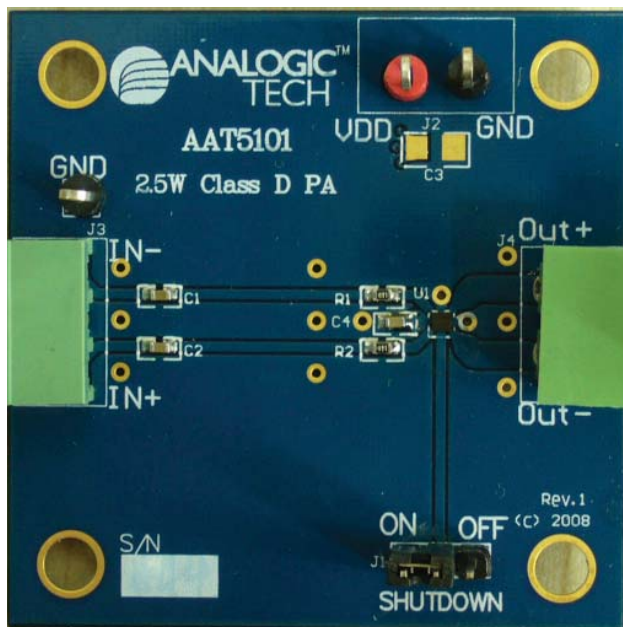
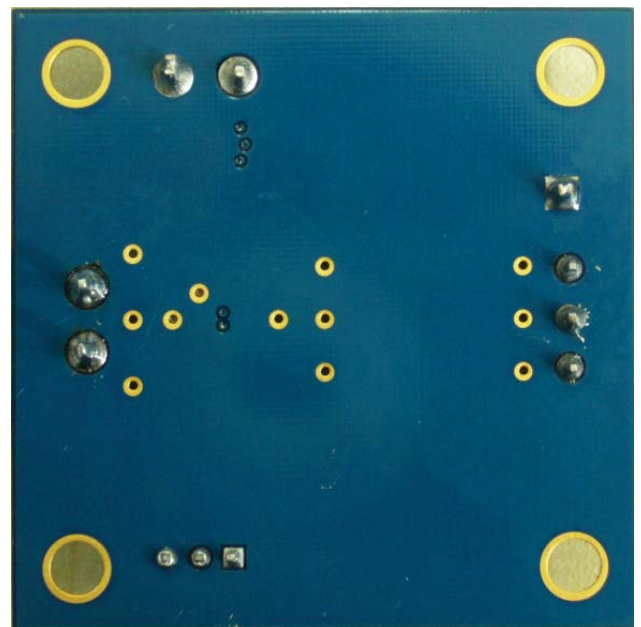
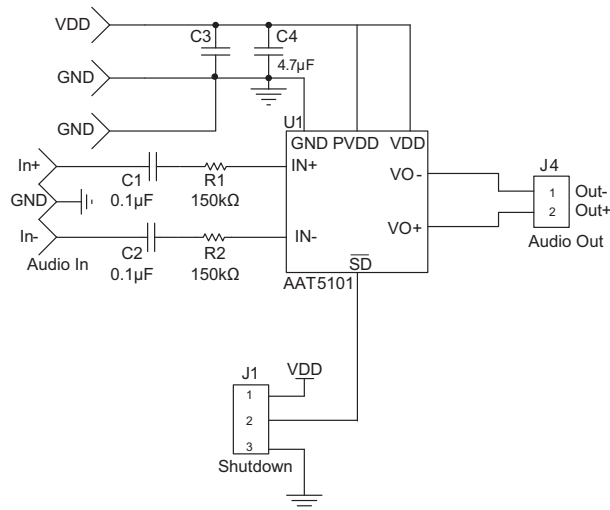


AAT5101 EVAL: 2.5W Mono Class D Audio Power Amplifier
Introduction

The AAT5101 is a high efficiency mono filter-free Class D audio power amplifier with fully differential architecture and BTL (Bridge Tied Load) output. The AAT5101 evaluation board is provided for demonstration and evaluation of the AAT5101. The board contains one power decoupling capacitor, two input capacitors, and two input resistors in the 0603 package suitable for portable device applications. The PCB layout has been optimized to achieve high SNR and low THD+N with the 1.45mm x 1.45mm WCSP-9 package.

The "Audio Demonstration" section of this document is intended to help the user to start the evaluation board for demonstration purposes. The "Amplifier Gain, THD+N, and Efficiency Evaluation" section explains procedures to measure amplifier gain, THD+N, and efficiency using the AAT5101 evaluation board. The AAT5101 evaluation board is shown in Figure 1; Figures 2 and 15 depict the AAT5101 evaluation board schematic and layout. For additional information, please consult the AAT5101 product datasheet.

