TS4995

1.2W Differential Input/Output Audio Power Amplifier with Selectable Standby and 6dB fixed gain

- **Differential inputs**
- **80dB PSRR @ 217Hz with grounded inputs**
- **Operating from V_{cc} = 2.5V to 5.5V**
- **1.2W rail to rail output power @ Vcc=5V, THD=1%, F=1kHz, with 8Ω load**
- **6dB integrated fixed gain**
- **Ultra-low consumption in standby mode (10nA)**
- **Selectable standby mode (active low or active high**
- **Ultra-fast startup time: 15ms typ.**
- **Available in 9-bump flip-chip (300µm bump diameter)**
- **Advanced pop & clickless circuitry**

Description

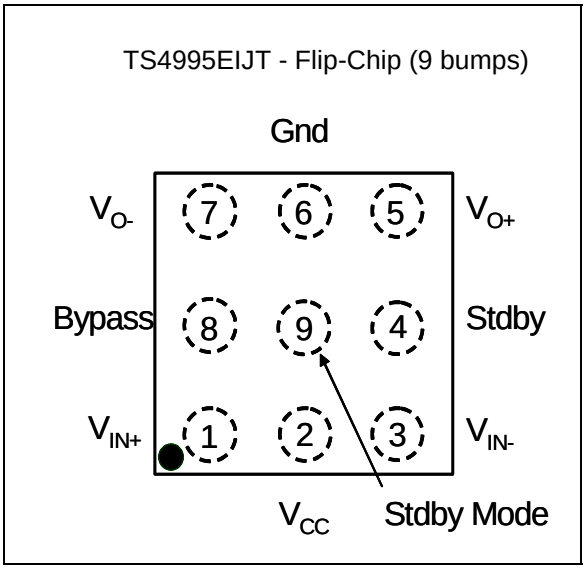
The TS4995 is an audio power amplifier capable of delivering 1.2W of continuous RMS output power into an 8Ω load @ 5V. Thanks to its differential inputs, it exhibits outstanding noise immunity.

An external standby mode control reduces the supply current to less than 10nA. A STBY MODE pin allows the standby pin to be active HIGH or LOW. An internal thermal shutdown protection is also provided, making the device capable of sustaining short-circuits.

The device is equipped with Common Mode Feedback circuitry allowing outputs to be always biased at Vcc/2 regardless of the input common mode voltage.

The TS4995 has been designed for high quality audio applications such as mobile phones and requires few external components.

Pin Connections (top view)



Applications

- **Mobile phones (cellular / cordless)**
- **Laptop / notebook computers**
- **PDAs**
- **Portable audio devices**

