Low No-Load Current, AM Suppression Function, with Master-Slave Mode, 2X75W Stereo Class D Audio Amplifier

General Description

IU8689E is a 2X75W Stereo Class D audio amplifier; This device is designed with a heat dissipation pad on the top. When the heat sink is connected to the pad, it can output a maximum continuous power of 2X75W under the power supply voltage of 24V; Through the setting of master-slave mode, IU8689E can realize infinite cascade, so as to realize multi-channel output of the system; IU8689E has advanced EMI suppression technology. It uses surface mount technology and requires only a small number of peripheral devices to enable the system to have high-quality audio output power. IU8689E has built-in overcurrent protection, short circuit protection and overheating protection, which effectively protects the chip from being damaged under abnormal working conditions. The IU8689E can achieve a maximum efficiency of more than 95%, and the withstand voltage design of more than 40V provides ultra-high reliability for the chip, which can effectively reduce the proportion of defects in the production process.
IU8689E provides a special EQB32 package form for customers to choose. The appropriate package size provides the greatest convenience for customers to install heat sinks. Its rated working temperature range is - 40 ℃ to 85 ℃.

Features

- **Output Power**
  VDD = 24V@RL = 4 Ω THD+N=10% PO=2X75W
  VDD = 24V@RL = 4 Ω THD+N=1% PO=2X62W
  VDD = 26V@RL = 4 Ω THD+N=1% PO=2X70W
  VDD = 28V@RL = 6 Ω THD+N=1% PO=2X60W
  VDD = 30V@RL = 6 Ω THD+N=1% PO=2X68W
- Single Power Supply, Wide Power Supply Voltage Range: 5V~28V
- Audio System with Filter Network, Static Current 50mA@24V
- High Reliability Design: 40V with Stand Voltage Design
- Efficiency: 95%@PVCC=26V RL = 8Ω PO=2X20W
- Four Segment Gain (Optional)
- Mute Function Control
- Master Slave Mode Programmable Control, Realize Infinite Cascade Power Output
- Multiple Switching Frequency Options: AM Suppression Function
- Programmable Power Limit
- Good Short Circuit Protection and Temperature Protection with Automatic Recovery Function
- Good Distortion and Anti POP Function
- Enhanced Package Design: Special Design of Top Heat Dissipation Pad
- Meet The Application Requirements of Automobile

