TDD Rejection , Thermal AGC , 1.95W , Class AB Audio Power Amplifier

Features

- Proprietary TDD Suppression Technology to Effectively Suppress TDD Noise
- Excellent PSRR : 85dB(217Hz)
- Patented Thermal AGC Function Effectively Protects the Chip from Damage in the Event of Overheating while Providing a Comfortable Listening Experience
- Excellent Pop - Click Noise Suppression
- Support 1.8V Control Logic
- 1.26W Output Power (1% THD+N,5V,8Ω Load)
- 1.95W Output Power (10% THD+N,5V,6Ω Load)
- Low Quiescent Current (2.45mA)
- Low Shutdown Current (<0.1μA)
- Operating Voltage Range: 2.5V~5.5V
- MSOP-8L Package

Applications

- Portable Electronic Devices
- GPS / MP3 / PAD
- IOT

General Description

AW8091 is an upgraded Class AB audio power amplifier with lower noise, an upgrade to AW8090 series.

AW8091 is a dedicated TDD rejection power amplifier with Thermal AGC, 1.26W (8Ω), Class AB audio; The patented Thermal AGC function can effectively protect the device from being damaged under overheating conditions, and avoid the phenomenon that traditional AB products play music intermittently under overheating conditions.

AW8091 has a built-in excellent Pop-Click noise suppression circuit to avoid Pop-Click noise during chip startup and shutdown operations.

AW8091 is capable of delivering 1.26W of continuous output power with typically 1% distortion (THD+N) when it drives an 8Ω speaker from a 5.0V power supply.

AW8091 is available in MSOP-8 package. It operates over an ambient temperature range of -40°C to +85°C.

Typical Application Circuit

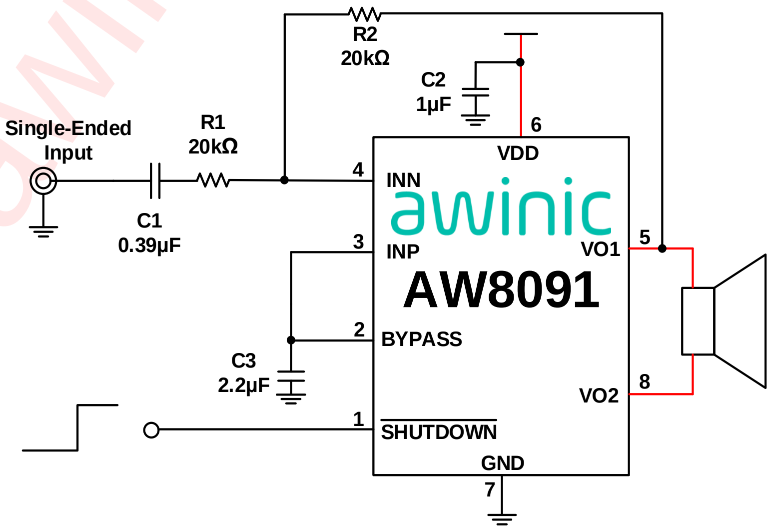
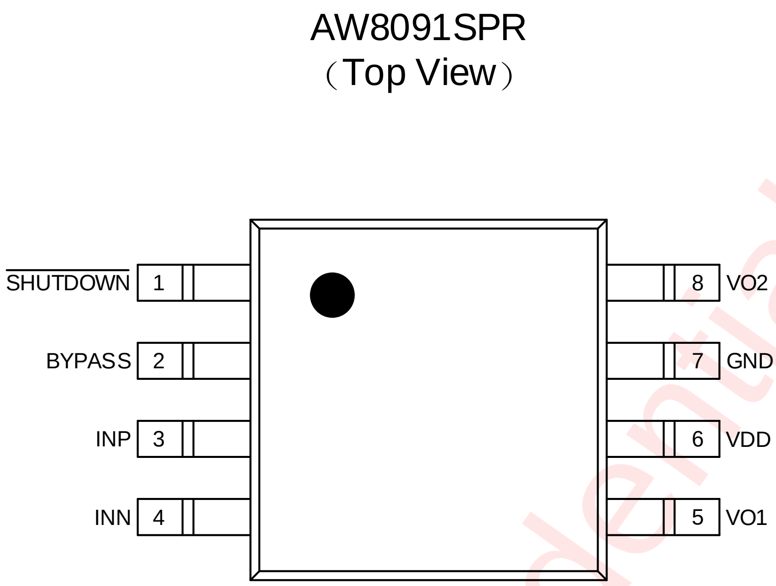
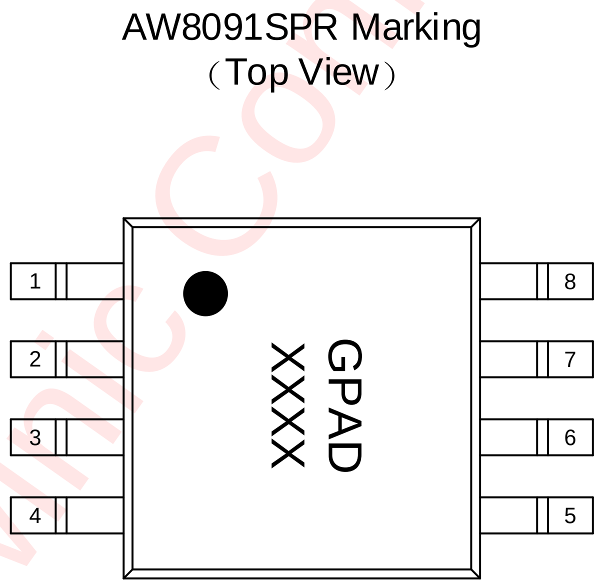


Figure 1 AW8091 Application Diagram

Pin Configuration And Top Mark





GPAD－ AW8091SPR
XXXX － Production Tracing Code

Figure 2 AW8091 Pin Diagram Top View and Device Marking

Pin Definition

No.	NAME	DESCRIPTION
1	SHUTDOWN	Turn the amplifier off when a logic low is placed on the shutdown pin
2	BYPASS	Analog common-mode level
3	INP	Positive audio input terminal
4	INN	Negative audio input terminal
5	VO1	Positive audio output terminal
6	VDD	Power supply
7	GND	Ground
8	VO2	Negative audio output terminal

