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Bi-CMOS IC

LV4991TH — For Portable Audio Equipment Monaural BTL Power Amplifier

Overview

LV4991TH incorporates the power amplifier circuit operable at low voltage (2.7V or more) and has additionally the standby function to reduce the current drain. This is the best LSI for speaker drive for the battery-driven portable equipment, such as portable DVD player, Notebook PC, etc. The LV4991TH is a HMSOP8 (150mil) package, and The LV4991TT of MSOP8 (150mil) package is available.

Function and Feature

- Monaural BTL power amplifier incorporated
  Standard output power 1 = 450mW (V_{CC} = 3.6V, R_L = 8Ω, THD = 10%)
  Standard output power 2 = 1000mW (V_{CC} = 5V, R_L = 8Ω, THD = 10%)
  Output coupling capacitor not necessary because of differential output type
- Operation at low voltage possible
  V_{CC} = 2.7V or more
- Standby function incorporated
  Standard current drain at standby = 0.1μA (V_{CC} = 3.6V)
- Second amplifier stop control function incorporated : Reducing the pop sound at startup, simple MUTE
- Overheat protection circuit incorporated
- Gain setting possible
  BTL voltage gain = 0 to 26dB
- Output phase compensation capacitor not necessary

LV4991TH

Specifications

Maximum Ratings at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{CC} max		6	V
Allowable power dissipation	Pd max	Substrate mounted*	1.1	V
Operating temperature	Topr		-40 to +85	°C
Storage temperature	Tstg		-40 to +150	°C

* Substrate mounted : with 60mm × 60mm × 1.6mm, glass epoxy substrate

Operating Conditions at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Recommended supply voltage	V_{CC}		3.6	V
Recommended load resistance	R_L		8 to 32	Ω
Allowable operating supply voltage range	V_{CC} op		2.7 to 5.5	V

* Determine the supply voltage to be used with due consideration of allowable power dissipation.

Electrical Characteristics Ta = 25°C, V_{CC} = 3.6V, fin = 1kHz, R_L = 8Ω

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Quiescent current drain	$I_{CCO}P$	No signal, R_L = ∞		3.6	6	mA
Stand-by current drain	$I_{STB}Y$	No signal, R_L = ∞, V3 = LOW		0.1	10	μA
Maximum output power 1	P_OMX1	THD = 10%	300	450		mW
Maximum output power 2	P_OMX2	THD = 10%, V_{CC} = 5V	665	1000		mW
Voltage gain	VG	V_{IN} = -30dBV	4.5	6	7.5	dB
Voltage gain use range	VGR		0		26	dB
Total harmonic distortion ratio	THD	V_{IN} = -30dBV		0.3	1	%
Output noise voltage	V_NOUT	Rg = 620Ω, 20 to 20kHz		120	280	μVrms
Ripple removal ratio	SVRR	Rg = 620Ω, fr = 100Hz, Vr = -20dBV		48		dB
Output offset voltage	V_OS	Rg = 620Ω	-50		50	mV
Reference (pin 1) voltage	VREF			1.81		V
Pin 3 control HIGH voltage	VSTBH	Power amplifier operation mode	1.9		V_{CC}	V
Pin 3 control LOW voltage	VSTBL	Power amplifier standby mode	0		0.3	V
Pin 2 control HIGH voltage	VCNTH	Second power amplifier operation mode	1.6		V_{CC}	V
Pin 2 control LOW voltage	VCNTL	Second power amplifier standby mode	0		0.3	V

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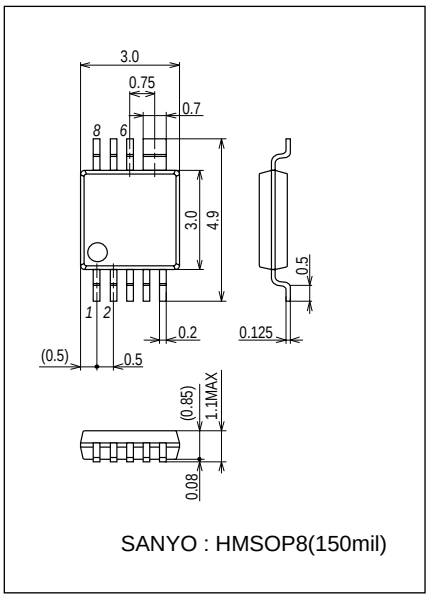
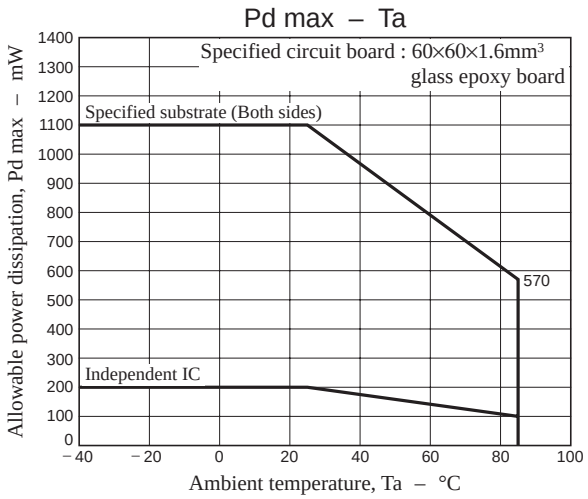
Package Dimensions

unit : mm (typ)

