TPA3140D2EVM User's Guide

This user's guide describes the operation of the evaluation module for the TPA3140D2. The user's guide also provides design information such as the schematic, BOM, and PCB layout.

Contents

List of Figures

List of Tables

1 Overview

The TPA3140D2 EVM customer evaluation module demonstrates the integrated circuits TPA3140D2 from Texas Instruments (TI).

The TPA3140D2 is a 10-W (per channel) efficient stereo digital amplifier power stage for driving 2 bridge-tied speakers.

This document covers EVM specifications and design documentation that includes schematics, parts list and layout design.

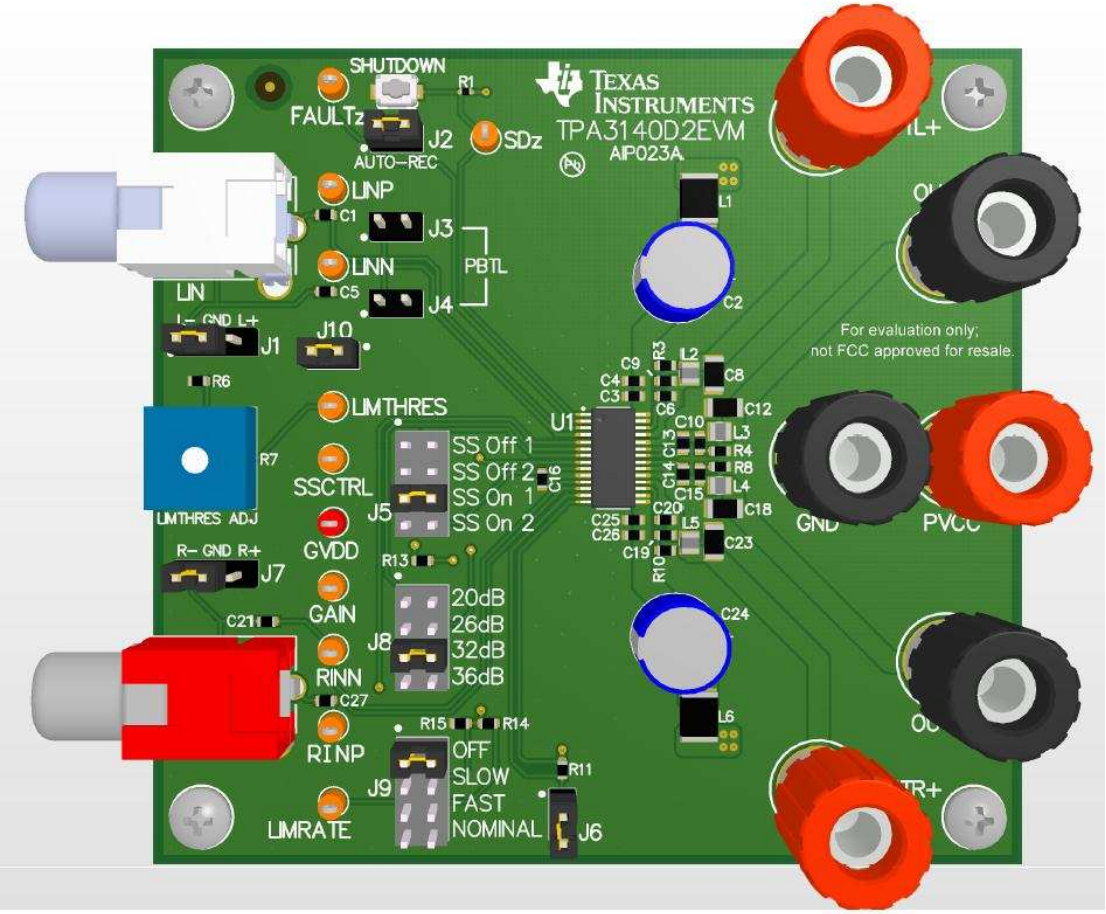

Figure 1. TAS3140D2 PCB

Table 1. TPA3140D2EVM Specification

KEY PARAMETERS	VALUE
Power Supply Voltage	4.5 V to 14.4
Number of Channels	2 Bridge Tied Load (BTL) Stereo
Load Impedance	4 Ω (12 V) to 6 Ω (> 12 V)
Output Power BTL	10 W per channel into a 8 Ω load

2 Operation

This chapter describes the TPA3140D2EVM board in regards to power supply and system interfaces. The chapter provides information regarding handling and unpacking, absolute operating conditions, and a description of the factory default switch and jumper configuration.