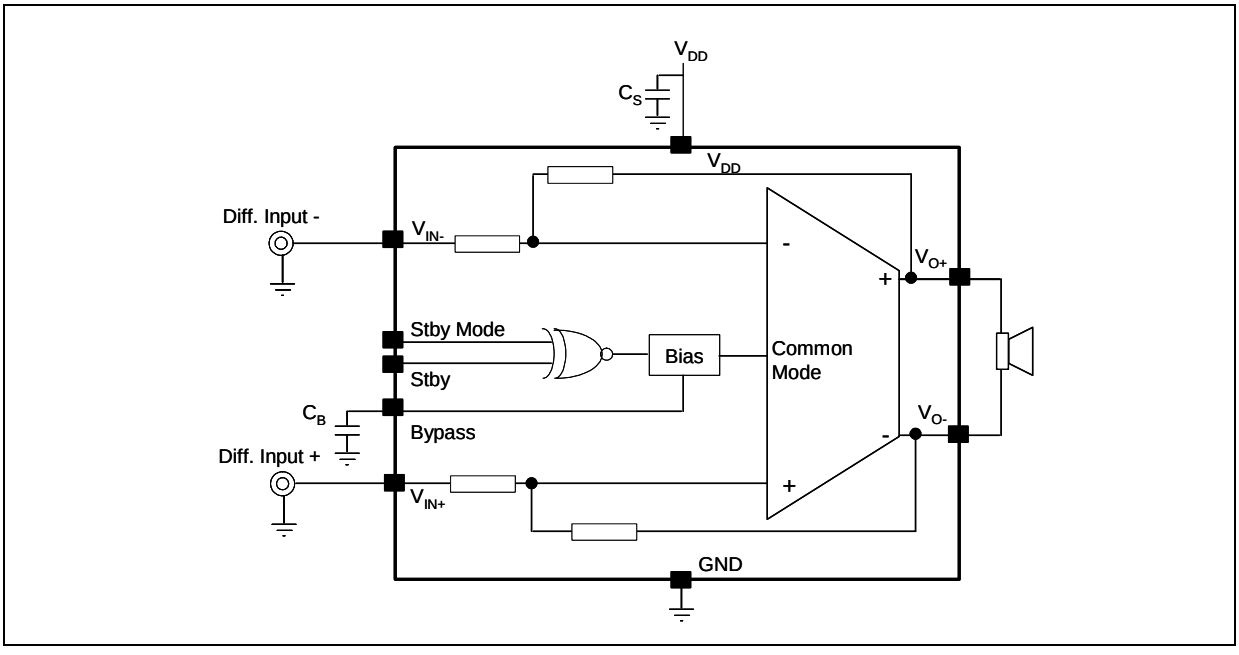
Order Codes

Part Number	Temperature Range	Package	Packaging	Marking
TS4995EIJT	-40 , +85°C	Lead free Flip-Chip9	Tape & Reel	A95

1 Application Component Information

Components	Functional Description
C_S	Supply Bypass capacitor which provides power supply filtering.
C_B	Bypass capacitor which provides half supply filtering.
C_{IN}	Optional input capacitor making a high pass filter together with R_{IN}. (fcl = 1 / (2 x Pi x R_{IN} x C_{IN})

Figure 1. Typical application



2 Absolute Maximum Ratings

Table 1. Key parameters and their absolute maximum ratings

Symbol	Parameter	Value	Unit
VCC	Supply voltage [1]	6	V
V_i	Input Voltage [2]	G_{ND} to V_{CC}	V
T_{oper}	Operating Free Air Temperature Range	-40 to + 85	°C
T_{stg}	Storage Temperature	-65 to +150	°C
T_j	Maximum Junction Temperature	150	°C
R_{thja}	Thermal Resistance Junction to Ambient [3]	250	°C/W
Pd	Power Dissipation	internally limited	W
ESD	Human Body Model	2	kV
ESD	Machine Model	200	V
	Latch-up Immunity	200	mA
	Lead Temperature (soldering, 10sec)	260	°C

1) All voltages values are measured with respect to the ground pin.

2) The magnitude of input signal must never exceed V_{CC} + 0.3V / G_{ND} - 0.3V

3) The device is protected by a thermal shutdown active at 150°C

Table 2. Operating conditions

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	2.5 to 5.5	V
V_{SM}	Standby Mode Voltage Input: Standby Active LOW Standby Active HIGH	 V_{SM}=GND V_{SM}=V_{CC}	V
V_{STB}	Standby Voltage Input: Device ON (V_{SM}=GND) or Device OFF (V_{SM}=V_{CC}) Device OFF (V_{SM}=GND) or Device ON (V_{SM}=V_{CC})	 $1.5 \leq V_{STB} \leq V_{CC}$ $G_{ND} \leq V_{STB} \leq 0.4$ [1]	V
T_{SD}	Thermal Shutdown Temperature	150	°C
R_L	Load Resistor	≥ 4	Ω
R_{THJA}	Thermal Resistance Junction to Ambient	100	°C/W

1) The minimum current consumption ($I_{STANDBY}$) is guaranteed when V_{STB}=GND or V_{CC} (i.e. supply rails) for the whole temperature range.

