Ordering number: EN4335A

Monolithic Linear IC

LA4800V

3 V Stereo Headphone Power Amplifier

Overview

The LA4800V is a headphone stereo power amplifier IC that features a high signal-to-noise ratio, high ripple rejection, low distortion and low current consumption, making it ideal for portable CD players.

Functions

- Headphone stereo power amplifier
- Beep tone
- Power switch
- Power mute switch

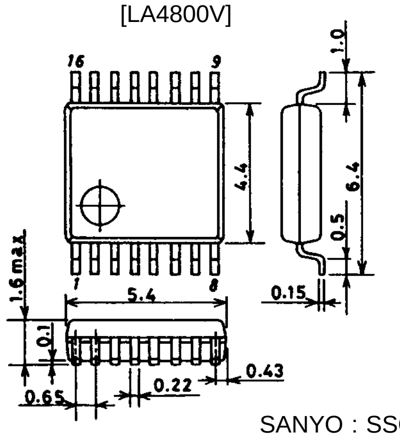
Features

- 96 dB (typ) high S/N ratio at 7 µV
- 76 dB (typ) high ripple rejection
- 0.07% (typ) low distortion with R_L = 16 Ω
- 6.2 mA (typ) low current consumption
- Outputs do not require electrolytic capacitors.
- Available in 16-pin SSOPs

Package Dimensions

unit : mm

3178-SSOP16



Specifications

Maximum Ratings at Ta = 25°C

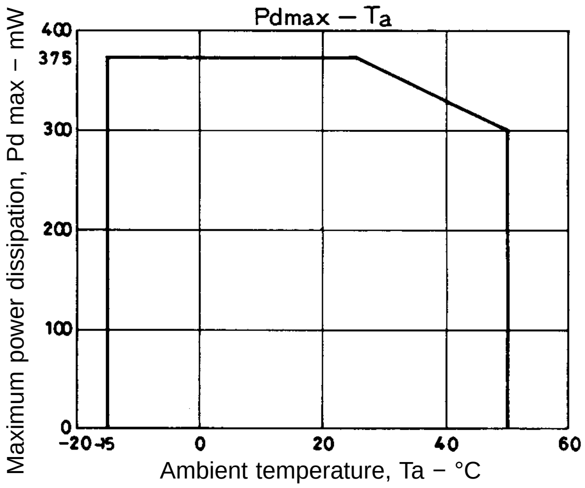
Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{CC} max		4.5	V
Power dissipation	Pd max		375	mW
Operating temperature range	Topr		–15 to 50	°C
Storage temperature range	Tstg		–40 to 150	°C

Recommended Operating Ranges at Ta = 25°C

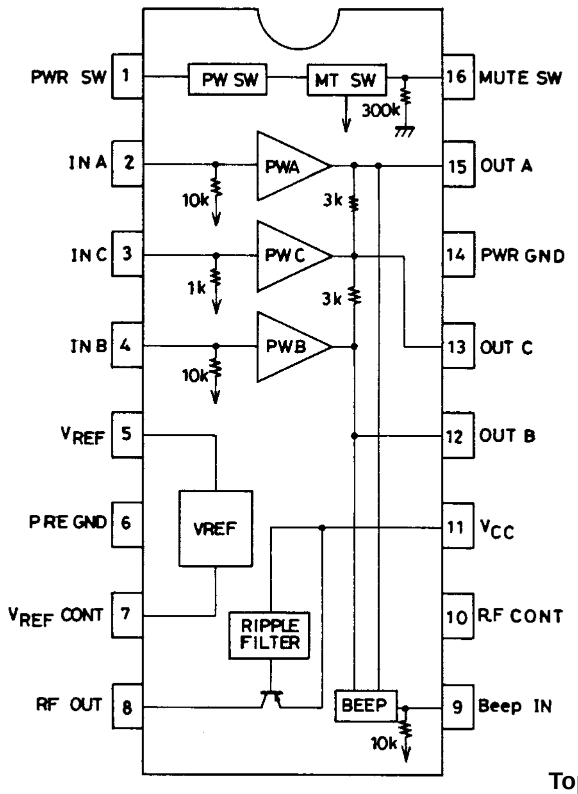
Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	V_{CC}		3.0	V
Load resistance	R_L		16 to 32	Ω
Operating supply voltage range	V_{CC} op		1.8 to 3.6	V

Operating Characteristics at Ta = 25°C, V_{CC} = 2.5 V, R_L = 16 Ω, f = 1 kHz unless otherwise noted. Values in parentheses indicate V_{CC} = 3.0 V

