

8.0W Anti-Clipping Mono Class D Audio Amplifier with Boost Converter

FEATURE

- Anti-Clipping Function (ACF)
- Filter-less Modulation, Eliminating Output Filter
- Output Power
 - 6.5W ($V_{BAT}=4.2V$, $PVDD = 7.0V$, $R_L=4\Omega$, $THD+N=10\%$)
 - 8.0W ($V_{BAT}=4.2V$, $PVDD = 7.0V$, $R_L=3\Omega$, $THD+N=10\%$)
 - 3.5W ($V_{BAT}=4.2V$, $PVDD = 7.0V$, $R_L=8\Omega$, $THD+N=10\%$)
- Power Supply
 - Boost Input V_{BAT} : 2.5V to 5.5V
 - Boost Output $PVDD$: V_{BAT} to 7.5V
- Adjustable BOOST Output Voltage
- Class AB / Class D
- Over Current Protection, Thermal Protection, Low voltage malfunction prevention function included
- Pb-Free Packages , SOP16L-PP/SOP16L

APPLICATIONS

- Bluetooth Speakers
- Portable Speakers
- 2.1 Channel Speakers
- Megaphone
- iphone/ipod/ipod docking
- MP4/GPS
- Tablet PC/Note Book
- Smart Phones
- LCD TV/Monitor
- Portable Gamers

GENERAL DESCRIPTION

HT8692 integrates a boost converter with a filter-less stereo class D audio power amplifier to provide 6.5W continuous power into a 4 Ω speaker, and 8.0W continuous power into a 3 Ω speaker when operating from a Li-battery voltage boosted to 7.0V. Meanwhile, the boost output voltage is adjustable.

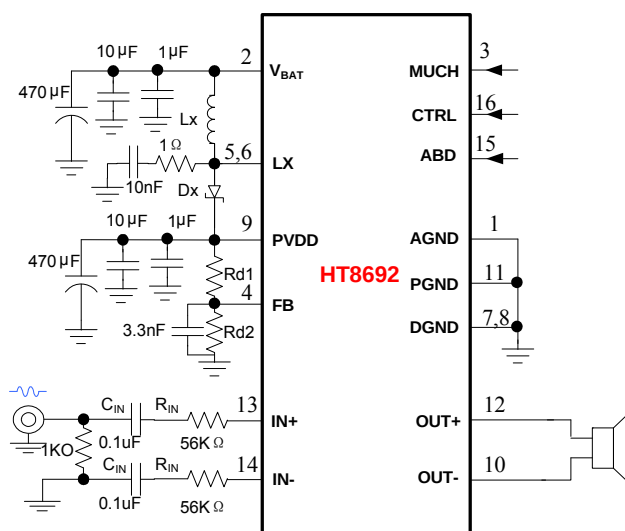
HT8692 features Anti-Clipping Function (ACF) which detects output signal clip due to the over input signal and suppresses the output signal clip automatically. Also, the ACF function can adapt the output clip caused by power supply voltage down with battery. It can significantly improve the sound quality, creating a very comfortable musical enjoyment, and to protect the speakers from overload damage. It also supplies ACF OFF mode.

Class AB amplifier mode is also available for HT8692. Once the EMI Interference from class D and Boost Converter becomes an annoying problem, HT8692 can be changed into Class AB mode.

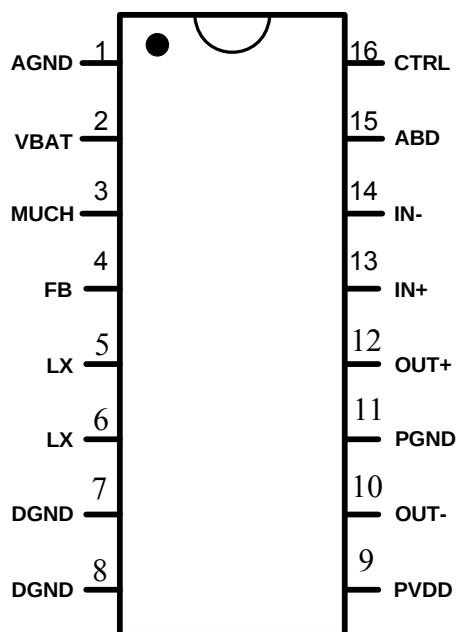
HT8692 has a filter-less modulation circuit which directly drives speakers while realizes low distortion and low noise characteristics. Thanks to filter-less, circuit design with fewer external parts can be made in portable applications.

HT8692 has the independent Shutdown function which can minimize the power consumption at standby and MUTE function. As for protection function, over current protection function for speaker output terminals, over temperature protection function, and low supply voltage malfunction preventing function are also prepared.

TYPICAL APPLICATION



■ TERMINAL CONFIGURATION



SOP16L-PP/SOP16L Top View

■ TERMINAL FUNCTION ^{*1}

SOP Terminal No.	Name	I/O	ESD Protection	Function
1	AGND	GND	PN	Analog Ground
2	V _{BAT}	Power	PN	Power Supply
3	MUCH	I	PN	Mute Control Terminal
4	FB	I	PN	Regulator Feedback Input
5,6	LX	I	-	Internal Switch Input
7,8	DGND	GND	-	Power Ground for Boost converter
9	PVDD	Power	-	Boost Converter Output Voltage
10	OUT-	O	-	Negative Output Terminal (BTL-)
11	PGND	GND		Power Ground for Class D
12	OUT+	O		Positive Output (BTL+)
13	IN+	I	PN	Positive Input Terminal (differential +)
14	IN-	I	PN	Negative Input Terminal (differential -)
15	ABD	I	PN	Class D or Class AB Amplifier Mode Control Terminal
16	CTRL	I	PN	Shutdown and ACF Control Terminal

^{*1} I: Input O:Output

ORDERING INFORMATION

H	T	8	6	9	2	XX
---	---	---	---	---	---	----

Package type

Part Number	Package Type	Marking	Operating Temperature Range	MOQ/Shipping Package
HT8692SP	SOP16L-PP	HT8692SP K#####*2	-40℃~85℃	Tape 50PCS
HT8692SP	SOP16L	HT8692SP B#####*2	-40℃~85℃	Tape 50PCS

*2: ##### is production track code.

ELECTRICAL CHARACTERISTIC

Absolute Maximum Ratings *3

Item	Symbol	Min.	Max.	Unit
Power supply voltage range	V _{BAT}	-0.3	6.0	V
BOOST converter output voltage range	PVDD	V _{BAT}	7.8	V
Input terminal voltage range (IN+, IN-)	V _{IN}	V _{SS} -0.6	PVDD+0.6	V
Input terminal voltage range (except IN+, IN-)	V _{IN}	V _{SS} -0.3	PVDD+0.3	V
Operating Ambient Temperature	T _A	-40	85	℃
Junction Temperature	T _J	-40	150	℃
Storage Temperature	T _{STG}	-50	150	℃

*3: Absolute Maximum Ratings is values which must not be exceeded to guarantee device reliability. With a system in which supply voltage might exceed supply voltage of PVDD/GND, external diodes are recommended to be used to assure that the voltage does not exceed the absolute maximum rating.

Recommended Operating Condition

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Power Supply Voltage *4	V _{BAT}		2.5	3.6	5.5	V
BOOST converter output voltage range	PVDD		V _{BAT}	7.0	7.5	V
Operating Ambient Temperature	T _a		-40	25	85	℃
Speaker Impedance	R _L	SOP16L-PP	2			Ω
Speaker Impedance	R _L	SOP16L	4			Ω

*4: The rising time of V_{BAT} should be more than 1μs.

