Class-AB Speaker Amplifiers

1.9W+1.9W Stereo Speaker Amplifier

BD7836EFV

No.10077EAT07

●Description

BD7836EFV is a Class-AB stereo speaker amplifier, developed for note-book PC, desktop PC, portable devices and others. Class-AB amplifier has no EMI noise. Power package HTSSOP-B20 can realize high output power.
Low circuit current at active mode reduce consumption of battery. Shutdown current is 0.1μA typically, and pop noise level when shutdown turns on and off is very small. This device is suitable for the application that often changes mode between "shutdown state" and "active state".

●Features

1) High power 1.9W typ. (VDD=5V, R_L=4Ω, THD+N=1%, stereo input)
   High power 1.2W typ. (VDD=5V, R_L=8Ω, THD+N=1%, stereo input)
2) Gain selectable by the external control (6,10,15.6,21.6dB)
3) Pop noise suppression circuitry
4) Shutdown function (also Mute function) [I_{sd}=0.1μA(typ.)]
5) Protection circuitry (Thermal shutdown, Under voltage lockout)
6) Power Package with thermal pad HTSSOP-B20

●Applications

Note-book PC, Desktop PC, etc.

●Absolute maximum ratings (Ta=+25℃)

Parameter	Symbol	Ratings	Unit
Power Supply Voltage	VDDmax	7.0	V
Power Dissipation	Pd	1 *1	W
		3.2 *2	W
Storage Temperature	Tstg	-55 ～ +150	℃
Input Terminal Input Voltage Range *3	Vin	-0.3～VDD+0.3	V
Control Terminal Input Voltage Range *4	Vctl	-0.3～VDD+0.3	V

*1 70mm×70mm×1.6mm FR4 1-layer glass epoxy board(Copper on top layer 0%)
Derating in done at 8mW/℃ for operating above Ta=25℃. There are thermal via on the board.
*2 70mm×70mm×1.6mm FR4 4-layer glass epoxy board (Copper on bottom 2 and 3 layer 100%)
Derating in done at 25.6mW/℃ for operating above Ta=25℃. There are thermal via on the board.
*3 Input Terminal (LIN+, LIN-, RIN+, RIN-)
*4 Control Terminal ($\overline{\text{SHUTDOWN}}$, GAIN0, GAIN1)

●Operating conditions

Parameter	Symbol	Range	Unit
Power Supply Voltage	VDD	+4.5 ～ +5.5	V
Temperature	Topr	-40 ～ +85	℃

* These products aren't designed for protection against radioactive rays.

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●**Electric characteristic** (Unless otherwise specified, Ta=+25℃, VDD=+5.0V, R_L=8Ω, AC stereo input)

Parameter	Symbol	Limits			Unit	Condition
		Min.	Typ.	Max.		
Circuit current (Active)	I_{cc}	—	5	10	mA	IC active, No load $\overline{SHUTDOWN}$ =Hi
Circuit current (Shutdown)	I_{sd}	—	0.1	2.0	μA	IC Shutdown $\overline{SHUTDOWN}$ =Lo
<Speaker amplifier>						
Output power 1	P_{O1}	0.7	1.2	—	W	RL=8Ω, BTL, f=1kHz, THD+N=1% *1
Output power 2	P_{O2}	—	1.9	—	W	RL=4Ω, BTL, f=1kHz, THD+N=1% *1
Gain	G_V	5.5	6.0	6.5	dB	BTL, GAIN0=GAIN1=L
		9.5	10	10.5	dB	BTL, GAIN0=L, GAIN1=H
		14.6	15.6	16.5	dB	BTL, GAIN0=H, GAIN1=L
		20.6	21.6	22.6	dB	BTL, GAIN0=GAIN1=H
Input resistance	R_{IN}	63	90	117	kΩ	GAIN0=GAIN1=L
		49	70	91	kΩ	GAIN0=L, GAIN1=H
		31	45	59	kΩ	GAIN0=H, GAIN1=L
		17	25	33	kΩ	GAIN0=GAIN1=H
Supply ripple rejection ratio	PSRR	62	68	—	dB	Vripple=0.2Vp-p,C_{BYP}=0.47μF f=1kHz, BTL
Output noise	Vnoise	—	16	80	μVrms	BTL, f=1kHz, 20-20kHz
S/N	S_N	—	105	—	dB	BTL, Po=1W, BTL, f=1kHz, 20-20kHz
Output DC offset voltage	⊿Vo	—	0	±25	mV	
<Control terminal ($\overline{SHUTDOWN}$,GAIN0,GAIN1)>						
Control terminal Input voltage	Hi level	VIH	2.0	—	VDD	V	
	Lo level	VIL	0	—	0.8	V	

*1: B.W.=400～30kHz, BTL：The voltage between 4pin and 8pin, 14pin and 18pin.

●**Control terminal's settings**

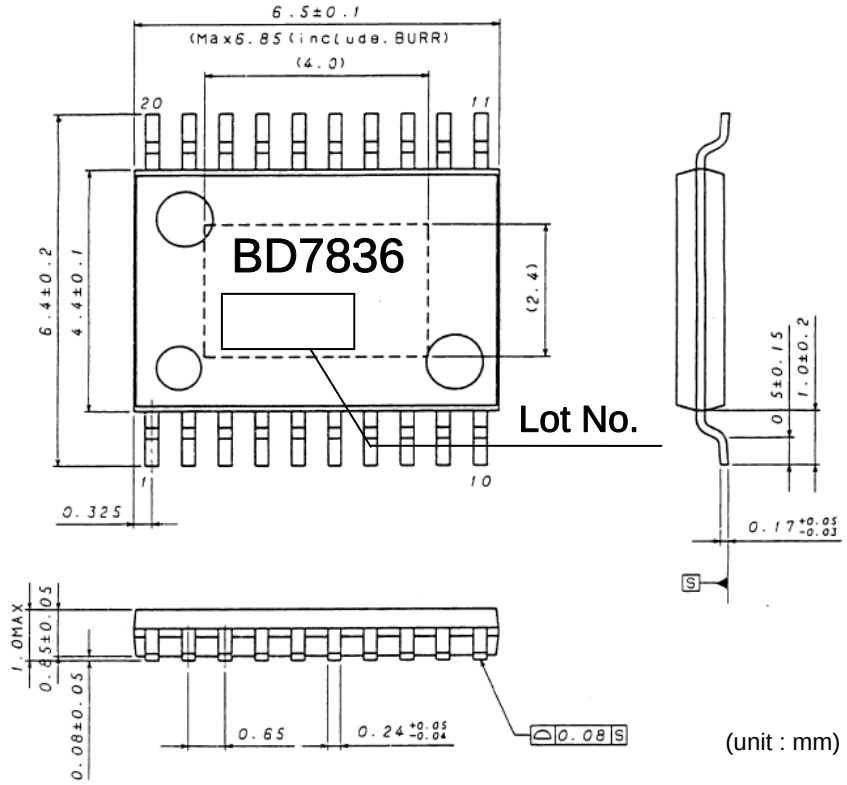
$\overline{SHUTDOWN}$	IC condition
Hi	Active
Lo	Shutdown

GAIN0	GAIN1	Gain	Input resistance
Lo	Lo	6dB	90kΩ (TYP.)
Lo	Hi	10dB	70kΩ (TYP.)
Hi	Lo	15.6dB	45kΩ (TYP.)
Hi	Hi	21.6dB	25kΩ (TYP.)

