TPA3116D2EVM Evaluation Module

This user's guide describes the operation of the TPA3116D2 evaluation module and provides measurement data and design information like the schematic, bill of materials, and the printed-circuit board layout.

Contents

1 Overview 2
2 Operation 2
2.1 Electrostatic Discharge Warning 2
2.2 Unpacking the EVM 3
2.3 Power Supply Setup 3
2.4 Evaluation Mode Preparations 4
2.5 Inputs and Outputs 4
2.6 Control Inputs 4
2.7 Power Up 4
2.8 Short-Circuit Protection and Automatic Recovery Feature 4
3 Design Documentation 5
3.1 TPS3116D2EVM Schematic 5
3.2 TPA3116D2EVM PCB Layers 6
3.3 TPA3116D2EVM Bill of Materials 9

List of Figures

1 TPA3116D2EVM Evaluation Module 3
2 TPA3116D2EVM Schematic 5
3 TPA3116D2EVM Top-Side Layout 6
4 TPA3116D2EVM Bottom-Side Layout 7
5 TPA3116D2EVM Top X-Ray View 8

List of Tables

1 TPA3116D2EVM Specification 2
2 TPA3116D2DADEVM Bill of Materials 9

Copyright © 2012–2013, Texas Instruments Incorporated

1 Overview

The TPA3116D2EVM evaluation module (EVM) demonstrates the TPA3116D2 integrated circuit from Texas Instruments (TI).

The TPA3116D2 is a 50-W (per channel), efficient, stereo, digital-amplifier power stage for driving two bridge-tied speakers or a single parallel bridge-tied load. The TPA3116D2 can drive a speaker with an impedance as low as 3.2 Ω (4 Ω typical).

The TPA3116D2 is available in a 32-pin TSSOP.

Table 1. TPA3116D2EVM Specification

Key Parameters	
Power supply voltage	4.5 V to 26 V
Number of channels	Two bridge-tied load (BTL) stereo
Load impedance	3.2 Ω to 8 Ω
Output power BTL (PBTL)	50 W per channel
Output PBTL	100 W

This document covers EVM specifications and design documentation that includes schematics, bill of materials, and layout design.

2 Operation

This section describes the TPA3116D2EVM board in regards to power supply and system interfaces. It provides information regarding handling and unpacking, absolute operating conditions, and a description of the factory default switch and jumper configuration.

The following sections provide a step-by-step guide to configuring the TPA3116D2EVM for device evaluation.

2.1 Electrostatic Discharge Warning

Many of the components on the TPA3116D2EVM are susceptible to damage by electrostatic discharge (ESD). Users are advised to observe proper ESD handling precautions when unpacking and handling the EVM, including the use of a grounded wrist strap at an approved ESD workstation.

CAUTION

Failure to observe ESD handling procedures can result in damage to EVM components.

Copyright © 2012–2013, Texas Instruments Incorporated

2.2 Unpacking the EVM

On opening the TPA3116D2EVM package, ensure that the following item is included:

- One TPA3116D2EVM board using one TPA3116D2 (Figure 1)

If either of the board or the TPA3116D2 device is missing, contact the Texas Instruments Product Information Center to inquire about a replacement.

