Ordering number : ENA1834D

SANYO Semiconductors

DATA SHEET

An ON Semiconductor Company

LV4993TH

Bi-CMOS IC

For Portable Audio Equipment

Monaural BTL Power Amplifier

Overview

LV4993TH built-in the power amplifier circuit operable at low voltage (1.8V or more) and has additionally the standby function to reduce the current drain. It is power amplifier IC optimal for speaker drive used in battery-driven portable equipment and the low output power system equipment.

Application

IC recorder, Portable-TV, Radio, Portable-NAVI, LCD-monitor, Digital-photo-frame, and etc.

Function and Feature

- Monaural BTL power amplifier built-in
  - Standard output power 1 = 1.5W (V_{CC} = 5V, R_L = 8Ω, THD = 10%)
  - Standard output power 2 = 0.5W (V_{CC} = 3V, R_L = 8Ω, THD = 10%)
  - Output coupling capacitor not necessary because of differential output type
- Operation at low voltage possible (Operate with two dry battery cells)
  - V_{CC} = 1.8V or more
- Standby function built-in
  - Standard current drain at standby = 0.02μA (V_{CC} = 5V)
- Second amplifier stop control function built-in: For BTL/SE mode switching, and signal muting at BTL mode.
- Overheat protection circuit built-in
- Gain setting possible
  - BTL voltage gain = 0 to 26dB
- Output phase compensation capacitor not necessary

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	PCB mounted*	0.85	W
Maximum junction temperature	Tj max		150	°C
Operating temperature	Topr		-40 to +85	°C
Storage temperature	Tstg		-40 to +150	°C

* PCB mounted : with 40mm × 40mm × 1.6mm, double-sided glass epoxy circuit board

Operating Conditions at Ta = 25°C

Parameter	Symbol	Conditions	Ratings	Unit
Recommended supply voltage	V_{CC}		5	V
Recommended load resistance	R_L		4 to 32	Ω
Allowable operating supply voltage range1	V_{CC} op1	RL=8 to 32Ω, Ta=-10 to 85°C	* 1.8 to 5.5	V
Allowable operating supply voltage range2	V_{CC} op2	RL=8 to 32Ω, Ta=-40 to 85°C	2.0 to 5.5	V
Allowable operating supply voltage range3	V_{CC} op3	RL=4 to 7Ω, Ta=-10 to 85°C	2.0 to 4.0	V
Allowable operating supply voltage range4	V_{CC} op4	RL=4 to 7Ω, Ta=-40 to 85°C	2.2 to 4.0	V

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

* It is assumed the operation guarantee from V_{CC}=1.8V to 2.0V.

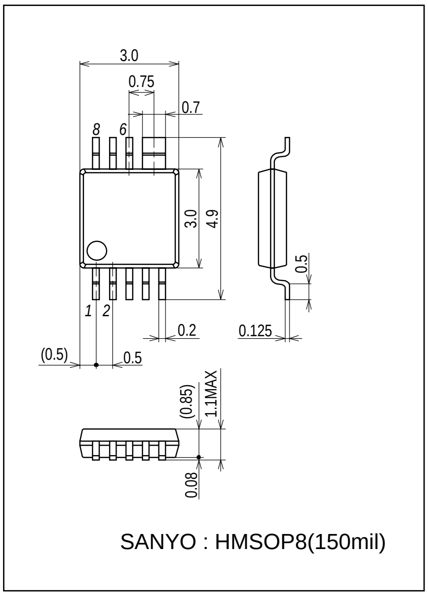
Electrical Characteristics Ta = 25°C, V_{CC} = 5V, fin = 1kHz, R_L = 8Ω, V3=1.6V

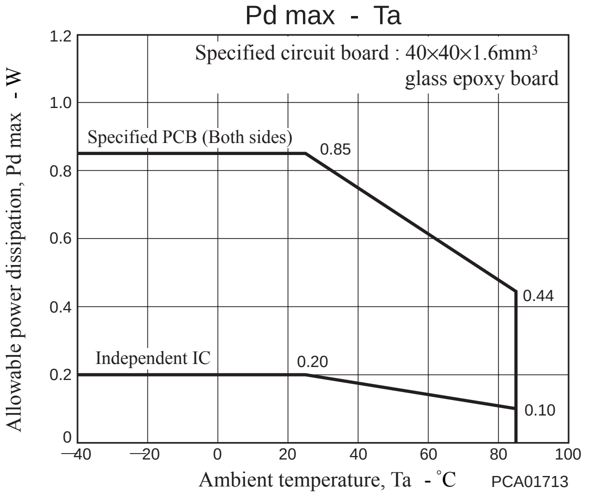
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Quiescent current drain	$I_{CCO}P$	No signal, $R_L = \infty$		3.6	6	mA
Stand-by current drain	I_{STBY}	No signal, $R_L = \infty$, V3 = 0.3V		0.02	5	μA
Maximum output power 1	P_OMX1	THD = 10%	1.0	1.5		W
Maximum output power 2	P_OMX2	THD = 10%, V_{CC} = 3V		0.5		W
Voltage gain	VG	V_{IN} = -10dBV	4.4	5.9	7.4	dB
Voltage gain use range	VGR		0		26	dB
Total harmonic distortion	THD	V_{IN} = -10dBV		0.3	1	%
Output noise voltage	V_NOUT	Rg = 620Ω, 20 to 20kHz		35	100	μVrms
MUTE attenuation level 1	MUTE1	V_{IN} = 0dBV, V3=0.3V(at standby)		-105	-90	dBV
MUTE attenuation level 2	MUTE2	V_{IN} = 0dBV, V2=0.3V (at Second power amplifier stop)		-105	-90	dBV
Ripple rejection ratio	SVRR	Rg = 620Ω, fr = 100Hz, Vr = -20dBV		50		dB
Output offset voltage	V_OS	Rg = 620Ω	-30		30	mV
Reference (pin 1) voltage	VREF			0.5V_{CC}		V
Pin 3 control HIGH voltage	VSTBH	Power amplifier operation mode	1.6		3	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 (BTL mode)	1.6		V_{CC}	V
Pin 2 control LOW voltage	VCNTL	Second power amplifier standby mode (SE mode)	0		0.3	V

Package Dimensions

unit : mm (typ)