Board Picture

a: Top Layer

b: Bottom Layer
Figure 1: AAT5101 Evaluation Board.

AAT5101 EVAL: 2.5W Mono Class D Audio Power Amplifier
Schematic and BOM

Figure 2: AAT5101 Evaluation Board Schematic.

Ref	Part Description	PCB Footprint
U1	AAT5101 Class D Audio Amplifier	WCSP-9
R1, R2	SMD Resistor 150kΩ	0603
C1, C2	Ceramic Capacitor 0.1µF, 50V, X7R	0603
C4	Ceramic Capacitor 4.7µF, 6.3V, X5R	0603
C3	Not Populated	

Table 1: AAT5101 Evaluation Board Build of Materials (BOM).
Audio Demonstration
Demonstration Equipment

1. Unit Under Test: AAT5101 Evaluation Board.
2. Power Supply: DC Power Supply, Battery, USB or equivalent.
3. Audio Source: Notebook, MP3, DVD Player or equivalent.
4. Speaker: 8/4Ω Speaker.

Set-up and Demonstration

1. Power supply is connected to J2.
2. Differential inputs are connected to IN+ and IN- of J3 as illustrated in Figure 3. If input is single-ended, ground one of two input pins of J3 by tying it to the center pin of J3 as illustrated in Figure 4.
3. Connect the speaker to J4.
4. Configure all connections as shown in Figures 3 and 4.
5. Make sure the signal source is set to minimum and the SHUTDOWN jumper is at OFF position, then turn on the power supply.
6. Set the SHUTDOWN jumper to the ON position to turn on the device.
7. Increase the input signal to your favorite volume.

AAT5101 EVAL: 2.5W Mono Class D Audio Power Amplifier

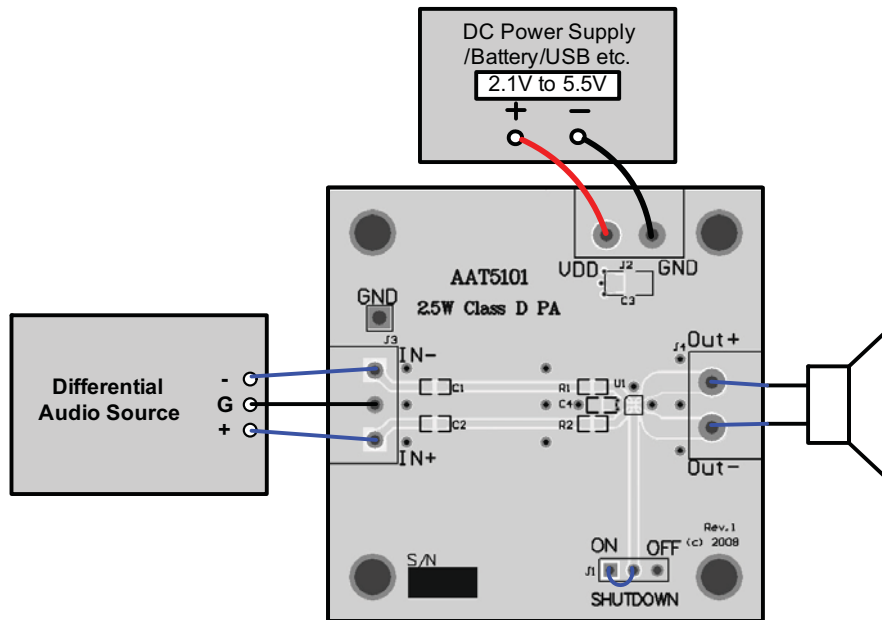


Figure 3: AAT5101 Evaluation Board Demo Set-up for Differential Audio Input.

