Using the DCPA1 EVM

This user's guide contains information for the single output and dual output DCPA1 evaluation modules (PWR861 and PWR868).The DCPA1 evaluation modules are designed as an easy-to-use platform that facilitate an extensive evaluation of the performance of the DCPA1 family of power modules. This guide provides information on the correct usage of the EVM and an explanation of the numerous test points on the board.

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1 Description

This EVM features either a single output device, DCPA10505 (5-V), DCPA10512 (12-V), or DCPA10515 (15-V), or a dual output device, DCPA10505D (±5-V), DCPA10512D (±12-V), or DCPA10515D (±15-V). All of these devices are rated for 1 watt of output power, provide galvanic isolation, and operate from a typical 5-V input bus. The full output current rating of each device can be supplied by the EVM. Required input and output capacitors are included on the board. Monitoring test points are provided to allow measurement of efficiency, power dissipation, input ripple, output ripple, and line and load regulation. The EVM uses a recommended PCB layout that maximizes thermal performance and minimizes output ripple and noise.

2 Getting Started

Figure 1 shows a single output DCPA1 EVM and Figure 2 shows a dual output DCPA1 EVM. For either EVM, the supply voltage terminal block, TB1 is used for connection to the host input supply. The input voltage range for any of the DCPA1 devices is 4.5 V to 5.5 V. For the single output EVM, the output voltage terminal block, TB2 is used for connection to the load while the dual output EVM uses both TB2 and TB3 for connection to the load. These terminal blocks can accept up to 16-AWG wire.

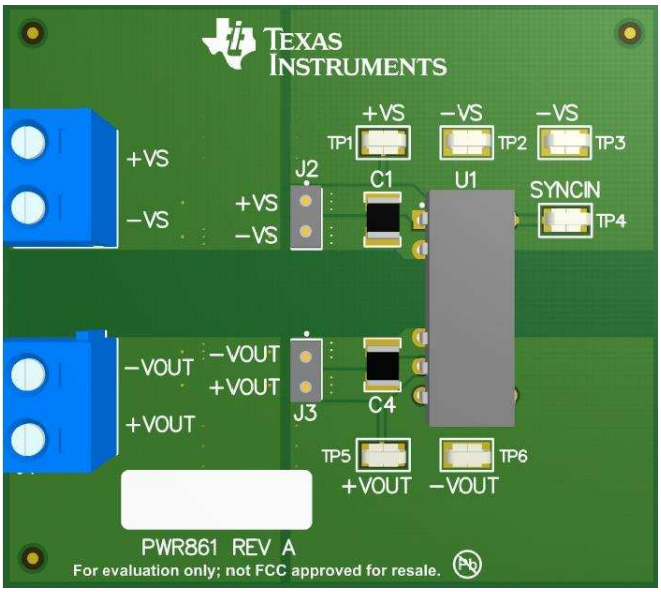

Figure 1. DCPA1 Single Output

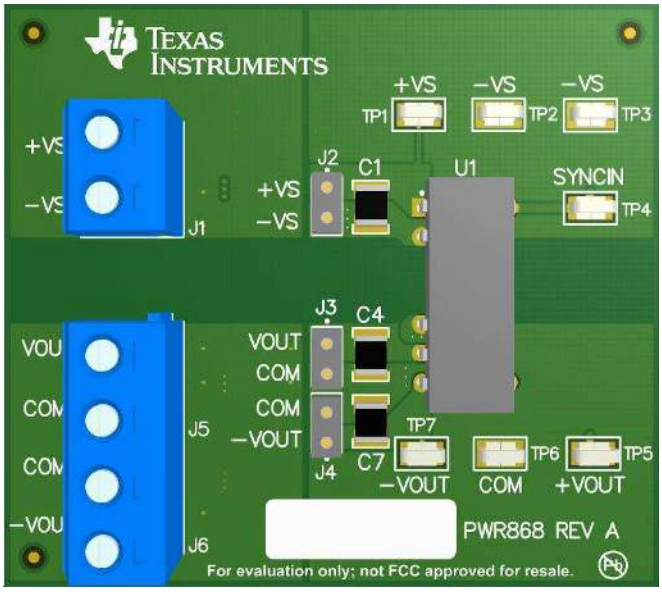

Figure 2. DCPA1 Dual Output

The *+VS* and *−VS* test points (TP1 and TP2) located above the DCPA1 device are intended to be used as input voltage monitoring points where voltmeters can be connected. Additionally, output voltage test points TP5 and TP6 for a single output EVM and TP5, TP6, and TP7 for a dual output EVM, should be used to monitor the output voltage using a voltmeter. Do *not* use these 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 +VS scope and VOUT scope test points J1, J2, and J3 (for dual output) can be used to monitor 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 barrel. The two sockets of each test point are on 0.1 in centers.

