

Ambient Light Sensor IC Series

# Digital 16bit Serial Output Type Color Sensor IC

## BH1749NUC

### General Description

BH1749NUC is a digital color sensor IC with I<sup>2</sup>C bus interface. This IC senses Red, Green, Blue (RGB) and Infrared and converts them to digital values. The high sensitivity, wide dynamic range and excellent Ircut characteristics make it possible for this IC to obtain the accurate illuminance and color temperature of ambient light. It is ideal for adjusting LCD backlight of TV, mobile phone and tablet PC.

### Features

- Built-in Ircut Filter
- Rejecting 50 Hz / 60 Hz Light Noise
- I<sup>2</sup>C Bus Interface (f/s mode support)
- It is possible to select 2 type of I<sup>2</sup>C bus slave address.
- Correspond to 1.8 V Logic Interface
- Resolution 0.0125 lx/count (Typ)  
(In highest gain and longest measurement time setting)

### Applications

Mobile Phone, Tablet PC, Note PC, Digital Camera  
Portable Game Machine, LCD TV

### Key Specifications

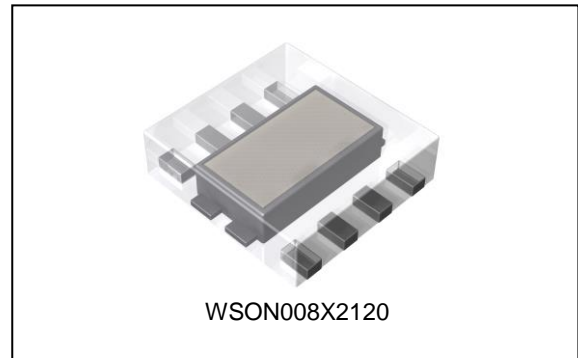
- VCC Voltage Range: 2.3 V to 3.6 V
- Illuminance Detection Range<sup>(Note 1)</sup>: 80 lx (Typ)
- Current Consumption: 190 μA (Typ)
- Power Down Current: 0.8 μA (Typ)
- Operating Temperature Range: -40 °C to +85 °C  
*(Note 1) White LED is used.*

### Package(s)

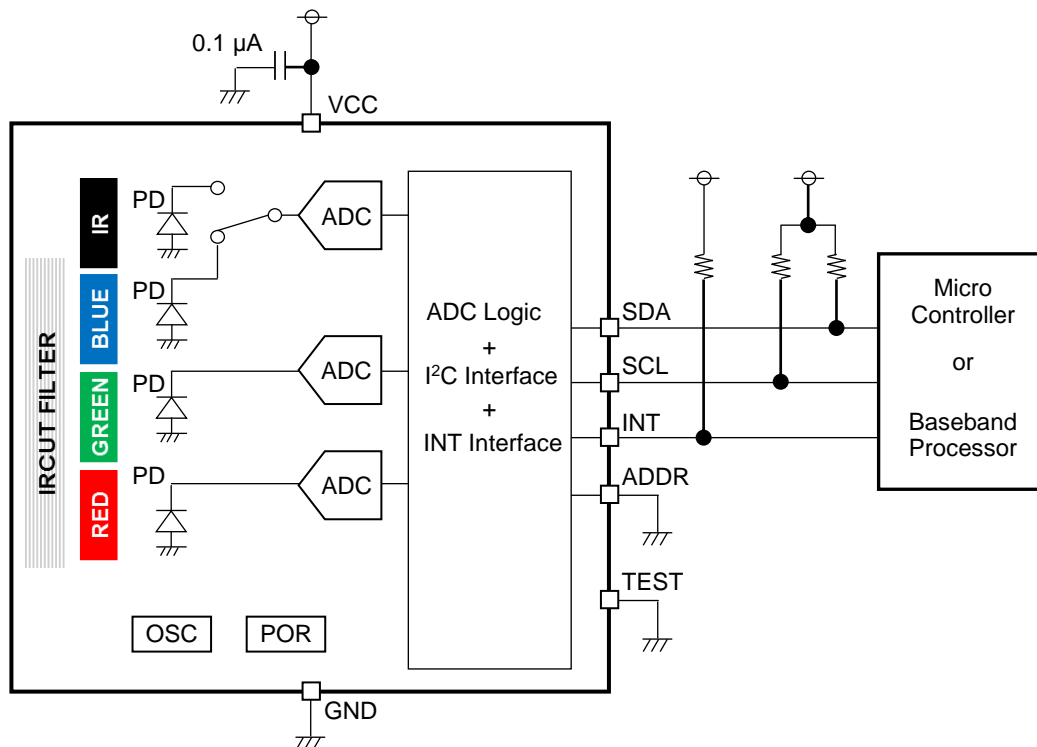
WSON008X2120

W(Typ) x D(Typ) x H(Max)

