Audio Accessory IC Series

Ground Isolation Amplifier

BA3121F, BA3123F

No.09092EAT01

●Description

The BA3121F/BA3123F are ground isolation amplifiers developed for use in car audio applications.
This IC efficiently eliminate problems caused by wiring resistance, and remove noise generated by the electrical devices used in automobiles. The capacitance values of the external capacitors required for the ICs are small to allow compact and reliable set design.

●Features

1) Large capacitors not required
2) High common-mode rejection ratio (57dB typ. at f = 1kHz).
3) Low noise (VNO = 3.5μVrms Typ.).
4) Low distortion (THD = 0.002% Typ.).
5) Two channels.

●Applications

Car audio systems

●Line up matrix

	BA3121F	BA3123F
Operation temperature	−30～+85°C	−40～+85°C

●Absolute maximum ratings (Ta = 25°C)

Parameter		Symbol	Limits	Unit
Power supply voltage		Vcc	18	V
Power dissipation		Pd	450*	mW
Operation temperature	BA3121F	Topr	−30～+85	℃
	BA3123F		−40～+85	℃
Storage temperature		Tstg	−55～+125	℃

∗Reduced by 4.5mW in Ta of 1°C over 25°C.

●Recommended operating conditions (Ta = 25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power supply voltage	Vcc	4	12	18	V

●**Electrical characteristics** (unless otherwise noted, Ta = 25°C, VCC = 12V, f = 1kHz, Rg = 1.8kΩ)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Quiescent current	I_Q	5.6	9.0	14.0	mA	V_{IN}=0V_{rms}
Output noise voltage	V_{NO}	－	3.5	8.0	μV_{rms}	BPF＝20Hz-20kHz
Voltage gain	G_V	-1.5	-0.04	1.5	dB	V_O＝－10dBm, R_g＝0Ω
Maximum output voltage	V_{OM}	1.8	2.0	－	V_{rms}	THD＝0.1%, Vcc＝8V
Total harmonic distortion	THD	－	0.002	0.02	%	V_O＝0.7V_{rms}
Common-mode rejection ratio	CMRR	41	57	－	dB	
Common-made voltage	V_{CM}	2.5	3.75	－	V_{rms}	Vcc＝8V,CMRR＝40dB
Ripple rejection ratio	RR	72	80	－	dB	f_{RR}＝100Hz,V_{RR}＝－10dBm, R_g＝0Ω
Channel separation	CS	－	82	－	dB	V_{IN}＝－10dBm, R_g＝1.8kΩ/OPEN
Slew rate	SR	－	2.0	－	V/μS	
Input resistance	R_{IN}	44	55	66	kΩ	