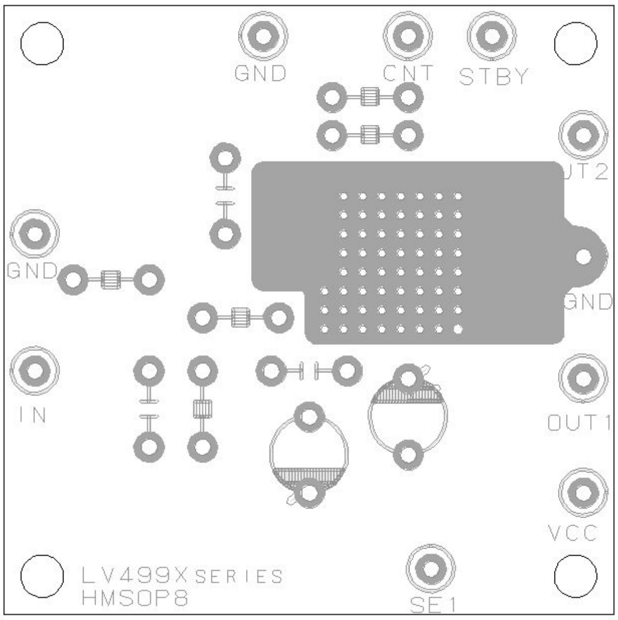
3339



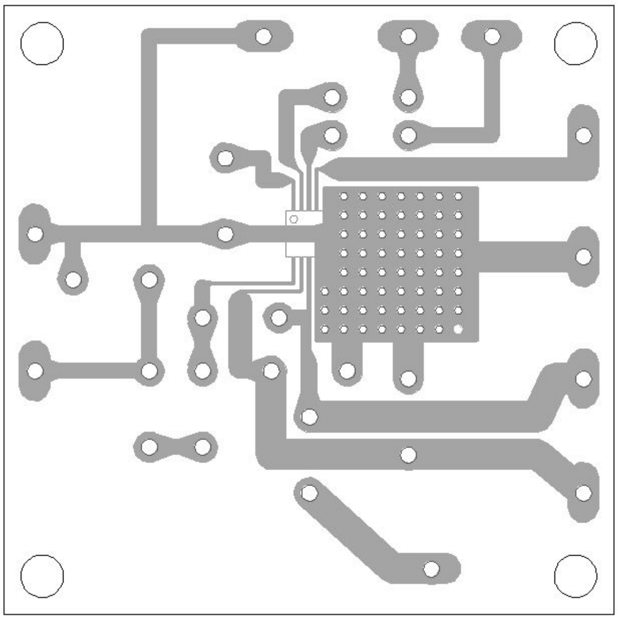


Evaluation board

Size : 40mm×40mm×1.6mm

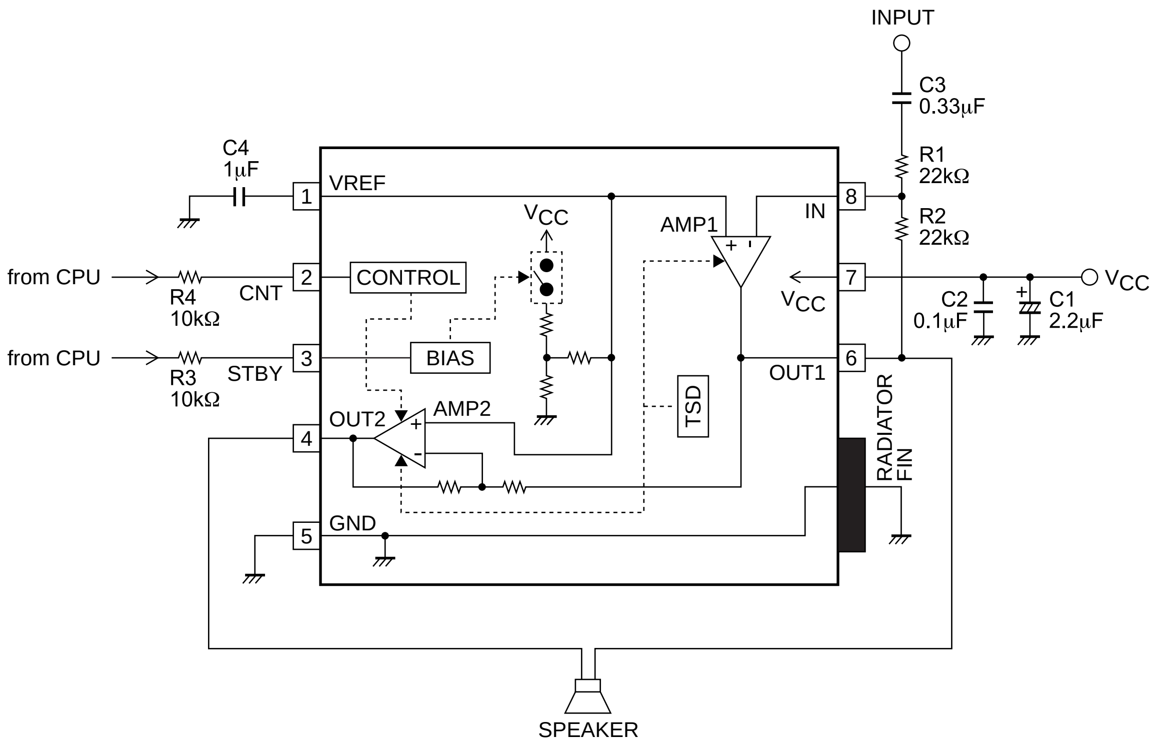


Top Layer (Top view)

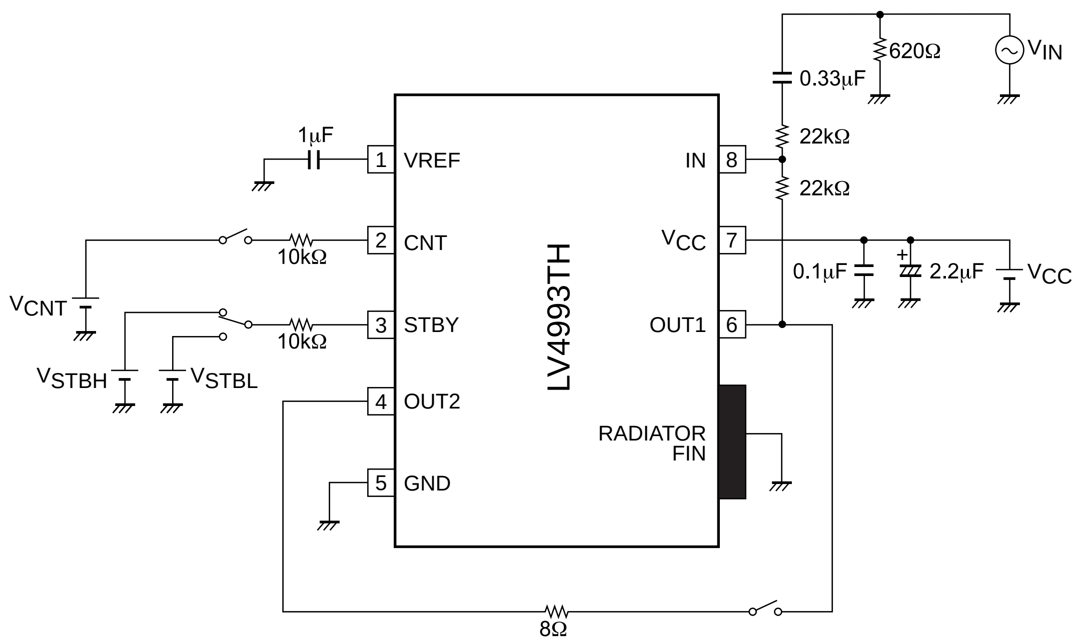


Bottom Layer (Top view)

