TECHNICAL NOTE

Audio Accessory IC Series

Ground Isolation Amplifier

BA3121F

●Description

The BA3121F are ground isolation amplifiers developed for use in car audio applications. This IC efficiently eliminates problems caused by wiring resistance, and removes noise generated by the electrical devices used in automobiles. The capacitance values of the external capacitors required for the ICs are small, in order 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 (V_{NO} = 3.5μVrms Typ.)
4) Low distortion (THD = 0.002% Typ.)
5) Two channels.

●Applications

Car audio systems

●Absolute maximum ratings (Ta = 25°C)

Parameter	Symbol	Limits	Unit
Power supply voltage	Vcc	18	V
Power dissipation	Pd	450*	mW
Operation temperature	Topr	−30～+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

Ver.B Oct.2005

● **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	

Note: This IC is not designed to be radiation-resistant.

● **Electrical characteristics curves**

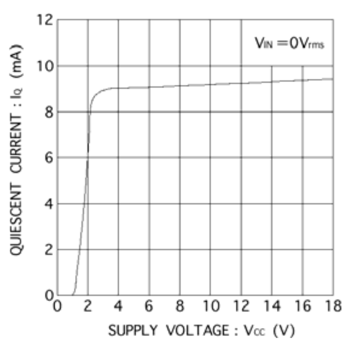


Fig.1 Quiescent current vs. power supply voltage

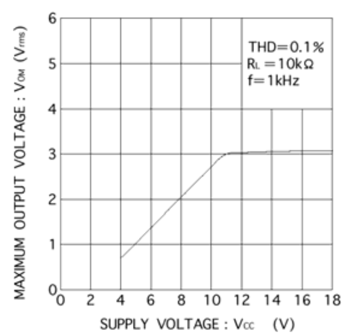


Fig.2 Maximum output voltage vs. power supply voltage

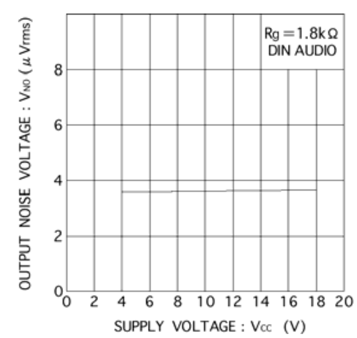


Fig.3 Output noise voltage vs. power supply voltage

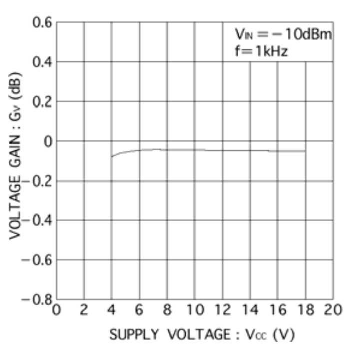


Fig.4 Voltage gain vs. power supply voltage

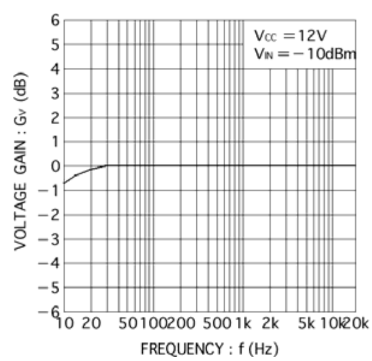


Fig.5 Voltage gain vs. frequency

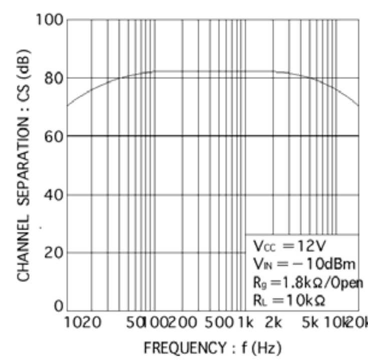


Fig.6 Channel separation vs. frequency

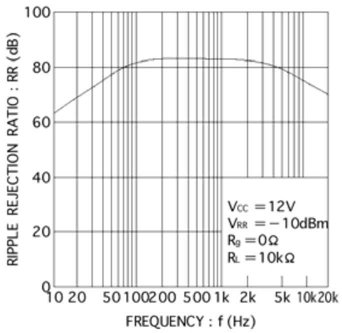


Fig.7 Ripple rejection ratio
vs. frequency

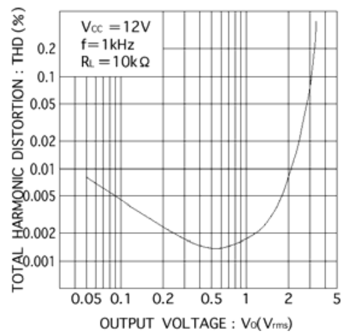


Fig.8 Total harmonic distortion
vs. output voltage

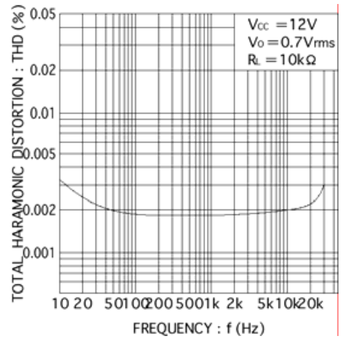


Fig.9 Total harmonic distortion
vs. frequency

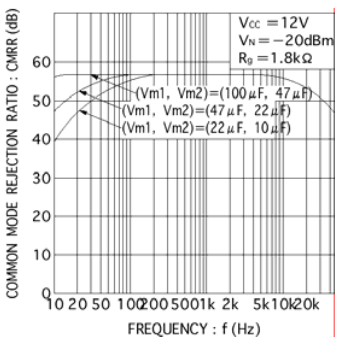


Fig.10 Common-mode rejection ratio
vs. frequency