◎Not designed for radiation resistance

●**Electrical characteristics curves**

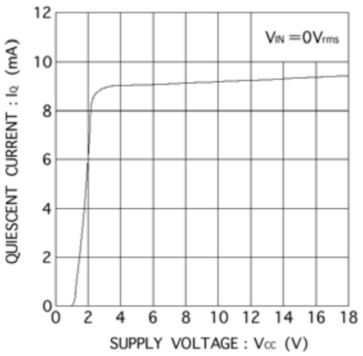


Fig.1 Quiescent current vs. power supply voltage

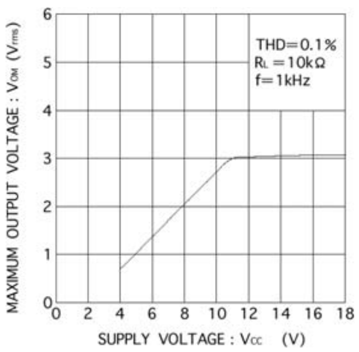


Fig.2 Maximum output voltage vs. power supply voltage

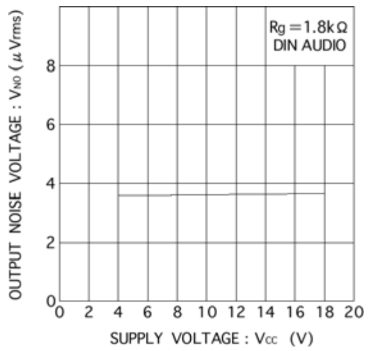


Fig.3 Output noise voltage vs. power supply voltage

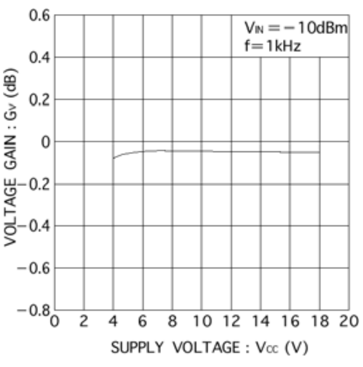


Fig.4 Voltage gain vs. power supply voltage

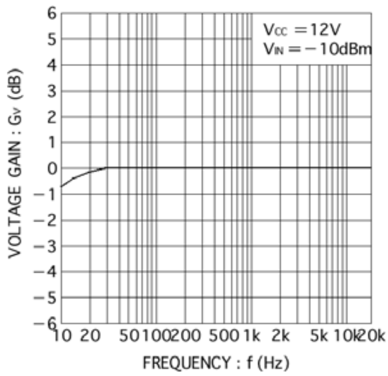


Fig.5 Voltage gain vs. frequency

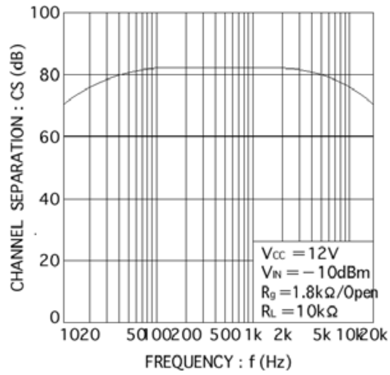


Fig.6 Channel separation