3339

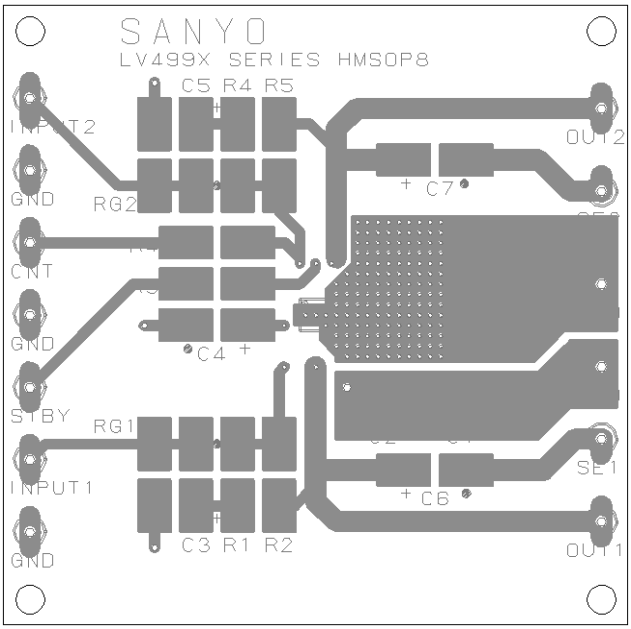


SANYO : HMSOP8(150mil)



Recommended substrate

Size : 60mm×60mm×1.6mm



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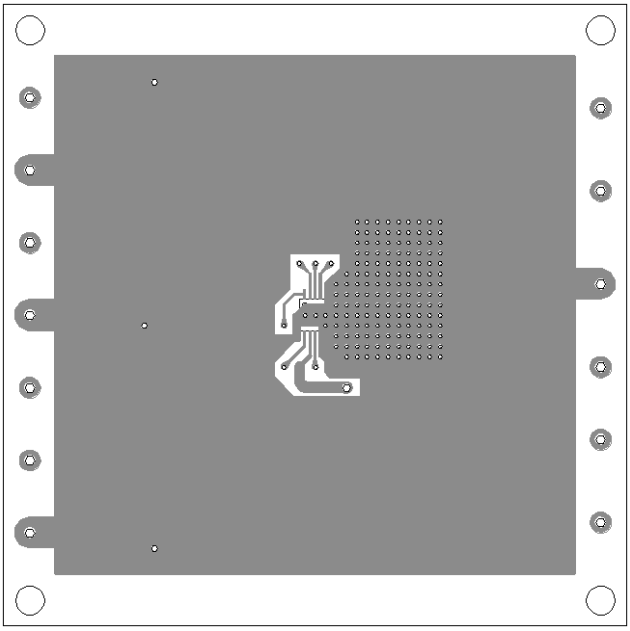

Bottom Layer

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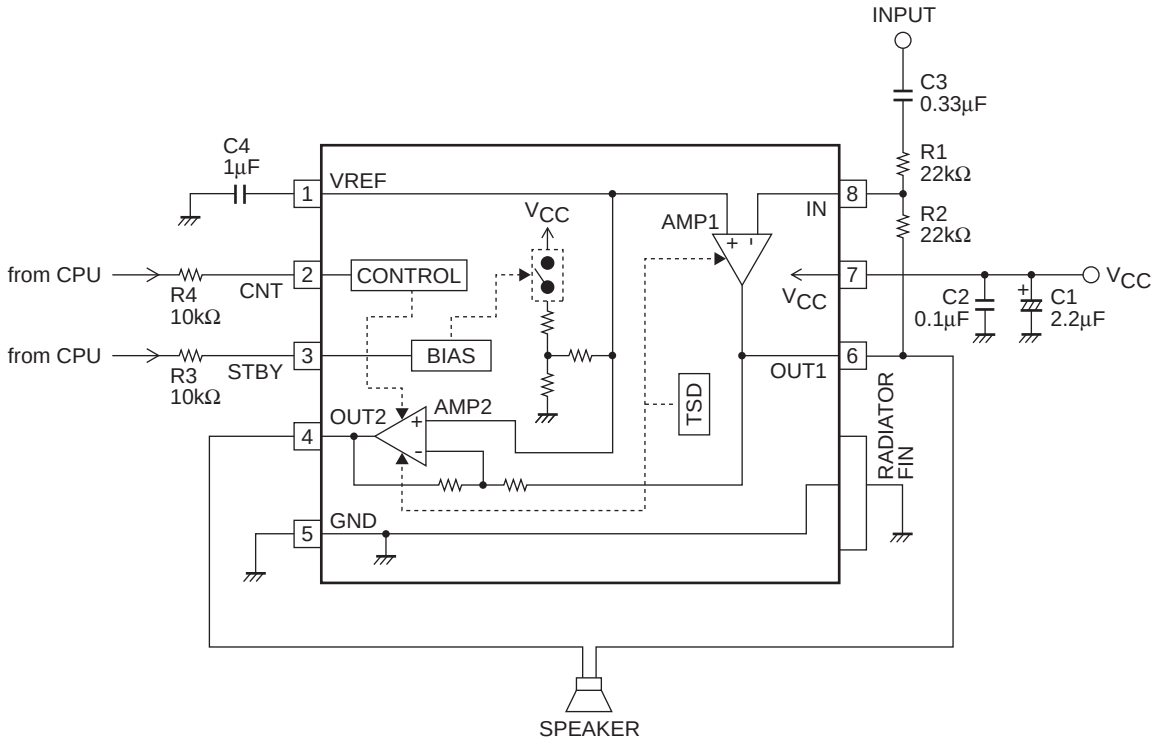
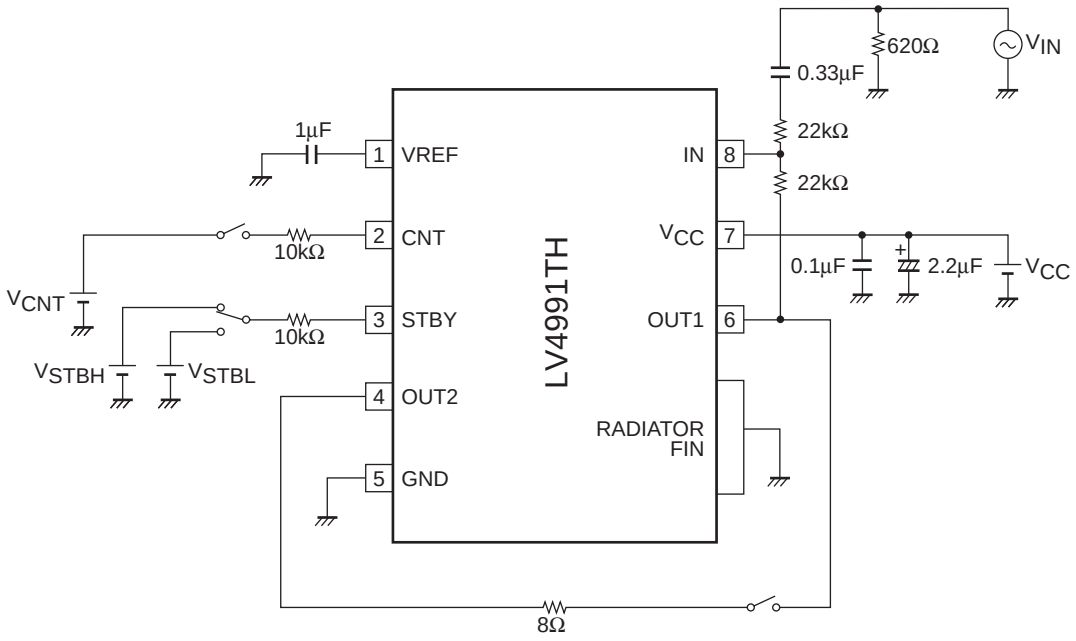
Block Diagram and Sample Application Circuit