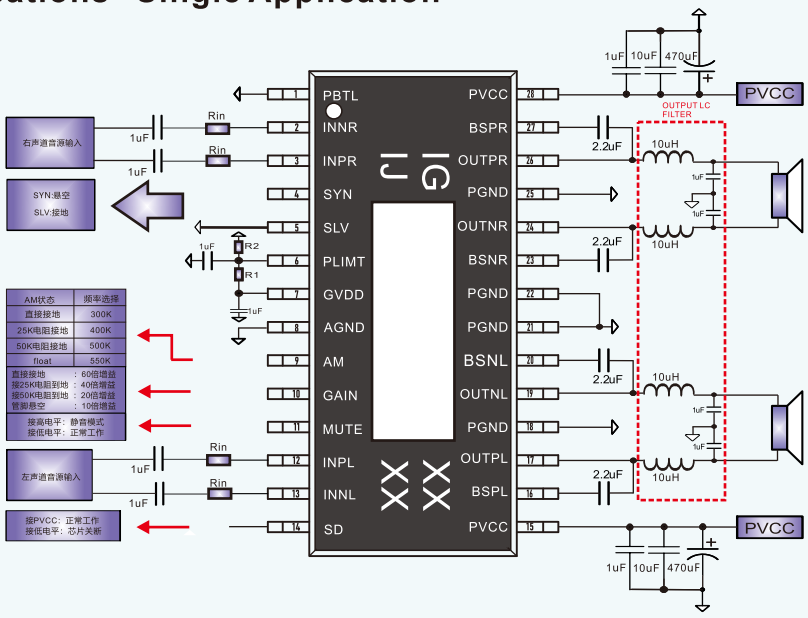
Package

- EQB28

Applications

- Car Audio
- Home Audio System
- Emergency Call

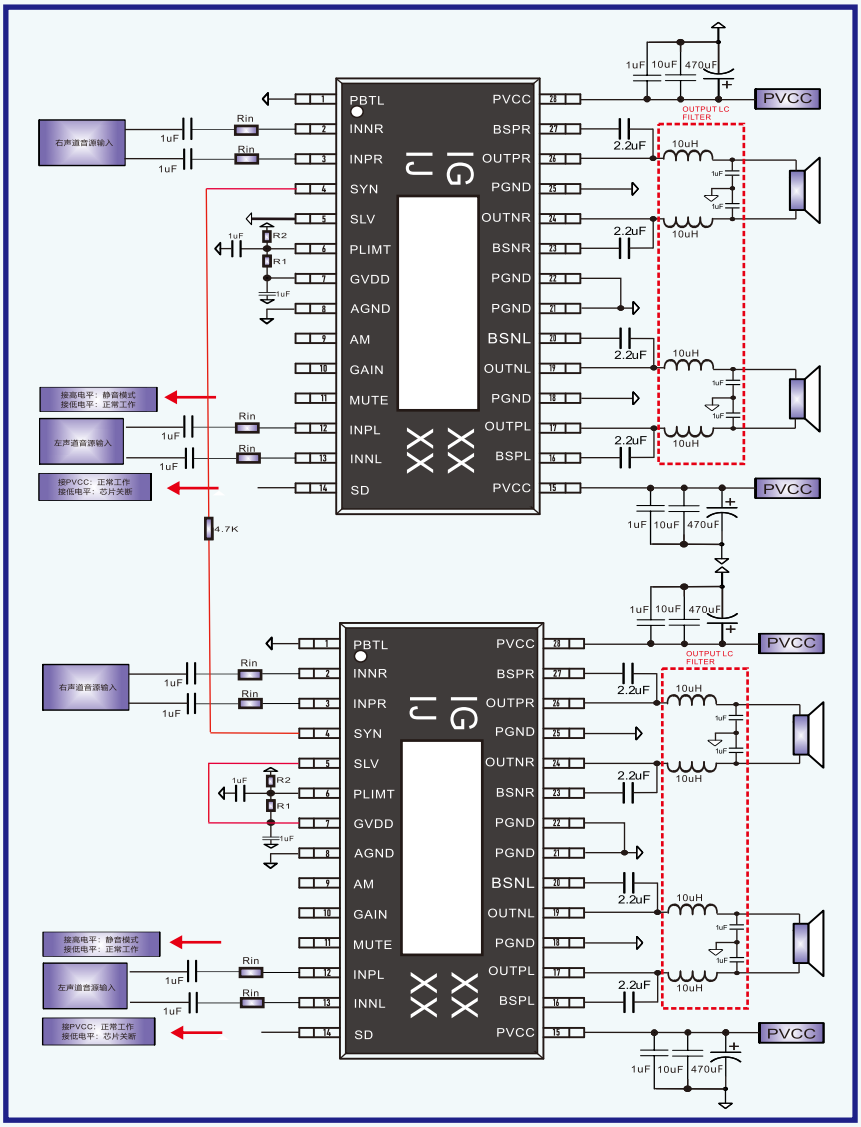
Typical Applications--Single Application

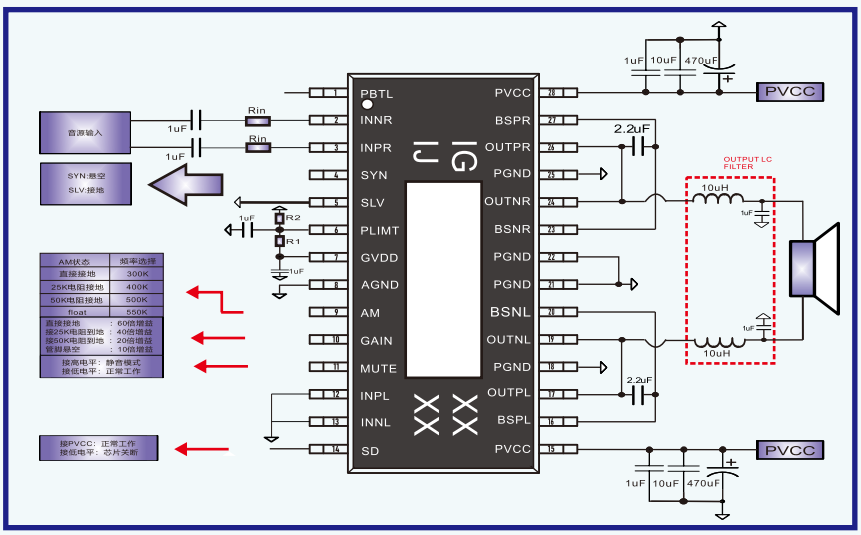


Note:

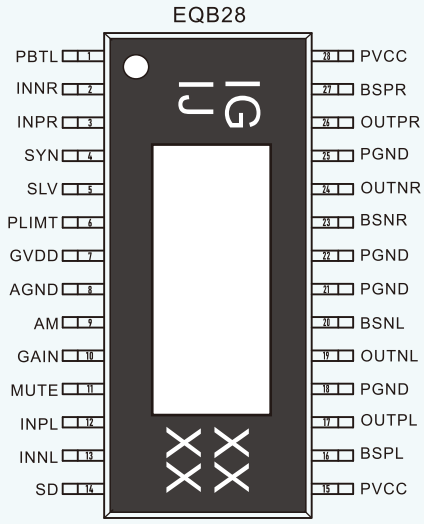
- It is recommended to select the output inductance with saturation current above 6A.
- The gain terminal is grounded, integrating 12K input resistance and 650K feedback resistance; The gain terminal is suspended, integrating a 15.2K input resistor and a 610K feedback resistor;Gain terminal is connected to high level, integrating 25.5K input resistance and 510K feedback resistance.

