Low No-Load Current, AM Suppression Function, with Master-Slave Mode, 2X45W Stereo Class D&88W Mono Audio Amplifier

General Description

IU8687E is a 2X45W stereo D-class audio amplifier; Under a power supply voltage of 25V and a load of 8 Ω, the maximum continuous power output can be 2X45W. In PBTL mode, the maximum continuous power output can be 88W (load of 4 Ω); By setting the master-slave mode, IU8687E can achieve infinite cascading, thereby achieving multi-channel output of the system; IU8687E has advanced EMI suppression technology, which uses surface mount technology and only requires a small number of peripheral devices to provide high-quality audio output power to the system. IU8687E has built-in overcurrent protection, short circuit protection, and overheating protection, effectively protecting the chip from damage under abnormal working conditions. IU8687E can achieve a maximum efficiency of over 95%, and the 35V withstand voltage design provides ultra-high reliability for the chip, effectively reducing the proportion of defects in the production process.

IU8687E offers a slim EQA28 packaging format for customers to choose from, with packaging dimensions consistent with ESOP16 and a rated operating temperature range of -40 ℃ to 85 ℃.

Features

- Output Power - Stereo Sound
  VDD = 16V@RL = 4 Ω THD+N=10% PO=2X33W
  VDD = 24V@RL = 8 Ω THD+N=10% PO=2X42W
  VDD = 25V@RL = 8 Ω THD+N=10% PO=2X45W
- Output Power - PBTL Mono
  VDD = 24V@RL = 4 Ω THD+N=10% PO=80W
  VDD = 25V@RL = 4 Ω THD+N=10% PO=88W
- Single Power Supply, Wide Power Supply Voltage Range: 5V~26V
- Audio System with Filtering Network, Static Current 50mA@24V
- High Reliability Design: 35V withstand Voltage Design
- Efficiency:95%@PV_{CC}=20V RL = 8Ω P_O=2X20W
- Four Stage Gain Options
- Mute Function Control
- Master Slave Mode Programmable Control, Capable of Achieving Infinite Cascaded Power Output
- Multiple Switching Frequencies Optional: AM Suppression Function
- Programmable Power Limitation
- Good Short-Circuit Protection and Temperature Protection with Automatic Recovery Function
- Good Distortion and Anti Popping Function