2.10 mm x 2.00 mm x 0.6 mm



### Typical Application Circuits

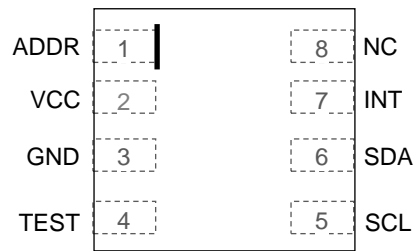


○Product structure : Silicon monolithic integrated circuit.  
 ○This product does not include laser transmitter.  
 ○This product includes Photo detector, ( Photo Diode ) inside of it.

○This product has no designed protection against radioactive rays.  
 ○This product does not include optical load.

## Pin Configuration

TOP VIEW

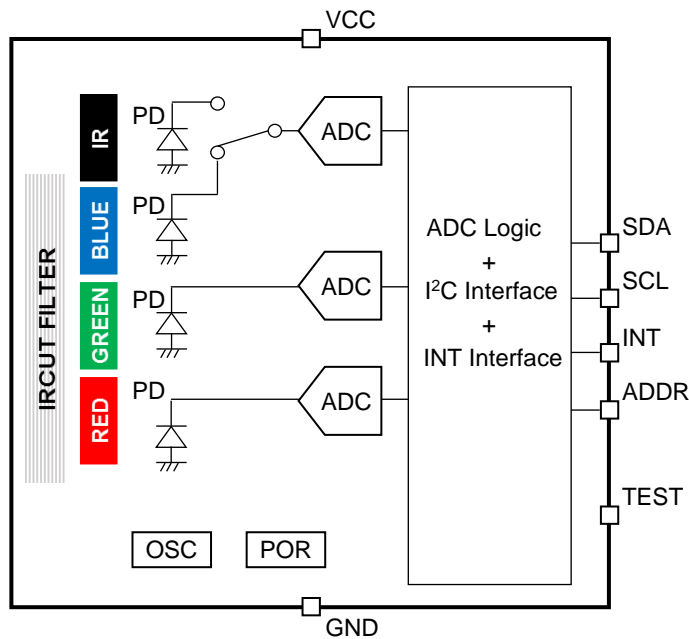


## Pin Description

Pin No.	Pin Name	Function
1	ADDR	I <sup>2</sup> C bus slave address selector
2	VCC	Power supply <sup>(Note 1)</sup>
3	GND	Ground
4	TEST	Test pin (Connect to GND)
5	SCL	I <sup>2</sup> C bus serial clock
6	SDA	I <sup>2</sup> C bus serial data
7	INT	Interrupt
8	NC	Non connect

(Note 1) Dispose a bypass capacitor as close as possible to the IC

## Block Diagram



## Description of Blocks

- IRCUT FILTER  
Infrared cut filter
- RED, GREEN, BLUE, IR  
Red, Green, Blue, Infrared pass filter
- PD  
Photodiode
- ADC  
Analog-to-Digital Converter for obtaining 16bit digital data.
- ADC Logic + I<sup>2</sup>C Interface + INT Interface  
ADC control logic and I/F logic
- OSC  
Clock generator for internal logic
- POR  
Power ON Reset. All registers are reset after VCC is supplied.