3 Electrical Characteristics

Table 3. Electrical characteristics - V_{CC} = +5V, GND = 0V, T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
I_{CC}	Supply Current No input signal, no load		4	7	mA
$I_{STANDBY}$	Standby Current No input signal, Vstdby = V_{SM} = G_{ND}, RL = 8Ω No input signal, Vstdby = V_{SM} = V_{CC}, RL = 8Ω		10	1000	nA
Voo	Differential Output Offset Voltage No input signal, RL = 8Ω		0.1	10	mV
V_{ICM}	Input Common Mode Voltage CMRR ≤ -60dB	0.6		V_{CC}- 0.9	V
Po	Output Power THD = 1% Max, F= 1kHz, RL = 8Ω	0.8	1.2		W
THD + N	Total Harmonic Distortion + Noise Po = 850mW rms, 20Hz ≤ F ≤ 20kHz, RL = 8Ω		0.5		%
$PSRR_{IG}$	Power Supply Rejection Ratio with Inputs Grounded[1] F = 217Hz, R = 8Ω, C_{in} = 4.7µF, C_b =1µF Vripple = 200mV_{PP}	tbd	tbd		dB
CMRR	Common Mode Rejection Ratio F = 217Hz, RL = 8Ω, C_{in} = 4.7µF, C_b =1µF Vic = 200mV_{PP}		tbd		dB
SNR	Signal-to-Noise Ratio (A Weighted Filter) (R_L = 8Ω, THD +N < 0.7%, 20Hz ≤ F ≤ 20kHz)		100		dB
GBP	Gain Bandwidth Product R_L = 8Ω		2		MHz
V_N	Output Voltage Noise, 20Hz ≤ F ≤ 20kHz, R_L = 8Ω Unweighted A weighted Unweighted, Standby A weighted, Standby		12 10.5 1.5 1		µV_{RMS}
Zin	Input impedance	tbd	tbd	tbd	kΩ
	Gain mismatch	5.5	6	6.5	dB
T_{WU}	Wake-Up Time[2] C_b =1µF		15		ms

1) Dynamic measurements - 20*log(rms(Vout)/rms (Vripple)). Vripple is the super-imposed sinus signal relative to Vcc.

2) Transition time from standby mode to fully operational amplifier.

Table 4. Electrical Characteristics: V_{CC} = +3.3V (all electrical values are guaranteed with correlation measurements at 2.6V and 5V) GND = 0V, T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
I_{CC}	Supply Current No input signal, no load		3	7	mA
$I_{STANDBY}$	Standby Current No input signal, Vstdby = V_{SM} = G_{ND}, RL = 8Ω No input signal, Vstdby = V_{SM} = V_{CC}, RL = 8Ω		10	1000	nA
Voo	Differential Output Offset Voltage No input signal, RL = 8Ω		0.1	10	mV
V_{ICM}	Input Common Mode Voltage CMRR ≤ -60dB	0.6		V_{CC}- 0.9	V
Po	Output Power THD = 1% Max, F= 1kHz, RL = 8Ω	300	500		mW
THD + N	Total Harmonic Distortion + Noise Po = 300mW rms, 20Hz ≤ F ≤ 20kHz, RL = 8Ω		0.5		%
$PSRR_{IG}$	Power Supply Rejection Ratio with Inputs Grounded[1] F = 217Hz, R = 8Ω,C_{in} = 4.7µF, C_b =1µF Vripple = 200mV_{PP}	tbd	tbd		dB
CMRR	Common Mode Rejection Ratio F = 217Hz, RL = 8Ω, C_{in} = 4.7µF, C_b =1µF Vic = 200mV_{PP}		tbd		dB
SNR	Signal-to-Noise Ratio (A Weighted Filter) (R_L = 8Ω, THD +N < 0.7%, 20Hz ≤ F ≤ 20kHz)		100		dB
GBP	Gain Bandwidth Product R_L = 8Ω		2		MHz
V_N	Output Voltage Noise, 20Hz ≤ F ≤ 20kHz, R_L = 8Ω Unweighted, Av = 2.5 A weighted, Av = 2.5 Unweighted, Standby A weighted, Standby		12 10.5 1.5 1		µV_{RMS}
Zin	Input impedance	tbd	tbd	tbd	kΩ
	Gain mismatch	5.5	6	6.5	dB
T_{WU}	Wake-Up Time[2] C_b =1µF		15		ms

1) Dynamic measurements - 20*log(rms(Vout)/rms (Vripple)). Vripple is the super-imposed sinus signal relative to Vcc.

2) Transition time from standby mode to fully operational amplifier.