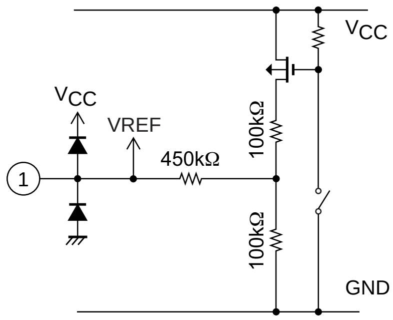
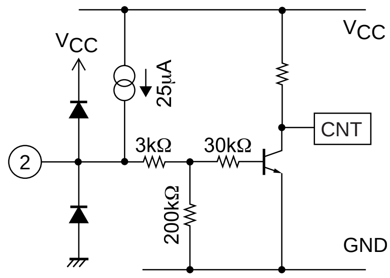
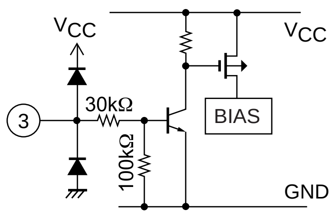
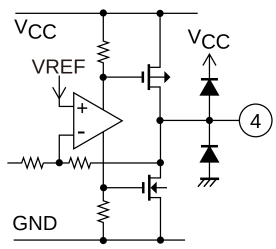
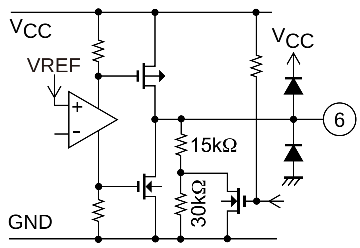
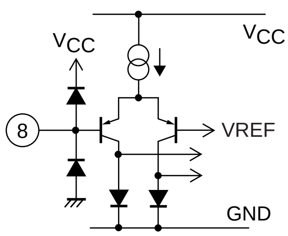
Block Diagram and Sample Application Circuit



Test Circuit



Pin Description

Pin No.	Symbol	Pin voltage V_{CC} = 5V	Description	Equivalent circuit
1	VREF	2.5	Standard voltage pin	
2	CNT	1.4	Second amplifier stop control pin •When OPEN : BTL mode •When external is impressed BTL mode at 1.6V to V_{CC} SE mode at 0 to o.3V	
3	STBY	External impression	Standby control pin •Standby mode at 0 to 0.3V •Operation mode at 1.6 to 3V	
4	OUT2	2.5	Second output pin	
5	GND	0	Ground pin	-
6	OUT1	2.5	First output pin	
7	V_{CC}	External impression	Power pin	-
8	IN	2.5	Input pin	

Cautions for use

1. Input coupling capacitor (C3)
   C3 is an input coupling capacitor, and it has aimed at the DC cutting. However, please set it in consideration of the cutoff frequency when you decide the capacitance value so that the high-pass filter may be composed by this capacitor (C3) and input resistance (R1), and the bass frequency signal may attenuate.
   The cutoff frequency is shown by the next formula.

$$fc = \frac{1}{2\pi * C3 * R1}$$

   Moreover, this capacitor influences a pop noise at start-up. Please note it enough so that the charging time to the capacitor may become long when the value is enlarged, and the pop noise level may grow.

2. BTL voltage gain
   The voltage gain of the first amplifier is decided depending on the ratio of resistance R1 and R2.
   Vg=20 * log(R2/R1) (dB)
   Therefore, the BTL voltage gain:
   VgBTL=6+20 * log(R1/R2) (dB)
   It is shown by the above-mentioned calculating formula. Please set the BTL voltage gain within the range from 0 to 26dB.

3. Pin 1 capacitor (C4)
   C4 is a capacitor for the ripple filter. It is a purpose to compose the low-pass filter of internal resistance (100kΩ+450kΩ) and C4, to reduce the power supply ripple element, and to improve the ripple elimination factor.
   Please operate the automatic pop noise reduction circuit by using the standing up transition response characteristic of one pin voltage (standard voltage), and design in IC in consideration of a pop noise at the time of start-up growing when the C3 capacity value is reduced to hasten the start-up speed.

4. Capacitor for power supply line (C1, C2)
   Bypass capacitor (C2) has aimed at the high frequency aphaeresis that cannot be removed with the power supply capacitor (C1: Chemical capacitor). This capacity must arrange as much as possible near IC, and use the ceramic capacitor with good high-frequency property.
   It is also possible to bring it together in the ceramic capacitor of one 2.2μF when a steady power supply is used. Please enlarge the capacity value of power supply capacitor (C1) when the power supply line is comparatively unstable.

5. Standby pin (pin 3)
   By controlling the standby pin, the mode changeover can be made between standby and operation modes. The series resistance (R3:1kΩ or more) is recommended to be inserted might receive the influence of a digital noise from CPU though it is possible to control with the output port of CPU directly.
   Standby mode ⇒ V2 = 0 to 0.3V
   Operation mode ⇒ V2 = 1.6 to 3V
   Please suppress the impressed voltage to become a static test mode (heat protection circuit operation check mode) when 3V or more is impressed to 3rd pin within 3V. Moreover, it is also possible to synchronize with the power supply and to use the pin as shown in Figure 1 when the standby function is not used. Please set the value of series resistance (R3) so that 3rd pin voltage may become 3V or less.

   Current (I_3) that flows in 3rd pin can be calculated by the next formula.

$$I_3 = \frac{7*10^{-6}+(V_{CC}-0.7)}{R3+30000}$$

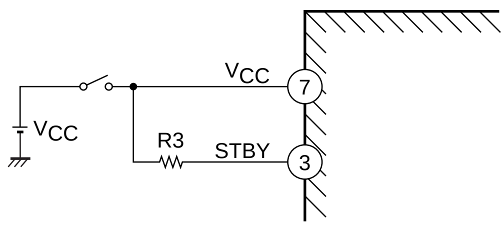


Fig. 1

6. Pin 2 control (second amplifier stop control function)
Pin 2 are pin that control ON/OFF as for the movement of the second amplifier of the BTL amplifier. The switch of the speaker drive (BTL output method) and the earphone drive (shingle end output method) can operate by using this function. Moreover, it is possible to use it as a voice mute function in the BTL output method.

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

Make it to the opening when this function is not used.