The top side of each EVM is loaded with the required components for proper operation. The bottom side of both boards have additional footprints for adding both input and output filtering. For a single output device, reference the EVM schematic (Figure 3) and BOM (Table 1). For a dual output device, reference the EVM schematic (Figure 4) and BOM (Table 2).

3 Schematics and BOMs

The schematics and BOMs for both the single output (PWR861) and dual output (PWR868) EVMs are shown in this section.

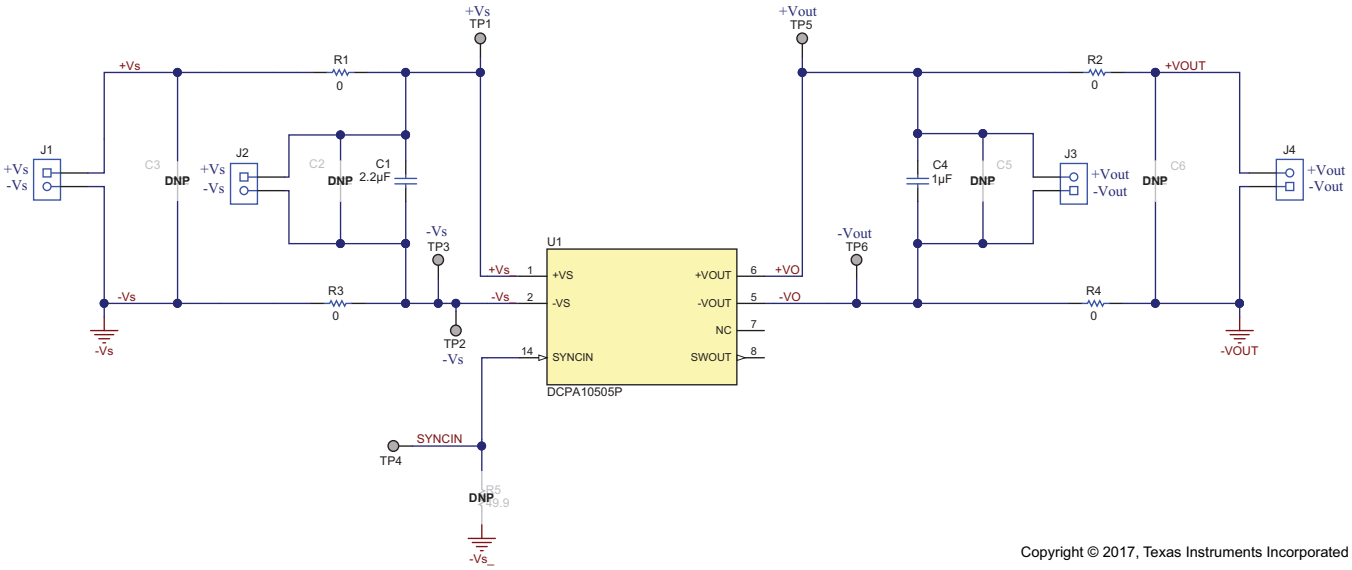

Figure 3. DCPA105xxEVM-861 Schematic

Table 1. DCPA105xxEVM-861 Bill of Materials

-001	-002	-003	RefDes	Value	Description	Size	Part Number	Mfg
1	1	1	C1	2.2uF	Capacitor, Ceramic, 100V, X7R, 10%	1210	GRM32ER61E226K	Murata
0	0	0	C2, C3	2.2uF	Capacitor, Ceramic, 100V, X7R, 10%	1210	GRM32ER61E226K	Murata
1	1	1	C4	1.0uF	Capacitor, Ceramic, 50V, X7R, 10%	1210	GRM32RR71H105KA01L	Murata
0	0	0	C5, C6	1.0uF	Capacitor, Ceramic, 50V, X7R, 10%	1210	GRM32RR71H105KA01L	Murata
2	2	2	J1, J4		Terminal Block, 5.08 mm, 2x1, Brass, TH	2x1 5.08 mm	ED120/2DS	On-Shore Technology
2	2	2	J2, J3	310-43-102-41-001000	Header, Female, 1x2 socket, 0.1" centers	0.100 inch x 1 x 2	310-43-102-41-001000	Mill-Max
4	4	4	R1, R2, R3, R4	0Ω	Resistor, Chip, 1/8W, 5%	0805	CRCW08050000Z0EA	Vishay-Dale
0	0	0	R5	49.9Ω	Resistor, Chip, 1W, 1%	2512	CRCW251249R9FKEG	Vishay-Dale
6	6	6	TP1, TP2, TP3, TP4, TP5, TP6	---	Test Point, Miniature, SMT	SMT	5019	Keystone
1	0	0	U1	DCPA10505P	Series 1-W, Isolated, Unregulated DC/DC Converter Module, NVA0007A (PDIP-7)	NVA0007A	DCPA10505P	TI
0	1	0	U1	DCPA10512P	Series 1-W, Isolated, Unregulated DC/DC Converter Module, NVA0007A (PDIP-7)	NVA0007A	DCPA10512P	TI
0	0	1	U1	DCPA10515P	Series 1-W, Isolated, Unregulated DC/DC Converter Module, NVA0007A (PDIP-7)	NVA0007A	DCPA10515P	TI
1	1	1	---	---	Printed Circuit Board	2 x 2 x 0.062 inch	PWR861	Any