Test Circuit



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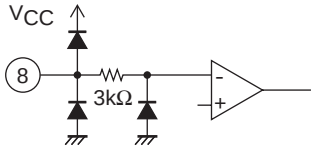
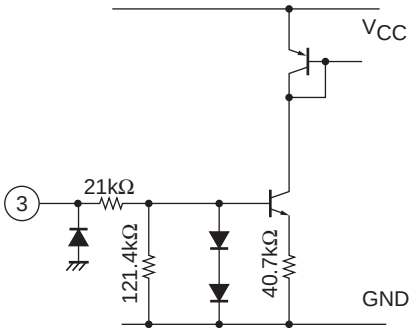
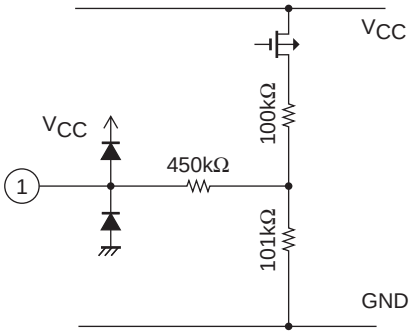
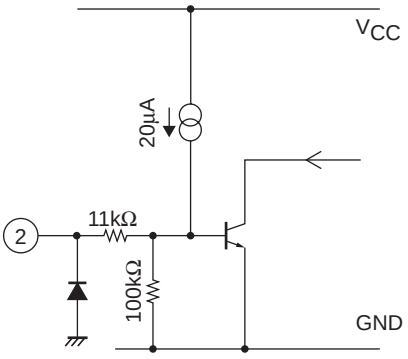
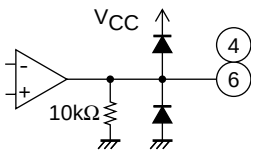
Pin Description

Pin No.	Symbol	Pin voltage V_{CC} = 3.6V	Description	Equivalent circuit
8	IN	1.81	Input pin	
3	STBY	Voltage impression	Standby pin •Standby mode at 0 to 0.3V •Operation mode at 1.9 to VCC	
1	VREF	1.81	Ripple filter pin (For connection of capacitor for filter)	
2	CNT	Voltage impression	Second amplifier stop control pin •Second amplifier stopped at 0 to 0.3V	
4 6	OUT2 OUT1	1.81	Power amplifier output pin	
5	GND	0	Ground pin	
7	V_{CC}	Voltage impression (3.6)	Power pin	

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Cautions for use

1. Input coupling capacitor (C3)
   The input coupling capacitor C3 and input resistor R1 make up the high-pass filter, attenuating the bass frequency. Therefore, the capacitance value must be selected with due consideration of the pass band. Note with care that this capacitance value affects the pop sound at startup.
   Namely, the increased capacitance value will make the pop sound louder.

2. Pin 1 capacitor (C4)
   This capacitor C4 is designed to reduce the power ripple. The ripple removal ratio increases when the capacitance is larger. Note however that this capacitor affects the pop sound at startup.
   Design must therefore be made by taking into both features as above described.

3. Pin 2 control (second amplifier stop control function)
   Pin 2 is a pin to turn ON/OFF the operation of second amplifier. By using this function, the pop sound at startup can be reduced. Note that pin 2 can be controlled by applying the voltage described below :

   Second amplifier ON $\Rightarrow$ V2 = 1.6 to V_{CC}V or OPEN
   Second amplifier OFF $\Rightarrow$ V2 = 0 to 0.3V

   When the pin-1 capacitor C4 is downsized, the pop sound becomes louder. The pop sound can be reduced by providing the time Tmu to stop the second amplifier (see Fig. 1) while utilizing this function of the microcomputor. The recommended mute time Tmu is as follows.