Parameter	Symbol	Conditions	min	typ	max	Unit
Quiescent supply current	I_{CCO1}	IC OFF		0.05	1.0	µA
	I_{CCO2}	Mute ON		1.6 (1.65)	3.0	mA
	I_{CCO3}	No input signal		6.2 (6.8)	9.0	mA
Voltage gain	VG	V_O = –10 dBm	10.3	11.8	13.3	dB
Channel balance	V_{RL}	V_O = –10 dBm	–1	0	1	dB
Output power	P_O	V_{CC} = 3.0 V, THD = 10%	15	25		mW
Total harmonic distortion	THD	V_O = 0.35 V		0.075	0.2	%
Output noise voltage	V_{NO}	Rg = 1 kΩ, DIN AUDIO		7.8	15	µV
Crosstalk	CT	f = 1 kHz, TUN, V_O = –10 dBm	35	45		dB
Ripple rejection	R.R	V_{CC} = 1.7 V, f = 100 Hz, V_{CR} = –20 dBm, TUN = 100 Hz	65	76		dB
Mute attenuation	V_{OFF}	THD = 1%	–80	–96		dB
Beep tone output voltage	$V_{O\ BEEP}$	V_I = –13.5 dBm (sine wave)	1.5	3.0		mV
Output DC offset voltage	$V_{DC\ OFF}$	V_I = 0 V, Rg = 1 kΩ	–20	0	20	mV
Power ON current sensitivity	$I_{1\ ON}$	V_{CC} = 1.7 V, $V_5 \geqq$ 1.0 V		50	60	µA
Power OFF voltage sensitivity	$V_{1\ OFF}$	V_{CC} = 1.7 V, $V_5 \leqq$ 0.1 V	0.5	0.6		V
Mute OFF current sensitivity	$I_{16\ OFF}$	V_{CC} = 1.7 V, $V_5 \geqq$ 1.0 V		4.5	6.0	µA
Mute OFF voltage sensitivity	$V_{16\ OFF}$	V_{CC} = 1.7 V	1.0	1.25	1.5	V
Mute ON voltage sensitivity	$V_{16\ ON}$	V_{CC} = 1.7 V		0.9	1.0	V



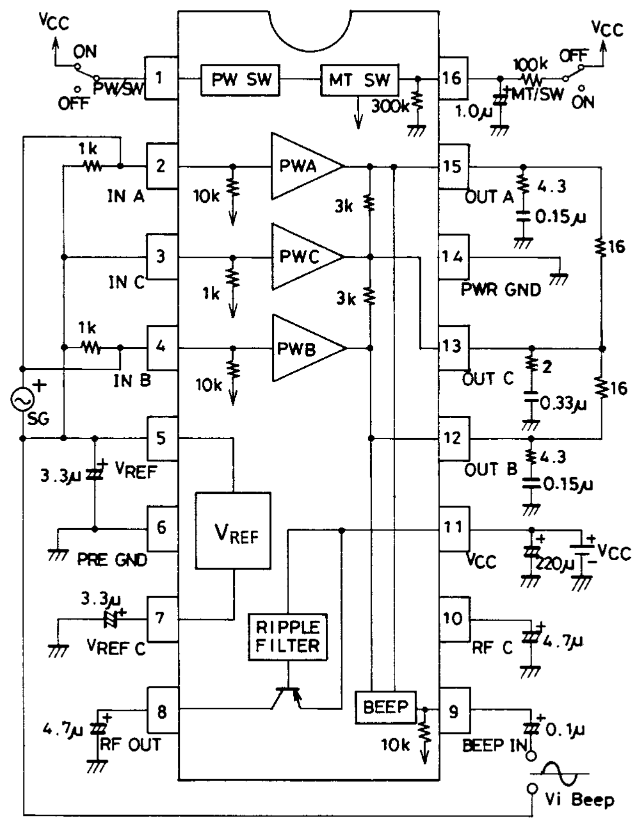
Pin Assignment and Block Diagram



Top view

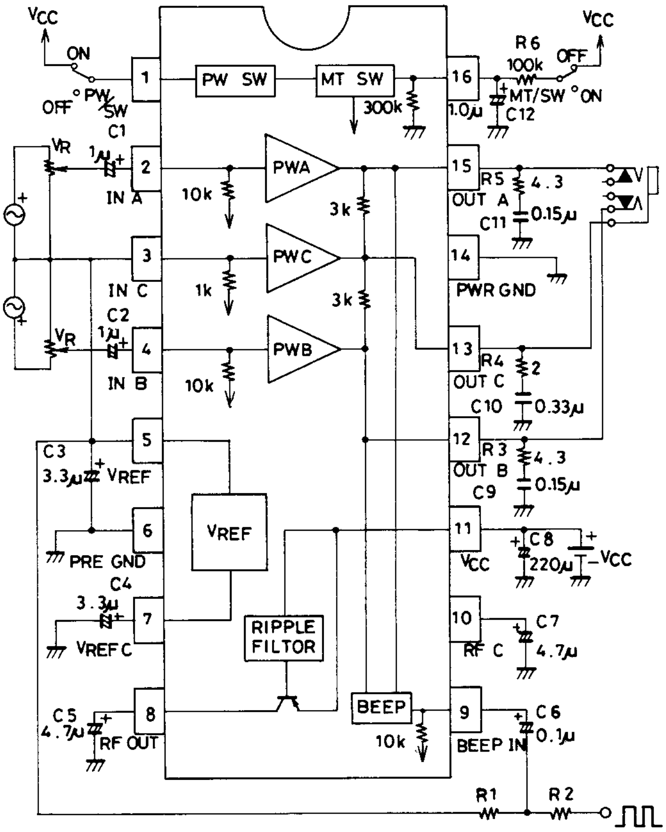
Unit (resistance: Ω)

Test Circuit



Unit (resistance: Ω, capacitance: F)

Sample Application Circuit



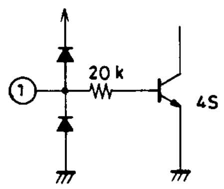
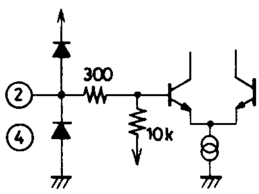
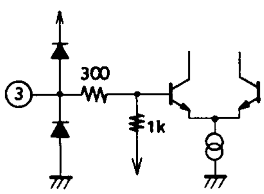
Signal from microcontroller