The following is a step–by–step guide to configuring the TPA3140D2EVM for device evaluation.

2.1 Electrostatic Discharge Warning

Many of the components on the TPA3140D2EVM are susceptible to damage by electrostatic discharge (ESD). Customers 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 may result in damage to EVM components.

2.2 Unpacking the EVM

On opening the TPA3140D2EVM package, ensure that the following items are included:

- 1 piece TPA3140D2EVM board using one TPA3140D2.

If either of these items is missing, contact the Texas Instruments Product Information Center nearest you to inquire about a replacement.

2.3 Power Supply Setup

A single power supply is required to power up the EVM. Since most of the pins are PVCC compliant, the PVCC supply can also be used to power the analog supply (AVCC) and can be used to pull up the logic pins for shutdown ($\overline{SD}$) control, and fault detection ($\overline{FAULT}$).

Table 1. Power Requirements

DESCRIPTION	VOLTAGE RANGE	CURRENT REQUIREMENT	MINIMUM WIRE SIZE
PVCC	4.5 to 14.4 V	4 A	24 AWG

CAUTION

Applying voltages above the limitations given in table above may cause permanent damage to your hardware.

2.4 Evaluation Module 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 14.4 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 (OUTL+ and OUTL–) and (OUTR+ and OUTR–).
2. 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. Apply a single input, differential or single-ended, to the RIN RCA phono plug and tie LINP and LINN directly to Ground (without capacitors) via J3 and J4.

2.6 Power Up

1. Select the desired gain and mode of operation via J5, J8, and J9 headers. Verify correct voltage and input polarity and turn the external power supplies ON. The EVM should begin operation.
2. Adjust the audio source for the correct volume.

2.7 Automatic Gain Control (AGC)

The AGC allows the adjustment of the maximum output voltage without signal clipping for enhancement speaker protection and audio quality.

Gain limit threshold (LIMTHRES) adjust the input gain control with a fast attack such that the audio output is largely attenuated to highest unclipped possible amplitude such that excessive input signals will not result in hard distortion, and equally important it reduces the maximum output power as well as reduces the amount of high frequency audio energy fed to a tweeter in a 2-way speaker; thus, protecting the speaker and increase overall system reliability. Resistor pot R7 is used to adjust the gain limit threshold level. The user can adjust the R7 pot such that LIMTHRES voltage equals to GVDD to defeat the limit threshold.

The AGC release speed is set by an external voltage divider (J9) to select from fixed modes including disabling AGC (J9 = OFF, hard clip action operation as TPA3110D2 PLIMIT) as well as a selection between fast, nominal or slow rates.

2.8 Thermal Foldback

A thermal foldback circuit is implemented to enhance system reliability by reducing risk of thermal runaway and/or shutdown by reducing the amplifier's gain such that the output power is reduced. The thermal foldback is activated when a thermal trip point at a lower level than the OTE (Over Temperature Error) trip point is tripped. Thermal foldback acts as the AGC function, but with an attack speed chosen to match thermal time constants in a system with a TPA3140D2 mounted with a realistic PCB layout. Thermal foldback can be disabled with J9 set to OFF.

3 Design Documentation

3.1 TPA3140D2 EVM Schematic

Figure 2 shows the TPA3140D2 EVM schematic.