C4 [µF]	0.1	0.22	0.33
Tmu [ms]	≥ 170	≥ 270	≥ 280

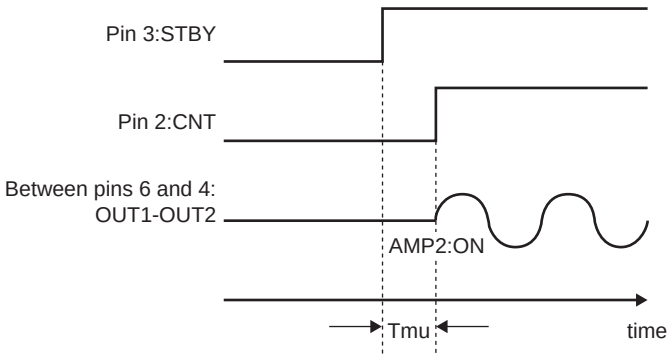


Fig. 1

4. Standby pin (pin 3)
   By controlling the standby pin, the mode changeover can be made between standby and operation modes.
   Standby mode $\Rightarrow$ V3 = 0 to 0.3V
   Operation mode $\Rightarrow$ V3 = 1.9 to V_{CC}V
   When using the standby pin as interlocked with power supply as shown in Fig. 2, care should be taken because the current I_{STBY} as expressed by the following equation flows through the standby pin.

$$I_{STBY} = \frac{V_{CC} - 1.4V}{R3 + 21k\Omega}$$

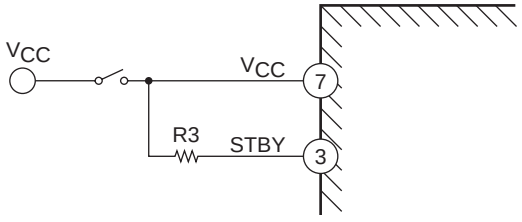


Fig. 2

5. Bypass capacitor (C2) of the power supply block
   The bypass capacitor attached to the power pin (pin 7) must be arranged as near to this pin as possible.

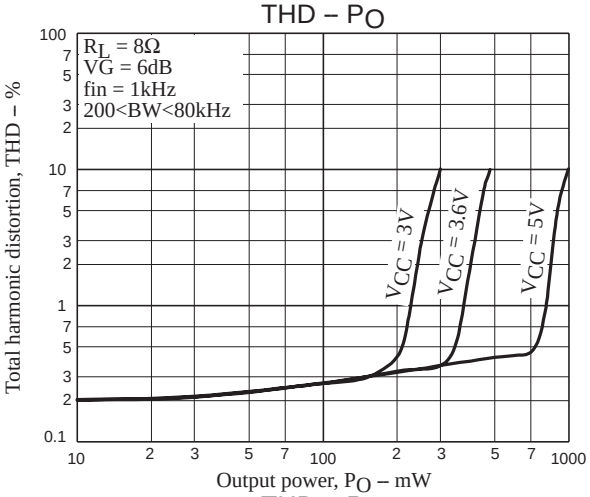
6. Short-circuit between pins
   When power is applied with pins left short-circuited, deterioration or damage may result.
   Therefore, check before power application if pins are short-circuited with solder, etc. during mounting of IC to the substrate.

7. Short-circuit of load
   If the load is left short-circuited for a long period of time, deterioration or damage may occur.
   Never allow the load to short-circuit.

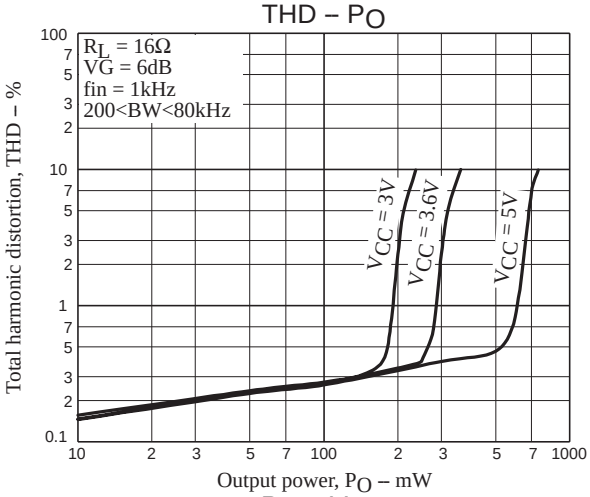
8. Maximum rating
   When IC is used near the maximum rating, there is a possibility that the maximum rating may be exceeded even under the smallest change of conditions, resulting in failure. Take the sufficient margin for variation of supply voltage and use IC within a range where the maximum rating will never be exceeded.

