TPA2029D1 Audio Power Amplifier EVM

1 Introduction

1.1 Description

The TPA2029D1 is a mono, filter-free Class-D audio power amplifier with automatic gain control (AGC), dynamic range compression (DRC). The AGC and DRC functions enhance the perceived audio loudness, and at the same time prevent speaker damage from overdrive. Availability in the WCSP package makes TPA2029D1 an ideal choice for laptop and portable applications. The TPA2029D1 evaluation module (EVM) is a complete, stand-alone audio board. It contains the TPA2029D1 WCSP (YZF) Class-D audio power amplifier.

The TPA2029D1 evaluation module (EVM) is a complete stand-alone audio board. All components are Pb-free.

1.2 TPA2029D1EVM Specifications

Supply voltage range, V_{DD}	2.5 V to 5.5 V
Supply current, I_{DD}	1 A, maximum
Speaker amplifier output power per channel, P_O: 4Ω, V_{DD} = 5 V, THD+N = 1%	2 W

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2 Operation

2.1 Quick-Start List for Stand-Alone Operation

2.1.1 Speaker Amplifier

Follow these steps to use the TPA2029D1EVM stand-alone or when connecting it into existing circuits or equipment. Connections to the EVM can be made by inserting stripped wire or using banana plugs for the power supply and output connections. The inputs accept standard RCA plugs.

2.1.2 Power Supply

1. Ensure that all external power sources are set to OFF.
2. Connect an external regulated power supply adjusted to 5 V to the module VDD and GND banana jacks, taking care to observe marked polarity.

2.1.3 Evaluation Module Preparations

Inputs and Outputs

1. If connecting to a fully differential input or a grounded input (the shield of the RCA is GND), remove jumpers JP1 from the EVM. If connecting to a floating source like a portable CD, install jumpers JP1. After setting the JP1 jumper appropriately, connect the input source to the speaker inputs (IN) .
2. Connect a speaker across OUT+ and OUT-.

Control Inputs

1. **Enable:** Hold down switch EN to place the amplifier in shutdown. Release EN to reactivate the amplifier.
2. **AGC1/AGC2:** Together, these terminals determine the AGC setting of the amplifier. See Table 1. Installing the jumpers in position 0 sets the respective terminal to GND. Installing the jumpers in position 1 sets the respective terminals to VDD.

Table 1. Gain Settings

AGC1	AGC2	Function
0	0	AGC Function disabled
0	1	AGC Limiter Function enabled
1	0	AGC, Limiter, and Compression Functions enabled
1	1	AGC, Limiter, Compression, and Noise Gate Functions enabled

2.1.4 Power Up

1. Verify correct voltage and input polarity, and turn on the external power supplies.
   The EVM should begin operation.
2. Adjust the input signal.
3. Adjust the control inputs to the desired settings.
4. Adjust the amplifier AGC setting by installing/removing the jumpers, AGC1 and AGC2.

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3 Schematic and Bill of Materials