Unit (resistance: Ω, capacitance: F)

Pin Description

V_{CC} = 2.5 V

Unit (resistance: Ω)

Pin number	Pin name	V_{DC} (V)	Equivalent circuit	Pin description
1	PWR SW	0 to 0.7		Power switch Turns ON the power to the V_{CC} pin.
2	IN A	1.1		Power input pins 10 kΩ input resistance
4	IN B			
3	IN C	1.1		Power amplifier common input pin Usually connected to Vref

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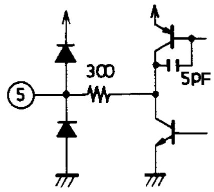
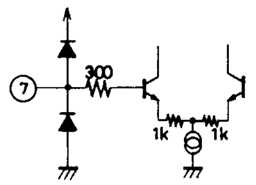
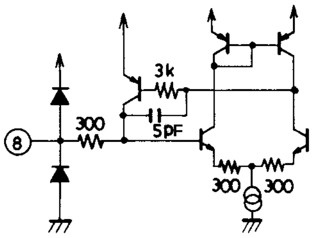
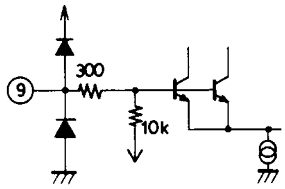
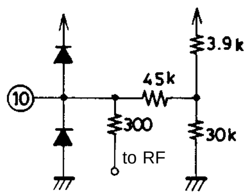
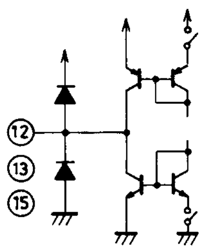
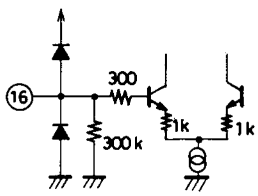
Unit (resistance: Ω)

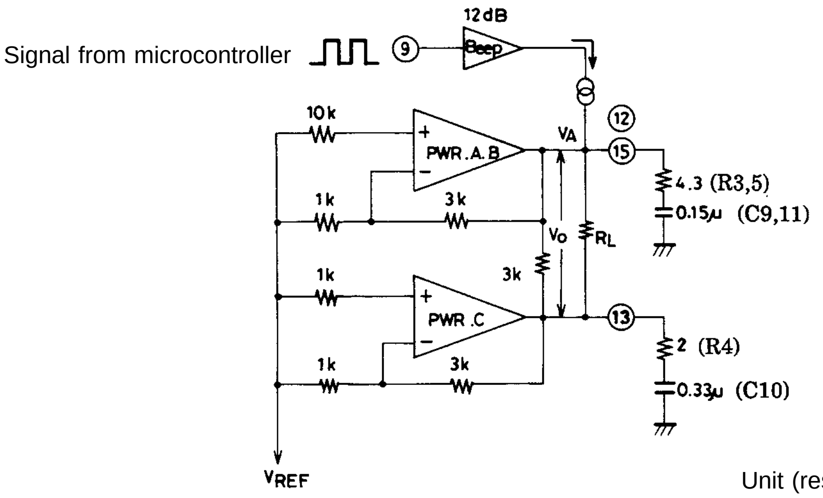
Pin number	Pin name	V_{DC} (V)	Equivalent circuit	Pin description
5	V_{REF}OUT	1.1		1.1 V fixed bias
6	PRE GND			Preamplifier ground
7	V_{REF}CONT	1.1		1.1 V reference control pin
8	RF OUT	2.2		Preset to approximately $V_{CC} \times 0.88$ V
9	Beep IN	1.1		Beep tone input pin Active only when mute is ON.
10	RF CONT	2.2		RF control pin
11	V_{CC}			Power supply
12 13 15	OUT B OUT C OUT A	1.1 1.1 1.1		Power output pins Pin 13 is the headphone center common drive. (No electrolytic capacitors required)
14	PWR GND			Power amplifier ground
16	MUTE SW	0 to 1.85		The mute pin is floating when ON, and tied to V_{CC} through a 100 kΩ when OFF.

External Components Description

Components	Recommended value	Description
C1, C2	1 to 4.7 µF	Input coupling capacitors
C3, C4	3.3 to 10 µF	Reference bias (V_{REF}) decoupling capacitors
C5, C4	4.7 to 10 µF	Ripple filter capacitors. Increasing the capacitance also increases the distortion and the supply rise time at turn ON.
C6	0.1 to 1 µF	Input coupling capacitor for the beep tone. Choose a value that does not attenuate the beep tone signal.
C8	220 µF	Supply line coupling capacitor
C9, C10, C11	0.22 to 0.47 µF	Oscillation damping capacitors. Film capacitors are recommended.
C12	0.1 to 1.0µF	Mute time setting capacitor. See the description in the Operating Notes.
R1, R2		Beep tone input signal adjustment resistors. Follow the manufactures instructions.
R3, R4, R5	0.5 to 4.3 Ω	Power amplifier oscillation damping resistors.
R6	100 kΩ	Mute OFF pin 16 bias setting resistor. The internal 300 kΩ resistor and this 100 kΩ resistor together set the mute switch (pin 16) threshold.

