TPA6013A4 Audio Power Amplifier EVM

This user's guide describes the operation of TPA6013A4 evaluation module and presents the schematic, board layout, and bill of materials of the printed-circuit board.

Contents

List of Figures

List of Tables

1 Introduction

This section provides an overview of the Texas Instruments (TI) TPA6013A4 evaluation module (EVM). The EVM user guide includes a brief description of the module and a list of EVM specifications.

1.1 Description

The TPA6013A4 is a stereo amplifier with 32-steps DC volume control. TPA6013A4 supports both speaker and headphone output. TPA6013A4 also has 2-to-1 stereo input MUX.

The TPA6013A4 EVM is a complete, stand-alone audio board. It contains the TPA6013A4 TSSOP (PWP) stereo amplifier. All components are Pb-free.

1.2 EVM Specifications

Supply voltage range, V_{DD}	4 V to 5.5 V
Supply current, I_{DD}	1.2 A, maximum
Speaker continuous output power, P_O, V_{DD} = 5.5 V, 3 Ω, THD+N = 10 %	3 W
Headphone continuous output power, P_O, V_{DD} = 5 V, 16 Ω, THD+N = 1 %	180 mW

2 Operation

This section describes how to operate the TPA6013A4EVM.

2.1 Quick-Start List for Stand-Alone Operation

Use the following steps when operating the TPA6013A4EVM stand-alone board or when connecting the EVM into an existing circuit.

2.1.1 Power and Ground

1. Ensure that the external power sources are set to OFF.
2. Set the power supply voltage between 4 V and 5.5 V. When connecting the power supply to the EVM, first connect the ground connection to GND at the POWER terminal block, and then connect the positive supply to V_{DD} at the POWER terminal block. Verify that the connections are made to the correct terminals.

2.1.2 Inputs and Outputs

2.1.2.1 Audio Input

1. Connect audio source at the RCA jacks LLINEIN and RLINEIN. Shunt jumper RIN and LIN for single-ended input.
2. Short position 2 and 3 at 3-pin header RH JP. Audio source right channel will go into RLINEIN of the amplifier.
3. Short position 2 and 3 at 3-pin header LH JP. Audio source left channel will go into LLINEIN of the amplifier.
4. TPA6013A4 has 2-to-1 input MUX that can accept 2 single-ended stereo source. To use the MUX:
   (a) Connect the first audio source at RCA jacks LLINEIN and RLINEIN. Shunt jumper RIN and LIN for single-ended input.
   (b) Connect the second audio source at test points RHPIN and LHPIN.
   (c) Remove shunts at 3-pin headers RH JP and LH JP.
   (d) To select LLINEIN and RLINEIN, remove shunt at HP/LINE.
   (e) To select LHPIN and RHPIN, shunt at HP/LINE.

2.1.2.2 Audio Output

1. Connect speakers at terminal blocks ROUT and LOUT.
2. TPA6013A4 supports both speaker and headphone output. To select speaker output, remove headphone in the headphone jack. To select headphone output, insert headphone into the headphone jack; speaker amplifiers will be turned off automatically.