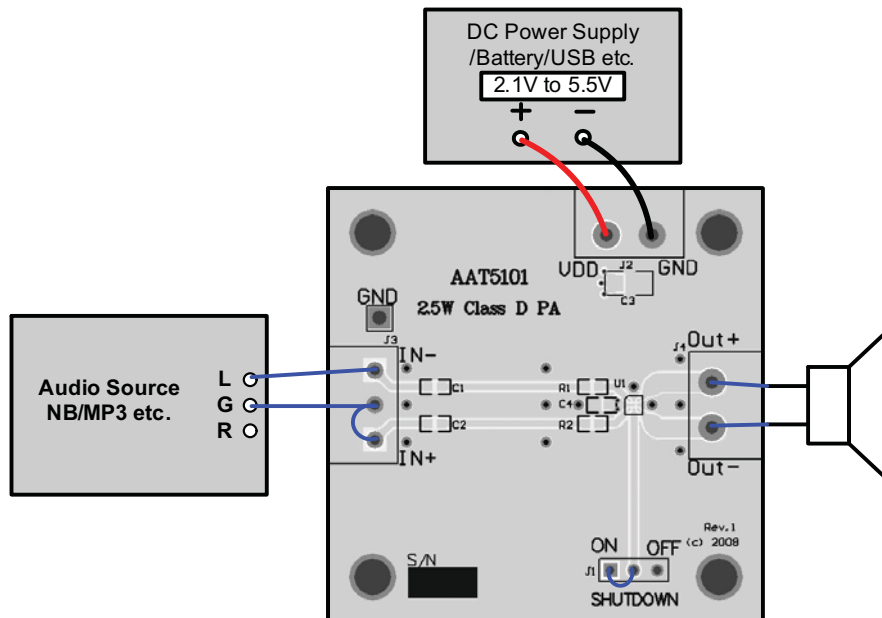


Figure 4: AAT5101 Evaluation Board Demo Set-up for Single-Ended Audio Input.

AAT5101 EVAL: 2.5W Mono Class D Audio Power Amplifier

Amplifier Gain, THD+N, and Efficiency Evaluation

Evaluation Equipment

1. AAT5101 Evaluation Board.
2. Power Supply.
3. Audio Analyzer.
4. One Voltage Meter and Two Current Meters.
5. 30kHz Low Pass Filter.

A 30kHz RC low pass filter (100 Ω , 47nF) is required on each output even if the analyzer has an internal low-pass filter. An RC low pass filter (1k Ω , 4.7nF) is required for efficiency measurement.

Amplifier Gain and THD+N Measurement

Amplifier Gain and THD+N Measurement Set-up

1. Connect the power supply to J2.
2. Differential inputs are connected to IN+ and IN- of J3 as shown in Figure 5. If input is single-ended, ground one of two input pins of J3 by tying it to the center pin of J3 as shown in Figure 6.
3. Connect a 5W power resistor load of 8/4 Ω to OUT+ and OUT- of J4.
4. Connect the low pass filter to the resistor load.
5. The differential outputs of low pass filter are connected to audio analyzer AC IN+ and IN-.

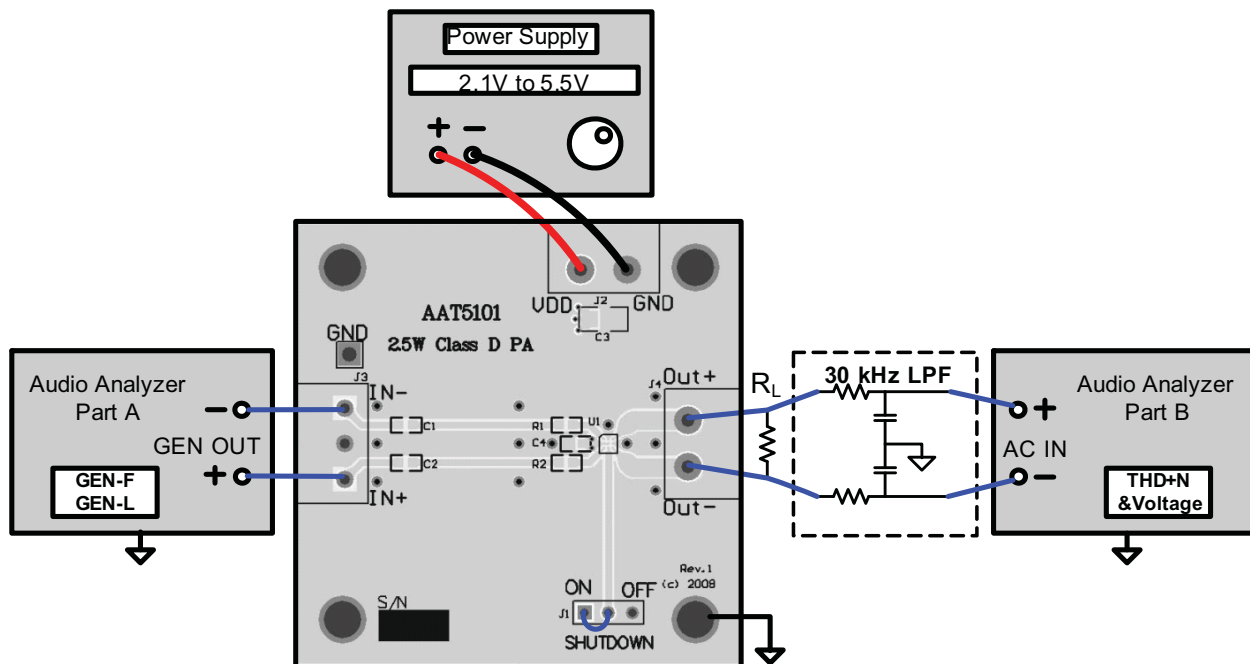


Figure 5: AAT5101 Amplifier Gain and THD+N Measurement Set-up for Differential Input.