Operating Notes

Beep tone operating principle



Unit (resistance: Ω, capacitance: F)

The design of the above when mute is ON (pin 16 open) is as follows:

The output voltage V_O as function of R_L is

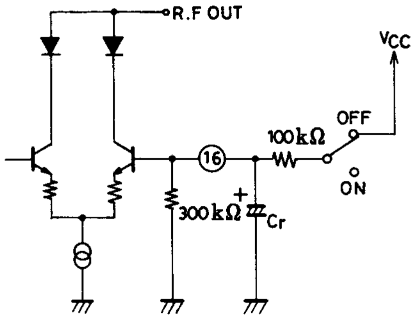
$$V_O = \frac{R_L}{R_L + 3k + 1k} \times V_A$$

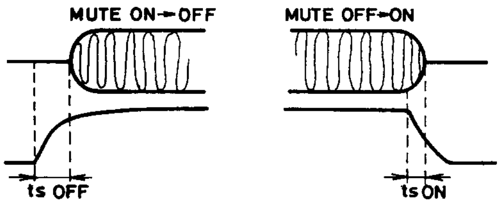
For example, if R_L = 16 Ω and V_A = 0.5 V (V_A is the adjusted input voltage on pin 9),

$$V_O = \frac{16\Omega}{16\Omega + 3k + 1k} \times 0.5 \cong 2 \text{ mV}$$

The beep tone output voltage V_O is determined by the above equation. However, the oscillation damping RC components are connected to the PWR output and hence these RC components will also influence the actual value of V_O. When using the beep tone, the impedance of C10, connected to the common output (pin 13), must be greater than the impedance of C9 and C11, i.e. C10 must be greater than C9 and C11.

Mute time adjustment

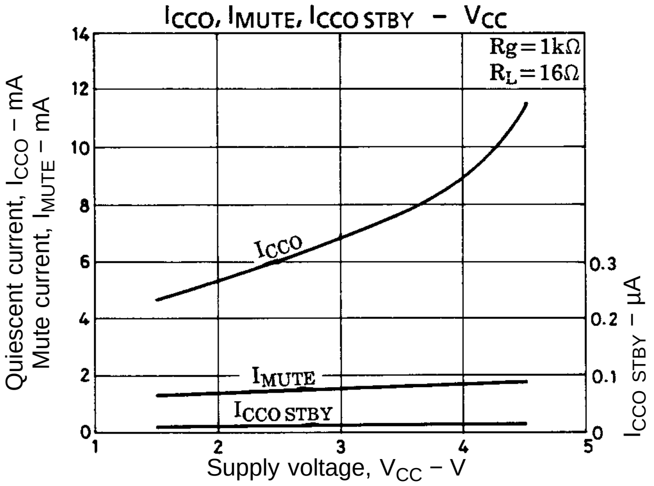


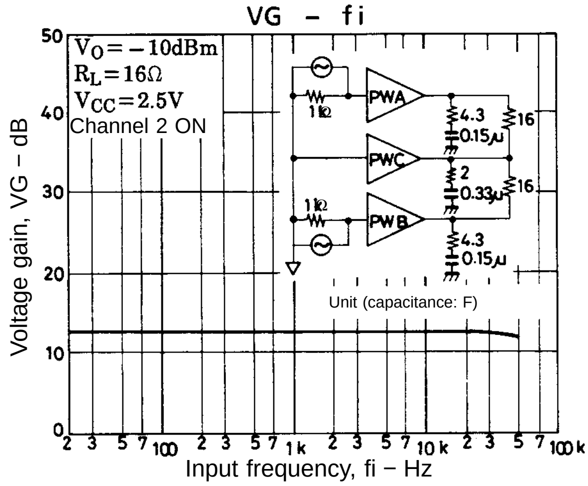


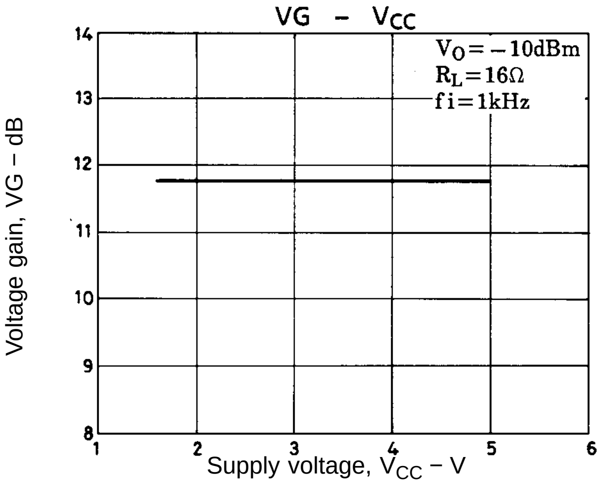
The mute ON/OFF switching waveforms are shown in the figure above. The settling time t_S is determined by the capacitor C_r connected to pin 16. The recommended value of C_r is 1 µF. If the value used is less than 1 µF, pop noise will increase.

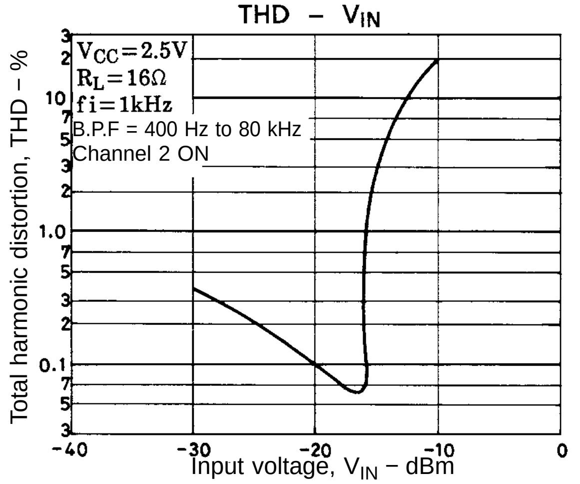
The setting time for different values of C_r are shown in the table below.