7. Load capacitance
The phase margin degree of the power amplifier might decrease by the influence of this capacitor when the capacitor is connected by the purpose of the anti-electric wave radiation measures etc. between output pins GND and the oscillation be caused. Note the capacity value when you add this capacitor.
Recommended capacity value: 100pF or less or 1000pF to 1μF

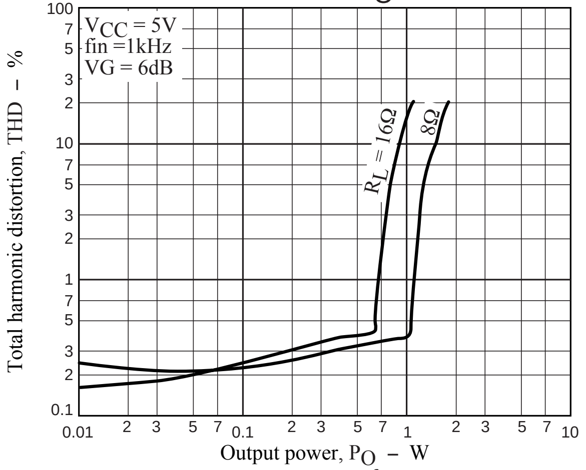
8. Thermal protector circuit
The thermal protector circuit is built into in IC, and when heat is abnormally generated because of some causes, the risk of destruction/deterioration can be reduced. The protection circuit operates when junction temperature (Tj) of the chip in IC rises to about 165℃, the current supply source to the power amplifier is intercepted, and the signal is not output. It returns automatically if the temperature of the chip decreases (about 140℃). This circuit must note handling enough because it is able surely not to prevent destruction/deterioration. Turn off power promptly when you abnormally generate heat, and pinpoint the cause.

9. 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.

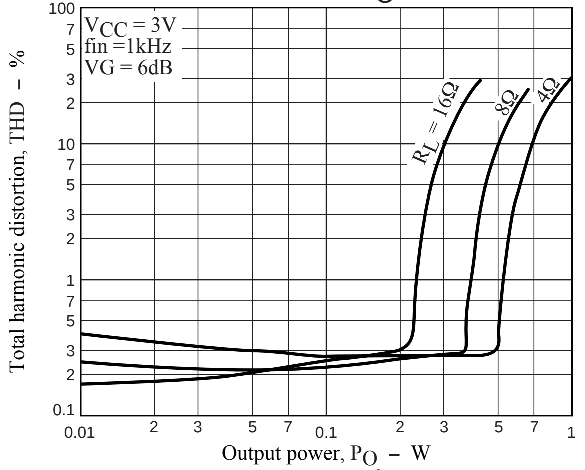
10. Short-circuit of load
If the load is left short-circuited for a long period of time, deterioration or damage may occur.
Never allow the load to short-circuit.

11. 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.

