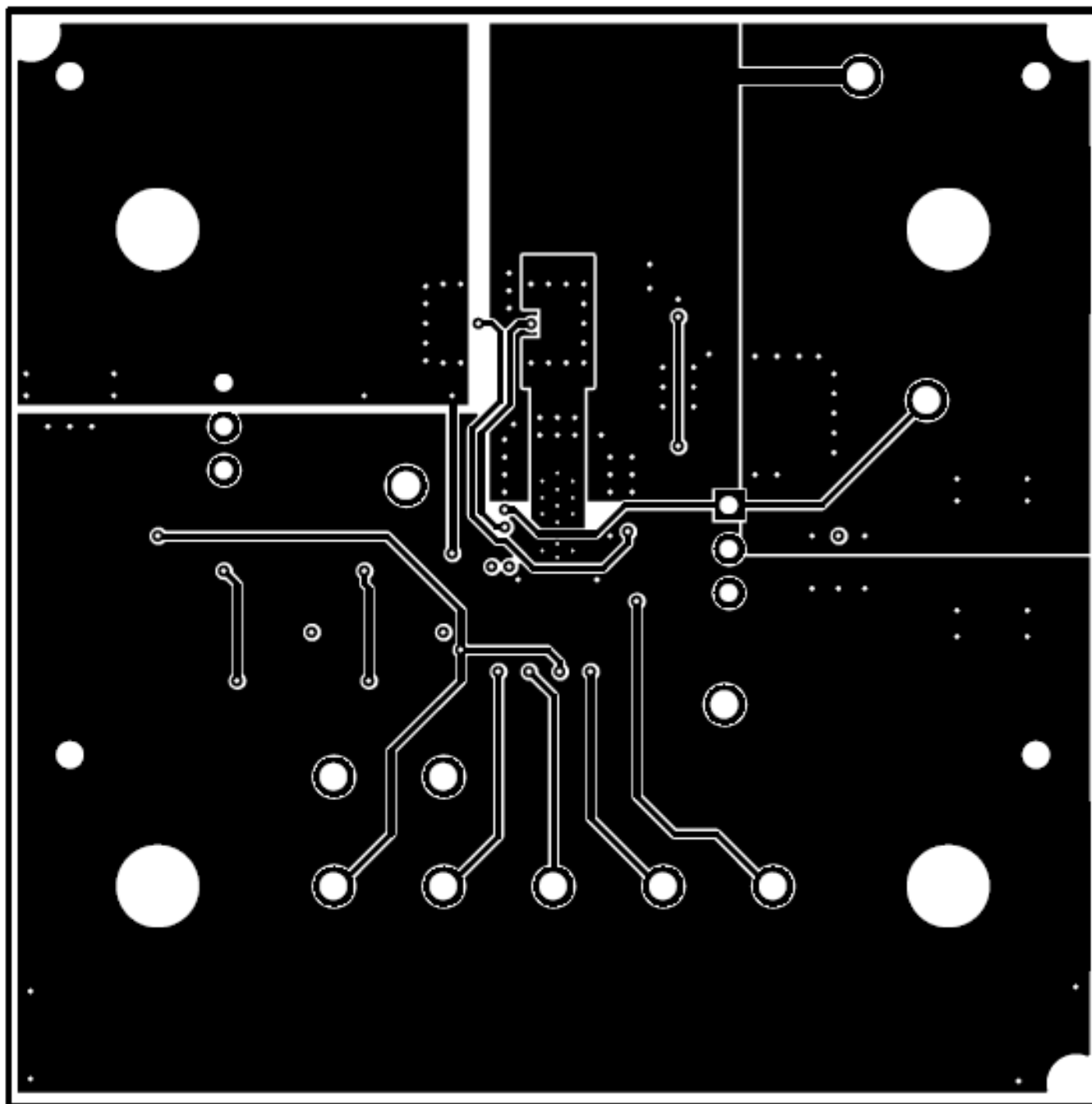


Figure 6. Layer 3 Routing

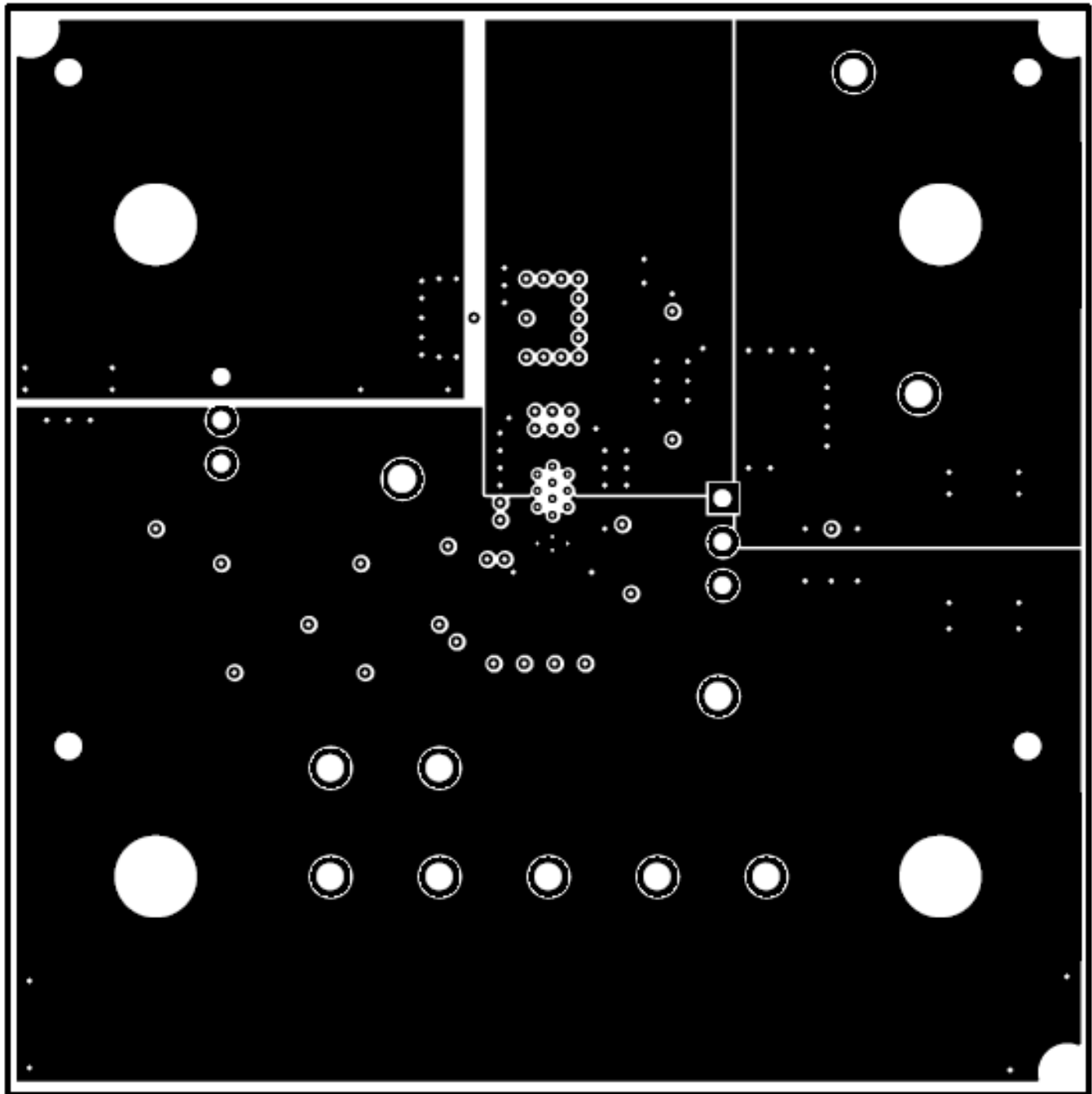


Figure 7. Bottom Side Routing

6 Bill of Materials

Table 5. TPS2475XEVm Bill of Materials

Designator	QTY	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number
PCB1	1		Printed Circuit Board		PWR546	Any	—
C1, C3	2	0.1uF	CAP, CERM, 0.1uF, 25V, +/-10%, X7R, 0603	0603	06033C104KAT2A	AVX	—
C2	1	0.047uF	CAP, CERM, 0.047uF, 25V, +/-10%, X7R, 0603	0603	C1608X7R1E473K	TDK	
C4	1	470uF	CAP, AL, 470uF, 25V, +/-20%, 0.15 ohm, SMD	SMT Radial G	EEE-FC1E471P	Panasonic	
C5	1	1000pF	CAP, CERM, 1000pF, 100V, +/-20%, X7R, 0603	0603	06031C102MAT2A	AVX	—
C6	1	0.047uF	CAP, CERM, 0.047uF, 100V, +/-10%, X7R, 0603	0603	C0603C473K1RACTU	Kemet	
C7	1	22uF	CAP, CERM, 22uF, 25V, +/-20%, X5R, 1210	1210	12103D226MAT2A	AVX	
D1	1	16V	Diode, Zener, 16V, 500mW, SOD-123	SOD-123	MMSZ4703T1G	ON Semiconductor	
D2	1	Green	LED, Green, SMD	Power TOPLED w/lens	LT E63C-CADB-35-L-Z	OSRAM	—