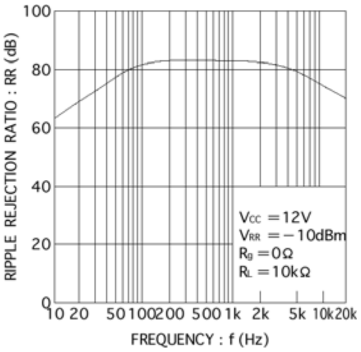


Fig.7 Ripple rejection ratio
vs. frequency

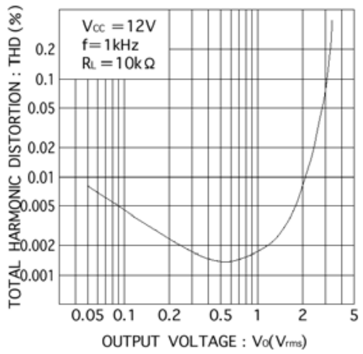


Fig.8 Total harmonic distortion
vs. output voltage

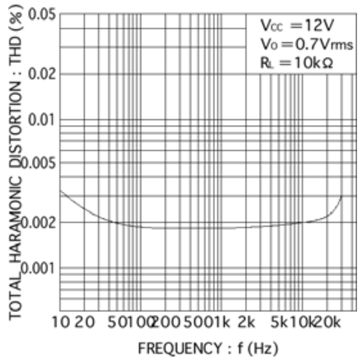


Fig.9 Total harmonic distortion
vs. frequency

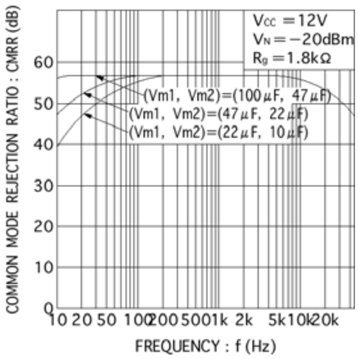


Fig.10 Common-mode rejection ratio
vs. frequency

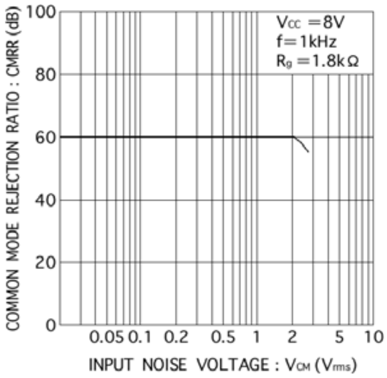


Fig.11Common-mode rejection ration
vs. input voltage

● **Measurement circuits**

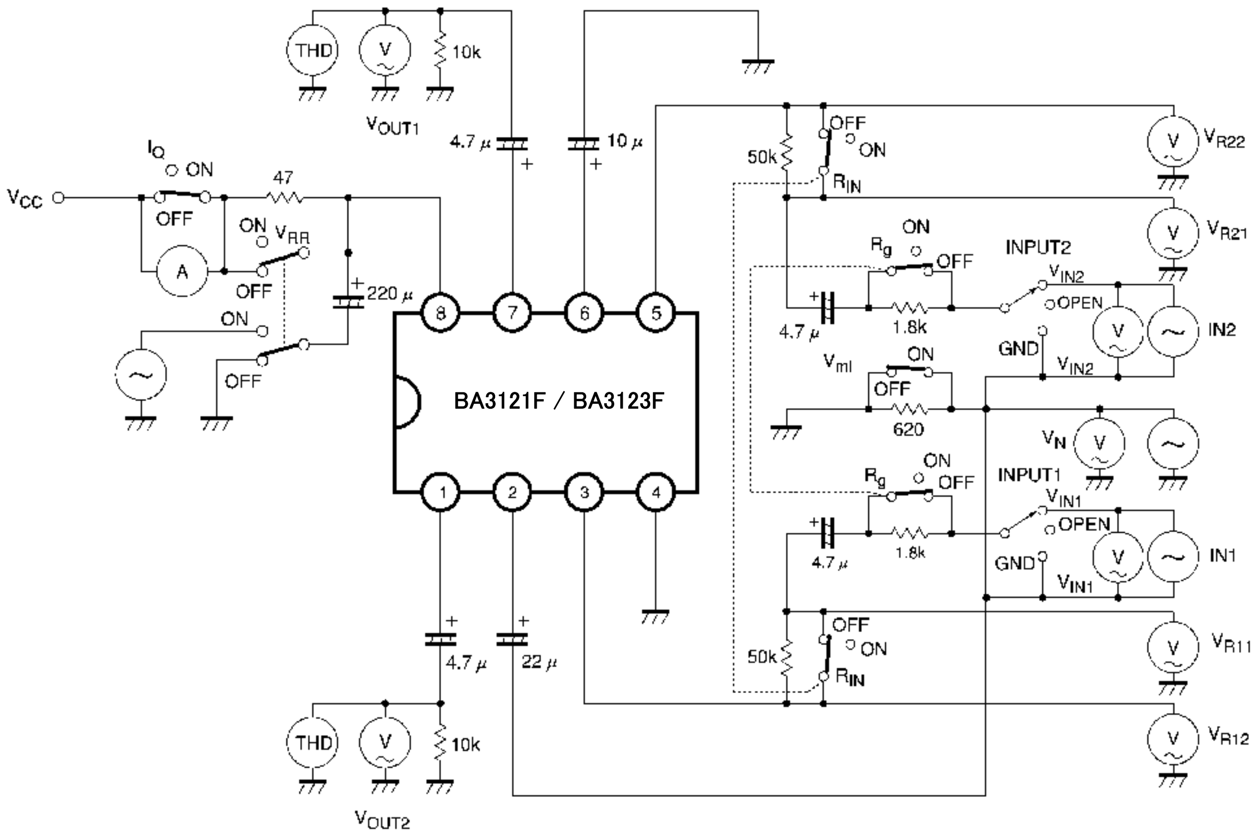


Fig.12

●**Block Diagram**

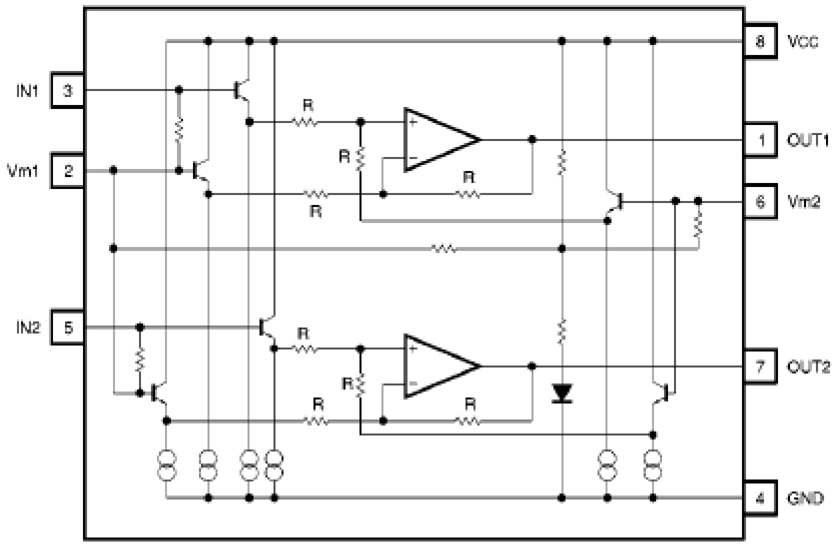


Fig.13

●Circuit operation