● Electrical Specification *5

Item	Symbol	Conditions		Min.	Typ.	Max.	Unit
BOOST Converter							
Boost converter output voltage	PVDD			V _{BAT}	7.0	7.5	V
Boost converter frequency	f _{SW}				410		kHz
Boost converter input current limit	I _{LIMTRIP}				3.2		A
Class D Channel V _{SS} =0V, V _{BAT} =3.6V, R _{IN} = 56K, Ta=25°C, C _{IN} =0.1uF, ACF-Off mode, unless otherwise specified							
Carrier clock frequency	f _{PWM}				410		kHz
Over current protection	I _{max}					5	A
System Gain	A _{V0}	R _{IN} =56 kΩ			26		dB
Start-up time (power-on or shutdown release)	t _{STUP}				280		ms
ACF attenuation gain	A _a			-16		0	dB
Consumption current in shutdown mode	I _{SD}	CTRL=V _{SS}			25		μA
PVDD = 6.5V							
Output Power	P _O	R _L =4Ω	V _{BAT} =4.2V, f=1kHz, THD+N=10%		5.6		W
		R _L =3Ω ^{*9}			7.0		
		R _L =8Ω			3.1		
		R _L =4Ω	V _{BAT} =4.2V, f=1kHz, THD+N=1%		4.5		
		R _L =3Ω ^{*9}			5.6		
		R _L =8Ω			2.5		
Total Harmonic Distortion plus Noise	THD+N	P _O =0.1W	R _L =4Ω, f=1kHz		0.23		%
		P _O =1.0W			0.12		%
		P _O =3.0W			0.15		%
Output Noise	V _N	f=20Hz~20kHz, A weighted, A _v =26dB			150		μV _{rms}
Signal to Noise Ratio	SNR	A weighted, A _v =26dB, THD+N = 1%			90		dB
Output offset voltage	V _{OS}				±2		mV
Efficiency (Class D + Boost)	η	V _{BAT} =3.6V, R _L =4Ω+22uH, THD+N = 10%			70		%
		V _{BAT} =3.6V, R _L =8Ω+33uH, THD+N = 10%			75		%
Quiescent current	I _{BAT}	No Load	Input Grounded		20		mA
		With Load ^{*6}			20		mA
Quiescent current in mute mode	I _{MUTE}	No Load	Input Grounded, MUCH = H		8		mA
		With Load ^{*6}			8		mA
Maximum Input Signal	V _{INmax}	f _{IN} = 1kHz, THD+N ≤ 10%, ACF-1 ON			1.2		V _{rms}
PVDD = 7.0V							
Output Power	P _O	R _L =4Ω	V _{BAT} =4.2V, f=1kHz, THD+N=10%		6.6		W
		R _L =3Ω ^{*9}			8.2		
		R _L =8Ω			3.5		
		R _L =4Ω	V _{BAT} =4.2V, f=1kHz, THD+N=1%		5.3		
		R _L =3Ω ^{*9}			6.6		
		R _L =8Ω			2.9		
Total Harmonic Distortion plus Noise	THD+N	P _O =0.1W	R _L =4Ω, f=1kHz		0.23		%
		P _O =1.0W			0.12		%
		P _O =3.0W			0.15		%
Output Noise	V _N	f=20Hz~20kHz, A weighted, A _v =26dB			150		μV _{rms}

Signal to Noise Ratio	SNR	A weighted, Av=26dB, THD+N = 1%			90		dB
Output offset voltage	VOS				±2		mV
Efficiency (Class D + Boost)	η	VBAT=3.6V, RL=4Ω+22uH, THD+N = 10%			70		%
		VBAT=3.6V, RL=8Ω+33uH, THD+N = 10%			75		%
Quiescent current	IBAT	No Load	Input Grounded		30		mA
		With Load ^{*6}			30		mA
Consumption current in mute mode	IMUTE	No Load	Input Grounded, MUCH = H		10		mA
		With Load ^{*6}			10		mA
Maximum Input Signal	VINmax	fIN = 1kHz, THD+N≤10%, ACF-1 ON			1.35		Vrms
Class AB Channel ^{*7} VSS=0V, VBAT =3.6V, Av=20dB, Ta=25°C, CIN=0.1uF, unless otherwise specified							
Output Power	PO	RL=4Ω, VBAT=3.6V	f=1kHz, THD+N=10%		1.3		W
		RL=4Ω, VBAT=4.2V			1.8		
		RL=4Ω, VBAT=5.0V			2.65		W
		RL=4Ω, VBAT=3.6V	f=1kHz, THD+N=1%		1.0		W
		RL=4Ω, VBAT=4.2V			1.5		
		RL=4Ω, VBAT=5.0V			2.1		W
Total Harmonic Distortion plus Noise	THD+N	PO=0.01W	RL=4Ω, f=1kHz		0.12		%
		PO=0.1W			0.1		%
Output Noise	VN	f=20Hz~20kHz, A weighted, Av=20dB			75		μVrms
Signal to Noise Ratio	SNR	A weighted, Av=20dB, THD+N = 1%			90		dB
Output offset voltage	VOS				±4		mV
Efficiency	η	RL=4Ω+22uH, THD+N = 10%			70		%
		RL=8Ω+33uH, THD+N = 10%			74.5		%
Quiescent current	IBAT	No Load	Input Grounded		20		mA
		With Load			20		mA
Consumption current in mute mode	IMUTE	No Load	Input Grounded, MUCH = H		2.0		mA
		With Load			2.0		mA
Consumption current in shutdown mode	ISD	CTRL=Vss			36		μA
System Gain	AV0	RIN=56 kΩ			20		dB
Start-up time (power-on, shutdown release, or switch from Class D to Class AB)	tSTUP				270		ms
Digital Input/Output							
ACF-Off mode setting threshold voltage	VMOD1			0.75×PVDD		PVDD	V
ACF-1 mode setting threshold voltage	VMOD2			0.45×PVDD		0.70×PVDD	V
ACF-2 mode setting threshold voltage ^{*8}	VMOD3			0.10×PVDD		0.40×PVDD	V
SD mode setting threshold voltage	VMOD4			Vss		0.06×PVDD	V
SD wake up voltage	VCTRL_ON			0.8			
Internal pull-down Resistor of CTRL	RCTRL	Class D			125		K Ω
		Class AB			+∞		
ABD, MUCH Input High	VIH			1.5			V

ABD, MUCH Input Low	V_{IL}				0.4	V
Internal pull-down Resistor of ABD	R_{ABD}			250		K Ω
Internal pull-down Resistor of MUCH	R_{MUCH}			300		K Ω
MISCELLANEOUS						
V _{BAT} start-up threshold voltage	V_{UVLH}			2.5		V
V _{BAT} shut-down threshold voltage	V_{UVLL}			2.3		V

*5: Depending on parts and pattern layout, characteristics may be changed.

*6: 4ohm resistor and 22uH coil are used as an output load in order to simulate a speaker.

*7: In Class AB amplifier mode, boost converter is shutdown automatically. Due to the schottky rectifier, the voltage of PVDD terminal can be lower than V_{BAT}, depending on the forward voltage of the rectifier.

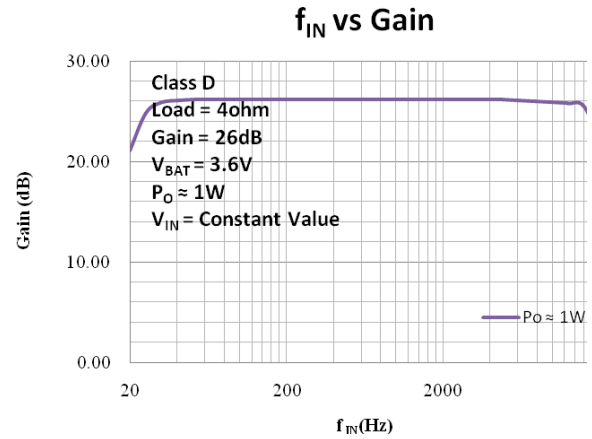
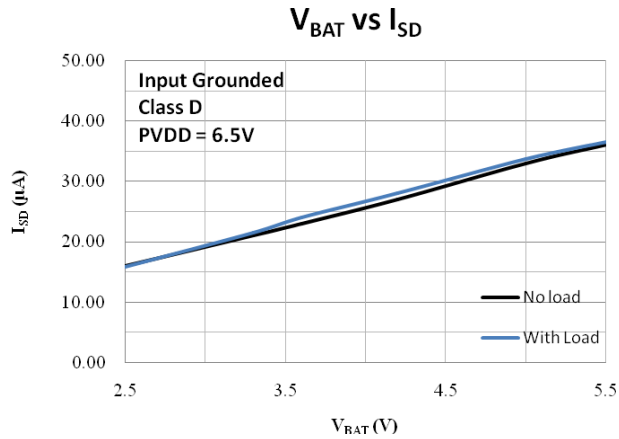
*8: ACF-1 and ACF-2 mode is only available in Class D amplifier mode.

*9: Only for HT8692 SOP16L-PP.