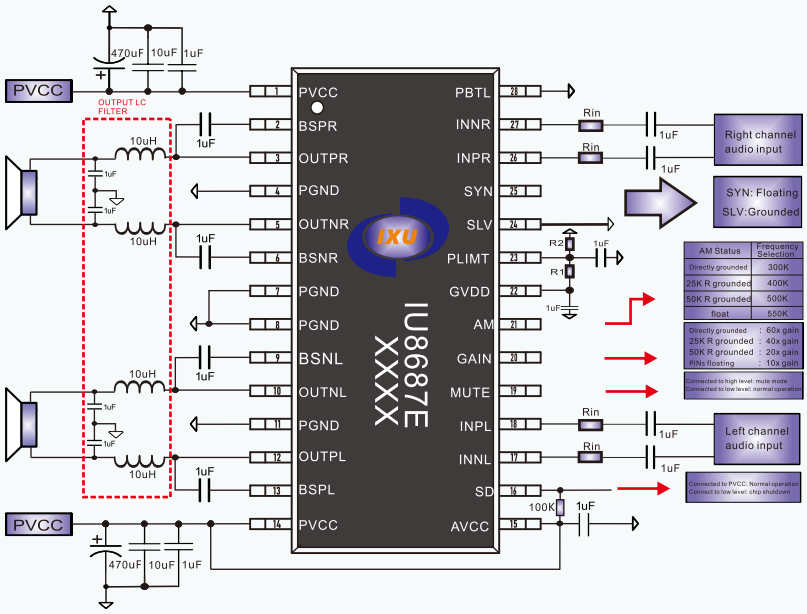
Package

- EQA28

Applications

- Car Audio
- Home Audio System
- Emergency Call

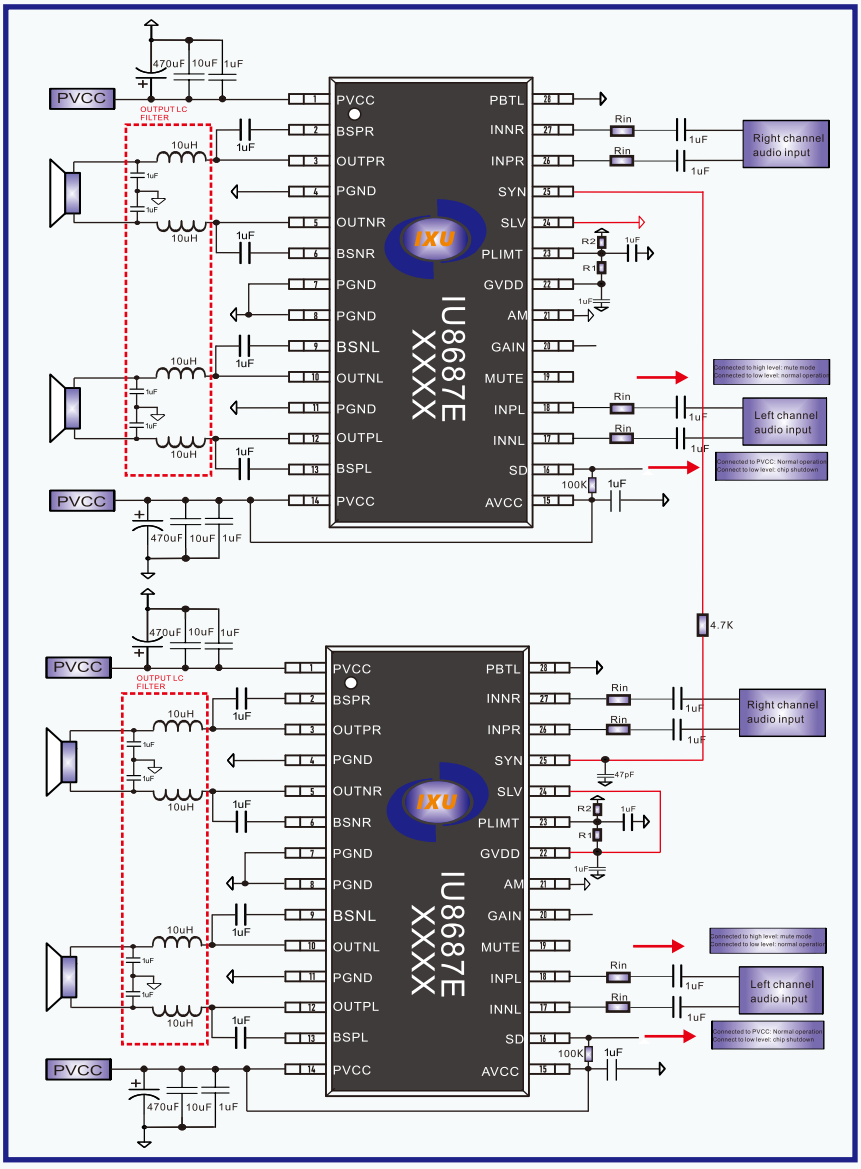
Typical Applications



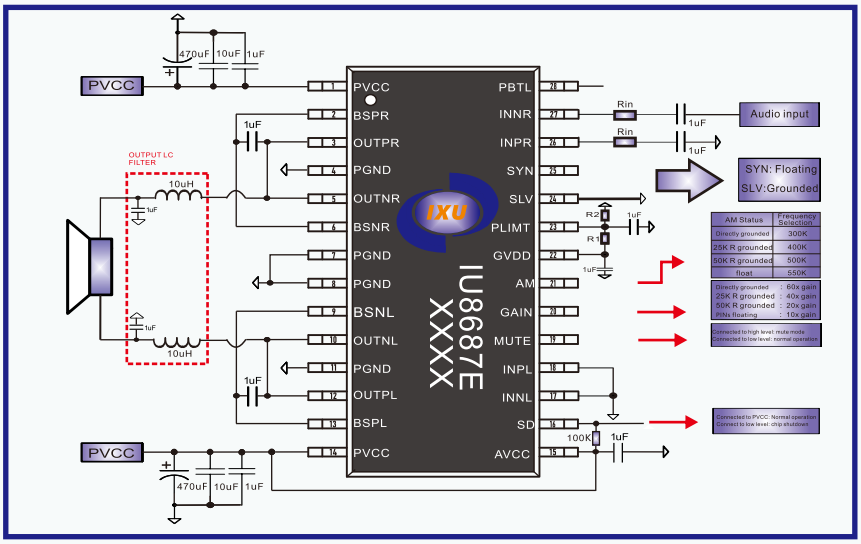
Notes：

- It is recommended to choose a saturation current of 6A or above for the output inductance
- Ground the GAIN end and integrate a 9K input resistor and a 540K feedback resistor; GAIN end suspended, integrated with 36K input resistor and 360K feedback resistor;If the GAIN terminal is connected with a 25K resistor to ground, it integrates a 13.5K input resistor and a 540K feedback resistor; If the GAIN is terminated with a 50K resistor to ground, a 23K input resistor and a 460K feedback resistor are integrated.