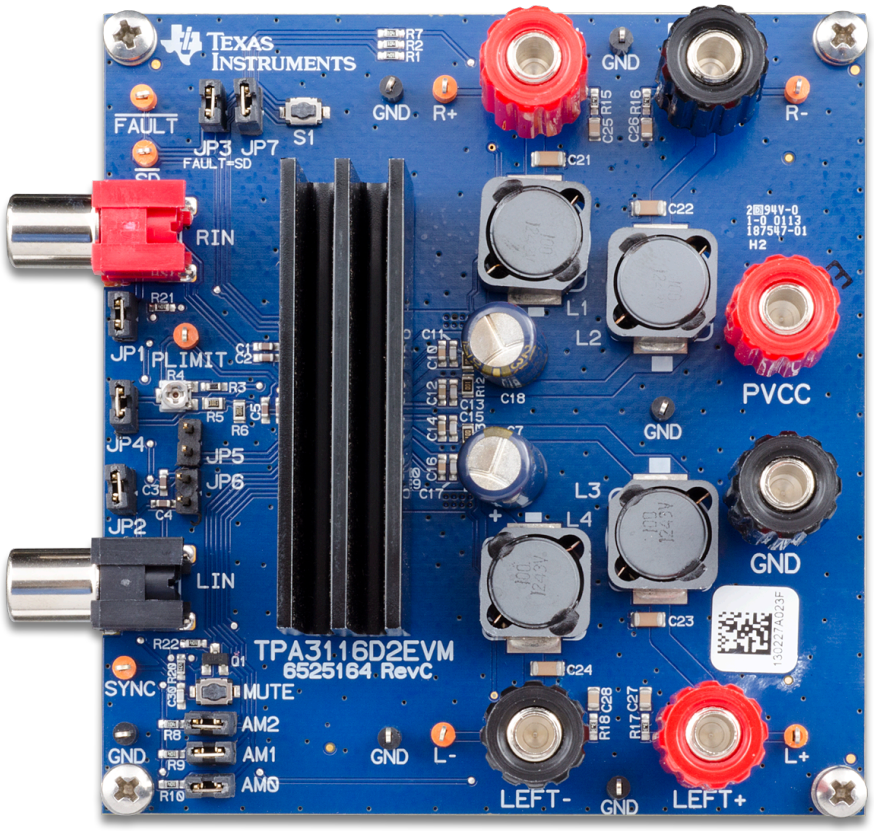


Figure 1. TPA3116D2EVM Evaluation Module

2.3 Power Supply Setup

A single power supply is required to power up the EVM. Because most of the pins are PVCC compliant, the PVCC supply also can be used to power the analog supply (AVCC) and can be used to pull up the logic pins for shutdown (SD) control and fault detection (FAULT). GVDD is an internally generated supply for the output FETs and also is used to power the PLIMIT voltage divider circuit on the EVM. PLIMIT is GVDD compliant, but not PVCC compliant. PLIMIT also can be powered by an external supply connected to the PLIMIT pin.

Description	Voltage Range	Current Requirement	Minimum Wire Size
PVCC	4.5 V to 26 V	8 A	24 AWG

CAUTION

Applying voltages above the 4.5-V to 26-V limitation can cause permanent damage to your hardware.

Copyright © 2012–2013, Texas Instruments Incorporated

2.4 Evaluation Mode Preparations

1. Ensure that the external power source is set to OFF.
2. Connect the external regulated power supply adjusted from 4.5 V to 26 V to the module PVCC and GND banana jacks, taking care to observe marked polarity.

2.5 Inputs and Outputs

1. For a BTL configuration, connect a load(s) across the outputs (LEFT+ and LEFT–) and (RIGHT+ and RIGHT–). For PBTL configuration, connect a single load from one of the left-speaker jacks to one of the right-speaker jacks, depending on how the filters are loaded.
2. Connect audio inputs, either differential or single-ended, to the LIN and RIN RCA phonograph (phono) plugs for BTL operation. For PBTL operation, apply a single input, differential or single-ended, to the RIN RCA phono plug and tie INPL and INNL directly to Ground (without capacitors).

2.6 Control Inputs

Ensure that the mode jumpers, AM0, AM1, AM2, R5, and R6 are set correctly, depending on the desired operating state. If PBTL operation is desired, connect JP5 and JP6 to GND.

2.7 Power Up

1. Verify correct voltage and input polarity, and turn the external power supplies ON. The EVM begins operation.
2. Adjust the audio source for the correct volume.

2.8 Short-Circuit Protection and Automatic Recovery Feature

The TPA3116D2 family has protection from overcurrent conditions caused by a short circuit on the output stage. The short circuit protection fault is reported on the FAULTZ pin as a low state. The amplifier outputs are switched to a high impedance state when the short circuit protection latch is engaged. The latch can be cleared by cycling the SDZ pin through the low state. If automatic recovery from the short circuit protection latch is desired, connect the FAULTZ pin directly to the SDZ pin. This allows the FAULTZ pin function to automatically drive the SDZ pin low which clears the short circuit protection latch. In systems where the possibility of a permanent short from the output to PVDD or to a high voltage battery (like a car battery) can occur; pull the MUTE pin low with the FAULTZ signal and an inverting transistor to ensure a high-Z restart. Please refer to the datasheet (SLOS708) for the application circuit.

Copyright © 2012–2013, Texas Instruments Incorporated

3 Design Documentation

This section contains the schematic, PCB layers, and BOM for this EVM.

3.1 TPS3116D2EVM Schematic

Figure 2 illustrates the schematic for this EVM.