Typical Applications--Master Slave Mode Application





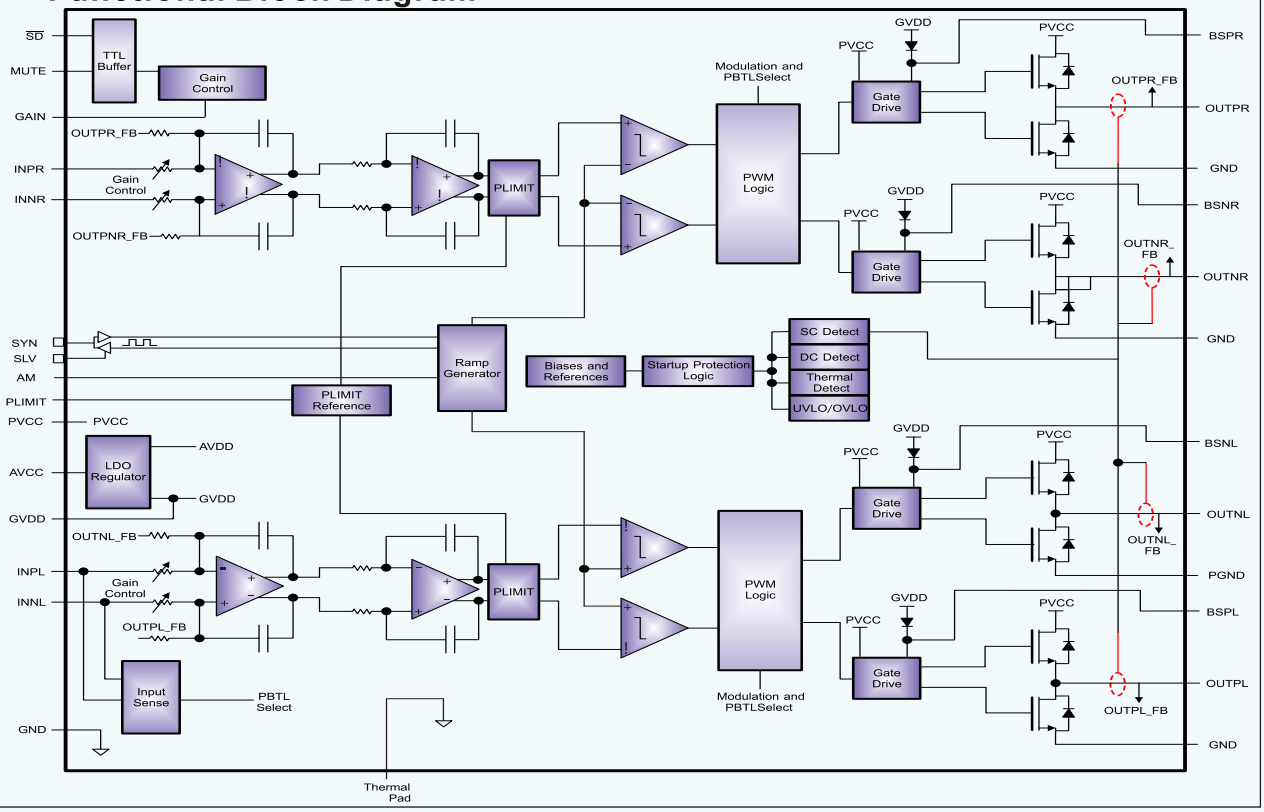
PIN Configuration and Functions



Note
- The above figure is a top view
- The white frame in the figure is the top heat sink

NO.	NAME	TYPE	DESCRIPTION
1	PBTL	P	Parallel BTL mode switch
2	INNR	I	Right channel audio input negative terminal
3	INPR	I	Right channel audio input Positive terminal
4	SYN	I/O	The clock input/output pin is used to synchronize multiple chip
5	SLV	I	The synchronization direction is determined by the SLV pin The master-slave mode selection pin is connected to the low to select the master chip, and the high to select the slave chip
6	PLIMT	I	Output power limit pin
7	GVDD	I	Driving voltage of upper tube gate
8	AGND	P	Analog ground
9	AM	I	Am frequency control pin
10	GAIN	I	Gain control pin
11	MUTE	I	Mute mode control pin
12	INPL	I	Left channel audio input Positive terminal
13	INNL	I	Left channel audio input negative terminal
14	SD	I	Turn off control pin
15	PVCC	P	Power supply
16	BSPL	I	Left channel positive output upper tube bootstrap
17	OUTPL	O	Left channel audio output Positive terminal
19	OUTNL	O	Left channel audio output negative terminal
20	BSNL	I	Left channel negative output upper tube bootstrap
23	BSNR	I	Right channel negative output upper tube bootstrap
24	OUTNR	O	Right channel audio output negative terminal
26	OUTPR	O	Right channel audio output Positive terminal
27	BSPR	I	Right channel positive output upper tube bootstrap
28	PVCC	P	Power supply
18,21,22,25	PGND	P	Power Ground让