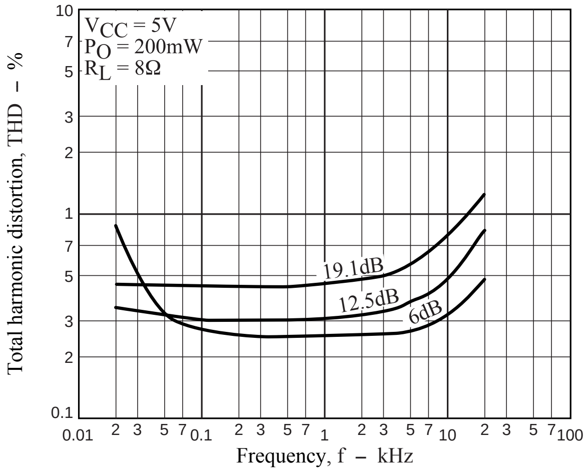
THD – P_O



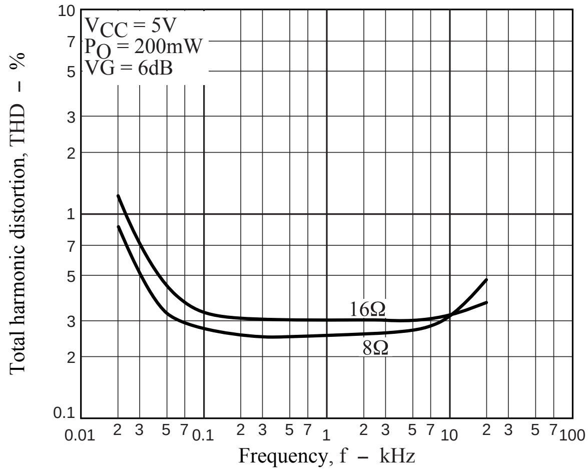
THD – P_O



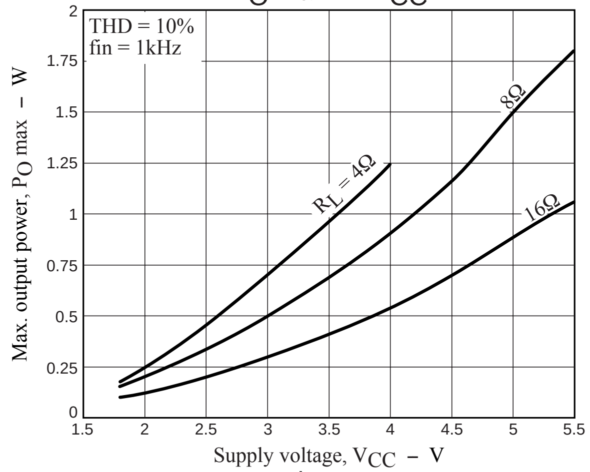
THD – f



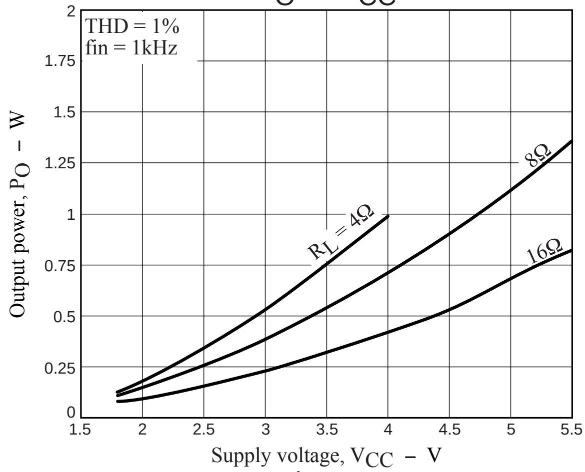
THD – f



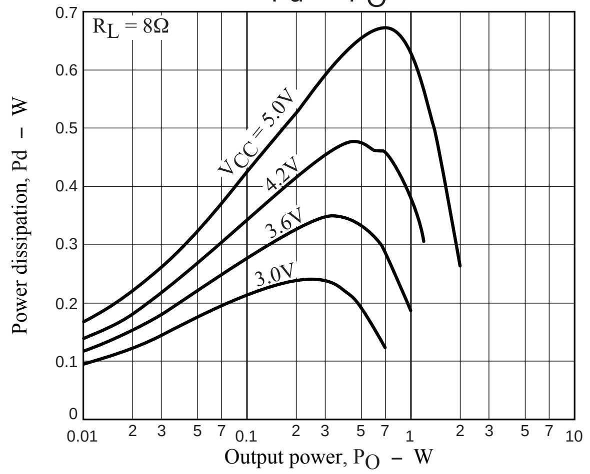
P_O max – V_{CC}



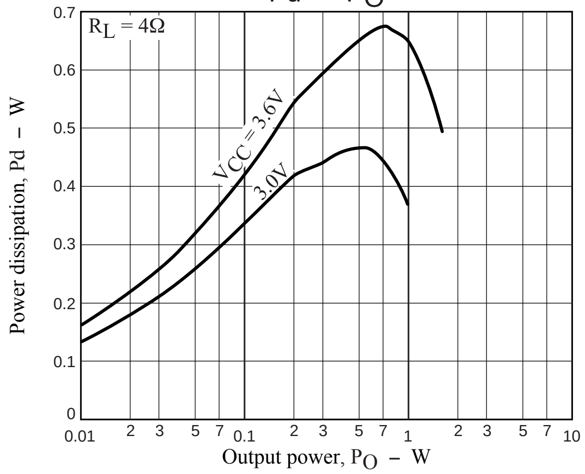
P_O – V_{CC}



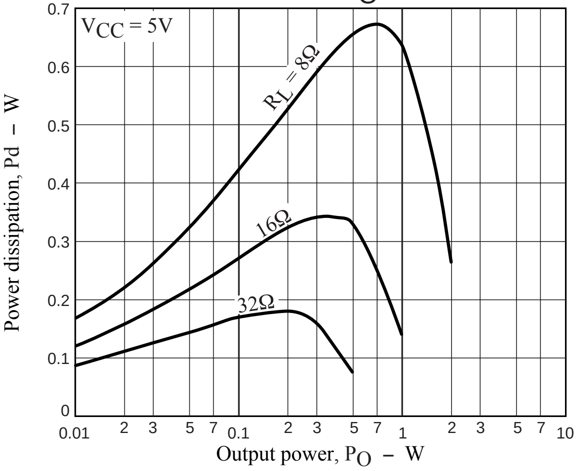
Pd – P_O



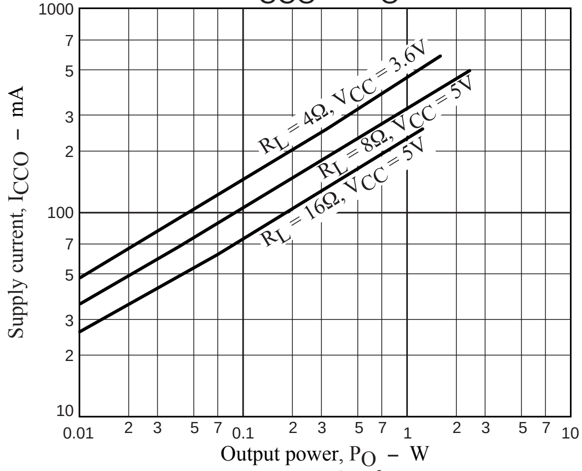
Pd – P_O



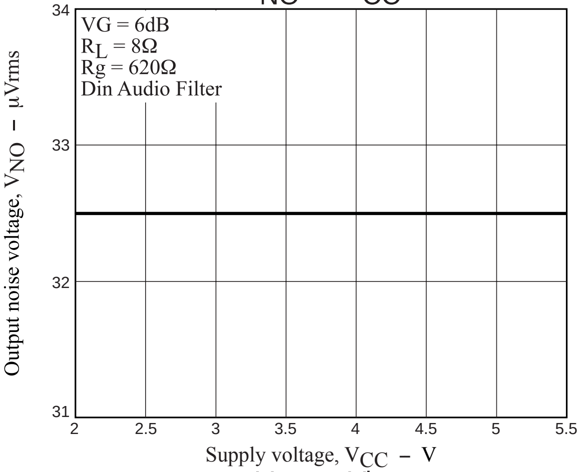
Pd – PO



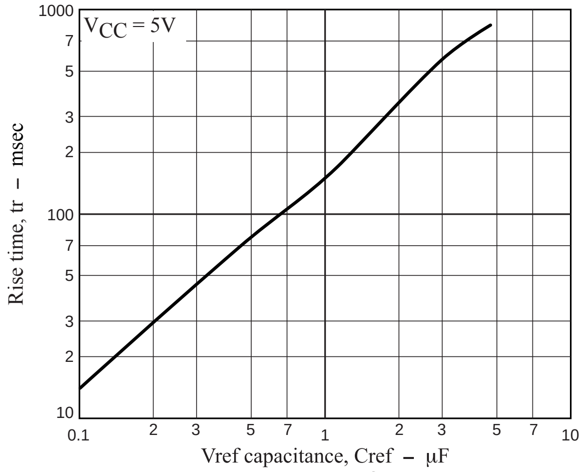
ICCO – PO



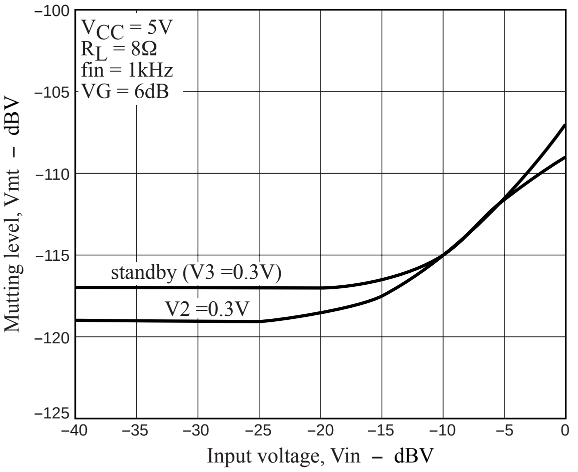
VNO – VCC



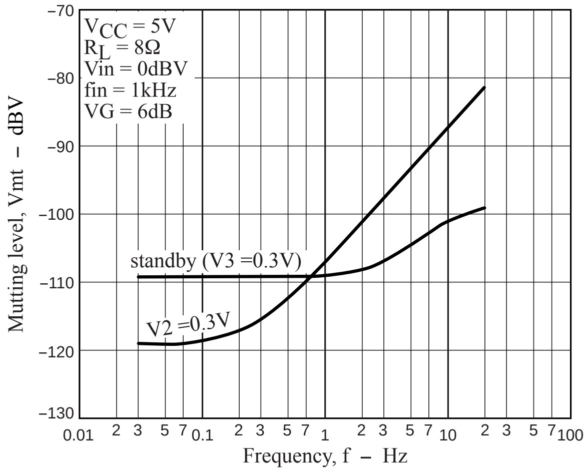
tr – Cref



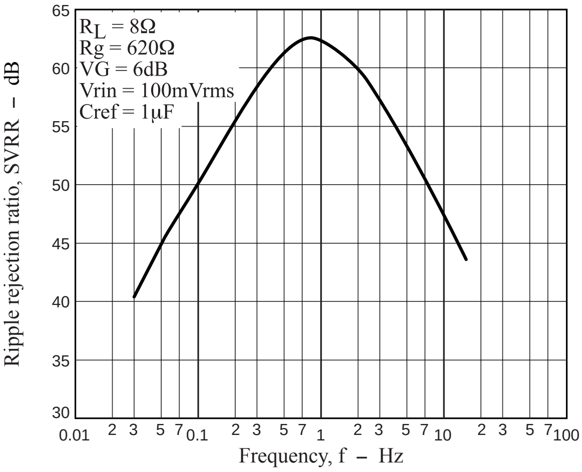
Vmt – Vin



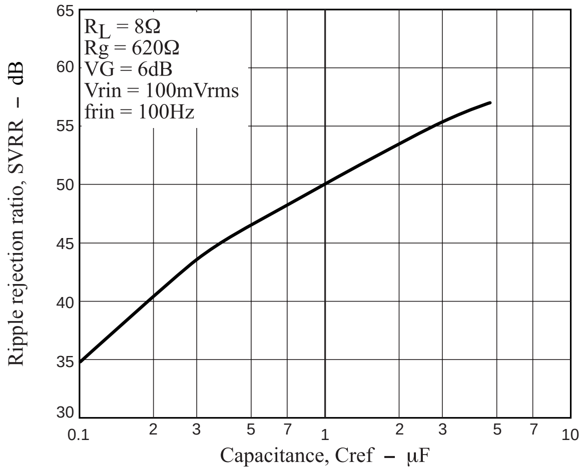
Vmt – f



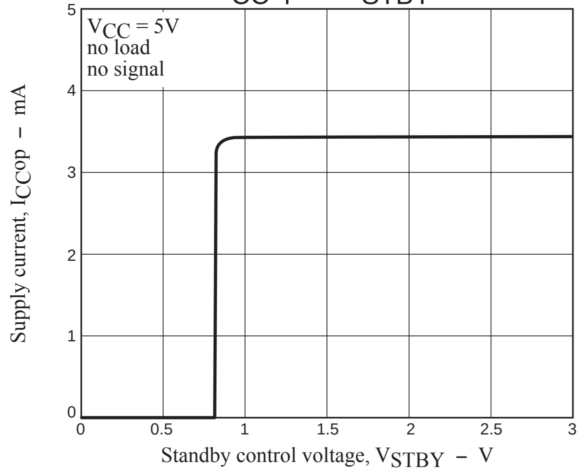