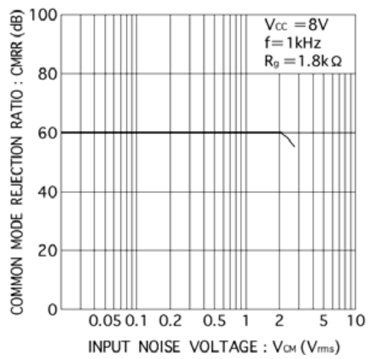


Fig.11Common-mode rejection ration
vs. input voltage

●**Measurement circuits**

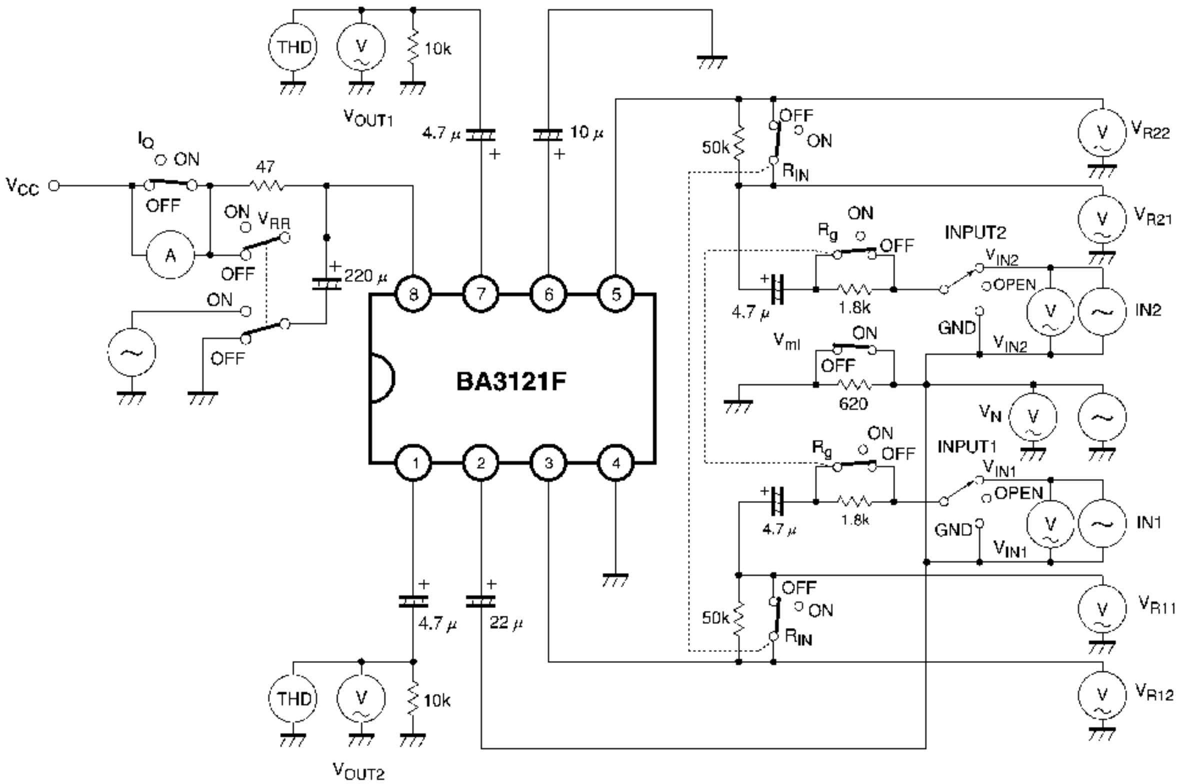


Fig.12

●Block diaglam

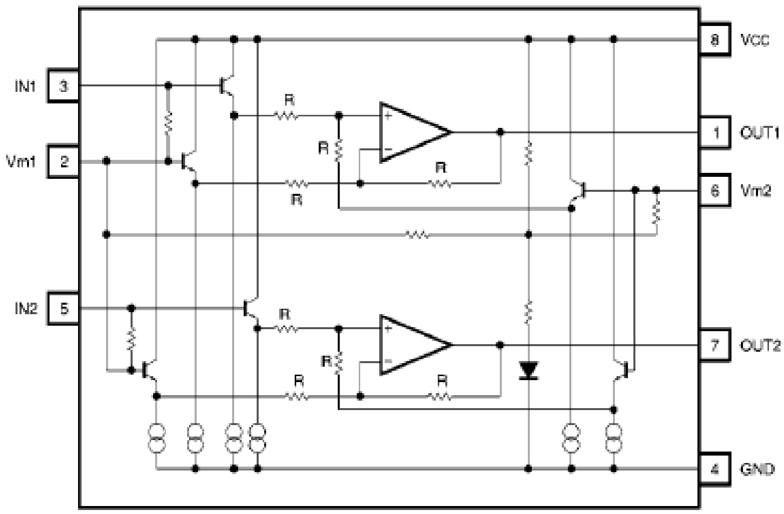


Fig.13

●Circuit operation

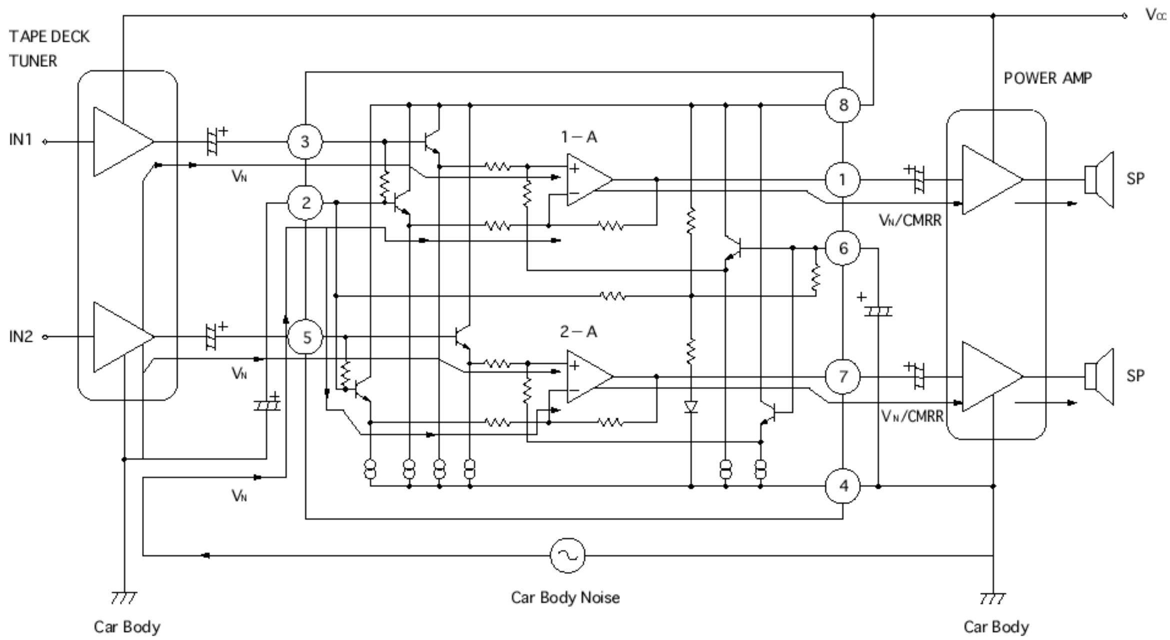


Fig.14 Flow of noise in car audio systems

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 makes use of the common-mode rejection characteristics of an operational amplifier to eliminate this noise. Without the BA3121F, 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 (e_O)

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

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

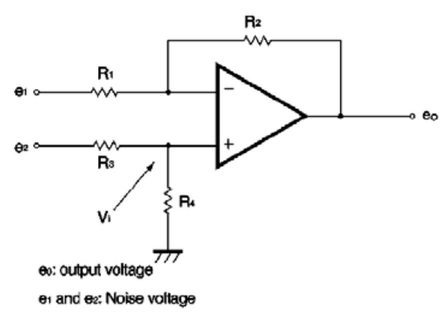


Fig.15 The principle of noise rejection

From ① and ②

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

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