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●Package outlines



(unit : mm)

Fig.1 HTSSOP-B20

●Block diagram

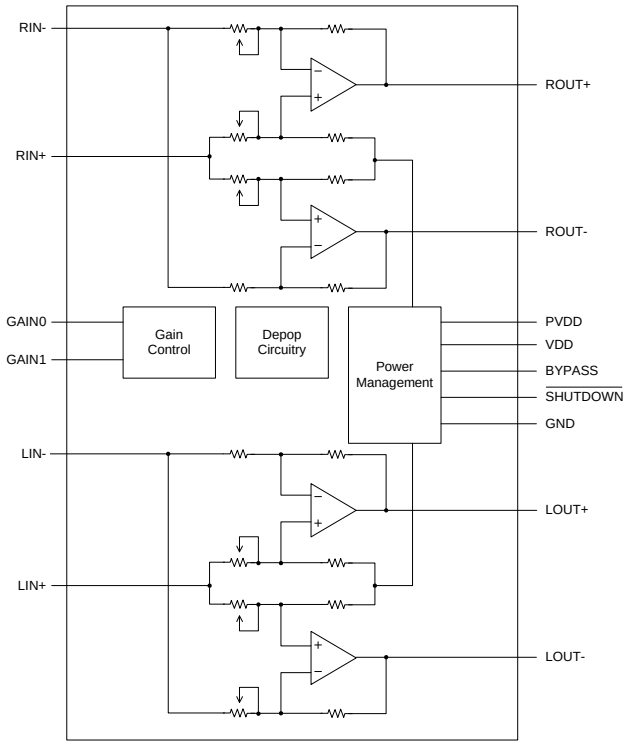


Fig.2

●Pin assignment table

Pin No.	Terminal name	Function
1	GND	Ground
2	GAIN0	Bit 0 of gain select
3	GAIN1	Bit 1 of gain select
4	LOUT+	Left channel positive output
5	LIN-	Left channel negative differential input
6	PVDD	Supply voltage terminal
7	RIN+	Right channel negative differential input
8	LOUT-	Left channel negative output
9	LIN+	Left channel positive differential input
10	BYPASS	Tap to voltage divider for internal midsupply bias generator
11	GND	Ground
12	NC	No connection
13	GND	Ground
14	ROUT-	Right channel negative output
15	PVDD	Supply voltage terminal
16	VDD	Supply voltage terminal
17	RIN-	Right channel negative differential input
18	ROUT+	Right channel positive output
19	$\overline{\text{SHUTDOWN}}$	Places IC in shutdown mode when held low
20	GND	Ground

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●Measurement circuit diagram

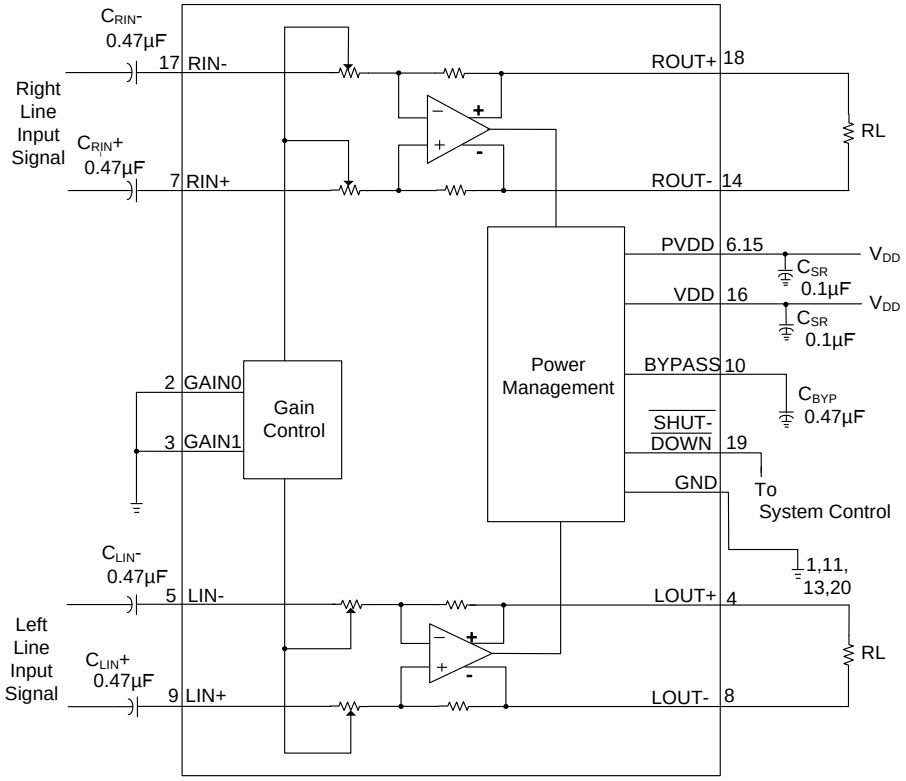


Fig.3

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●Application circuit example