Table 5. Electrical Characteristics - V_{CC} = +2.6V, GND = 0V, T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
I_{CC}	Supply Current No input signal, no load		3	7	mA
$I_{STANDBY}$	Standby Current No input signal, Vstdby = V_{SM} = G_{ND}, RL = 8Ω No input signal, Vstdby = V_{SM} = V_{CC}, RL = 8Ω		10	1000	nA
Voo	Differential Output Offset Voltage No input signal, RL = 8Ω		0.1	10	mV
V_{ICM}	Input Common Mode Voltage CMRR ≤ -60dB	0.6		V_{CC}- 0.9	V
Po	Output Power THD = 1% Max, F= 1kHz, RL = 8Ω	200	300		mW
THD + N	Total Harmonic Distortion + Noise Po = 225mW rms, 20Hz ≤ F ≤ 20kHz, RL = 8Ω		0.5		%
$PSRR_{IG}$	Power Supply Rejection Ratio with Inputs Grounded[1] F = 217Hz, R = 8Ω, C_{in} = 4.7µF, C_b =1µF Vripple = 200mV_{PP}	tbd	tbd		dB
CMRR	Common Mode Rejection Ratio F = 217Hz, RL = 8Ω, C_{in} = 4.7µF, C_b =1µF Vic = 200mV_{PP}		tbd		dB
SNR	Signal-to-Noise Ratio (A Weighted Filter) (R_L = 8Ω, THD +N < 0.7%, 20Hz ≤ F ≤ 20kHz)		100		dB
GBP	Gain Bandwidth Product R_L = 8Ω		2		MHz
V_N	Output Voltage Noise, 20Hz ≤ F ≤ 20kHz, R_L = 8Ω Unweighted A weighted Unweighted, Standby A weighted, Standby		12 10.5 1.5 1		μV_{RMS}
Zin	Input impedance	tbd	tbd	tbd	kΩ
	Gain mismatch	5.5	6	6.5	dB
T_{WU}	Wake-Up Time[2] C_b =1µF		15		ms

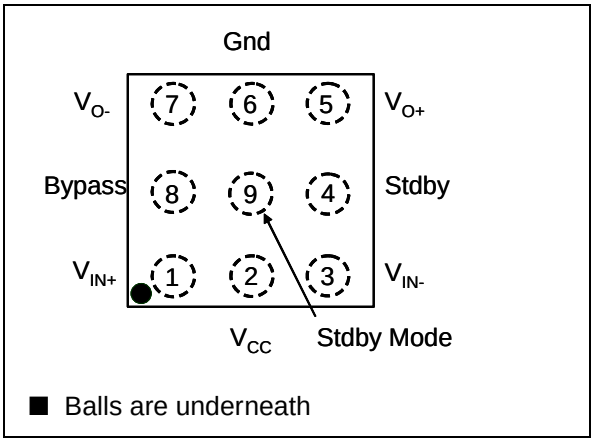
1) Dynamic measurements - 20*log(rms(Vout)/rms (Vripple)). Vripple is the super-imposed sinus signal relative to Vcc.

2) Transition time from standby mode to fully operational amplifier.

4 Flip-chip package (9 bumps)

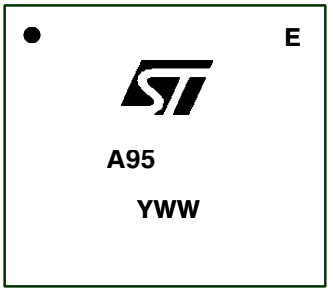
Dimensions in millimeters unless otherwise indicated.

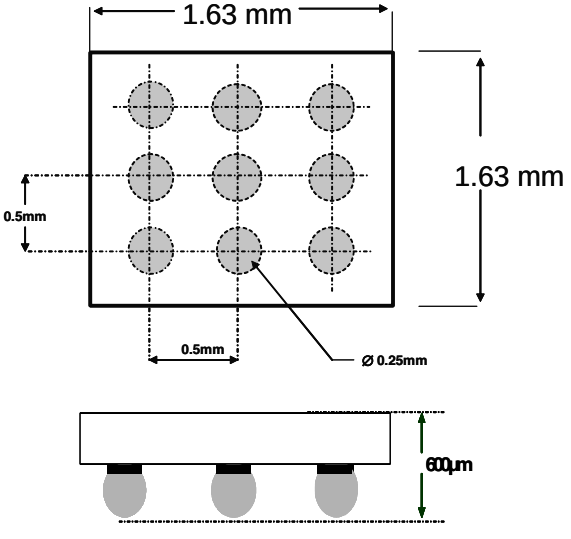
Pin Out (top view)