Ideally, if $R_1R_4 = R_2R_3$, and $e_1 = e_2$, the noise voltage will become zero. However, due to mismatching between the resistors, difference in the noise voltages (e_1 and e_2), and tolerances in the operational amplifier, a noise voltage exists.

With the BA3121F, 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.

●Applications

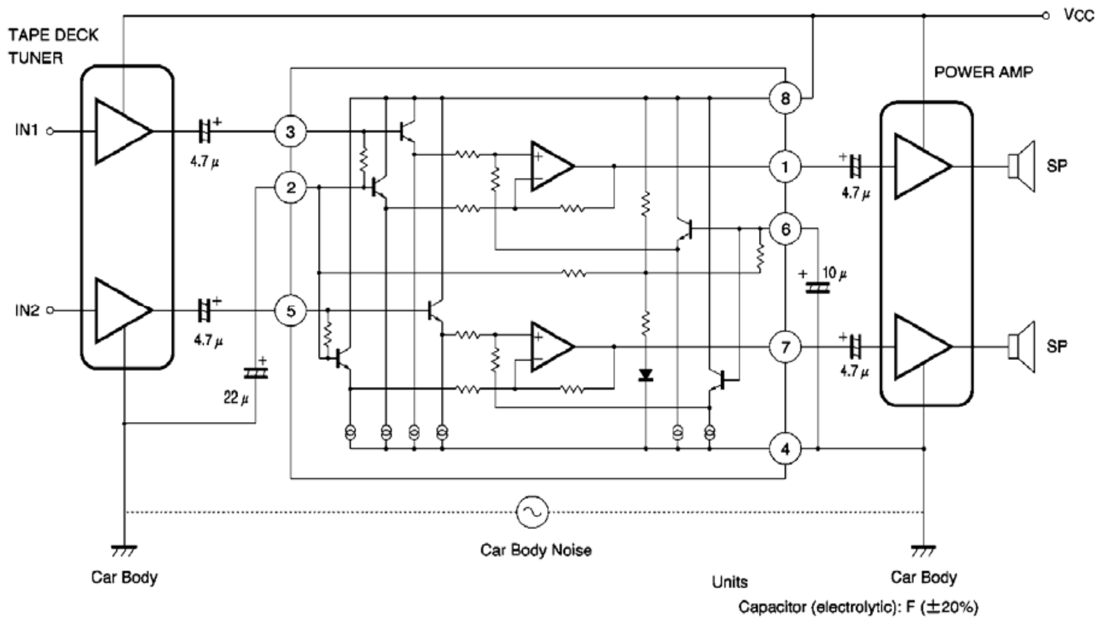


Fig.16

●Cautions on use

(1) Numbers and data in entries

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

(2) Example application circuit

Although ROHM is confident that the example application circuit reflects the best possible recommendations, be sure to verify circuit characteristics for your particular application. Modification of constants for other externally connected circuits may cause variations in both static and transient characteristics for external components as well as this Rohm IC. Allow for sufficient margins when determining circuit constants.