LV4991TH

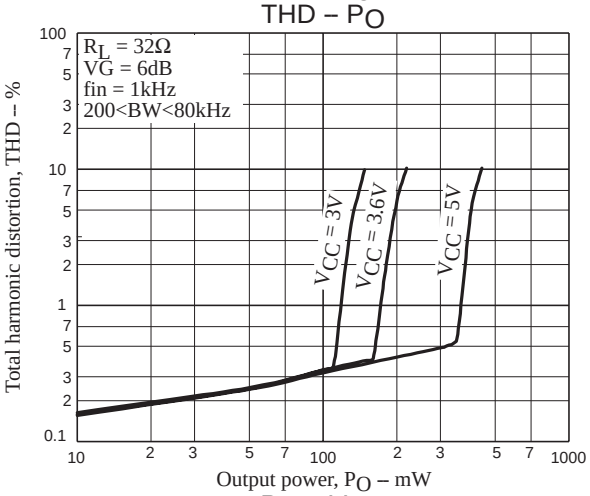
THD – PO



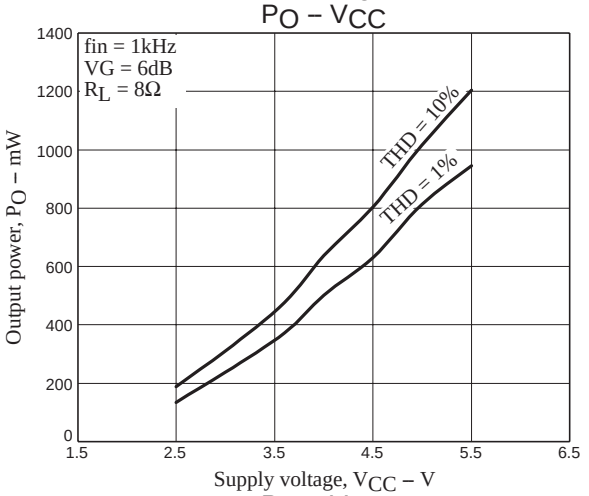
THD – PO



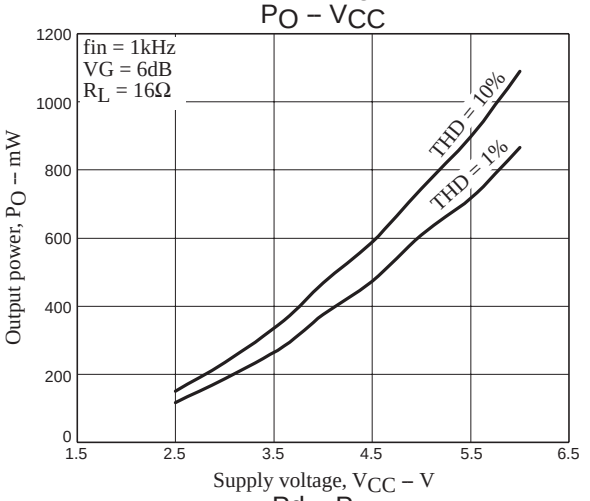
THD – PO



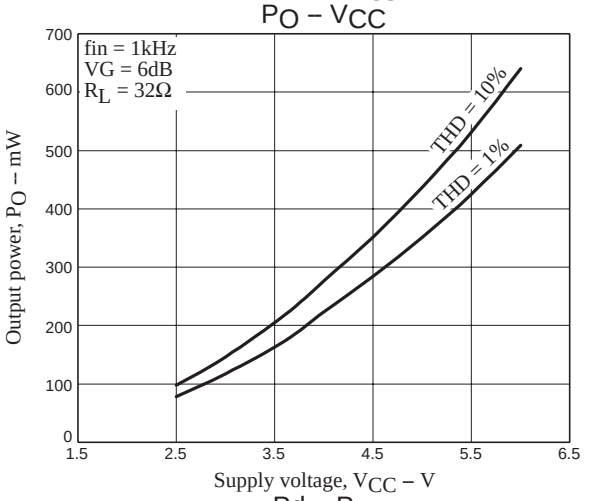
PO – VCC



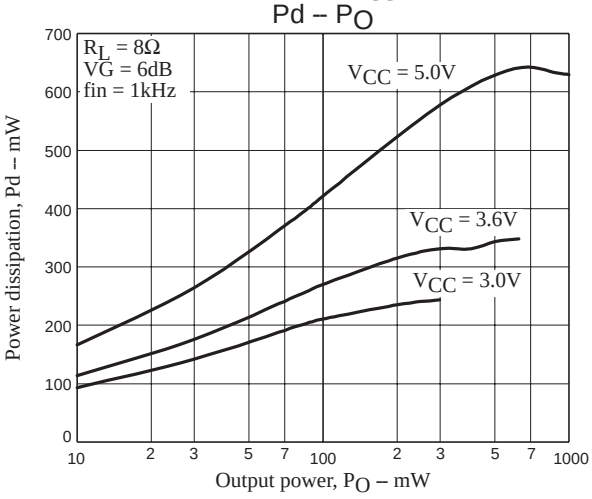
PO – VCC



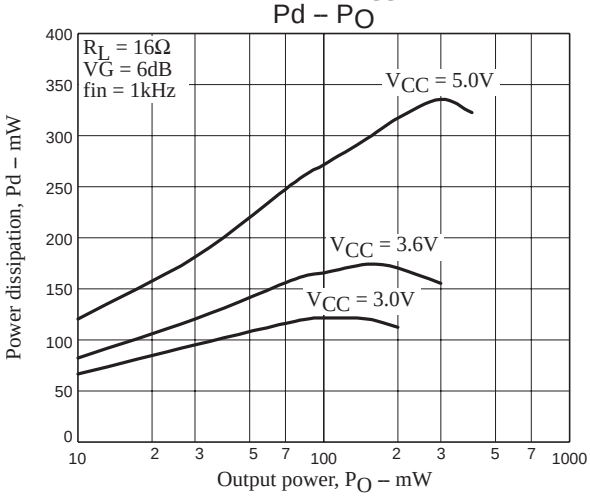
PO – VCC



Pd – PO



Pd – PO



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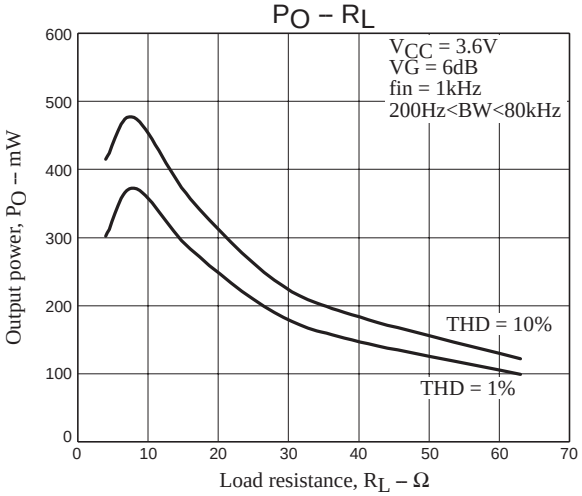
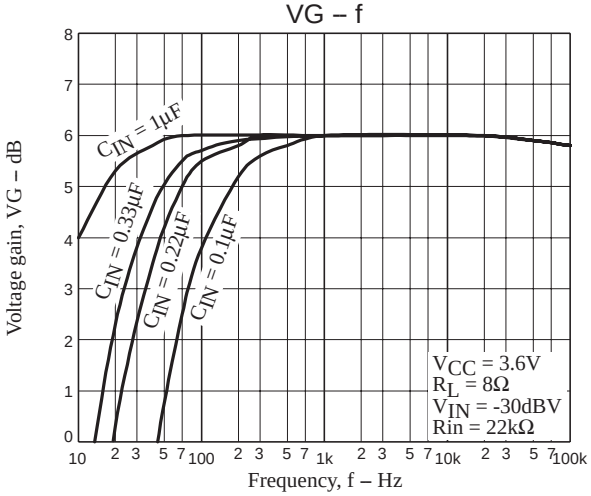
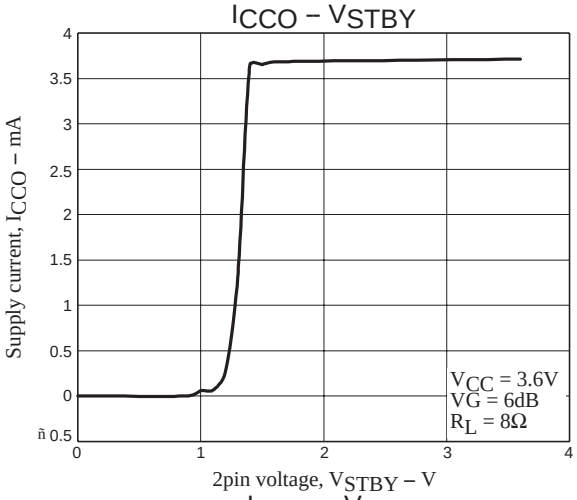
PO – RL



