

TPA2022D1YFFEVM Audio Power Amplifier Evaluation Module

The TPA2022D1YFFEVM is a programmable-gain audio power amplifier evaluation module for the TPA2022D1YFF. The TPA2022D1YFF is a mono Class-D amplifier with industry-leading ultra-low radiated emissions and beat-frequency elimination technology. The TPA2022D1YFF is capable of delivering 3 W and 2.5 W into 4 Ω at 10% and 1% THD+N, respectively. All components and the evaluation module are Pb-free. The TPA2022D1YFFEVM evaluation module (EVM) consists of a TPA2022D1YFF device and all necessary components to evaluate it.

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1 Introduction

This section provides an overview of the Texas Instruments (TI) TPA2022D1YFFEVM NanoFree™ WCSP audio amplifier evaluation module. It includes a brief description of the module and a list of EVM specifications.

1.1 TPA2022D1EVM Specifications

Operation at room temperature assumed.

Supply voltage range, V_{DD}	2.5 V to 5.5 V
Power supply current rating required	1.5 A
Continuous output power, P_O : 4- Ω BTL, $V_{DD} = 5$ V, THD+N = 10%	3 W
Audio input voltage, V_I	0 V to V_{DD}
Minimum load impedance, Z_L	3.2 Ω

2 Operation

This section describes how to operate the TPA2022D1YFFEVM.

2.1 Quick Start for Stand-Alone Operation

Use the following steps when operating the TPA2022D1YFFEVM stand-alone or when connecting it to existing circuits or equipment.

2.1.1 Power and Ground

1. Make sure 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 banana jacks.

2.1.2 Inputs and Outputs

2.1.2.1 Audio

1. Make sure that the audio source is set to the minimum level.
2. Connect the audio source to the RCA input socket, IN.
3. Connect a speaker (4 Ω -32 Ω) between the output banana jacks, OUT+ and OUT-.

2.1.2.2 Enable Settings

The TPA2022D1YFF has an active-high enable pin EN. A high value on this pin places the device in the operating mode, and a low value on this pin places the device in the shutdown mode. Press and hold pushbutton S1 to place the TPA2022D1YFFEVM in shutdown mode. Release pushbutton S1 to restart normal operation.

2.1.2.3 MODE Settings

Configure the operation mode of the TPA2022D1YFFEVM using the MODE jumper as shown in [Table 1](#). The master mode is set by default. For jumper changes to take effect, reset the TPA2022D1YFFEVM by pressing and releasing the Enable pushbutton S1.

Table 1. MODE Settings

No.	Mode of operation	Jumper between pins 1 and 2 of MODE	Jumper between pins 2 and 3 of MODE	SYNC pin functionality
1	Master mode	Yes	No	Output pin, with internal clock available on it.
2	Slave mode	No	Yes	Input pin, expecting clock from a master TPA2022D1YFFEM for proper operation.

2.1.2.4 GAIN Settings

Set the gain of the TPA2022D1YFFEVM using the GAIN1 and GAIN2 jumpers as shown in Table 2. Note that an empty cell in the table means “No”, i.e., no jumper inserted. A gain of 6 dB is set by default. For jumper changes to take effect, reset the TPA2022D1YFFEVM by pressing and releasing the Enable pushbutton S1.

Table 2. GAIN Settings

No.	Amplifier gain	Jumper between pins 1 and 2 of GAIN1	Jumper between pins 2 and 3 of GAIN1	Jumper between pins 1 and 2 of GAIN2	Jumper between pins 2 and 3 of GAIN2
1	0 dB		Yes		
2	3 dB				
3	6 dB (default)	Yes			
4	9 dB				Yes
5	12 dB			Yes	

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.

2.3 Operation with multiple TPA2022D1YFFEVM's in master mode

To evaluate the TPA2022D1YFF for multi-speaker systems, TI recommends using multiple TPA2022D1YFFEVM's in the master mode (with independent audio inputs and speaker loads). See Section 2.1.2.3 for information on how to configure a TPA2022D1YFFEVM in the master mode. Spread spectrum modulation provides excellent attenuation of beat frequency effects for most advanced multi-speaker systems.

2.4 Master-slave operation with multiple TPA2022D1YFFEVM's

Use this configuration in the very unlikely event of multiple masters not providing sufficient beat-frequency attenuation in multi-speaker systems. This configuration completely eliminates beat frequency by effectively maintaining a single clock for all the TPA2022D1YFFEVM's in the system, with the overhead of extra SYNC routing.

To set up your system in this configuration, set up one TPA2022D1YFFEVM as master, and up to 3 other TPA2022D1YFFEVM's as slaves using the MODE settings described in Section 2.1.2.3. Then, connect the SYNC of the master to the SYNC of the slaves, and connect the SYNC GND (the GND pin just next to the SYNC) of the master to the SYNC GND of the slaves. Take care to ensure that the extra capacitive load on the SYNC of the master does not exceed datasheet limits. This completes the settings for master-slave operation, and the multiple TPA2022D1YFFEVM's are ready for multi-speaker audio playback.

