

TPS24772EVM-685 Evaluation Module

This user's guide describes the TPS24772 evaluation module (TPS24772EVM-685). The TPS24772EVM-685 contains evaluation and reference circuitry for the TPS24772. The TPS24772 device is an easy-to-use, 2.5 to 18 V, high performance hot-swap controller.

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1 Introduction

The TPS24772EVM-685 evaluation module (EVM) is a fully assembled and tested circuit for evaluating the TPS24772 high performance hot-swap controller. The EVM contains header connectors for easy connection to external test and application circuitry.

1.1 TPS2477x IC Features

- 2.5-V to 18-V bus operation (30-V absolute max)
- Programmable FET SOA protection
- Dual fault timer (overcurrent/inrush)
- Analog current monitor (1% at 25 mV)
- Programmable protection settings:
 - Current limit: $\pm 5\%$ at 10 mV
 - Fast trip: $\pm 10\%$ at 20 mV
- 4 mm \times 4 mm 24-pin QFN
- 70 = Latch, 71 = Retry, 72 = Immediate latch off
- Overvoltage protection

1.2 Applications

- Enterprise storage
- Enterprise server
- Networking cards

1.3 TPS24772EVM-685 Electrical Specifications

Table 1. TPS24772EVM-685 Electrical and Performance Specifications at 25°C.

Characteristic	TPS24772EVM-685
Input voltage range (operating)	11-13 V
Current Operating	100 A
C _{OUT} on EVM	440 μ F
Max allowed external C _{OUT}	5000 μ F
Power Limit (nom)	117 W
Current Limit (nom)	110 A
Fault Timer (Nom)	300 ms
UVLO rising (Nom)	10 V
UVLO falling (Nom)	9.6 V
Overvoltage rising (nom)	14 V
Overvoltage falling (nom)	13.5 V
Pass "Hot-Short" on output	Yes
Pass "Start into short"?	Yes
Max T _A at Full load	55°C

2 Description

2.1 Jumpers

Table 2. Jumper Descriptions

J1	Allows for same or individual timing for TFLT and TINR
J2	Shorting J3 disable overvoltage
J3	Shorting pins 2 and 3 pulls flag pullup voltage to external voltage source Shorting pin 2 and 1 pulls flag pullup voltage to VIN
J4	Shorting J4 allows setting the voltage (through resistor R1) to enable the hot swap

2.2 Jumper Connections

- Place a jumper between pins 1 and 2 of J1
- J2 should be open
- Place a jumper between pins 1 and 2 of J3
- Place a jumper on J4

3 Schematic

Figure 1 illustrates the TPS24772EVM-685 schematic.