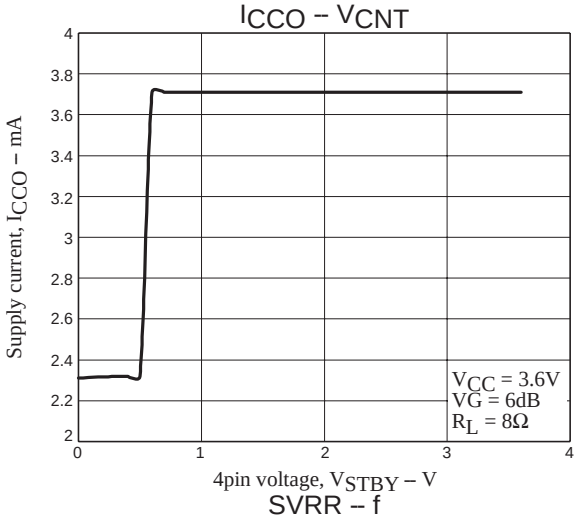
VG – f



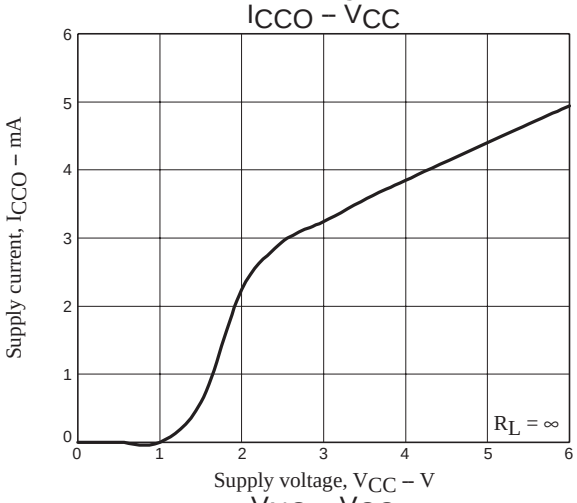
ICCO – VSTBY



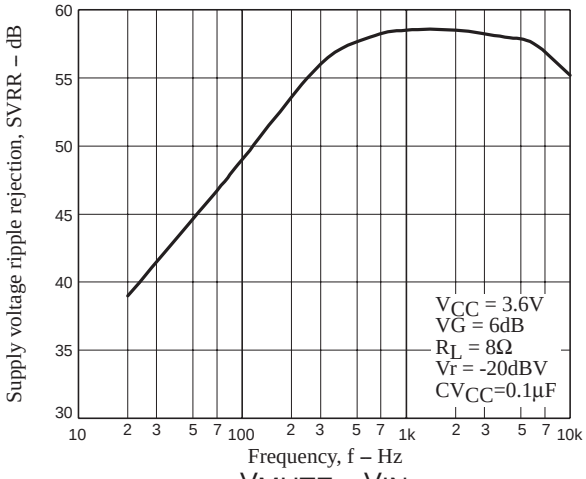
ICCO – VCNT



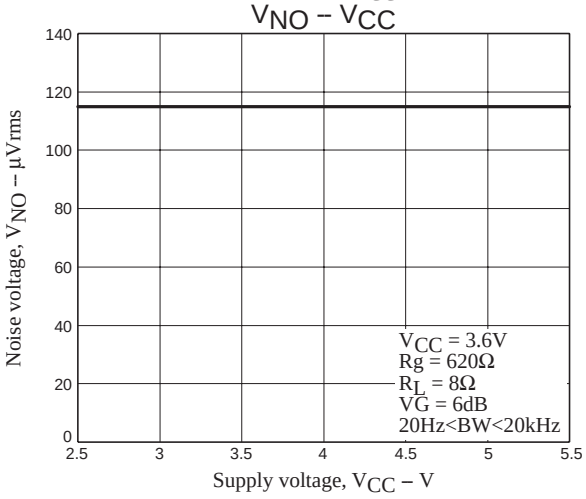
ICCO – VCC



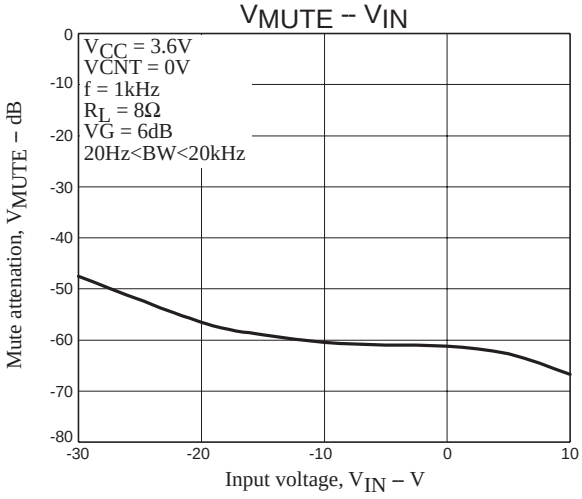
SVRR – f



VNO – VCC



VMUTE – VIN