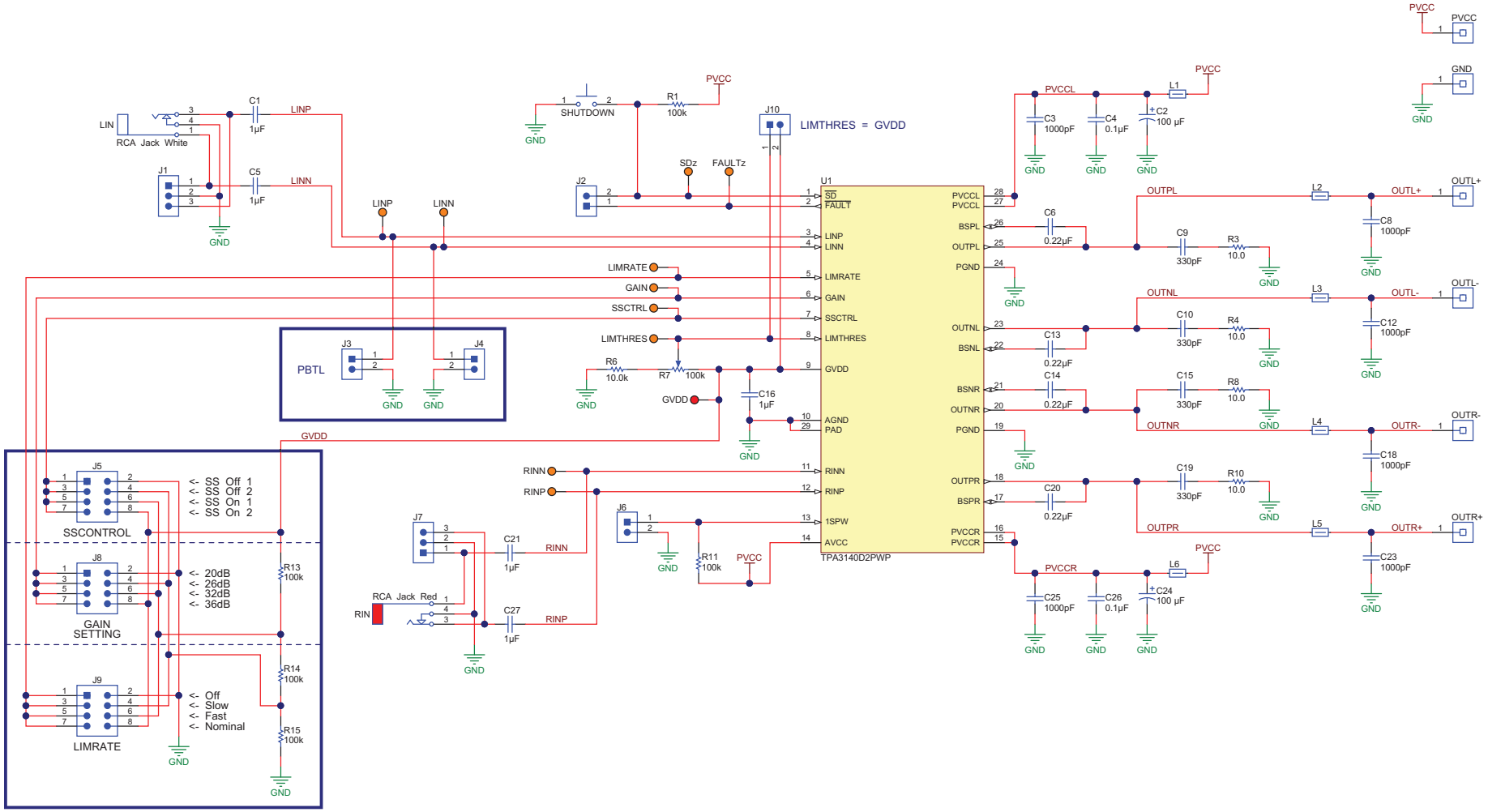

Figure 2. TPA3140D2 EVM Schematic

3.2 TPA3140D2 EVM PCB Layers