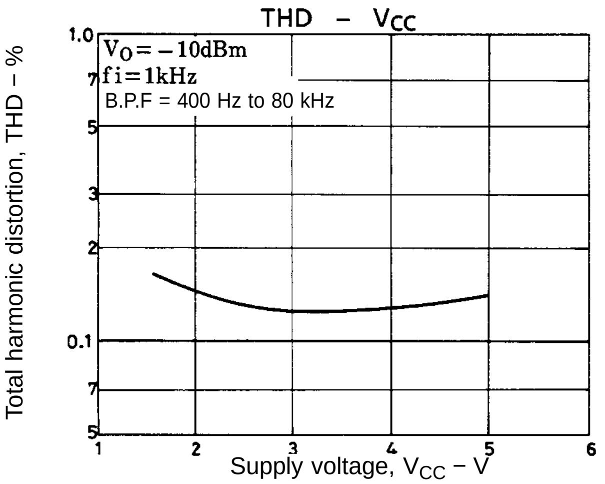
C_r (µF)	$t_{S\ OFF}$(ms)	$t_{S\ ON}$ (ms)
0.1	15	3.2
1.0	150	30
2.2	300	56

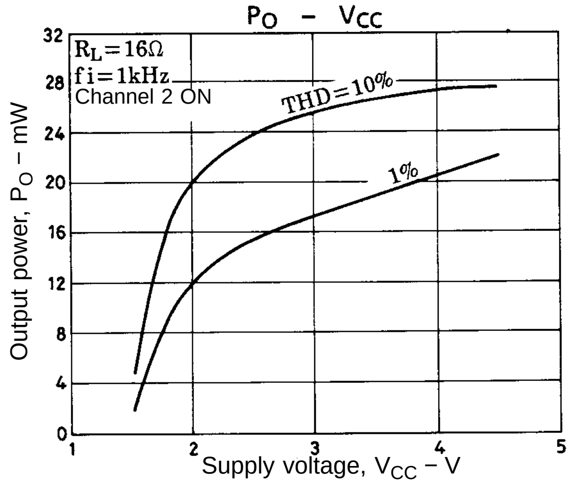

ICCO, IMUTE, ICCO STBY – VCC
Rg=1kΩ
RL=16Ω
ICCO
IMUTE
ICCO STBY
Quiescent current, ICCO – mA
Mute current, IMUTE – mA
ICCO STBY – µA
Supply voltage, VCC – V

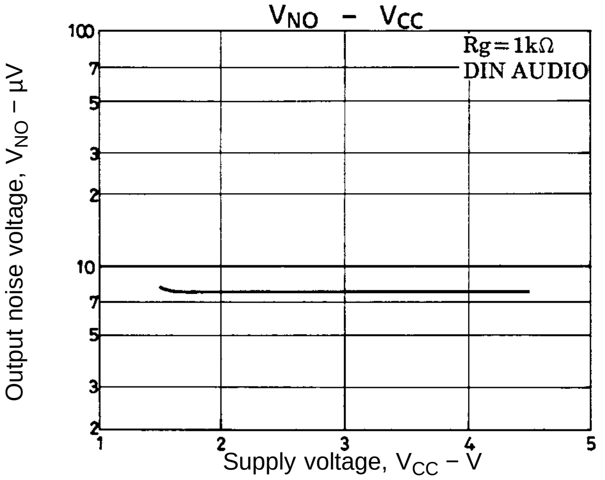

VG – fi
VO=–10dBm
RL=16Ω
VCC=2.5V
Channel 2 ON
PWA
PWC
PWB
1kΩ
4.3
0.15µ
16
2
0.33µ
Unit (capacitance: F)
Voltage gain, VG – dB
Input frequency, fi – Hz