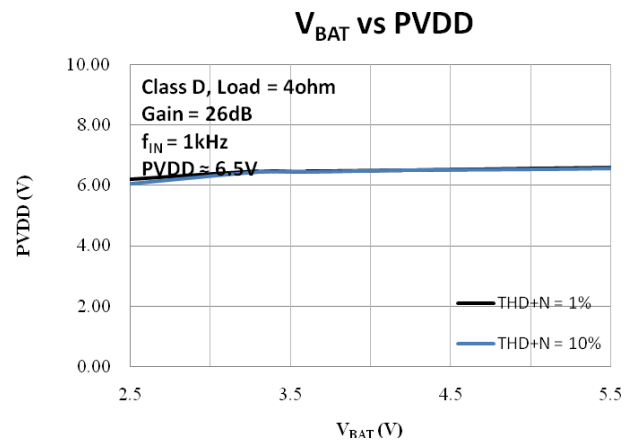
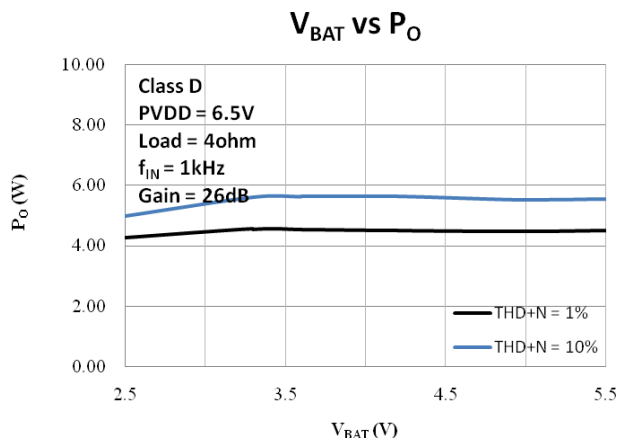
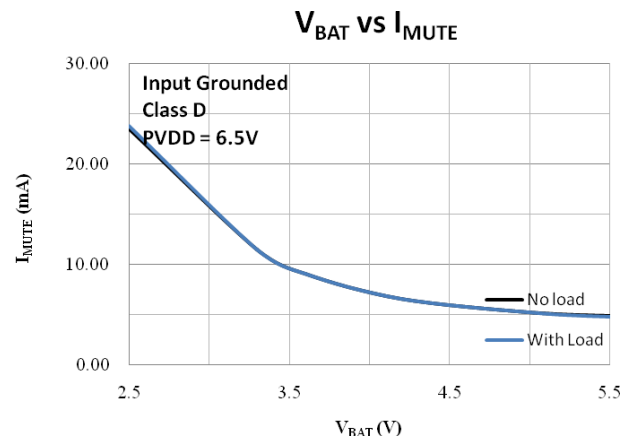
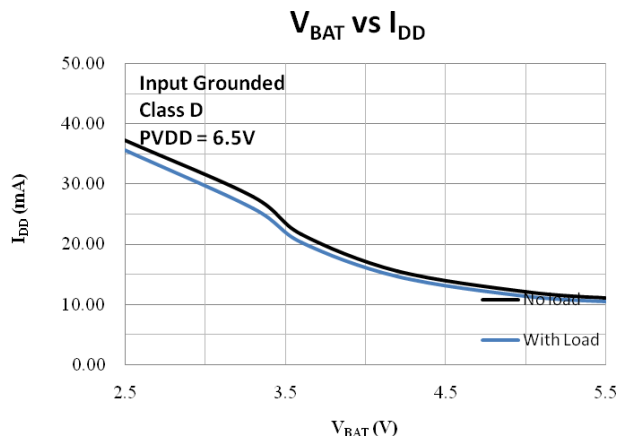
TYPICAL OPERATING CHARACTERISTICS

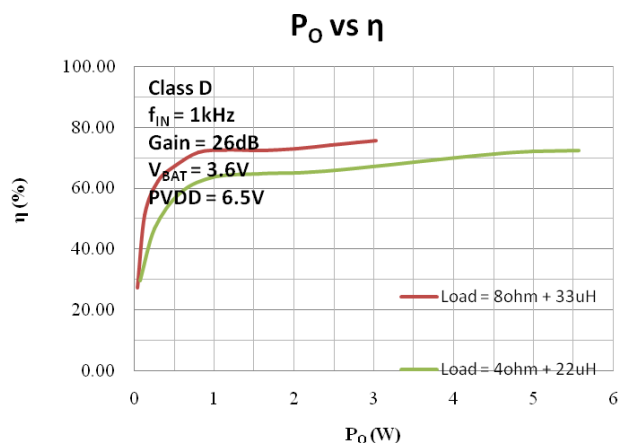
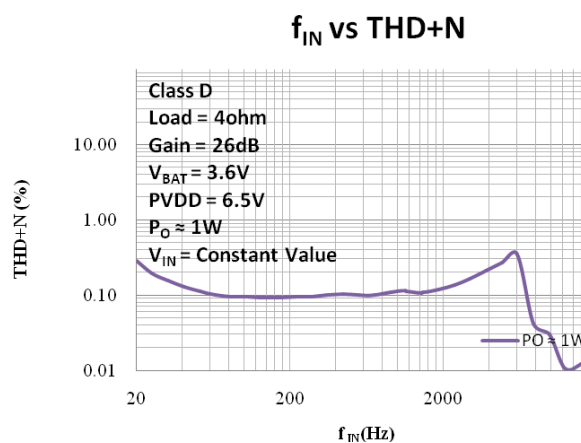
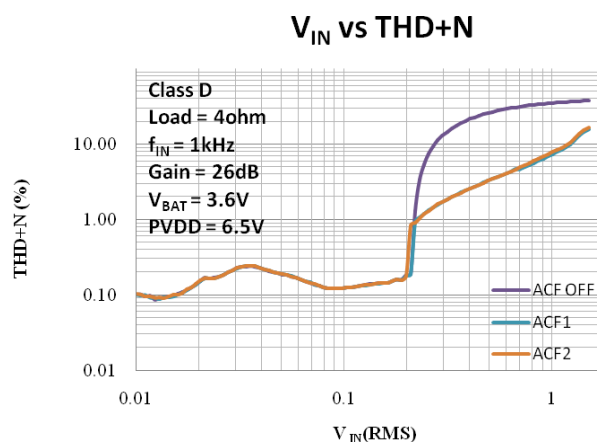
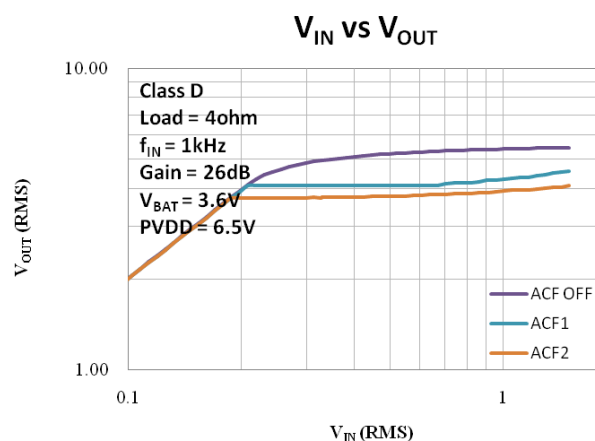
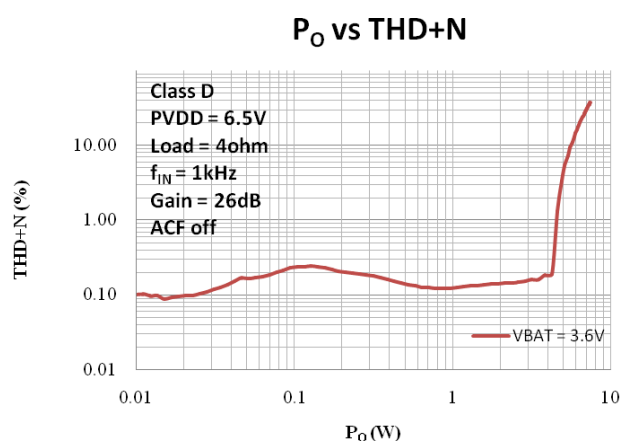
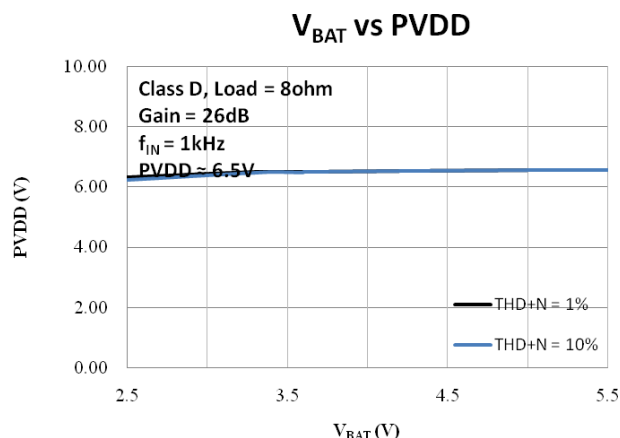
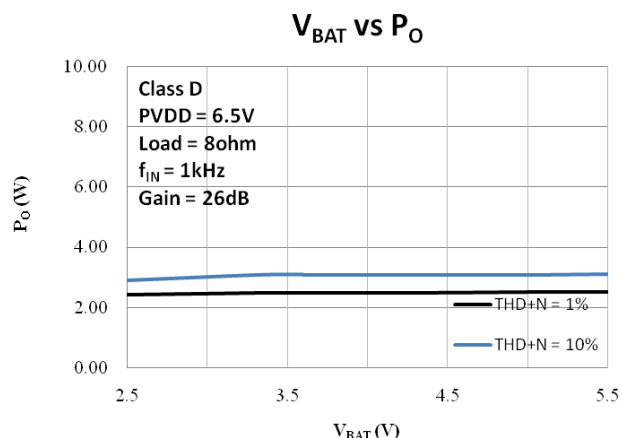
Class D Channel

Condition: Class D mode, $V_{BAT} = 3.6V$, $f_{IN} = 1kHz$, $R_{IN} = 56k$, Gain = 26dB, ACF off, Output = Load + Filter, Load = 4ohm, Filter = 100ohm + 47nF, unless otherwise specified