Functional Block Diagram



Absolute Maximum Ratings [1]

SYMBOL	PARAMETER	VALUE	UNIT
Power supply	PVCC	-0.3~36	V
Input pin voltage	SD	-0.3~36	V
	GAIN,PLIMT,AM,MUTE,SYN,SLV	-0.3~5	
	INN,INP	-0.3~5	
T_A	Operating temperature range	-40~85	℃
T_J	Junction operating temperature range	-40~150	℃
T_{STG}	Storage temperature range	-60~150	℃

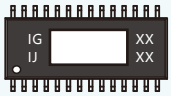
Recommended Operating Conditions

SYMBOL	PARAMETER	VALUE	UNIT
PV_{CC}	supply voltage	5~30	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	25	℃/W
θ_{JC}	Package thermal resistance - chip to package surface thermal resistance	7	℃/W

Ordering Information

Product Name	Package Type	Device Marking	Packing Types	Quantity
IU8689E	EQB28		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.

Recommended Operating Conditions

DESCRIPTION		TEST CONDITIONS	MIN	MAX	UNIT
V_{CC}	Power supply	PVCC	5	28	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

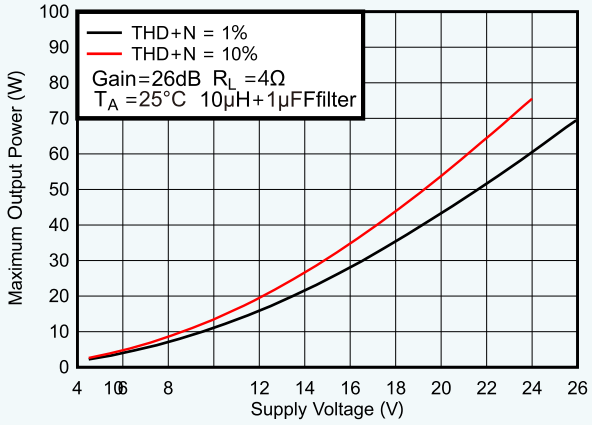
DESCRIPTION		TEST CONDITIONS		MIN	TYP	MAX	UNIT
V_{OS}	Output offset voltage	V_{IN}=0V，GAIN=36dB			6	15	mV
I_{CC}	Quiescent current	SD=2V,4Ω loudspeaker，PV_{CC}=24V			50	60	mA
$I_{CC(SD)}$	Standby current	SD=0V,No load and filtering,PV_{CC}=24V			20	30	uA
$r_{DS(on)}$	Drain source on resistance	V_{CC}=21V,I_O=500mA, T_J=25℃	Upper tube		80		mΩ
			Lower tube		80		
t_{on}	Turn on time	SD=2V			220		ms
t_{OFF}	Turn off time	SD=0V			4		us
GVDD	Gate drive voltage	I_{GVDD}=100 mA		4.25	4.75	5.25	V
f_{OSC}	Oscillation frequency	AM Direct grounding		270	300	330	KHz
		AM Grounded through 25K resistance		360	400	440	
		AM Grounded through 50K resistance		450	500	550	
		AM Float		500	550	600	

AC Parameters

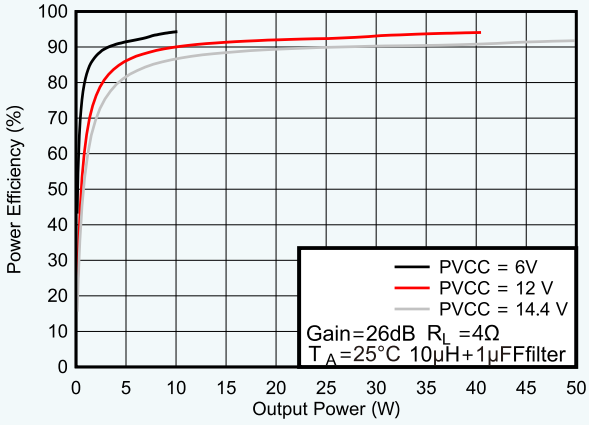
DESCRIPTION		TEST CONDITIONS	MIN	TYP	MAX	UNIT
K_{SVR}	Power ripple rejection ratio	1kHz，200mVpp Ripple，Gain=20dB，Input AC coupled to ground		70		dB
THD+N	Total harmonic distortion + noise	PV_{CC}=24V，f=1KHz, Po=20W		0.05		%
Vn	Output noise	20~22KHz，Aweight，Gain=20dB		100		uV
				-78		dBV
	Efficiency	PV_{CC}=26V,f=1kHz,RL=8Ω, Po=2X20W		95		%
SNR	Signal to noise ratio	Maximum output at gain = 20dB□THD+N□1%□f=1kHz		102		dB
Thermal protection temperature				170		℃
Hysteresis temperature				15		℃

