Small-sized Class-D Speaker Amplifiers

Analog Input Monaural Class-D Speaker Amplifier

BD5461GUL

No.10101EAT02

Description

BD5461GUL is a low voltage drive class-D monaural speaker amplifier that was developed for cellular phones, mobile audio products and the others.LC-filter of speaker output is unnecessary, and the number of external components is three. It is suitable for the application of battery drive because of high efficiency and low power consumption.
Also, stand-by current is 0µA (typ.), and fast transitions from standby to active with little pop noise. It is suitable for applications that switch repeatedly between stand-by and active.

Features

1) No LC filter required
2) Only three external components
3) High power 2.5W/4 /BTL (VDD=5V, RL=4 , THD+N=10%, typ.)
4) High power 0.85W/8 /BTL (VDD=3.6V, RL=8 , THD+N=10%, typ.)
5) Gain 12dB
6) Analog differential input / PWM digital output
7) Pop noise suppression circuitry
8) Built-in standby function
9) Protection circuitry (Short protection [Auto recover without power cycling], Thermal shutdown, Under voltage lockout)
10) Very small package 9-Bump WL-CSP (1.6*1.6*0.55mmMAX)

Applications

Mobile phones, PDA, Mobile electronics applications, Note-book PC etc.

Absolute Maximum Ratings(Ta=25 `)

Parameter	Symbol	Ratings	Unit
Power Supply Voltage	VDD	7.0	V
Power Dissipation	Pd	690 *1	mW
Storage Temperature Range	Tstg	-55 :* +150	`
STBY Terminal Input Range	Vstby	-0.1:*VDD+0.1	V
IN+, IN- Terminal Input Range	Vin	-0.1:*VDD+0.1	V

*1 When mounted on a 50 mm×58mm Rohm standard board, reduce by 5.52 mW/°C above Ta = +25 °C.

Operating Conditions

Parameter	Symbol	Ratings	Unit
Power Supply Voltage	VDD	+2.5 :* +5.5	V
Temperature Range	Topr	-40 :* +85	`

* This product is not designed for protection against radioactive rays

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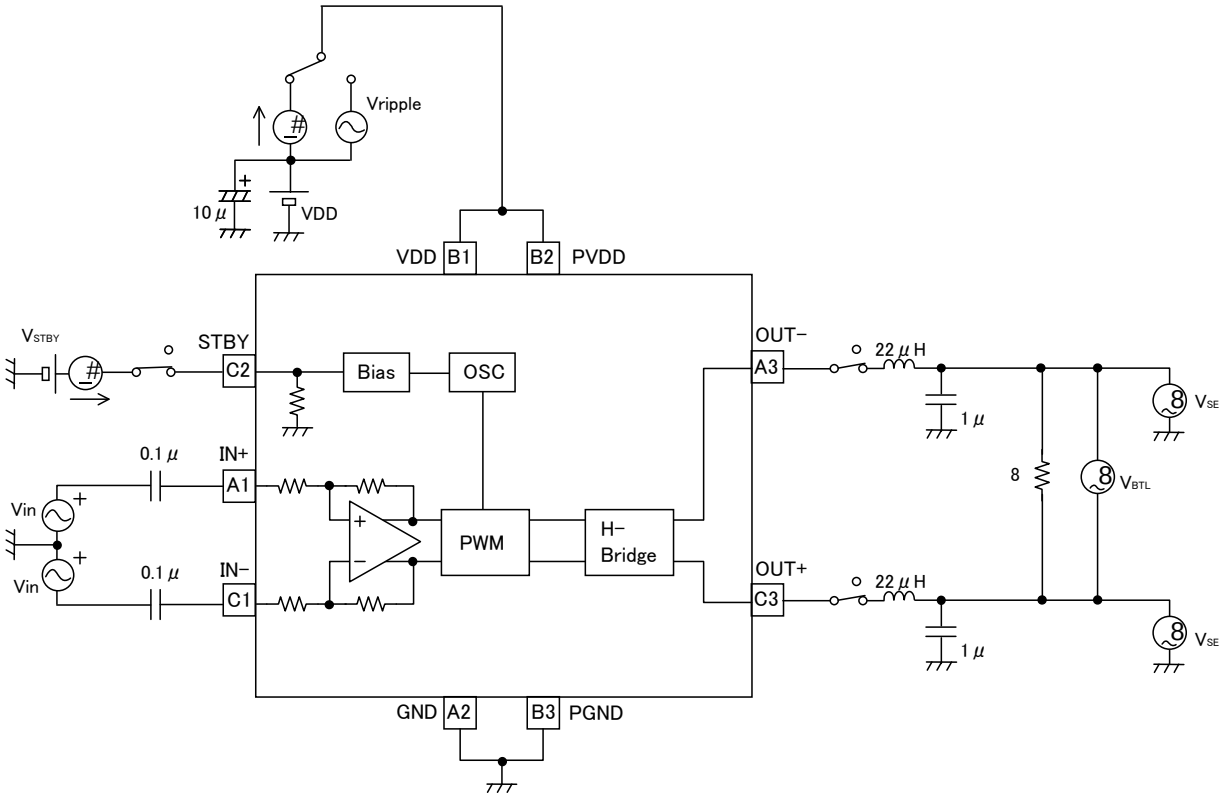
h Electric Characteristics

(Unless otherwise specified, Ta=25 `, VDD=3.6V, f=1kHz, RL=8 , AC item=LC Filter ; L=22µH, C=1µF)

Parameter		Symbol	Rating			Unit	Conditions
			MIN.	TYP.	MAX.		
Circuit current (No signal)		I_{CC}	Š	2.0	4.0	mA	Active mode, No load
Circuit current (Standby)		I_{STBY}	Š	0.1	2	A	Standby mode
Output power 1		P_{O1}	450	680	Š	mW	BTL, f=1kHz, THD+N=1% *1
Output power 2		P_{O2}	550	850	Š	mW	BTL, f=1kHz, THD+N=10% *1
Voltage gain		G_V	11.4	11.9	12.4	dB	BTL
Power Supply Rejection Ratio		P_{SRR}	45	53	Š	dB	BTL, f=1kHz, Vripple=0.1Vpp *2
Output offset voltage		ûVo	-25	0	+25	mV	Vin=0V, BTL
Switching Frequency		fosc	175	250	325	kHz	
Start-up time		Ton	0.39	0.51	0.73	msec	
Standby input Voltage	High-level	V_{STBYH}	1.4	Š	VDD	V	Active mode
	Low-level	V_{STBYL}	0	Š	0.4	V	Standby mode
Standby input current	High-level	I_{STBYH}	6	12	18	A	V_{STBY}=3.6V
	Low-level	I_{STBYL}	-5	0	5	A	V_{STBY}=0V