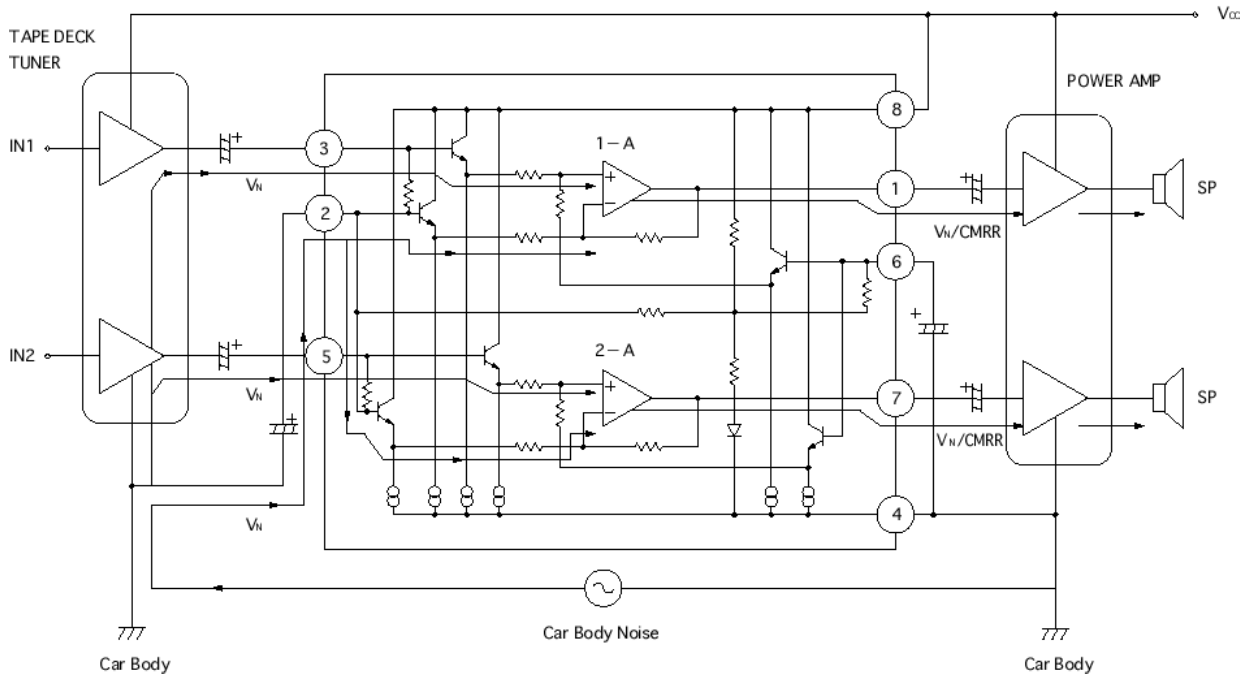


Fig.14 Flow of noise in car audio systems

Car audio systems are earthed to the car body, and for this reason, electrical noise generated by the car electrics can enter the power amplifier input via the chassis, and become audible.
The BA3121F/BA3123F makes use of the common-mode rejection characteristics of an operational amplifier to eliminate this noise. Without the BA3121F/BA3123F noise enters the power amplifier input directly, when used, the CMMR of operational amplifiers 1-A and 2-A eliminates the noise.
Principles of noise elimination:
To obtain the output voltage (eO)