Po	Output power	V_{DD} = 22V@RL = 4Ω	THD+N=10%@P_O=2X62W THD+N=1%@P_O=2X50W
		V_{DD} = 24V@RL = 4Ω	THD+N=10% @P_O=2X75W THD+N=1%@P_O=2X62W
		V_{DD} = 26V@RL = 4Ω	THD+N=1% @P_O=2X70W
		V_{DD} = 28V@RL = 6Ω	THD+N=10%@P_O=2X73W THD+N=1%@P_O=2X60W
		V_{DD} = 30V@RL = 6Ω	THD+N=10%@P_O=2X85W THD+N=1%@P_O=2X68W
		V_{DD} = 28V@RL = 8Ω	THD+N=10%@P_O=2X56W THD+N=1%@P_O=2X45W

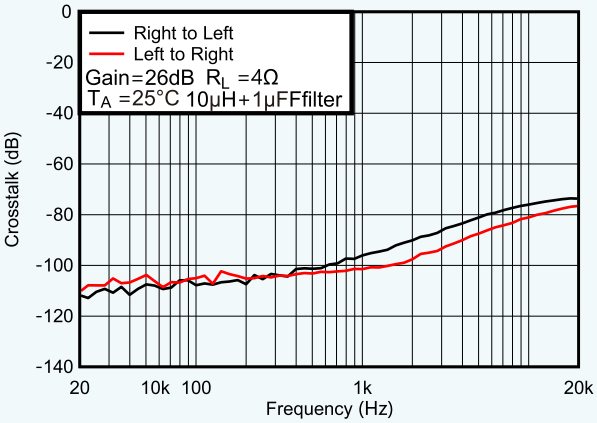
Electrical Characteristics (All tests are based on 1KHz signals unless otherwise specified)



