

### Ambient Light Sensor IC Series

# Analog Current Output Type

## Ambient Light Sensor IC

### BH1603FVC



#### ● Descriptions

BH1603FVC is an analog current output ambient light sensor. This IC is the most suitable to obtain the ambient light data for adjusting LCD and Keypad backlight of Mobile phone for power saving and better visibility

#### ● Features

- 1) Compact surface mount package 3.0 × 1.6 mm
- 2) Spectral sensitivity close to human eyes sensitivity.
- 3) Output current in proportion to brightness.
- 4) Minimum supply voltage 2.4V
- 5) Built-in shutdown function
- 6) 3 steps controllable output current gain.
- 7) 1.8V logic input interface
- 8) Low sensitivity variation (+/-15%)

#### ● Applications

Mobile phone, LCD TV, PDP TV, Laptop PC, Portable game console, Digital camera, Digital video camera, Car navigation, PDA, LCD display

#### ● Absolute Maximum Ratings

Parameter	Symbol	Limits	Units
Supply Voltage	Vmax	7	V
Operating Temperature	Topr	-40~85	°C
Storage Temperature	Tstg	-40~100	°C
Iout Current	Ioutmax	7.5	mA
Power Dissipation	Pd	260 <sub>※</sub>	mW

※ 70mm × 70mm × 1.6mm glass epoxy board. Derating at 3.47mW/°C for operating above Ta=25°C.

#### ● Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Units
VCC Voltage	Vcc	2.4	3.0	5.5	V

● Electrical Characteristics ( VCC = 3.0V, Ta = 25°C, unless otherwise noted )

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Supply Current1 (Operate)	I <sub>cc1</sub>	51	74	97	uA	E <sub>v</sub> =100 lx (H-Gain Mode) ※
Supply Current2 (0 lx)	I <sub>cc2</sub>	4.5	9	13.5	uA	E <sub>v</sub> =0 lx (H-Gain Mode)
Supply Current3(Shutdown)	I <sub>cc3sd</sub>	-	0.2	0.4	uA	V <sub>GC1</sub> =V <sub>GC2</sub> =0 No Input Light
IOUT Output Current1 (Dark Current)	I <sub>out1</sub>	-	-	0.2	uA	E <sub>v</sub> =0 lx
IOUT Output Current2	I <sub>out2</sub>	51	60	69	uA	E <sub>v</sub> =100 lx (H-Gain Mode) ※
Peak Wave Length	λ <sub>p</sub>	-	560	-	nm	
Incandescent/Fluorescent Light Current Ratio	r <sub>IF</sub>	-	1.0	-	times	E <sub>v</sub> =100 lx
Saturated Output Voltage	V <sub>OMAX</sub>	2.6	2.9	3.0	V	E <sub>v</sub> =100 lx, R <sub>L</sub> =220kΩ (H-Gain Mode) ※
GC1, GC2 Input 'L' Voltage	V <sub>IL</sub>	0	-	0.4	V	
GC1,GC2 Input 'H' Voltage1	V <sub>IH1</sub>	1.4	-	V <sub>CC</sub>	V	2.4V ≤ VCC ≤ 3.6V
GC1,GC2 Input 'H' Voltage2	V <sub>IH2</sub>	2.0	-	V <sub>CC</sub>	V	3.6V < VCC ≤ 5.5V
Wake-up Time	twu	-	45	128	us	Shutdown → H-Gain Mode E <sub>v</sub> =100lx ※
Gain Ratio H-Gain Mode/M-Gain Mode	r <sub>HM</sub>	9.5	10	10.5	times	E <sub>v</sub> =100lx ※
Gain Ratio M-Gain Mode/L-Gain Mode	r <sub>ML</sub>	9.5	10	10.5	times	E <sub>v</sub> =100lx ※

※ White LED is used as optical source

● Reference Data

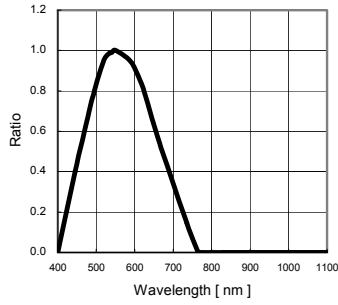


Fig.1 Spectral Response

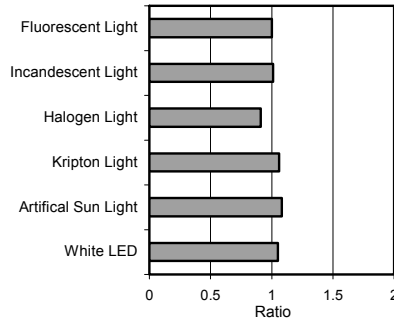


Fig.2 Light Source Dependency (Fluorescent Light is set to '1')