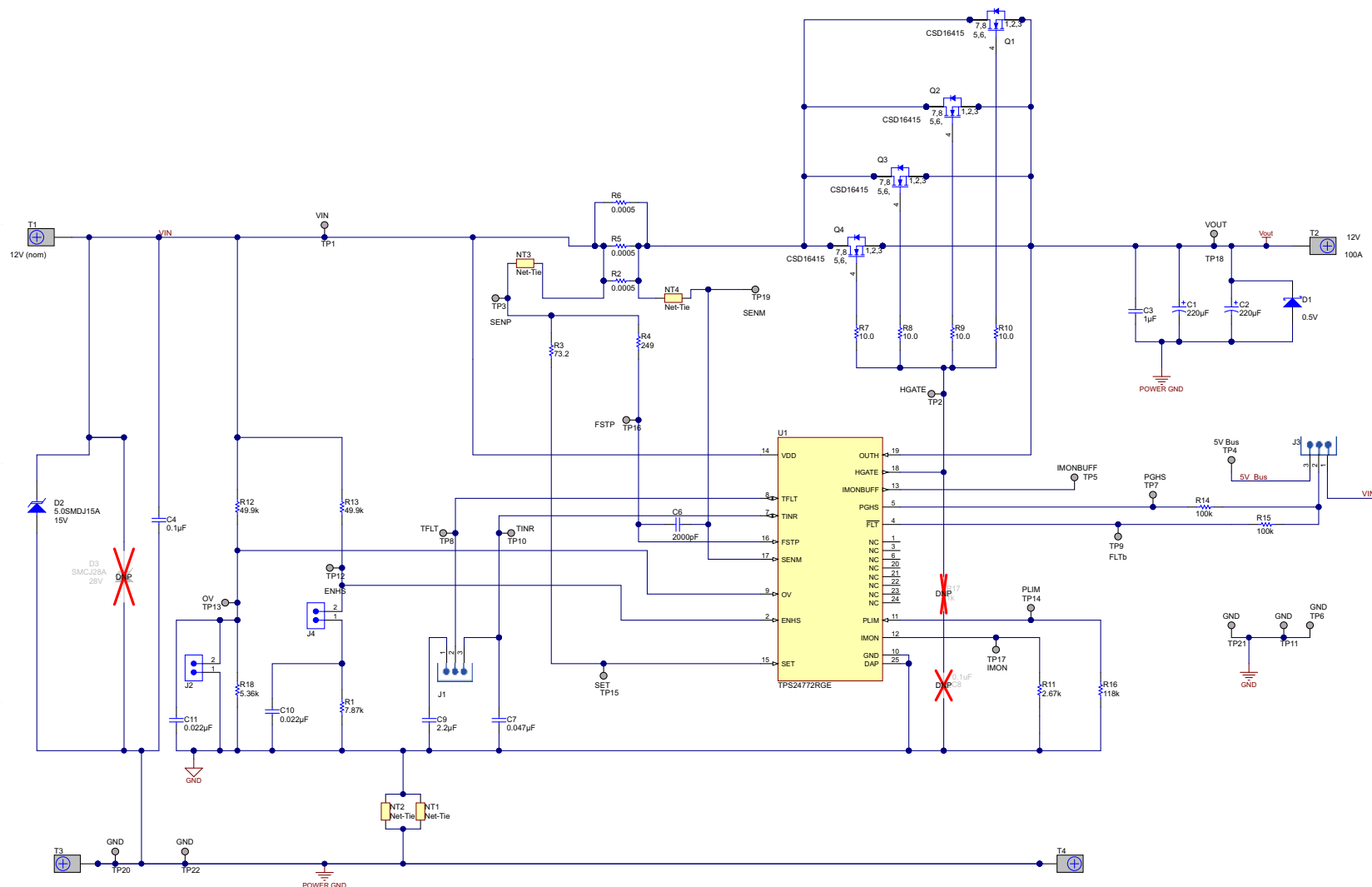


Figure 1. TPS24772EVM-685 Schematic

4 TPS24772EVM-685 Performance

TPS24772EVM-685 performance scopes are illustrated in Figure 2 through Figure 9.

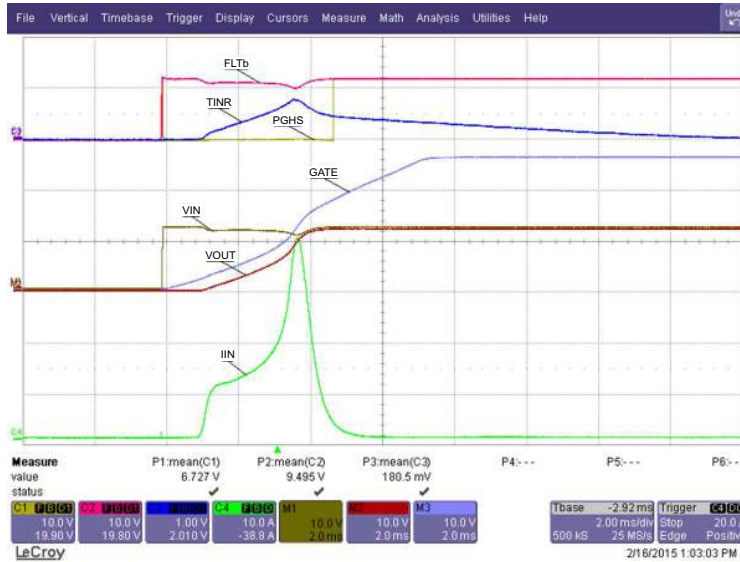


Figure 2. Start Up (COUT (on EVM + External) = 5500 μ F)



Figure 3. Hot Short With No Load on VOUT (Zoomed Out)

