

TS4974

PRODUCT PREVIEW

1W Differential Audio Power Amplifier with Up/Down Digital Volume Control Pins

- Operating from V_{cc} = 2.5V to 5.5V
- Zero pop&clickless circuit
- 1.W output power @ Vcc=5V, THD=1%, F=1kHz, with 8Ω Load
- Ultra low consumption in standby mode (2µA max.)
- 85dB PSRR @ 217Hz
- 16 digital volume control steps
- Two up and down volume control discrete pins
- Gain range from -33dB to + 12dB
- Integrated debouncing system
- Ultra fast start up time: 15ms typ.
- DFN10 3X3 mm pitch 0.5

Description

At 3.3v, the TS4974 is a dual power audio amplifier capable of delivering 380mW of continuous RMS ouput power into a 8Ω bridgedtied loads with 1% THD+N. An external standby mode control reduces the supply current to less than 2µA. An internal over-temperature shutdown protection is provided.

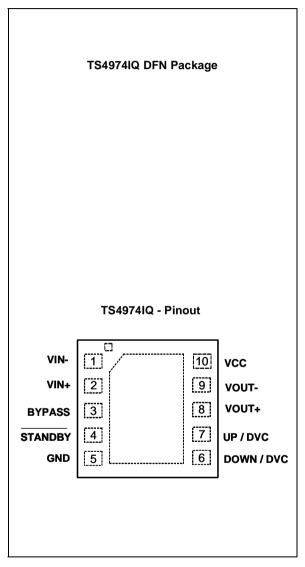
The TS4974 has been designed for high quality audio applications such as mobile phones and for minimizing the number of external components.

The TS4974 features a 16 step digital volume control through two discrete control Up and Down pins. The start-up gain is internally fixed to -12dB. An integrated debounce system prevents voltage pikes on UP/DOWN pins during volume control mode to be taken into account during a debounce time of 10ms (typ.).

Applications

- Mobile phones (cellular / cordless)
- PDAs

Pin Connections (top view)



- Laptop/notebook computers
- Portable audio devices

Order Codes

Part Number Temperature Range		Package	Packaging	Marking	
TS4974IQT	-40, +85°C	QFN	Tape & Reel	TBA	

November 2004

Revision 1

1/8

This is preliminary information on a new product now in development. Details are subject to change without notice.

1 Absolute Maximum Ratings

Table 1: Key parameters and their absolute maximum ratings

Symbol	Parameter	Value	Unit
Vcc	Supply voltage ¹	6	V
Vi	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
Т _ј	Maximum Junction Temperature	150	°C
R _{thja}	Thermal Resistance Junction to Ambient ³	200	°C/W
Pd	Power Dissipation	Internally Limited ⁴	
ESD	Human Body Model ⁵	2	kV
ESD	Machine Model (min Value)	200	V
Latch-up	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) Device is protected in case of over temperature by a thermal shutdown active @ 150°C.

4) Exceeding the power derating curves during a long period, may involve abnormal operating condition.

5) Human body model, 100pF discharged through a 1.5kOhm resistor, into pin to Vcc device.

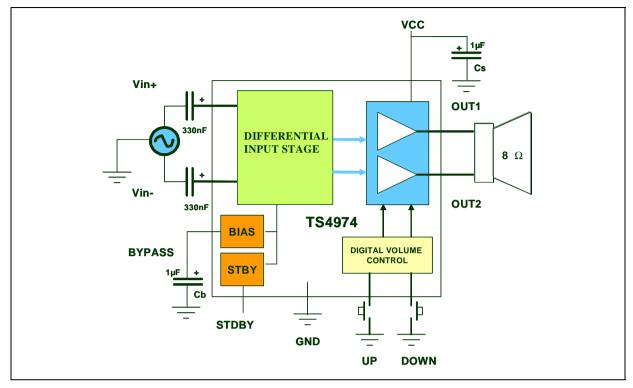
Table 2: Operating Conditions

Symbol	Parameter	Value	Unit
Vcc	Supply Voltage	2.5 to 5.5	V
VSTB	Standby Voltage Input : Device ON Device OFF	$1.5 \le V_{STB} \le V_{CC}$ GND $\le V_{STB} \le 0.4$	V
VU/D	Volume control UP/DOWN voltage input: UP/DOWN mode ON UP/DOWN mode OFF	$0 \le V_{U/D} \le 30\%$ of V_{CC} 40% of $V_{CC} \le V_{U/D} \le V_{CC}$	V
RL	Load Resistor	≥ 8	Ω
TSD	Thermal Shutdown Temperature	150	°C
R _{thja}	Thermal Resistance Junction to Ambient ¹	80	°C/W

1) With Heat Sink Surface = 125mm².