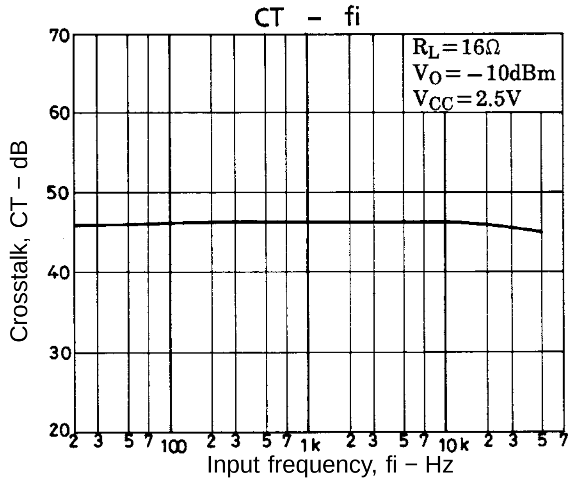

VG – VCC
VO=–10dBm
RL=16Ω
fi=1kHz
Voltage gain, VG – dB
Supply voltage, VCC – V

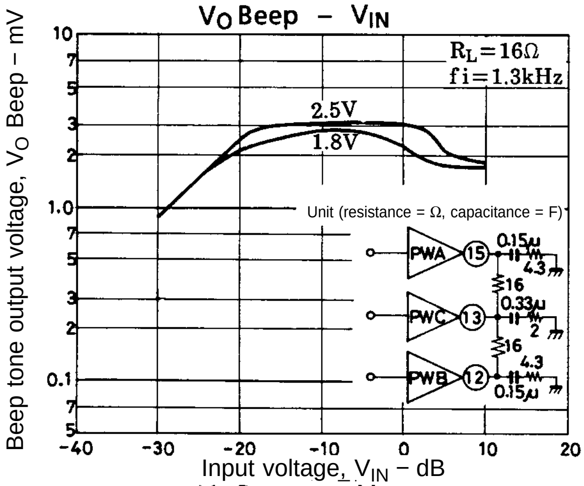

THD – VIN
VCC=2.5V
RL=16Ω
fi=1kHz
B.P.F = 400 Hz to 80 kHz
Channel 2 ON
Total harmonic distortion, THD – %
Input voltage, VIN – dBm

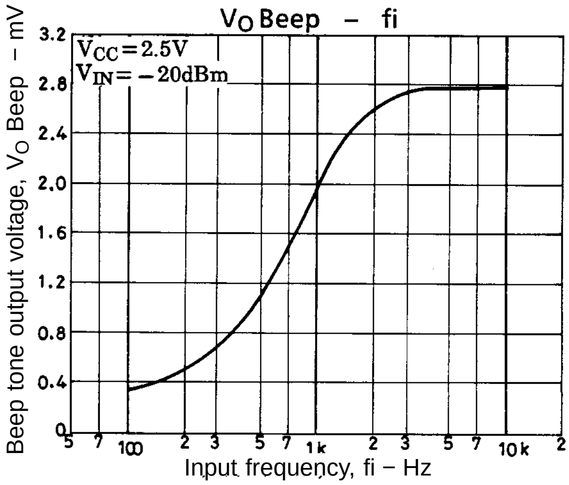

THD – VCC
VO=–10dBm
fi=1kHz
B.P.F = 400 Hz to 80 kHz
Total harmonic distortion, THD – %
Supply voltage, VCC – V

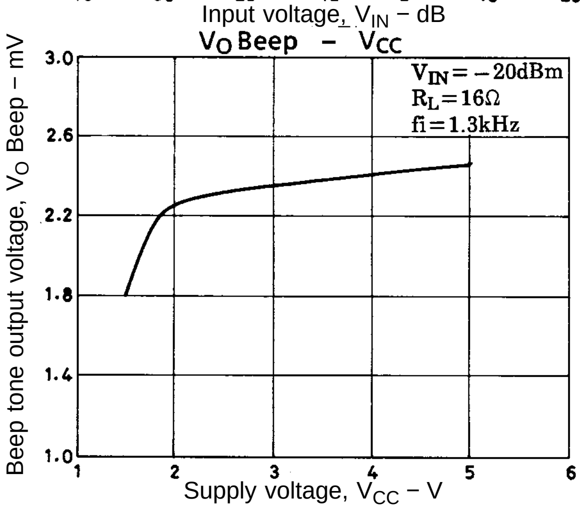

PO – VCC
RL=16Ω
fi=1kHz
Channel 2 ON
THD=10%
1%
Output power, PO – mW
Supply voltage, VCC – V

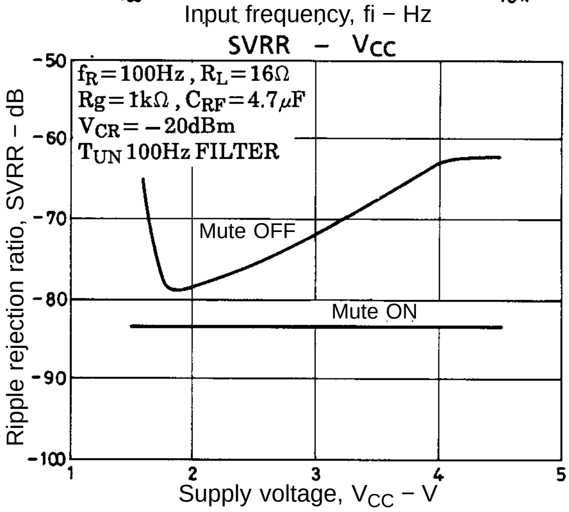

VNO – VCC
Rg=1kΩ
DIN AUDIO
Output noise voltage, VNO – µV
Supply voltage, VCC – V