(3) Absolute maximum ratings

Use of the IC in excess of absolute maximum ratings, such as the applied voltage or operating temperature range (Topr), may result in IC damage. Assumptions should not be made regarding the state of the IC (short mode or open mode) when such damage is suffered. A physical safety measure, such as a fuse, should be implemented when using the IC at times where the absolute maximum ratings may be exceeded.

(4) GND potential

Ensure a minimum GND pin potential in all operating conditions. Make sure that no pins are at a voltage below the GND at any time, regardless of whether it is a transient signal or not.

(5) Thermal design

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

(6) Short circuit between terminals and erroneous mounting

Pay attention to the assembly direction of the ICs. Wrong mounting direction or shorts between terminals, GND, or other components on the circuits, can damage the IC.

(7) Operation in strong electromagnetic field

Using the ICs in a strong electromagnetic field can cause operation malfunction.

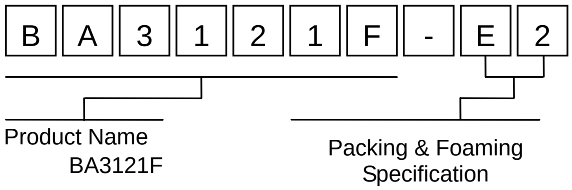
(8) Ripple removal characteristics

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

(9) CMRR

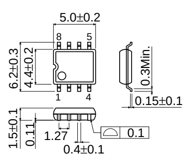
Setting the capacitor to the double or half will change the CMRR to a low range of +6dB or -6dB (Fig. 10).

●Order model name selection



SOP8

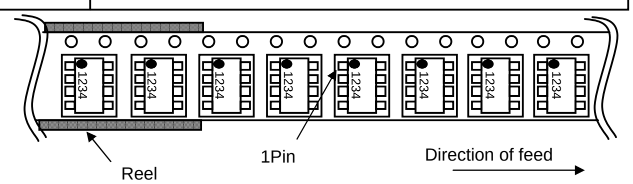
<Dimension>



(Unit:mm)

<Tape and Reel information>

Tape	Embossed carrier tape
Quantity	2500pcs
Direction of feed	E2 (Correct direction: 1pin of product should be at the upper left when you hold reel on the left hand, and you pull out the tape on the right hand)



※Orders are available in complete units only.

The products listed in this catalog are designed to be used with ordinary electronic equipment or devices (such as audio visual equipment, office-automation equipment, communications devices, electrical appliances and electronic toys).
Should you intend to use these products with equipment or devices which require an extremely high level of reliability and the malfunction of which would directly endanger human life (such as medical instruments, transportation equipment, aerospace machinery, nuclear-reactor controllers, fuel controllers and other safety devices), please be sure to consult with our sales representative in advance.

Excellence in Electronics

ROHM CO., LTD.
21, Saiin Mizosaki-cho, Ukyo-ku, Kyoto
615-8585, Japan
TEL: (075)311-2121 FAX: (075)315-0172
URL http: // www. rohm. com

Published by
Application Engineering Group

Contact us for further information about the products.