Application diagram of IU8687E master-slave mode

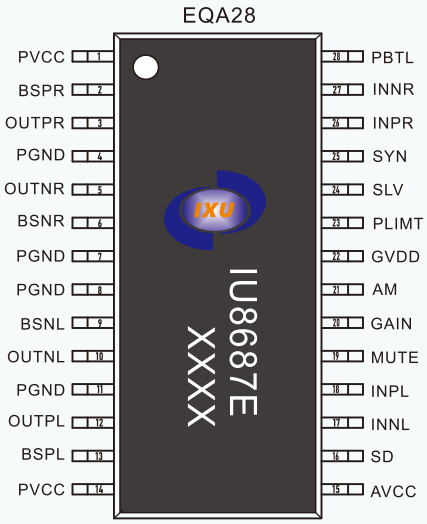


Application diagram of IU8687E PBTL mode



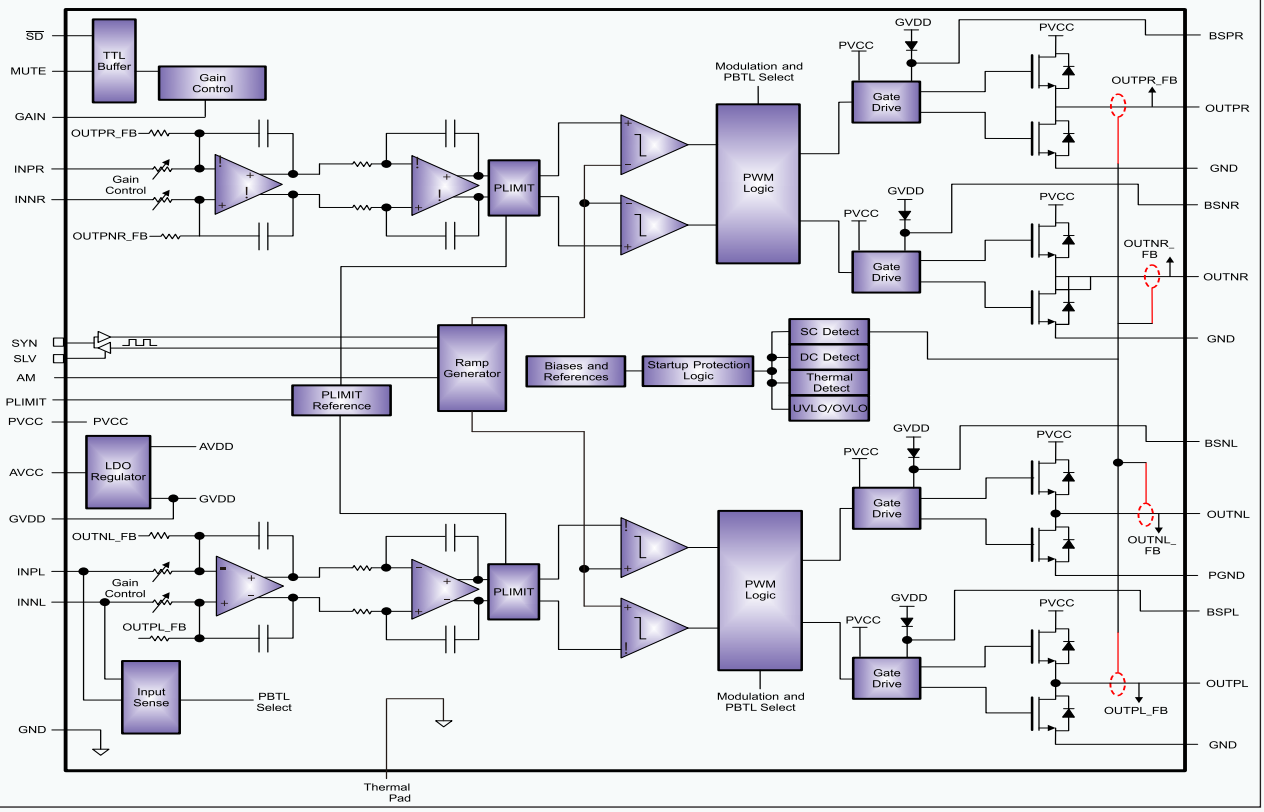
PIN Configuration and Functions

EQA28



NO.	NAME	I/O	DESCRIPTION
1,14	PVCC	P	Power supply terminal
2	BSPR	I	Right channel positive output upper tube bootstrap
3	OUTPR	O	Right channel audio output positive end
4,7,8,11	PGND	P	Power ground
5	OUTNR	O	Right channel audio output negative end
6	BSNR	I	Right channel negative output upper tube bootstrap
9	BSNL	I	Left channel negative output upper tube bootstrap
10	OUTNL	O	Left channel audio output negative end
12	OUTPL	O	Left channel audio output positive end
13	BSPL	I	Left channel positive output upper tube bootstrap
15	AVCC	P	Analog power supply
16	SD	I	Turn off control pins
17	INNL	I	Left channel audio input negative end
18	INPL	I	Left channel audio input positive end
19	MUTE	I	Mute mode control pin
20	GAIN	I	Gain control pins
21	AM	I	AM frequency control pin
22	GVDD	I	Upper gate drive voltage
23	PLIMT	I	Output power limiting pins
24	SLV	I	Master slave mode selection pin
25	SYN	I/O	Clock input/output pins
26	INPR	I	Right channel audio input positive end
27	INNR	I	Right channel audio input negative end
28	PBTL	I	Mono mode selection end

Functional Block Diagram



Absolute Maximum Ratings [1]

SYMBOL	PARAMETER	VALUE	UNIT
V_{CC}	Power supply	-0.3~35	V
V_I	SD	-0.3~35	V
	GAIN,PLIMT,AM,MUTE,SYN,SLV,INN,INP	-0.3~5	V
T_J	Junction operating temperature range	-40~150	℃
T_{STG}	Storage temperature range	-40~150	℃
T_A	Ambient temperature range	-40~85	℃

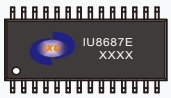
Recommended Operating Conditions

SYMBOL	PARAMETER	VALUE	UNIT
PV_{CC}	Input power supply voltage	5~26	V
T_J	Junction operating temperature range	-40~125	℃
T_A	Ambient temperature range	-40~85	℃

Thermal Information [2]

SYMBOL	PARAMETER	VALUE	UNIT
θ_{JA}	Package thermal resistance - chip to environment thermal resistance	45	℃/W