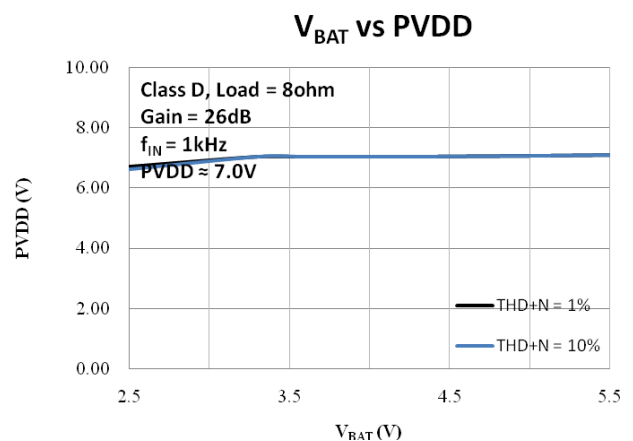
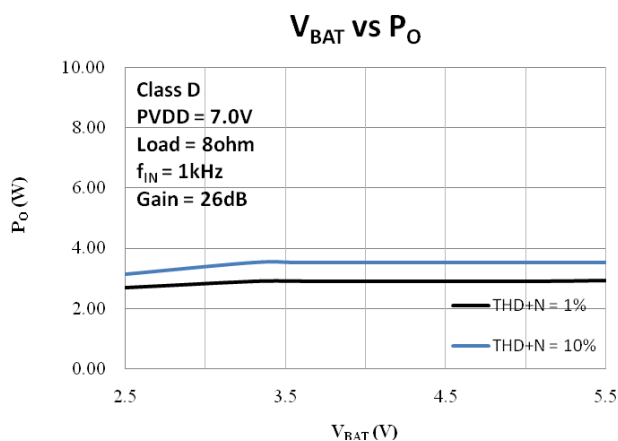
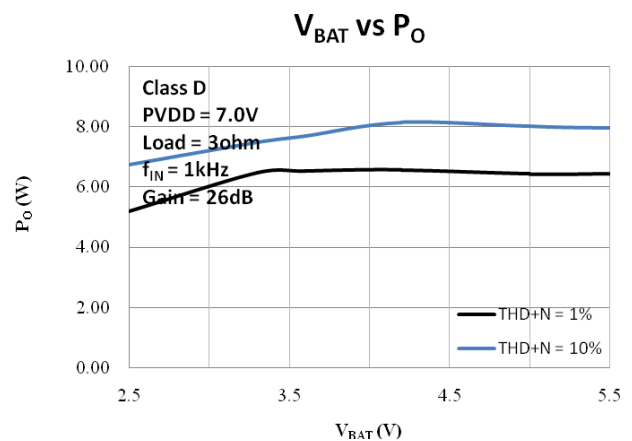
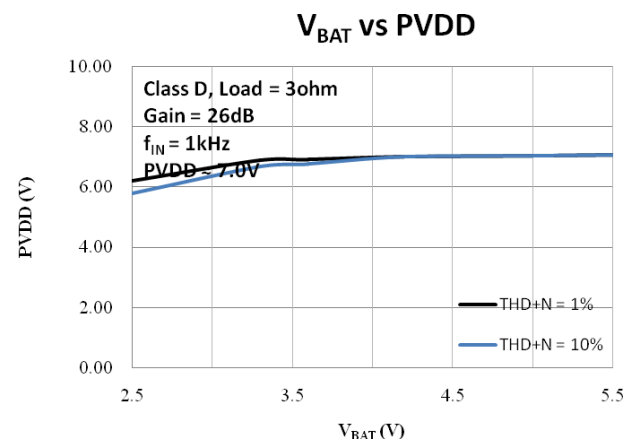
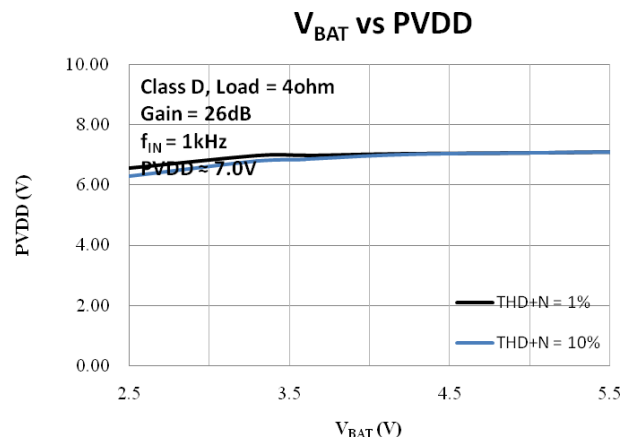
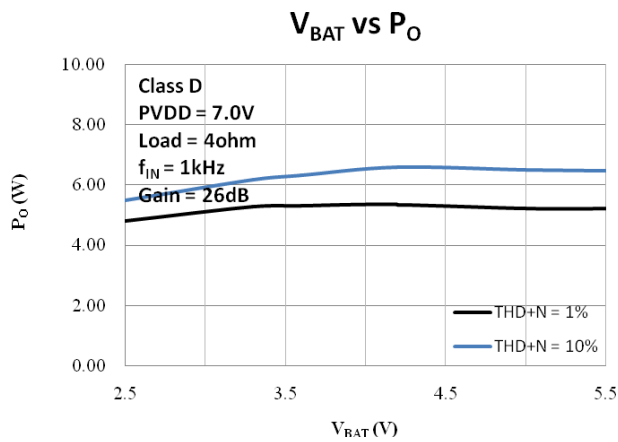
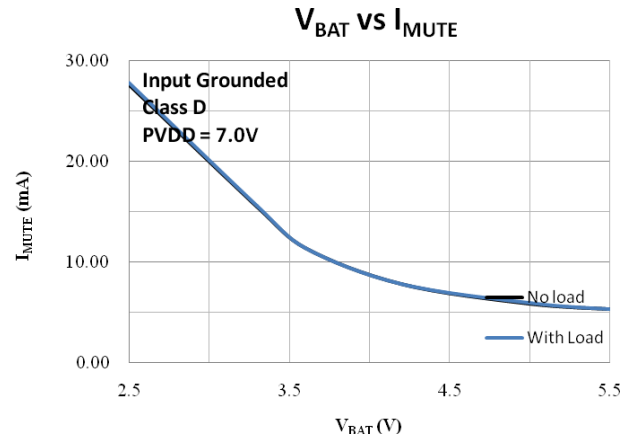
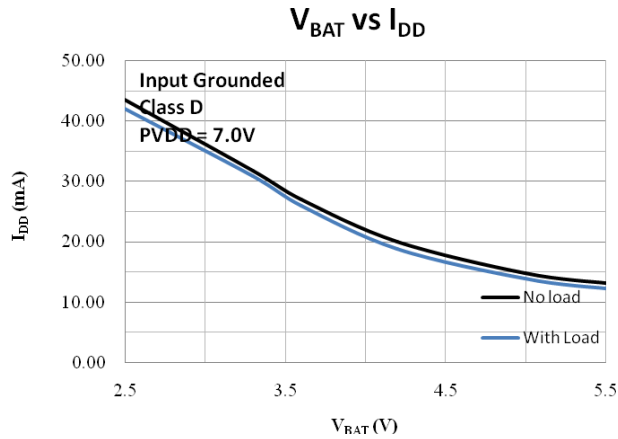