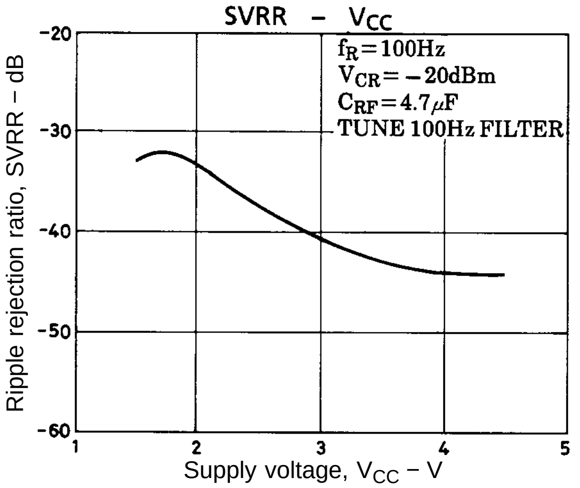

CT – fi
RL=16Ω
VO=–10dBm
VCC=2.5V
Crosstalk, CT – dB
Input frequency, fi – Hz

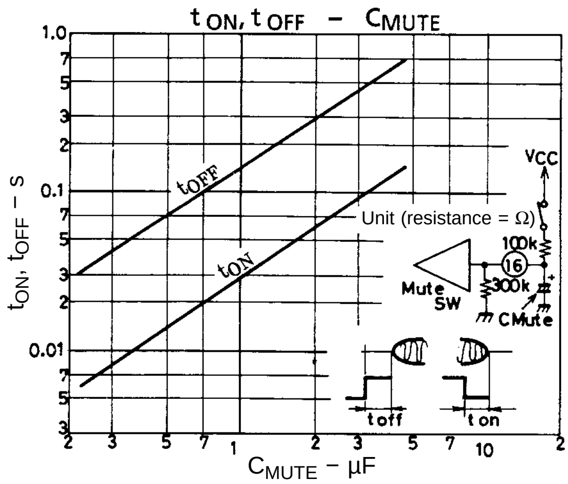

VO Beep – VIN
RL=16Ω
fi=1.3kHz
2.5V
1.8V
Unit (resistance = Ω, capacitance = F)
PWA
PWC
PWB
Beep tone output voltage, VO Beep – mV
Input voltage, VIN – dB

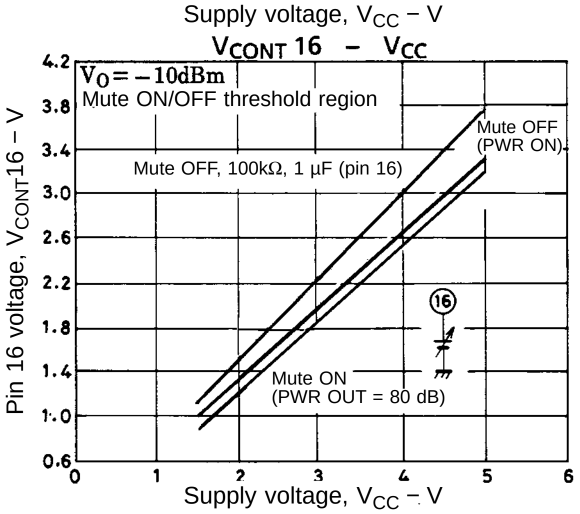

VO Beep – fi
VCC=2.5V
VIN=–20dBm
Beep tone output voltage, VO Beep – mV
Input frequency, fi – Hz

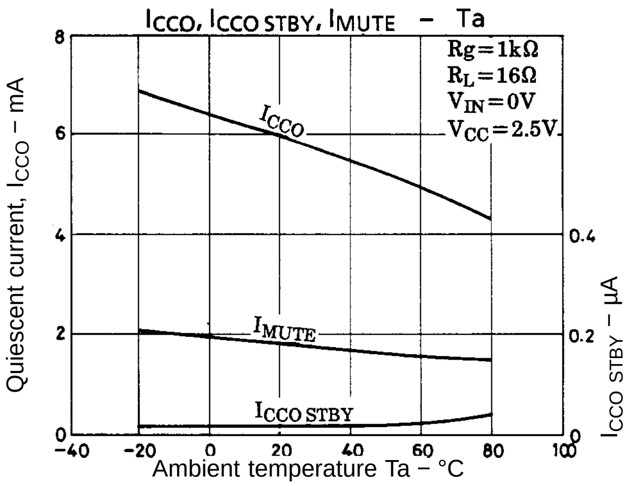

VO Beep – VCC
VIN=–20dBm
RL=16Ω
fi=1.3kHz
Beep tone output voltage, VO Beep – mV
Supply voltage, VCC – V


SVRR – VCC
fR=100Hz, RL=16Ω
Rg=1kΩ, CRF=4.7μF
VCR=–20dBm
TUN 100Hz FILTER
Mute OFF
Mute ON
Ripple rejection ratio, SVRR – dB
Supply voltage, VCC – V

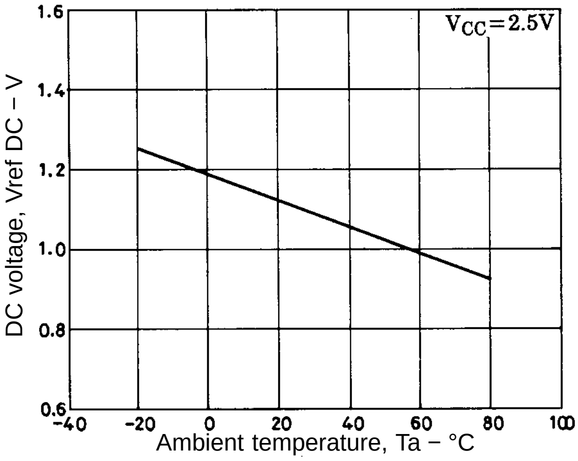

SVRR – VCC
fR=100Hz
VCR=–20dBm
CRF=4.7μF
TUNE 100Hz FILTER
Ripple rejection ratio, SVRR – dB
Supply voltage, VCC – V


tON, tOFF – CMUTE
tOFF
tON
Unit (resistance = Ω)
VCC
100k
300k
Mute SW
CMute
toff
ton
tON, tOFF – s
CMUTE – μF