D3	1	Red	LED, Red, SMD	Power TOPLED w/lens	LS E63F-DBFA-1-Z	OSRAM	—
D4	1	18V	Diode, TVS, Uni, 18V, 600W, SMB	SMB	SMBJ18A-13-F	Diodes Inc.	—
D5	1	0.5V	Diode, Schottky, 30V, 3A, SMC	SMC	MBRS330T3G	ON Semiconductor	
D6	1	1.25V	Diode, Ultrafast, 100V, 0.15A, SOD-123	SOD-123	1N4148W-7-F	Diodes Inc.	
J1, J2	2	1x3	Header, TH, 100mil, 1x3, Gold plated, 230 mil above insulator	PBC03SAAN	PBC03SAAN	Sullins Connector Solutions	Equivalent
LBL1	1		Thermal Transfer Printable Labels, 1.250" W x 0.250" H – 10,000 per roll	PCB Label 1.25"H x 0.250"W	THT-13-457-10	Brady	
Q1	1	30V	MOSFET, N-CH, 30V, 100A, SON 5x6mm	SON 5x6mm	CSD17501Q5A	Texas Instruments	
R1	1	0.002	RES, 0.002 ohm, 1%, 1W, 2512	2512	ERJ-M1WTF2M0U	Panasonic	
R3, R4, R6	3	10.0k	RES, 10.0k ohm, 1%, 0.1W, 0603	0603	CRCW060310K0FKEA	Vishay-Dale	
R5	1	130k	RES, 130k ohm, 1%, 0.1W, 0603	0603	CRCW0603130KFKEA	Vishay-Dale	
R7	1	51.1	RES, 51.1 ohm, 1%, 0.1W, 0603	0603	CRCW060351R1FKEA	Vishay-Dale	