Functional Block Diagram

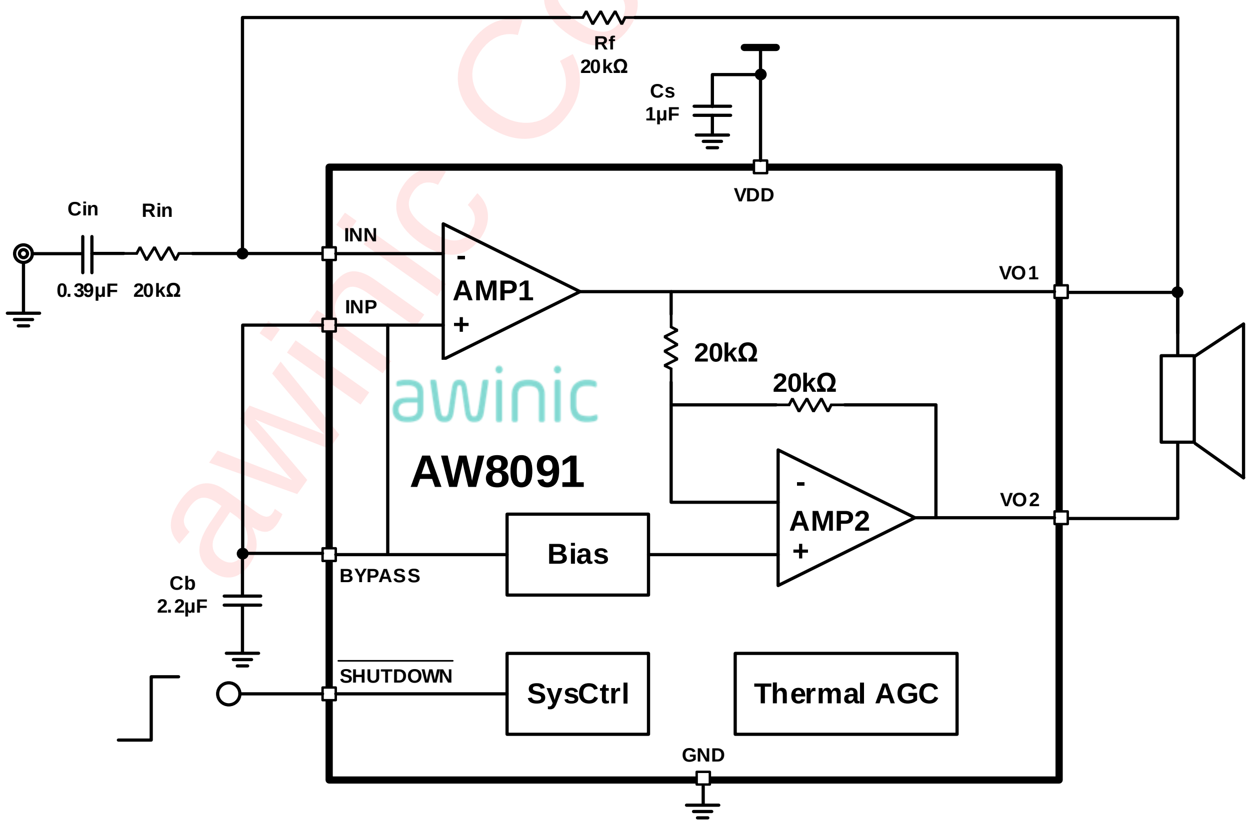


Figure 3 AW8091 Functional Block Diagram

Typical Application Circuits

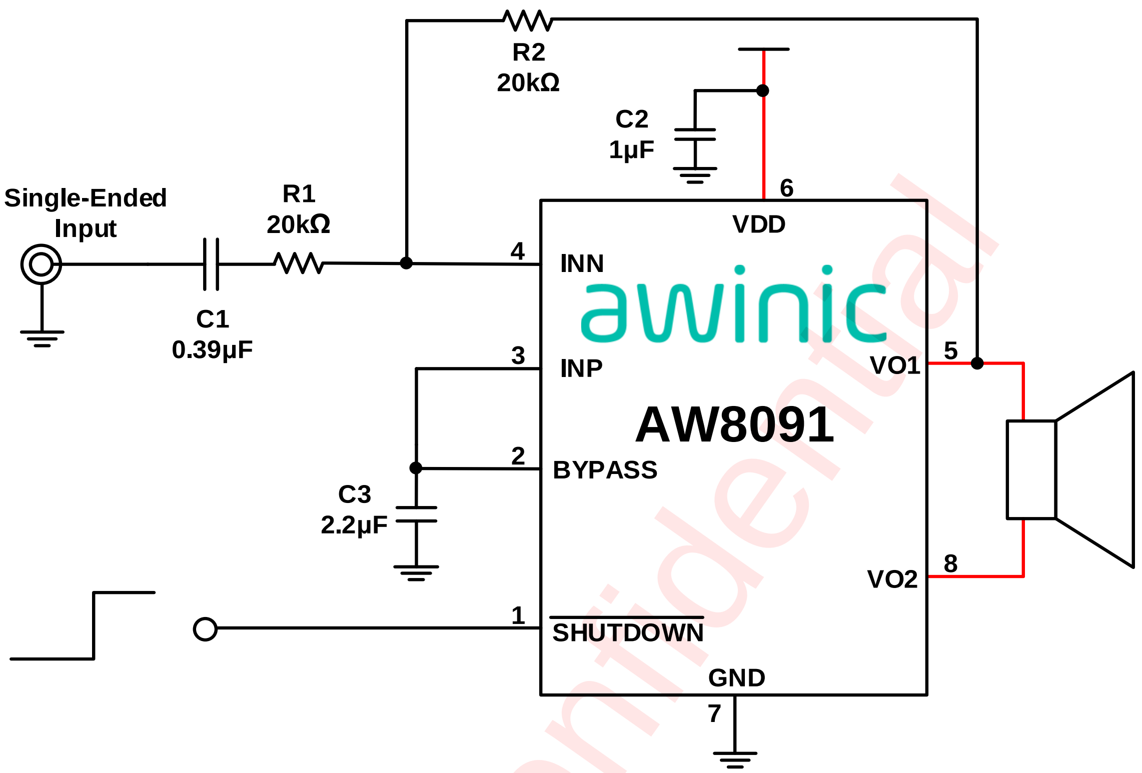


Figure 4 AW8091 Single-ended Input Application Diagram (Gain=6dB)

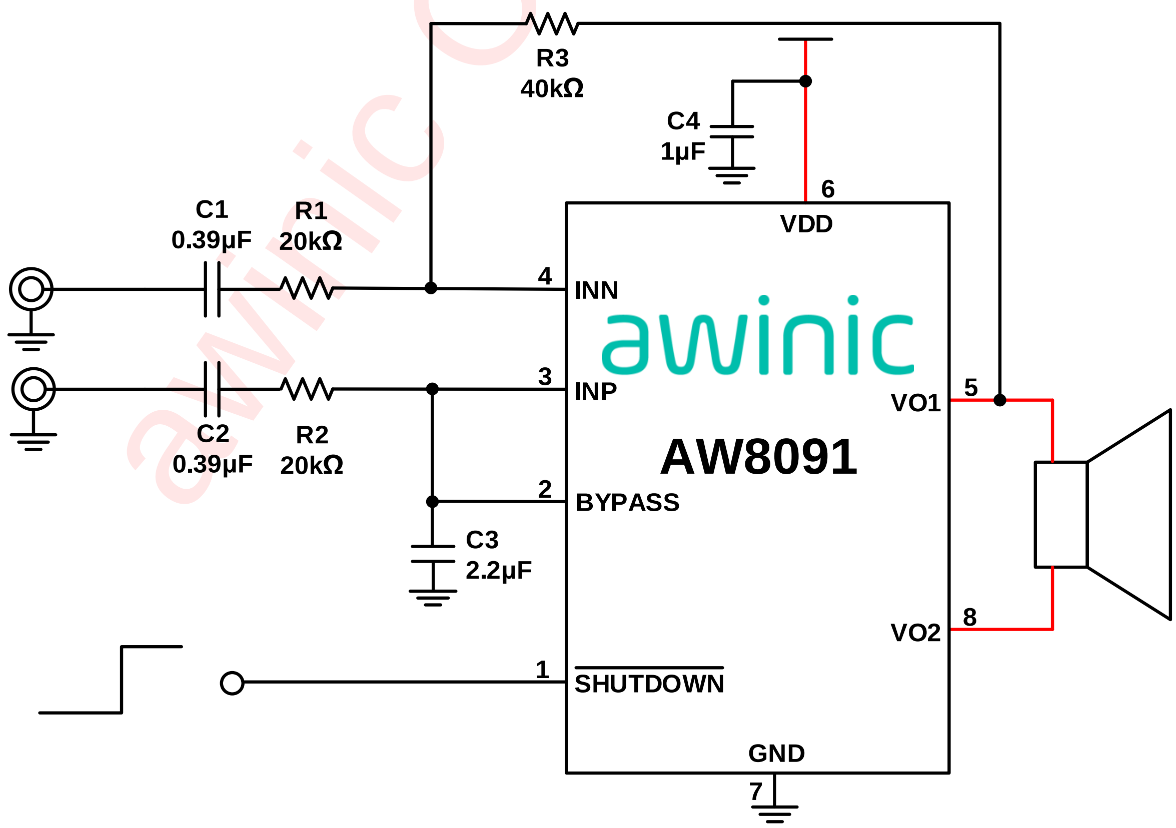


Figure 5 AW8091 Pseudo-differential Application Diagram (Gain=6dB)