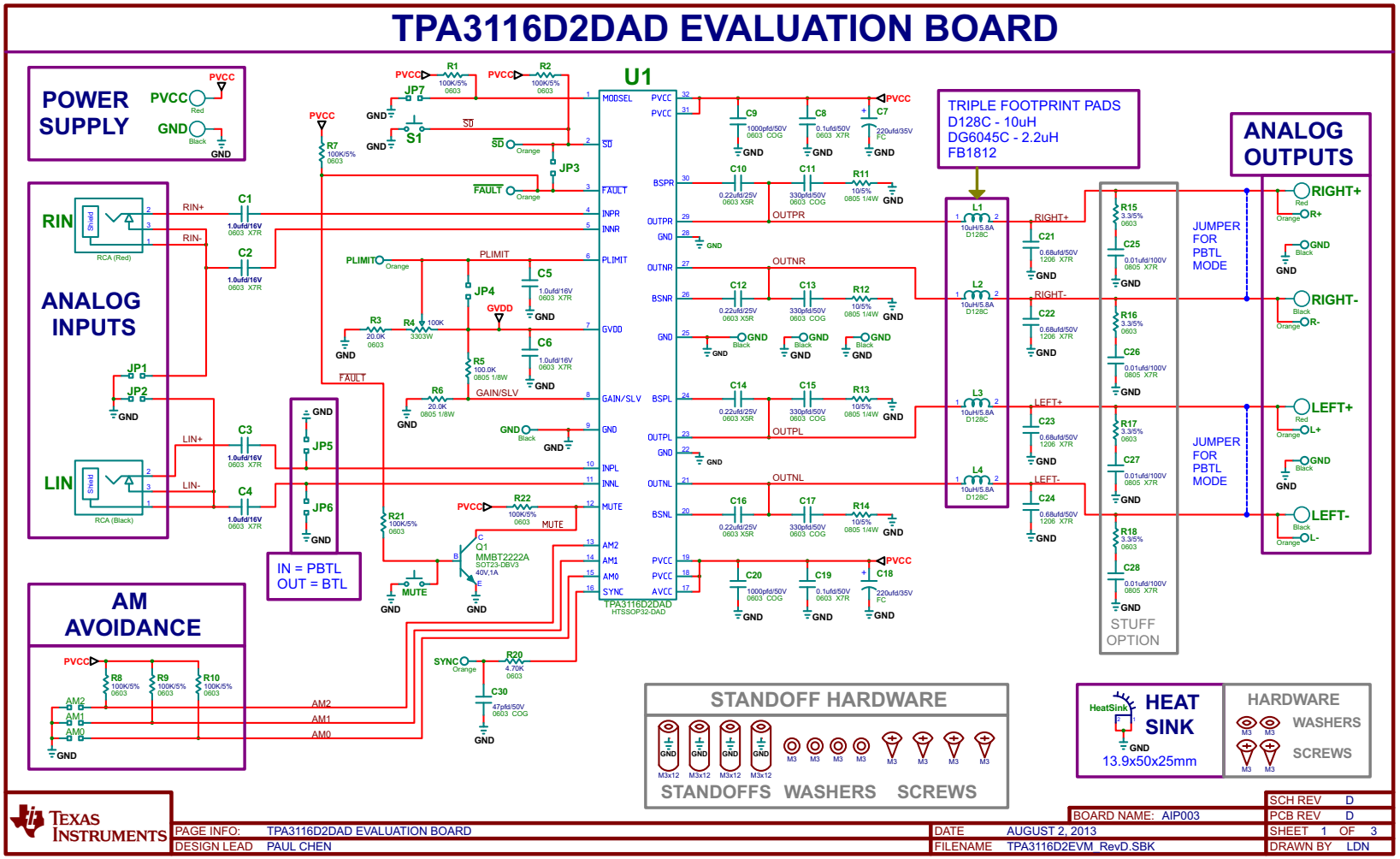


Figure 2. TPA3116D2EVM Schematic

Copyright © 2012–2013, Texas Instruments Incorporated

3.2 TPA3116D2EVM PCB Layers

Figure 3, Figure 4, and Figure 5 illustrate the PCB layers of this EVM.