R8	1	1.00k	RES, 1.00k ohm, 1%, 0.1W, 0603	0603	CRCW06031K00FKEA	Vishay-Dale	
R9	1	15.0k	RES, 15.0k ohm, 1%, 0.1W, 0603	0603	CRCW060315K0FKEA	Vishay-Dale	
R10	1	64.9k	RES, 64.9k ohm, 1%, 0.1W, 0603	0603	CRCW060364K9FKEA	Vishay-Dale	
R11	1	1.58k	RES, 1.58k ohm, 1%, 0.1W, 0603	0603	CRCW06031K58FKEA	Vishay-Dale	
S1	1		Switch, Push Button, SMD	2.9x2x3.9mm SMD	SKRKAEE010	Alps	Equivalent
SH-J1	1	1x2	Shunt, 100mil, Gold plated, Black	Shunt	969102-0000-DA	3M	SNT-100-BK-G
T1–T4	4	50A	Terminal 50A Lug	CB35-36-CY	CB35-36-CY	Panduit	
TP1, TP2	2	Red	Test Point, TH, Multipurpose, Red	Keystone5010	5010	Keystone	Equivalent
TP3–TP5, TP8–TP10, TP15–TP17	9	White	Test Point, TH, Multipurpose, White	Keystone5012	5012	Keystone	Equivalent
TP6, TP7	2	Orange	Test Point, TH, Multipurpose, Orange	Keystone5013	5013	Keystone	Equivalent
TP11, TP14	2	Black	Test Point, TH, Multipurpose, Black	Keystone5011	5011	Keystone	Equivalent