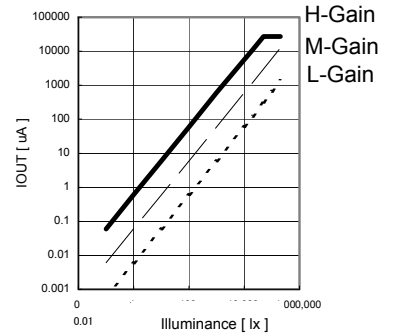


Fig.3 Illuminance – IOUT Characteristics

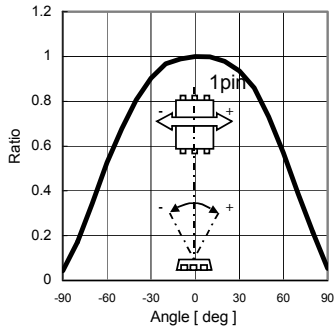


Fig.4 Directional Characteristics 1

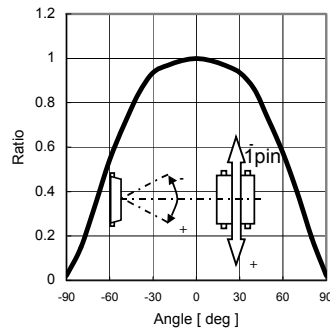


Fig.5 Directional Characteristics 2

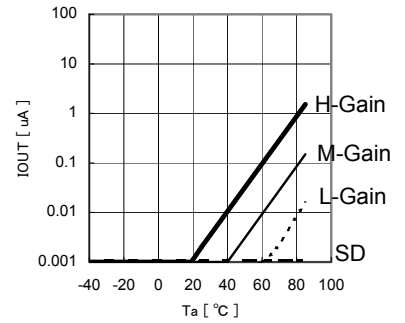


Fig.6 Ta – IOUT ( 0 lx )

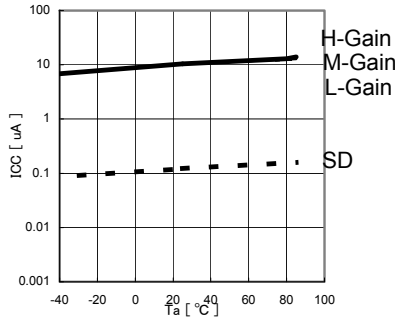


Fig.7 Ta – ICC ( 0 lx )

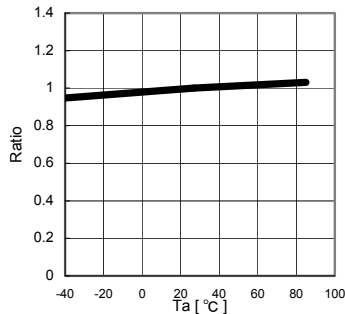


Fig.8 IOUT Temperature dependency ( 100 lx )