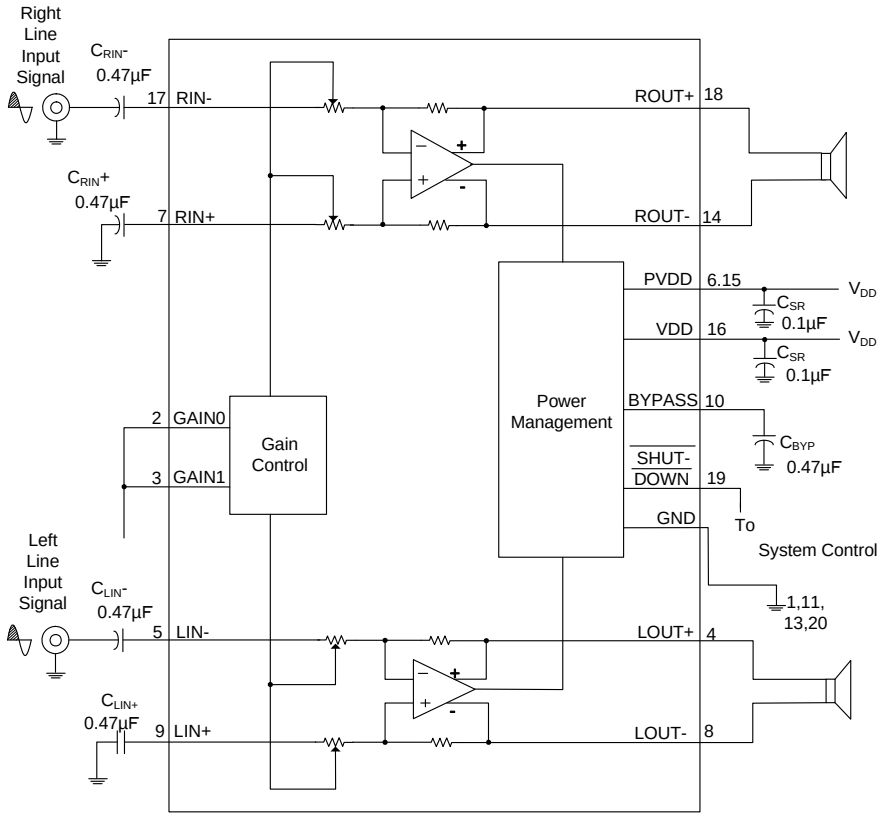


Fig.4 Single Ended inputs

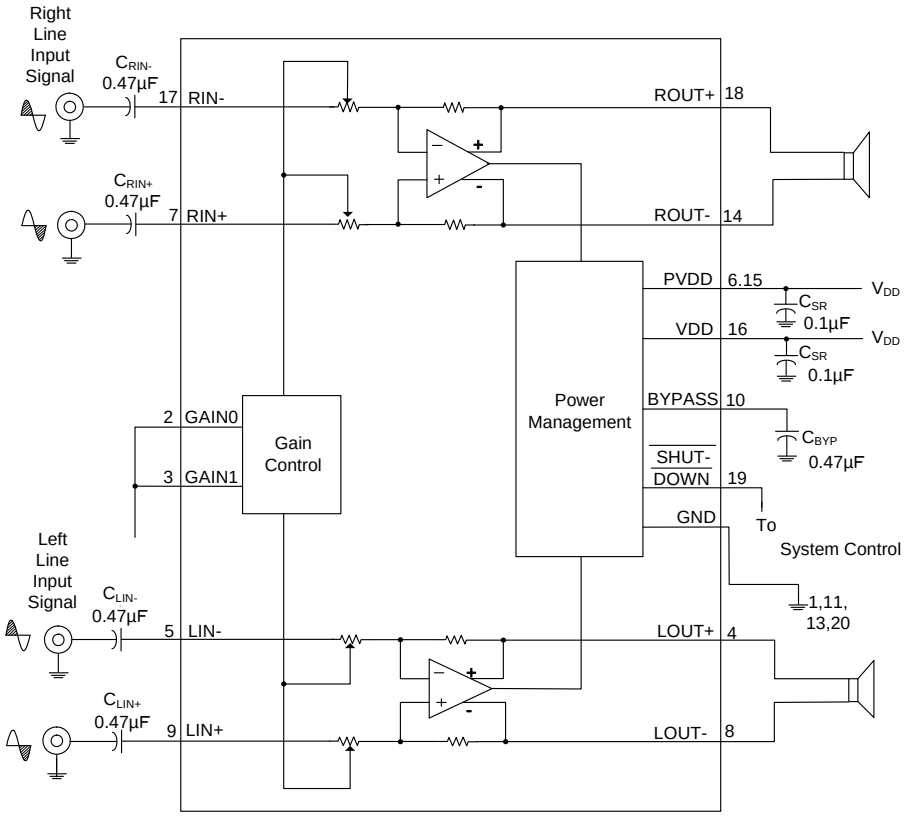
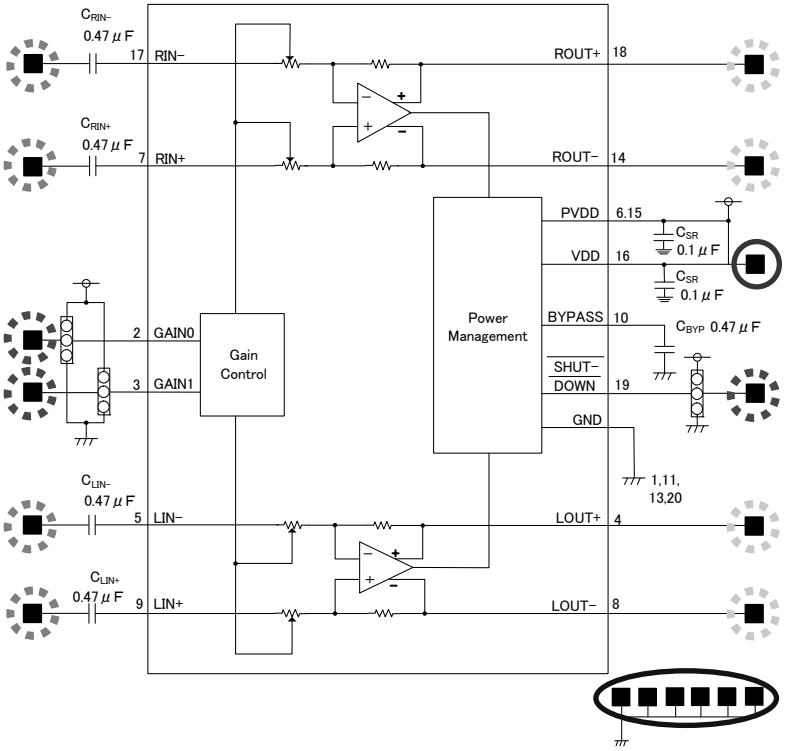


Fig.5 Differential inputs

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●Evaluation board circuit diagram



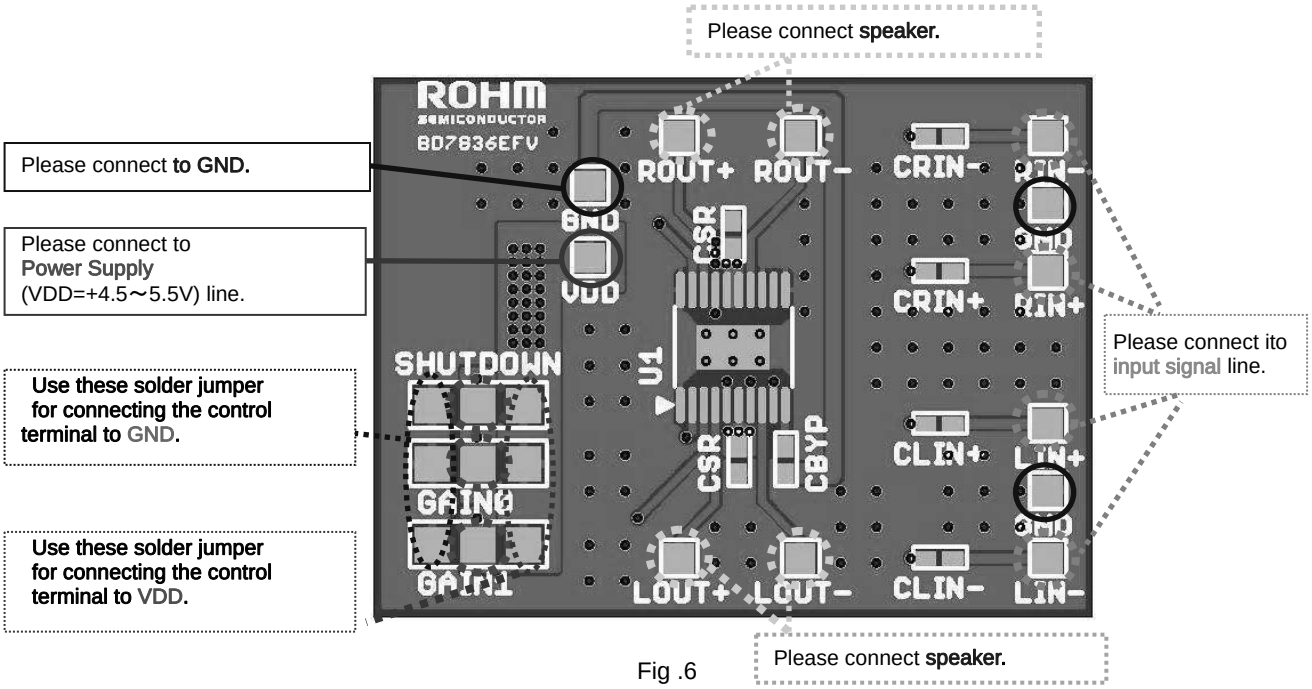


Fig .6

●Evaluation board partts list

Number	Part name	Type, Value	SMD size	Manufacturer/ Part number
4	CLIN+/-,CRIN+/-	Capacitor, 0.47μF	1608	Murata GRM188R71C474KA01D
2	CSR	Capacitor, 0.1μF	1608	Murata GRM188R71C104KA01D
1	CBYP	Capacitor, 0.47μF	1608	Murata GRM188R71C474KA01D
1	U1	IC, BD7836EFV, Class-AB stereo speaker Amplifier	PKG:HTSSOP-B20	ROHM BD7836EFV-E2
1	PCB1	Printed-circuit board BD7836EFV	—	—