## Absolute Maximum Ratings (Ta=25 °C)

Parameter	Symbol	Rating	Unit
Supply Voltage	V <sub>CC_MR</sub>	4.5	V
Input Voltage 1 [INT,SCL,SDA]	V <sub>IN1_MR</sub>	-0.3 to +4.5	V
Input Voltage 2 [ADDR]	V <sub>IN2_MR</sub>	-0.3 to (V <sub>CC</sub> +0.3) or +4.5 whichever is less	V
Storage Temperature Range	T <sub>stg</sub>	-40 to +100	°C
Maximum Junction Temperature	T <sub>jmax</sub>	100	°C

**Caution 1:** Operating the IC over the absolute maximum ratings may damage the IC. The damage can either be a short circuit between pins or an open circuit between pins and the internal circuitry. Therefore, it is important to consider circuit protection measures, such as adding a fuse, in case the IC is operated over the absolute maximum ratings.

**Caution 2:** Should by any chance the maximum junction temperature rating be exceeded the rise in temperature of the chip may result in deterioration of the properties of the chip. In case of exceeding this absolute maximum rating, design a PCB boards with thermal resistance taken into consideration by increasing board size and copper area so as not to exceed the maximum junction temperature rating.

Thermal Resistance<sup>(Note 1)</sup>

Parameter	Symbol	Thermal Resistance (Typ)		Unit
		1s <sup>(Note 3)</sup>	2s2p <sup>(Note 4)</sup>	
WSON008X2120				
Junction to Ambient	θ <sub>JA</sub>	384.2	54.2	°C/W
Junction to Top Characterization Parameter <sup>(Note 2)</sup>	Ψ <sub>JT</sub>	82	12	°C/W

(Note 1) Based on JESD51-2A(Still-Air).

(Note 2) The thermal characterization parameter to report the difference between junction temperature and the temperature at the top center of the outside surface of the component package.

(Note 3) Using a PCB board based on JESD51-3.

(Note 4) Using a PCB board based on JESD51-5, 7.

Layer Number of Measurement Board	Material	Board Size
Single	FR-4	114.3 mm x 76.2 mm x 1.57 mmt

Top	
Copper Pattern	Thickness
Footprints and Traces	70 μm

Layer Number of Measurement Board	Material	Board Size	Thermal Via <sup>(Note 5)</sup>	
			Pitch	Diameter
4 Layers	FR-4	114.3 mm x 76.2 mm x 1.6 mmt	1.20 mm	Φ0.30 mm

Top		2 Internal Layers		Bottom	
Copper Pattern	Thickness	Copper Pattern	Thickness	Copper Pattern	Thickness
Footprints and Traces	70 μm	74.2 mm x 74.2 mm	35 μm	74.2 mm x 74.2 mm	70 μm

(Note 5) This thermal via connects with the copper pattern of all layers.

## Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Unit
Operating Temperature	T <sub>opr</sub>	-40	+25	+85	°C
Supply Voltage	V <sub>CC</sub>	2.3	2.5	3.6	V
Input Voltage [INT,SCL,SDA]	V <sub>IN</sub>	0	-	3.6	V

**Electrical Characteristics (Unless otherwise specified, VCC=2.5 V, Ta=25 °C, 35 ms mode, x1 gain mode)**

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Current Consumption	I <sub>CC1</sub>	-	190	295	μA	Ev=100 lx <sup>(Note 1)</sup>
Power Down Current	I <sub>CC2</sub>	-	0.8	1.5	μA	Power down mode No input light
Red Data Count Value	D <sub>RED</sub>	60	71	82	count	Ev=20 μW/cm <sup>2</sup> <sup>(Note 2)</sup>
Green Data Count Value	D <sub>GREEN</sub>	84	99	114	count	Ev=20 μW/cm <sup>2</sup> <sup>(Note 3)</sup>
Blue Data Count Value	D <sub>BLUE</sub>	59	70	81	count	Ev=20 μW/cm <sup>2</sup> <sup>(Note 4)</sup>
Ir Data Count Value	D <sub>IR</sub>	18	25	32	count	Ev=20 μW/cm <sup>2</sup> <sup>(Note 5)</sup>
Dark Count Value	S <sub>0_0</sub>	-	-	3	count	No input light
Measurement Time	t <sub>MT</sub>	-	35	50	ms	
INT Output 'L' Voltage	V <sub>INTL</sub>	0	-	0.4	V	I <sub>OL</sub> =3 mA
SCL SDA Input 'H' Voltage	V <sub>IH</sub>	1.26	-	-	V	
SCL SDA Input 'L' Voltage	V <sub>IL</sub>	-	-	0.54	V	
SDA Output 'L' Voltage	V <sub>OL</sub>	0	-	0.4	V	I <sub>OL</sub> =3 mA
ADDR Input 'H' Voltage	V <sub>ADDRH</sub>	0.7*V <sub>CC</sub>	-	-	V	
ADDR Input 'L' Voltage	V <sub>ADDRL</sub>	-	-	0.3*V <sub>CC</sub>	V	

(Note 1) White LED is used.