θ_{JC}	Package thermal resistance - chip to package surface thermal resistance	10	℃/W

Ordering Information

Product Name	Package Type	Device Marking	Package Type	Quantity
IU8687E	EQA28		Tube	50

ESD Range

HBM (Human Body Model) ---------- ±2kV

MM (Machine model) ---------- ±200V

1. The above parameters are only the limit values of device operation. It is not recommended that the working conditions of the device exceed the limit values. Otherwise, the reliability and life of the device will be affected, and even permanent damage will be caused.
2. Where the PCB board is placed in IU8687E, a heat dissipation design is needed. The heat sink at the bottom of IU8687E is connected with the heat sink area of PCB board.

Recommended Working Conditions

PARAMETER		TEST CONDITIONS	MIN	MAX	UNIT
V_{CC}	Power supply	PVCC	5	26	V
V_{IH}	Input high Level	SD,MUTE,AM,PLIMT,GAIN,SYN,SLV	1.5		V
V_{IL}	Input low Level	SD,MUTE,AM,PLIMT,GAIN,SYN,SLV		0.3	V
I_{IH}	High level input current	SD,MUTE,AM,PLIMT,GAIN,V_I=2V,V_{CC}=20V		50	uA
I_{IL}	Low level input current	SD,MUTE,AM,PLIMT,GAIN,V_I=0.2V,V_{CC}=20V		5	uA
OVP	Overvoltage protection			40	V

DC Parameters

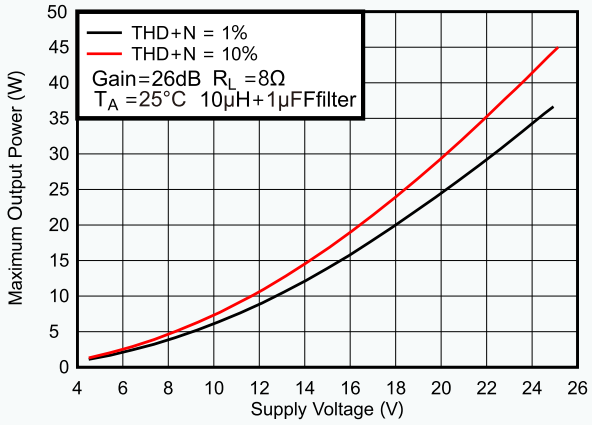
PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_{OS}	Output Offset Voltage	V_{IN}=0V，GAIN=36dB			6	15	mV
I_{CC}	Quiescent current	SD=2V,4Ω loudspeaker ,PV $_{CC}$=24V			50	60	mA
$I_{CC(SD)}$	Standby current	SD=0V,No load and filterless,PV$_{CC}$=24V			20	30	uA
$r_{DS(on)}$	Drain source conduction resistance	V_{CC} =21V,I_O=500mA, T_J =25℃	Upper tube		80		mΩ
			Lower tube		80		
t_{on}	on-time	SD=2V			220		ms
t_{OFF}	off-time	SD=0V			4		us
GVDD	Gate drive voltage	I_{GVDD} =100 mA		4.25	4.75	5.25	V
f_{OSC}	Frequency	AM direct grounded		270	300	330	KHz
		AM is grounded through 25K resistance		360	400	440	
		AM is grounded through 50K resistance		450	500	550	
		AM float without connection		500	550	600	