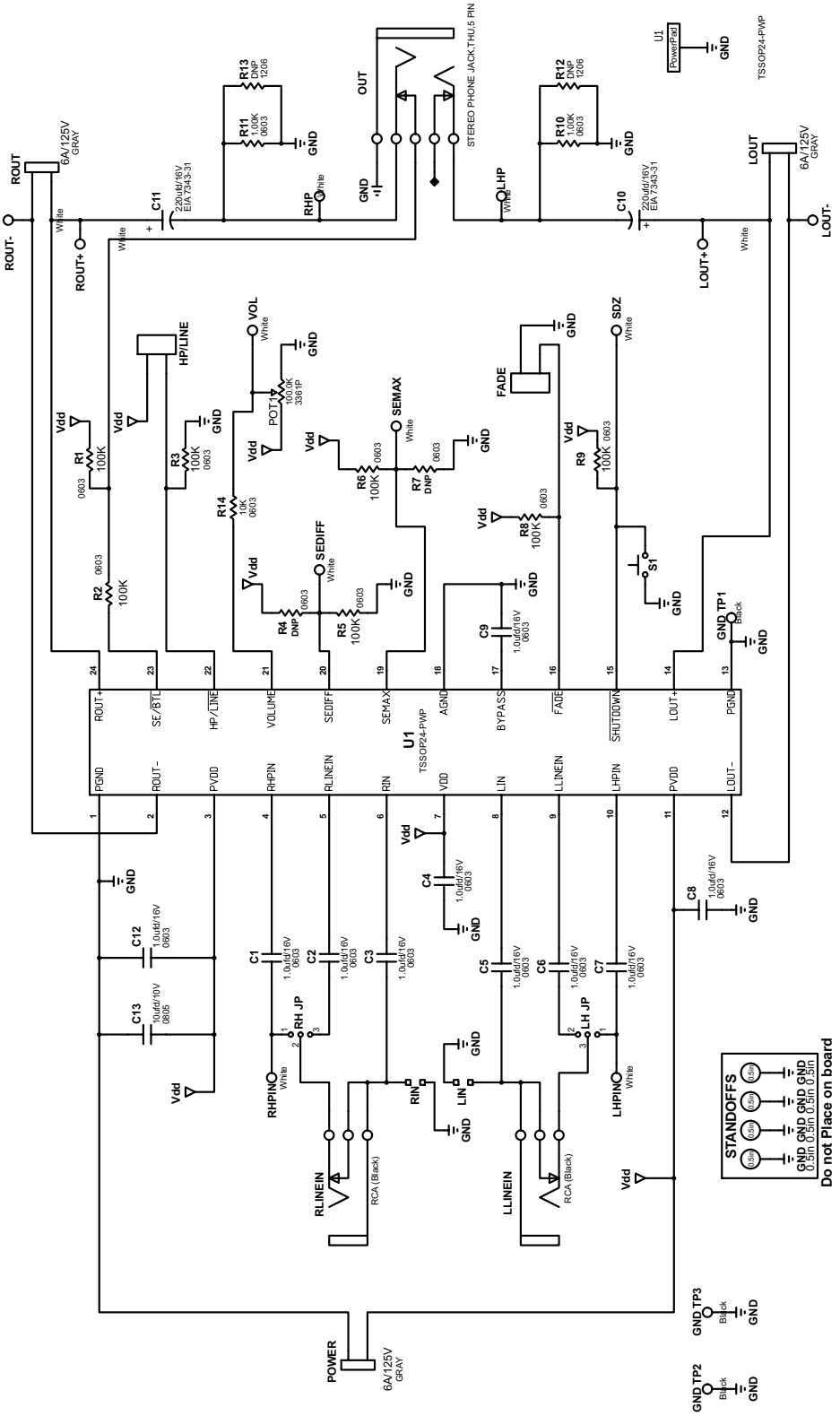
2.1.2.3 Other Controls

1. Shutdown is controlled by pushbutton S1. Press and hold S1 to place the TPA6013A4 in shutdown mode. Release S1 to reactivate the TPA6013A4.
2. Volume is controlled by potentiometer.
3. Shunt FADE to enable fade function. Remove shunt to disable fade function.
4. To use SEDIFF and SEMAX function, apply voltage at test points SEDIFF and SEMAX. SEDIFF and SEMAX can also be controlled by placing resistors of different values at R4 and R7.

3 Reference

This section includes the EVM schematic, board layout reference, and parts list.