(Note 2) Red LED is used.

(Note 3) Green LED is used.

(Note 4) Blue LED is used.

(Note 5) Infrared LED is used.

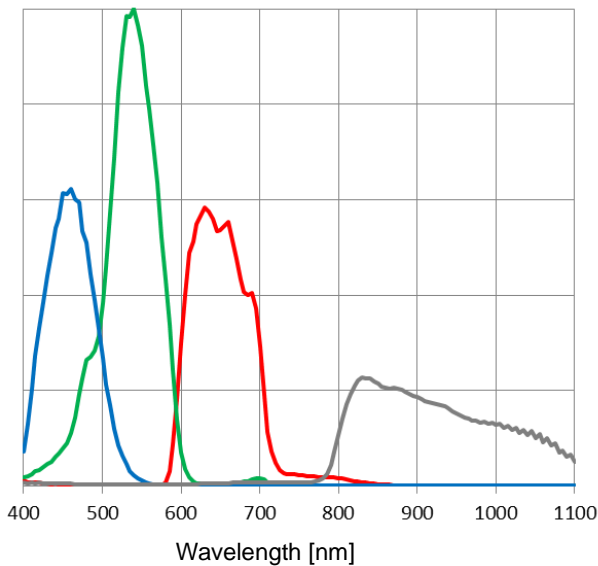
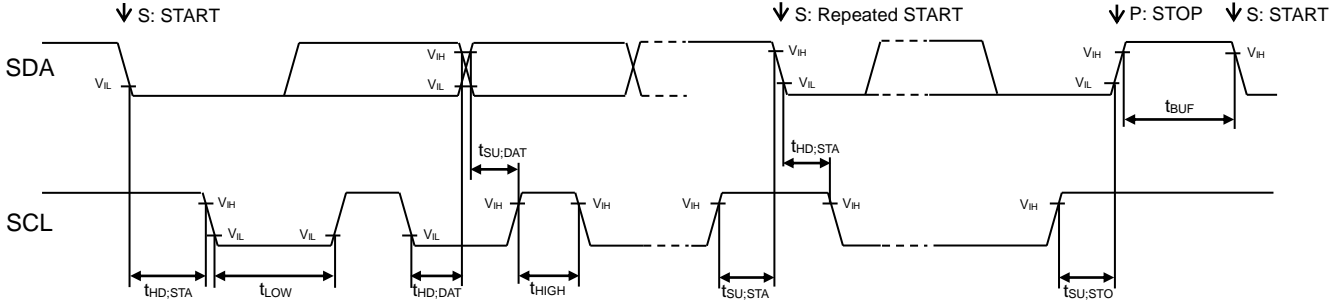
**Typical Performance Curves**

Figure 1. Ratio vs Wavelength  
(Spectral Response)

I<sup>2</sup>C Bus Timing Characteristics (Unless otherwise specified VCC=2.5 V, Ta=25 °C)



Parameter	Symbol	Min	Typ	Max	Unit	Conditions
SCL Clock Frequency	f <sub>SCL</sub>	0	-	400	kHz	
'L' Period of the SCL Clock	t <sub>LOW</sub>	1.3	-	-	µs	
'H' Period of the SCL Clock	t <sub>HIGH</sub>	0.6	-	-	µs	
Setup Time for Repeated START	t <sub>SU,STA</sub>	0.6	-	-	µs	
Hold Time for START	t <sub>HD,STA</sub>	0.6	-	-	µs	
Data Setup Time	t <sub>SU,DAT</sub>	100	-	-	ns	
Data Hold Time	t <sub>HD,DAT</sub>	0	-	-	µs	
Setup Time for STOP	t <sub>SU,STO</sub>	0.6	-	-	µs	
Bus Free Time between STOP and START	t <sub>BUF</sub>	1.3	-	-	µs	