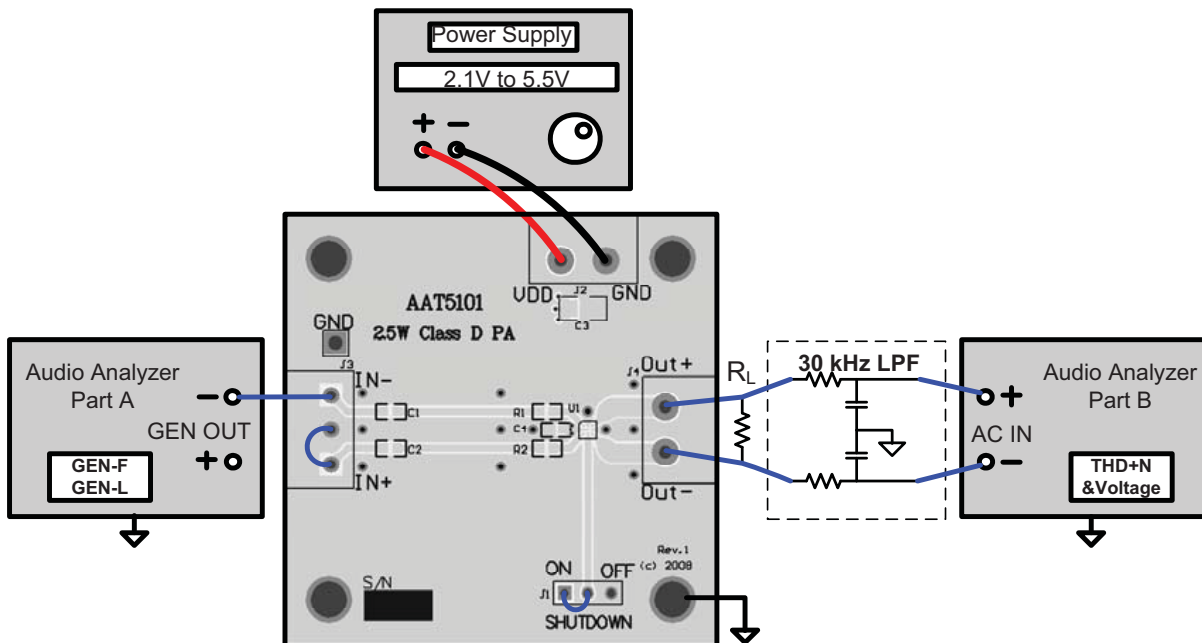
AAT5101 EVAL: 2.5W Mono Class D Audio Power Amplifier


Figure 6: AAT5101 Amplifier Gain and THD+N Measurement Set-up for Single-Ended Input.

Amplifier Gain Measurement

1. Configure all connections as shown in Figures 5 and 6.
2. Make sure signal source is set to minimum and the SHUTDOWN jumper is in the OFF position, then turn on the power supply.
3. Set the SHUTDOWN jumper at the ON position to turn on the device.
4. Tune the input frequency to 1kHz, increase input amplitude to a middle point (output THD+N should be less than 1% at this point), measure input voltage (V_{IN}) and output voltage (V_{OUT}) by audio analyzer. Calculate the amplifier gain (G) using the following equation:

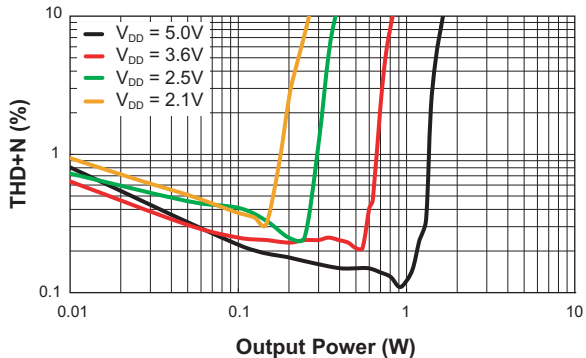
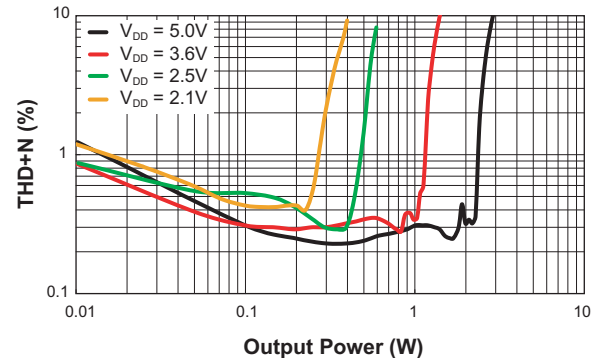
$$G = \frac{V_{OUT}}{V_{IN}} = \frac{300k\Omega}{R_I}$$

Where $R_I = 150k\Omega$ is 1% standard metal film resistor connected to R1 and R2 of the board.