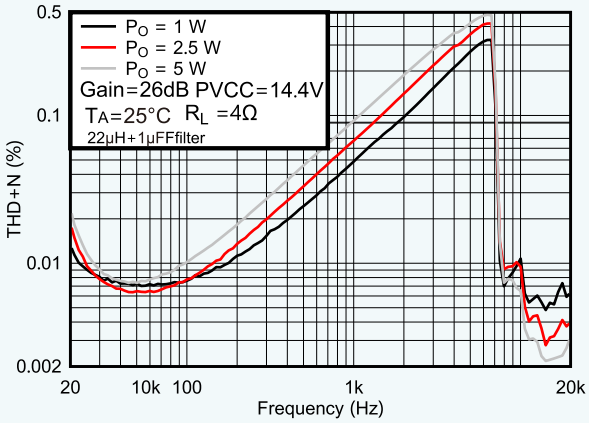
MaximumOutputPower(BTL)vsSupplyVoltage



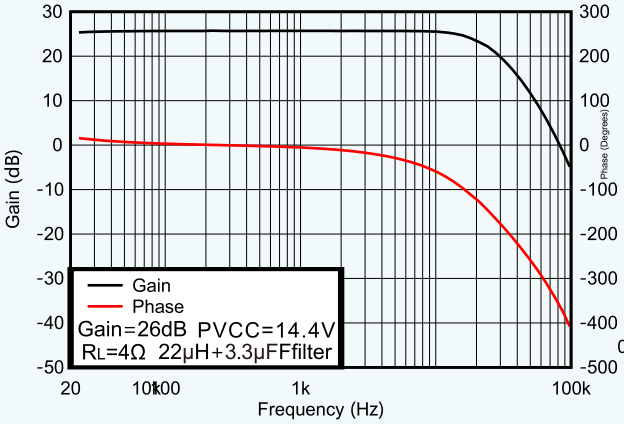
PowerEfficiency(BTL)vsOutputPower



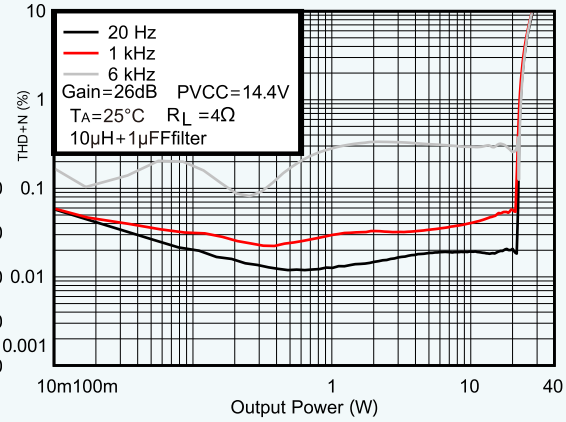
CrosstalkvsFrequency



TotalHarmonicDistortion+Noise(BTL)vs Frequency



GainandPhase(BTL)vsFrequency



TotalHarmonicDistortion+Noise(BTL)vs OutputPower

Application Points

1. Overview

IU8689E is a 2X75W Stereo Class D audio amplifier; This device is designed with a heat dissipation pad on the top. When the heat sink is connected to the pad, it can output a maximum continuous power of 2X75W under the power supply voltage of 24V; Through the setting of master-slave mode, IU8689E can realize infinite cascade, so as to realize multi-channel output of the system; IU8689E has advanced EMI suppression technology. It uses surface mount technology and requires only a small number of peripheral devices to enable the system to have high-quality audio output power. IU8689E has built-in overcurrent protection, short circuit protection and overheating protection, which effectively protects the chip from being damaged under abnormal working conditions. The IU8689E can achieve a maximum efficiency of more than 93%, and the withstand voltage design of more than 40V provides ultra-high reliability for the chip, which can effectively reduce the proportion of defects in the production process.

2. Gain Setting

IU8689E is set with gain control pin gain. The following table shows the gain control mode of IU8689E and the corresponding integrated input and feedback resistance values.

GAIN State	Magnification	Input Res	Feedback Res
Direct grounding	60X	9K	540K
25K R grounding	40X	13.5K	540K
50K R grounding	20X	23K	460K
Float	10X	36K	360K

3. Short Circuit Protection and Automatic Recovery

IU8689E protects the overcurrent state caused by short circuit at the output end. In case of short circuit, IU8689E immediately closes the output. After the short circuit fault at the output end is eliminated, IU8689E only needs to wait 110ms to recover itself.

4. Temperature Protection

The temperature protection of IU8689E is to prevent device damage when the temperature exceeds 170°C. There is an upper and lower allowable range of ± 15°C between devices at this temperature point. Once the temperature exceeds the set temperature point, the device enters the closed state without output. When the temperature drops by 20°C, the temperature protection will be eliminated and the device starts to work normally.

5. Mute Function and Shutdown Control

When the IU8689E works normally, the SD input port should be high potential. When the SD is pulled to the low potential, the output is turned off, the circuit enters the standby mode, and the SD terminal can be connected to PVCC at most The mute input port should be low potential when the IU8689E works normally. When the mute is pulled to the high potential, the IU8689E output stage is turned off, the IU8689E enters the mute mode, and the maximum withstand voltage of the mute terminal is 5V.

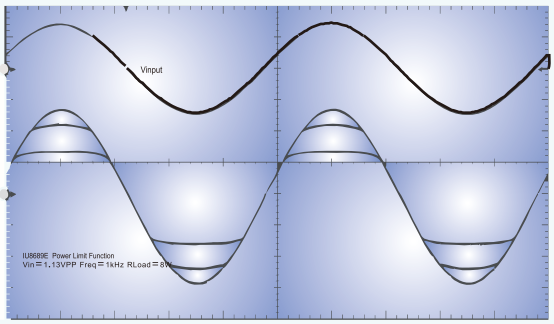
6. AM Suppression Function

IU8689E realizes the selection of MOS switching frequency through the control of AM pin, as shown in the table below:

AM Status	Frequency
Direct grounding	300KHz
25K Res grounding	400KHz
50K Res grounding	500KHz
Float	550KHz

7. Power Limit

The principle of power limiting function is to limit the maximum duty cycle of power amplifier output PWM, so as to limit the maximum output power. The user can control the value of the maximum duty cycle by setting the voltage on the PLIMIT pin, so as to determine the set value of the maximum power. The result obtained by the power limiting method of limiting the maximum duty cycle is the same as reducing the PVCC supply voltage, and the output waveform is the clipping waveform with distortion, as shown in the figure. When the power is limited, if the input analog signal is further increased, the distortion of the output waveform will increase and the power will rise slowly. A voltage dividing resistor can be added between GVDD and the ground to set the voltage of pin 7 (PLIMIT) to limit the output power. The higher the voltage of pin 7, the greater the allowable output power. Add a 1uF capacitor from pin 7 to the ground.



