TPA6120A2RGY Evaluation Module

This user's guide describes the characteristics, operation, and use of the TPA6120A2RGY evaluation module (EVM). This user's guide includes EVM description, performance specifications, board layout, bill of materials (BOM), and schematic diagram.

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1 Introduction

The TPA6120A2RGY is a high-fidelity audio amplifier. The amplifier can operate from a split power supply, and is designed for low noise, high dynamic range performance.

1.1 Related Documentation from Texas Instruments

TPA6120A2 data sheet (literature number SLOS431)

1.2 Description

The TPA6120A2RGY EVM is designed to operate specifically with a split power supply and is configured with differential inputs with a gain of 1 V/V. The output signal is routed into a 3.5-mm headphone jack J4. The EVM is approximately 1.5 x 1.25 in.

1.3 Performance Specifications

Table 1. TPA6120A2RGY EVM Specifications

		MIN	MAX	UNIT
V_{CC}	Supply voltage range	±5	±15	V
	Power supply current rating required		1	A
	Continuous output power, Po: 32-Ω stereo, V_{CC} = ±12 V		2	W
V_I	Audio input voltage	$-V_{CC}$	V_{CC}	
$Z_{(L)}$	Minimum load impedance		8	Ω

CAUTION

1. Accidental swapping of supply polarities causes damage to the device and can cause damage to the other components on the board.
2. Do not short the outputs of the TPA6120A2RGY to either the positive or negative supply when operating with a split power supply. When operating with a single power supply, do not short the outputs to the positive supply. This damages the device.

2 Getting Started

Follow these steps to use the TPA6120A2RGY EVM in its original configuration:

Power Supply

1. Make sure all external power supplies are turned off.
2. Connect an external power supply with the positive voltage set between 5 V and 15 V to the terminal marked V+ (J1) on the EVM.
3. Connect the negative voltage to the terminal marked V– (J2), making sure the negative voltage is set to the same magnitude as that of the positive (that is, ±5 V, ±12 V, ±15 V).
4. Connect the left signal sources to the screw terminal labeled LIN (J3), and the right signal source to the screw terminal labeled RIN (J5).

NOTE: This EVM is configured for differential mode. To operate in single-ended mode, see Single-Ended Inverting Configuration.

Inputs and Outputs

1. Ensure the signal source is turned off or set to a minimum.
2. Connect the left signal source to the RCA jack labeled LIN+ (J5), and the right signal source to the RCA jack labeled RIN+ (J6).
3. Insert headphones into 3.5 mm headphone jack (J4).

Power Up

1. Verify correct voltage polarity on the supplies.
2. Turn on the power supply.
3. Turn on the signal source.
4. Adjust signal source level as needed.