3.1 TPA6013A4EVM Schematic



3.2 TPA6013A4EVM PCB Layers

Figure 1. Top Layer

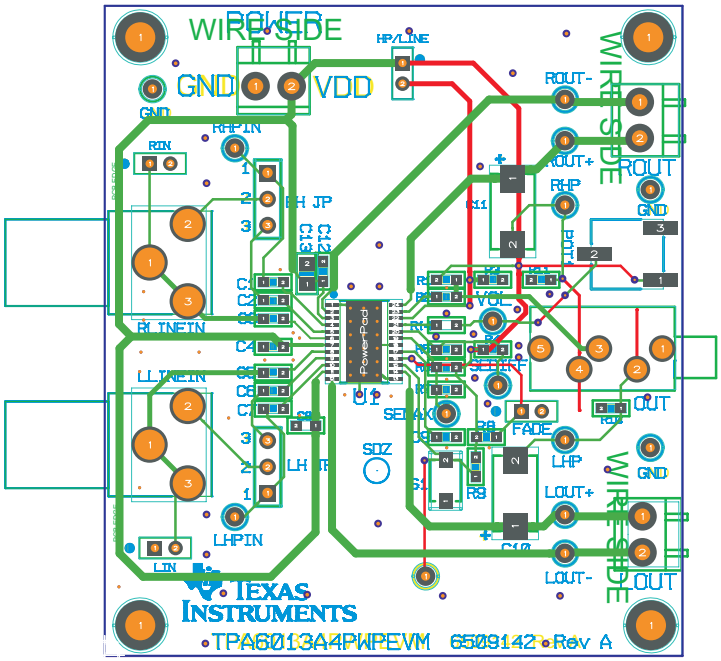
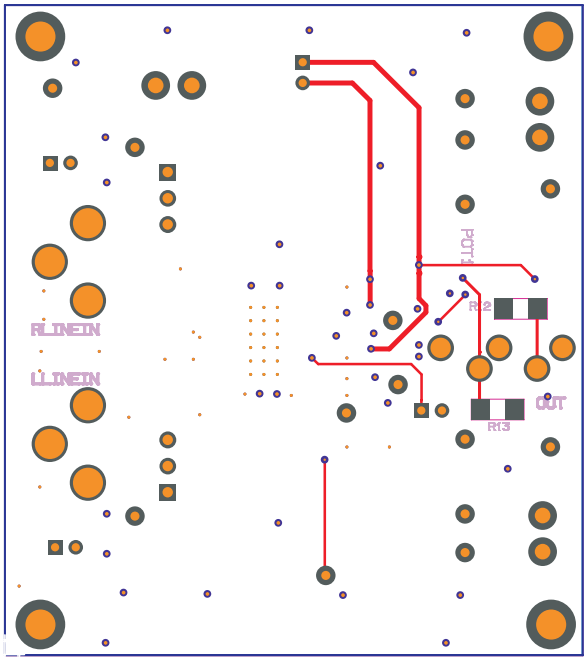