BTL=Bridged Tied Load (Voltage between A3-C3.), *1;B.W.=400:*30kHz,*2;DIN AUDIO

h Measurement Circuit Diagram



h Active / Standby Control

STBY Pin(C2pin)

Mode	Pin level	Conditions
Active	H	IC active
Standby	L	IC shutdown

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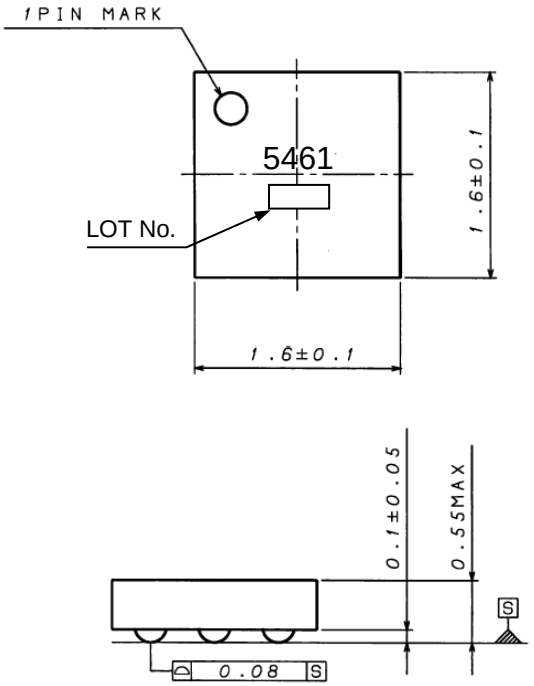
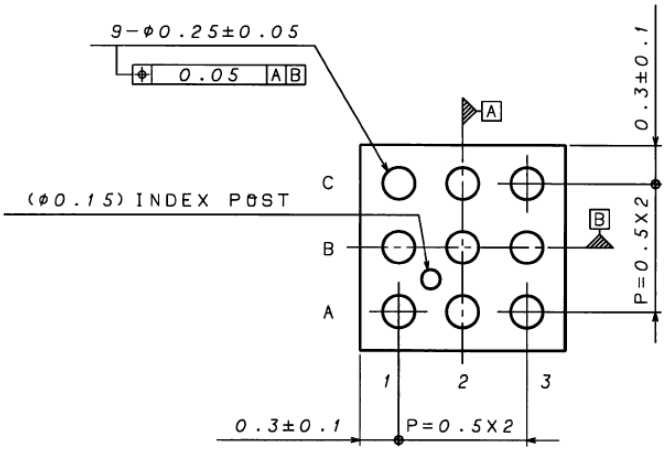
h Package Outlines

TOP VIEW



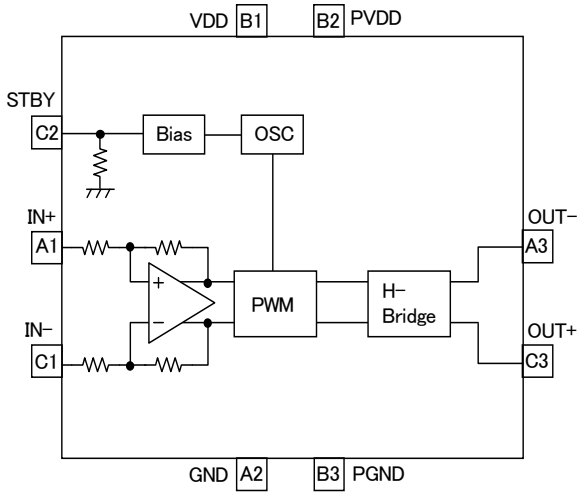
BOTTOM VIEW



(Unit: mm)

WL-CSP 9æ VCSP50L1

h Block Diagram



h Pin Assignment Chart

Pin No.	Pin Name
A1	IN+
A2	GND
A3	OUT-
B1	VDD
B2	PVDD
B3	PGND
C1	IN-
C2	STBY
C3	OUT+

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h Application Circuit Example