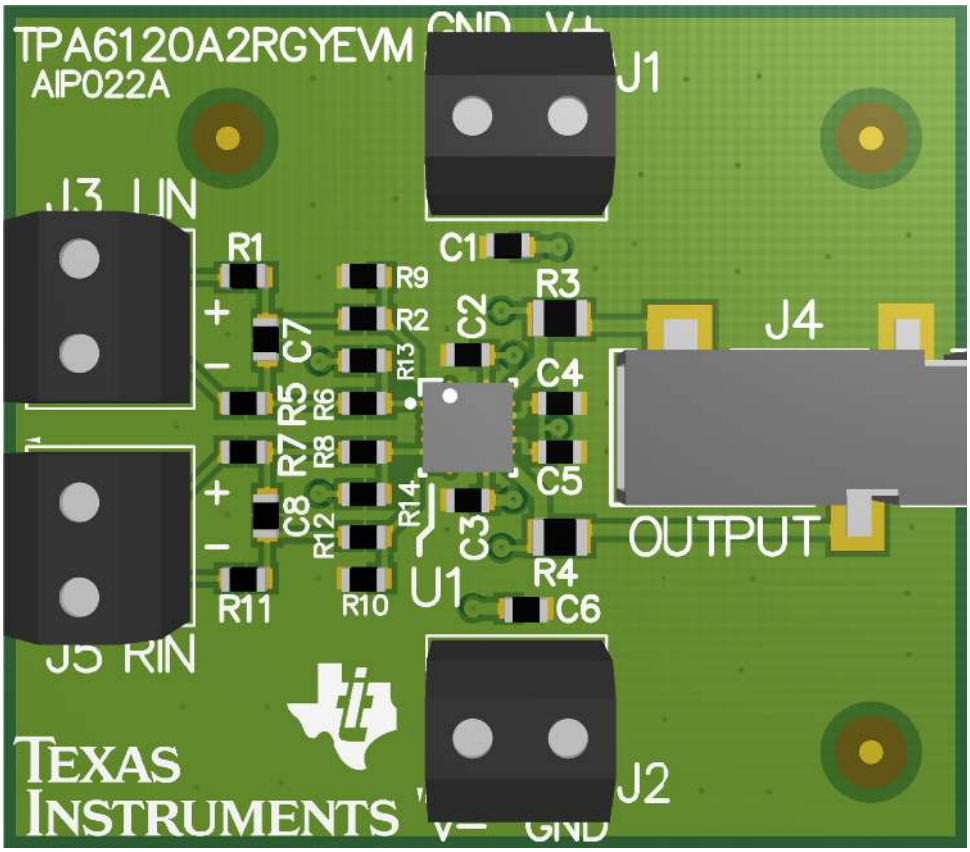

Figure 1. TPA6120A2RGY EVM Top Layer

3 Customizing the EVM

The TPA6120A2RGY EVM comes in a differential configuration with a gain of 1 V/V. However, the EVM is designed to be flexible, and can be converted to operate in single-ended inverting and noninverting configurations. The TPA6120A2RGY EVM can also be operated in a single power supply configuration.

3.1 Single-Ended Inverting Configuration

The TPA6120A2RGY EVM can operate in a single-ended inverting gain configuration without modification. To operate in single-ended mode with the unmodified EVM, simply put the signal line into the inverting terminal (–) and the ground line into the noninverting terminal (+). This yields an inverting configuration with a gain of –1 V/V.

The EVM can also be modified to operate in single-ended inverting only mode with a reduced BOM. To do this, short resistors R1, R2, R9 (for the left channel) and short R10, R11, and R12 (for the right channel). Put the signal line on the inverting terminal and the ground line on the noninverting terminal. This yields an inverting configuration with a gain of –1 V/V.

3.2 Single-Ended Noninverting Configuration

The EVM can operate in a single-ended noninverting gain configuration without modification by applying the signal line to the noninverting input and the ground line to the inverting input. This yields a gain of +1 V/V.

Another possible setup for noninverting configuration is to remove R9 (for the left channel) and R10 (for the right channel). Apply the signal line to the noninverting input and the ground line to the inverting input. This yields a gain of +2 V/V.

3.3 Special Note on Filtering and Capacitors C7 and C8

Capacitors C7 and C8 can be added into the EVM to form a low-pass filter into the amplifier. A typical application for this is to block out the band noise caused by the output of a DAC. When selecting capacitance values, the cut-off frequency of the filter becomes $1/(\pi \times R \times C)$ instead of $1/(2\pi \times R \times C)$ because the capacitor is connected differentially, which halves the required capacitance.

3.4 Special Note on Gain and Input Configurations

The TPA6120A2RGY high-fidelity audio power amplifier has two separate channels, left and right. It is not necessary to operate each channel in the same configuration. For test purposes, it may be desirable to operate the left channel with a noninverting configuration, and the right channel with an inverting configuration. One channel may be configured to operate with differential inputs while the other channel with single-ended inputs. The TPA6120A2RGY EVM allows for this flexibility. From a listening standpoint, the best audio performance is achieved when both channels are operated with the same configuration. In this case, there is no sound difference between the left and right channels for the human ear to detect.