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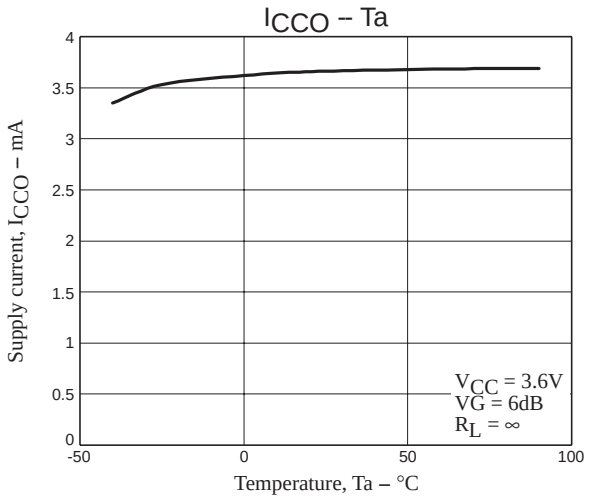
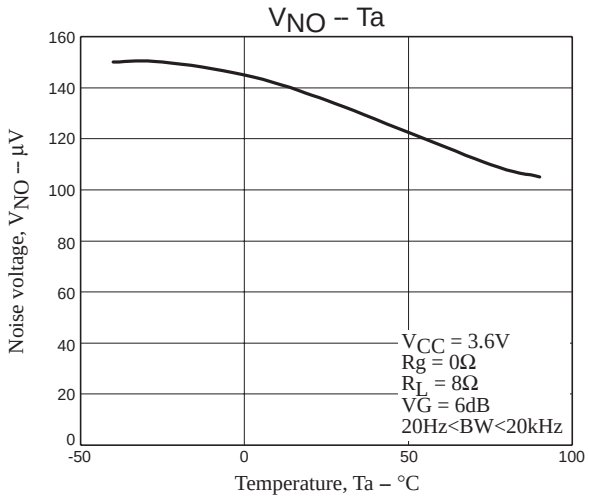
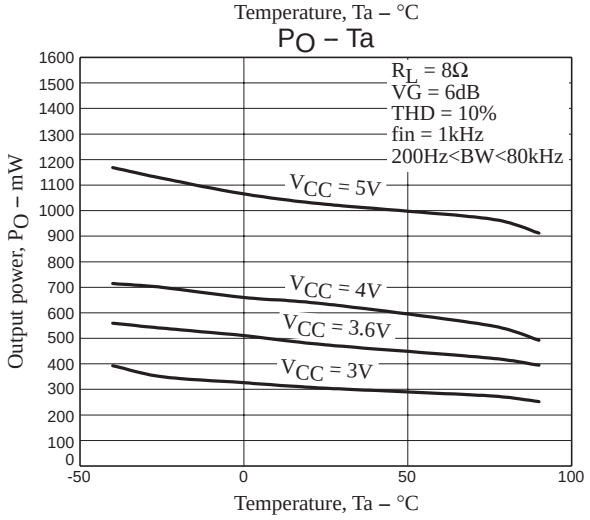
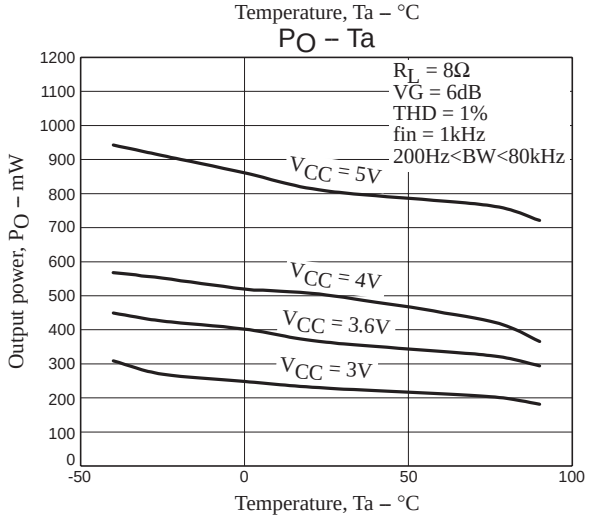
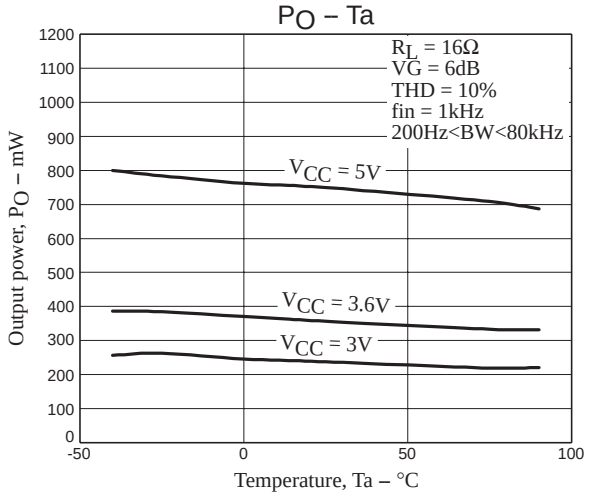
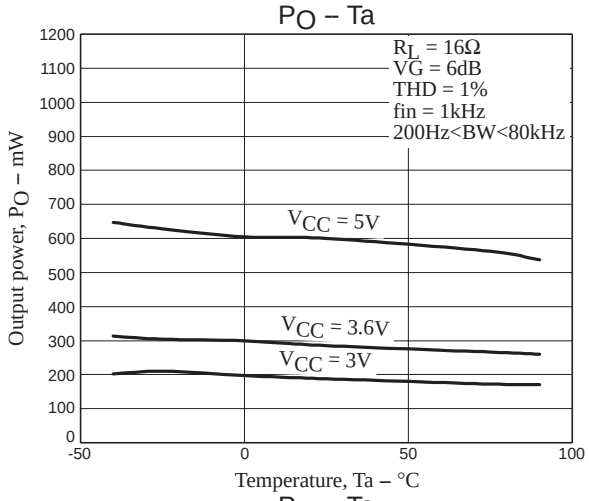