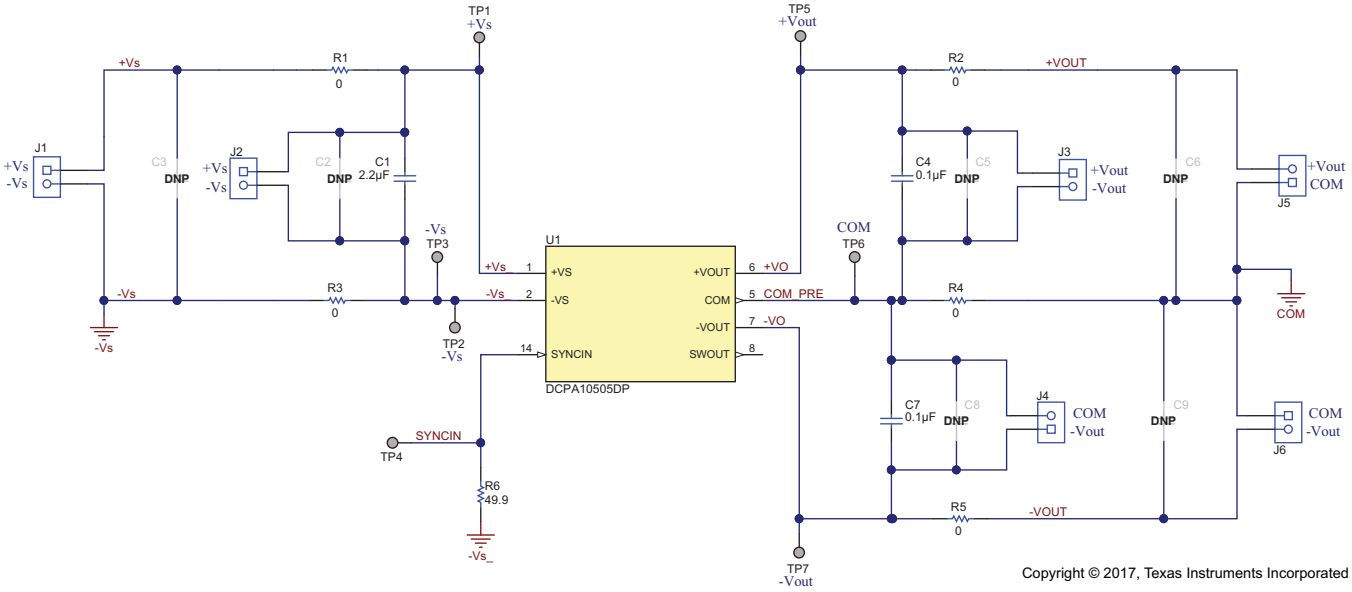

Figure 4. DCPA105xxDEVM-868 Schematic

Table 2. DCPA105xxDEVM-868 Bill of Materials

-001	-002	-003	RefDes	Value	Description	Size	Part Number	Mfg
1	1	1	C1	2.2uF	Capacitor, Ceramic, 100V, X7R, 10%	1210	GRM32ER61E226K	Murata
0	0	0	C2, C3	2.2uF	Capacitor, Ceramic, 100V, X7R, 10%	1210	GRM32ER61E226K	Murata
2	2	2	C4, C7	1.0uF	Capacitor, Ceramic, 50V, X7R, 10%	1210	GRM32RR71H105KA01L	Murata
0	0	0	C5, C6, C8, C9	1.0uF	Capacitor, Ceramic, 50V, X7R, 10%	1210	GRM32RR71H105KA01L	Murata
3	3	3	J1, J5, J6		Terminal Block, 5.08 mm, 2x1, Brass, TH	2x1, 5.08 mm	ED120/2DS	On-Shore Technology
3	3	3	J2, J3, J4	310-43-102-41-001000	Header, Female, 1x2 socket, 0.1" centers	0.100 inch x 1 x 2	310-43-102-41-001000	Mill-Max
5	5	5	R1, R2, R3, R4, R5	0Ω	Resistor, Chip, 1/8W, 5%	0805	CRCW08050000Z0EA	Vishay-Dale
0	0	0	R6	49.9Ω	Resistor, Chip, 1W, 1%	2512	CRCW251249R9FKEG	Vishay-Dale
7	7	7	TP1, TP2, TP3, TP4, TP5, TP6, TP7	---	Test Point, Miniature, SMT	SMT	5019	Keystone
1	0	0	U1	DCPA10505DP	Series 1-W, Isolated, Unregulated DC/DC Converter Module, NVA0007A (PDIP-7)	NVA0007A	DCPA10505DP	TI
0	1	0	U1	DCPA10512DP	Series 1-W, Isolated, Unregulated DC/DC Converter Module, NVA0007A (PDIP-7)	NVA0007A	DCPA10512DP	TI
0	0	1	U1	DCPA10515DP	Series 1-W, Isolated, Unregulated DC/DC Converter Module, NVA0007A (PDIP-7)	NVA0007A	DCPA10515DP	TI
1	1	1	---	---	Printed Circuit Board	2 x 2 x 0.062 inch	PWR861	Any

4 PCB Layout

The layout images for both the single output (PWR861) and dual output (PWR868) EVMs are shown in this section.