3.5 Single Power Supply Configuration

The TPA6120A2RGY EVM was not optimized for single power supply operation. To operate in this mode, the V– terminal must be connected to GND. DC-blocking capacitors must be used at the outputs to prevent large amounts of dc current from flowing through the headphones due to the high midrail bias. Likewise, dc-blocking capacitors must be used at the input. R9 and R10 must be removed. The positive input nodes must be biased to midrail. Resistors R9 and R10 tie the positive node to ground.

4 EVM Circuit and Layout

The TPA6120A2RGY EVM layout was carefully planned to minimize the capacitance and inductance detected by the output and input pins of the amplifier.

This chapter includes the EVM layout, the TPA6120A2RGY EVM component selection, schematic, and BOM.

4.1 Layout Guidelines

Use the following guidelines during layout:

- Keep layout tight to minimize layout parasitics (that is, keep traces as short as possible and do not cross signal lines, if possible)
- Maintain symmetry in the layout to maximize common-mode rejection (CMR)
- Maximize copper area connection to the PowerPad for best heat dissipation performance (if cutting the ground plane, make cuts radially and not circularly)
- Remove ground plane from inputs to minimize stray capacitance

4.2 TPA6120A2RGY EVM PCB Layouts

Figure 2 shows the top copper layer of the TPA6120A2RGY EVM. The RCA jacks at the inputs are configured to short to ground when no plug is inserted. The noninverting configuration of the EVM requires that RIN. and LIN. be at ground. Rather than have the signal go through the long signal trace to get to the input jacks, 0-Ω resistors R11 and R12 are used to provide a connection to ground much closer to the device.

A star point for ground should be chosen. For the TPA6120A2RGY EVM, the ground terminal of the board is (J7). Current paths to the star ground should be as direct as possible.

Figure 3 through Figure 5 illustrate other TPA6120A2RGY EVM copper layers.