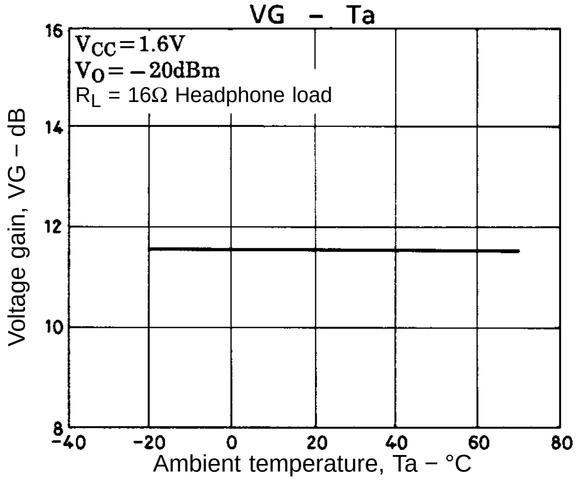

VCONT 16 – VCC
VO=–10dBm
Mute ON/OFF threshold region
Mute OFF (PWR ON)
Mute OFF, 100kΩ, 1 μF (pin 16)
Mute ON (PWR OUT = 80 dB)
Pin 16 voltage, VCONT16 – V
Supply voltage, VCC – V


ICCO, ICCO STBY, IMUTE – Ta
Rg=1kΩ
RL=16Ω
VIN=0V
VCC=2.5V
ICCO
IMUTE
ICCO STBY
Quiescent current, ICCO – mA
ICCO STBY – μA
Ambient temperature Ta – °C

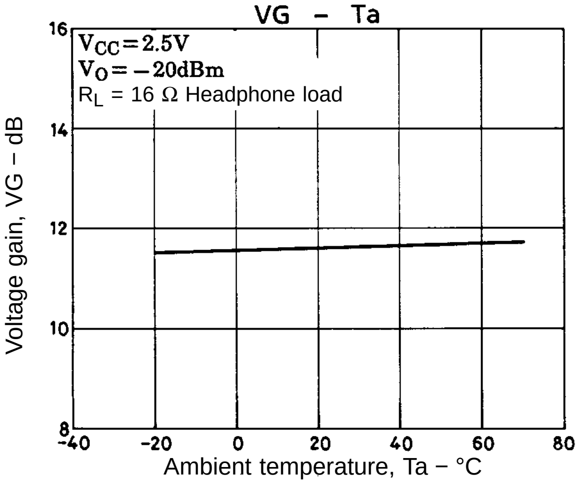
Vref DC − Ta



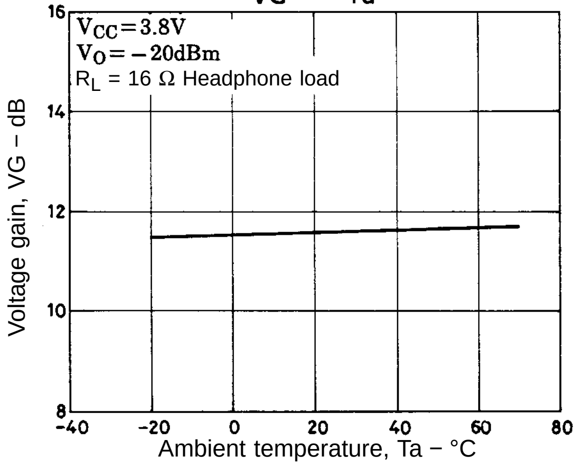
VG − Ta



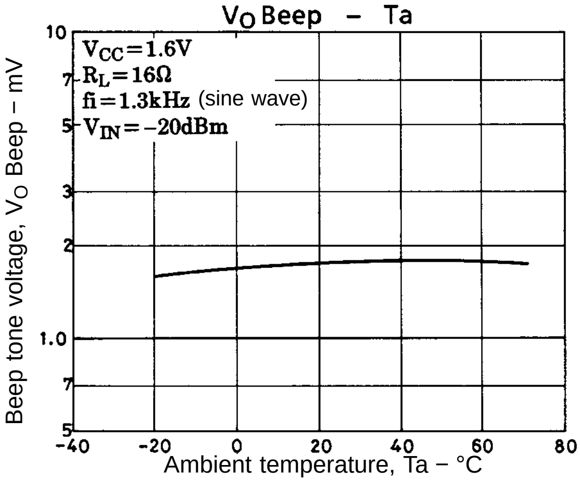
VG − Ta



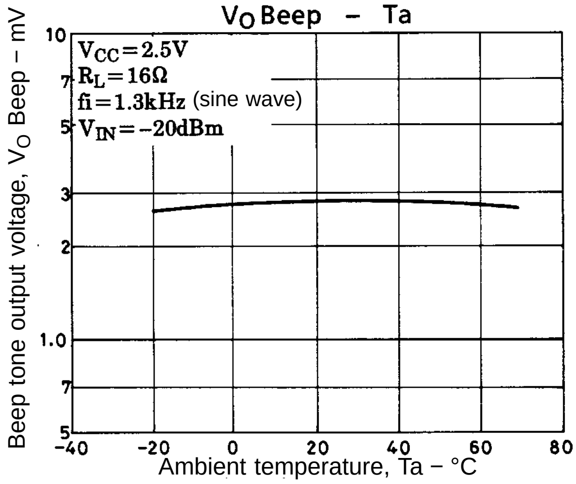
VG − Ta



VO Beep − Ta



VO Beep − Ta



VO Beep − Ta