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●Description of external parts

①Input coupling capacitors Ci (CLIN+/-,CRIN+/-)

It sets cutoff frequency fc by the following formula by input coupling capacitors Ci(CLIN+/-,CRIN+/-) and input impedance Zi.

$$fc = \frac{1}{2\pi \times Zi \times Ci}[Hz]$$

It makes an input coupling capacitors of evaluation board 0.47μF on evaluation board..
Input impedance Zi and cutoff frequency fc in each gain settings are given in Table1.

Table1. The relations in the gain settings and cutoff frequency fc.

GAIN0	GAIN1	Gain [dB]	Ri Ω]	Zi [Ω]	fc [Hz]
Lo	Lo	6	90k	45k	7.5
Lo	Hi	12	70k	35k	9.7
Hi	Lo	18	45k	22.5k	15
Hi	Hi	24	25k	12.5k	27

②The power decoupling capacitors (C_{SR})

It makes a power decoupling capacitors 0.1μF. Because power decoupling capacitors influences total harmonic distortion (THD) and some audio characteristics, please place a good low equivalent-series-resistance (ESR) capacitors as close as possible to IC.

③BYPASS capacitor (C_{BYP})

Because BYPASS capacitor influences THD, PSRR and some audio characteristics, please place good low equivalent-series-resistance (ESR) capacitor as close as possible to IC.
The value of BYPASS capacitor determines the turn on time and turn off time.
Refer to the following section of “Turn ON and Turn OFF”.
It makes BYPASS capacitor of evaluation board 0.47μF.

④Control terminal

Each control terminal ($\overline{\text{SHUTDOWN}}$, GAIN0, GAIN1) don’t have pull-down resistance internal circuit.
Connect to GND line or VDD line or input Low or high level voltage to terminals in order to avoid the terminals made high Impedance.
Using IC under the control terminal let high impedance, operation fault may occur.

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●Evaluation board PCB layer

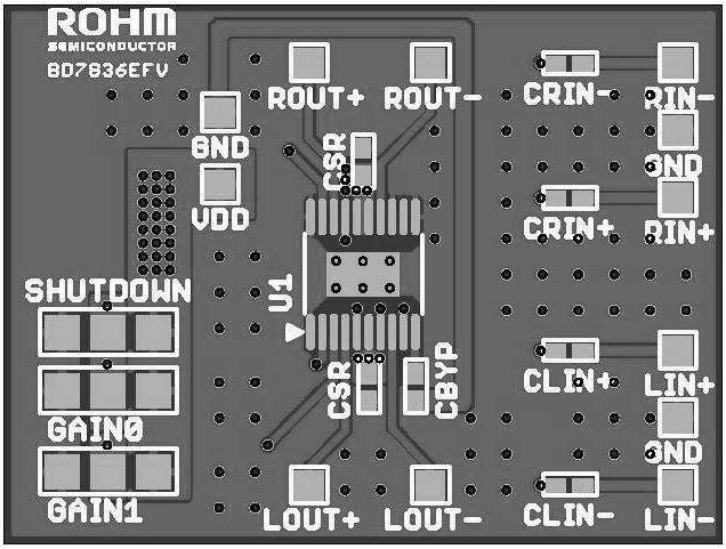


Fig.7 Top layer

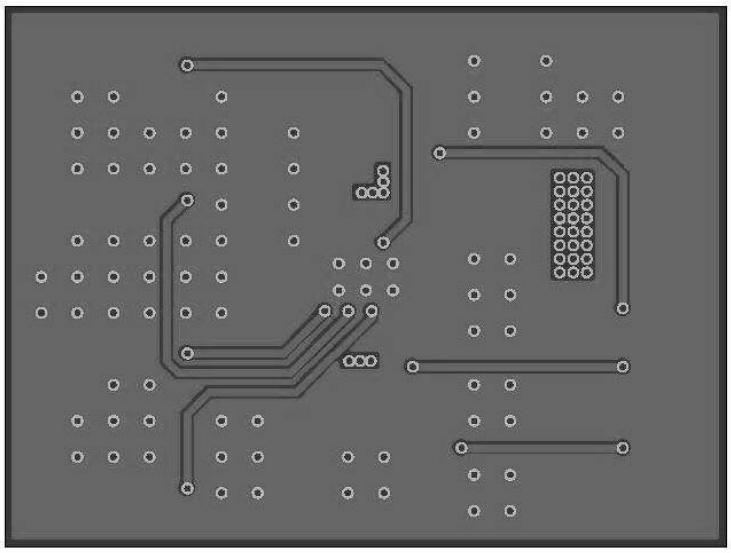


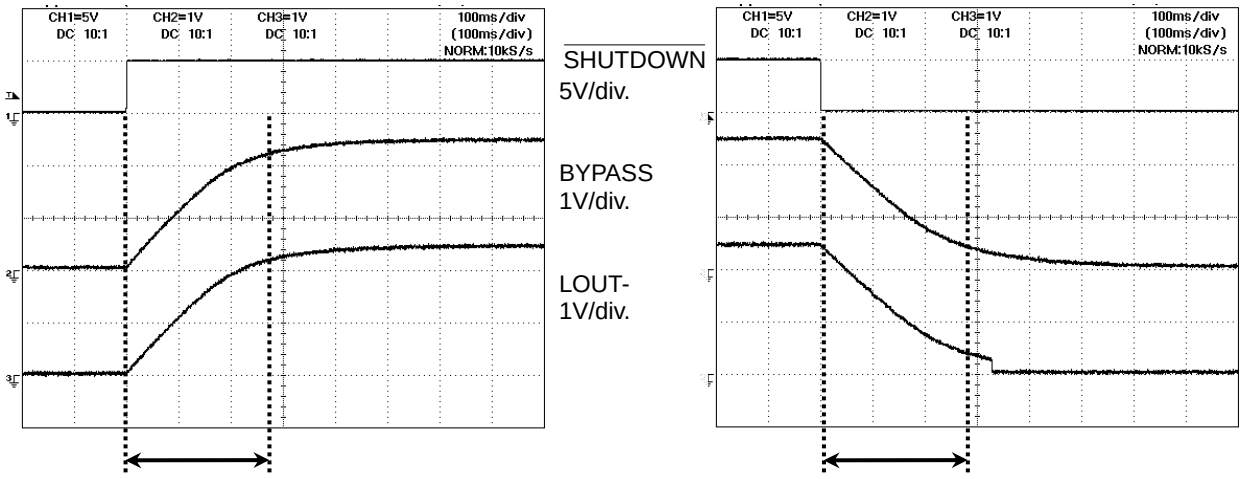
Fig.8 Bottom Layer

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●Turn on and Turn off

This IC has the circuit that reduces pop noise at “turn on” and “turn off”.
Reducing pop noise is realized in controlling to adjust the turn on and turn off time.



