

TPA2038D1 Audio Power Amplifier Evaluation Module

The TPA2038D1 evaluation module (EVM) features a Class-D, mono audio power amplifier capable of delivering 1.4 W into 8 Ω and 2.5 W into 4 Ω at 1% THD+N (YFF package). Amplifier gain is selectable to either 6 dB or 12 dB. The EVM comprises all necessary components to evaluate the TPA2038D1. All components are Pb-free.

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1 Introduction

This section provides an overview of the Texas Instruments (TI) TPA2038D1 NanoFree™ WCSP audio amplifier evaluation module (TPA2038D1EVM). It includes a brief description of the module and a list of EVM specifications.

1.1 TPA2038D1EVM Specifications

Supply voltage range, V_{DD}	2.5 V to 5.5 V
Power supply current rating required	2.5 A
Continuous output power, P_O : 4- Ω BTL, $V_{DD} = 5$ V, THD+N = 10%	3.2 W
Audio input voltage, V_I	0 V to V_{DD}
Minimum load impedance, Z_L	4 Ω

2 Operation

This section describes how to operate the TPA2038D1EVM.

2.1 Quick Start for Stand-Alone Operation

Use the following steps when operating the TPA2038D1EVM stand-alone or when connecting the EVM into existing circuits or equipment.

2.1.1 Power and Ground

1. Ensure that the external power sources are set to OFF.
2. Set the power supply voltage between 2.5 V and 5.5 V. When connecting the power supply to the EVM, attach the ground connection to the GND header pin first, and then connect the positive supply to the VDD header pin. Verify that the connections are made to the correct header pins.

2.1.2 Inputs and Outputs

2.1.2.1 Audio

1. Ensure that the audio source is set to the minimum level.
2. Connect the audio source to the RCA input socket, IN. For differential audio input sources, leave the JP IN header open. For single-ended sources, insert JP IN jumper, connecting IN- to ground through input capacitor C2.
3. Connect a speaker (4 Ω -32 Ω) between the output banana jacks OUT+ and OUT-.

2.1.2.2 Enable Control

The TPA2038D1 has an active-high enable pin EN. A logic high on this pin places the device in the operating mode, and a logic low on this pin places the device in the shutdown mode. Press and hold pushbutton S1 on the EVM to place the TPA2038D1 in shutdown mode. Release pushbutton S1 to resume normal operation.

2.1.2.3 Gain

The header labeled GAIN set the TPA2038D1 Class-D amplifier gain. R2 pulls up the TPA2038D1 gain pin (ball A2) to VDD when the 2 mm jumper is removed.

1. For +12 dB gain, connect a jumper to the GAIN header.
2. For +6 dB gain, leave the GAIN header open.

2.1.2.4 Output filter

Test points TPOUT+ and TPOUT- are low-pass filtered TPA2038D1 OUT+ and OUT- outputs. Populate filter components R4, R5, C9 and C10 (see [Table 1](#) for typical components) to use the filter. This filter reduces measurement error from TPA2038D1 Class-D switching when using equipment such as the Audio Precision.

2.2 Power Up

1. Verify the correct connections as described in Sections 2.1.1 and 2.1.2.
2. Verify the voltage setting of the power supply is between 2.5 V and 5.5 V, and turn on the power supply. Proper operation of the EVM begins.
3. Adjust the audio signal source as needed.