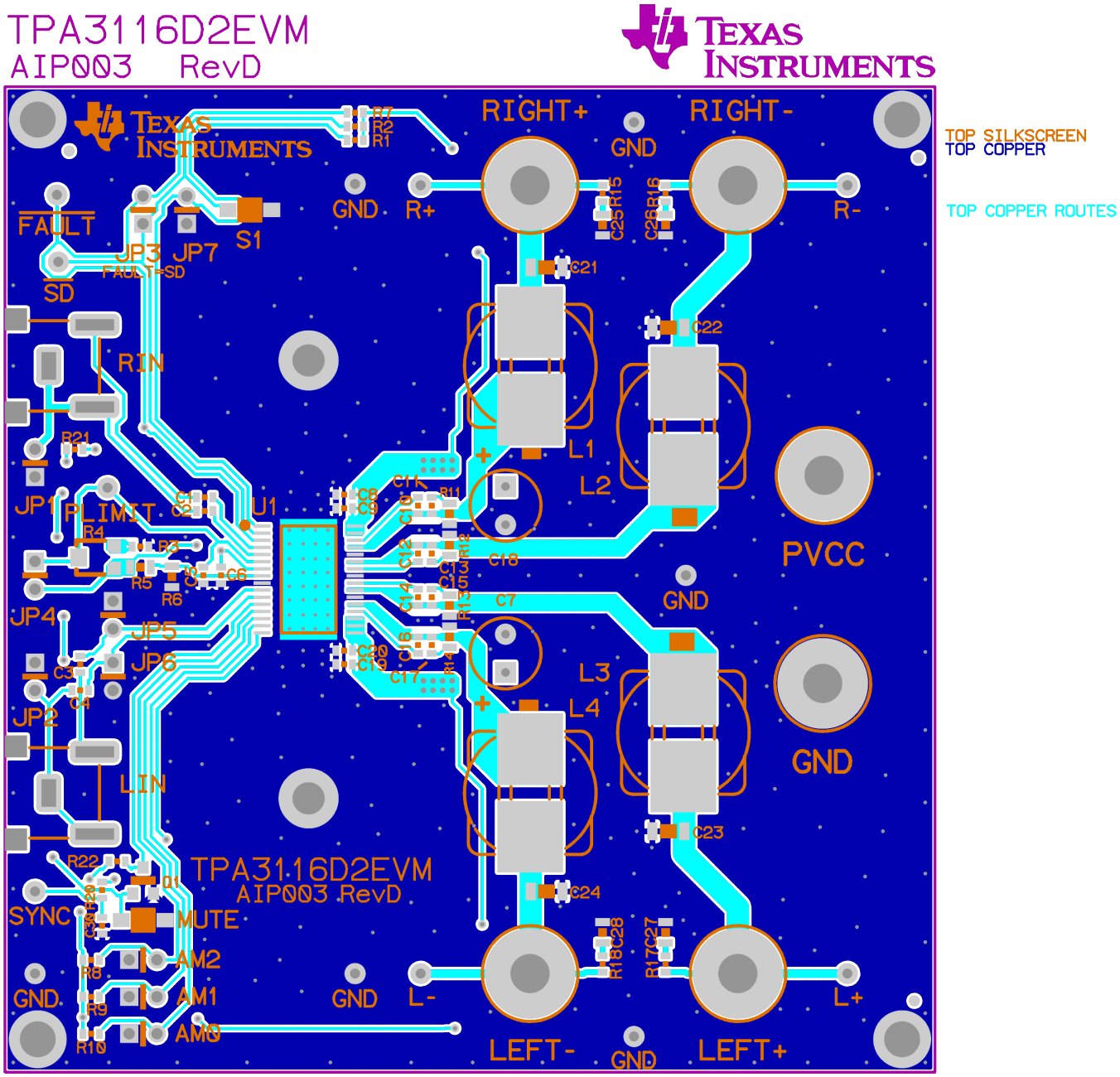


Figure 3. TPA3116D2EVM Top-Side Layout

Copyright © 2012–2013, Texas Instruments Incorporated

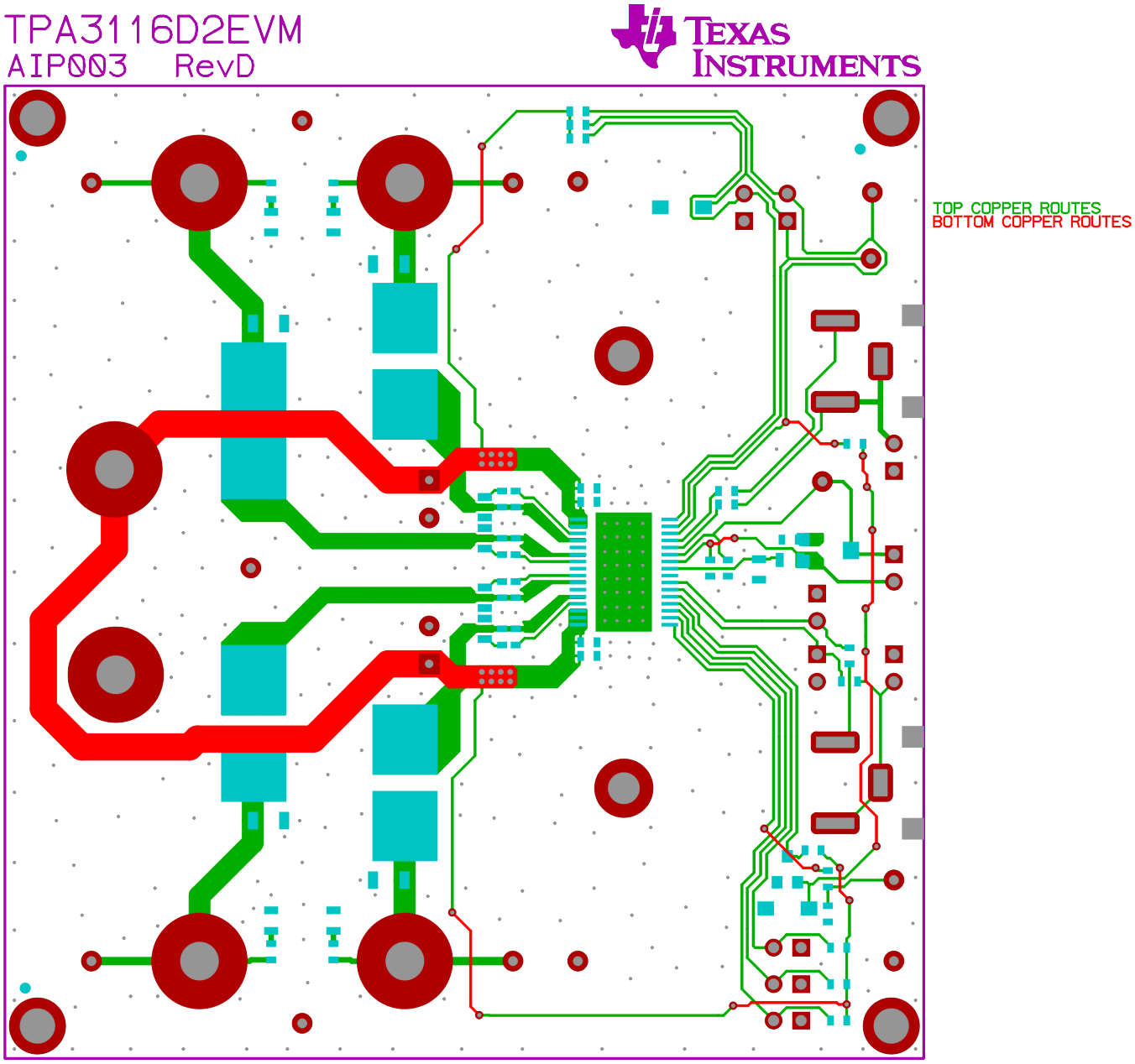