SVRR – f



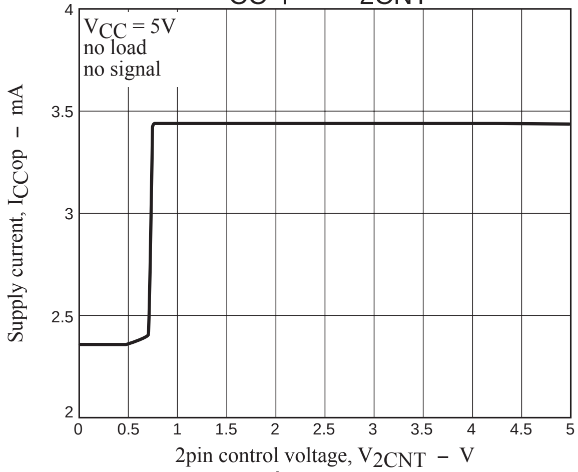
SVRR – Cref



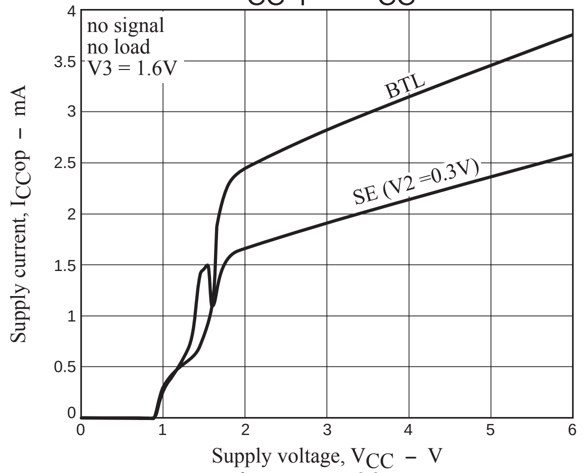
$I_{CC}op$ – V_{STBY}



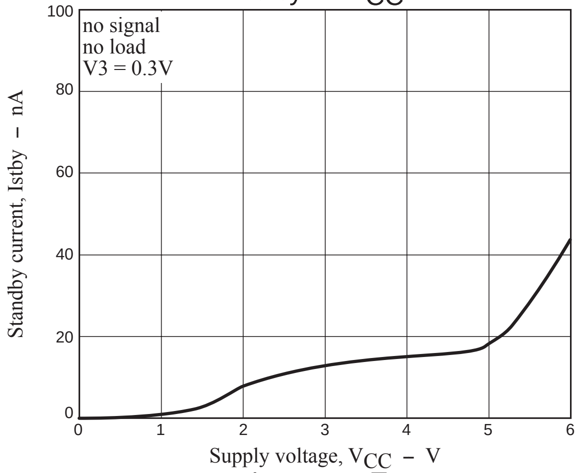
$I_{CC}op$ – V_{2CNT}



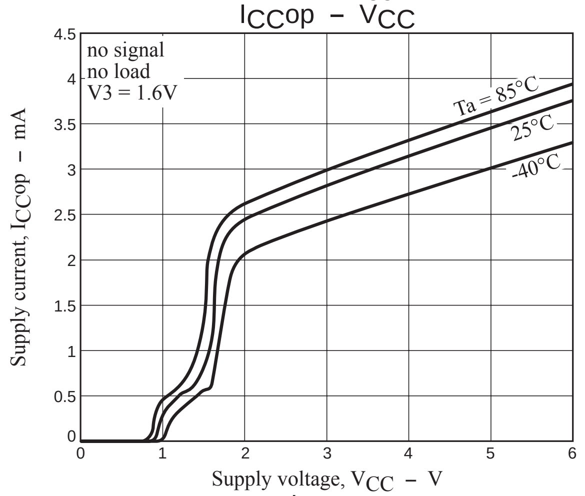
$I_{CC}op$ – V_{CC}



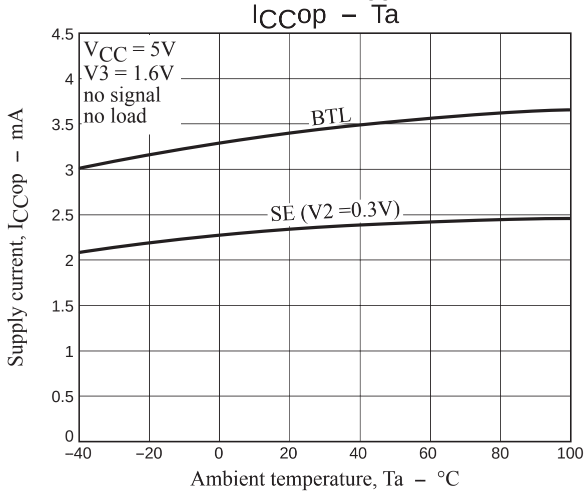
Istby – V_{CC}



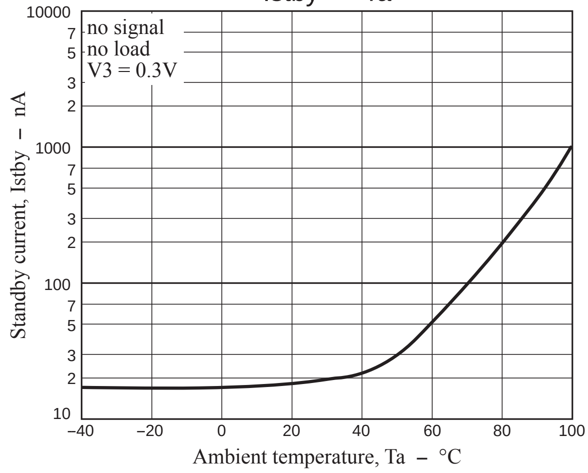
$I_{CC}op$ – V_{CC}



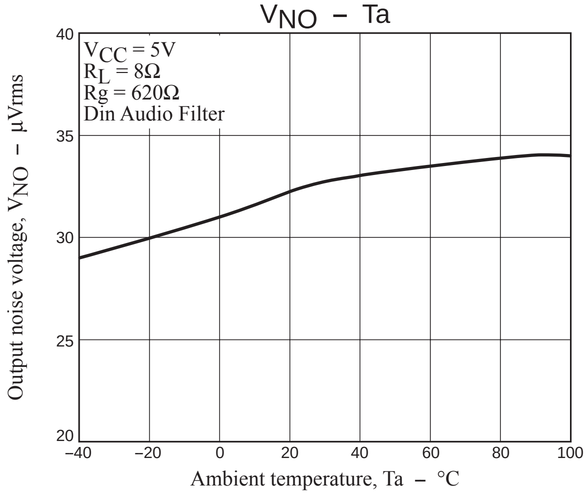
$I_{CC}op$ – Ta

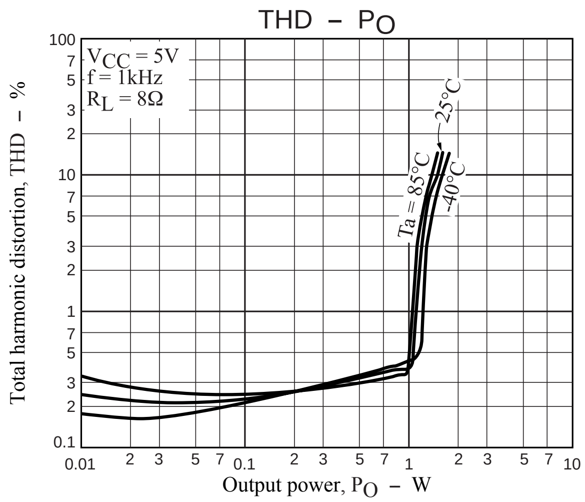


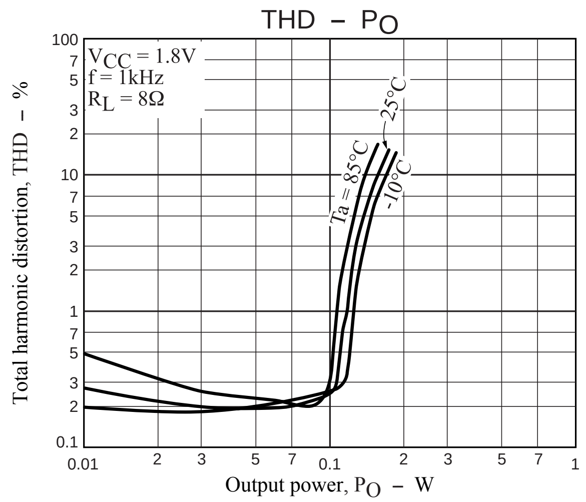
Istby – Ta

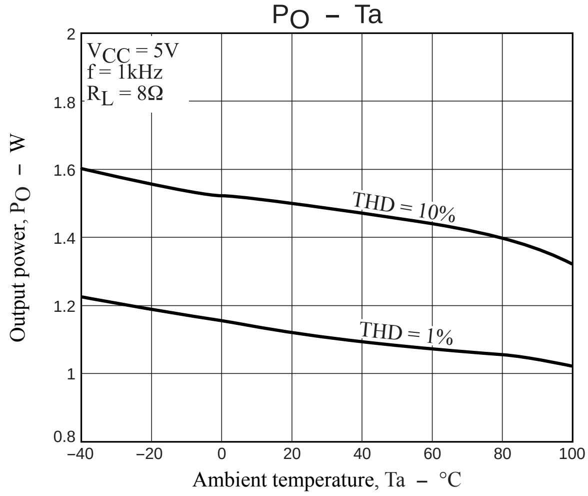


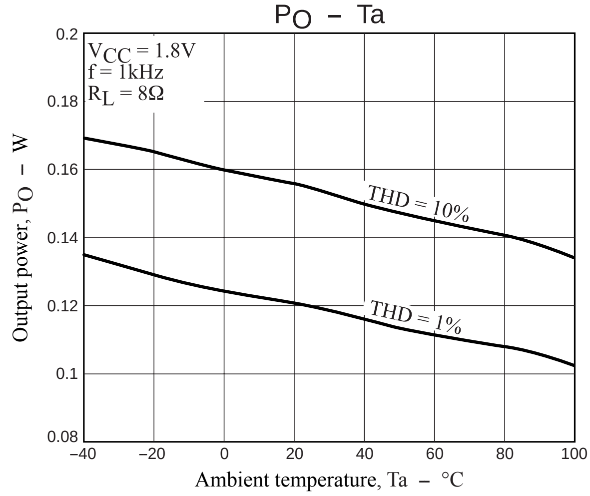
V_{NO} – Ta

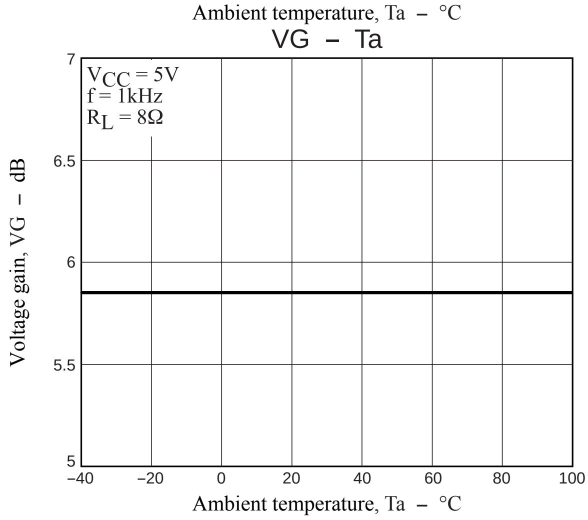


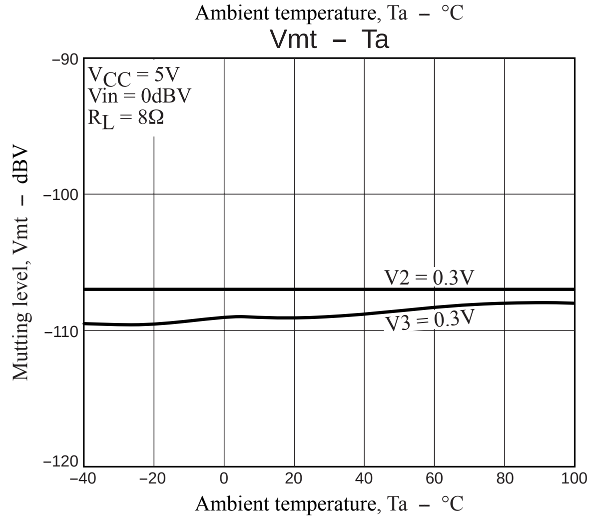

THD – PO
VCC = 5V
f = 1kHz
RL = 8Ω
Ta = 85°C