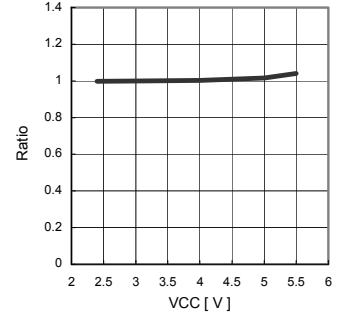


Fig.9 IOUT VCC dependency

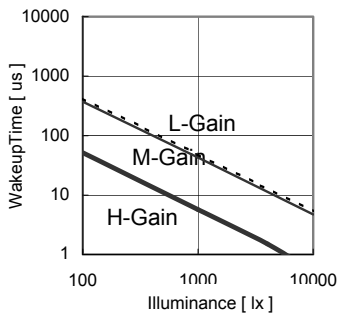
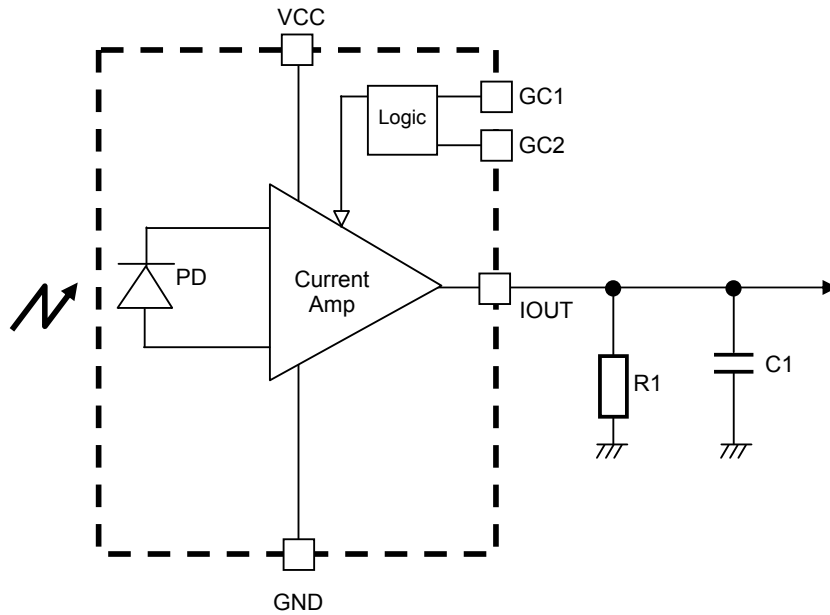


Fig.10 Illuminance – Wake up Time

● Block Diagram



● Block Diagram Descriptions

- PD  
Photo diode close to human eyes sensitivity.
- Current AMP  
To amplify Photo diode current ( H-Gain / M-Gain / L-Gain )  
Gain controllable in 3 steps by input voltage from GC1 and GC2.
- Logic  
Logic block for mode setting by input voltage from GC1 and GC2

● Mode Setting

GC2	GC1	Mode
0	0	Shutdown
0	1	H-Gain Mode
1	0	M-Gain Mode
1	1	L-Gain Mode

● External parts Setting

1) Gain setting of BH1603FVC

Please select the best gain controlled by 5 and 6pin based on the required illuminance range.

The reference is as follows.

Illuminance detection range [lx]	Gain Mode
~1,000	H-Gain Mode
~10,000	M-Gain Mode
~100,000	L-Gain Mode

This device will be mounted under the optical window in actual designing. Therefore, there is a possibility that the illuminance to ALS( Ambient Light Sensor) will be less than the illuminance on the final product surface.

Please consider the attenuation of light through the optical window.

Please set output resistance value( R1) within the range of 1 k $\Omega$  ~ 1M $\Omega$  which needs to be smaller than the input impedance of the next circuit.

## 2) Approximate formula of IOUT output voltage in each Gain Mode

### (1) H-Gain mode

The output voltage is calculated as below.

$$\mathbf{Viout= 0.6 \times 10^{-6} \times Ev \times R1}$$

Viout is IOUT output voltage [V]. Ev is an illuminance of the ALS surface [lx].

R1 is IOUT output resistor[ $\Omega$ ].

(For example) In case you want to convert the illuminance value up to 500 lx by ADC.

If the maximum voltage of ADC input is 2V, output resistor value will be as below.

$$\begin{aligned} R1 &= Viout/(0.6 \times 10^{-6} \times Ev) \\ &= 2 / (0.6 \times 10^{-6} \times 500) = 6667[\Omega] \\ &\Rightarrow 6.8[\text{k}\Omega] \end{aligned}$$

### (2) M-Gain mode

The output voltage is calculated as follows.

$$\mathbf{Viout= 0.06 \times 10^{-6} \times Ev \times R1}$$

### (3) L-Gain mode

The output voltage is calculated as follows.