Figure 4. TPA3116D2EVM Bottom-Side Layout

Copyright © 2012–2013, Texas Instruments Incorporated

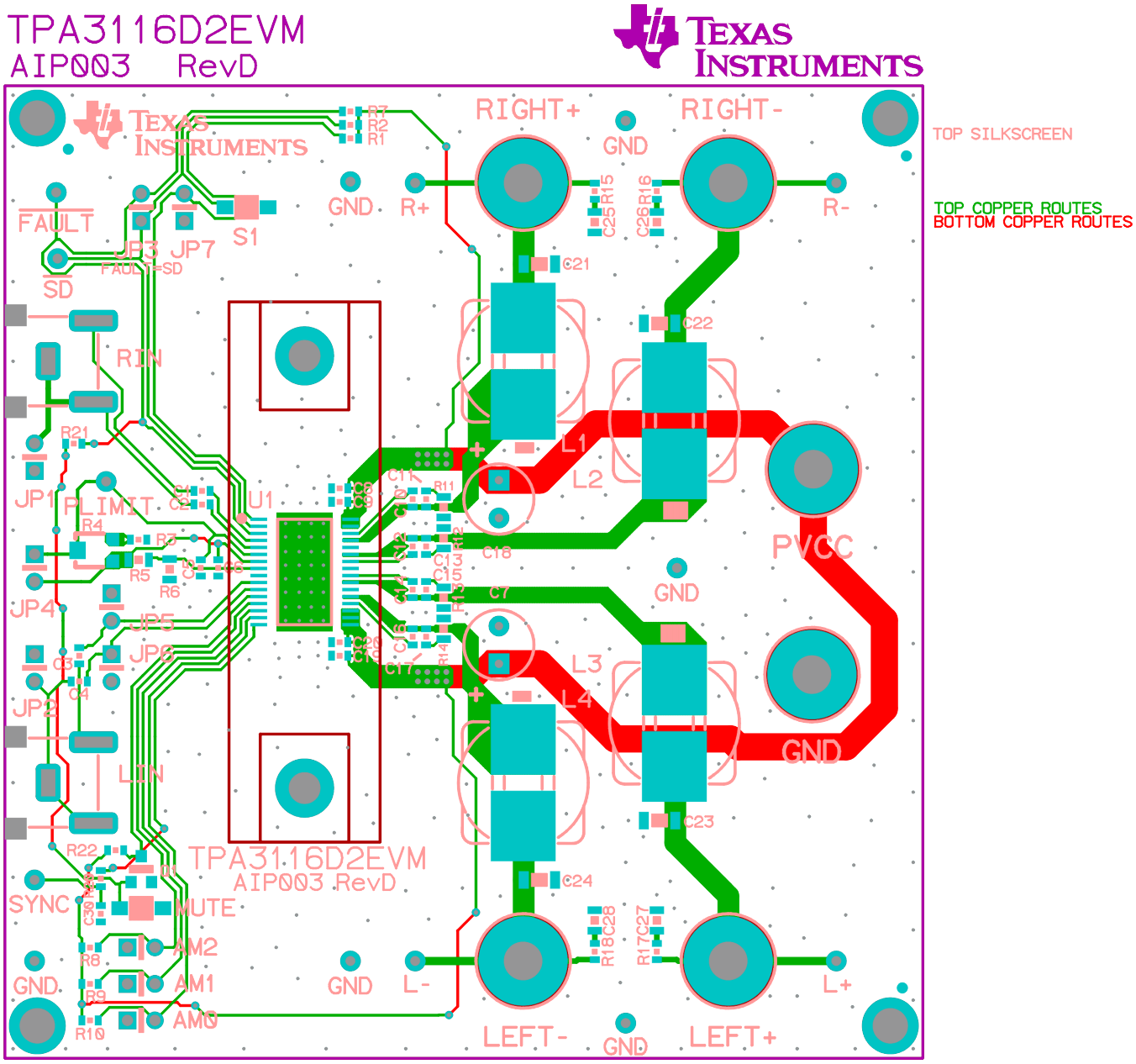


Figure 5. TPA3116D2EVM Top X-Ray View

Copyright © 2012–2013, Texas Instruments Incorporated

3.3 TPA3116D2EVM Bill of Materials

Table 2 lists the BOM for this EVM.