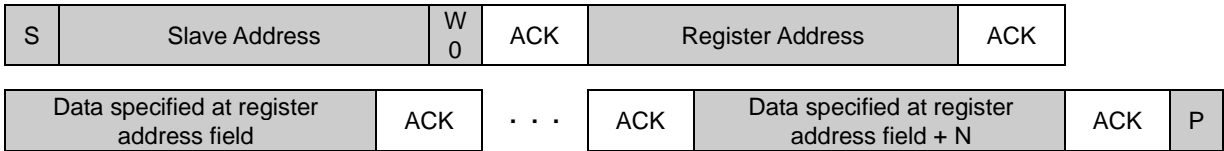
I<sup>2</sup>C Bus Communication

1. Write Format

(1) Indicate register address

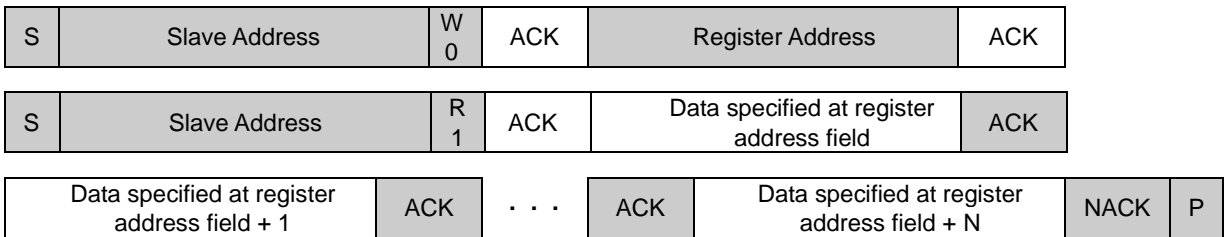


(2) Write data after indicating register address

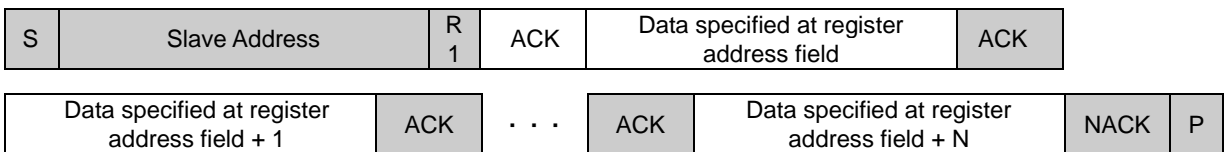


2. Read Format

(1) Read data after indicating register address (Master issues restart condition)



(2) Read data from the specified register



**I<sup>2</sup>C Bus Slave Address**

The slave address is selectable from 2 addresses by ADDR pin.

ADDR	Slave Address
L	0111000
H	0111001

**Register MAP** (Note 1)

Register Address	Register Name	R/W	D7	D6	D5	D4	D3	D2	D1	D0
0x40	SYSTEM_CONTROL	RW	SW RESET	INT RESET	PART ID [5:0]					
0x41	MODE_CONTROL1	RW	0	IR GAIN [1:0]		RGB GAIN [1:0]		MEASUREMENT MODE [2:0]		
0x42	MODE_CONTROL2	RW	VALID	0	0	RGB_EN	0	0	0	0
0x50	RED_DATA	R	RED_DATA [7:0]							
0x51		R	RED_DATA [15:8]							
0x52	GREEN_DATA	R	GREEN_DATA [7:0]							
0x53		R	GREEN_DATA [15:8]							
0x54	BLUE_DATA	R	BLUE_DATA [7:0]							
0x55		R	BLUE_DATA [15:8]							
0x56	RESERVED	R	RESERVED							
0x57	RESERVED	R	RESERVED							
0x58	IR_DATA	R	IR_DATA [7:0]							
0x59		R	IR_DATA [15:8]							
0x5A	GREEN2_DATA	R	GREEN2_DATA [7:0]							
0x5B		R	GREEN2_DATA [15:8]							
0x60	INTERRUPT	RW	INT STATUS	0	0	0	INT SOURCE [1:0]		0	INT ENABLE
0x61	PERSISTENCE	RW	0	0	0	0	0	0	PERSISTENCE [1:0]	
0x62	TH_HIGH	RW	TH_HIGH [7:0]							
0x63		RW	TH_HIGH [15:8]							
0x64	TH_LOW	RW	TH_LOW [7:0]							
0x65		RW	TH_LOW [15:8]							
0x92	MANUFACTURER_ID	R	MANUFACTURER_ID [7:0]							

(Note 1) Do not write any commands to other addresses except above. Do not write '1' to the field in which value is '0' in above table.