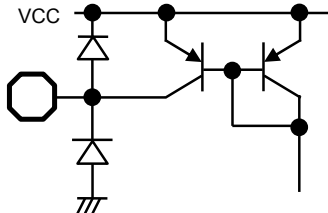
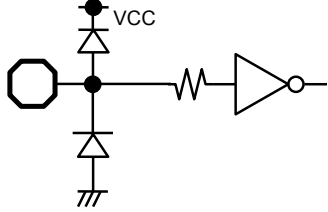
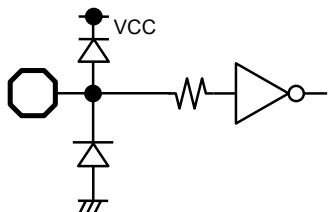
$$\mathbf{Viout= 0.006 \times 10^{-6} \times Ev \times R1}$$

## 3) C1

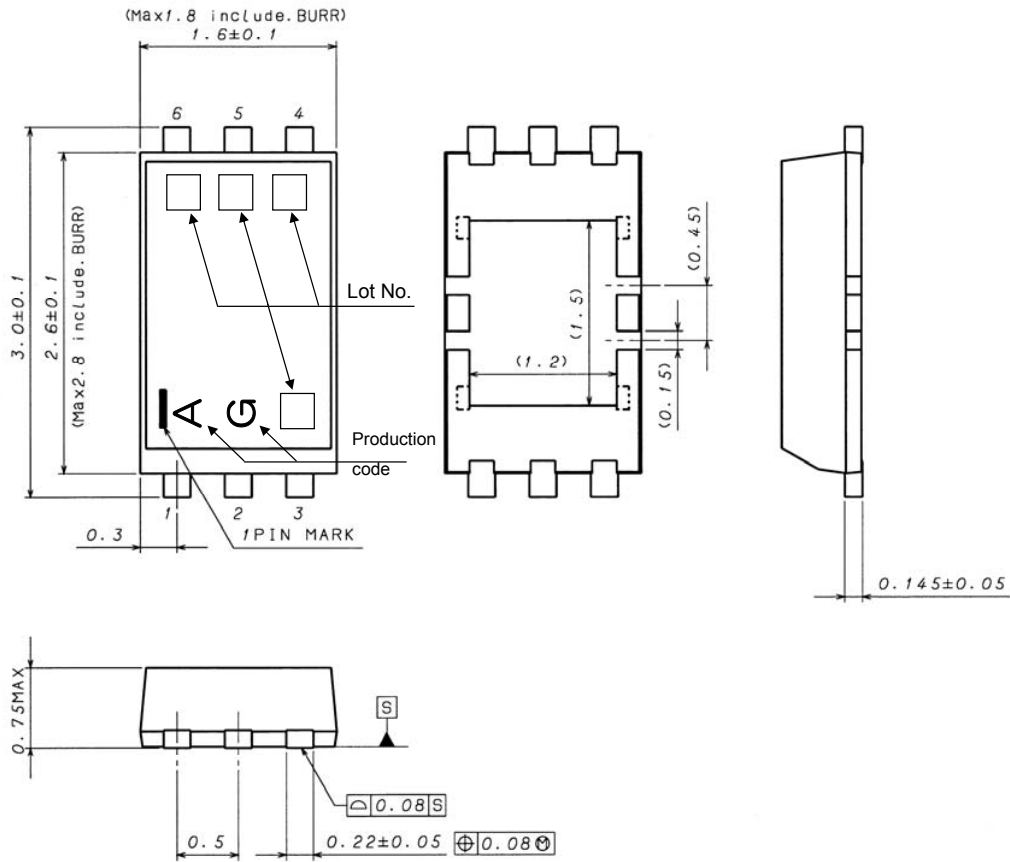
In case IOUT output is R1 only and an ALS receives the artificial lights such as fluorescent lamps and incandescent lamps synchronized with 50/60 Hz of AC power supplies, the output current has a ripple. Therefore, please add C1 to R1 in parallel if necessary.

When you control back light by using illuminance value, C1 is effective to control smoothly for a rapid changing of the illuminance. In general, please set it to C1 x R1 = about 1 ~ 10 as a time constant. In this case, the rise time becomes slow at power-on and recovery from shutdown mode to operation mode.