Table 2. TPA3116D2DADEVM Bill of Materials

Item	MFG Part Number	MFG	Qty	Ref Designators	Description
1	TPA3116D2DAD	TEXAS INSTRUMENTS	1	U1	2x50W CLASS D STEREO AMP AM AVOIDANCE HTSSOP32-DAD ROHS
2	MMBT2222A-7-F	DIODES INC.	1	Q1	TRANSISTOR NPN GENERAL PURPOSE 40V 1A SOT23 DBV3 ROHS
3	C1608X7R1C105K	TDK	6	C1, C2, C3, C4, C5, C6	CAP SMD0603 CERM 1.0UFD 16V 10% X7R ROHS
4	EEU-FC1V221L	PANASONIC	2	C7, C18	CAP THRU ALUM-ELECT FC SERIES 220ufd 35V 20% 8x3.5x15mm ROHS
5	GRM188R71H104KA93D	MURATA	2	C8, C19	CAP SMD0603 CERM 0.1UFD 50V 10% X7R ROHS
6	C1608C0G1H102J	TDK CORP.	2	C9, C20	CAP SMD0603 CERM 1000PFD 50V 5% COG ROHS
7	06033D224KAT2A	AVX	4	C10, C12, C14, C16	CAP SMD0603 CERM 0.22UFD 25V 10% X5R ROHS
8	GRM1885C1H331JA01D	MURATA	4	C11, C13, C15, C17	CAP SMD0603 CERM 330PFD 50V 5% COG ROHS
9	C1206C684K5RACTU	KEMET	4	C21, C22, C23, C24	CAP SMD1206 CERM 0.68UFD 50V 10% X7R ROHS
10	GRM21BR72A103KA01L	MURATA	4	C25, C26, C27, C28	CAP SMD0805 CERM 0.01UFD 100V 10% X7R ROHS
11	GRM1885C1H470JA01D	MURATA	1	C30	CAP SMD0603 CERM 47PFD 50V 5% COG ROHS
12	RMCF0603JT100K	STACKPOLE ELECTRONICS	8	R1, R2, R7, R8, R9, R10, R21, R22	RESISTOR SMD0603 100K OHMS 5% 1/10W ROHS
13	ERJ-3EKF2002V	PANASONIC	1	R3	RESISTOR SDM0603 20.0K OHM 1% THICK FILM 1/16W ROHS
14	3303W-3-104E	BOURNS	1	R4	POT SMD CERMET 100K OHMS 25% TOP ADJ ROHS
15	MCR10EZHF1003	ROHM	1	R5	RESISTOR SMD0805 100.0 KOHMs 1% 1/8W ROHS
16	MCR10EZHF2002	ROHM	1	R6	RESISTOR SMD0805 20.0 KOHMs 1% 1/8W ROHS
17	ESR10EZPJ100	ROHM	4	R11, R12, R13, R14	RESISTOR SMD0805 10 OHM 5% 1/4W ROHS
18	ERJ-3GEYJ3R3V	PANASONIC	4	R15, R16, R17, R18	RESISTOR SMD0603 3.3 OHMS 5% 1/10W ROHS
19	RC0603FR-074K7L	PANASONIC	1	R20	RESISTOR SMD0603 4.70K OHMS 1% 1/10W ROHS
20	931BS-100M	TOKO	4	L1, L2, L3, L4	INDUCTOR 10uH 5.8A TYPE D128C ROHS
21	PBC02SAAN	SULLINS	10	AM0, AM1, AM2, JP1, JP2, JP3, JP4, JP5, JP6, JP7	HEADER THRU MALE 2 PIN 100LS GOLD ROHS
22	PJRAN1X1U01X	SWITCHCRAFT	1	LIN	JACK, RCA 3-PIN PCB-RA BLACK ROHS
23	PJRAN1X1U013	SWITCHCRAFT	1	RIN	JACK, RCA 3-PIN PCB-RA RED ROHS
24	5001	KEYSTONE ELECTRONICS	6	GNDx6	PC TESTPOINT, BLACK, ROHS
25	5003	KEYSTONE ELECTRONICS	8	L+, L-, R+, R-, SD, SYNC, FAULT, PLIMIT	PC TESTPOINT, ORANGE, ROHS
26	TL1015AF160QG	E-SWITCH	2	S1, MUTE	SWITCH, MOM, 160G SMT 4X3MM ROHS
27	7006	KEYSTONE ELECTRONICS	3	PVCC, LEFT+, RIGHT+	BINDING POST, RED, 15A ECONO ROHS
28	7007	KEYSTONE ELECTRONICS	3	GND, LEFT-, RIGHT-	BINDING POST, BLACK, 15A ECONO ROHS
29	ATS-TI1OP-521-C1-R1	ADVANCED THERMAL SOLUTIONS	1	HEATSINK	HEATSINK ALUMINUM ATS-521 13.9x50x25mm 40mm PITCH ROHS
30	92148A150	MCMASTER-CARR	2	HEATSINK WASHERS	WASHER SPLIT-LOCK M3 6.2mm OD 0.7mm THICK STAINLESS STEEL ROHS
31	92000A118	MCMASTER-CARR	2	HEATSINK SCREWS	SCREW M3x8 PHILIPS PANHEAD STAINLESS STEEL ROHS
32	95947A121	MCMASTER-CARR	4	STANDOFFS	STANDOFF M3x12mm 4.5mm DIA HEX ALUM F-F ROHS
33	92148A150	MCMASTER-CARR	4	STANDOFF WASHERS	WASHER SPLIT-LOCK M3 6.2mm OD 0.7mm THICK STAINLESS STEEL ROHS
34	92000A118	MCMASTER-CARR	4	STANDOFF SCREWS	SCREW M3x8 PHILIPS PANHEAD STAINLESS STEEL ROHS
35	969102-0000-DA	3M	8	AM0, AM1, AM2, JP1, JP2, JP3, JP4, JP7	SHUNT BLACK AU FLASH 0.100LS OPEN TOP ROHS

Copyright © 2012–2013, Texas Instruments Incorporated

Revision History

Changes from A Revision (June 2012) to B Revision **Page**

- Changed 6 V to 4.5 V in Table 1, first row 2
- Changed 6 V to 4.5 V in Voltage Range column of Section 2.3. 3
- Changed 6 V to 4.5 V in Caution in Section 2.3. 3
- Changed 6 V to 4.5 V in Section 2.4, second step. 4
- Changed schematic for rev. D. 5
- Changed top-side layout with rev. D image. 6
- Changed bottom-side layout with rev. D image. 7
- Changed top X-ray view with rev. D image. 8
- Changed bill of materials for rev. D. 9

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

Copyright © 2012–2013, Texas Instruments Incorporated

EVALUATION BOARD/KIT/MODULE (EVM) ADDITIONAL TERMS

Texas Instruments (TI) provides the enclosed Evaluation Board/Kit/Module (EVM) under the following conditions:

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods.