3 Reference

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

3.1 TPA2022D1YFFEVM PCB Layers

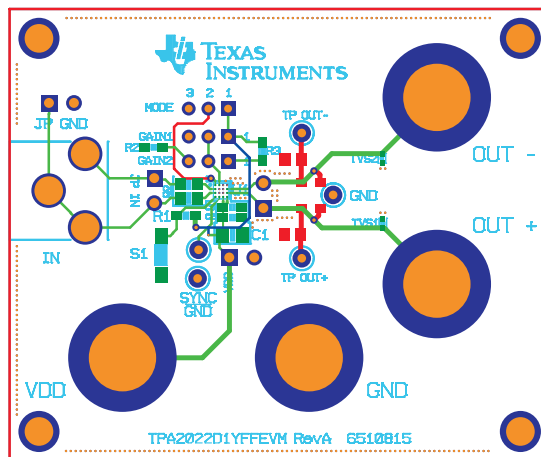


Figure 1. Top Layer

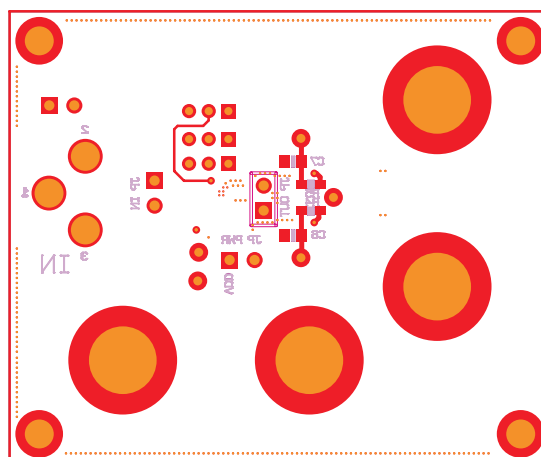


Figure 2. Bottom Layer

3.2 TPA2022D1YFFEVM Schematic Diagram

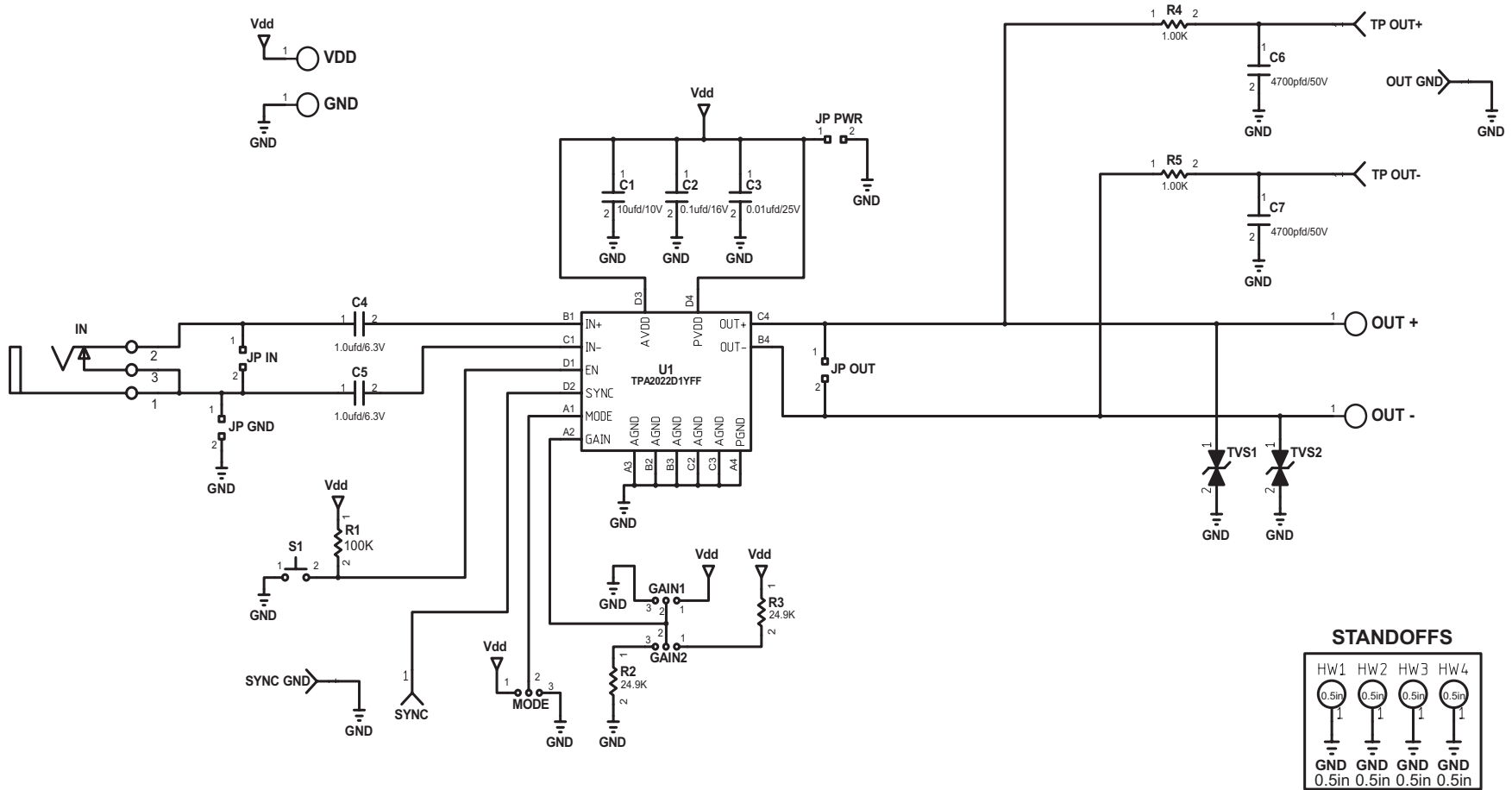


Figure 3. TPA2022D1YFFEVM Schematic Diagram

3.3 TPA2022D1YFFEVM Audio Power Amplifier Evaluation Module Parts List

Table 3. TPA2022D1YFFEVM Parts List

ITEM	MANUFACTURER PART NUMBER	QTY	REFERENCE DESIGNATORS	VENDOR PART NUMBER	DESCRIPTION	VENDOR	MANUFACTURER
1	TPA2022D1YFF	1	U1	TPA2022D1YFF	WCSP16-YFF ROHS	TEXAS INSTRUMENTS	TEXAS INSTRUMENTS
2	ESDALC6V1-1BT2	2	TVS1,TVS2	ESDALC6V1-1BT2	TRANSIENT VOLTAGE SUPPRESSION BIDIR 6.1V 9A SOD-882 ROHS	MOUSER	ST MICROELECTRONICS
3	06031C103JAT2A	1	C3	478-3700-1	CAP SMD0603 CERM 0.01UFD 25V 5% X7R ROHS	DIGI-KEY	AVX
4	GRM21BR71A106KE51L	1	C1	490-3905-1	CAP SMD0805 CERM 10UFD 10V10% X7R ROHS	DIGI-KEY	MURATA
5	ECJ-1VB1C104K	1	C2	PCC1762CT	CAP SMD0603 CERM 0.1UFD 16V 10% X7R ROHS	DIGI-KEY	PANASONIC
6	GRM188R60J105KA01D	2	C4,C5	490-1550-1-ND	CAP SMD0603 CERM 1.0UFD 16V 10% X7R ROHS	DIGI-KEY	MURATA
7	GRM188R71H472KA01D	2	C6,C7	490-1506-1-ND	CAP SMD0603 CERM 4700pF 50V 10% X7R ROHS	DIGI-KEY	MURATA
8	ERJ-3EKF1003V	1	R1	P100KHCT	RESISTOR SMD0603 100K OHM 1% THICK FILM 1/10W ROHS	DIGI-KEY	PANASONIC
9	ERJ-3EKF2492V	2	R2,R3	P24.9KHCT	RESISTOR SMD0603 24.9K 1% THICK FILM 1/10W ROHS	DIGI-KEY	PANASONIC