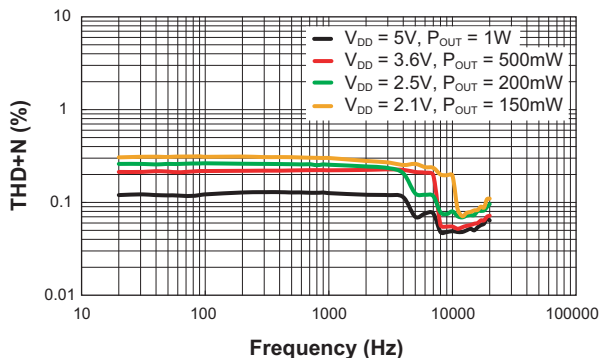
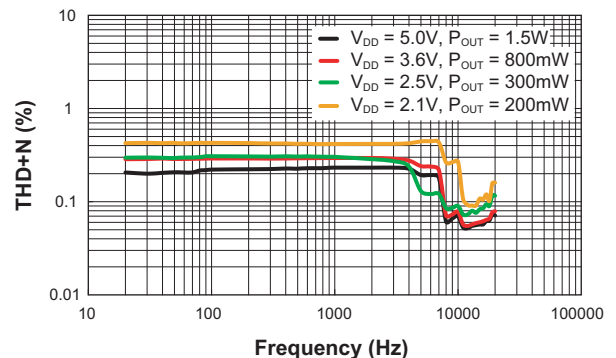
THD+N vs. Output Power Measurement

1. Configure all connections as shown in Figures 5 and 6.
2. Make sure signal source is set to minimum and the SHUTDOWN jumper is at OFF position, then turn on the power supply.
3. Set the SHUTDOWN jumper at the ON position to turn on the device.
4. Tune the input frequency to 1kHz, increase input amplitude until output THD+N = 10%, measure output THD+N and output voltage (V_{OUT}) by audio analyzer. Calculate the output power (P_{OUT}) using the following equation:

$$P_{OUT} = \frac{(V_{OUT})^2}{R_L}$$

AAT5101 EVAL: 2.5W Mono Class D Audio Power Amplifier
THD+N vs. Output Power
 (f = 1kHz; $R_L = 8\Omega$)

Figure 7: THD+N vs. Output Power @ $R_L = 8\Omega$.
THD+N vs. Output Power
 (f = 1kHz; $R_L = 4\Omega$)

Figure 8: THD+N vs. Output Power @ $R_L = 4\Omega$.
THD+N vs. Frequency Measurement

1. Configure all connections as shown in Figures 5 and 6.
2. Make sure the signal frequency is set to 20Hz and the SHUTDOWN jumper is in the OFF position, then turn on the power supply
3. Set the SHUTDOWN jumper to the ON position to turn on the device.
4. Increase frequency to 20kHz. Measure output THD+N vs. frequency.

THD+N vs. Frequency
 ($C_I = 2.2\mu\text{F}$; $R_L = 8\Omega$)

Figure 9: THD+N vs. Frequency @ $R_L = 8\Omega$.
THD+N vs. Frequency
 ($C_I = 2.2\mu\text{F}$; $R_L = 4\Omega$)

Figure 10: THD+N vs. Frequency @ $R_L = 4\Omega$.
Efficiency Measurement
Efficiency Measurement Set-up

1. Connect the power supply to J2 through the current meter.
2. Connect the voltage meter to VDD and GND on the board.
3. Connect the differential inputs to IN+ and IN- of J3 as shown in Figure 11. If input is single-ended, ground one of two input pins of J3 by tying it to the center pin of J3 as shown in Figure 12.
4. Connect a 5W power resistor of 8/4Ω and a 33μH inductor in series with the current meter as load to OUT+ and OUT- of J4.
5. Connect the low pass filter to the load.
6. The differential outputs of the low pass filter are connected to the audio analyzer AC IN+ and AC IN-.