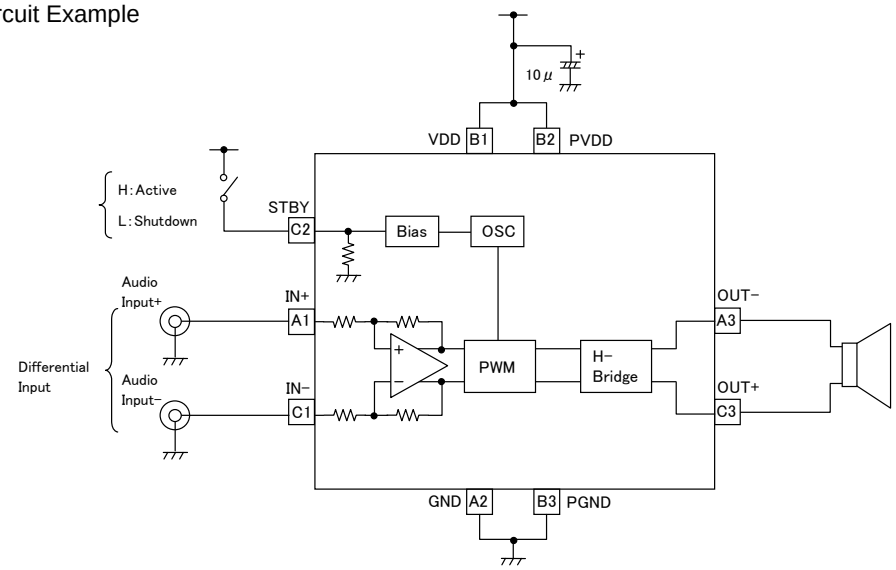

Fig.1 Differential input for mobile phone

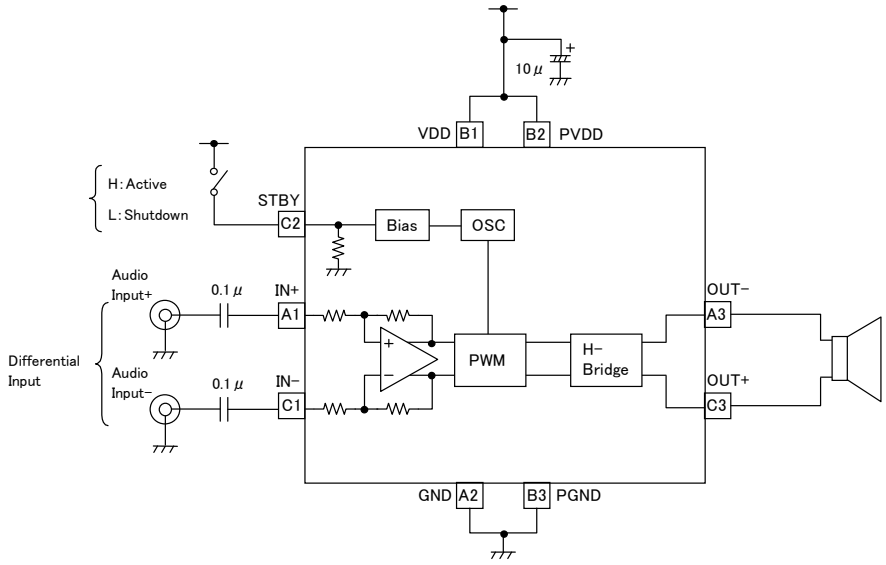

Fig.2 Differential input with coupling input capacitors

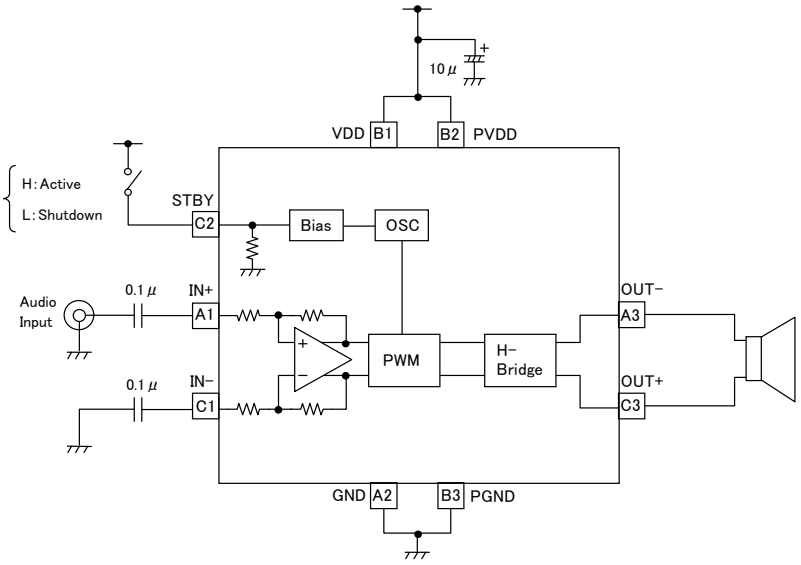

Fig.3 Single-Ended input

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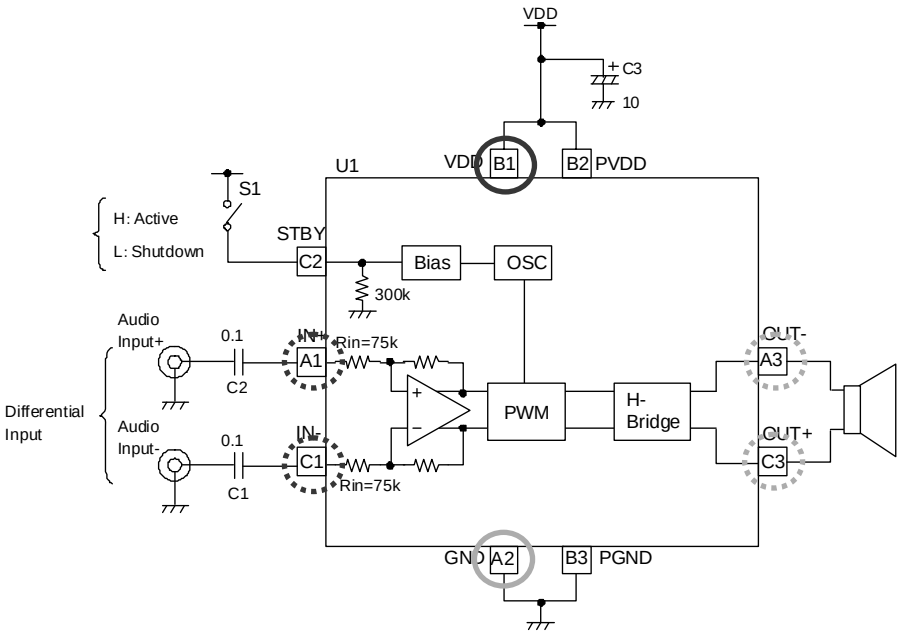
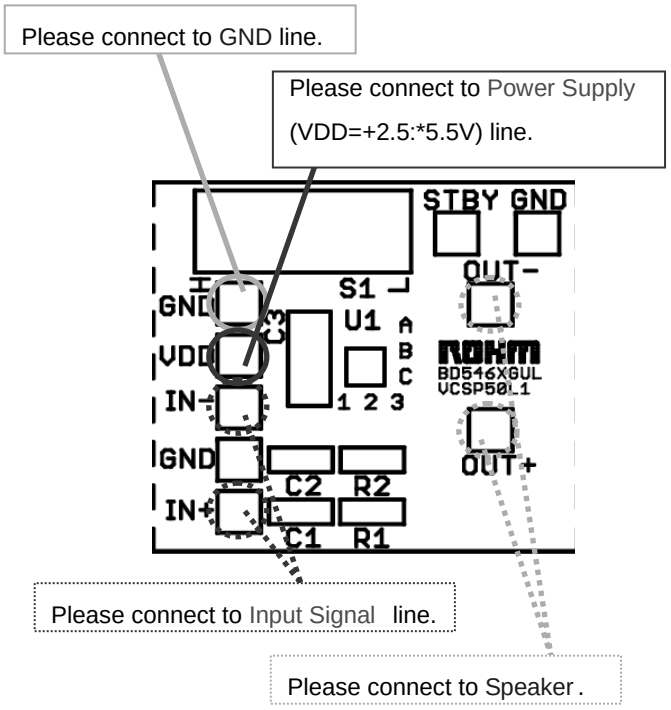
h Evaluation board Circuit Diagram





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h Evaluation board Parts List

Qty.	Item	Description	SMD Size	Manufacturer/ Part Number
2	C1, C2	Capacitor, 0.1 F	0603	Murata GRM188R71C104KA01D
1	C3	Capacitor, 10 F	A (3216)	ROHM TCFGA1A106M8R
1	S1	Slide Switch	4mm X 10.2mm	NKK SS-12SDP2
1	U1	IC, BD5461GUL, Mono Class-D audio amplifier	1.6mm X 1.6mm WL-CSP Package	ROHM BD5461GUL
1	PCB1	Printed-circuit board, BD5460GUL EVM	Š	Š

h Description of External components

Input coupling capacitor (C1,C2)

It makes a Input coupling capacitor 0.1µF.
Input impedance is 75k (Typ.).
It sets cutoff frequency fc by the following formula by input coupling capacitor C1(=C2) and input impedance Ri.

$$fc = \frac{1}{2\pi \times Ri \times C1} [Hz]$$

In case of Ri=75k , C1 (=C2)=0.1µF, it becomes fc = about 21 Hz.

Power decoupling capacitor (C3)

It makes a power decoupling capacitor 10 µF.
When making capacitance of the power decoupling capacitor, there is an influence in the Audio characteristic.
When making small, careful for the Audio characteristic at the actual application.