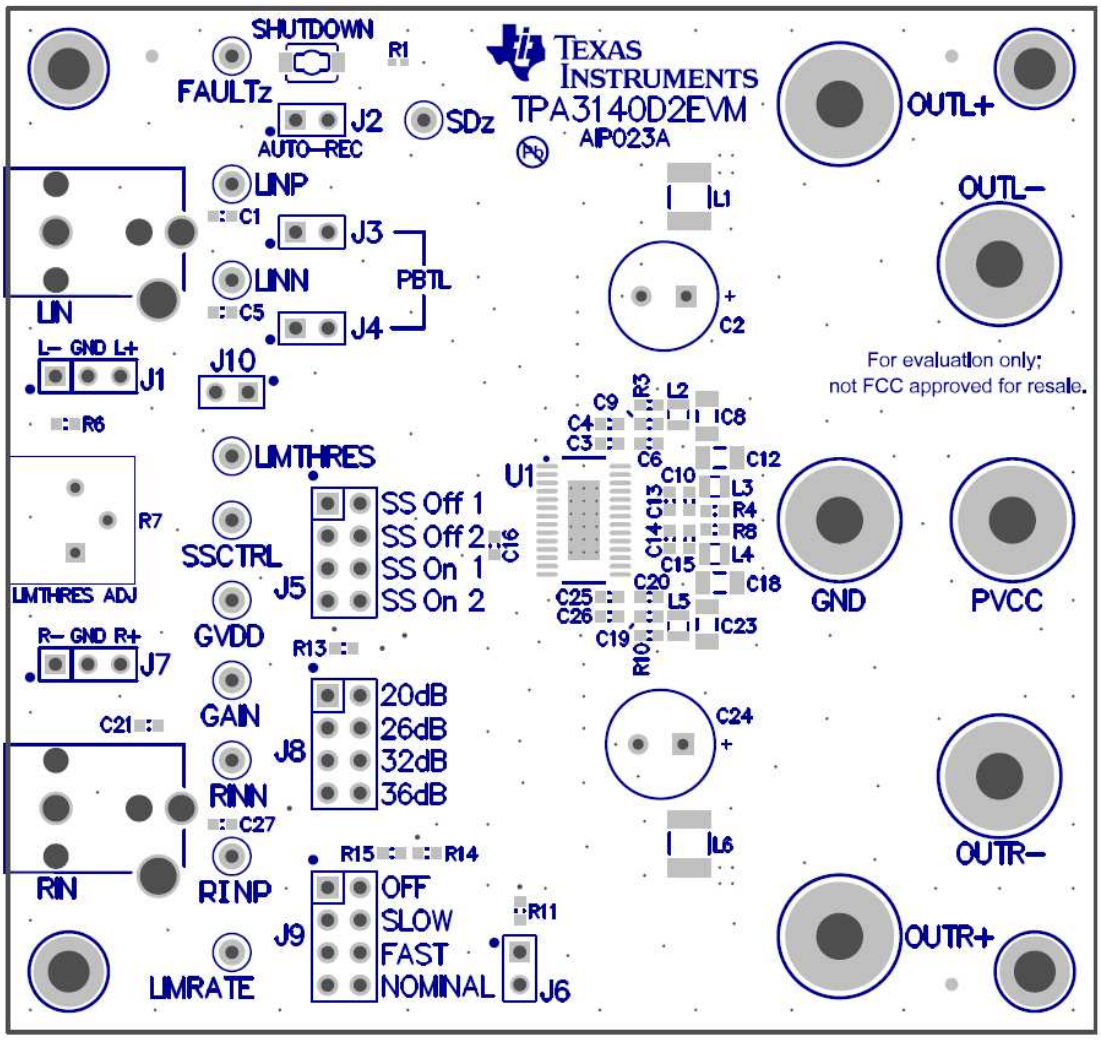

Figure 3. TPA3140D2 Assembly Drawing

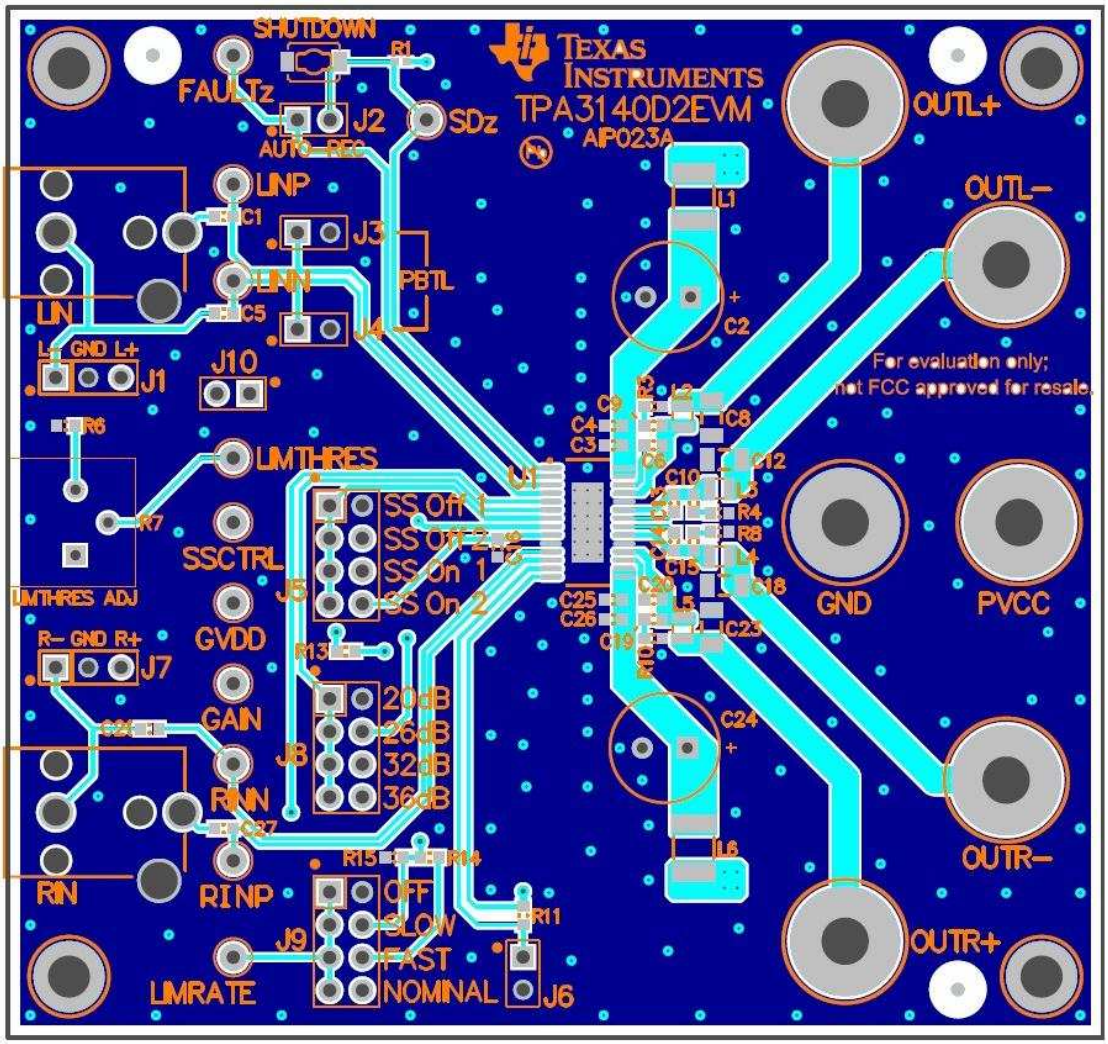