● Terminal Descriptions

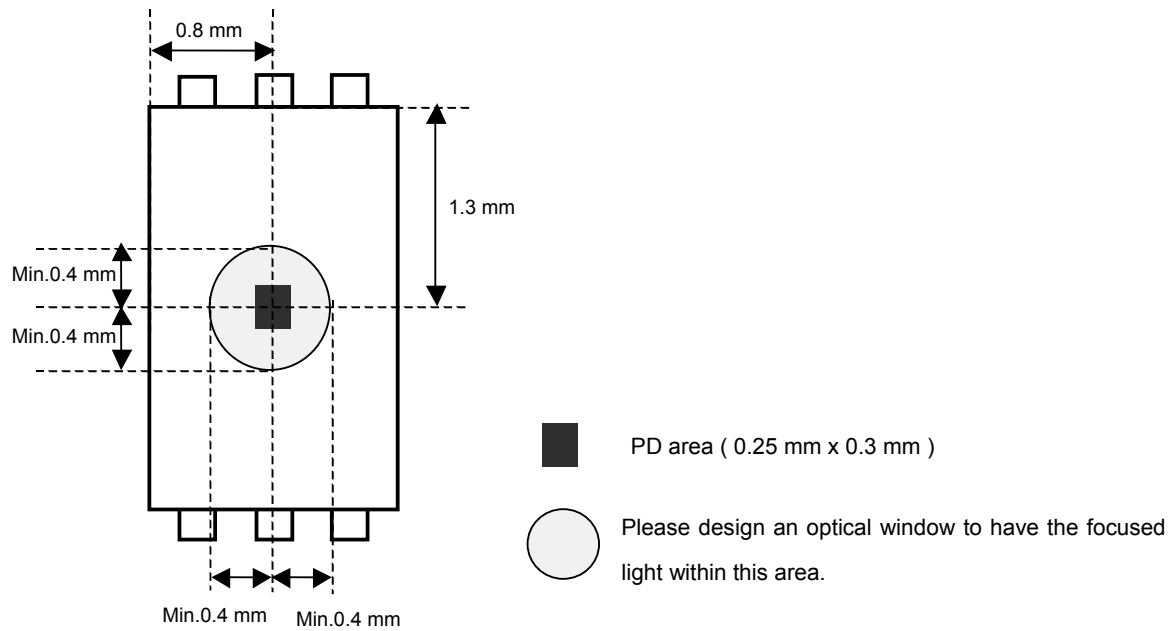
PIN No.	Terminal Name	Equivalent Circuit	Function
1	IOUT		<p>This terminal outputs current depending on illuminance level.</p> <p>Use this pin by putting resistor between GND.</p>
2	GND		GND Terminal
3	VCC		Power Supply Terminal
4	NC		<p>NC( Non connection)Terminal</p> <p>Open or short to GND</p>
5	GC1		Mode Setting Terminal 1
6	GC2		Mode Setting Terminal 2

● Package Outlines



WSOF6 ( Unit : mm )

● Optical design for the device



● Cautions on use

1) Absolute Maximum Ratings

An excess in the absolute maximum ratings, such as supply voltage (  $V_{max}$  ), temperature range of operating conditions (  $T_{opr}$  ), etc., can break down devices, thus making impossible to identify breaking mode such as a short circuit or an open circuit. If any special mode exceeding the absolute maximum ratings is assumed, consideration should be given to take physical safety measures including the use of fuses, etc.

2) GND voltage

Make setting of the potential of the GND terminal so that it will be maintained at the minimum in any operating state. Furthermore, check to be sure no terminals are at a potential lower than the GND voltage including an actual electric transient.

3) Short circuit between terminals and erroneous mounting

In order to mount ICs on a set PCB, pay thorough attention to the direction and offset of the ICs. Erroneous mounting can break down the ICs. Furthermore, if a short circuit occurs due to foreign matters entering between terminals or between the terminal and the power supply or the GND terminal, the ICs can break down.

4) Operation in strong electromagnetic field

Be noted that using ICs in the strong electromagnetic field can malfunction them.

5) Inspection with set PCB

On the inspection with the set PCB, if a capacitor is connected to a low-impedance IC terminal, the IC can suffer stress. Therefore, be sure to discharge from the set PCB by each process. Furthermore, in order to mount or dismount the set PCB to/from the jig for the inspection process, be sure to turn OFF the power supply and then mount the set PCB to the jig. After the completion of the inspection, be sure to turn OFF the power supply and then dismount it from the jig. In addition, for protection against static electricity, establish a ground for the assembly process and pay thorough attention to the transportation and the storage of the set PCB.

6) Input terminals

In terms of the construction of IC, parasitic elements are inevitably formed in relation to potential. The operation of the parasitic element can cause interference with circuit operation, thus resulting in a malfunction and then breakdown of the input terminal. Therefore, pay thorough attention not to handle the input terminals; such as to apply to the input terminals a voltage lower than the GND respectively, so that any parasitic element will operate. Furthermore, do not apply a voltage to the input terminals when no power supply voltage is applied to the IC. In addition, even if the power supply voltage is applied, apply to the input terminals a voltage lower than the power supply voltage or within the guaranteed value of electrical characteristics.