10	RC0603FR-071KL	2	R4,R5	311-1.00KHRCT	RESISTOR SMD0603 THICK FILM 1.00K OHM 1% 1/10W ROHS	DIGI-KEY	YAGEO
11	26630301RP2	3	MODE,GAIN1,GAIN2	2663S-03	HEADER 3 PIN, PCB 2.0MM ROHS	DIGI-KEY	NORCOMP
12	PJRA1X1U01X	1	IN	65K7770	JACK, RCA 3-PIN PCB-RA BLACK ROHS	NEWARK	SWITCHCRAFT
13	5000	2	TP OUT+,TP OUT-	5000K	PC TESTPOINT, RED, ROHS	DIGI-KEY	KEYSTONE ELECTRONICS
14	5001	2	OUT GND,SYNC GND	5001K	PC TESTPOINT, BLACK, ROHS	DIGI-KEY	KEYSTONE ELECTRONICS
15	5002	1	SYNC	5002K	PC TESTPOINT, WHITE, ROHS	DIGI-KEY	KEYSTONE ELECTRONICS
16	TL1015AF160QG	1	S1	EG4344CT	SWITCH, MOM, 160G SMT 4X3MM ROHS	DIGI-KEY	E-SWITCH
17	2027	4	HW1,HW2,HW3,HW4	2027K	STANDOFF, 4-40,0.5INx3/16IN,ALUM RND F-F	DIGI-KEY	KEYSTONE ELECTRONICS
18	111-2223-001	4	GND,VDD,OUT +, OUT -	J587	BINDING-POST,NONINS,THRU,ROHS	DIGI-KEY	EMERSON NPCS
COMPONENTS NOT ASSEMBLED							
19	PBC02SAAN	4	JP IN,JP GND,JP OUT,JP PWR	S1011E-02	HEADER THRU MALE 2 PIN 100LS GOLD ROHS	DIGI-KEY	SULLINS

4 Related Documentation From Texas Instruments

- TPA2022D1YFF Datasheet: [3 W Mono Class-D Amplifier with Ultra-Low EMI and Beat Frequency Elimination](#).

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EVM Warnings and Restrictions

It is important to operate this EVM within the input voltage range of 2.5 V to 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 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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Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
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