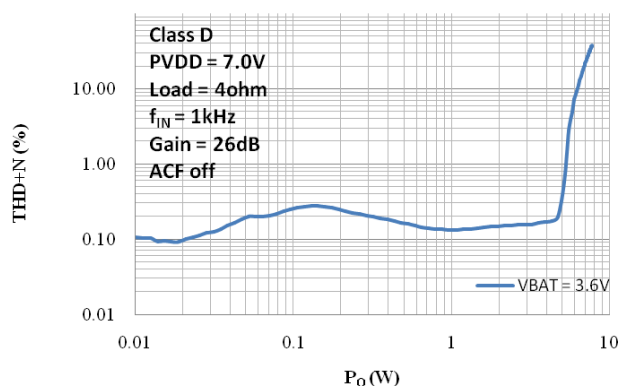
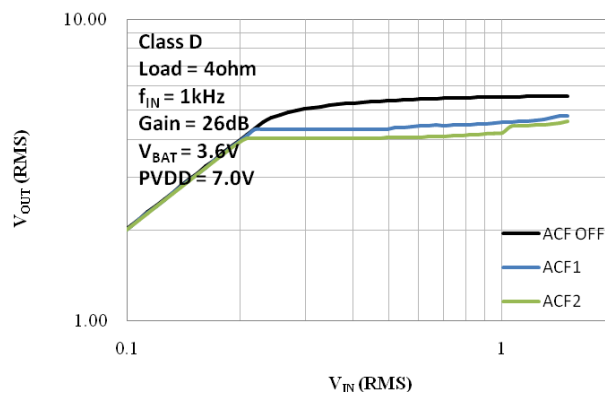
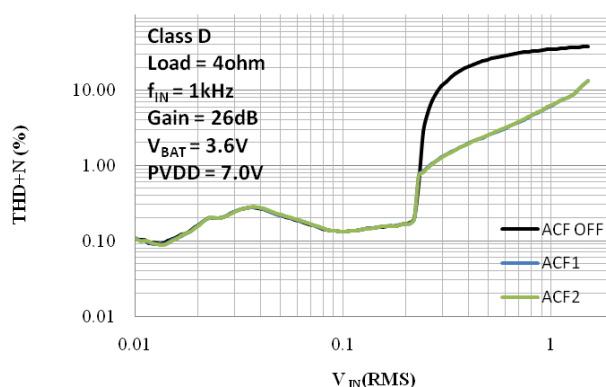
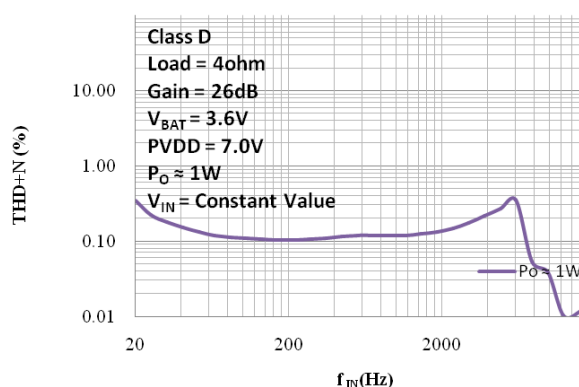
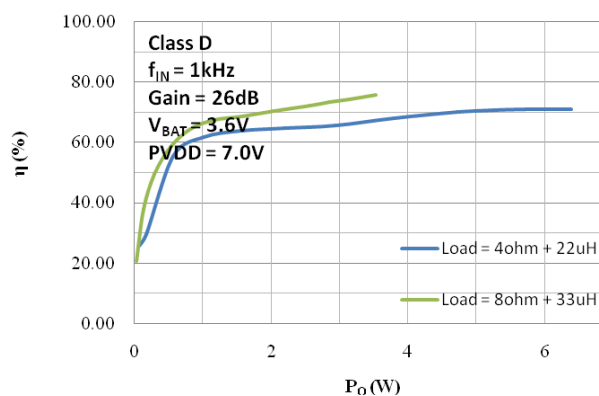
PVDD = 6.5V





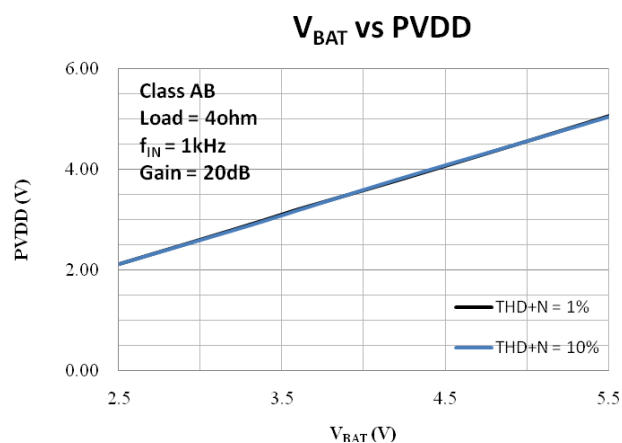
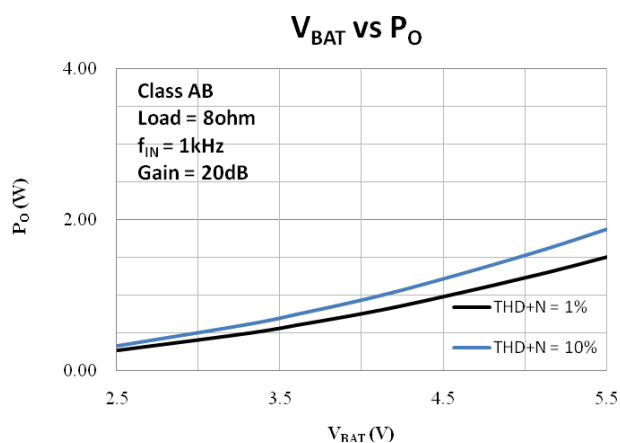
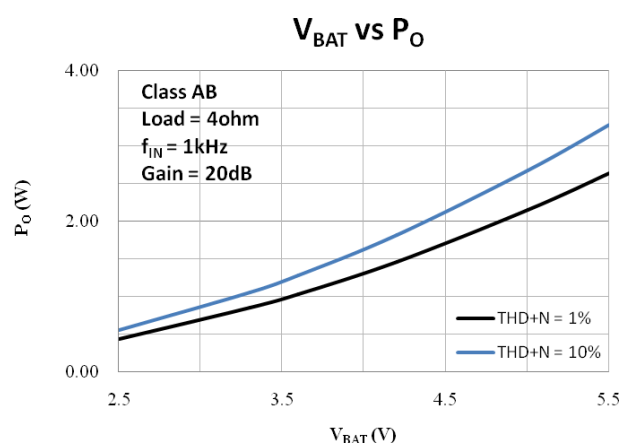
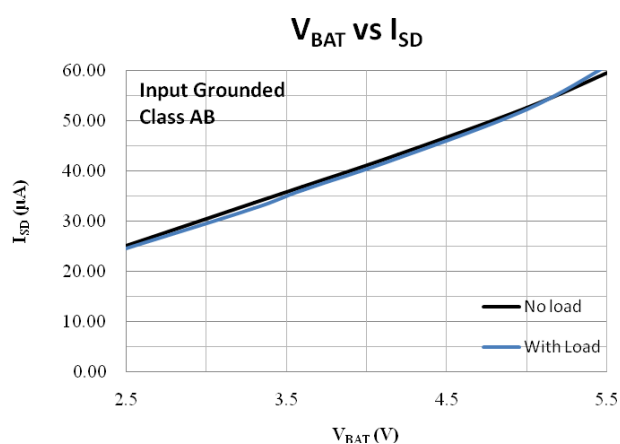
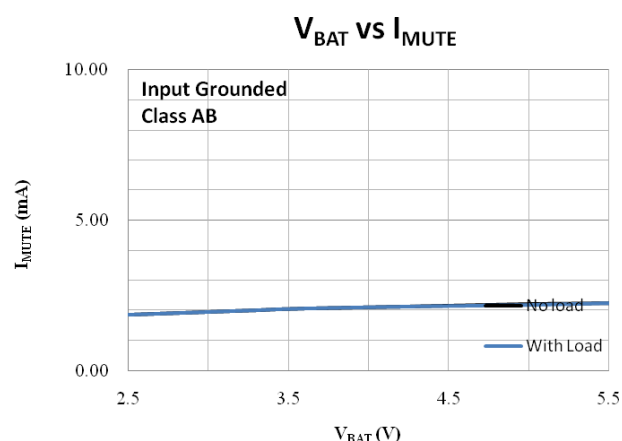
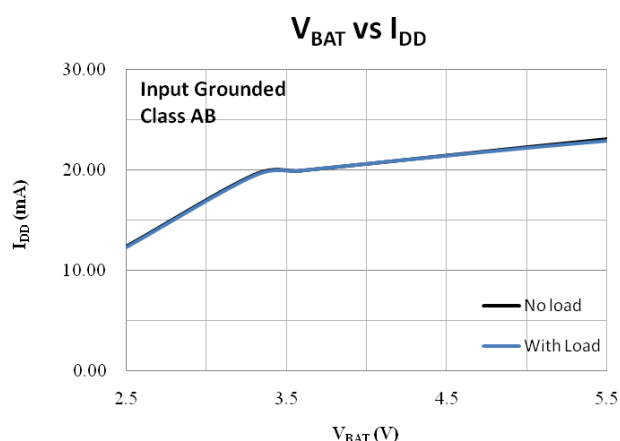
PVDD = 7.0V