25°C
-40°C
Total harmonic distortion, THD – %
Output power, PO – W


THD – PO
VCC = 1.8V
f = 1kHz
RL = 8Ω
Ta = 85°C
25°C
-10°C
Total harmonic distortion, THD – %
Output power, PO – W


PO – Ta
VCC = 5V
f = 1kHz
RL = 8Ω
THD = 10%
THD = 1%
Output power, PO – W
Ambient temperature, Ta – °C

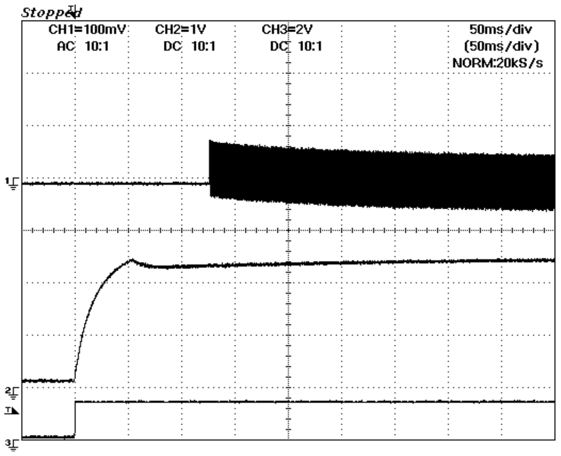

PO – Ta
VCC = 1.8V
f = 1kHz
RL = 8Ω
THD = 10%
THD = 1%
Output power, PO – W
Ambient temperature, Ta – °C


VG – Ta
VCC = 5V
f = 1kHz
RL = 8Ω
Voltage gain, VG – dB
Ambient temperature, Ta – °C

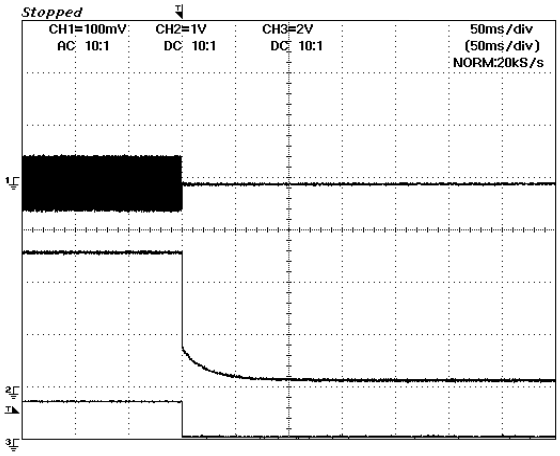

Vmt – Ta
VCC = 5V
Vin = 0dBV
RL = 8Ω
V2 = 0.3V
V3 = 0.3V
Muting level, Vmt – dBV
Ambient temperature, Ta – °C

Transient response characteristics
V_{CC} = 5V, R_L = 8Ω, VG = 6dB, Cref = 1μF, Cin = 0.33μF