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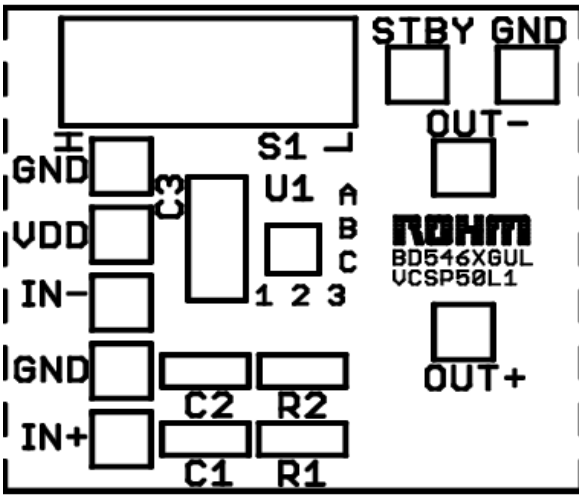
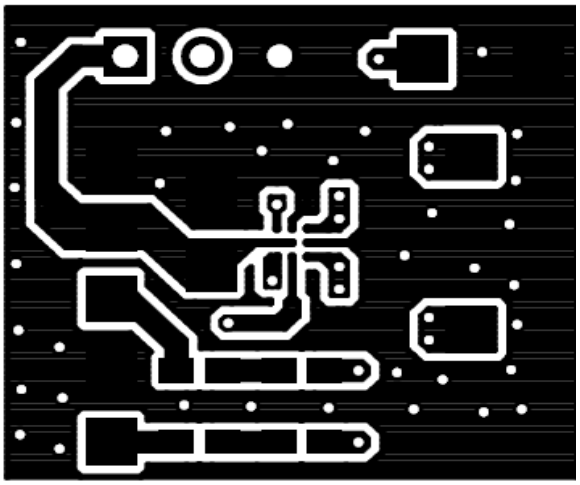
h Evaluation board PCB layer

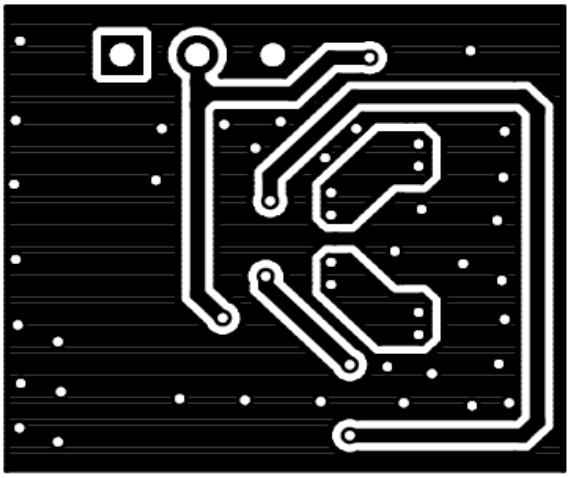
TOP Layer silk pattern



TOP Layer



Bottom Laver



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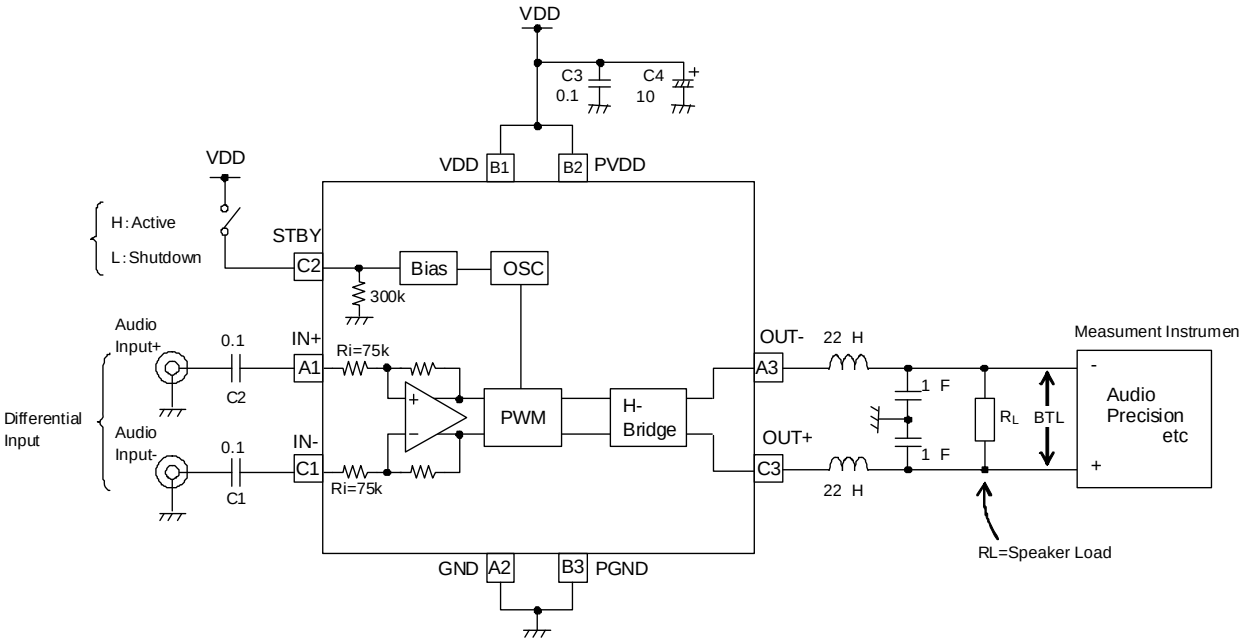
h The way of evaluating Audio characteristic

Evaluation Circuit Diagram



When measuring Audio characteristics, insert LC filter during the output terminal of IC and the speaker load and measure it.
Arrange LC filter as close as possible to the output terminal of IC.
In case of L=22 H, C=1 F, the cutoff frequency becomes the following.

$$fc = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\pi\sqrt{22\ \mu H \times 1\ \mu F}} \cong 34\ kHz$$

Use a big current type - Inductor L.
(Reference)
TDK: SLF12575T-220M4R0

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h About the thermal design by the IC

Characteristics of an IC have a great deal to do with the temperature at which it is used, and exceeding absolute maximum ratings may degrade and destroy elements. Careful consideration must be given to the heat of the IC from the two standpoints of immediate damage and long-term reliability of operation. Pay attention to points such as the following.