ICCO – Ta
Supply current, ICCO – mA
Temperature, Ta – °C
VCC = 3.6V
VG = 6dB
RL = ∞

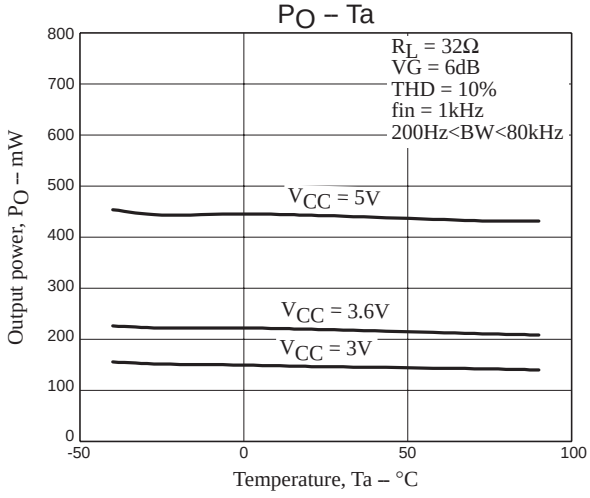

VNO – Ta
Noise voltage, VNO – µV
Temperature, Ta – °C
VCC = 3.6V
Rg = 0Ω
RL = 8Ω
VG = 6dB
20Hz<BW<20kHz

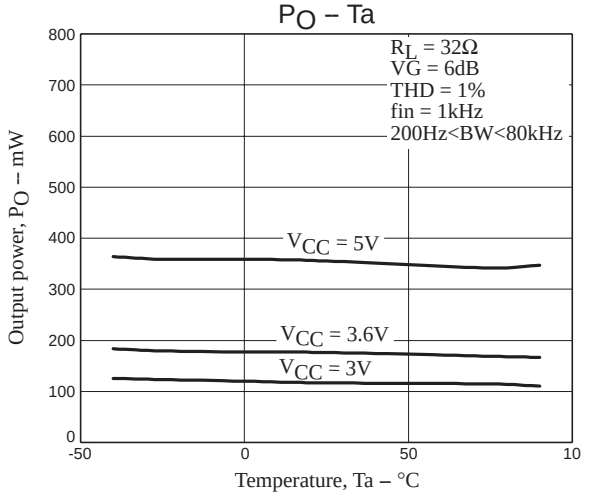

PO – Ta
Output power, PO – mW
Temperature, Ta – °C
RL = 8Ω
VG = 6dB
THD = 10%
fin = 1kHz
200Hz<BW<80kHz
VCC = 5V
VCC = 4V
VCC = 3.6V
VCC = 3V


PO – Ta
Output power, PO – mW
Temperature, Ta – °C
RL = 8Ω
VG = 6dB
THD = 1%
fin = 1kHz
200Hz<BW<80kHz
VCC = 5V
VCC = 4V
VCC = 3.6V
VCC = 3V


PO – Ta
Output power, PO – mW
Temperature, Ta – °C
RL = 16Ω
VG = 6dB
THD = 10%
fin = 1kHz
200Hz<BW<80kHz
VCC = 5V
VCC = 3.6V
VCC = 3V


PO – Ta
Output power, PO – mW
Temperature, Ta – °C
RL = 16Ω
VG = 6dB
THD = 1%
fin = 1kHz
200Hz<BW<80kHz
VCC = 5V
VCC = 3.6V
VCC = 3V

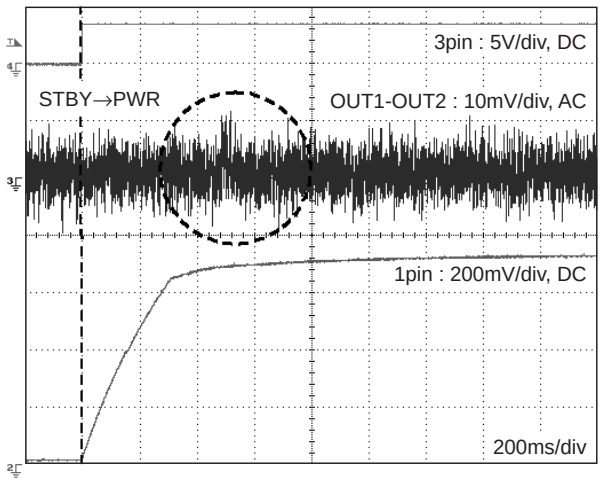

PO – Ta
Output power, PO – mW
Temperature, Ta – °C
RL = 32Ω
VG = 6dB
THD = 10%
fin = 1kHz
200Hz<BW<80kHz
VCC = 5V
VCC = 3.6V
VCC = 3V


PO – Ta
Output power, PO – mW
Temperature, Ta – °C
RL = 32Ω
VG = 6dB
THD = 1%
fin = 1kHz
200Hz<BW<80kHz
VCC = 5V
VCC = 3.6V
VCC = 3V

LV4991TH

Pop sound

1. Startup



2. Fall