Atlanta U.S.A. / ROHM ELECTRONICS ATLANTA SALES OFFICE (DIVISION OF ROHM ELE. U.S.A ,LLC)
TEL: +1(770)754-5972 FAX: +1(770)754-0691
Dallas U.S.A. / ROHM ELECTRONICS DALLAS SALES OFFICE (DIVISION OF ROHM ELE. U.S.A ,LLC)
TEL: +1(972)312-8818 FAX: +1(972)312-0330
San Diego U.S.A. / ROHM ELECTRONICS SAN DIEGO SALES OFFICE (DIVISION OF ROHM ELE. U.S.A ,LLC)
TEL: +1(858)625-3630 FAX: +1(858)625-3670
Germany / ROHM ELECTRONICS GMBH (GERMANY)
TEL: +49(2154)9210 FAX: +49(2154)921400
United Kingdom / ROHM ELECTRONICS GMBH (UK)
TEL: +44(0)1908-306700 FAX: +44(0)1908-235788
France / ROHM ELECTRONICS GMBH (FRANCE)
TEL: +33(0)1 56 97 30 60 FAX: +33(0)1 56 97 30 80
Hong Kong China / ROHM ELECTRONICS (H.K.) CO., LTD.
TEL: +852(2)7406262 FAX: +852(2)375-8971
Shanghai China / ROHM ELECTRONICS (SHANGHAI) CO., LTD.
TEL: +86(21)6279-2727 FAX: +86(21)6247-2066
Dalian China / ROHM ELECTRONICS TRADING (DALIAN) CO., LTD.
TEL:+86(411)8230-8549 FAX:+86(411)8230-8537
Beijing China / BEIJING REPRESENTATIVE OFFICE
TEL: +86(10)8525-2483 FAX: +86(10)8525-2489
Taiwan / ROHM ELECTRONICS TAIWAN CO., LTD.
TEL: +886(2)2500-6956 FAX: +886(2)2503-2869
Korea / ROHM ELECTRONICS KOREA CORPORATION
TEL: +82(2)8182-700 FAX: +82(2)8182-715
Singapore / ROHM ELECTRONICS ASIA PTE. LTD. (RES / REI)
TEL: +65-6332-2322 FAX: +65-6332-5662
Malaysia / ROHM ELECTRONICS (MALAYSIA) SDN. BHD.
TEL: +60(3)7958-8355 FAX: +60(3)7958-8377
Philippines / ROHM ELECTRONICS (PHILIPPINES) SALES CORPORATION
TEL: +63(2)807-6872 FAX: +63(2)809-1422
Thailand / ROHM ELECTRONICS (THAILAND) CO., LTD.
TEL: +66(2)254-4890 FAX: +66(2)256-6334

Catalog NO.05T413Be '05.10 ROHM©2000 TSU

Notes

- No technical content pages of this document may be reproduced in any form or transmitted by any means without prior permission of ROHM CO.,LTD.
- The contents described herein are subject to change without notice. The specifications for the product described in this document are for reference only. Upon actual use, therefore, please request that specifications to be separately delivered.
- Application circuit diagrams and circuit constants contained herein are shown as examples of standard use and operation. Please pay careful attention to the peripheral conditions when designing circuits and deciding upon circuit constants in the set.
- Any data, including, but not limited to application circuit diagrams information, described herein are intended only as illustrations of such devices and not as the specifications for such devices. ROHM CO.,LTD. disclaims any warranty that any use of such devices shall be free from infringement of any third party's intellectual property rights or other proprietary rights, and further, assumes no liability of whatsoever nature in the event of any such infringement, or arising from or connected with or related to the use of such devices.
- Upon the sale of any such devices, other than for buyer's right to use such devices itself, resell or otherwise dispose of the same, no express or implied right or license to practice or commercially exploit any intellectual property rights or other proprietary rights owned or controlled by
- ROHM CO., LTD. is granted to any such buyer.
- Products listed in this document are no antiradiation design.

The products listed in this document are designed to be used with ordinary electronic equipment or devices (such as audio visual equipment, office-automation equipment, communications devices, electrical appliances and electronic toys).
Should you intend to use these products with equipment or devices which require an extremely high level of reliability and the malfunction of which would directly endanger human life (such as medical instruments, transportation equipment, aerospace machinery, nuclear-reactor controllers, fuel controllers and other safety devices), please be sure to consult with our sales representative in advance.
It is our top priority to supply products with the utmost quality and reliability. However, there is always a chance of failure due to unexpected factors. Therefore, please take into account the derating characteristics and allow for sufficient safety features, such as extra margin, anti-flammability, and fail-safe measures when designing in order to prevent possible accidents that may result in bodily harm or fire caused by component failure. ROHM cannot be held responsible for any damages arising from the use of the products under conditions out of the range of the specifications or due to non-compliance with the NOTES specified in this catalog.

Thank you for your accessing to ROHM product informations.
More detail product informations and catalogs are available, please contact your nearest sales office.

ROHM Customer Support System — **THE AMERICAS** / **EUROPE** / **ASIA** / **JAPAN**

www.rohm.com

Contact us : webmaster@rohm.co.jp

ROHM CO., LTD. 21 Saiin Mizosaki-cho, Ukyo-ku, Kyoto 615-8585, Japan
TEL : +81-75-311-2121
FAX : +81-75-315-0172