Figure 2. Bottom Layer



4 TPA6013A4EVM Bill of Materials

Table 1. Bill of Materials for TPA6013A4PWPEVM

Manufacturer/ Part Number	RefDes	Vendor/ Part Number	Description	MFR
TPA6013A4PWP	U1	Texas Instruments TPA6013A4PWP	3-W STEREO AUDIO POWER AMP W/DC VOLUME TSSOP24-PWP ROHS	TEXAS INSTRUMENTS
CAPACITORS				
EMK107B7105KA-T	C1, C2, C3, C4, C5, C6, C7, C8, C9, C12	DIGI-KEY 587-1241-1	CAP SMD0603 CERM 1.0µF 16V 10% X7R ROHS	TAIYO YUDEN
GRM21BR71A106KE51L	C13	DIGI-KEY 490-3905-1	CAP SMD0805 CERM 10µF 10V 10% X7R ROHS	MURATA
B45197A3227K509	C10, C11	DIGI-KEY 495-1552-1	CAP TANT EIA7343-31 220µF 16V 10% LOW ESR ROHS	EPCOS
RESISTORS				
ERJ-3GEYJ104V	R1, R2, R3, R5, R6, R8, R9	DIGI-KEY P100KGCT	RESISTOR SMD0603 100KΩ 5% THICK FILM 1/10W ROHS	PANASONIC
RC0603FR-071KL	R10, R11	DIGI-KEY 311-1.00KHRCT	RESISTOR SMD0603 THICK FILM 1.00KΩ 1% 1/10W ROHS	YAGEO
ERJ-3GEYJ103V	R14	DIGI-KEY P10KGCT	RESISTOR SMD0603 10KΩ 5% 1/10W ROHS	PANASONIC
3361P-1-104GLF	VOL	DIGI-KEY 3361P-104GLFCT	POTENTIOMETER, SMD CERMET 100.0KΩ, 10% SINGLE-TURN, TOP ADJUST 1/2W ROHS	BOURNS
JACKS AND HEADERS AND TERMINAL BLOCKS				
26630201RP2	LIN, RIN, FADE, HP/LINE	DIGI-KEY 2663S-02	HEADER 2-PIN, PCB 2.0MM ROHS	NORCOMP
PBC03SAAN	LH JP, RH JP	DIGI-KEY S1011E-03-ND	HEADER THRU MALE 3 PIN 100LS GOLD ROHS	SULLINS
PJRAN1X1U01X	LLINEIN, RLINEIN	NEWARK 65K7770	JACK, RCA 3-PIN PCB-RA BLACK ROHS	SWITCHCRAFT
ED555/2DS	LOUT, ROUT, POWER	DIGI-KEY ED1514	TERMINAL BLOCK 2PIN 6A/125V GRAY 3.5mm PITCH 16-28AWG ROHS	ON SHORE TECHNOLOGY
35RAPC4BV4	OUT	DIGI-KEY 35RAPC4BV4-ND	STEREO PHONE JACK, THU, 5-PIN, 3.5mm	SWITCHCRAFT
TESTPOINTS AND SWITCHES				
5002	LHP, RHP, SDZ, VOL, LHPIN, LOUT+, LOUT-, RHPIN, ROUT+, ROUT-, SEMAX, SEDIFF	DIGI-KEY 5002K	PC TESTPOINT, WHITE, ROHS	KEYSTONE ELECTRONICS
5001	GND TP1, GND TP2, GND TP3	DIGI-KEY 5001K	PC TESTPOINT, BLACK, ROHS	KEYSTONE ELECTRONICS
TL1015AF160QG	S1	DIGI-KEY EG4344CT	SWITCH, MOM, 160G SMT 4x3MM ROHS	E-SWITCH
COMPONENTS NOT ASSEMBLED				
HW1, HW2, HW3, HW4, R4, R7, R12, R13				

EVALUATION BOARD/KIT IMPORTANT NOTICE

Texas Instruments (TI) provides the enclosed product(s) under the following conditions:

This evaluation board/kit 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. Persons handling the product(s) must have electronics training and observe good engineering practice standards. As such, the goods being provided are not intended to be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety and environmental measures typically found in end products that incorporate such semiconductor components or circuit boards. This evaluation board/kit does not fall within the scope of the European Union directives regarding electromagnetic compatibility, restricted substances (RoHS), recycling (WEEE), FCC, CE or UL, and therefore may not meet the technical requirements of these directives or other related directives.

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 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.

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. Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge.

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.

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.**

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 contact the TI application engineer or visit www.ti.com/esh.

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.

FCC Warning

This evaluation board/kit 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 rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments 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.

EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of HPVSS - 0.3 V to HPVDD + 0.3 V and the output voltage range of HPVSS to HPVDD.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. 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 85°C. The EVM is designed to operate properly with certain components above 85°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

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

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI 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 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. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

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

TI products are not authorized for 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, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		**Applications**	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DLP® Products	www.dlp.com	Broadband	www.ti.com/broadband
DSP	dsp.ti.com	Digital Control	www.ti.com/digitalcontrol
Clocks and Timers	www.ti.com/clocks	Medical	www.ti.com/medical
Interface	interface.ti.com	Military	www.ti.com/military
Logic	logic.ti.com	Optical Networking	www.ti.com/opticalnetwork
Power Mgmt	power.ti.com	Security	www.ti.com/security
Microcontrollers	microcontroller.ti.com	Telephony	www.ti.com/telephony
RFID	www.ti-rfid.com	Video & Imaging	www.ti.com/video
RF/IF and ZigBee® Solutions	www.ti.com/lprf	Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265