7) Thermal design

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

8) Treatment of package

Dusts or scratch on the photo detector may affect the optical characteristics. Please handle it with care.

9) Rush current

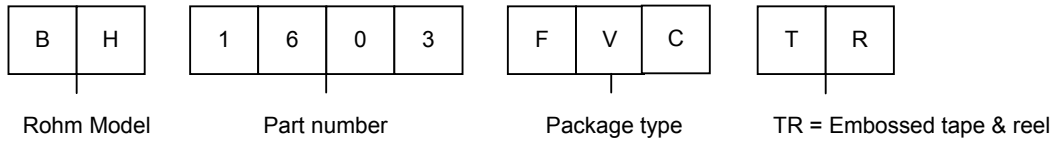
When power is first supplied to this IC, rush current may flow instantaneously. Because it is possible that the charge current to the parasitic capacitance of internal photo diode or the internal logic may be unstable. Therefore, give special consideration to power coupling capacitance, power wiring, width of GND wiring, and routing of connections.

10) The exposed central pad on the back side of the package

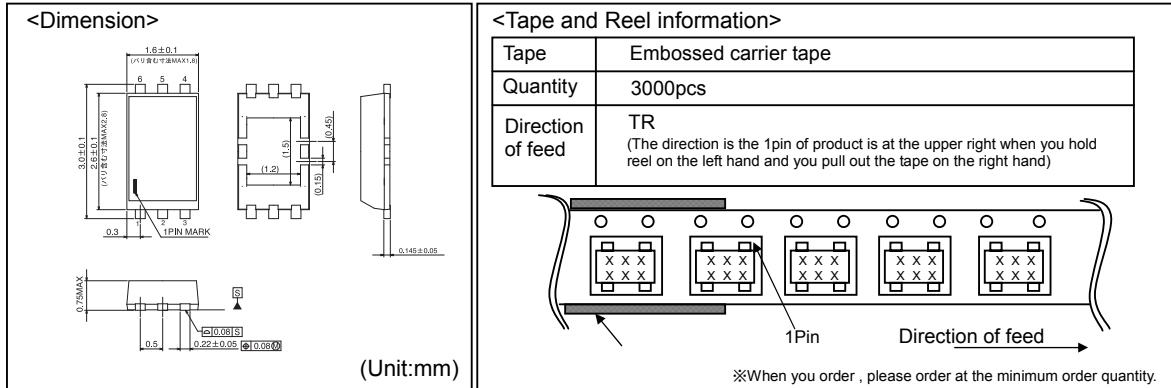
There is an exposed central pad on the back side of the package. But please do it non connection. ( Don't solder, and don't do electrical connection ) Please mount by Footprint dimensions described in the Jisso Information for WSO6. This pad is GND level, therefore there is a possibility that LSI malfunctions and heavy-current is generated.



● Product Designations (ROHM part number for ordering)



**WSOF6**



- The contents described herein are correct as of June, 2008
- The contents described herein are subject to change without notice. For updates of the latest information, please contact and confirm with ROHM CO.,LTD.
- Any part of this application note must not be duplicated or copied without our permission.
- 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 and 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, 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.
- The products described herein utilize silicon as the main material.
- The products described herein are not designed to be X ray proof.

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.

Contact us for further information about the products.

Excellence in Electronics



**ROHM CO., LTD.**

21, Saiin Mizosaki-cho, Ukyo-ku, Kyoto  
615-8585, Japan  
TEL: +81-75-311-2121 FAX: +81-75-315-0172  
URL: <http://www.rohm.com>

Published by  
LSI Business Promotion Dept.