AAT5101 EVAL: 2.5W Mono Class D Audio Power Amplifier

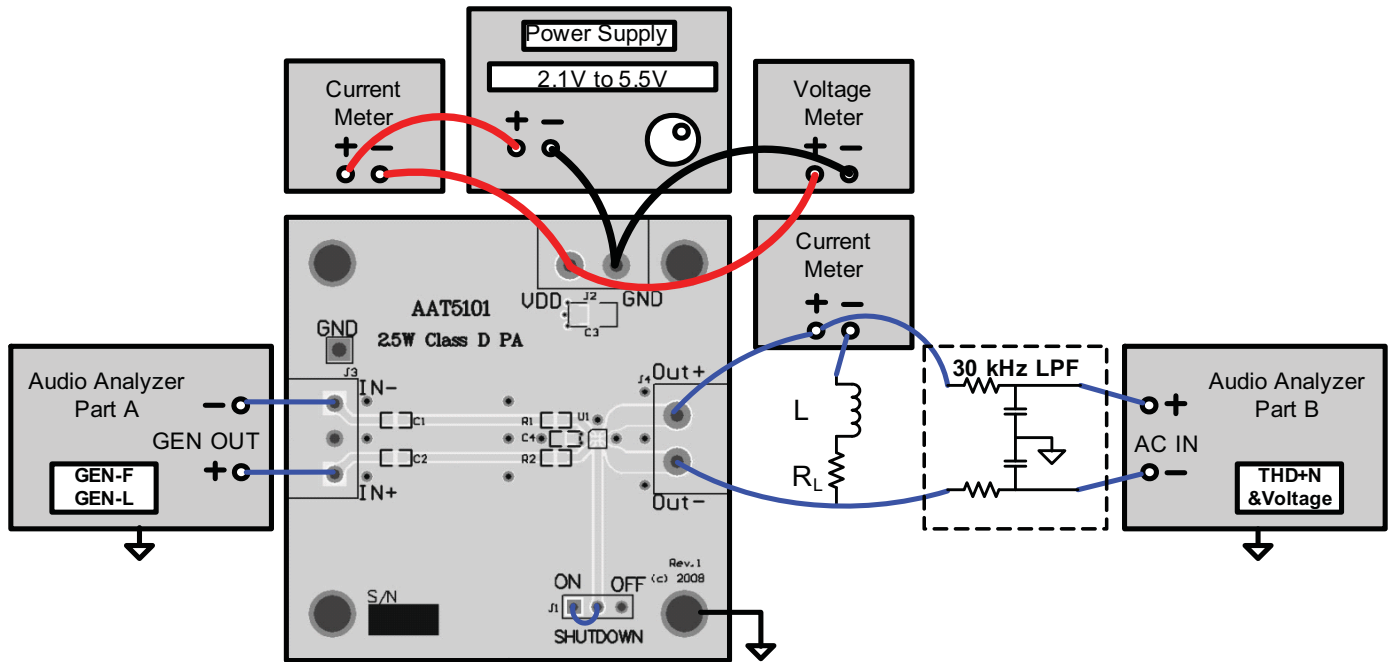


Figure 11: AAT5101 Efficiency Measurement Set-up for Differential Input.