3 Reference

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

3.1 TPA2038D1EVM PCB Layers

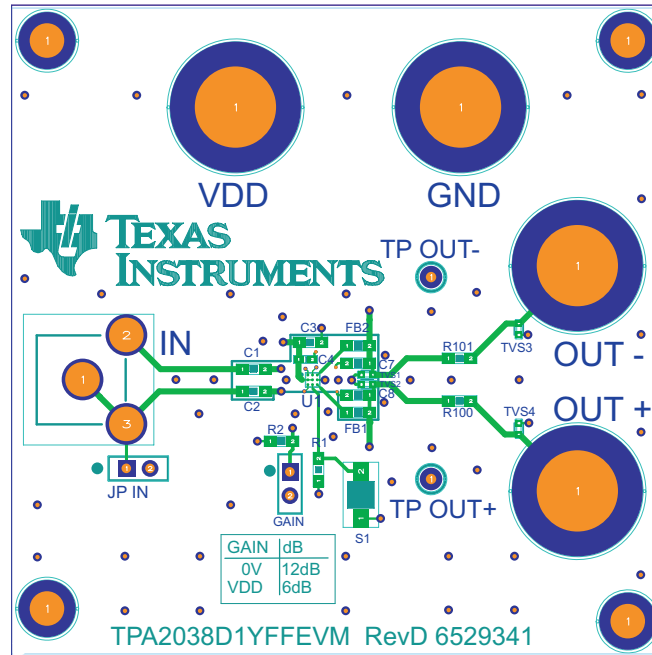


Figure 1. Top Layer

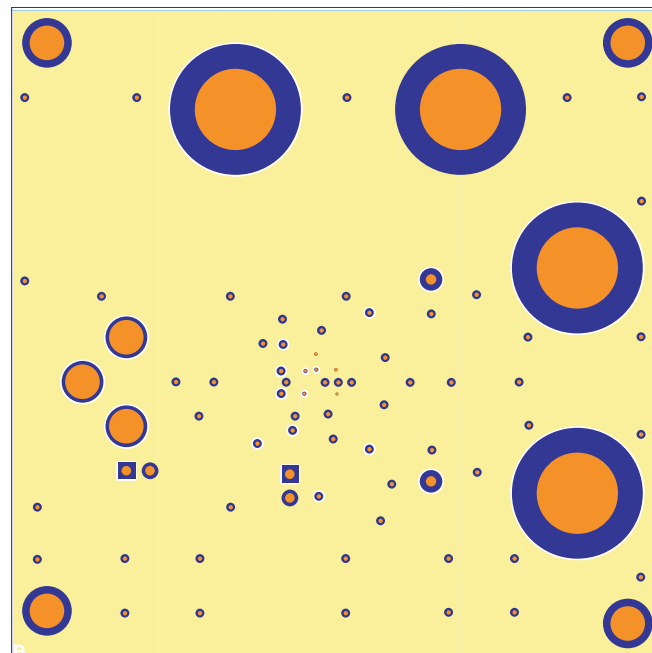


Figure 2. Middle Layer 1 - Ground

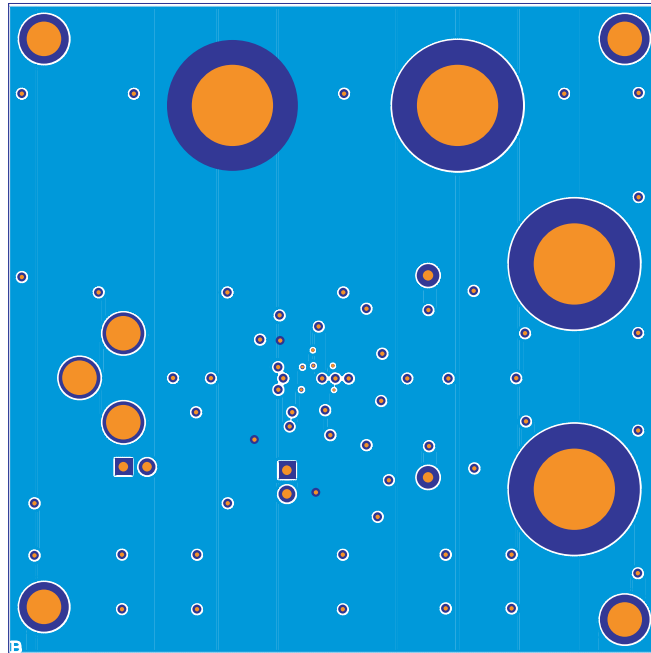


Figure 3. Middle Layer 2 - Power

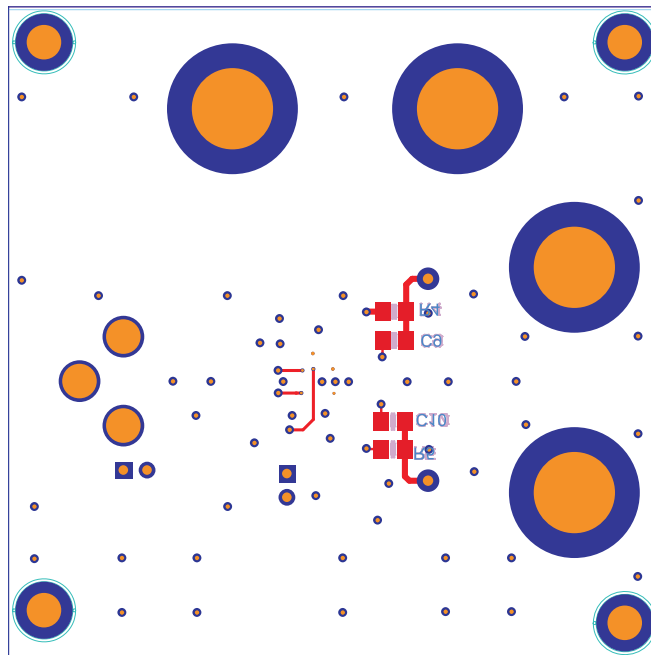


Figure 4. Bottom Layer

3.3 TPA2038D1 Audio Power Amplifier Evaluation Module Parts List

Table 1. TPA2038D1EVM Parts List

Part No.	Description	Size	Qty	Manufacturer Part Number
U1	3.2 W MONO CLASS-D AMP WCSP9-YFF ROHS		1	Texas Instruments, TPA2038D1YFF
TVS1, TVS2	TRANSIENT VOLTAGE SUPPRESSION BIDIR ILINE 8 V TSLP-2-17 ROHS (NOT POPULATED)		0	Infineon, ESD8V0R1B-02LRHE6327INCT-ND or equiv.
TVS3, TVS4	NOT POPULATED		0	
C1, C2	CERAMIC 0.1UFD 25 V 10% X5R ROHS	0603	2	AVX, 06033D104KAT2A
C3	CERAMIC 10 UFD 6.3 V 20% X5R ROHS	0603	1	Panasonic, ECJ-1VB0J106M
C4	CERAMIC 0.1 UFD 16 V 10% X7R ROHS	0402	1	Taiyo Yuden, GRM155R71C104KA88D
C7, C8	CERAMIC 1000 PFD 100 V 5% COG ROHS	0603	2	TDK, C1608C0G2A102J
C9, C10	CERAMIC 4700 PFD 50 V 5% X7R ROHS	0805	2	AVX, 08055C472JAT2A
R1, R2	100K OHM 1/10 W 1% ROHS	0603	1	Panasonic, ERJ-3EKF1003V
R4,R5	1.0K OHM 1/8 W 5% ROHS	0805	2	Panasonic, ERJ-6GEYJ102V
R100, R101	0.0 OHM 1/10 W 5% ROHS	0603	2	Panasonic, ERJ-3GEY0R00V
FB1,FB2	FERRITE CHIP, 220 OHMS 2 A 100 MHZ SMD ROHS	0603	2	TDK, MPZ1608S221A