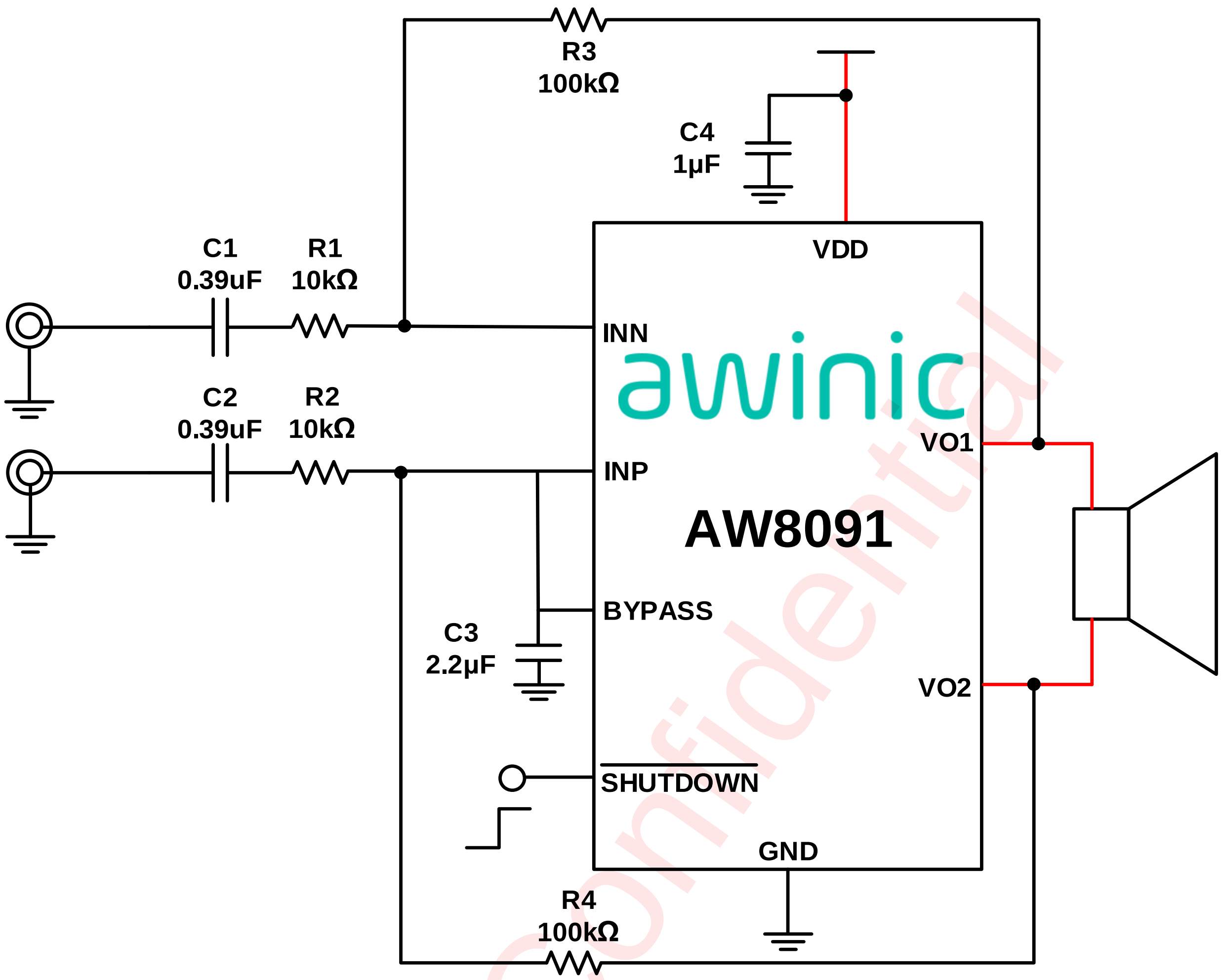


Figure 6 AW8091 Fully-differential Application Diagram (Gain=20dB)

Notice for typical application circuits:

1. Please place C3 (C_{bypass}) , C4 (C_{supply}) as close to the chip as possible;
2. Bypass capacitance has a direct relationship with the system startup time and POP suppression performance, bypass capacitance is proportional to the system startup time, and the larger the capacitance value, the better the POP suppression performance, so it is recommended to choose 2.2μF best, 1μF is also acceptable.

Ordering Information

Part Number	Temperature	Package	Marking	Moisture Sensitivity Level	Environmental Information	Delivery Form
AW8091SPR	-40 to 85 °C	MSOP-8L	GPAD	MSL1	RoHS+HF	3000 units/ Tape and Reel

Absolute Maximum Ratings(NOTE1)

PARAMETERS	RANGE
Supply Voltage VDD	-0.3V to 6V
Input Voltage INP/INN	-0.3V to 6V
Input IO Voltage $\overline{\text{SHUTDOWN}}$	-0.3V to 6V
BYPASS Voltage	-0.3V to 6V
Output Pin Voltage VO1/VO2	-0.3V to 6V
Ambient Temperature T_{amb}	-40 to 85 °C
Storage and Junction Temperature T_{STG}, T_j	-55 to 150 °C
Package Thermal Resistance θ_{JA}	165°C/W
ESD Rating (NOTE 2)	
HBM (human body model)	±2kV
CDM (charged-device model)	±1.5kV
Latch-Up	
Test condition:JESD78F	+IT : 200mA -IT : -200mA

NOTE1: Conditions out of those ranges listed in "absolute maximum ratings" may cause permanent damages to the device. In spite of the limits above, functional operation conditions of the device should within the ranges listed in "recommended operating conditions". Exposure to absolute-maximum-rated conditions for prolonged periods may affect device reliability.

NOTE2: The human body model is a 100pF capacitor discharged through a 1.5kΩ resistor into each pin. Test method: ESDA/JEDEC JS-001-2017.Test method of the charge device model: ESDA/JEDEC JS -002-2018

Electrical Characteristics

Test condition : T_A=25°C for typical values (unless otherwise noted)