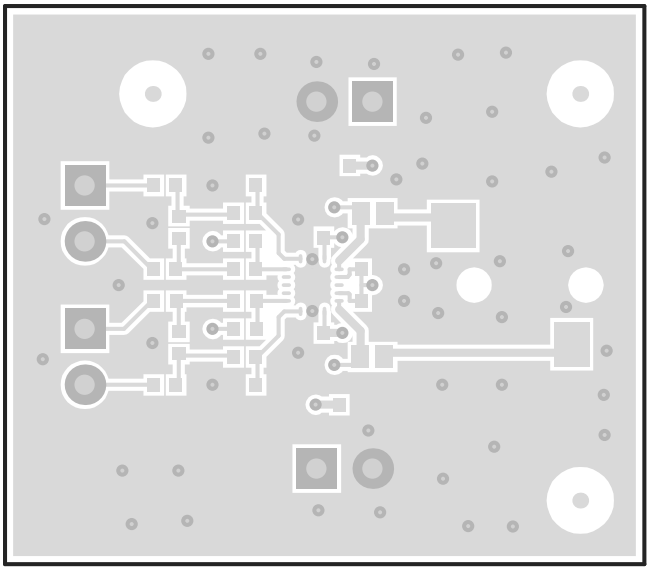

Figure 2. TPA6120A2RGY EVM Top Copper Layer

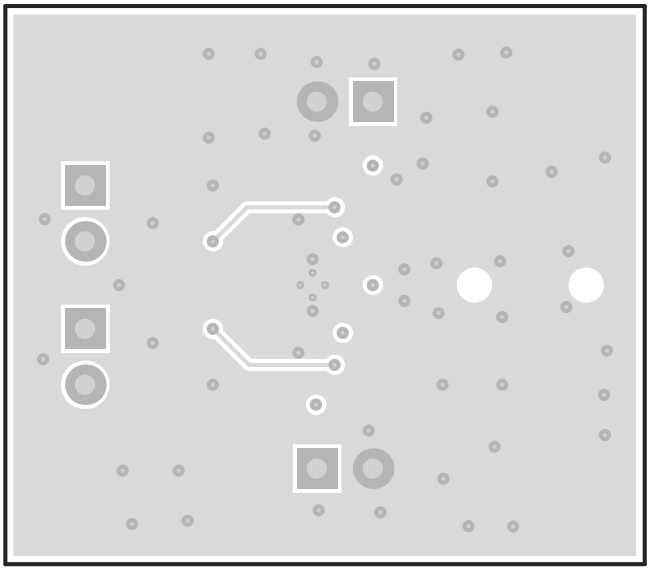

Figure 3. TPA6120A2RGY EVM Middle Layer 1

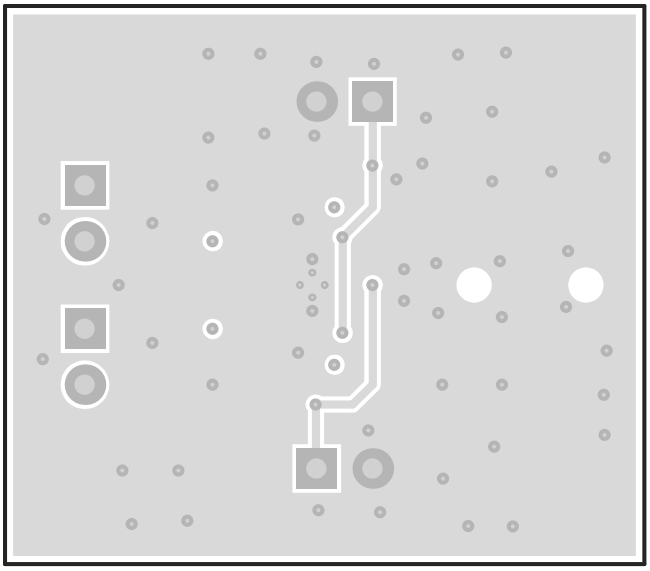

Figure 4. TPA6120A2RGY EVM Middle Layer 2

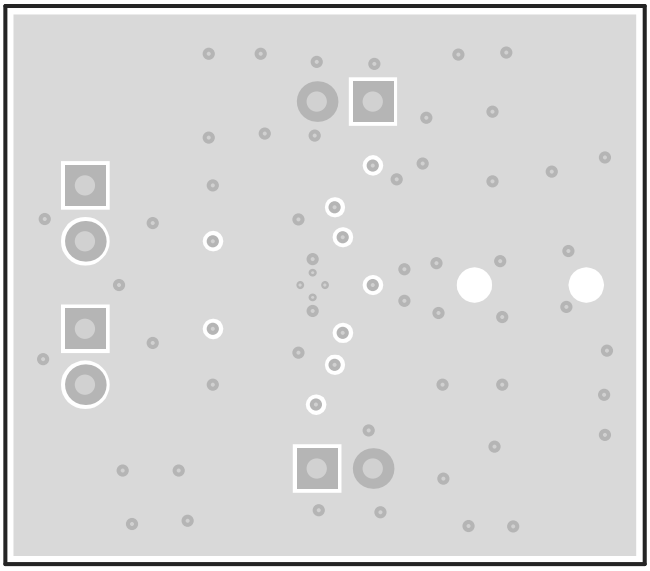

Figure 5. TPA6120A2RGY EVM Bottom Layer

4.3 Schematic

Figure 6 illustrates the TPA6120A2RGY EVM schematic.