3.1 TPA2029D1EVM Schematic

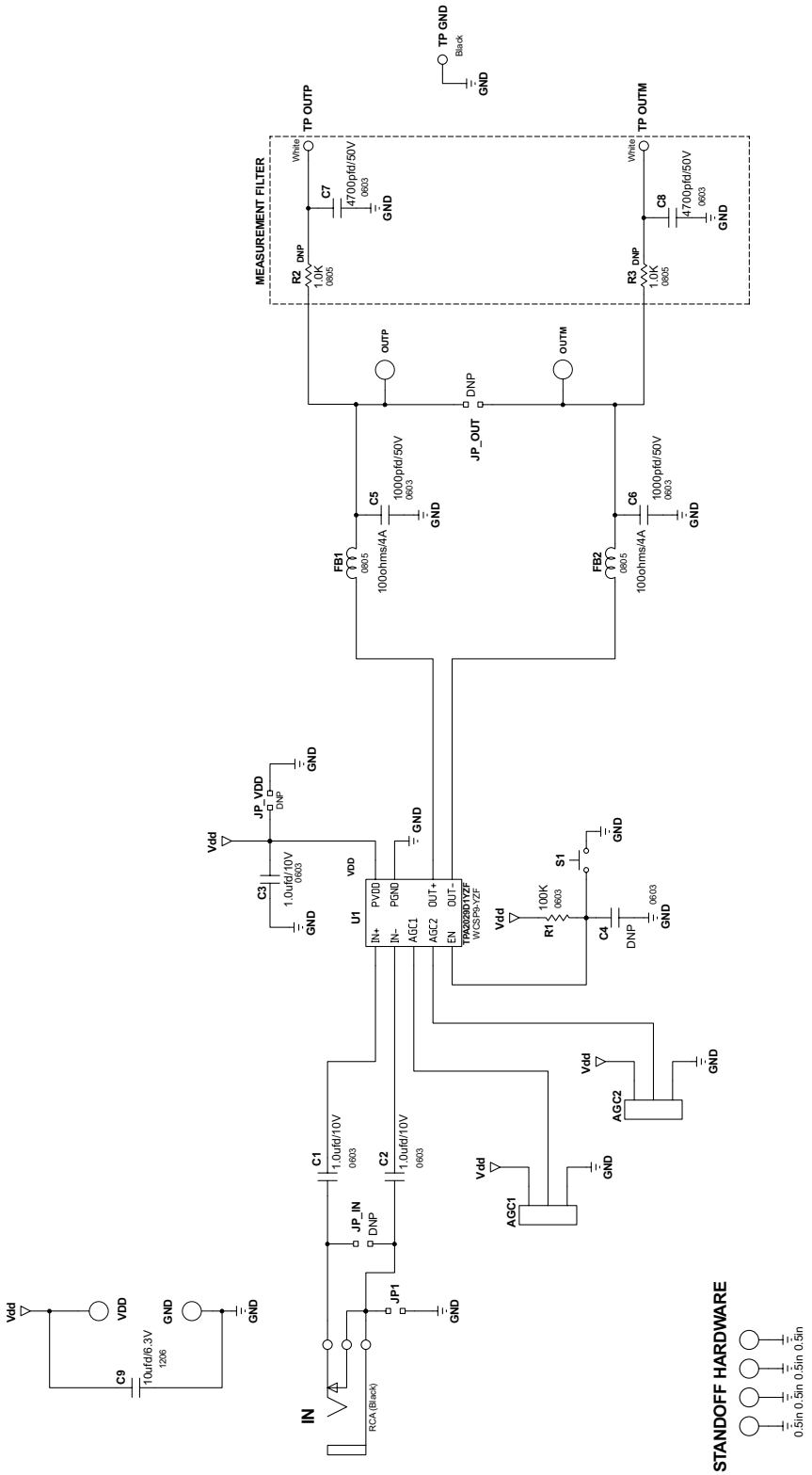


Figure 1. EVM Schematic

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3.2 TPA2029D1EVM PCB Layers

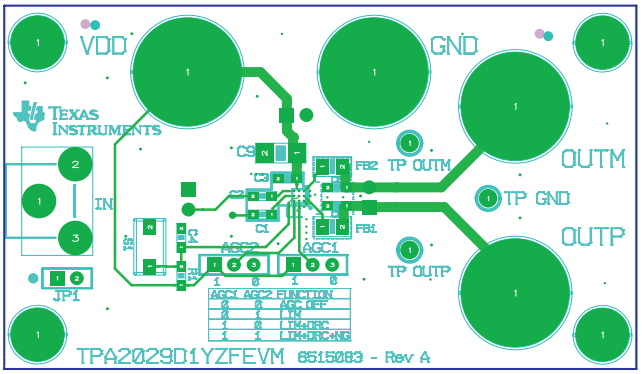


Figure 2. Top Side Layout

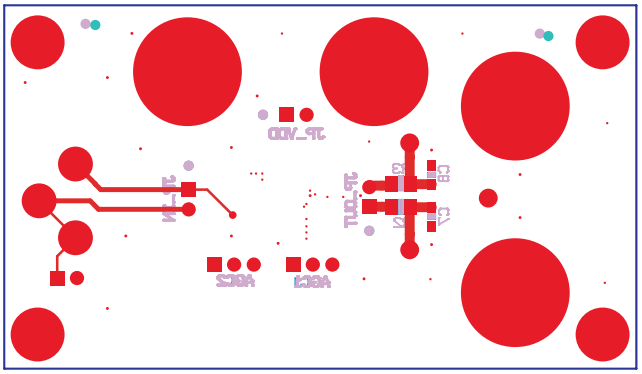


Figure 3. Bottom Side Layout

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3.3 TPA2029D1EVM Bill of Materials