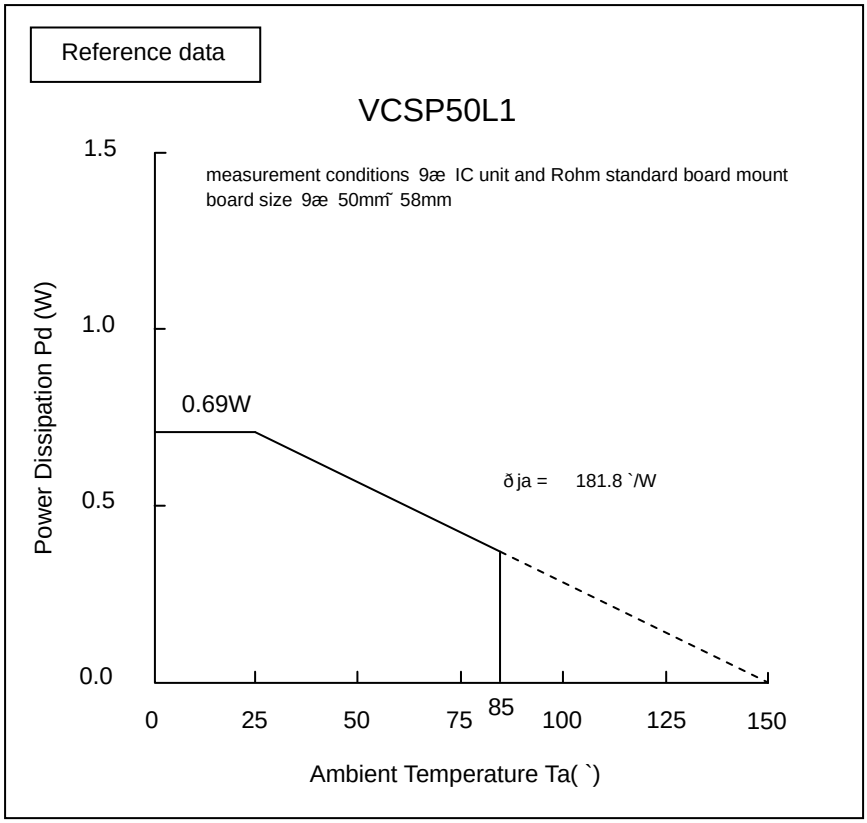
Since an maximum junction temperature (Tj_{MAX}.)or operating temperature range (Topr) is shown in the absolute maximum ratings of the IC, to reference the value, find it using the Pd-Ta characteristic (temperature derating curve).

If an input signal is too great when there is insufficient radiation, TSD (thermal shutdown) may operate.

TSD, which operates at a chip temperature of approximately +180 ` , is canceled when this goes below approximately +100 ` .

Since TSD operates persistently with the purpose of preventing chip damage, be aware that long-term use in the vicinity that TSD affects decrease IC reliability.

Temperature Derating Curve



Note) Values are actual measurements and are not guaranteed.

Power dissipation values vary according to the board on which the IC is mounted. The Power dissipation of this IC when mounted on a multilayer board designed to radiate is greater than the values in the graph above.

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h Typical Characteristics

Table of graphs

Items	Parameter	Figure
Efficiency	vs Output power	4, 6
Supply current (Icc)	vs Output power	5, 7
	vs Supply voltage	8
Shutdown current (Istby)	vs Supply voltage	9
Output power (Po)	vs Load resistance	10, 11
	vs Supply voltage	12
Total harmonic distortion plus noise (THD+N)	vs Output power	13, 14
	vs Frequency	15, 16, 17, 18, 25, 26, 27
	vs Common-mode input voltage	19
Supply voltage rejection ratio (PSRR)	vs Frequency	20, 21, 22, 23
Common-mode rejection ratio (CMRR)	vs Frequency	24
Gain	vs Frequency	28, 29