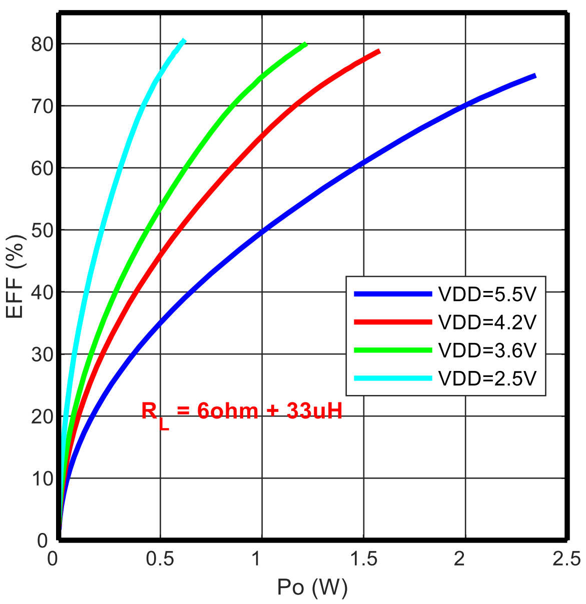
PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
INPUT SOURCE AND BATTERY PROTECTION						
V_{DD}	Supply voltage		2.5		5.5	V
V_{IH}	$\overline{SHUTDOWN}$ high level input		1.3		VDD	V
V_{IL}	$\overline{SHUTDOWN}$ low level input		0		0.54	V
I_{SD}	Shutdown current	V_{DD}=3.6V,$\overline{SHUTDOWN}$=0		0.06		μA
I_Q	Quiescent current	V_{DD}=3.6V,$\overline{SHUTDOWN}$=1		2.45		mA
TIMING						
T_{WU}	Wake-up time	V_{DD}=3.6V,C_{BYPASS}=2.2μF	200		220	ms
		V_{DD}=4.2V,C_{BYPASS}=2.2μF	220		240	ms
T_{TG}	Thermal AGC start-up temperature threshold			145		°C
T_{TGR}	Thermal AGC exit temperature threshold			120		°C
T_{SD}	Overtemperature protection threshold			160		°C
T_{SDR}	Overtemperature protection exit threshold			120		°C
CLASS-AB(Single-ended Input、Pseudo-differential application)						
P_O	Output power (f = 1kHz ; Gain = 6 dB)	THD+N=10%,R_L=8Ω,V_{DD}=5V		1.58		W
		THD+N=1%,R_L=8Ω,V_{DD}=5V		1.26		W
		THD+N=10%,R_L=6Ω,V_{DD}=5V		1.95		W
		THD+N=1%,R_L=6Ω,V_{DD}=5V		1.53		W
		THD+N=10%,R_L=8Ω,V_{DD}=4.2V		1.1		W
		THD+N=1%,R_L=8Ω,V_{DD}=4.2V		0.89		W
		THD+N=10%,R_L=8Ω,V_{DD}=3.6V		0.81		W
		THD+N=1%,R_L=8Ω,V_{DD}=3.6V		0.65		W
E_N	Speaker Output noise	Gain = 6 dB , 20Hz to 20kHz , A-weighting		17		μV
V_{OS}	Output offset voltage	No input	-10		+10	mV
THD+N	Total harmonic distortion + noise (f = 1kHz ; Gain = 6 dB)	P_O=1W,R_L=8Ω,V_{DD}=5V		0.12		%
		P_O=0.5W,R_L=8Ω,V_{DD}=4.2V		0.12		%
		P_O=0.25W,R_L=8Ω,V_{DD}=4.2V		0.12		%
		P_O=0.25W,R_L=8Ω,V_{DD}=3.6V		0.12		%
PSRR	Power supply rejection ratio	V_{pp_sin}=200mV,217Hz		85		dB
		V_{pp_sin}=200mV,1kHz		76		dB

PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
CLASS-AB(Fully-differential application)						
P_O	Output power (f = 1kHz ; Gain = 6 dB)	THD+N=10%,R_L=8Ω,V_{DD}=5V		1.6		W
		THD+N=1%,R_L=8Ω,V_{DD}=5V		0.9		W
		THD+N=10%,R_L=8Ω,V_{DD}=4.2V		1.1		W
		THD+N=1%,R_L=8Ω,V_{DD}=4.2V		0.6		W
	Output power (f = 1kHz ; Gain = 20 dB)	THD+N=10%,R_L=8Ω,V_{DD}=5V		1.6		W
		THD+N=1%,R_L=8Ω,V_{DD}=5V		1.1		W
		THD+N=10%,R_L=8Ω,V_{DD}=4.2V		1.1		W
		THD+N=1%,R_L=8Ω,V_{DD}=4.2V		0.7		W
E_N	Speaker Output noise	Gain = 6 dB , 20Hz to 20kHz , A-weighting		23		μV
		Gain = 20 dB , 20Hz to 20kHz , A-weighting		74		μV
THD+N	Total harmonic distortion + noise (f = 1kHz ; Gain = 6 dB)	P_O=0.5W,R_L=8Ω,V_{DD}=4.2V		0.13		%
	Total harmonic distortion + noise (f = 1kHz ; Gain =20 dB)	P_O=1W,R_L=8Ω,V_{DD}=5V		0.5		%
		P_O=0.5W,R_L=8Ω,V_{DD}=4.2V		0.26		%