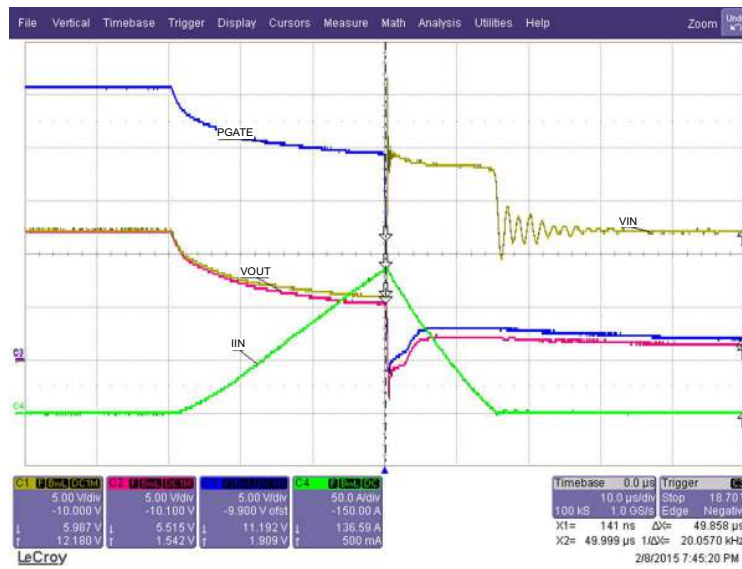


Figure 4. Hot Short With Full Load on VOUT (Zoomed In)

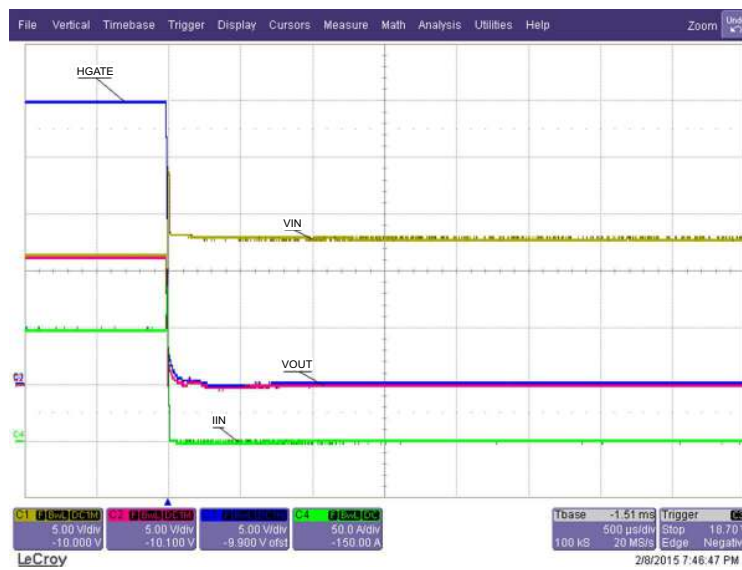


Figure 5. Hot Short With Full Load on VOUT (Zoomed Out)

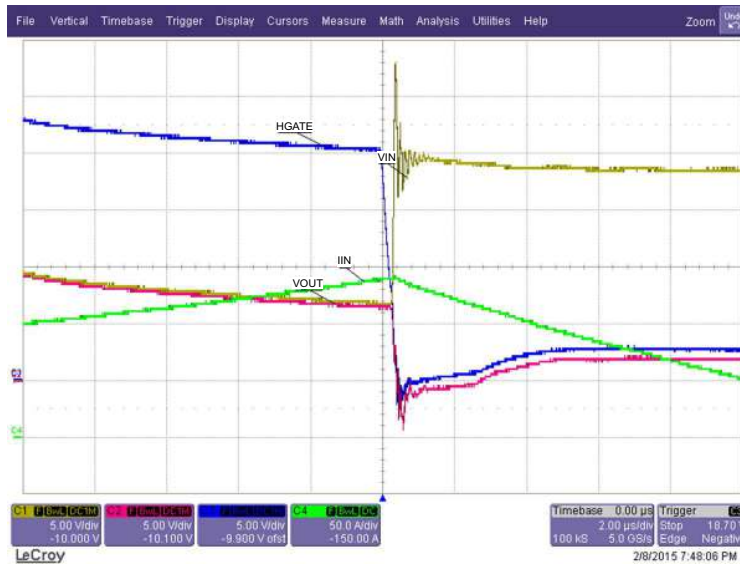


Figure 6. Hot Short With Full Load on VOUT(Zoomed In)