(a)Turn ON (b)Turn OFF

Fig. 9

The following table show the Turn ON time and Turn OFF time when It makes the BYPASS capacitor 0.47uF.

CBYP	Turn ON	Turn OFF
0.47uF	280ms	340ms

Turn ON time is defined as the time until BYPASS terminal voltage reaches the 90% of VDD/2 after $\overline{\text{SHUTDOWN}}$ L→H.
Turn OFF time is defined as the time until BYPASS terminal voltage reaches the 10% of VDD/2 after $\overline{\text{SHUTDOWN}}$ H→L.

The values of above table are typical characteristics. These values will shift by 30% at some conditions.

●Input terminal

This IC can be inputed signal by differntial inputs or single ended inputs.
When sing the single ended inputs, connect the terminal of not signal inputed line to AC GND with input couppling capacitors.
Please makes the value of all input capacitors same because of preventing pop noise.
If they are not same value, for example, LOUT+=0.47µF, LOUT-=0.33µF, it caused pop noise increase and characteristics become worse.

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●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.

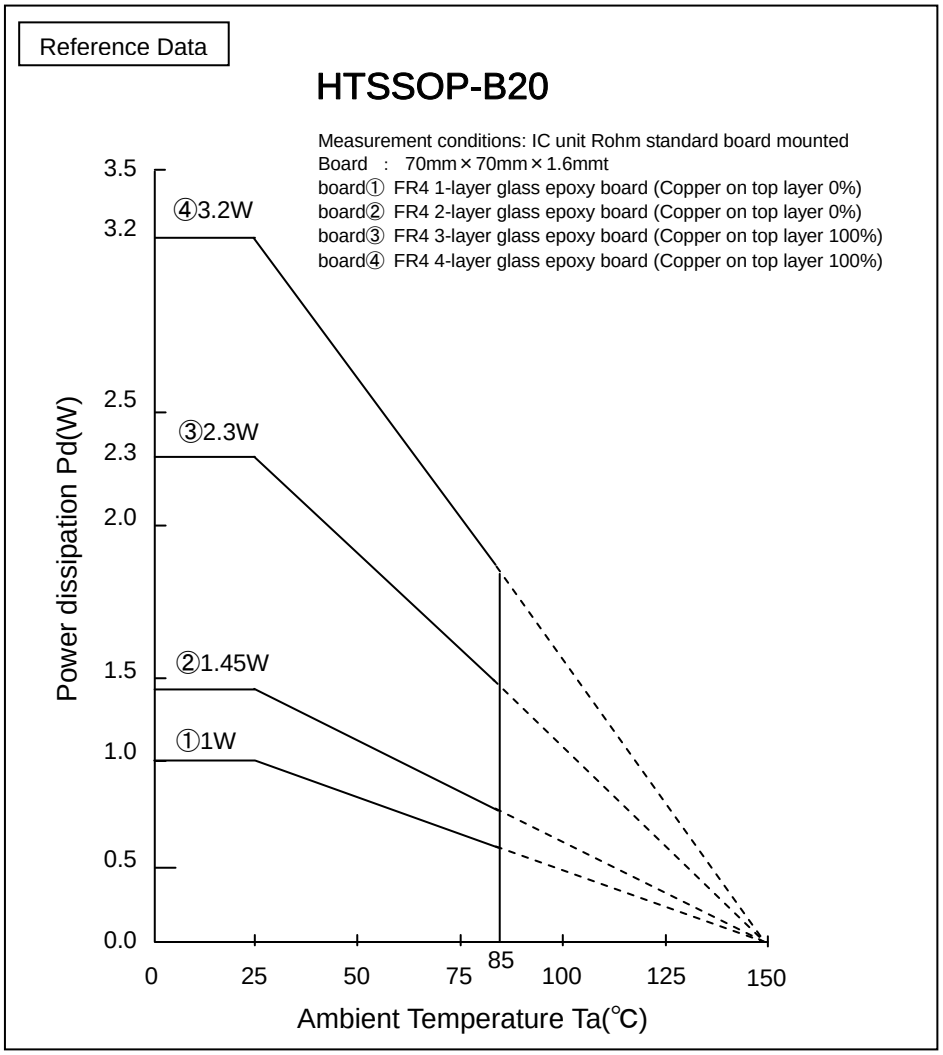
Since an maximum junction temperature (Tj_{MAX}.)or operating temperature range (Topr) is shown in the absolute maximum ratings of the IC, to reference the value, find it using the Pd-Ta characteristic (temperature derating curve).

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.

Fig.10 Power dissipation vs. Ambient temperature

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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●Typical Characteristics

TABLE OF GRAPHS

Items	Parameter	Figure number
Total harmonic distortion plus noise (THD+N)	vs. Frequency	11, 12, 17, 18
	vs. Output power	13, 14, 15, 16, 19, 20, 21, 22
Supply current (Icc)	vs. Supply voltage	23
Shutdown current (Isd)	vs. Supply voltage	24
Gain	vs. Frequency	25
Crosstalk	vs. Frequency	26
Supply ripple rejection ratio	vs. Frequency	27
Shutdown attenuation	vs. Frequency	28
Power dissipation	vs. Output power	29
Efficiency	vs. Output power	30
Output power	vs. Load resistance	31

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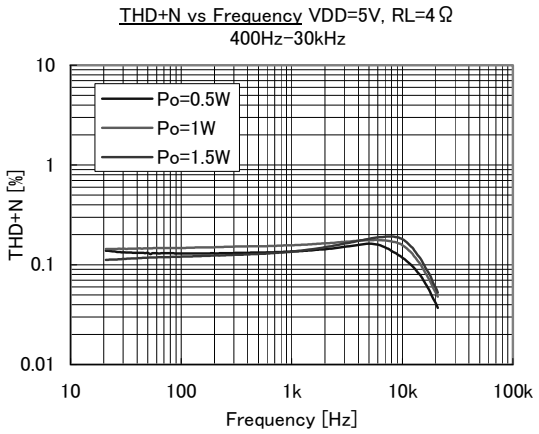