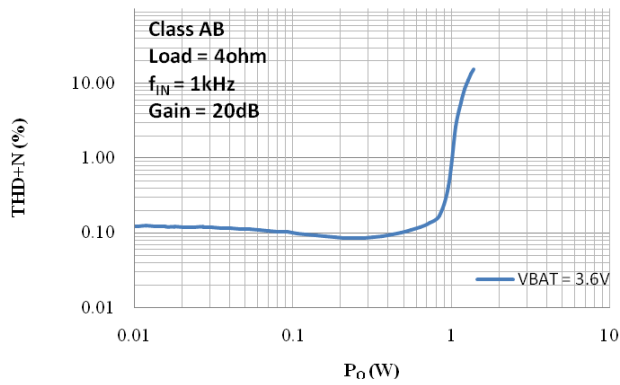
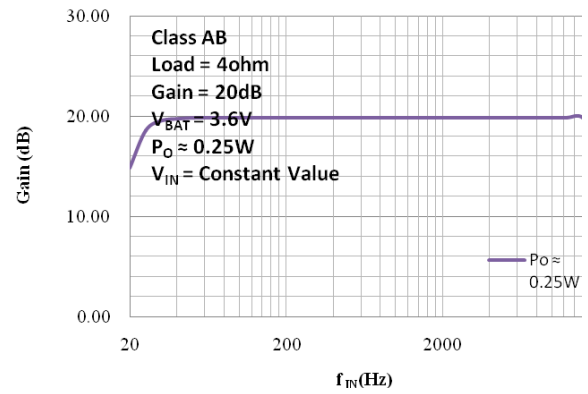
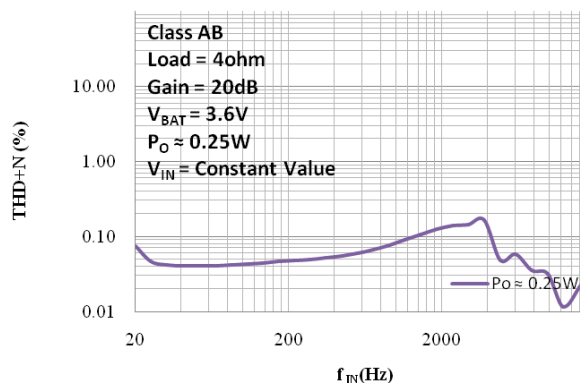
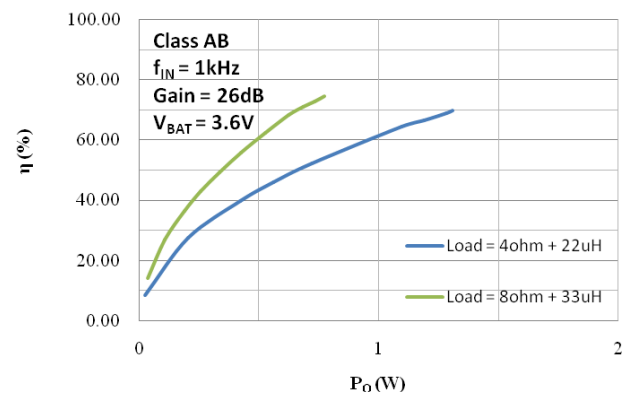


P_O vs THD+N

 V_{IN} vs V_{OUT}

 V_{IN} vs THD+N

 f_{IN} vs THD+N

 P_O vs η


Class AB Channel

Condition: Class AB mode, $V_{BAT} = 3.6V$, $f_{IN} = 1kHz$, $R_{IN} = 56k$, Gain = 20dB, Output = Load = 4ohm, unless otherwise specified



P_O vs THD+N

 f_{IN} vs Gain

 f_{IN} vs THD+N

 P_O vs η


APPLICATION INFORMATION

● BOOST Converter

(1) Setting Output Voltage

The output voltage is set by a resistive voltage divider from the output voltage to FB terminal, which is shown below. The output voltage can be calculated by $PVDD = 1.24 \cdot (Rd1 + Rd2) / Rd2$.

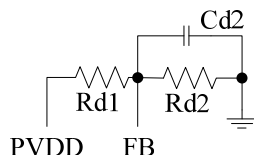


Fig. 1 FB Terminal Configuration

Some typical output voltages can be got by following settings.

Table 1. Output Voltage Setting

PVDD	Rd1	Rd2	Cd2
5.0V	120K	39.5K	3.3nF
6.5V	120K	28K	3.3nF
7.0V	120K	25.5K	3.3nF

(2) LX Terminal

It is strongly recommended to place an RC circuit from the terminal of LX to Ground, shown as following, so that the ripple current of Boost Converter can be decreased. Meanwhile, the total consumption current of the system will be larger so that the efficiency of the system will be lower. Specifications in this file is measured under the condition with RC.

Notes: RC should be placed as closely to LX pin as possible.

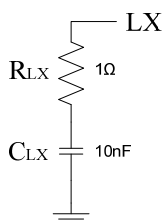


Fig. 2 LX Terminal Configuration

(3) Capacitor Selection

The input and output capacitor (C_{IN} and C_{OUT}) is required to maintain the DC voltage. Low ESR capacitors are preferred to reduce the output voltage ripple. 1uF//10uF//470uF (paralleled) is highly recommended to be placed in both input and output terminal as closely to the pin as possible.

(4) Inductor Selection

Inductance value is decided based on different condition. $L \geq 4.7\mu H$, $DCR < 10m\Omega$, $I_{SAT} \geq 3.5 A$ is recommended for general application circuit.

(5) Schottky Diode Selection

$V_{RRM} > 12V$, $V_{FM} < 0.5V$, $I_F \geq 2 A$ is recommended for general application circuit.

(6) Layout Consideration

1. The power traces, consisting of the GND, LX, V_{BAT} and PVDD trace should be kept short, direct, wide, and as closely to the pin as possible. The switching node LX should be paid more attention for EMI and

reliability consideration.

2. Place C_{IN} and C_{OUT} near V_{BAT} and $PVDD$ as closely as possible to maintain voltage steady, and filter out the pulsing current.
3. The resistive divider R should be connected to pin directly as closely as possible. FB is a sensitive node. Please keep it away from switching node, LX .
4. The GND of the IC, C_{IN} and C_{OUT} should be connected close together directly to ground plane.

● Analog Signal Input Configuration

HT8692 is an amplifier with analog input (single-ended or differential). For a differential input between $IN+$ and $IN-$ pins, signals input via DC-cut capacitors (C_{IN}). The input signal gain is calculated by $A_v \approx 1200k/R_{IN}$ (Class D mode) or $A_v \approx 600k/R_{IN}$ (Class AB mode). And, the low pass cut-off frequency of input signal, can be calculated by $f_c = 1/(2\pi R_{IN} C_{IN})$.

For a single-ended input at $IN+$ pin, signal input via a DC-cut capacitor (C_{IN}). $IN-$ pin should be connected to ground via a DC-cut capacitor (with the same value of C_{IN}). The Gain and low pass Cut-off frequency are the same as the above case.

The output impedance (Z_{out}) of the former source circuit, including signal paths up to $IN+$ terminal and $IN-$ terminal should be designed to be 600Ω or lower.

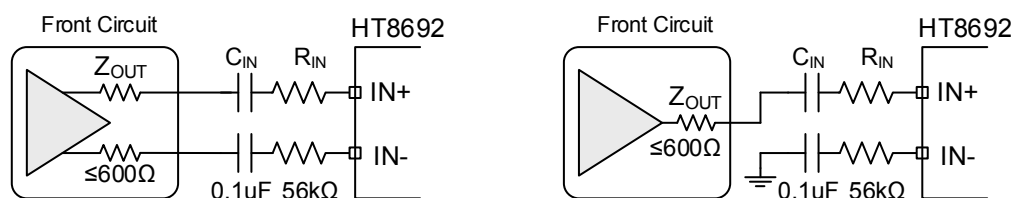


Fig. 3 (1) Differential Input;

(2) Single-ended Input

● Output Configuration

As mentioned, HT8692 can directly drive speakers without any other components. But there are exceptions. Once HT8692 works in class D mode, the cable lined to the speaker is very long, and EMI is concerned, ferrite beads or L-C filter is needed.

If the BOOST output voltage is high ($\geq 7V$), the power supply ripple for class D amplifier is high, the voltage level of input signals is high ($\geq 1.0V_{rms}$), or the impedance of the load speaker is low ($\leq 4\Omega$), a bigger value of capacitance ($\geq 470\mu F$) in the terminal of $PVDD$ needs to be added, and a Snubber circuit and two Schottky diodes added in the output terminal can be a choice to protect the chip from damage.

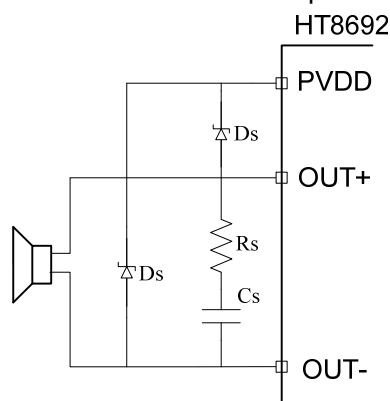


Fig. 4 Snubber Circuit and Schottky Diodes for Output Terminal

Recommended component parameters:

R_s : $1.5 \sim 2\Omega$;

C_s : $330pF \sim 680pF$;

D_s : Maximum Average Forward Rectified Current $I_{AV} \geq 3A$; Maximum Instantaneous Forward Voltage $\leq 0.5V$; Peak Forward Surge Current $I_{FSM} \geq 6A$.

● CTRL Terminal Mode Control

HT8692 can work in different modes by setting the CTRL terminal, shown as follow.

Table. 2 CTRL Terminal Mode Control

MODE	SYMBOL	MIN.	TYP.	MAX.	UNIT
CTRL voltage for ACF-Off	V_{MOD1}	0.75PVDD		PVDD	V
CTRL voltage for ACF-1	V_{MOD2}	0.45PVDD		0.70PVDD	V
CTRL voltage for ACF-2	V_{MOD3}	0.10PVDD		0.40PVDD	V
CTRL voltage for SD(Shutdown)	V_{MOD4}	VSS		0.06PVDD	V

Notes: ACF-1 and ACF-2 mode can only be worked in class D mode. A 120k Ω pull-down resistor are inside of the CTRL terminal, shown as follows, but the pull-down resistor will be gone in Class AB mode. An outside pull down resistor is still needed for stability.