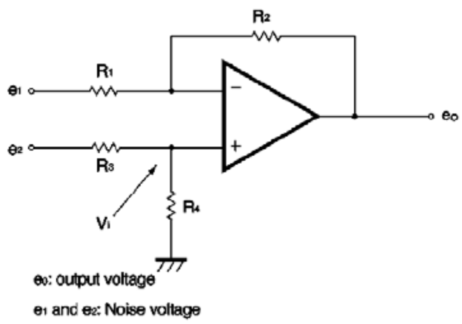


Fig.15 The principle of noise rejection

$$V_i = \frac{R_4}{(R_3+R_4)} \cdot e_2 \quad ①$$

$$e_0 = -\frac{R_2}{R_1} e_1 + \frac{R_1+R_2}{R_1} \cdot V_i \quad ②$$

With the BA3121F/BA3123F, the elimination level of the noise is expressed
as: CMMR = 20log $(e_0/e_I)(e_I = e_1 = e_2)$
Therefore, CMRR ≧ 41dB can be guaranteed.

From ① and ②

$$e_0 = -\frac{R_2}{R_1} e_1 + \frac{R_1+R_2}{R_1} \cdot \frac{R_4}{(R_3+R_4)} \cdot e_2$$

$$= -\frac{R_2}{R_1} \cdot (e_1 - e_2) + \frac{R_1R_4 - R_2R_3}{R_1 (R_3+R_4)} \cdot e_2$$

Ideally, if R1R4 = R2R3, and e1 = e2, the noise voltage will become zero. However, due to mismatching between the resistors, difference in the noise voltages (e1 and e2), and tolerances in the operational amplifier, a noise voltage does result.