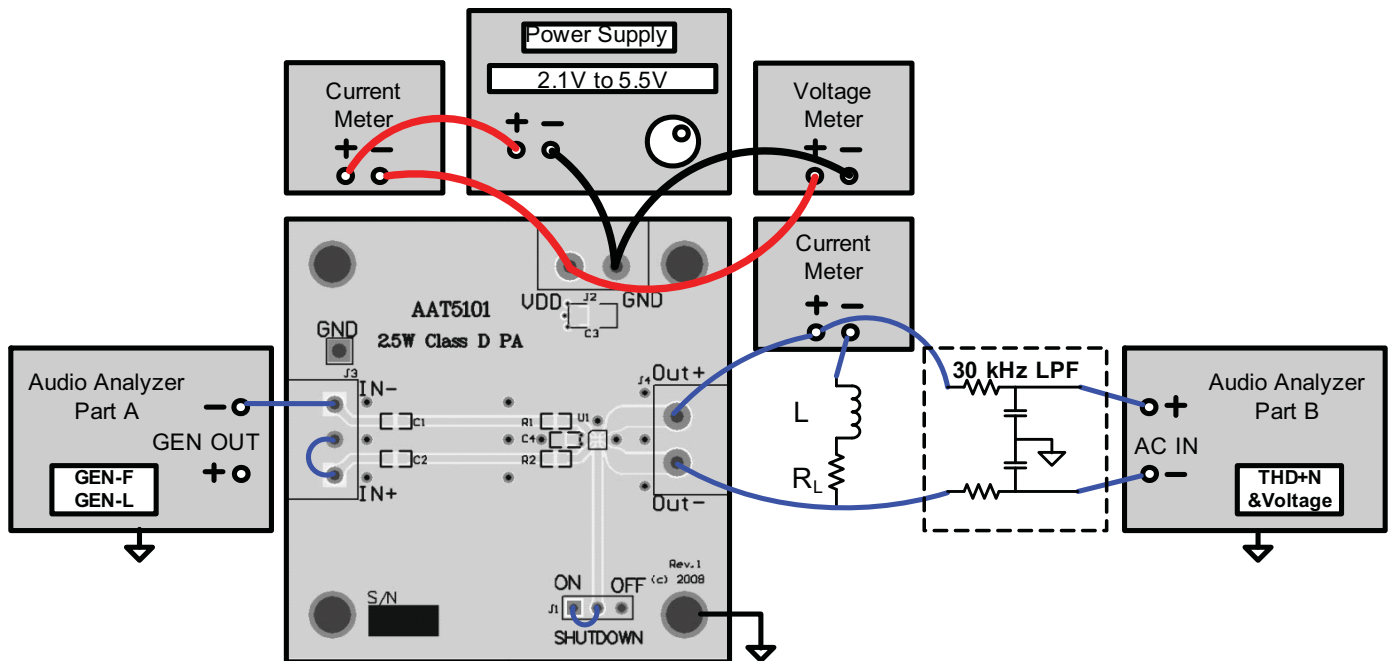
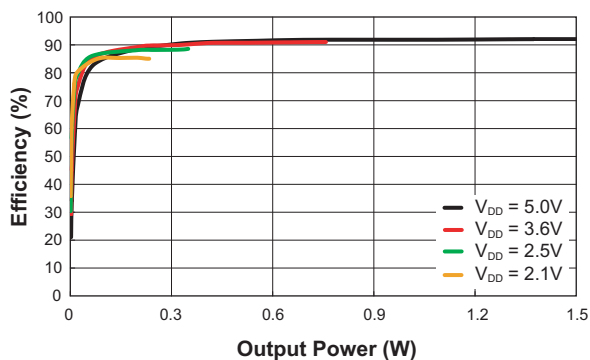
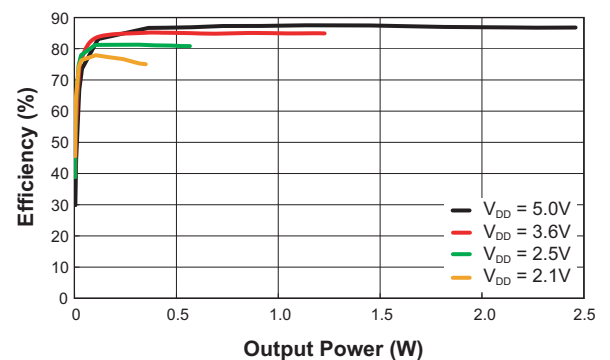


Figure 12: AAT5101 Efficiency Measurement Set-up for Single-Ended Input.

AAT5101 EVAL: 2.5W Mono Class D Audio Power Amplifier**Efficiency vs. Output Power Measurement**

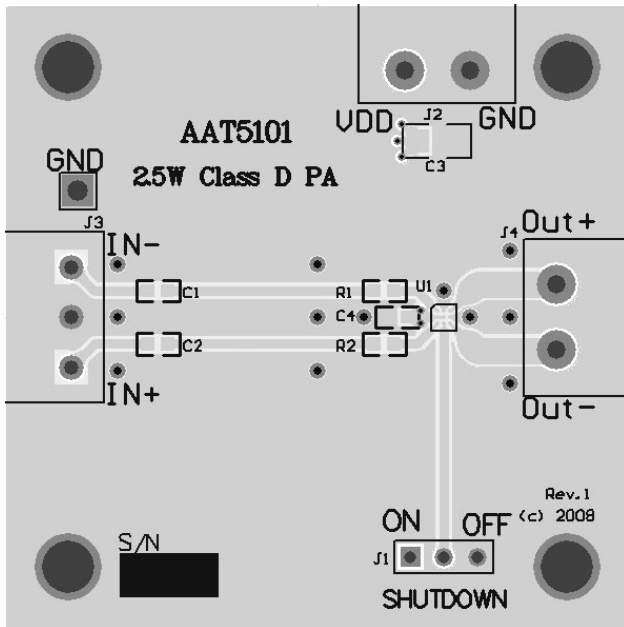
1. Configure all connections as shown in Figures 11 and 12.
2. Make sure signal source is set to minimum and the SHUTDOWN jumper is at OFF position then turn on the power supply.
3. Set the SHUTDOWN jumper at the ON position to turn on the device.
4. Tune the input frequency to 1kHz, increase input amplitude until output THD+N = 10%, then measure the supply voltage (V_S), supply current (I_S), output voltage (V_{OUT}) and output current (I_{OUT}) to calculate the efficiency (η) by the following equation:

$$\eta = \frac{V_{OUT} \cdot I_{OUT}}{V_S \cdot I_S}$$

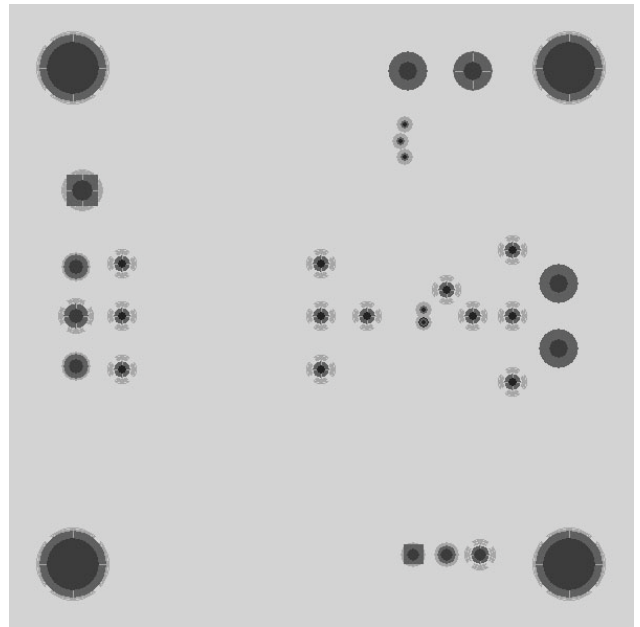
Efficiency vs. Output Power
 (f = 1kHz; $R_L = 8\Omega + 33\mu H$)

Figure 13: Efficiency vs. Output Power
 @ $R_L = 8\Omega + 33\mu F$
Efficiency vs. Output Power
 (f = 1kHz; $R_L = 4\Omega + 33\mu H$)

Figure 14: Efficiency vs. Output Power
 @ $R_L = 4\Omega + 33\mu F$

AAT5101 EVAL: 2.5W Mono Class D Audio Power Amplifier

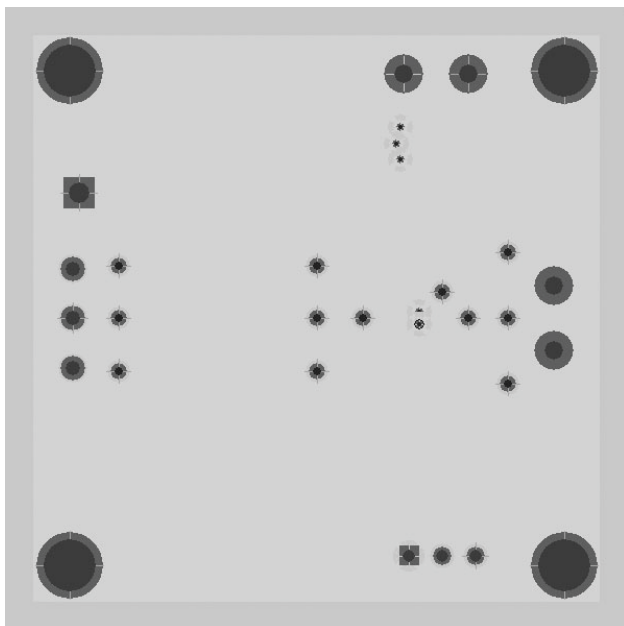
Evaluation Board PCB Layout



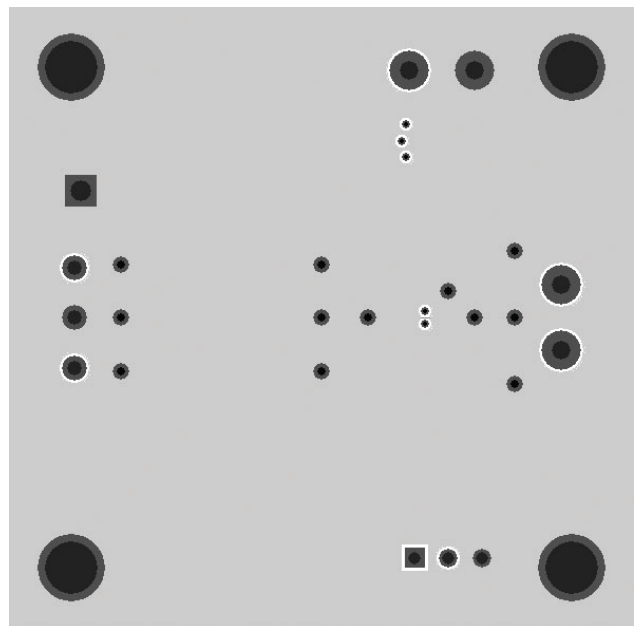
a: Top Layer



b: Ground Layer



c: Power Layer



d: Bottom Layer

Figure 15: AAT5101 Evaluation Board PCB Layouts.

AAT5101 EVAL: 2.5W Mono Class D Audio Power Amplifier

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