IU8689E power limit waveform

8. Master Slave Mode and Clock Control

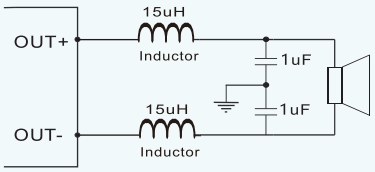
The master-slave mode of the IU8689E is set through the pin SLV. When the SLV is grounded, the current IU8689E is the main chip. At this time, the internal clock works, and the syn pin outputs the internal clock signal to the outside, which is used to synchronize other IU8689E to work together. The clock of the master 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 slave chip stops

working, and the SYN is switched to the receiving pin, which is locked synchronously by the internal PLL and the external frequency. SYN is a bidirectional IO, which can output CLK square wave or receive CLK square wave. When using SLV and syn, the following should be noted:

- SLV and SYN are low-voltage pins, and the maximum voltage should not exceed 5V;
- When only one IU8689E is used (master-slave synchronization is not required), SLV is grounded, SYN is suspended, and SYN always has signal output;
- The slave chip syn must be connected to the syn of the master chip. Otherwise, the slave chip does not work;
- There are scope requirements for clock synchronization of the slave chip. It is necessary to set the AM gear to be consistent with that of the master chip. For example, the master chip selects the master chip. For example, the master chip selects the AM frequency as 300KHz, and syn outputs the 300KHz signal. The slave chip should also select the 300KHz gear in am. Otherwise, the PLL inside the slave chip may be unlocked.

9. Inductance and Capacitance

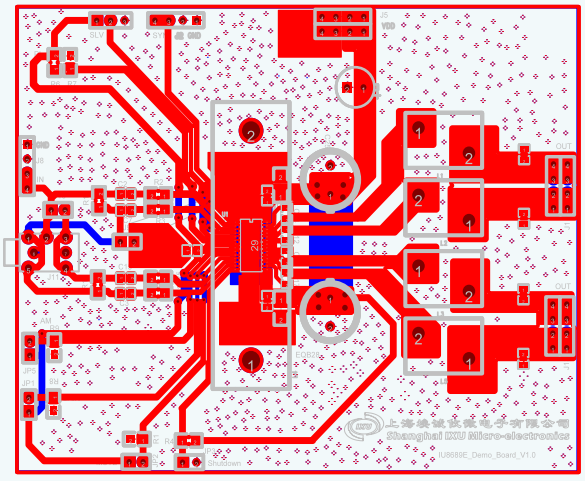
IU8689E needs to load inductor and filter capacitor at the output end. It is recommended that the inductance should reach a saturation current of more than 6A during use. The specific parameters are shown in the figure below:



IU8689E PCB Design Guide

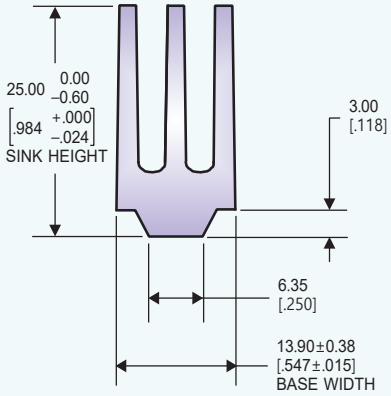
In order to provide reliable design performance of the audio system, please pay special attention to the following points when designing the PCB layout of IU8689E:

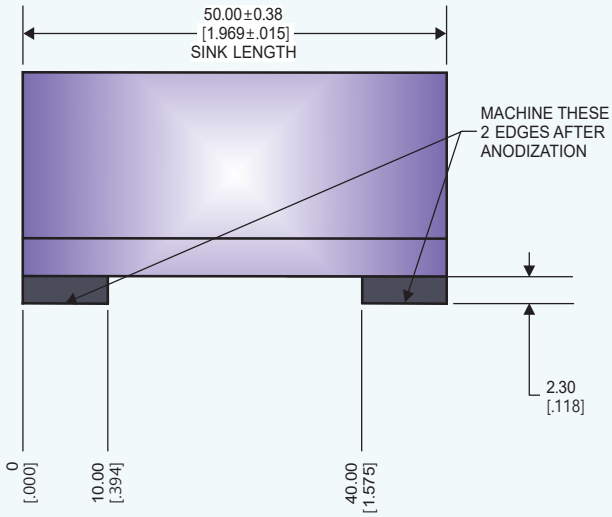
- The large current path of the chip is:Vin → chip PVCC → GND.
- The routing rule of large current path is as thick as possible to reduce the impedance caused by PCB routing.
- The power supply pin of IU8689E must be pasted with two ceramic capacitors 10uF and 1uF, and be as close to the chip pin as possible. 470uF/50V is recommended for power supply electrolytic capacitor.
- All GNDS, including the GND of each capacitor, should be well connected, which can be connected to the copper foil of large-area GND nearby to reduce the ground loop impedance and inductance as much as possible. Demo example is shown in the figure.