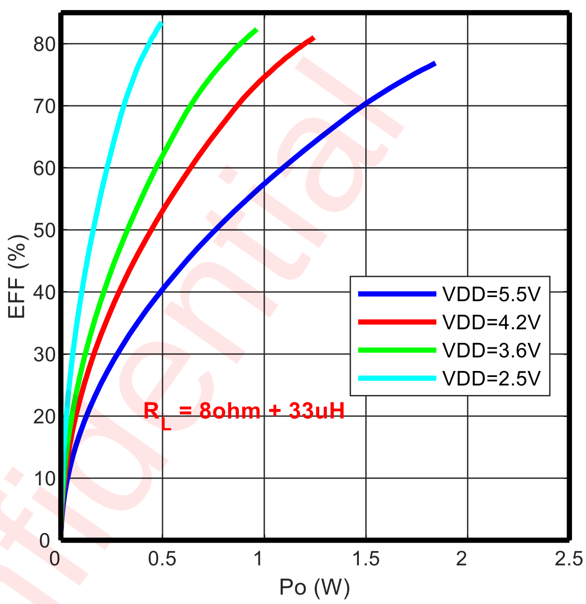
Typical Characteristics

T_A=25°C, Single-ended Input application

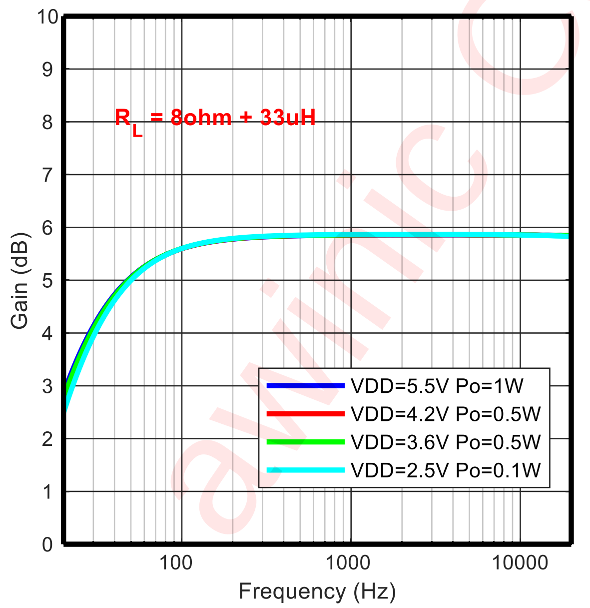
Efficiency VS. Output Power



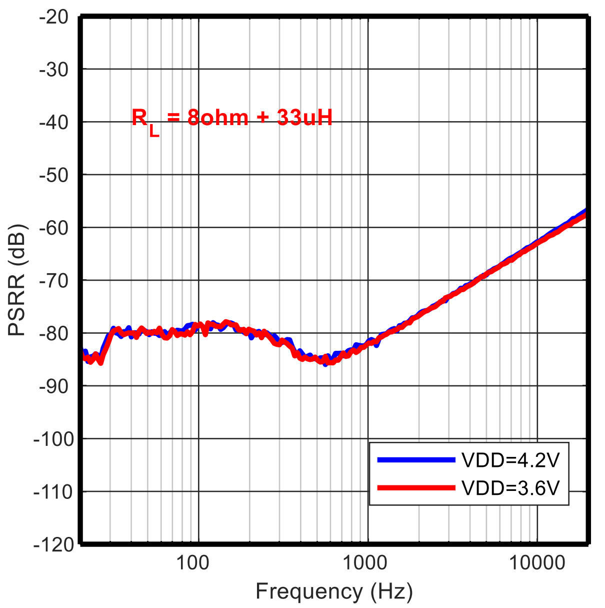
Efficiency VS. Output Power

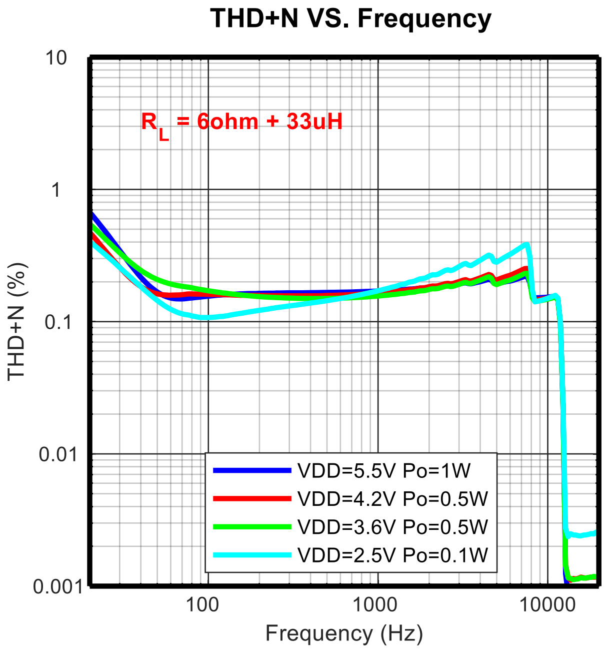


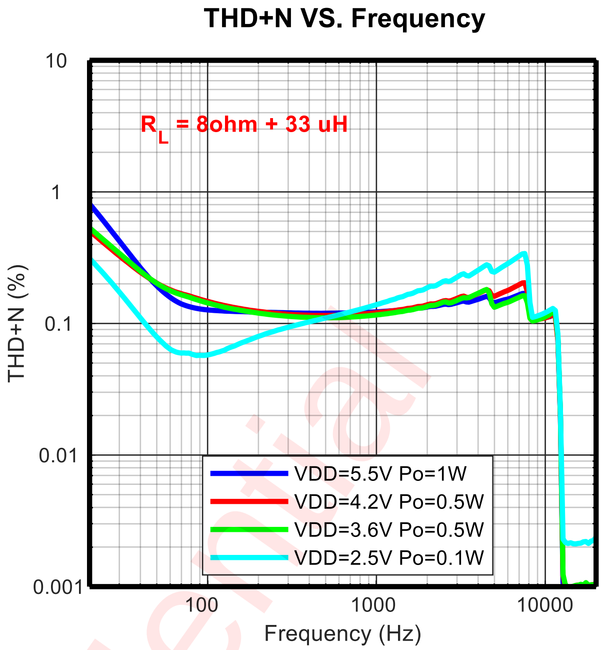
Gain VS. Frequency

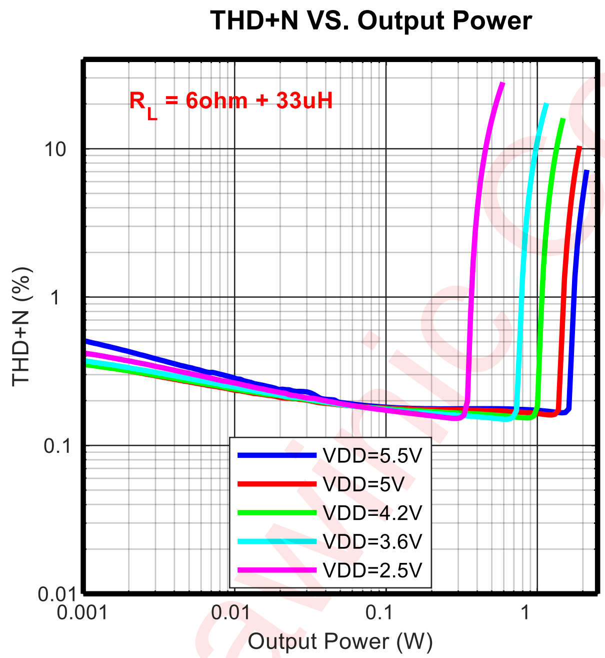


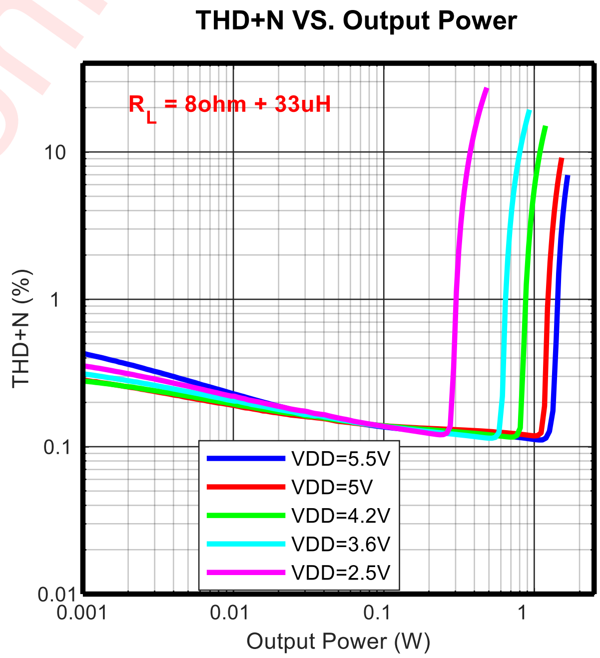
PSRR VS. Frequency



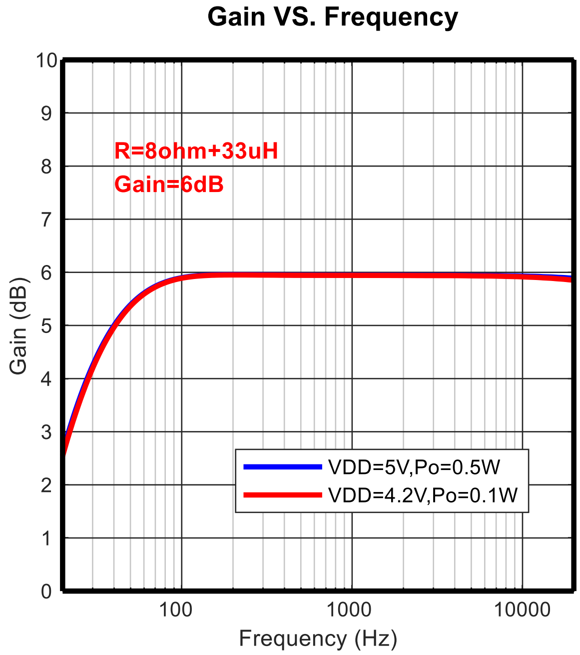

THD+N VS. Frequency
R_L = 6ohm + 33uH
10
1
0.1
0.01
0.001
THD+N (%)
100
1000
10000
Frequency (Hz)
VDD=5.5V Po=1W
VDD=4.2V Po=0.5W
VDD=3.6V Po=0.5W
VDD=2.5V Po=0.1W