AC Parameters

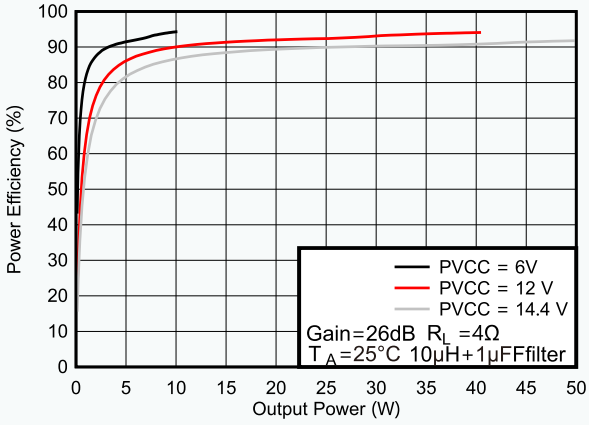
PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
K_{SVR}	PSRR	1KHz，200mVpp ripple，Gain=20dB，Input AC coupling to ground		70		dB
THD+N	Total harmonic distortion +noise	PVcc＝24V， f＝1kHz, Po＝20W		0.05		%
Vn	Output noise	20~22kHz， Aweight，Gain＝20dB		100		uV
				-78		dBV
	Efficiency	PVcc＝20V,f＝1kHz,RL=8Ω, Po＝2X20W		95		%
SNR	Signal to Noise Ratio	Gain=20dB maximum output，THD+N＜1%，f=1KHz		102		dB
Thermal protection temperature				170		℃
Hysteresis temperature				15		℃

Po	output power	V_{DD} = 16V@RL = 4Ω	THD+N=10%@Po=2X33W	THD+N=1%@Po=2X25W
		V_{DD} = 24V@RL = 8Ω	THD+N=10% @Po=2X42W	THD+N=1%@Po=2X34W
		V_{DD} = 25V@RL = 8Ω	THD+N=10% @PO=2X45W	THD+N=1%@PO=2X36W
		V_{DD} = 24V@RL = 4Ω(PBTL)	THD+N=10%@Po=80W	THD+N=1%@Po=64W
		V_{DD} = 25V@RL = 4Ω(PBTL)	THD+N=10%@Po=88W	THD+N=1%@Po=71W

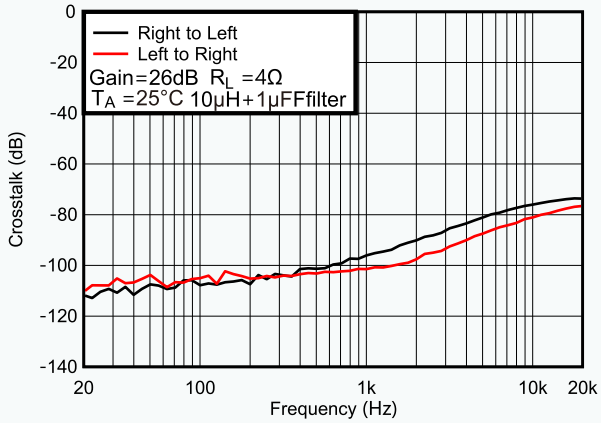
Typical Characteristics All tests are based on a 1KHz signal (unless otherwise specified)