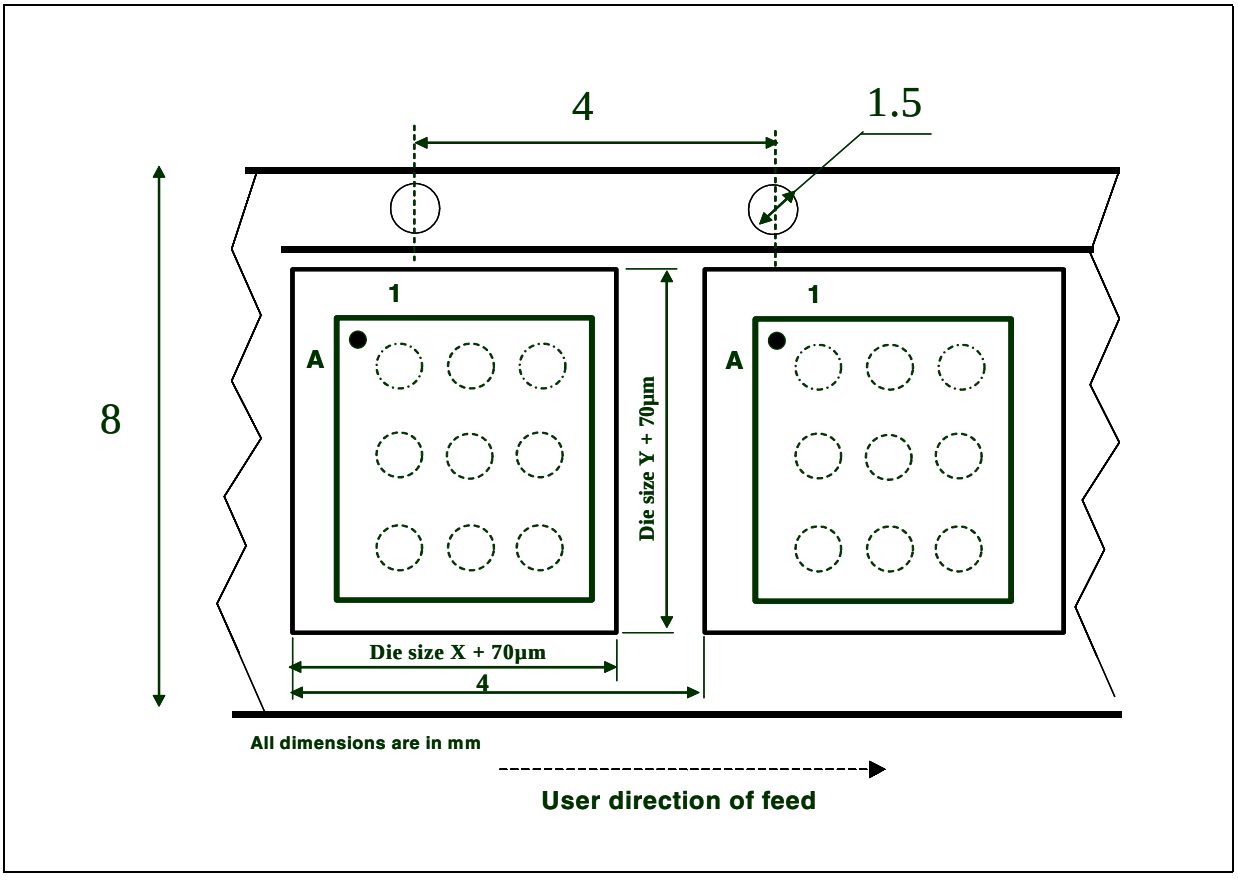
■ Balls are underneath

Marking (top view)





- Die size: **1.63mm x 1.63mm** ± 30µm
- Die height (including bumps): **600µm**
- Bumps diameter: **315µm** ±50µm
- Bump Diameter Before Reflow: **300µm** ±10µm
- Bumps Height: **250µm** ±40µm
- Die Height: **350µm** ±20µm
- Pitch: **500µm** ±50µm
- Coplanarity: **50µm max**


4
1.5
8
1
A
1
A
Die size Y + 70µm
Die size X + 70µm
4
All dimensions are in mm
User direction of feed

5 Revision History

Date	Revision	Description of Changes
17 October. 2005	1	First Release