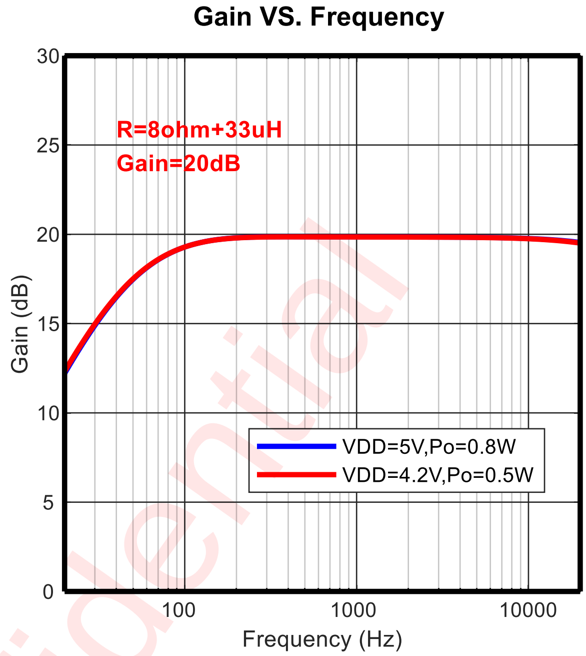

THD+N VS. Frequency
R_L = 8ohm + 33 uH
10
1
0.1
0.01
0.001
THD+N (%)
100
1000
10000
Frequency (Hz)
VDD=5.5V Po=1W
VDD=4.2V Po=0.5W
VDD=3.6V Po=0.5W
VDD=2.5V Po=0.1W

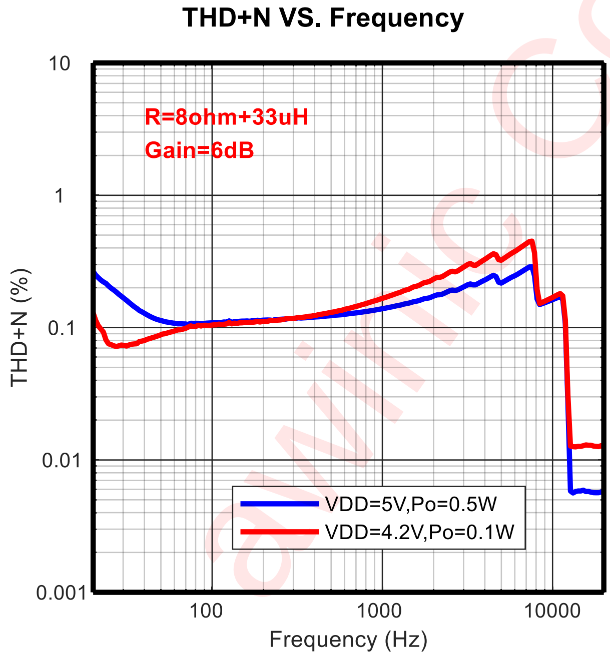

THD+N VS. Output Power
R_L = 6ohm + 33uH
10
1
0.1
0.01
THD+N (%)
0.001
0.01
0.1
1
Output Power (W)
VDD=5.5V
VDD=5V
VDD=4.2V
VDD=3.6V
VDD=2.5V

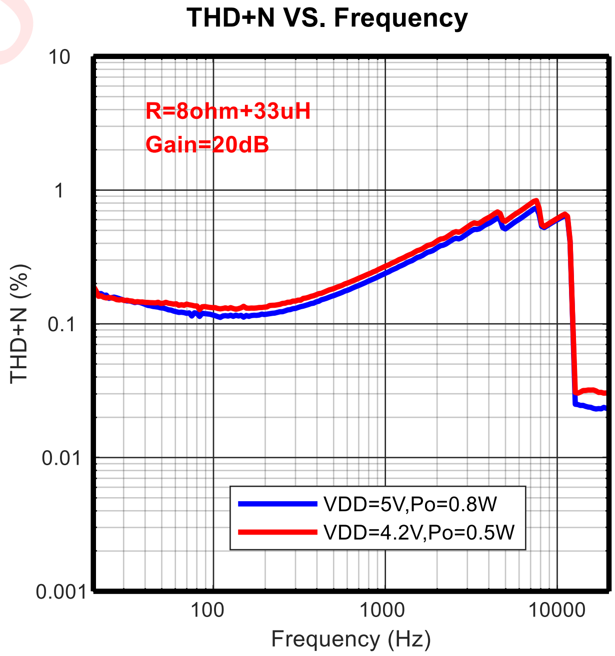

THD+N VS. Output Power
R_L = 8ohm + 33uH
10
1
0.1
0.01
THD+N (%)
0.001
0.01
0.1
1
Output Power (W)
VDD=5.5V
VDD=5V
VDD=4.2V
VDD=3.6V
VDD=2.5V

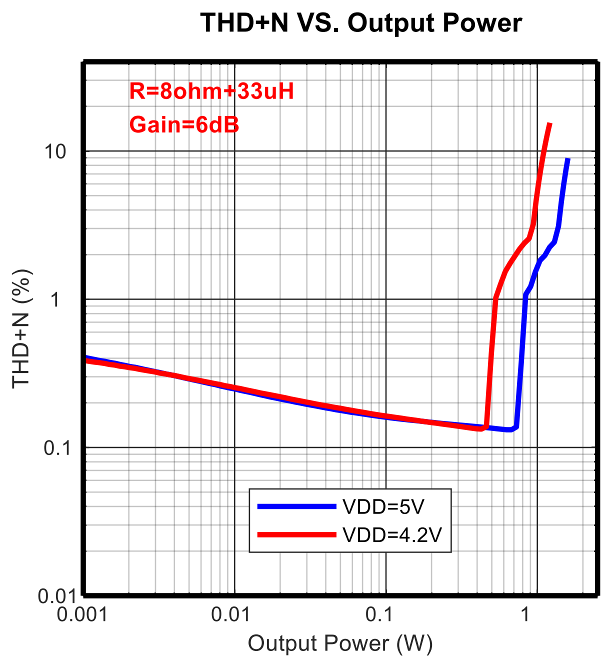
T_A=25°C, Fully-differential application