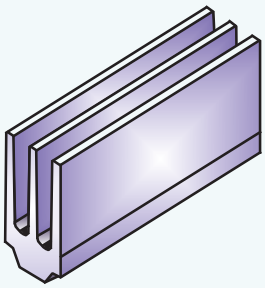


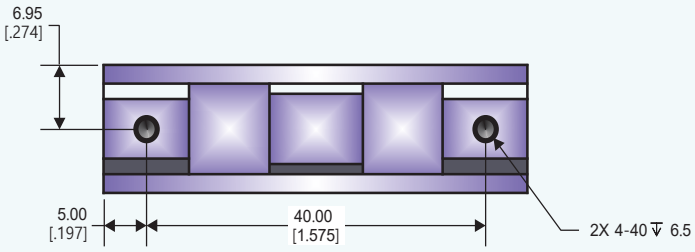
Description of Cooling Fins of Demo

The heat sink used on EVB of IU8689E is 14mm × 25mm × 50mm, aluminum radiator, with the following dimensions:



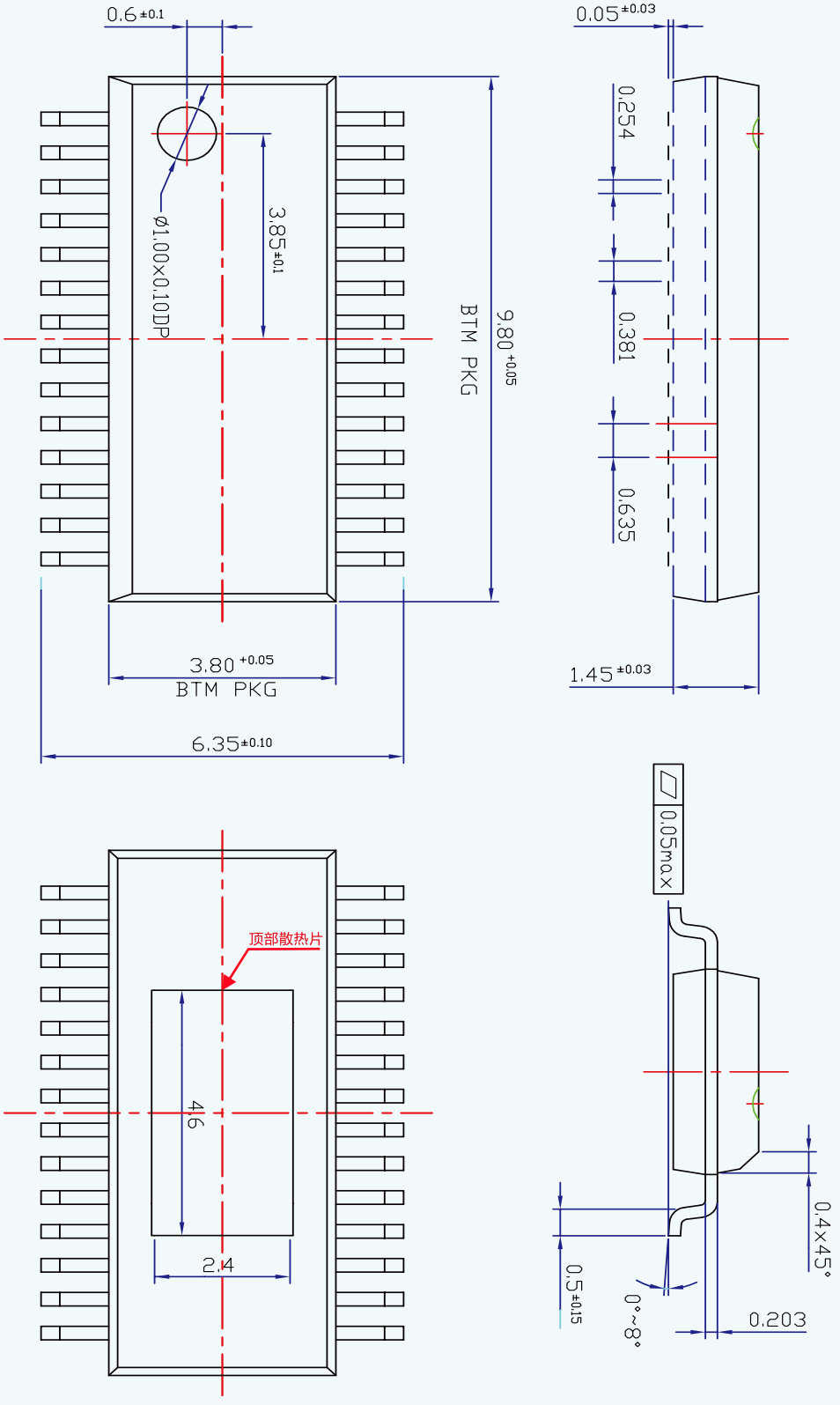






Package Information

IU8689E 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.
- Any semiconductor product has a certain possibility of failure or malfunction under specific conditions. The buyer is responsible for complying with safety standards and taking safety measures when using products from Shanghai IXU Semiconductor Co., Ltd. for system design and complete machine manufacturing, in order to avoid potential risks of failure that may cause personal injury or property damage!
- The pursuit of enhancing product quality is endless. Shanghai IXU Semiconductor Co., Ltd. will wholeheartedly provide customers with even better products!