Figure 4. TPA3140D2 EVM Top Side Layout

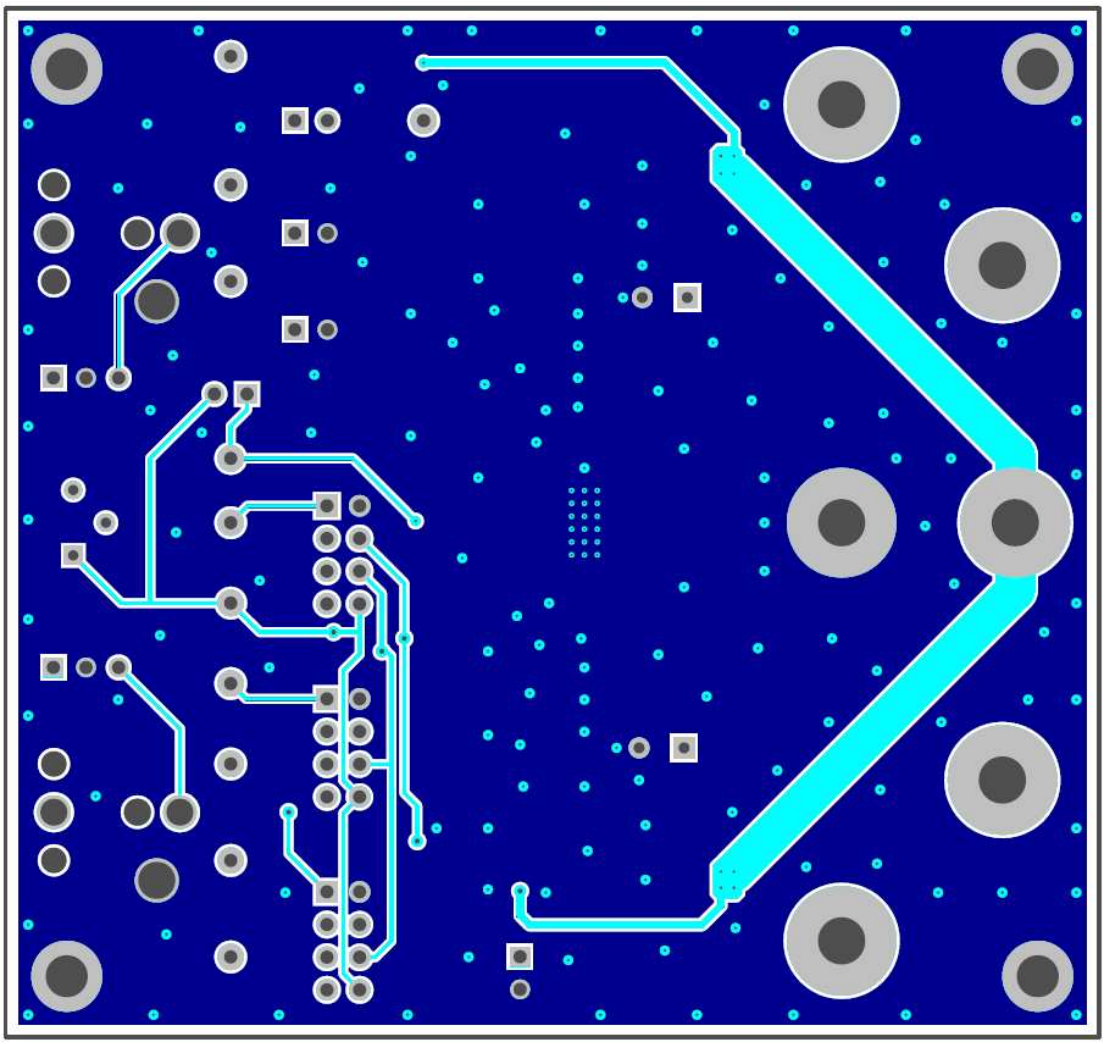

Figure 5. TPA3140D2 EVM Bottom Side Layout

3.3 TPA3140D2EVM Bill of Materials

Table 2 lists the TPA3140D2EVM bill of materials.

Table 2. TPA3140D2EVM Parts List(1)