Description	RefDes	QTY	MFG	MFG Part#	Vendor	Vendor Part#
TI-SEMICONDUCTORS						
Stereo AGC Class-D amplifier	U1	1	TEXAS INSTRUMENTS	TPA2029D1YZF	TEXAS INSTRUMENTS	TPA2029D1YZF
Description	**RefDes**	**QTY**	**MFG**	**MFG Part#**	**Vendor**	**Cut Tape Part#**
CAPACITORS						
CAP 1000PFD 50V CERM 0603 COG ROHS	C16, C17, C18, C19	4	TDK CORP.	C1608C0G1H102J	DIGI-KEY	445-1293-2
CAP 4700PFD 50V CERM 0603 X7R	C20, C21, C22, C23	4	PANASONIC	ECJ-1VB1H472K	DIGI-KEY	PCC1780TR
CAP .047UFD 25V CERM 0603 X7R ROHS	C2, C3, C4, C5	4	PANASONIC	ECJ-1VB1E473K	DIGI-KEY	PCC1771TR
CAP 0.1UFD 25V CERM 0603 X5R ROHS	C10, C11, C12, C14	4	PANASONIC	06033D104KAT2A	DIGI-KEY	478-1244-2
CAP 1.0UFD 10V 10% CERM 0603 X5R ROHS	C6, C7, C8, C9, C13, C15	6	PANASONIC	ECJ-1VB1A105K	DIGI-KEY	PCC2174TR
CAP 10UFD 16V 10% CERM 1206 X5R ROHS	C1	1	KEMET	C1206C106K4PACTU	DIGI-KEY	399-5091-2
RESISTORS						
RES 100 OHM 1/10W 1% SMD 0603 ROHS	R1, R2, R3, R4	4	VISHAY	CRCW0603100RFKEA	DIGI-KEY	541-100HTR
RES 1.00K OHM 1/16W 1% SMD 0603	R6, R7, R8, R9	4	PANASONIC	ERJ-3EKF1001V	DIGI-KEY	P1.00KHTR
RES 100K OHM 1/10W 5% SMD 0603 ROHS	R5	1	PANASONIC	ERJ-3GEYJ104V	DIGI-KEY	P100KGTR
FERRITE BEADS						
FERRITE BEAD, 100 Ohms 4A 100MHz SM0805	L1, L2, L3, L4	4	TDK CORPORATION	MPZ2012S101A	DIGI-KEY	445-1567-2
HEADERS AND JACKS						
HEADER, 2 PIN MALE, PCB STRAIGHT GOLD ROHS	J1, J2, J3	3	SULLINS	PBC02SAAN	DIGI-KEY	S1011E-02
HEADER 2 PIN, PCB 2.0MM ROHS	JP1, JP2	2	NORCOMP	26630201RP2	DIGI-KEY	2663S-02
HEADER 3 PIN, PCB 2.0MM ROHS	AGC1, AGC2	2	NORCOMP	26630301RP2	DIGI-KEY	2663S-03
JACK, RCA, PCB-RA, BLACK	INL	1	SWITCHCRAFT	PJRAN1X1U01	NEWARK	16C1858
JACK, RCA, PCB-RA, RED	INR	1	SWITCHCRAFT	PJRAN1X1U03	NEWARK	16C1860
TESTPOINTS AND SWITCHES						
PC Testpoint, Black	GND, GND	2	KEYSTONE ELECTRONICS	5001	DIGI-KEY	5001K
PC Testpoint, White	TP1, TP2, TP3, TP4	4	KEYSTONE ELECTRONICS	5002	DIGI-KEY	5002K
Switch, Momentary SMT-Short, Black Tab, 240g	EN	1	PANASONIC	EVQ-PPDA25	DIGI-KEY	P8087STR
BINDING POSTS						
BINDING POST, 15A, UNINSULATED	OUTL-, OUTL+, OUTR-, OUTR+	4	JOHNSON COMPONENTS	111-2223-001	DIGI-KEY	J587
BINDING POST, BLACK, 15A ECONO	GND	1	KEYSTONE ELECTRONICS	7007	DIGI-KEY	7007K
BINDING POST, RED, 15A ECONO	VDD	1	KEYSTONE ELECTRONICS	7006	DIGI-KEY	7006K
SHUNTS						
SHUNT, BLACK AU FLASH 2 MM ROHS	JP1, JP2, AGC1, AGC2	4	NORCOMP INC.	810-002-SP2L001	DIGI-KEY	SP2-001E
STANDOFFS AND HARDWARE						
Hex Nut, 4-40, Zinc/Steel	HW1, HW2, HW3, HW4	4	BUILDING FASTENERS	HNZ440	DIGI-KEY	H216
Standoff 4-40 Threaded M/F 0.50 in. ALUM-HEX	HW1, HW2, HW3, HW4	4	KEYSTONE ELECTRONICS	8401	DIGI-KEY	8401K
Component Count: 71						

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EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of 4.5 V to 5.5 V and the output voltage range of 0 V to 5.5 V .

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.

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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.

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This development kit is NOT certified as Confirming to Technical Regulations of Radio Law of Japan

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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.

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EVALUATION BOARD/KIT/MODULE (EVM)
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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.

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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. 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.

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