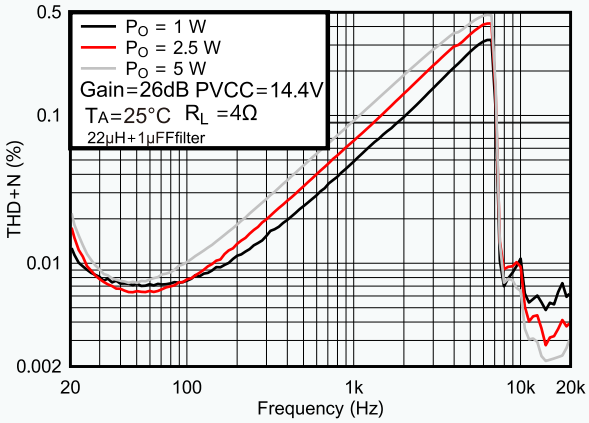
MaximumOutputPower(BTL)vsSupplyVoltage



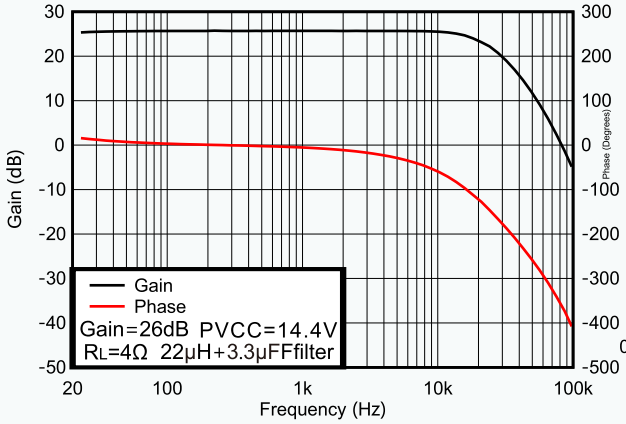
PowerEfficiency(BTL)vsOutputPower



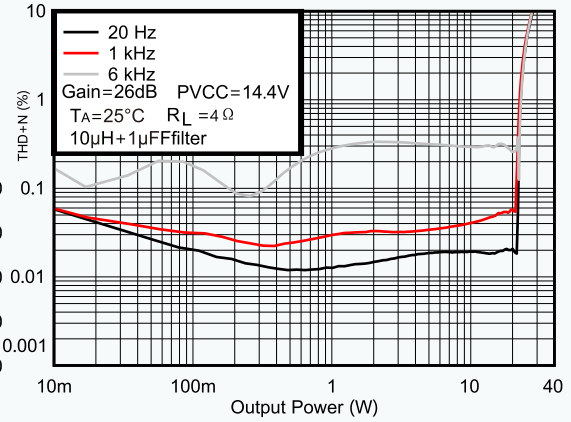
CrosstalkvsFrequency



TotalHarmonicDistortion+Noise(BTL)vs Frequency



GainandPhase(BTL)vsFrequency



TotalHarmonicDistortion+Noise(BTL)vs OutputPower

IU8687E Application Points

1. Overview

IU8687E is a 2X45W stereo D-class audio amplifier; Under a power supply voltage of 25V and a load of 8Ω, the maximum continuous power output can be 2X45W. In PBTL mode, the maximum continuous power output can be 88W (load of 4Ω); By setting the master-slave mode, IU8687E can achieve infinite cascading, thereby achieving multi-channel output of the system; IU8687E has advanced EMI suppression technology, which uses surface mount technology and only requires a small number of peripheral devices to provide high-quality audio output power to the system. IU8687E has built-in overcurrent protection, short circuit protection, and overheating protection, effectively protecting the chip from damage under abnormal working conditions. IU8687E can achieve a maximum efficiency of over 95%, and the 35V withstand voltage design provides ultra-high reliability for the chip, effectively reducing the proportion of defects in the production process.

2. Gain Setting

IU8687E has a gain control pin GAIN set. The following table shows the IU8687E gain control method and the corresponding integrated input and feedback resistance values.

GAIN Status	Magnification	Input Resistance	Feedback Resistance
Directly grounded	60X	9K	540K
25K R grounded	40X	13.5K	540K
50K R grounded	20X	23K	460K
Float	10X	36K	360K

3. Short Circuit Protection and Automatic Recovery

IU8687E provides protection against overcurrent caused by output short circuits. When a short circuit occurs, IU8687E immediately shuts down the output. After the output short circuit fault is resolved, IU8687E only needs to wait for 110ms to recover on its own.

4. Temperature Protection

The temperature protection of IU8687E is to prevent device damage when the temperature exceeds 170°C. There is an upper and lower allowable range of ±15°C between the devices at this temperature point. Once the temperature exceeds the set temperature point, the device enters a shutdown state with no output. When the temperature drops by 20°C, the temperature protection will be eliminated and the device will start working normally.