Table 5. TPS2475XEVm Bill of Materials (continued)

Designator	QTY	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number
TP12, TP13	2	SMT	Test Point, SMT, Compact	Testpoint_Keystone_Compact	5016	Keystone	
U1	1		2.5 to 18 V Positive Voltage 10A Integrated Hot-Swap Controller, RUV0036A	RUV0036A	TPS24750RUV or TPS24751RUV	Texas Instruments	
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	Fiducial	N/A	N/A	
R2	0	0.001	RES, 0.001 ohm, 1%, 1W, 1210	1210	PMR25HZPFV1L00	Rohm	
SH-J2	0	1x2	Shunt, 100mil, Gold plated, Black	Shunt	969102-0000-DA	3M	SNT-100-BK-G

NOTE: Unless otherwise noted in the alternate part number or alternate manufacturer columns, all parts may be substituted with equivalents.

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User Power/Frequency Use Obligations: This radio is intended for development/professional use only in legally allocated frequency and power limits. Any use of radio frequencies and/or power availability of this EVM and its development application(s) must comply with local laws governing radio spectrum allocation and power limits for this evaluation module. It is the user's sole responsibility to only operate this radio in legally acceptable frequency space and within legally mandated power limitations. Any exceptions to this are strictly prohibited and unauthorized by Texas Instruments unless user has obtained appropriate experimental/development licenses from local regulatory authorities, which is responsibility of user including its acceptable authorization.

For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant

Caution

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

For EVMs annotated as IC – INDUSTRY CANADA Compliant

This Class A or B digital apparatus complies with Canadian ICES-003.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Concerning EVMs including radio transmitters

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concerning EVMs including detachable antennas

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication.

This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Cet appareil numérique de la classe A ou B est conforme à la norme NMB-003 du Canada.

Les changements ou les modifications pas expressément approuvés par la partie responsable de la conformité ont pu vider l'autorité de l'utilisateur pour actionner l'équipement.

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Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

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This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

If you use this product in Japan, you are required by Radio Law of Japan to follow the instructions below with respect to this product:

1. Use this product in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use this product only after you obtained the license of Test Radio Station as provided in Radio Law of Japan with respect to this product, or
3. Use of this product only after you obtained the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to this product. Also, please do not transfer this product, unless you give the same notice above to the transferee. Please note that if you could not follow the instructions above, you will be subject to penalties of Radio Law of Japan.

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3. Since the EVM is not a completed product, it may not meet all applicable regulatory and safety compliance standards (such as UL, CSA, VDE, CE, RoHS and WEEE) which may normally be associated with similar items. You assume full responsibility to determine and/or assure compliance with any such standards and related certifications as may be applicable. You will employ reasonable safeguards to ensure that your use of the EVM will not result in any property damage, injury or death, even if the EVM should fail to perform as described or expected.
4. You will take care of proper disposal and recycling of the EVM's electronic components and packing materials.

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