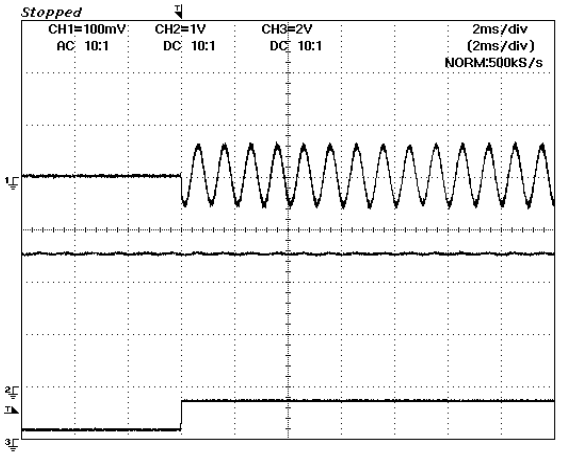
Rising Transient response characteristics
CH1:Load end [100mV/div]
CH2:6pin (OUT1) [1V/div]
CH3:3pin (STBY) [2V/div]
Time axis:50msec/div



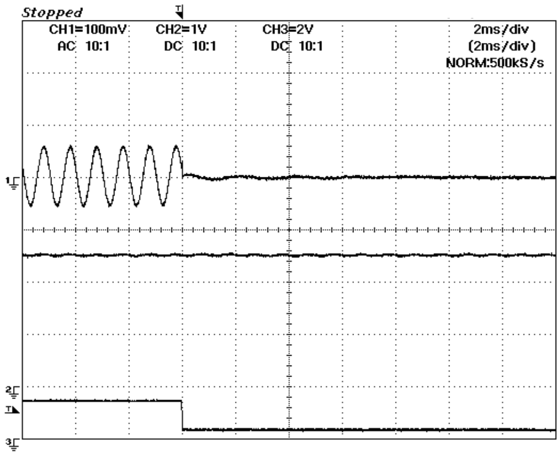
Falling Transient response characteristics
CH1:Load end [100mV/div]
CH2:6pin (OUT1) [1V/div]
CH3:3pin (STBY) [2V/div]
Time axis:50msec/div



Mute release Transient response characteristics (ON→OFF)
CH1:Load end [100mV/div]
CH2:6pin (OUT1) [1V/div]
CH3:2pin (CNT) [2V/div]
Time axis:2msec/div



Mute Transient response characteristics (OFF→ON)
CH1:Load end [100mV/div]
CH2:6pin (OUT1) [1V/div]
CH3:2pin (CNT) [2V/div]
Time axis:2msec/div



This catalog provides information as of June, 2011. Specifications and information herein are subject to change without notice.