Fig.11

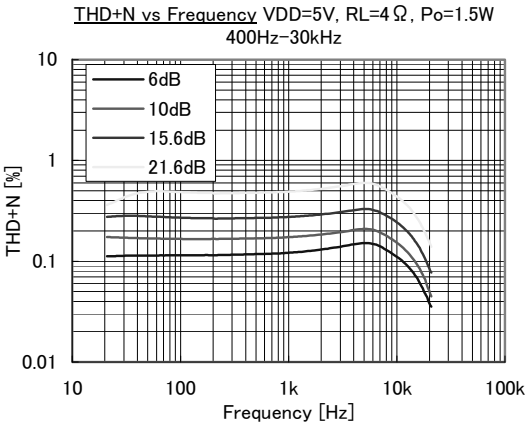


Fig.12

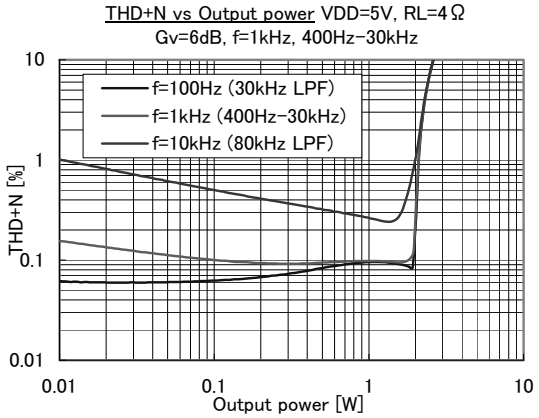


Fig.13

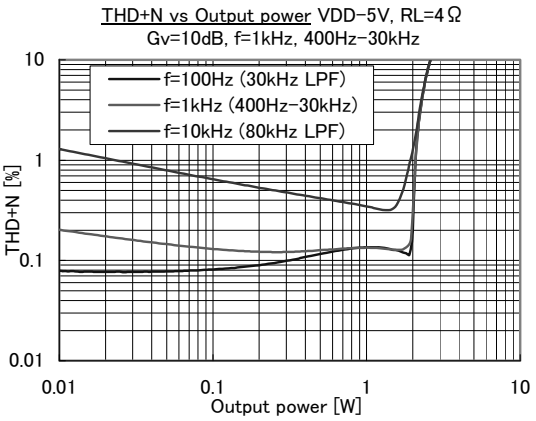


Fig.14

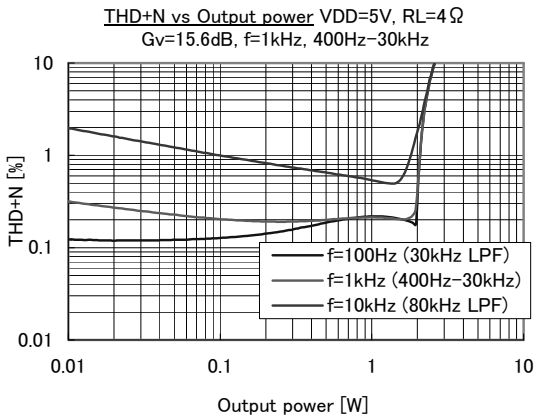


Fig.15

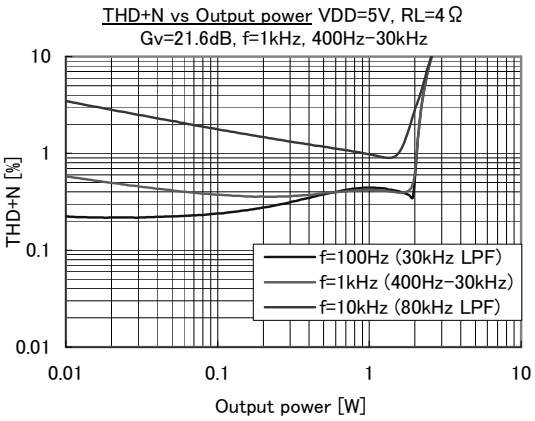


Fig.16

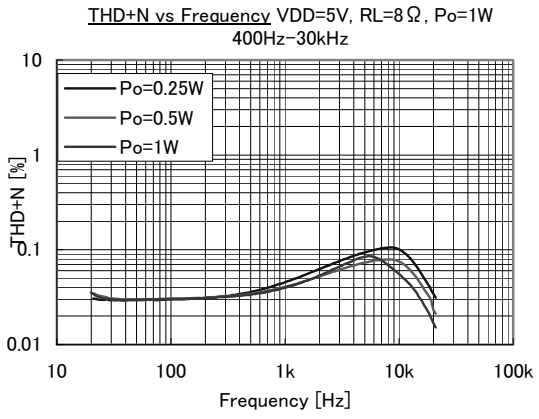


Fig.17

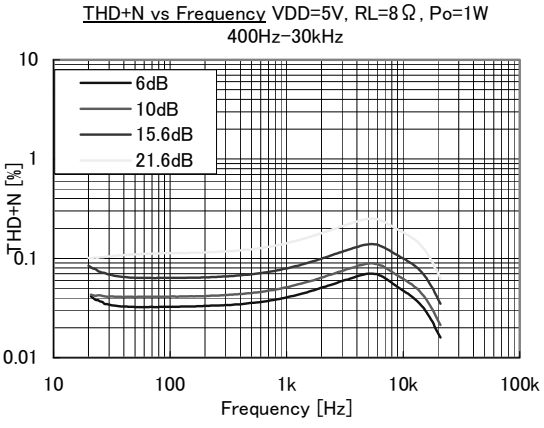


Fig.18

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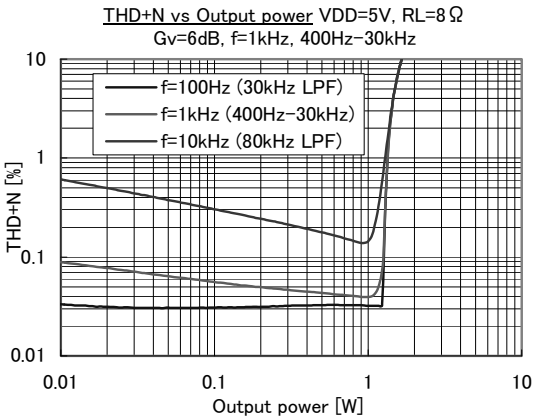