5. Mute Function and Shutdown Control

When the SD input port is operating normally at IU8687E, it should be at a high potential. When the SD is pulled towards a low potential, the output will turn off and the circuit will enter standby mode. The SD end can be connected to PVCC at the highest When the MUTE input port is operating normally at IU8687E, it should be at a low potential. When the MUTE is pulled towards a high potential, the output stage of IU8687E is turned off, and IU8687E enters silent mode. The maximum withstand voltage of the MUTE terminal is 5V.

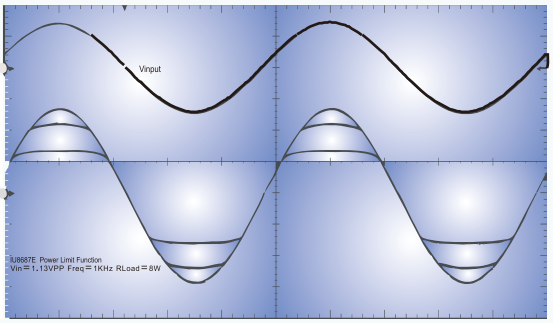
6. AM Suppression Function

IU8687E achieves the selection of MOS switch frequency through the control of AM pins, as shown in the table below:

AM Status	Frequency Selection
Directly grounded	300K
25K R grounded	400K
50K R grounded	500K
float	550K

7. Power Limitation

The principle of power limiting function is to limit the maximum duty cycle of the power amplifier's output PWM, thereby limiting the maximum output power. Users can control the maximum duty cycle value by setting the voltage on the PLIMIT pin, thereby determining the maximum power setting value. The power limitation method that limits the maximum duty cycle results in a distorted Clipping waveform, just like reducing the PVCC supply voltage, as shown in the figure. When power is limited, if the input analog signal is further increased, the distortion of the output waveform will increase, and the power will slowly rise. A voltage divider can be added between GVDD and ground to set the 7-pin (PLIMIT) voltage to limit output power. The higher the voltage applied to the 7-pin, the greater the allowed output power. A 1uF capacitor can be added between the 7-pin and ground.



IU8687E Power Limit Waveform

8. Master Slave Mode and Clock Control

Set the master-slave mode of IU8687E through pin SLV. When the SLV is grounded, the current IU8687E is the main chip, and the internal clock is working. The SYN pin outputs an internal clock signal to synchronize with other CS8683H working together. The clock of the main chip selects the frequency size through AM. When the SLV pin is connected high, it is selected as the slave chip. The CLK inside the chip stops working, and SYN is converted to the receiving

pin, which is synchronized and locked by the internal PLL and external frequency. SYN is a bidirectional IO that can output and receive CLK square waves. When using SLV and SYN, the following precautions should also be taken:

• SLV and SYN are both low-voltage pins, and the maximum voltage should not exceed 5V.

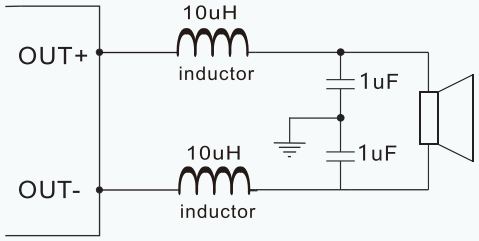
• When using only one IU8687E (without master-slave synchronization), the SLV is grounded, the SYN needs to be suspended, and there is always a signal output from the SYN.

• The slave chip SYN must be connected to the main chip SYN. Otherwise, the chip will not work.

There is a range requirement for clock synchronization from the chip, and it is necessary to set the AM gear to be consistent with the main chip. For example, if the main chip selects an AM frequency of 300K and SYN outputs a 300KHz signal, the slave chip should also select the 300KHz gear for AM. Otherwise, it may cause PLL to lose lock from within the chip.

9. Inductance and Capacitance

IU8687E requires loading inductance and filtering capacitor at the output end. It is recommended that the inductance reach a saturation current of 6A or above during use. The specific parameters are shown in the following figure:



10. IU8687E PCB Design Guide

To provide reliable performance in audio system design, please pay special attention to the following points when designing the PCBLayout for IU8687E:

• The high current path of the chip is : VIN → Chip PVCC → GND.