1 Application Information

Figure 1: Typical application schematics



Operation Mode

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The TS4974 is a fully differential power amplifier which enables better performances in terms of noise immunity and PSRR.

The TS4974 features a digital volume control with an internal gain range from -33dB up to +12dB, by steps of 3dB. When the device is firstly biased, an initial gain of -12dB is internally fixed. When standby mode is activated, the gain value is memorized and held until standby is released.

The volume is controlled by means of two pins UP and DOWN on which the application of a VIL voltage will activate the increase or decrease in gain. The TS4974 integrates a debouncing system which does not allow to take into account UP or DOWN pulse shorter than $T_{debounce}$ time. Moreover an autorepeat function is implemented. When a continuous voltage is applied on UP or DOWN pin, the gain is continuously increased or decreased after a certain time called $T_{autorepeat}$. The first period of each autorepeat sequence is longer (x1.5 T_{auto}) to avoid any parasitic activation. In this operational mode, T_{rance} time is necessary to cover the whole gain range of the device.

2 Electrical Characteristics

Table 3: V_{cc} = +5V, GND = 0V, T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter		Тур.	Max.	Unit	
I _{CC}	Supply Current No input signal, no load		3.2		mA	
ISTANDBY	Standby Current No input signal, Vstdby = Gnd, RL = 8Ω		300	2000	nA	
Voo	Output Offset Voltage No input signal, $RL = 8\Omega$, Floating inputs		5	20	mV	
Po	Output Power THD = 1% Max, f = 1kHz, RL = 8Ω	0.8	1		W	
THD + N	Total Harmonic Distortion + Noise Po = 500mW rms, 20Hz < F < 20kHz, RL = 8Ω, 0dB gain, Cb=1µF, Cin=330nF		0.5		%	
PSRR	Power Supply Rejection Ratio ¹ F = 217Hz, RL = 8Ω ,) Vripple = 200mVpp, Input Grounded, Cb=1µF, Cin=330nF	$7Hz$, $RL = 8\Omega$,) 75 85			dB	
CMRR	$\begin{tabular}{ c c c c } \hline Common Mode Rejection Ratio^2 & & & & & \\ F = 217 Hz, \ RL = 8\Omega, & & & 45 & 61 \\ \hline Vincm = 200 mVpp, \ Cb = 1 \mu F, \ Cin = 330 nF & & & & \\ \hline \end{tabular}$		61		dB	
SNR	Signal-to-Noise Ratio (Weighted A, 6dB gain) (RL = 8Ω , THD + N \leq 0.5%, 20Hz < F < 20kHz)		100		dB	
Gs	Start up Gain		-12		dB	
G	Digital Gain Range			+12	dB	
Gain Step size			3		dB	
Gain accu- racy	-			+1	dB	
Twu	Wake-up Time		15		ms	
V _N	Output Voltage Noise F = 20Hz to 20kHz, RL = 8Ω Unweighted Weighted A		21 17		μV_{RMS}	
Zin	Differential input impedance		60	75	kΩ	
T _{debounce}	Debouncing time		10		ms	
T _{autorepeat}	Time between volume changes		160		ms	
T _{range}	During autorepeat mode, necessary time to cover the whole gain range		2500		ms	

1) Dynamic measurements - $20*\log(rms(Vout)/rms(Vripple))$. Vripple is an added sinus signal to Vcc @ F = 217Hz.

2) Dynamic measurements - 20*log(rms(Vout)/rms(Vincm)).

Symbol	Parameter		Тур.	Max.	Unit
I _{CC}	Supply Current No input signal, no load		3.0		mA
ISTANDBY	Standby Current No input signal, Vstdby = Gnd, RL = 8Ω		230	2000	nA
Voo	Output Offset Voltage No input signal, RL = 8Ω , Floating inputs		5	20	mV
Po	Output Power THD = 1% Max, f = 1kHz, RL = 8 Ω	300	380		mW
THD + N	Total Harmonic Distortion + Noise Po = 250mW rms, 20Hz < F < 20kHz, RL = 8Ω, 0dB gain, Cb=1µF, Cin=330nF		0.5		%
PSRR	Power Supply Rejection Ratio175 $F = 217Hz, RL = 8\Omega,)$ 75Vripple = 200mVpp, Input Grounded, Cb=1µF, Cin=330nF			dB	
CMRR	$\label{eq:common Mode Rejection Ratio}^2 \\ F = 217 Hz, \ RL = 8\Omega, \\ Vincm = 200 mVpp, \ Cb = 1 \mu F, \ Cin=330 nF \\ \end{tabular}$		61		dB
SNR	Signal-to-Noise Ratio (Weighted A, 6dB gain) (RL = 8Ω , THD + N \leq 0.5%, 20Hz < F < 20kHz)		100		dB
Gs	Start up Gain		-12		dB
G	Digital Gain Range -33		+12	dB	
Gain Step size			3		dB
Gain accu- racy		-1		+1	dB
Twu	Wake-up Time		15		ms
V _N	Output Voltage Noise F = 20Hz to 20kHz, RL = 8Ω Unweighted Weighted A		21 17		μV_{RMS}
Zin	Differential input impedance		60	75	kΩ
T _{debounce}	Debouncing time 10		ms		
Tautorepeat	time between volume change		160		ms
T _{range}	During autorepeat mode, necessary time to cover the whole gain range		2500		ms