Fig.19

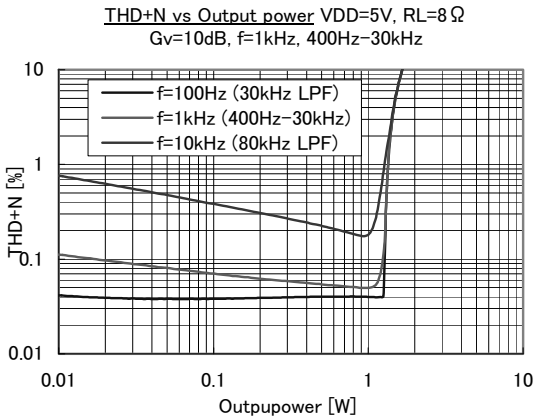


Fig.20

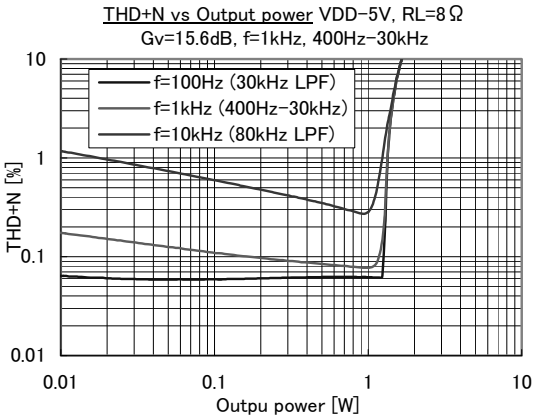


Fig.21

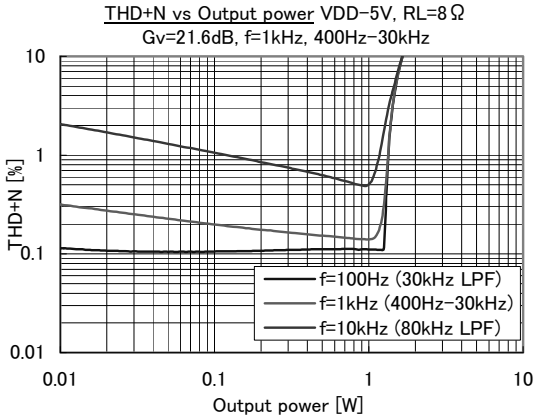


Fig.22

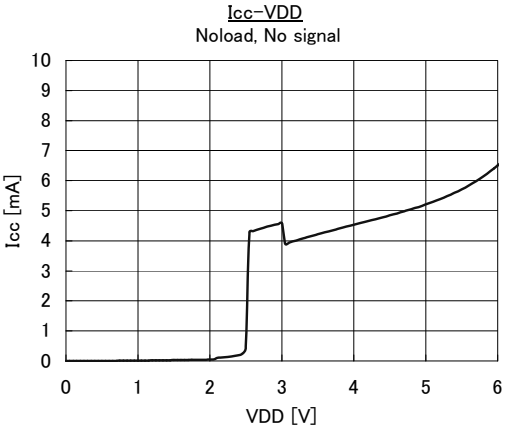


Fig.23

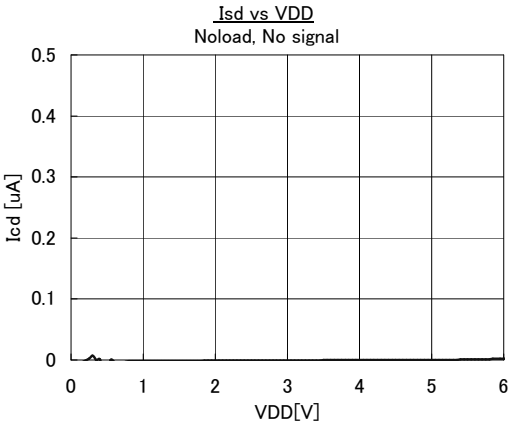


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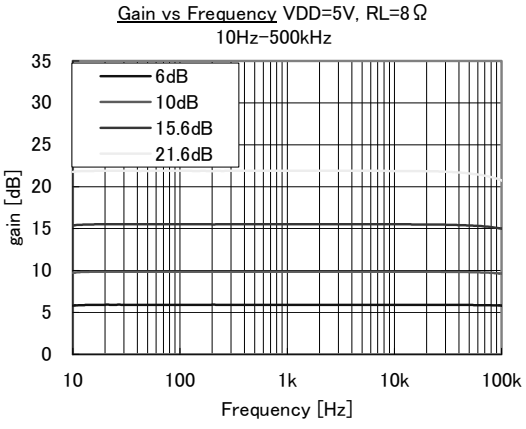


Fig.25

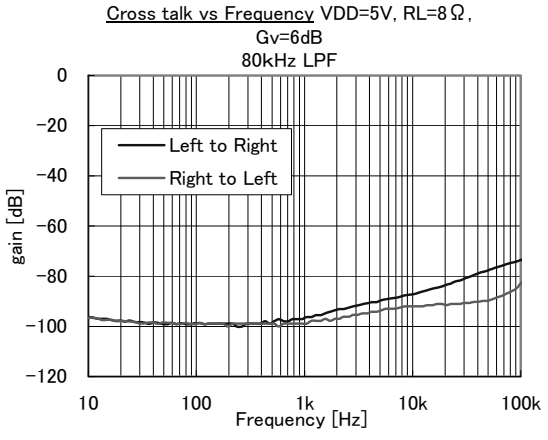


Fig.26

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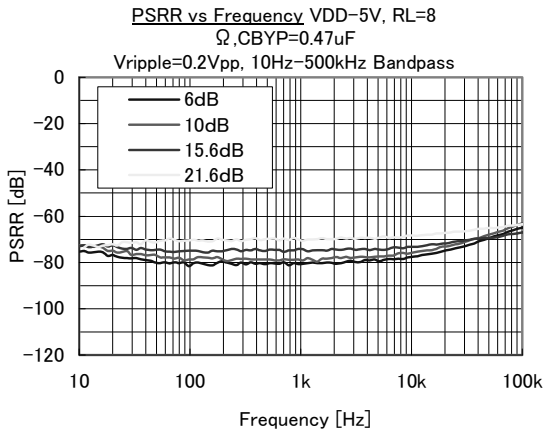


Fig.27

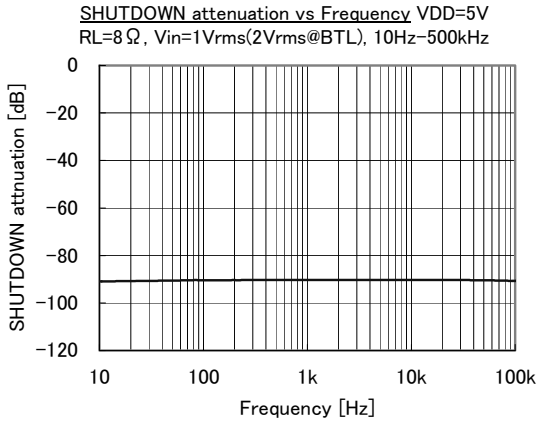


Fig.28

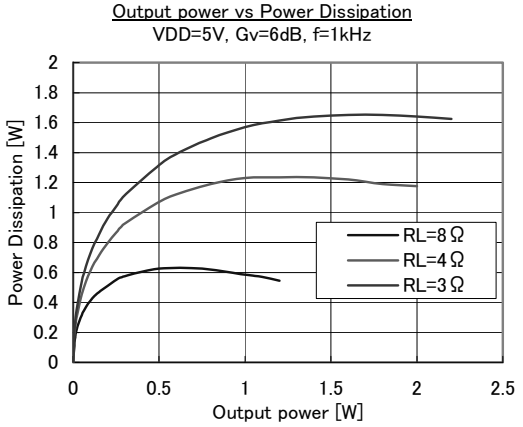


Fig.29

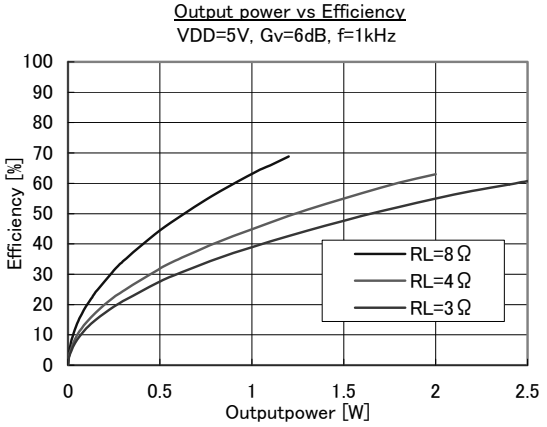


Fig.30

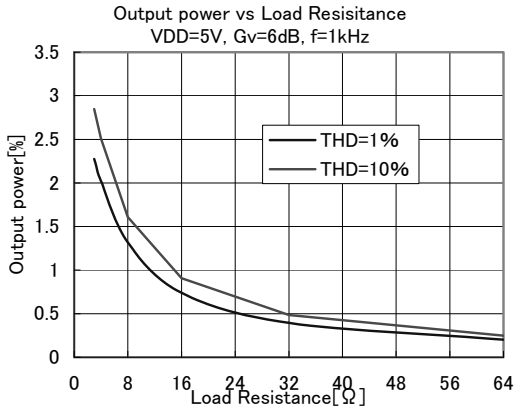


Fig.31

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●Notes for use

(1) Absolute maximum ratings
This IC may be damaged if the absolute maximum ratings for the applied voltage, temperature range, or other parameters
are exceeded. Therefore, avoid using a voltage or temperature that exceeds the absolute maximum ratings.
if it is possible that absolute maximum ratings will be exceeded, use fuses or other physical safety measures and determine ways to avoid exceeding the IC's absolute maximum ratings.