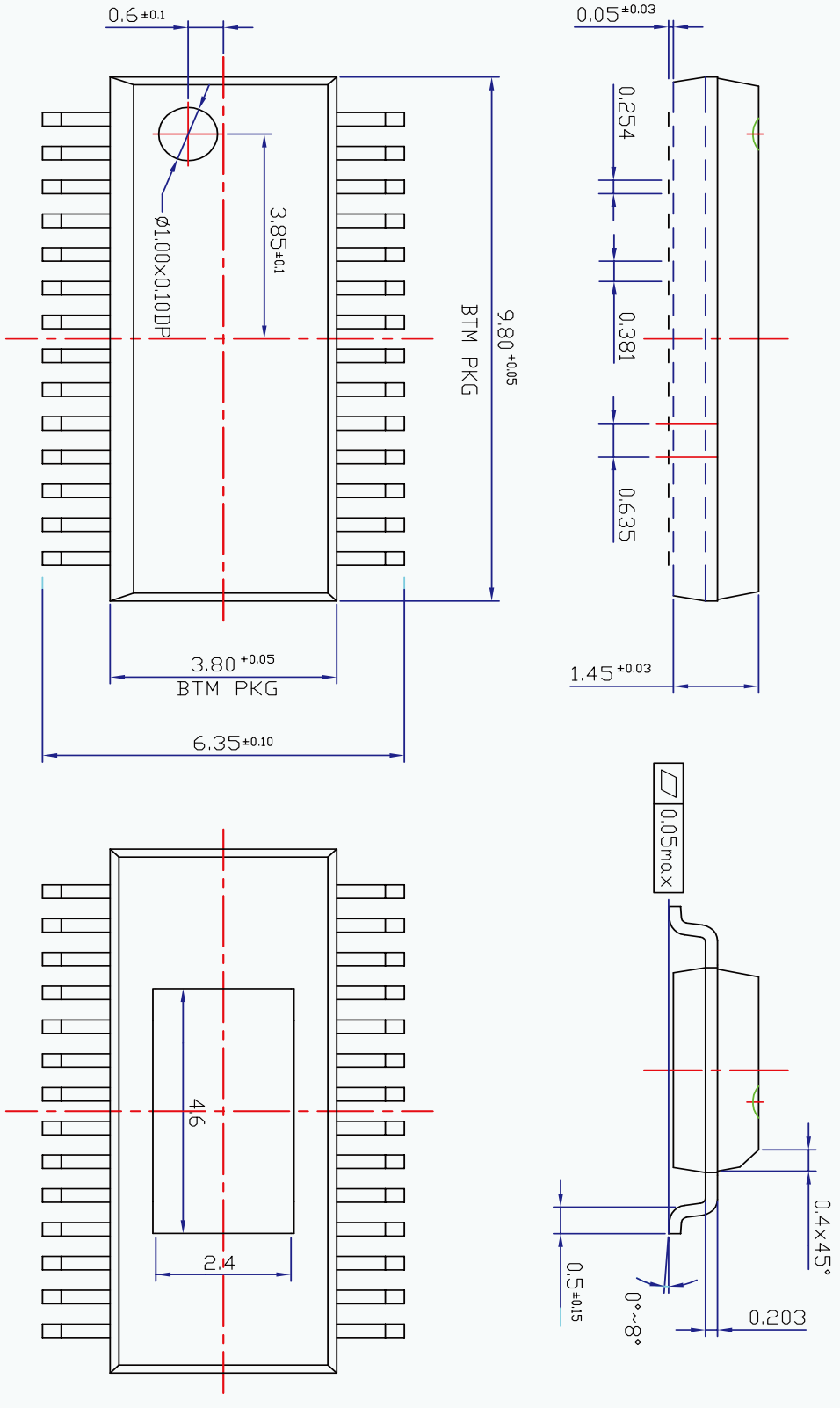
• The wiring rule for high current paths is to be as thick as possible to reduce the impedance caused by PCB wiring.

• The power supply pins of IU8687E must be attached with two ceramic capacitors 10uF and 1uF, and as close as possible to the chip pins. It is recommended to use 470uF/50V for power supply electrolytic capacitors.

• All GNDs, including the GNDs of each capacitor, should have good connections and can be connected to copper foils of large-area GNDs nearby, minimizing the impedance and inductance of the ground circuit as much as possible.

Package Information

IU8687E PACKAGE OUTLINE DIMENSIONS (units:mm)





Precautions for MOS Circuit Operation:

Static electricity can be generated in many places. The following precautions can effectively prevent MOS circuit from being damaged due to the sound of electrostatic discharge:

- Operators shall be grounded through anti-static wrist strap.
- The equipment enclosure must be grounded.
- Tools used during assembly must be grounded.
- Conductor packaging or anti-static materials must be used for packaging or transportation.

Declaration:
•Shanghai IXU Semiconductor Co., Ltd. reserves the right to make changes to the manual without prior notice! Customers should obtain the latest version of the material before use and verify whether the relevant information is complete and up-to-date.
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