Should this evaluation board/kit not meet the specifications indicated in the User's Guide, the board/kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING LIMITED WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

Please read the User's Guide and, specifically, the Warnings and Restrictions notice in the User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For additional information on TI's environmental and/or safety programs, please visit www.ti.com/esh or contact TI.

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used. TI currently deals with a variety of customers for products, and therefore our arrangement with the user is not exclusive. TI assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein.

REGULATORY COMPLIANCE INFORMATION

As noted in the EVM User's Guide and/or EVM itself, this EVM and/or accompanying hardware may or may not be subject to the Federal Communications Commission (FCC) and Industry Canada (IC) rules.

For EVMs **not** subject to the above rules, this evaluation board/kit/module is intended for use for ENGINEERING DEVELOPMENT, DEMONSTRATION OR EVALUATION PURPOSES ONLY and is not considered by TI to be a finished end product fit for general consumer use. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC or ICES-003 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of the equipment may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

General Statement for EVMs including a radio

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.

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.

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.

【Important Notice for Users of EVMs for RF Products in Japan】

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.

Texas Instruments Japan Limited
(address) 24-1, Nishi-Shinjuku 6 chome, Shinjuku-ku, Tokyo, Japan

http://www.tij.co.jp

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】

本開発キットは技術基準適合証明を受けておりません。

本製品のご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。

日本テキサス・インスツルメンツ株式会社
東京都新宿区西新宿６丁目２４番１号
西新宿三井ビル
http://www.tij.co.jp

EVALUATION BOARD/KIT/MODULE (EVM)
WARNINGS, RESTRICTIONS AND DISCLAIMERS

For Feasibility Evaluation Only, in Laboratory/Development Environments. Unless otherwise indicated, this EVM is not a finished electrical equipment and not intended for consumer use. It is intended solely for use for preliminary feasibility evaluation in laboratory/development environments by technically qualified electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems and subsystems. It should not be used as all or part of a finished end product.

Your Sole Responsibility and Risk. You acknowledge, represent and agree that:

1. You have unique knowledge concerning Federal, State and local regulatory requirements (including but not limited to Food and Drug Administration regulations, if applicable) which relate to your products and which relate to your use (and/or that of your employees, affiliates, contractors or designees) of the EVM for evaluation, testing and other purposes.
2. You have full and exclusive responsibility to assure the safety and compliance of your products with all such laws and other applicable regulatory requirements, and also to assure the safety of any activities to be conducted by you and/or your employees, affiliates, contractors or designees, using the EVM. Further, you are responsible to assure 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.
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.

Certain Instructions. It is important to operate this EVM within TI’s recommended specifications and environmental considerations per the user guidelines. Exceeding the specified EVM ratings (including but not limited to input and output voltage, current, power, and environmental ranges) may cause property damage, personal injury or death. If there are questions concerning these ratings please 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 result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM User's 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, some circuit components may have case temperatures greater than 60°C as long as the input and output are maintained at a normal ambient operating temperature. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors which can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during normal operation, please be aware that these devices may be very warm to the touch. As with all electronic evaluation tools, only qualified personnel knowledgeable in electronic measurement and diagnostics normally found in development environments should use these EVMs.

Agreement to Defend, Indemnify and Hold Harmless. You agree to defend, indemnify and hold TI, its licensors and their representatives harmless from and against any and all claims, damages, losses, expenses, costs and liabilities (collectively, "Claims") arising out of or in connection with any use of the EVM that is not in accordance with the terms of the agreement. This obligation shall apply whether Claims arise under law of tort or contract or any other legal theory, and even if the EVM fails to perform as described or expected.

Safety-Critical or Life-Critical Applications. If you intend to evaluate the components for possible use in safety critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, such as devices which are classified as FDA Class III or similar classification, then you must specifically notify TI of such intent and enter into a separate Assurance and Indemnity Agreement.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2013, Texas Instruments Incorporated

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers’ products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers’ products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2013, Texas Instruments Incorporated