●**Applications**

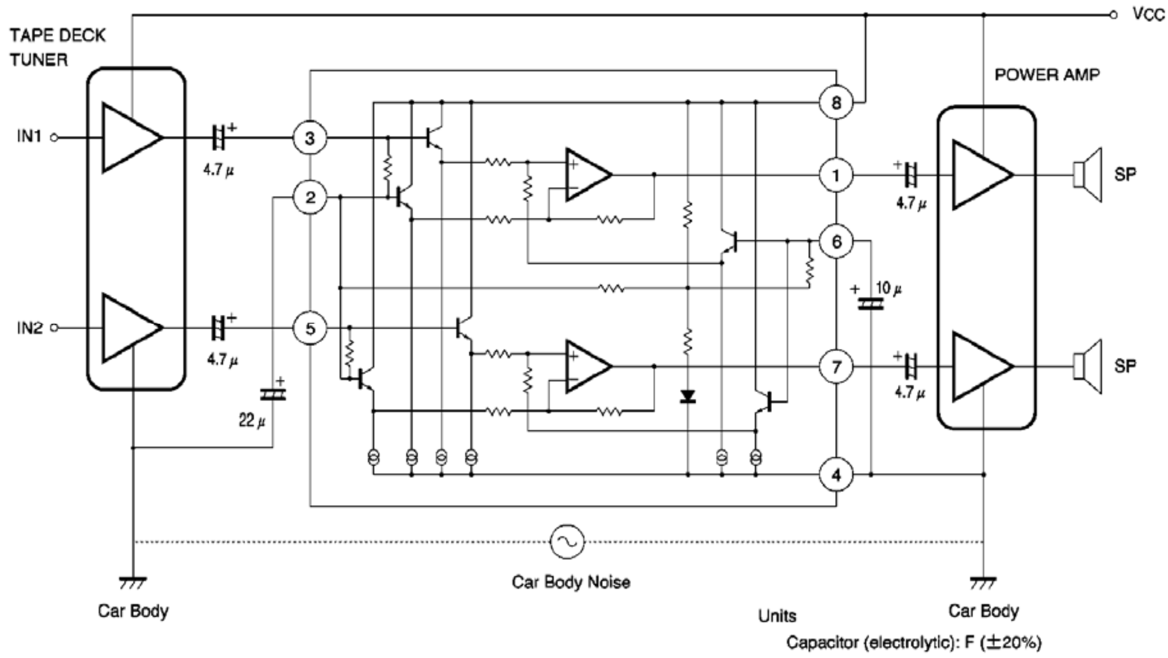


Fig.16

●**Cautions on use**

(1) Numbers and data in entries are representative design values and are not guaranteed values of the items.

(2) Although we are confident in recommending the sample application circuits, carefully check their characteristics further when using them. When modifying externally attached component constants before use, determine them so that they have sufficient margins by taking into account variations in externally attached components and the Rohm LSI, not only for static characteristics but also including transient characteristics.

(3) Absolute maximum ratings
If applied voltage, operating temperature range, or other absolute maximum ratings are exceeded, the LSI may be damaged. Do not apply voltages or temperatures that exceed the absolute maximum ratings. If you think of a case in which absolute maximum ratings are exceeded, enforce fuses or other physical safety measures and investigate how not to apply the conditions under which absolute maximum ratings are exceeded to the LSI.

(4) GND potential
Make the GND pin voltage such that it is the lowest voltage even when operating below it. Actually confirm that the voltage of each pin does not become a lower voltage than the GND pin, including transient phenomena.

(5) Thermal design
Perform thermal design in which there are adequate margins by taking into account the allowable power dissipation in actual states of use.

(6) Shorts between pins and misinstallation
When mounting the LSI on a board, pay adequate attention to orientation and placement discrepancies of the LSI. If it is misinstalled and the power is turned on, the LSI may be damaged. It also may be damaged if it is shorted by a foreign substance coming between pins of the LSI or between a pin and a power supply or a pin and a GND.

(7) Operation in strong magnetic fields
Adequately evaluate use in a strong magnetic field, since there is a possibility of malfunction.

(8) The capacitors of 2pin (Vm_1), and 6pin (Vm_2) should maintain the ratio of 2:1 for ripple removal characteristics. Maintaining this ratio will not cause ripple removal rate to reduce significantly even if the capacitance reduces to a half.

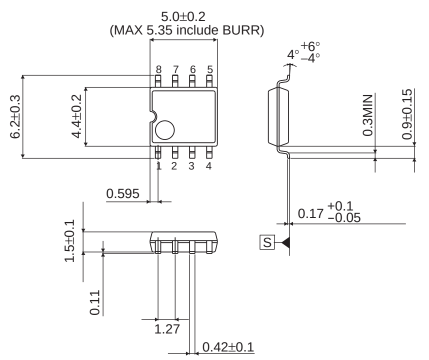
(9) Setting the capacitor to the double or half will make the CMRR in the low range to +6dB or -6dB respectively (Fig. 10)

●Ordering part number

B	A		3	1	2	1		F	-	E	2

- Part No.
- Part No.
  3121:
  Operation temperature
  -30~85°C
  3123:
  Operation temperature
  -40~85°C
- Package
  F: SOP8
- Packaging and forming specification
  E2: Embossed tape and reel

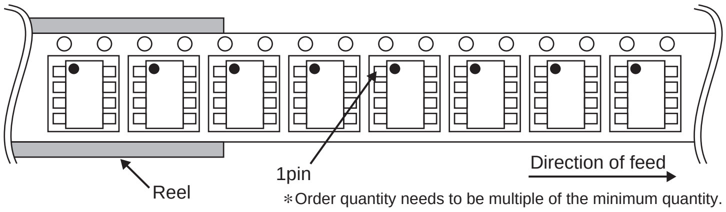
SOP8



(Unit : mm)

<Tape and Reel information>

Tape	Embossed carrier tape
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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JAPAN	USA	EU	CHINA
CLASSⅢ	CLASSⅢ	CLASSⅡb	CLASSⅢ
CLASSⅣ		CLASSⅢ	

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   [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

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.

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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.

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