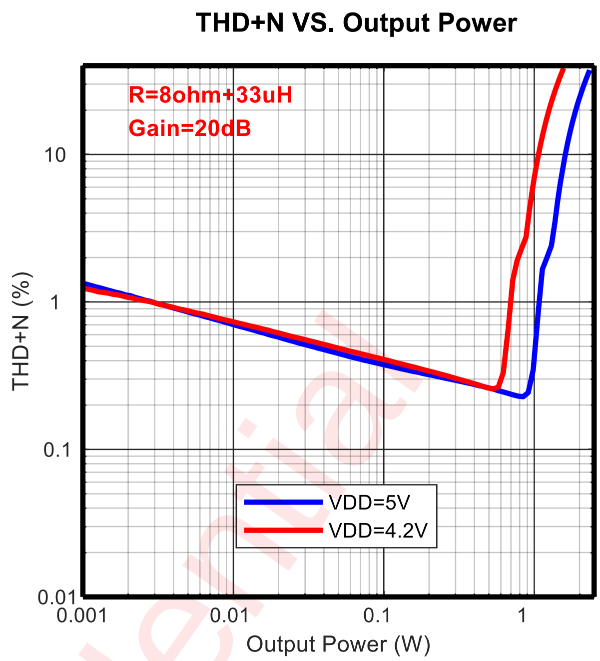












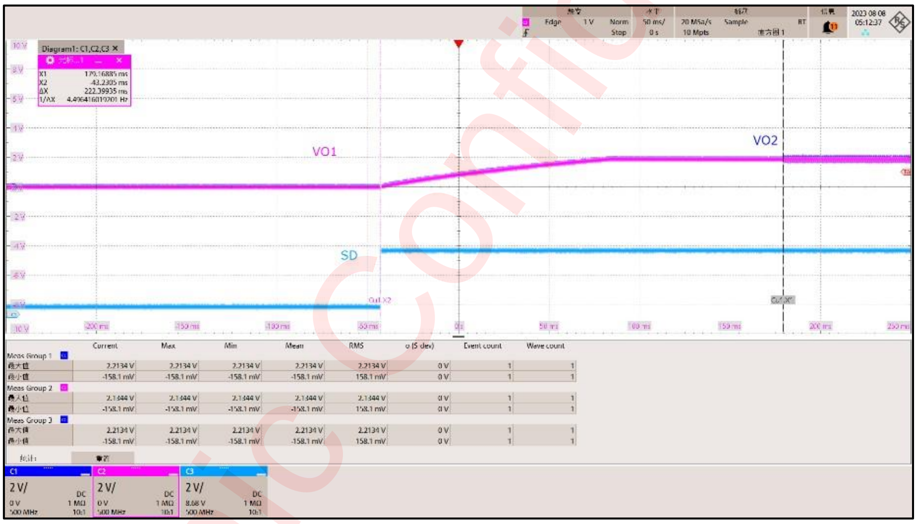


Figure 7 AW8091 Startup Timing

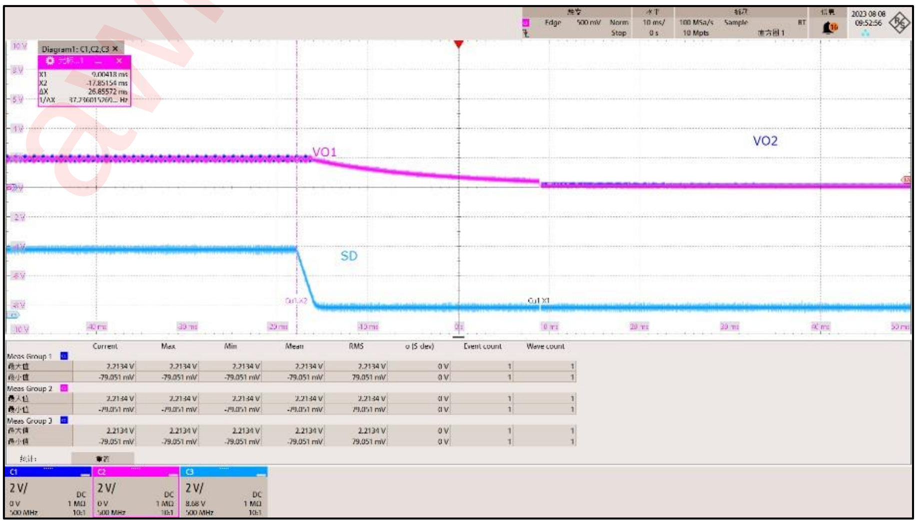


Figure 8 AW8091 Shutdown Timing

Application Information

Supply Decoupling Capacitor (C_S)

A good decoupling capacitor can improve the efficiency and the best performance of the power amplifier. At the same time, in order to get good high frequency transient performance, the ESR value of the capacitor should be as small as possible. Low ESR (equivalent-series-resistance) X7R or X5R ceramic capacitors are recommended. Generally, 10μF ceramic capacitors are used to bypass the VDD to the ground, and the decoupling capacitor should be placed as close to the VDD chip as possible in the layout. If you want to filter out low-frequency noise better, you need to add a 10μF or greater decoupling capacitor depending on your application. Meanwhile, a 33pF~0.1μF ceramic capacitor is placed on the pin of the power supply to filter the high frequency interference on the power supply.

Input Capacitor-C_{in} (Input High-pass Cutoff Frequency)

The input capacitors and input resistors form a high-pass filter to filter out the DC component of the input signal. The -3dB frequency points of the high pass filter is shown below：

$$f_H(-3\text{dB}) = \frac{1}{2 * \pi * R_{\text{in}} * C_{\text{in}}}(\text{Hz})$$

The selection of a smaller Cin capacitor in the application helps to filter out noise, which comes from the input coupling, and the smaller capacitor is advantageous to reduce the pop-click noise when the power amplifier turn on. Better matching of the input capacitors improves performance of the circuit and also helps to suppress pop-click noise. A capacitor value deviation of 10% or better capacitance is recommended. C_{in} can be selected from 15nF to 0.39uF as needed.

Take typical application as an example, the input high-pass cutoff frequency is calculated as below:

$$f_H(-3dB) = \frac{1}{2 * \pi * R_{in} * C_{in}} = \frac{1}{2 * \pi * 20k\Omega * 0.39\mu F}(Hz) = 20Hz$$

Input resistance & Feedback resistance (Gain setting)

When applied as single-ended input application, the gain setting of system:

$$Av = 2 * \frac{Rf}{Rin}(\text{V/V})$$

When applied as pseudo-differential application, the gain setting of system:

$$Av = \frac{Rf}{Rin}(\text{V/V})$$

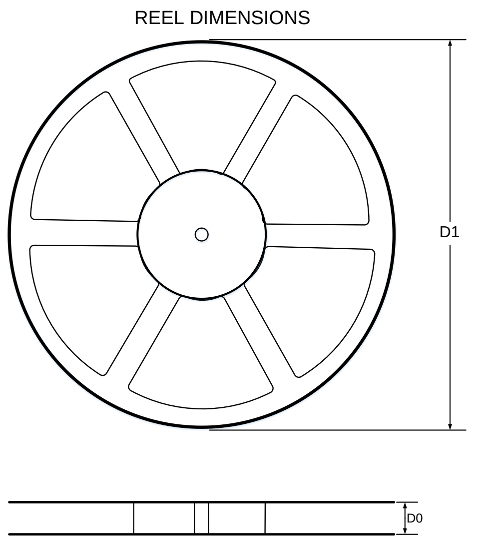
It is generally recommended that Av be set between 2~10 V/V, so that you can get better music playback effect.

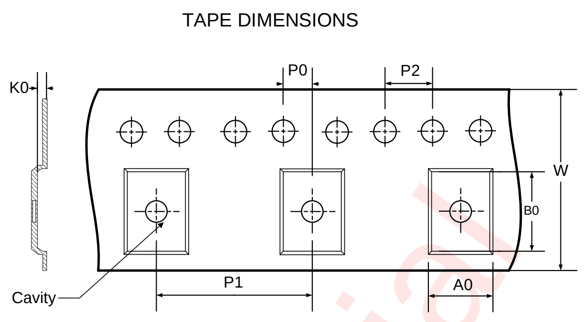
When applied as fully-differential application, the gain setting of system:

$$Av = \frac{Rf}{Rin}(V/V)$$

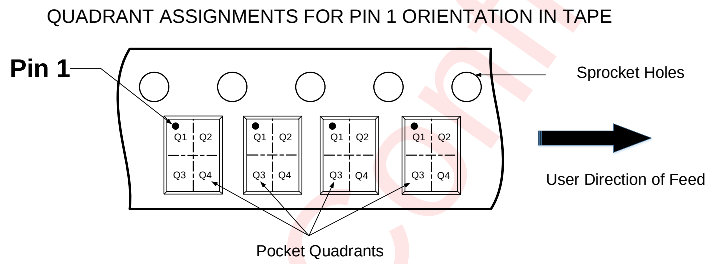
It is recommended that Av be set to 10V/V, so as to obtain better music playback and ensure better electrical performance such as THD+N.