Table 4: V_{CC} = +3.3V, GND = 0V, T_{amb} = 25°C (unless otherwise specified)

1) Dynamic measurements - 20*log(rms(Vout)/rms(Vripple)). Vripple is an added sinus signal to Vcc @ F = 217Hz.

2) Dynamic measurements - 20*log(rms(Vout)/rms(Vincm)).

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Symbol	Parameter		Тур.	Max.	Unit
I _{CC}	Supply Current No input signal, no load		2.8		mA
I _{STANDBY}	Standby Current No input signal, Vstdby = Gnd, RL = 8Ω		265	2000	nA
Voo	Output Offset Voltage No input signal, RL = 8Ω , Floating inputs		5	20	mV
Ро	Output Power THD = 1% Max, f = 1kHz, RL = 8 Ω	200	250		mW
THD + N	Total Harmonic Distortion + Noise Po = 150mW rms, 20Hz < F < 20kHz, RL = 8Ω, 0dB gain, Cb=1µF, Cin=330nF		0.5		%
PSRR	Power Supply Rejection Ratio ¹ F = 217Hz, RL = 8Ω ,) Vripple = 200mVpp, Input Grounded, Cb=1µF, Cin=330nF	75 85 Cin=330nF		dB	
CMRR	$\begin{tabular}{ c c c c } \hline Common Mode Rejection Ratio^2 & & & & \\ F = 217 Hz, \ RL = 8\Omega, & & & 45 \\ Vincm = 200 mVpp, \ Cb = 1 \mu F, \ Cin = 330 nF & & & \\ \hline \end{tabular}$		61		dB
SNR	Signal-to-Noise Ratio (Weighted A, 6dB gain) (RL = 8Ω , THD + N \leq 0.5%, 20Hz < F < 20kHz)		100		dB
Gs	Start up Gain		-12		dB
G	Digital Gain Range -33		+12	dB	
Gain Step size			3		dB
Gain accu- racy	1-			+1	dB
Twu	Wake-up Time		15		ms
V _N	Output Voltage Noise F = 20Hz to 20kHz, RL = 8Ω Unweighted Weighted A		21 17		μV_{RMS}
Zin	Differential input impedance		60	75	kΩ
T _{debounce}	Debouncing time		10		ms
Tautorepeat	t time between volume change		160		ms
T _{range}	During autorepeat mode, necessary time to cover the whole gain range		2500		ms

Table 5: V_{cc} = +2.6V, GND = 0V, T_{amb} = 25°C (unless otherwise specified)

1) Dynamic measurements - 20*log(rms(Vout)/rms(Vripple)). Vripple is an added sinus signal to Vcc @ F = 217Hz.

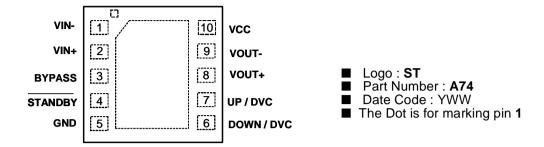
2) Dynamic measurements - 20*log(rms(Vout)/rms(Vincm)).

3 Package Mechanical Data

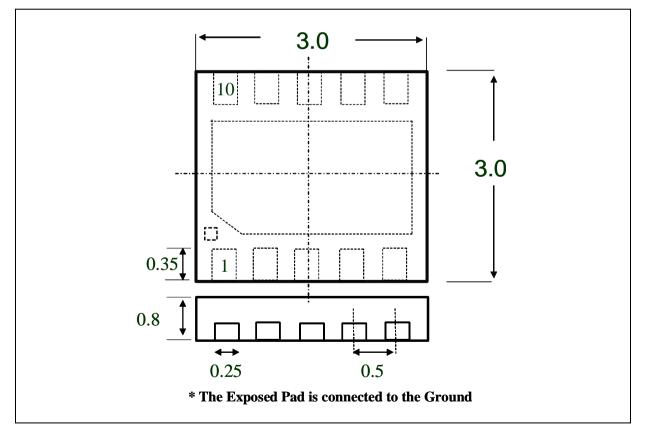
3.1 Pinout (top view)

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3.2 Marking (top view)



3.3 DFN10 3X3 Package (all dimensions in mm)



4 Revision History

Date	Revision	Description of Changes
01 Nov 2004	1	First Release

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