4.1 PWR861 PCB Layers

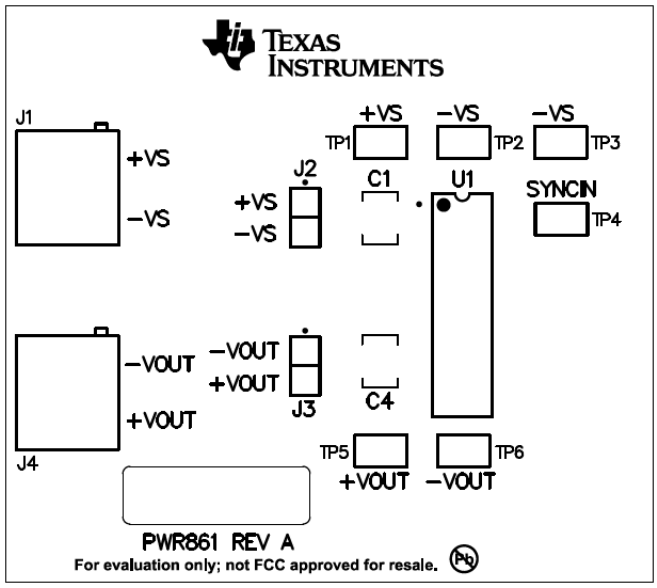

Figure 5. PWR861 Top Components

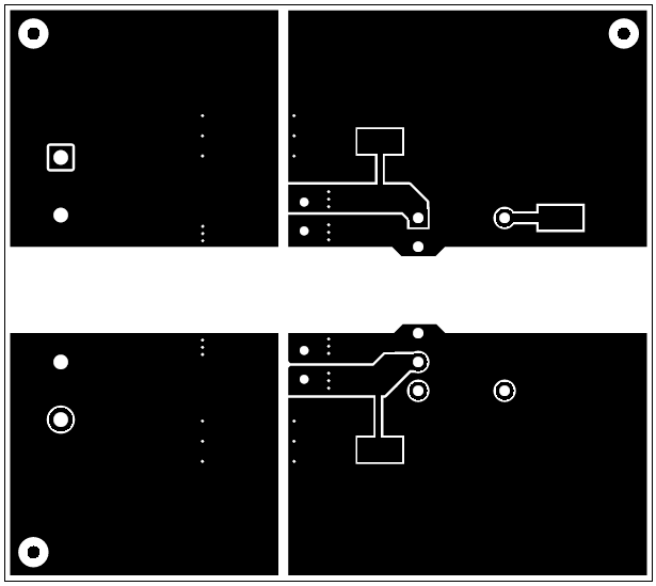

Figure 6. PWR861 Top Copper

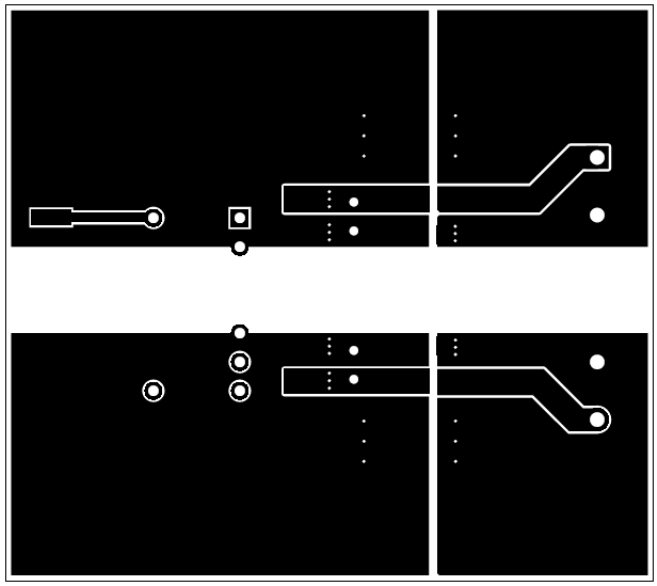

Figure 7. PWR861 Bottom Copper

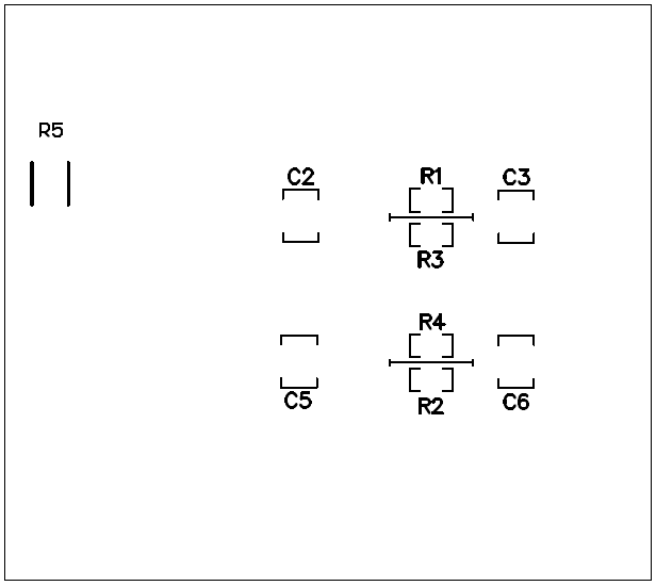

Figure 8. PWR861 Bottom Components

4.2 PWR868 PCB Layers

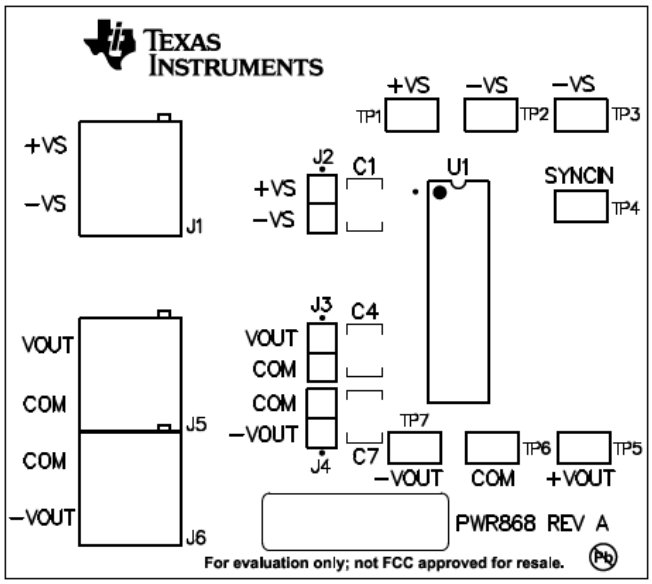

Figure 9. PWR868 Top Components

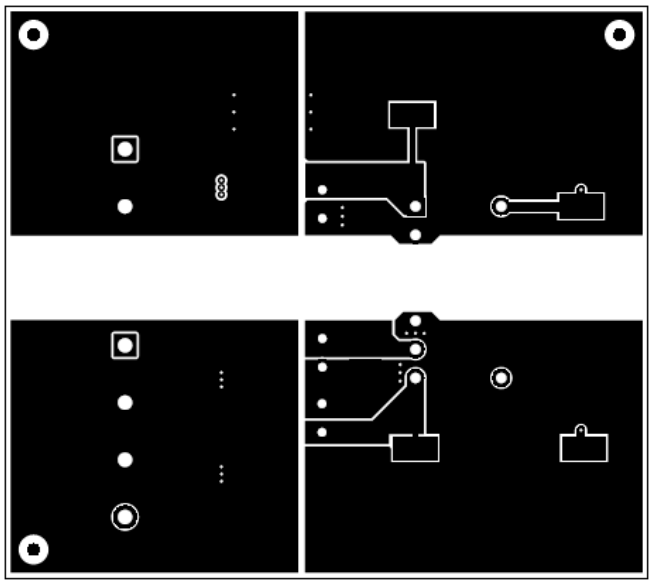

Figure 10. PWR868 Top Copper

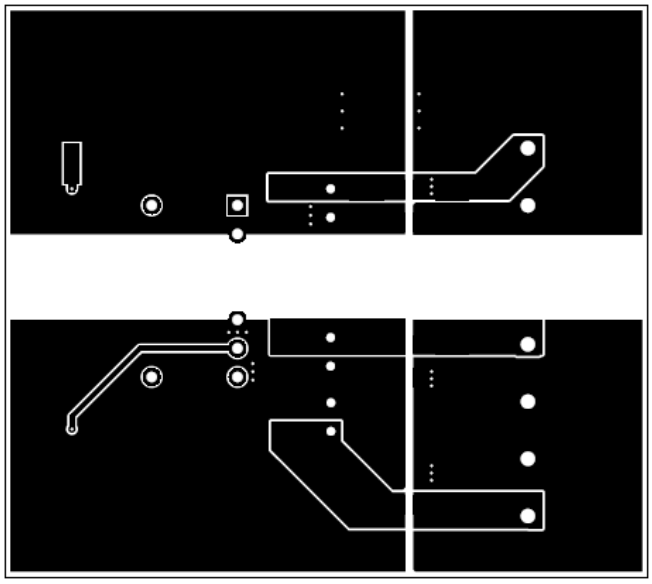

Figure 11. PWR868 Bottom Copper

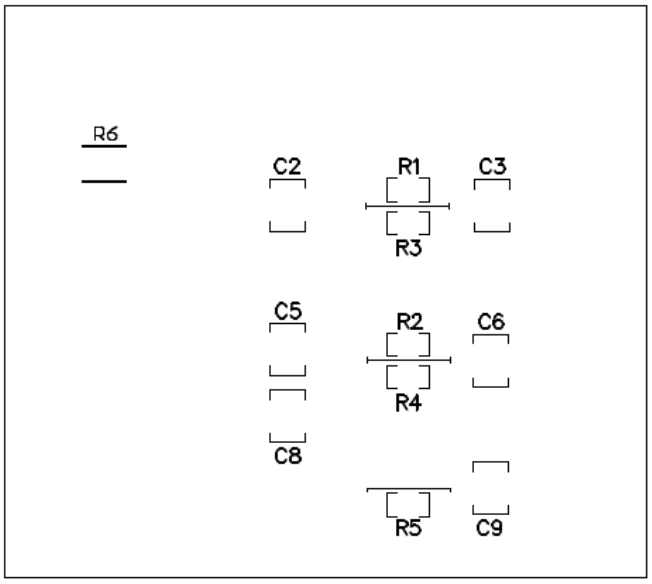

Figure 12. PWR868 Bottom Components

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   1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

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   2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

   2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

3 *Regulatory Notices:*

   3.1 *United States*

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

      FCC NOTICE: 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.

      3.1.2 *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

      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 or RSS-247*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. 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

3.3 *Japan*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。
http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

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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3.4 *European Union*

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive)*:

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

4 *EVM Use Restrictions and Warnings:*

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.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

6. *Disclaimers:*

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