Tape And Reel Information





A0：Dimension designed to accommodate the component width
B0：Dimension designed to accommodate the component length
K0：Dimension designed to accommodate the component thickness
W：Overall width of the carrier tape
P0：Pitch between successive cavity centers and sprocket hole
P1：Pitch between successive cavity centers
P2：Pitch between sprocket hole
D1：Reel Diameter
D0：Reel Width



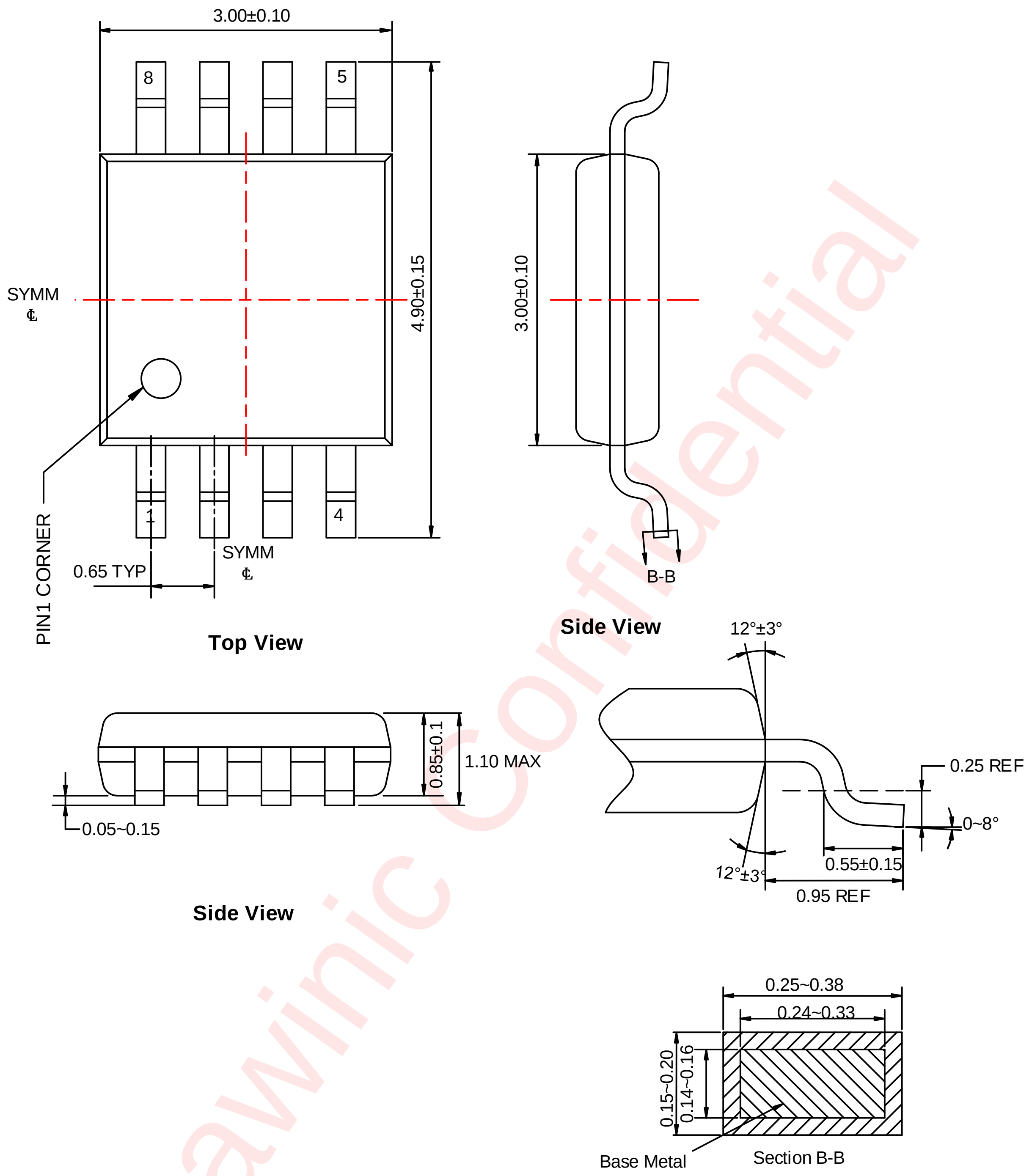
Note: The above picture is for reference only. Please refer the value in the table below for actual size.

DIMENSIONS AND PIN1 ORIENTATION

D1 (mm)	D0 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
330.0	12.4	5.25	3.35	1.25	2.0	8.0	4.0	12.0	Q1

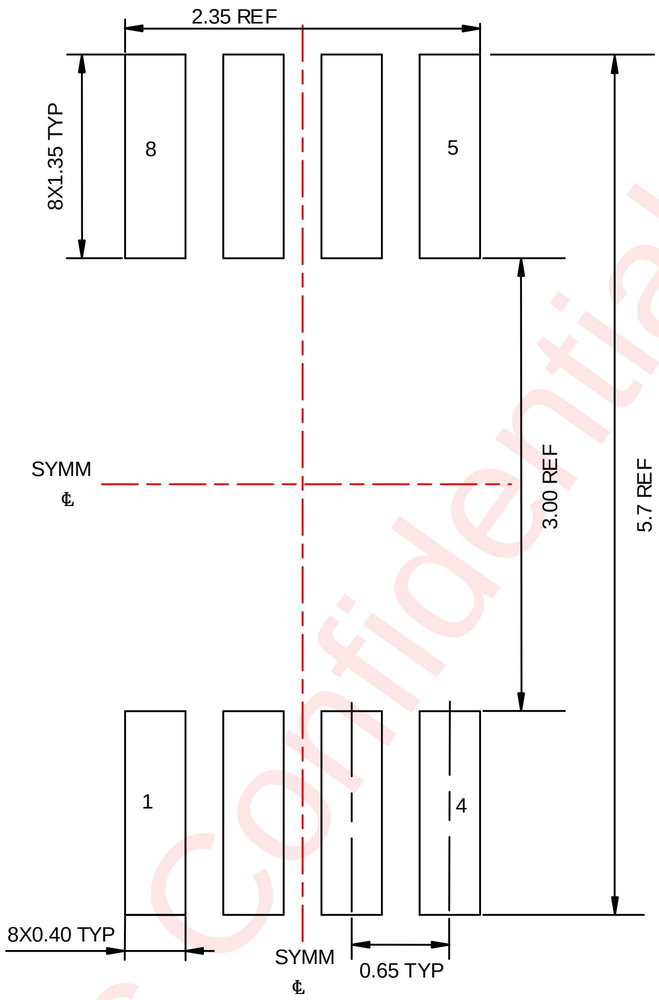
All dimensions are nominal

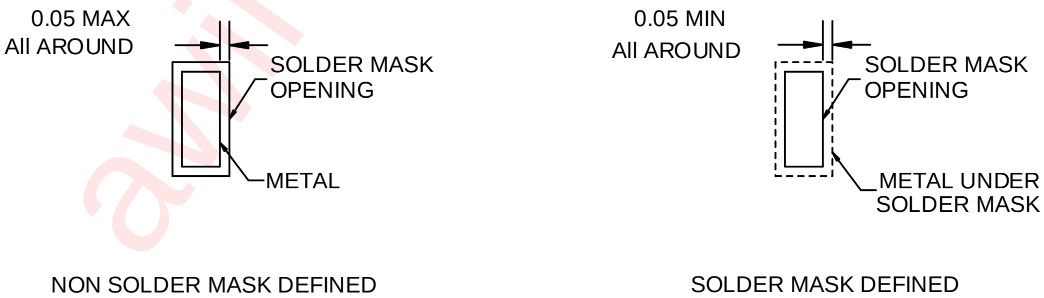
Package Description



Unit:mm

Land Pattern Data





UNIT: mm

Revision History

Version	Date	Change Record
V1.0	Sep.2023	Officially released
V1.1	Nov.2023	1. Pseudo-differential applications and fully-differential applications are described separately 2. Added application Information 3. Updated electrical characteristics

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