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h Reference Data

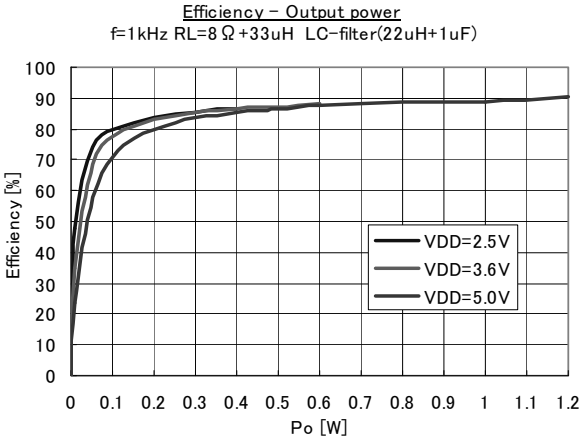

Fig.4

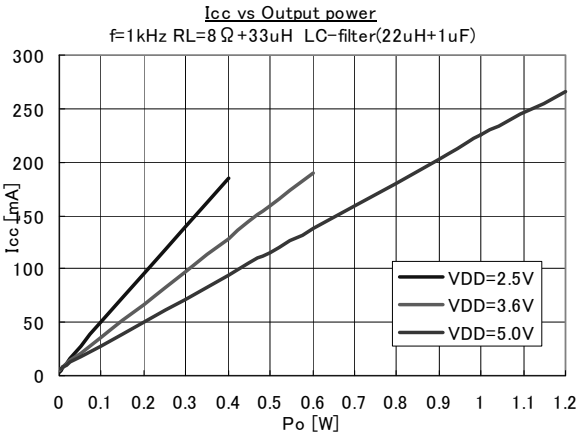

Fig.5

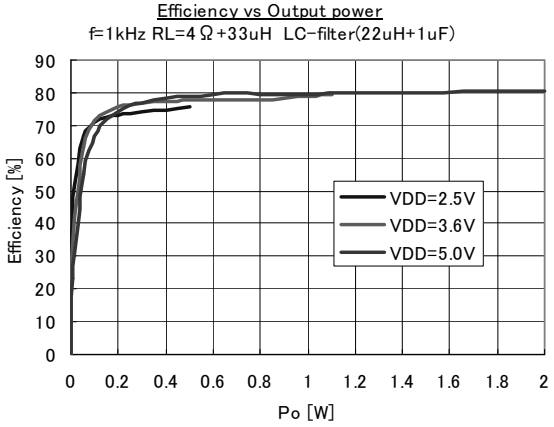

Fig.6

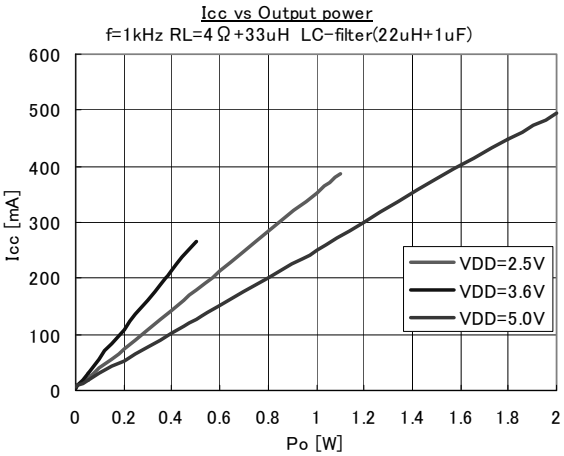

Fig.7

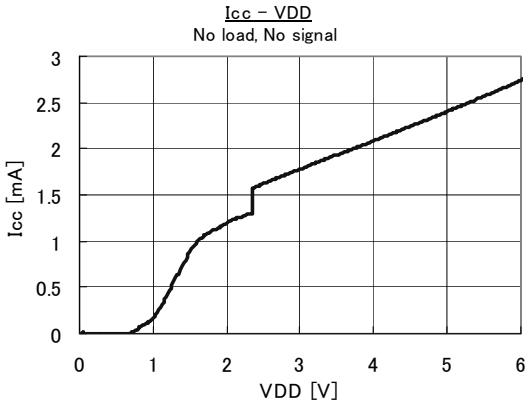

Fig.8

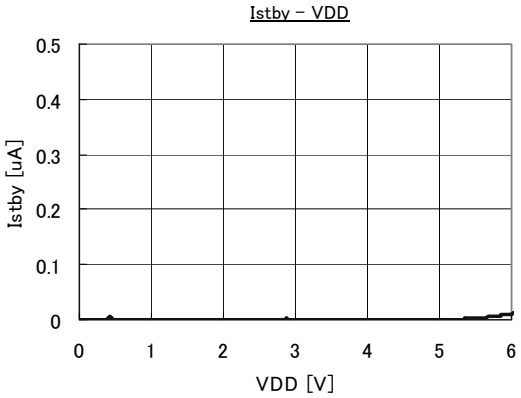

Fig.9

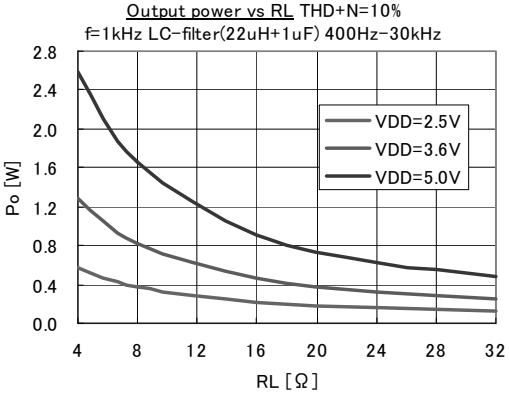

Fig.10

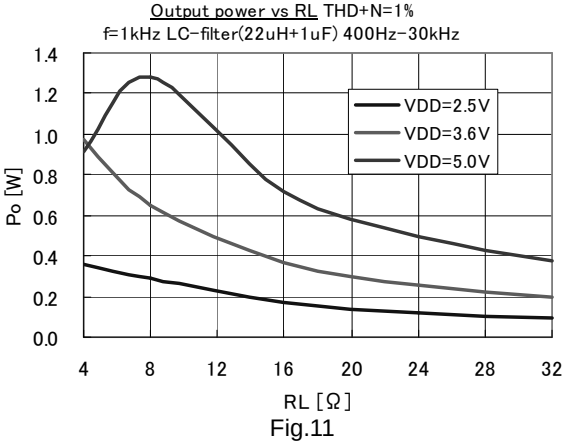

Fig.11

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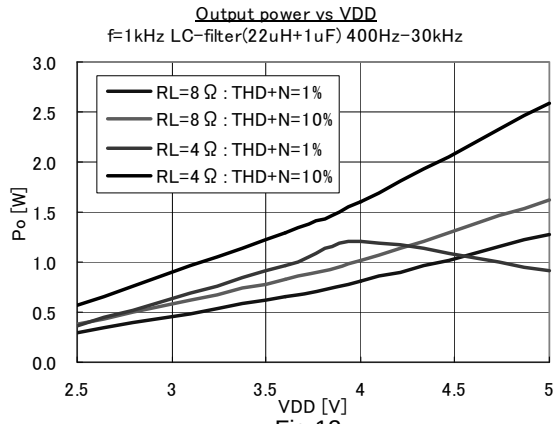