<b>San Diego</b>	TEL: +1-858-625-3630	FAX: +1-858-625-3670
<b>Atlanta</b>	TEL: +1-770-754-5972	FAX: +1-770-754-0691
<b>Boston</b>	TEL: +1-978-371-0382	FAX: +1-928-438-7164
<b>Chicago</b>	TEL: +1-847-368-1006	FAX: +1-847-368-1008
<b>Dallas</b>	TEL: +1-469-287-6366	FAX: +1-469-362-7973
<b>Denver</b>	TEL: +1-303-708-0908	FAX: +1-303-708-0858
<b>Detroit</b>	TEL: +1-248-348-9920	FAX: +1-248-348-9942
<b>Nashville</b>	TEL: +1-615-620-6700	FAX: +1-615-620-6702
<b>Mexico</b>	TEL: +52-33-3123-2001	FAX: +52-33-3123-2002
<b>Düsseldorf</b>	TEL: +49-2154-9210	FAX: +49-2154-921400
<b>Munich</b>	TEL: +49-8161-48310	FAX: +49-8161-483120
<b>Stuttgart</b>	TEL: +49-711-72723710	FAX: +49-711-72723720
<b>France</b>	TEL: +33-1-5697-3060	FAX: +33-1-5697-3080
<b>United Kingdom</b>	TEL: +44-1-908-306700	FAX: +44-1-908-235788
<b>Denmark</b>	TEL: +45-3694-4739	FAX: +45-3694-4789
<b>Barcelona</b>	TEL: +34-9375-24320	FAX: +34-9375-24410
<b>Hungary</b>	TEL: +36-1-4719338	FAX: +36-1-4719339
<b>Poland</b>	TEL: +48-22-575213	FAX: +48-22-5757001
<b>Russia</b>	TEL: +7-95-980-6755	FAX: +7-95-937-8290
<b>Seoul</b>	TEL: +82-2-8182-700	FAX: +82-2-8182-715
<b>Masan</b>	TEL: +82-55-240-6234	FAX: +82-55-240-6236
<b>Dalian</b>	TEL: +86-411-8230-8549	FAX: +86-411-8230-8537
<b>Beijing</b>	TEL: +86-10-8525-2493	FAX: +86-10-8525-2489
<b>Tianjin</b>	TEL: +86-22-23029181	FAX: +86-22-23029183

<b>Shanghai</b>	TEL: +86-21-6279-2727	FAX: +86-21-6247-2066
<b>Hangzhou</b>	TEL: +86-571-87658072	FAX: +86-571-87658071
<b>Nanjing</b>	TEL: +86-25-8689-0015	FAX: +86-25-8689-0393
<b>Ningbo</b>	TEL: +86-574-87654201	FAX: +86-574-87654208
<b>Qingdao</b>	TEL: +86-532-5779-312	FAX: +86-532-5779-653
<b>Suzhou</b>	TEL: +86-512-6807-1300	FAX: +86-512-6807-2300
<b>Wuxi</b>	TEL: +86-510-82702693	FAX: +86-510-82702992
<b>Shenzhen</b>	TEL: +86-755-8307-3008	FAX: +86-755-8307-3003
<b>Dongguan</b>	TEL: +86-769-8393-3320	FAX: +86-769-8398-4140
<b>Fuzhou</b>	TEL: +86-591-8801-8698	FAX: +86-591-8801-8690
<b>Guangzhou</b>	TEL: +86-20-8364-9796	FAX: +86-20-8364-9707
<b>Huizhou</b>	TEL: +86-752-205-1054	FAX: +86-752-205-1059
<b>Xiamen</b>	TEL: +86-592-238-5705	FAX: +86-592-239-8380
<b>Zhuhai</b>	TEL: +86-756-3232-480	FAX: +86-756-3232-460
<b>Hong Kong</b>	TEL: +852-2-740-6262	FAX: +852-2-375-8971
<b>Taipei</b>	TEL: +886-2-2500-6956	FAX: +886-2-2503-2869
<b>Kaohsiung</b>	TEL: +886-7-237-0881	FAX: +886-7-238-7332
<b>Singapore</b>	TEL: +65-6332-2322	FAX: +65-6332-5662
<b>Philippines</b>	TEL: +63-2-807-6872	FAX: +63-2-809-1422
<b>Thailand</b>	TEL: +66-2-254-4890	FAX: +66-2-256-6334
<b>Kuala Lumpur</b>	TEL: +60-3-7958-8355	FAX: +60-3-7958-8377
<b>Penang</b>	TEL: +60-4-2286453	FAX: +60-4-2286452
<b>Kyoto</b>	TEL: +81-75-365-1218	FAX: +81-75-365-1228
<b>Yokohama</b>	TEL: +81-45-476-2290	FAX: +81-45-476-2295

### 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](http://www.rohm.com)

Contact us : [webmaster@rohm.co.jp](mailto:webmaster@rohm.co.jp)