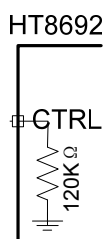


Fig. 5 CTRL Terminal

To wake up from SD mode to other working modes, the voltage of CTRL terminal should be no less than 0.8V.

● Ani-Clipping Function (ACF) Configuration

(1) ACF ON Mode

In ACF-1 and ACF-2 modes, HT8692 attenuates system gain to an appropriate value when an excessive input is applied, so as not to cause the clipping at the differential signal output. In this way, the output audio signal is controlled in order to obtain a maximum output level without distortion. And HT8692 also follows to the clips of the output waveform due to the decrease in the power-supply voltage.

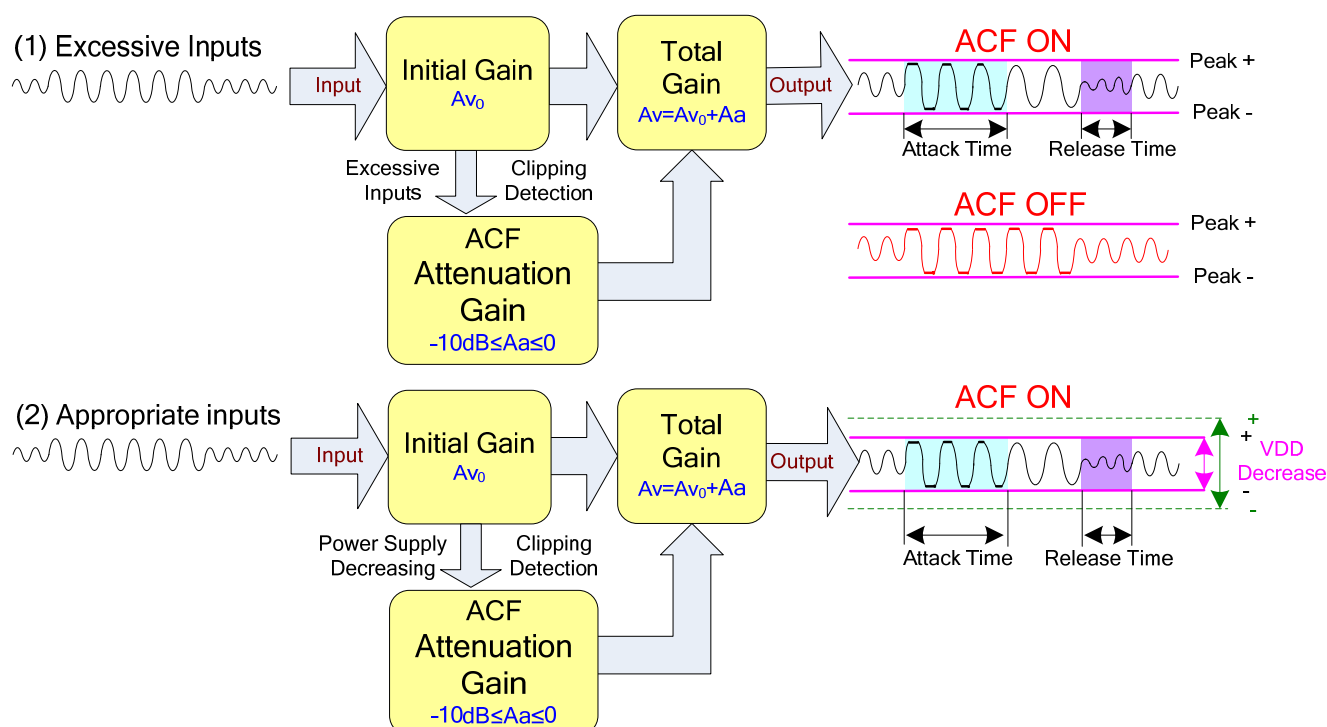


Fig. 6 the ACF Function Operation Outline

The Attack time of ACF Function is a time interval until system gain falls to target attenuation gain -3dB when a big enough signal inputs. And, the Release Time is a time from target attenuation gain to not working of ACF. The maximum attenuation gain is 16dB.

Table 3 Attack time and Release time

ACF mode	Attack time	Release time
ACF-1	50ms	64ms
ACF-2	2.5ms	1200ms

(2) ACF OFF Mode

In ACF-Off mode, ACF function is disenabled. HT8692 will not detect output clipping and the system gain is kept to be $A_v = A_{v0}$. The audio quality would worsen due to clipping distortion.

(3) SD Mode

In shutdown mode, HT8692 shuts all circuit down and minimizes the power consumption. And, the output terminals become Weak Low (A high resistance grounded state).

● ABD, MUCH Terminal Setting

HT8692 can work in different modes by setting the ABD and MUCH terminal, shown as follow.

Table 4 Mode Setting for ABD and MUCH

Logic Level Terminal	Logic High (H)	Logic Low (L)
ABD	Class D, Boost ON	Class AB, Boost OFF
MUCH	AMP mute	AMP ON

Notes: ABD and MUCH terminal can be floating as pull-up and pull-down resistors are inside them, which is shown as follow.

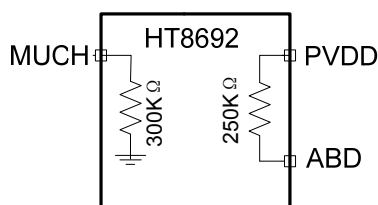


Fig. 7 ABD, MUCH Terminal

● Pop-Click Noise Reduction

The Pop-Click Noise Reduction Function of HT8692 works in the cases of Power-on, Power-off, Shutdown on, and Shutdown off. To achieve a more excellent noise reduction performance, it is recommended to use a DC-cut capacitor (C_{IN}) of 0.1μF or less.

Besides, POP noise can be minimal according to the following procedure of shutdown (mute) control.

- During power-on, Shutdown (mute) mode is not cancelled until the power supply is stabilized enough.
- Before Power-off, set Shutdown (mute) mode first.

The pop-click noise: Power-on/-off > Shutdown on/off > Mute on/off.

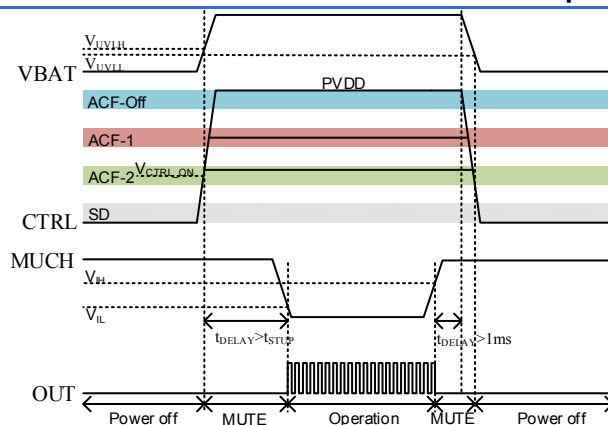


Fig. 8 Pop-Click Noise Reduction by MUTE

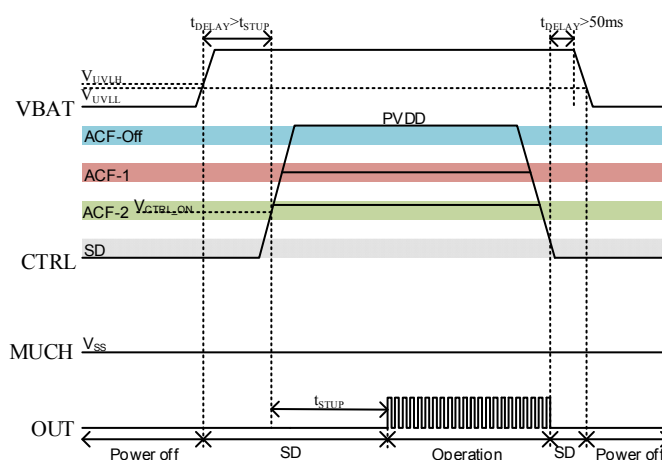


Fig. 9 Pop-Click Noise Reduction by Shutdown

● Protection Function

HT8692 has the protection functions such as Over-Current Protection function, Thermal Protection function, and Low Voltage Malfunction Prevention function.

(1) Over-current Protection function

When a short circuit occurs between one output terminal and Ground, Power, or the other output, the over-current protection mode starts up. In the over current protection mode, the differential output terminal becomes a high impedance state. Once the short circuit conditions are eliminated, the over current protection mode can be cancelled automatically.