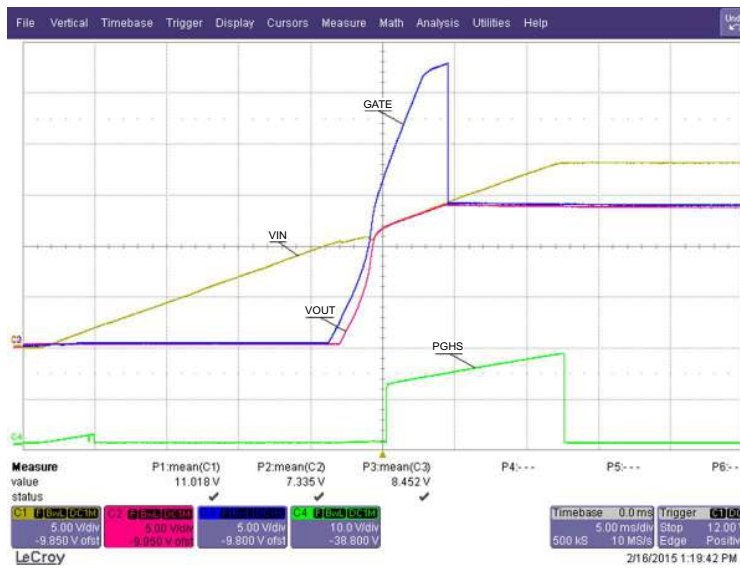


Figure 7. Under/OverVoltage With VIN Rising

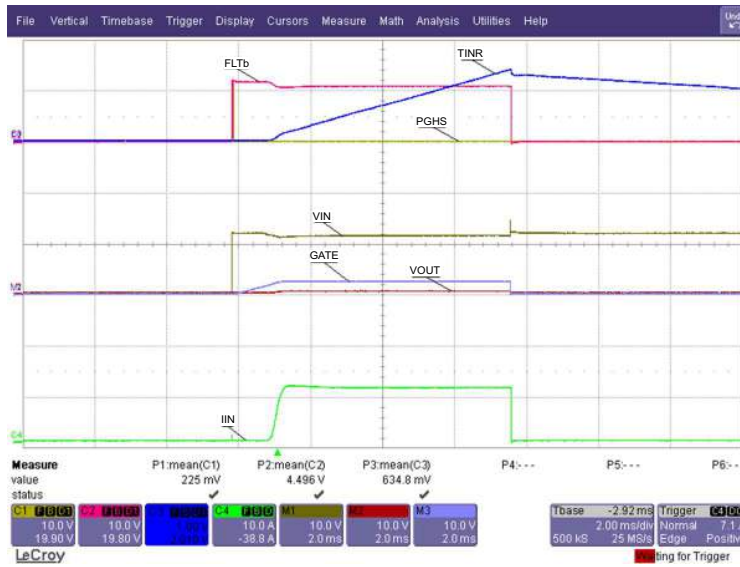


Figure 8. Start Into Short on VOUT

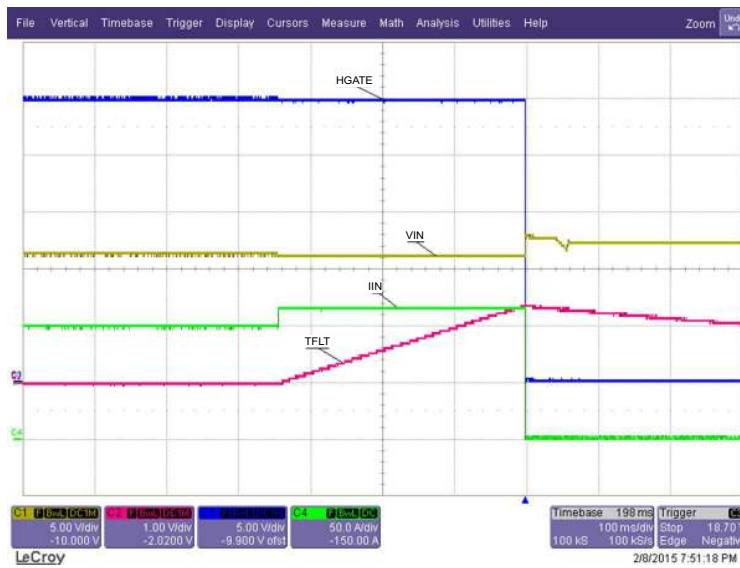


Figure 9. Load Step to Overcurrent

5 Single Sense Resistor Solutions

Figure 10 shows how to maintain high current sense accuracy for single sense resistor solutions. RSNS1 and RSNS3 are not populated and its current sense traces must be electrically open/cut.