Fig.12

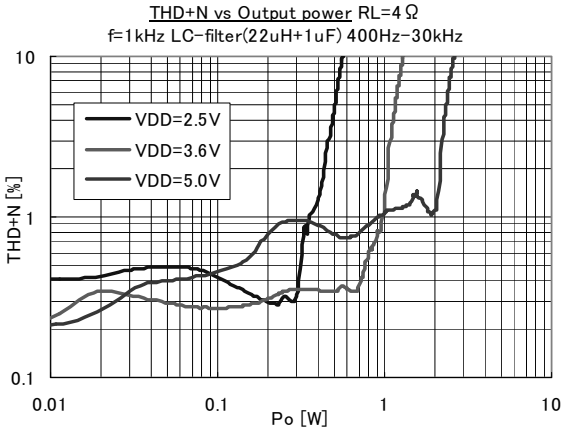

Fig.13

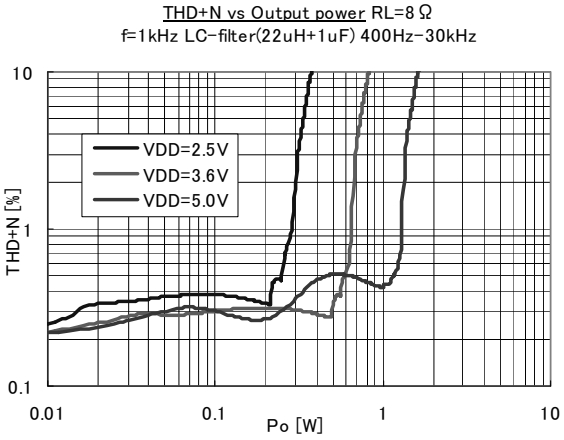

Fig.14

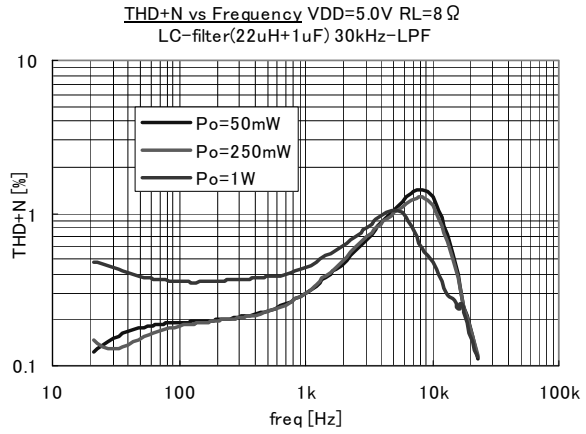

Fig.15

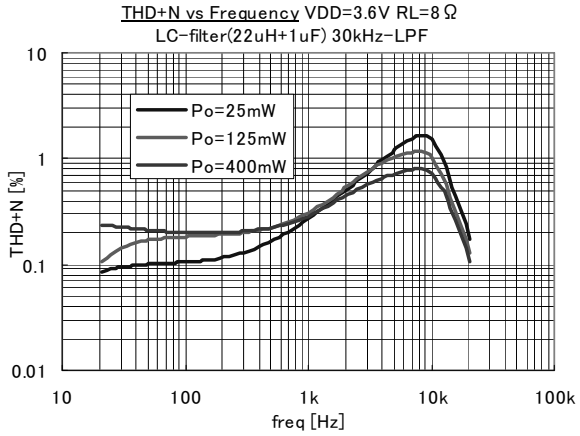

Fig.16

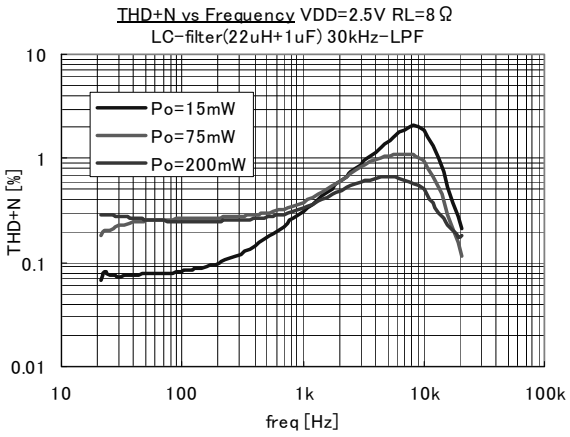

Fig.17

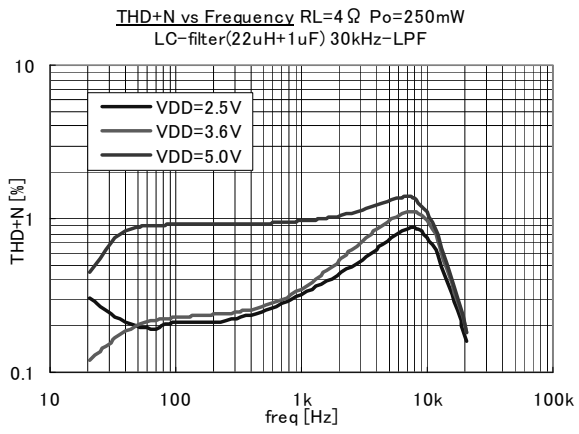

Fig.18

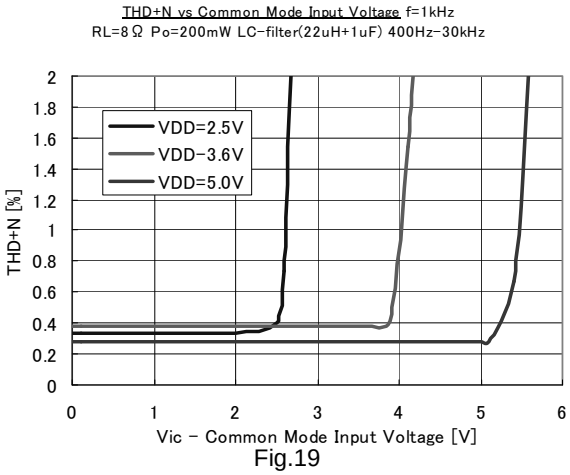

Fig.19

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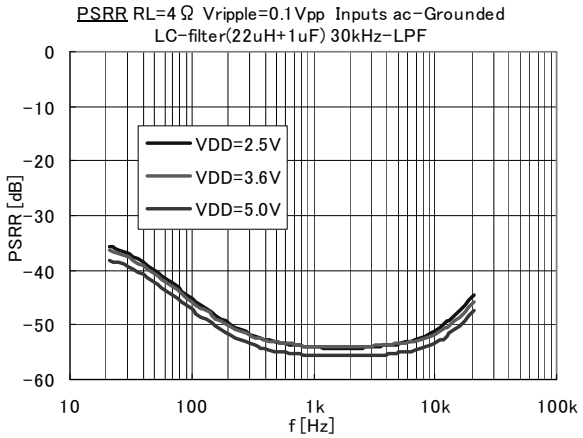