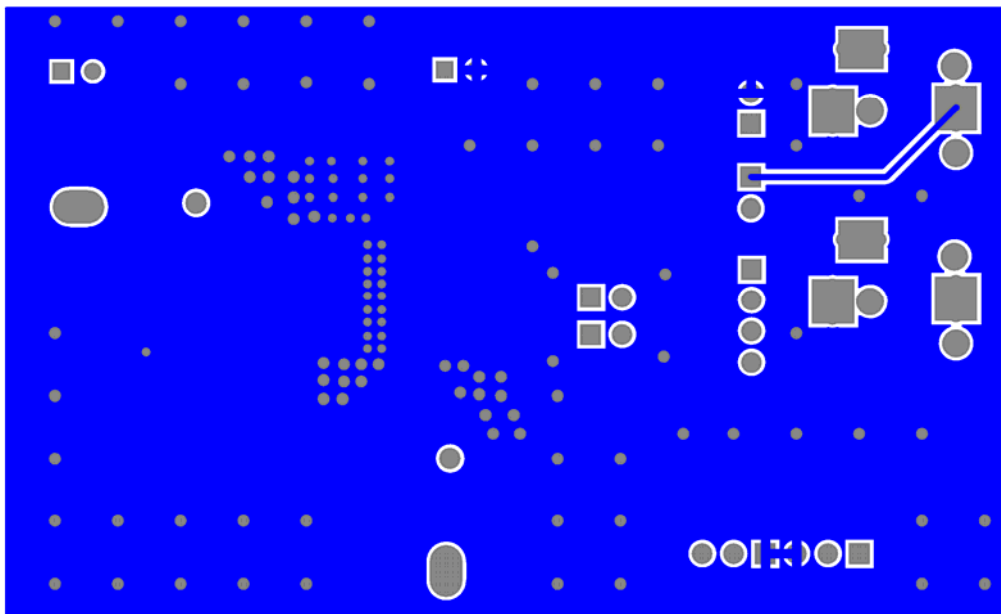
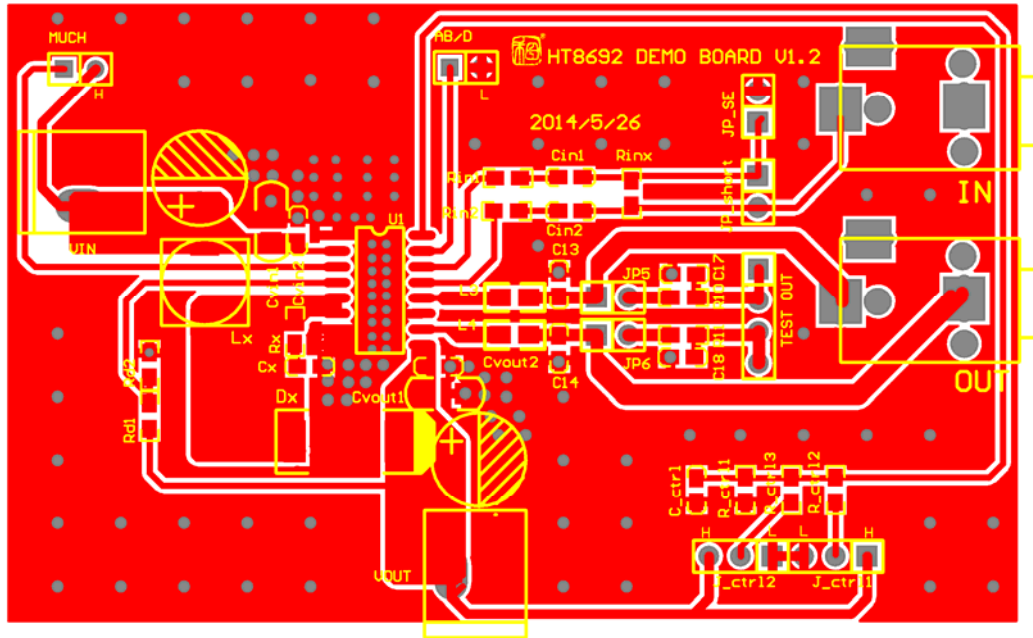
(2) Thermal Protection function

When excessive high temperature of HT8692 (150°C) is detected, the thermal protection mode starts up. In the thermal protection mode, the differential output terminal becomes Weak Low state (a state grounded through high impedance).

(3) Low voltage Malfunction Prevention function

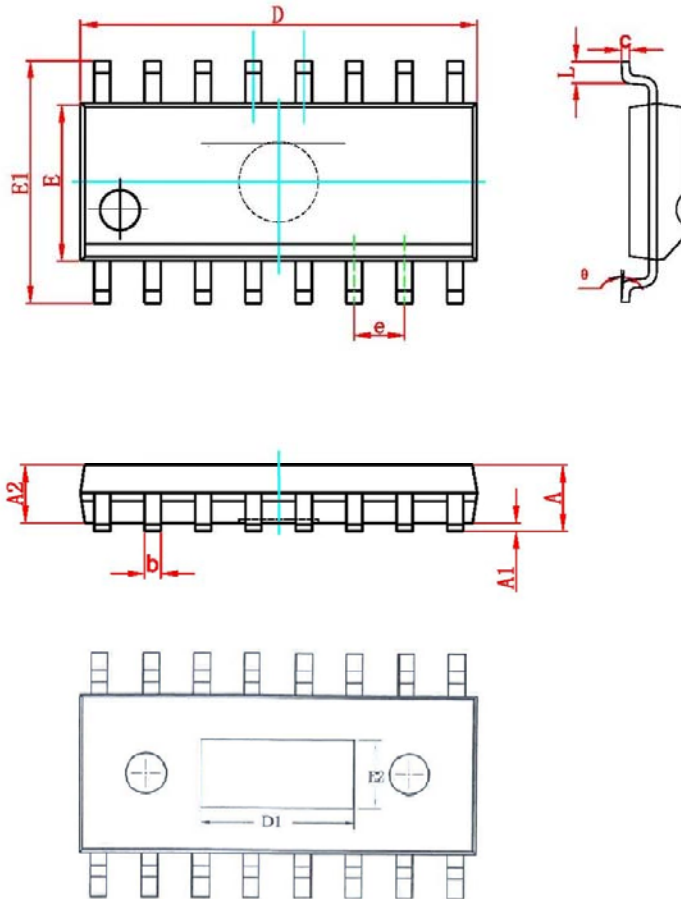
This is the function to establish the low voltage protection mode when VDD terminal voltage becomes lower than the detection voltage (V_{UVLL}) for the low voltage malfunction prevention. And the protection mode is canceled when VDD terminal voltage becomes higher than the threshold voltage (V_{UVLH}). In the low voltage protection mode, the differential output pin becomes Weak Low state (a state grounded through high impedance). HT8692 will start up within the start-up time (T_{STUP}) when the low voltage protection mode is cancelled.

● PCB Layout



■ PACKAGE OUTLINE

● SOP16L-PP



Symbol	Size (mm)	
	MIN	MAX
A	-	1.75
A1	0.05	0.15
A2	1.30	1.50
b	0.39	0.48
c	0.21	0.26
D	9.70	10.10
D1	4.57(REF) None for SOP16L	
E	3.70	4.10
E1	5.80	6.20
E2	2.41(REF) None for SOP16L	
e	1.27(BSC)	
L	0.50	0.80
θ	0°	8°

IMPORTANT NOTICE**注意**

Jiaxing Heroic Electronic Technology Co., Ltd (HT) reserves the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any products or services without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete.

嘉兴禾润电子科技有限公司（以下简称HT）保留对产品、服务、文档的任何修改、更正、提高、改善和其他改变，或停止提供任何产品和服务，并不提供任何通知的权利。客户在下单和生产前应确保所得到的信息是最新、最完整的。

HT assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using HT components.

HT对相关应用的说明和协助以及客户产品的板级设计不承担任何责任。

HT products are not authorized for use in safety-critical applications (such as life support devices or systems) where a failure of the HT product would reasonably be expected to affect the safety or effectiveness of that devices or systems.

HT的产品并未授权用于诸如生命维持设备等安全性极高的应用中。

The information included herein is believed to be accurate and reliable. However, HT assumes no responsibility for its use; nor for any infringement of patents or other rights of third parties which may result from its use.

本文中的相关信息是精确和可靠的，但HT并不对其负责，也不对任何可能的专利和第三方权利的侵害负责。

Following are URLs and contacts where you can obtain information or supports on any HT products and application solutions:

下面是可以联系到我公司的相关链接和联系方式：

嘉兴禾润电子科技有限公司**Jiaxing Heroic Electronic Technology Co., Ltd.**

地址： 浙江省嘉兴市凌公塘路3339号JRC大厦A座三层

Add: A 3rd floor, JRC Building, No. 3339, LingGongTang Road, Jiaxing, Zhejiang Province

Sales: 0573-82583866, sales@heroic.com.cn

Support: 0573-82586151, 18069667778, support@heroic.com.cn

Fax: 0573-82585078

Website: www.heroic.com.cn; wap.heroic.com.cn

Wechat MP: HEROIC_JX

QQ: 75467400

请及时关注禾润官方微信公众号，随时获取最新产品信息和技术资料！