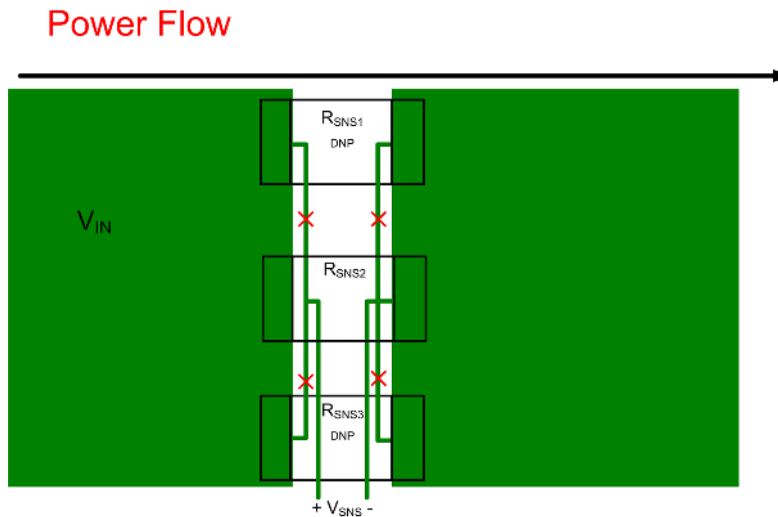


Figure 10. High Current Sense Accuracy Solution For Single Sense Resistor Applications

6 EVM Assembly Drawing and PCB Layout

6.1 PCB Drawings

Figure 11 to Figure 15 show component placement and layout of the TPS24772EVM-685.