Fig.20

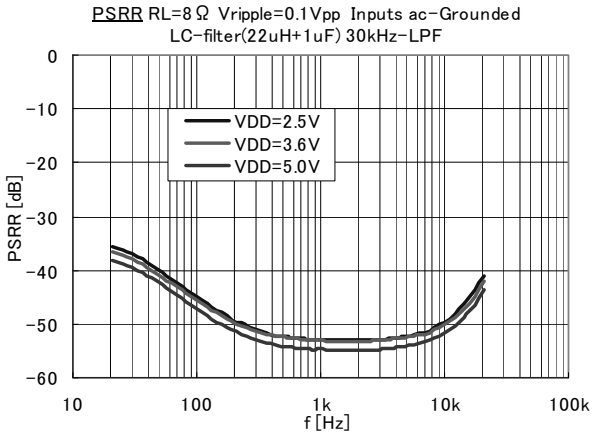

Fig.21

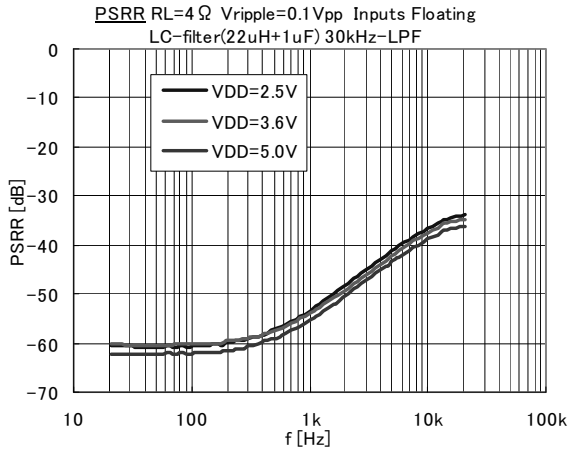

Fig.22

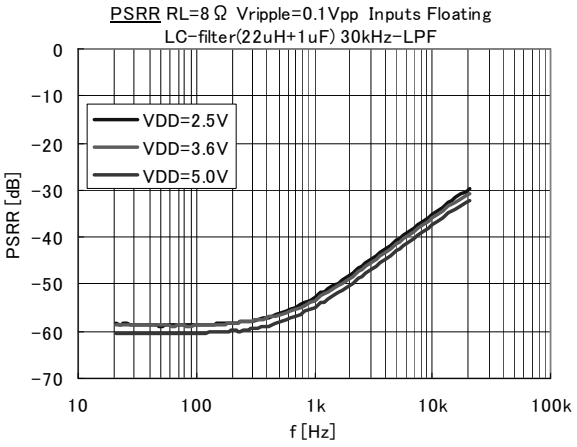

Fig.23

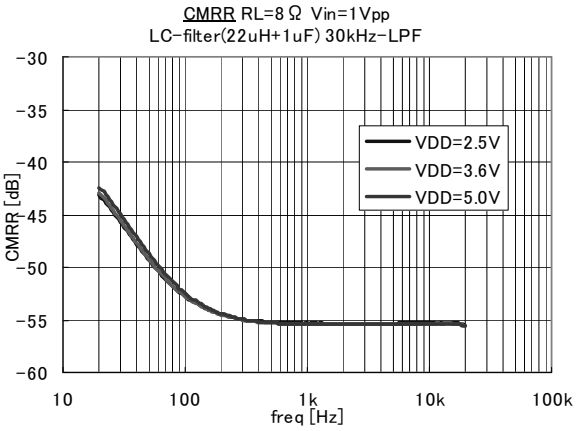

Fig.24

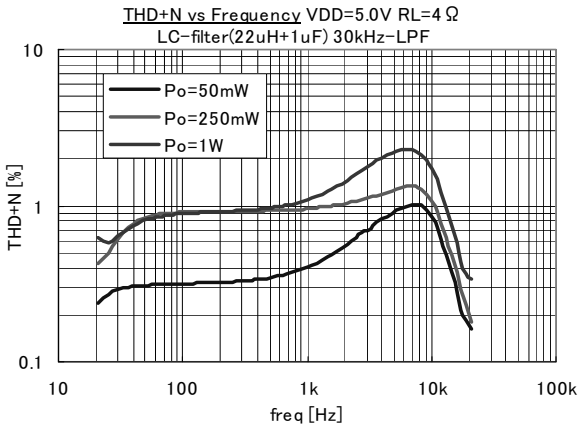

Fig.25

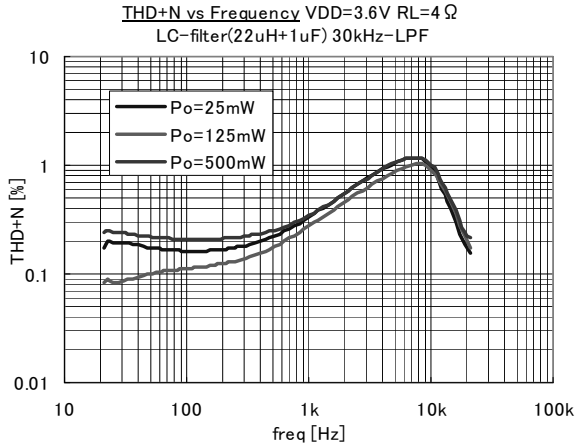

Fig.26

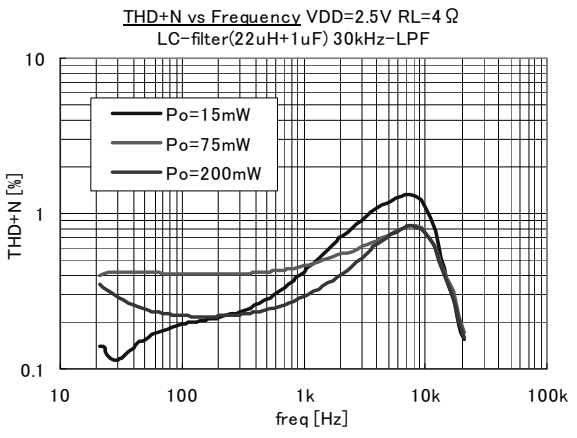

Fig.27

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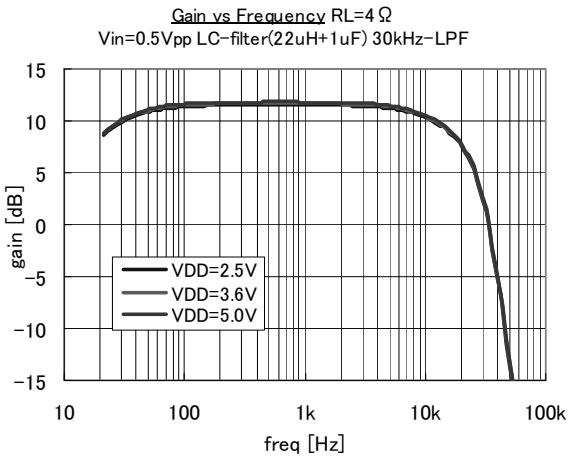

Fig.28

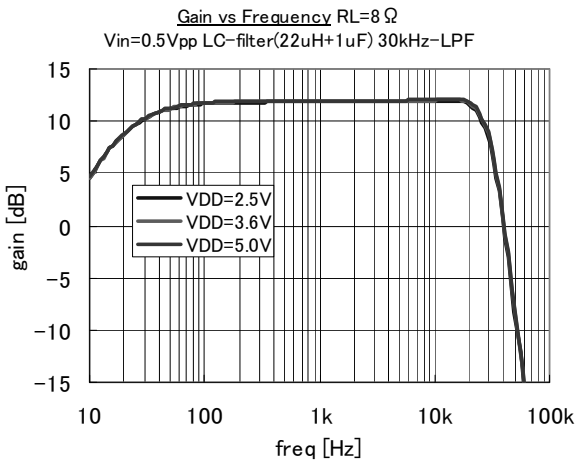

Fig.29

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Notice

Precaution on using ROHM Products

1. Our Products are designed and manufactured for application in ordinary electronic equipments (such as AV equipment, OA equipment, telecommunication equipment, home electroni

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Precautions Regarding Application Examples and External Circuits

1. If change is made to the constant of an external circuit, please allow a sufficient margin considering variations of the characteristics of the Products and external components, including transient characteristics, as well as static characteristics.

2. You agree that application notes, reference designs, and associated data and information contained in this document are presented only as guidance for Products use. Therefore, in case you use such information, you are solely responsible for it and you must exercise your own independent verification and judgment in the use of such information contained in this document. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of such information.

Precaution for Electrostatic

This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding the Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of Ionizer, friction prevention and temperature / humidity control).

Precaution for Storage / Transportation

1. Product performance and soldered connections may deteriorate if the Products are stored in the places where:
   [a] the Products are exposed to sea winds or corrosive gases, including Cl2, H2S, NH3, SO2, and NO2
   [b] the temperature or humidity exceeds those recommended by ROHM
   [c] the Products are exposed to direct sunshine or condensation
   [d] the Products are exposed to high Electrostatic

2. Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.

3. Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.

4. Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

Precaution for Product Label

QR code printed on ROHM Products label is for ROHM's internal use only.

Precaution for Disposition

When disposing Products please dispose them properly using an authorized industry waste company.

Precaution for Foreign Exchange and Foreign Trade act

Since our Products might fall under controlled goods prescribed by the applicable foreign exchange and foreign trade act, please consult with ROHM representative in case of export.

Precaution Regarding Intellectual Property Rights

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Other Precaution

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General Precaution

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