L1, L2	INDUCTOR CERAMIC 150 NH 390 MA 0.082 OHM 5% ROHS	0603	2	Coilcraft, 0603HP-R15XJLU
GAIN, JP IN	2.0 MM HEADER 2 PIN MALE, PCB STRAIGHT GOLD ROHS		1	Norcomp Inc., 26630201RP2
IN	JACK, RCA 3-PIN PCB-RA BLACK ROHS		1	Switchcraft, PJRAN1X1U01X
TP OUT+	PC TESTPOINT, RED, ROHS		1	Keystone Electronics, 5000K
TP OUT-	PC TESTPOINT, BLACK, ROHS		1	Keystone Electronics, 5001K
S1	SWITCH, MOM, 160G SMT 4x3 MM ROHS		1	E-Switch, TL1015AF160QG
GND, VDD, OUT+, OUT-	BINDING-POST,NONINS,THRU,ROHS		4	Emerson NPCS, J587
HW1, HW2, HW3, HW4	STANDOFF, 4-40 1/2 x 3/16 IN ALUM RND F-F		4	Keystone, 2027K
HW1, HW2, HW3, HW4	4-40 SCREW, STEEL 0.250 IN		4	Building Fasteners, H34

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During normal operation, some circuit components may have case temperatures greater than 60°C. The EVM is designed to operate properly with certain components above 60°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.

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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

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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.

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.

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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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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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