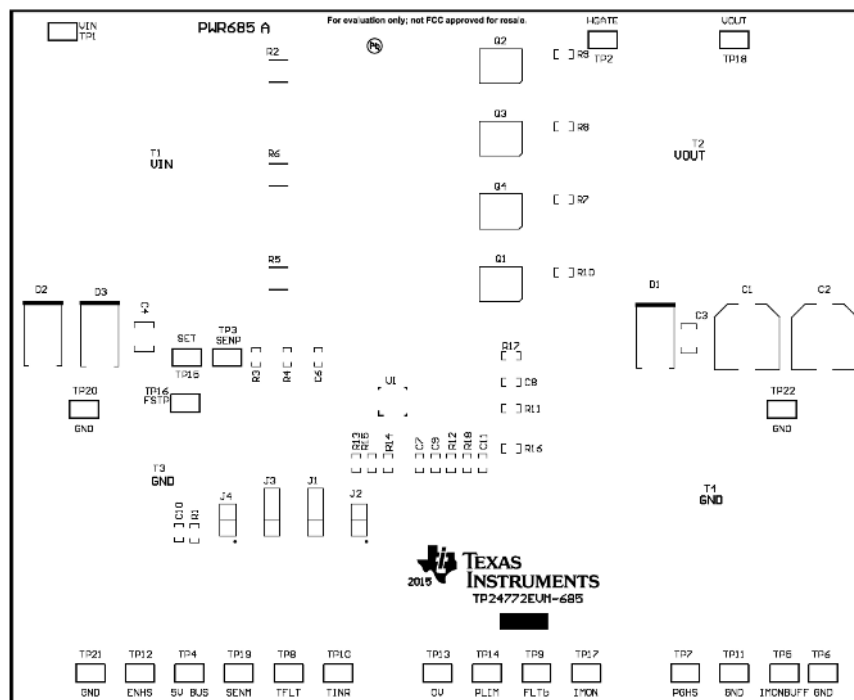


Figure 11. Top Side Component Placement

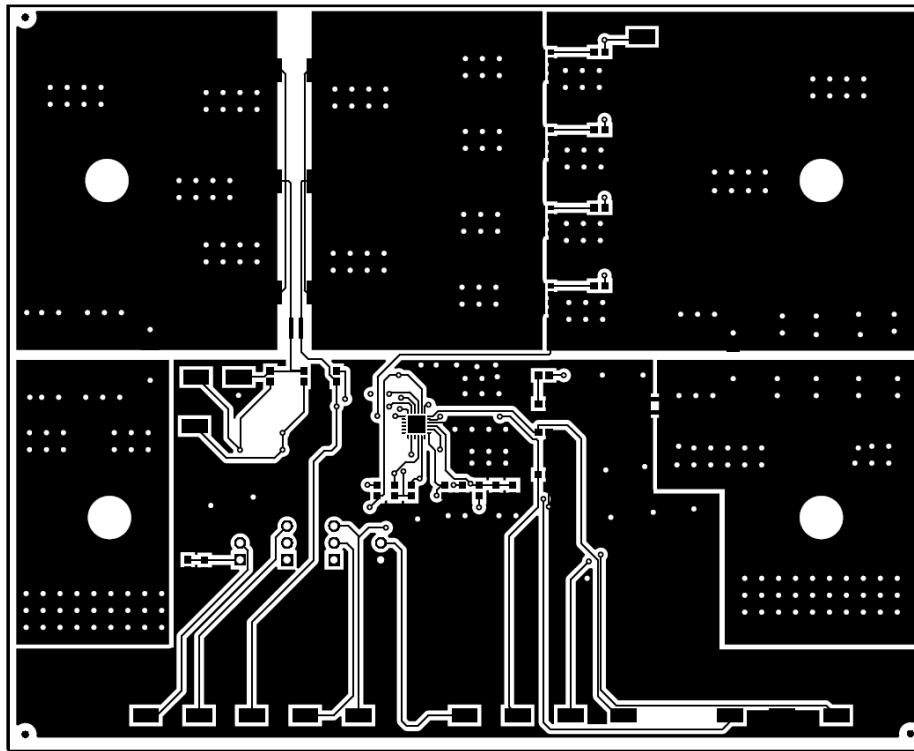


Figure 12. Top Side Routing

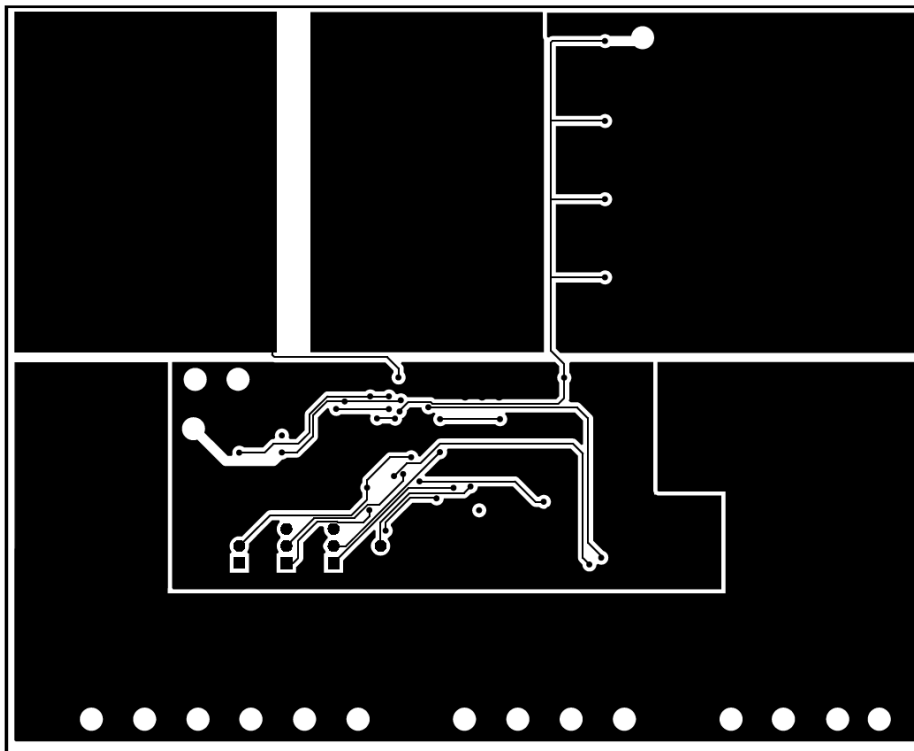


Figure 13. Midlayer 1 Routing