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer	Alternate Part Number	Alternate Manufacturer
!PCB1	1		Printed Circuit Board		AIP023	Any		
C1, C5, C16, C21, C27	5	1uF	CAP, CERM, 1uF, 16V, +/-10%, X7R, 0603	0603	GRM188R71C105KA12D	MuRata		
C2, C24	2	100uF	CAP, AL, 100uF, 50V, +/-20%, 0.17 ohm, TH	8.0x10.5mm	UHE1H101MPD	Nichicon		
C3, C25	2	1000pF	CAP, CERM, 1000pF, 50V, +/-5%, C0G/NP0, 0603	0603	GRM1885C1H102JA01D	MuRata		
C4, C26	2	0.1uF	CAP, CERM, 0.1uF, 50V, +/-10%, X7R, 0603	0603	GRM188R71H104KA93D	MuRata		
C6, C13, C14, C20	4	0.22uF	CAP, CERM, 0.22 µF, 25 V, +/- 10%, X7R, 0603	0603	GRM188R71E224KA88D	MuRata		
C8, C12, C18, C23	4	1000pF	CAP, CERM, 1000pF, 100V, +/-10%, X7R, 1206	1206	12061C102KAT2A	AVX		
C9, C10, C15, C19	4	330pF	CAP, CERM, 330pF, 50V, +/-5%, C0G/NP0, 0603	0603	GRM1885C1H331JA01D	MuRata		
FAULTz, GAIN, LIMRATE, LIMTHRES, LINN, LINP, RINN, RINP, SDz, SSCTRL	10	Orange	Test Point, Miniature, Orange, TH	Orange Miniature Testpoint	5003	Keystone		
GND, OUTL-, OUTR-	3		Binding Post, BLACK, TH	11.4x27.2mm	7007	Keystone		
GVDD	1	Red	Test Point, Miniature, Red, TH	Red Miniature Testpoint	5000	Keystone		
H1, H2, H3, H4	4		MACHINE SCREW PAN PHILLIPS M3 5mm	Screw M3 Phillips head	MPMS 003 0005 PH	B&F Fastener Supply		
H5, H6, H7, H8	4		Standoff, Hex, 12mm, M3, Aluminum	Aluminum M3 12mm Hex Standoff	24434	Keystone		
J1, J7	2		Header, 100mil, 3x1, Tin, TH	Header, 3 PIN, 100mil, Tin	PEC03SAAN	Sullins Connector Solutions		
J2, J3, J4, J6, J10	5		Header, 100mil, 2x1, Tin, TH	Header, 2 PIN, 100mil, Tin	PEC02SAAN	Sullins Connector Solutions		
J5, J8, J9	3		Header, 100mil, 4x2, Tin, TH	Header, 4x2, 100mil, Tin	PEC04DAAN	Sullins Connector Solutions		
L1, L6	2	100 ohm	Ferrite Bead, 100 ohm @ 100MHz, 8A, 2-Pin SMD, Body 4.5 x 3.2 mm, Height 2.55 mm	2-Pin SMD, Body 4.5 x 3.2 mm, Height 2.55 mm	HI1812V101R-10	Laird-Signal Integrity Products		
L2, L3, L4, L5	4	300 ohm	Ferrite Bead, 300 ohm @ 100 MHz, 3.1 A, 0806	0806	NFZ2MSM301SN10L	MuRata		
LIN	1		RCA Jack, White, R/A, TH	PC Mount Phono Jack-White, TH	970	Keystone		
OUTL+, OUTR+, PVCC	3		Binding Post, RED, TH	11.4x27.2mm	7006	Keystone		
R1	1	100k	RES, 100k ohm, 1%, 0.063W, 0402	0402	CRCW0402100KFKED	Vishay-Dale		
R3, R4, R8, R10	4	10.0	RES, 10.0 ohm, 1%, 0.1W, 0603	0603	CRCW060310R0FKEA	Vishay-Dale		
R6	1	10.0k	RES, 10.0k ohm, 0.1%, 0.1W, 0603	0603	RG1608P-103-B-T5	Susumu Co Ltd		
R7	1	100k	TRIMMER, 100k ohm, 0.5W, TH	375x190x375mil	3386P-1-104LF	Bourns		
R11, R13, R14, R15	4	100k	RES, 100k ohm, 1%, 0.1W, 0603	0603	RC0603FR-07100KL	Yageo America		
RIN	1		RCA Jack, Red, R/A, TH	PC Mount Phono Jack-Red, TH	971	Keystone		
SH-J1, SH-J2, SH-J5, SH-J6, SH-J7, SH-J8, SH-J9, SH-J10	8	1x2	Shunt, 100mil, Gold plated, Black	Shunt	969102-0000-DA	3M	SNT-100-BK-G	Samtec
SHUTDOWN	1		Switch, Tactile, SPST-NO, 0.05A, 12V, SMT	Switch, 4.4x2x2.9 mm	TL1015AF160QG	E-Switch		
U1	1		10W/4O/12V Stereo BTL Power Analog Input Output Amplifier, PWP0028E	PWP0028E	TPA3140D2PWP	Texas Instruments		None
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	Fiducial	N/A	N/A		

(1) Unless otherwise noted in the Alternate PartNumber and/or Alternate Manufacturer columns, all parts may be substituted with equivalents.

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      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*

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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.

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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.

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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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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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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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