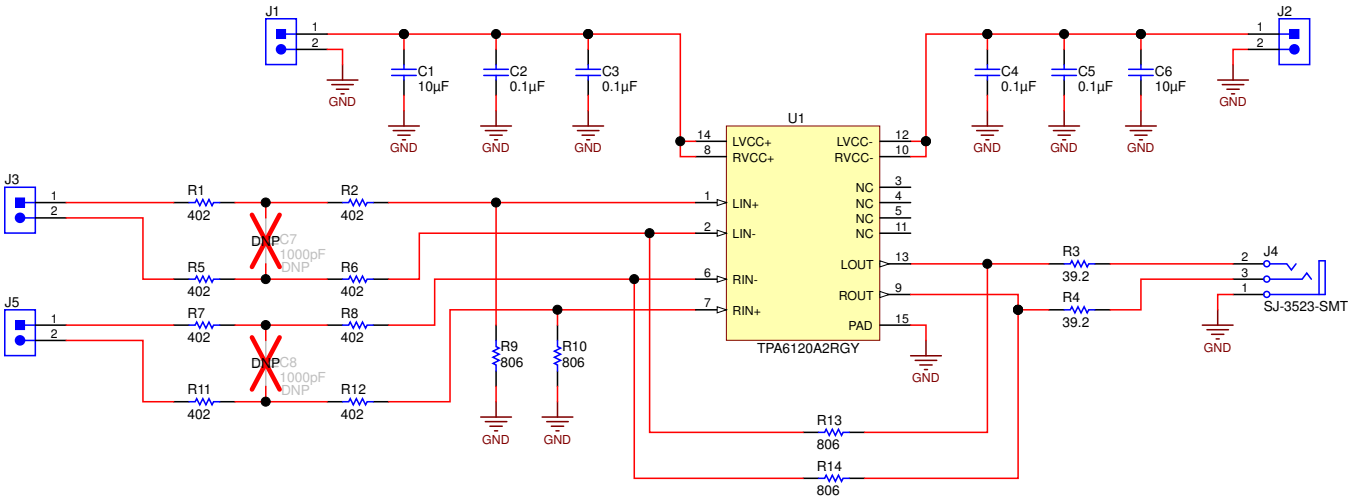

Figure 6. TPA6120A2RGY EVM Schematic

4.4 Bill of Materials

Table 2 list the BOM for this EVM.

Table 2. TPA6120A2RGY EVM Bill of Materials(1)

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer
!PCB	1		Printed Circuit Board		AIP022	Any
C1	1	10uF	CAP, CERM, 10uF, 25V, +/-20%, X5R, 0603	0603	C1608X5R1E106M080AC	TDK Corporation
C2, C3, C4, C5	4	0.1uF	CAP, CERM, 0.1uF, 25V, +/-10%, X7R, 0603	0603	GRM188R71E104KA01D	MuRata
C6	1	10uF	CAP, CERM, 10uF, 25V, +/-20%, X5R, 0603	0603	GRM188R61E106MA73	MuRata
H1, H2, H3, H4	4		Bumpon, Hemisphere, 0.25 X 0.075, Clear	75x250 mil	SJ5382	3M
J1, J2, J3, J5	4		Terminal Block, 6A, 3.5mm Pitch, 2-Pos, TH	7.0x8.2x6.5mm	ED555/2DS	On-Shore Technology
J4	1		Connector, Audio Jack, 3.5mm, Stereo, SMD	Audio Jack SMD	SJ-3523-SMT	CUI Inc.
R1, R2, R5, R6, R7, R8, R11, R12	8	402	RES, 402 ohm, 1%, 0.1W, 0603	0603	RC0603FR-07402RL	Yageo America
R3, R4	2	39.2	RES, 39.2 ohm, 1%, 0.125W, 0805	0805	CRCW080539R2FKEA	Vishay-Dale
R9, R10, R13, R14	4	806	RES, 806 ohm, 1%, 0.1W, 0603	0603	CRCW0603806RFKEA	Vishay-Dale
U1	1		HIGH FIDELITY HEADPHONE AMPLIFIER, RGY0014A	RGY0014A	TPA6120A2RGY	Texas Instruments
C7, C8	0	1000pF	CAP, CERM, 1000pF, 25V, +/-5%, C0G/NP0, 0603	0603	GRM1885C1E102JA01D	MuRata
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	Fiducial	N/A	N/A

(1) Unless otherwise noted, all parts may be substituted with equivalents.

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- 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.

Industry Canada Compliance (English)

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.

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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.

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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.

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

Concernant les EVMs avec antennes détachables

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

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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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