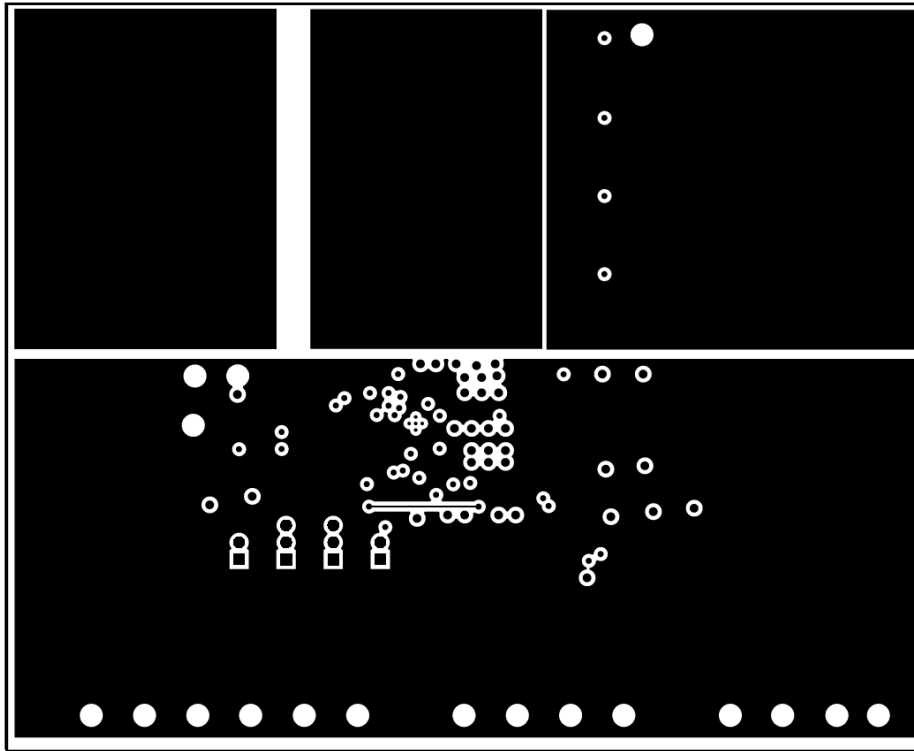


Figure 14. Midlayer 2 Routing

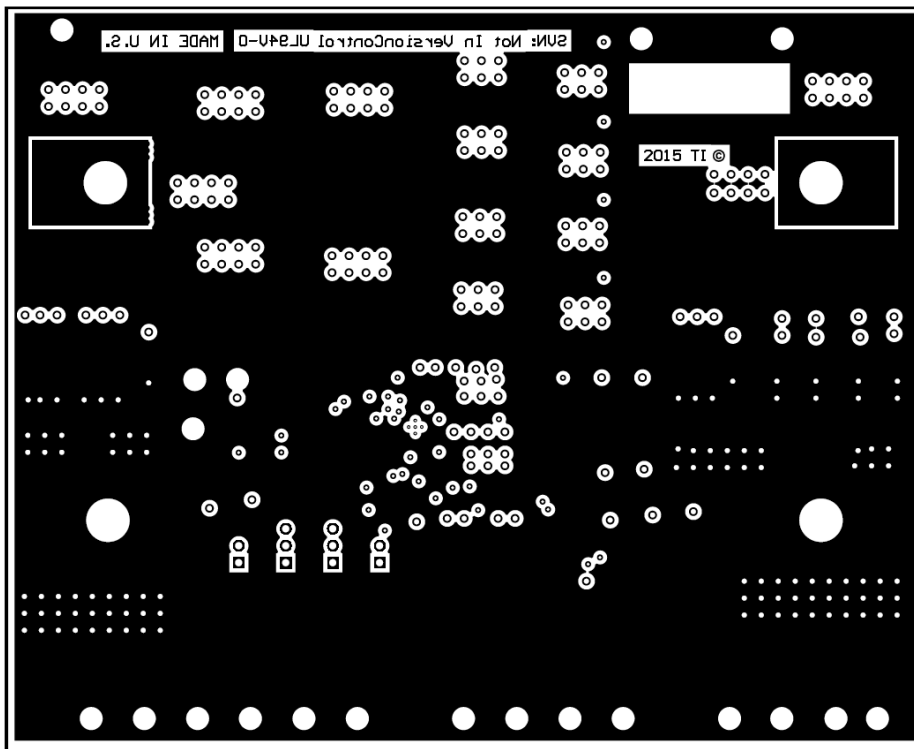


Figure 15. Bottom Layer Routing

7 Bill of Materials

Table 3 lists the TPS24772EVM-685 bill of materials (BOM).