(2) GND terminal's potential
Try to set the minimum voltage for GND terminal's potential, regardless of the operation mode.

(3) Shorting between pins and mounting errors
When mounting the IC chip on a board, be very careful to set the chip's orientation and position precisely.
When the power is turned on, the IC may be damaged if it is not mounted correctly.
The IC may also be damaged if a short occurs (due to a foreign object, etc.) between two pins, between a pin and the power supply, or between a pin and the GND.

(4) Operation in strong magnetic fields
Note with caution that operation faults may occur when this IC operates in a strong magnetic field.

(5) Thermal design
Ensure sufficient margins to the thermal design by taking in to account the allowable power dissipation during actual use modes, because this IC is power amp. When excessive signal inputs which the heat dissipation is insufficient condition, it is possible that thermal shutdown circuit is active

(6) Thermal shutdown circuit
This product is provided with a built-in thermal shutdown circuit. When the thermal shutdown circuit operates, the output transistors are placed under open status. The thermal shutdown circuit is primarily intended to shutdown the IC avoiding thermal runaway under abnormal conditions with a chip temperature exceeding Tjmax = +150℃, and is not intended to protect and secure an electrical appliance

(7) Load of the output terminal
This IC corresponds to dynamic speaker load, and doesn't correspond to the load except for dynamic speakers.

(8) The short protection of the output terminal
This IC has short protection circuit. The function protects the IC from rash current on road.

(9) Operating ranges
The rated operating power supply voltage range (VDD=+4.5V～+5.5V) and the rated operating temperature range (Ta=-40℃～+85℃) are the range by which basic circuit functions is operated. Characteristics and rated output power are not guaranteed in all power supply voltage ranges or temperature ranges.

(10) Electrical characteristics
Electrical characteristics show the typical performance of device and depend on board layout, parts, power supply.
The standard value is in mounting device and parts on surface of ROHM's board directly.

(11) Maximum output power
When stereo inputs at R_L=4Ω, maximum output power may not achieve up to typical value because the device heats.
Ensure sufficient margins to the thermal design to get larger output power.

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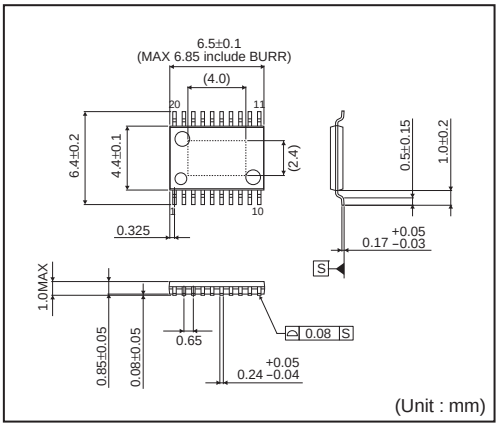
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●Ordering part number

B	D	7	8	3	6	E	F	V	-	E	2

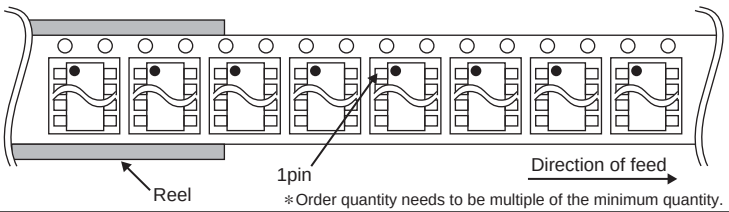
Part No.	Part No.	Package	Packaging and forming specification
	7836	EFV:HTSSOP-B20	E2: Embossed tape ad reel

HTSSOP-B20



<Tape and Reel information>

Tape	Embossed carrier tape (with dry pack)
Quantity	2500pcs
Direction of feed	E2 (The direction is the 1pin of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand)



∗Order quantity needs to be multiple of the minimum quantity.

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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 electronic appliances, amusement equipment, etc.). If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment (Note 1), transport equipment, traffic equipment, aircraft/spacecraft, nuclear power controllers, fuel controllers, car equipment including car accessories, safety devices, etc.) and whose malfunction or failure may cause loss of human life, bodily injury or serious damage to property ("Specific Applications"), please consult with the ROHM sales representative in advance. Unless otherwise agreed in writing by ROHM in advance, 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 any ROHM's Products for Specific Applications.

(Note1) Medical Equipment Classification of the Specific Applications

JAPAN	USA	EU	CHINA
CLASSⅢ	CLASSⅢ	CLASSⅡb	CLASSⅢ
CLASSⅣ		CLASSⅢ	

2. ROHM designs and manufactures its Products subject to strict quality control system. However, semiconductor products can fail or malfunction at a certain rate. Please be sure to implement, at your own responsibilities, adequate safety measures including but not limited to fail-safe design against the physical injury, damage to any property, which a failure or malfunction of our Products may cause. The following are examples of safety measures:
   [a] Installation of protection circuits or other protective devices to improve system safety
   [b] Installation of redundant circuits to reduce the impact of single or multiple circuit failure

3. Our Products are designed and manufactured for use under standard conditions and not under any special or extraordinary environments or conditions, as exemplified below. Accordingly, ROHM shall not be in any way responsible or liable for any damages, expenses or losses arising from the use of any ROHM's Products under any special or extraordinary environments or conditions. If you intend to use our Products under any special or extraordinary environments or conditions (as exemplified below), your independent verification and confirmation of product performance, reliability, etc, prior to use, must be necessary:
   [a] Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
   [b] Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
   [c] Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl_2, H_2S, NH_3, SO_2, and NO_2
   [d] Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
   [e] Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
   [f] Sealing or coating our Products with resin or other coating materials
   [g] Use of our Products without cleaning residue of flux (even if you use no-clean type fluxes, cleaning residue of flux is recommended); or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
   [h] Use of the Products in places subject to dew condensation

4. The Products are not subject to radiation-proof design.

5. Please verify and confirm characteristics of the final or mounted products in using the Products.

6. In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse. is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.

7. De-rate Power Dissipation (Pd) depending on Ambient temperature (Ta). When used in sealed area, confirm the actual ambient temperature.

8. Confirm that operation temperature is within the specified range described in the product specification.

9. ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

Precaution for Mounting / Circuit board design

1. When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.

2. In principle, the reflow soldering method must be used; if flow soldering method is preferred, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

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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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