Table 3. TPS24772EVM-685 BOM

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
PCB	1		Printed Circuit Board		PWR685	Any		
C1, C2	2	220 μ F	CAP, AL, 220 μ F, 50V, \pm 20%, 0.3 Ω , SMD	SMT Radial G	EEE-FC1H221P	Panasonic		
C3	1	1 μ F	CAP, CERM, 1 μ F, 100V, \pm 10%, X7R, 1206	1206	GRM31CR72A105KA01L	Murata		
C4	1	0.1 μ F	CAP, CERM, 0.1 μ F, 50 V, \pm 10%, X7R, 1210	1210	C1210C104K5RACTU	Kemet		
C6	1	2000 pF	CAP, CERM, 2000 pF, 50 V, \pm 5%, COG/NP0, 0603	0603	GRM1885C1H202JA01D	Murata		
C7	1	0.047 μ F	CAP, CERM, 0.047 μ F, 25 V, \pm 5%, X7R, 0603	0603	06033C473JAT2A	AVX		
C9	1	2.2 μ F	CAP, CERM, 2.2 μ F, 16 V, \pm 10%, X5R, 0603	0603	GRM188R61C225KE15D	Murata		
C10, C11	2	0.022 μ F	CAP, CERM, 0.022 μ F, 25 V, \pm 10%, X7R, 0603	0603	C0603C223K3RACTU	Kemet		
D1	1	0.5 V	Diode, Schottky, 30V, 3A, SMC	SMC	MBRS330T3G	ON Semiconductor		
D2	1	15 V	Diode, TVS, Uni, 15V, 5000W, SMC	SMC	5.0SMDJ15A	Littelfuse		
H1, H2, H3, H4	4		Bump, Hemisphere, 0.44 \times 0.20, Clear	Transparent Bump	SJ-5303 (CLEAR)	3M		
J1, J3	2	1x3	Header, TH, 100mil, 1x3, Gold plated, 230 mil above insulator	PBC03SAAN	PBC03SAAN	Sullins Connector Solutions	Equivalent	Any
J2, J4	2		Header, TH, 100mil, 2x1, Gold plated, 230 mil above insulator	TSW-102-07-G-S	TSW-102-07-G-S	Samtec, Inc.		
Q1, Q2, Q3, Q4	4	CSD16415	MOSFET, N-CH, 25V, 100A, SON 5x6mm	SON 5x6mm	CSD16415Q5	Texas Instruments		None
R1	1	7.87k	RES, 7.87 k, 1%, 0.1 W, 0603	0603	CRCW06037K87FKEA	Vishay-Dale		
R2, R5, R6	3	0.0005	RES, 0.0005, 1%, 3 W, 2512	2512	HCS2512FTL500	Stackpole Electronics Inc		
R3	1	73.2	RES, 73.2, 1%, 0.1 W, 0603	0603	CRCW060373R2FKEA	Vishay-Dale		
R4	1	249	RES, 249, 1%, 0.1 W, 0603	0603	CRCW0603249RFKEA	Vishay-Dale		
R7, R8, R9, R10	4	10.0	RES, 10.0, 1%, 0.1 W, 0603	0603	CRCW060310R0FKEA	Vishay-Dale		
R11	1	2.67k	RES, 2.67 k, 1%, 0.1 W, 0603	0603	CRCW06032K67FKEA	Vishay-Dale		
R12, R13	2	49.9k	RES, 49.9 k, 1%, 0.1 W, 0603	0603	CRCW060349K9FKEA	Vishay-Dale		
R14, R15	2	100k	RES, 100 k, 5%, 0.1 W, 0603	0603	CRCW0603100KJNEA	Vishay-Dale		
R16	1	118k	RES, 118 k, 1%, 0.1 W, 0603	0603	CRCW0603118KFKEA	Vishay-Dale		
R18	1	5.36k	RES, 5.36 k, 1%, 0.1 W, 0603	0603	CRCW06035K36FKEA	Vishay-Dale		
T1, T2, T3, T4	4	90A	Terminal 90A Lug	CB70-14-CY	CB70-14-CY	Panduit		

Table 3. TPS24772EVM-685 BOM (continued)

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
U1	1		2.5 to 18-V High Performance Hotswap and ORing Controller, RGE0024B	RGE0024B	TPS24772RGE	Texas Instruments		None
C8	0	0.1 μ F	CAP, CERM, 0.1 μ F, 16V, \pm 5%, X7R, 0603	0603	0603YC104JAT2A	AVX		
D3	0	28 V	Diode, TVS, Uni, 28V, 1500W, SMC	SMC	SMCJ28A	Fairchild Semiconductor		
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	Fiducial	N/A	N/A		
R17	0	1k	RES, 6.81k Ω , 1%, 0.1W, 0603	0603	CRCW06031K00FKEA	Vishay-Dale		
Note: Unless otherwise noted in the Alternate Part Number and/or Alternate Manufacturer columns, all parts may be substituted with equivalents.								

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 - 3.1.1 *Notice applicable to EVMs not FCC-Approved:*

This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.
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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

NOTE: 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

NOTE: 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.

3.2 Canada

3.2.1 For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-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.

Concernant les EVMs avec appareils radio:

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.

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.

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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http://www.tij.co.jp/lstds/ti_ja/general/eStore/notice_01.page

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If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required by Radio Law of Japan to follow the instructions below with respect to EVMs:

1. Use EVMs 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 EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

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4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user 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, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

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