**(0x40) SYSTEM\_CONTROL**

Fields	Function
SW RESET	All registers are reset and this IC is in power down state by software reset. 0 : Software reset is not done. 1 : Software reset is done.
INT RESET	0 : The INT pin status is not changed. 1 : Make the INT Pin status inactive (High impedance)
PART ID	Part ID 0x0D (Read only register)

default value 0x0D

**Register MAP - continued**

( 0x41 ) MODE\_CONTROL1

Fields	Function
IR GAIN	Gain setting for IR Data. 00 : Forbidden to use 01 : x1 gain mode 10 : Forbidden to use 11 : x32 gain mode
RGB GAIN	Gain setting for RED, GREEN and BLUE Data. 00 : Forbidden to use 01 : x1 gain mode 10 : Forbidden to use 11 : x32 gain mode
MEASUREMENT MODE	000 : Forbidden to use 001 : Forbidden to use 010 : 120 ms mode 011 : 240 ms mode 100 : Forbidden to use 101 : 35ms mode 110 : Forbidden to use 111 : Forbidden to use Measurement time is specified in Electrical Characteristics.

default value 0x00

( 0x42 ) MODE\_CONTROL2

Fields	Function
VALID	Refer to "About VALID Register"
RGB_EN	0 : Measurement is inactive and becomes power down. 1 : Measurement is active.

default value 0x00

( 0x50 / 0x51 ) RED\_DATA

Fields	Function
RED_DATA [15:0]	RED measurement result

default value 0x0000

( 0x52 / 0x53 ) GREEN\_DATA

Fields	Function
GREEN_DATA [15:0]	GREEN measurement result

default value 0x0000

( 0x54 / 0x55 ) BLUE\_DATA

Fields	Function
BLUE_DATA [15:0]	BLUE measurement result

default value 0x0000

( 0x56 / 0x57 ) RESERVED

default value 0x0000

( 0x58 / 0x59 ) IR\_DATA

Fields	Function
IR_DATA [15:0]	IR measurement result

default value 0x0000

( 0x5A / 0x5B ) GREEN2\_DATA

Fields	Function
GREEN2_DATA [15:0]	GREEN2 measurement result

default value 0x0000

**Register MAP - continued**

( 0x60 ) INTERRUPT

Fields	Function
INT STATUS	Interrupt status output. (Read only register) 0 : Interrupt signal is inactive 1 : Interrupt signal is active
INT SOURCE	INT source select 00 : Red channel 01 : Green channel 10 : Blue channel 11 : Forbidden to use
INT ENABLE	0 : The INT pin disable. 1 : The INT pin enable.

default value 0x00

( 0x61 ) PERSISTENCE

Fields	Function
PERSISTENCE	Interrupt persistence setting. 00 : Interrupt status becomes active at each measurement end. 01 : Interrupt status is updated at each measurement end. 10 : Interrupt status is updated if 4 consecutive threshold judgments are the same. 11 : Interrupt status is updated if 8 consecutive threshold judgments are the same.

default value 0x01

( 0x62 / 0x63 ) TH\_HIGH

Fields	Function
TH_HIGH [15:0]	Interrupt threshold upper level

default value 0xFFFF

( 0x64 / 0x65 ) TH\_LOW

Fields	Function
TH_LOW [15:0]	Interrupt threshold lower level

default value 0x0000

( 0x92 ) MANUFACTURER ID

Fields	Function
MANUFACTURER ID	MANUFACTURER ID : 0xE0

**About VALID Register**

VALID register is measurement data update flag. It turns to '1', when measurement data is updated.

It is cleared and turns to '0' by changing register setup or reading VALID register.

(Setting change target registers are 0x41, 0x42, 0x60, 0x61, 0x62, 0x63, 0x64, 0x65.)



**Interrupt Function**

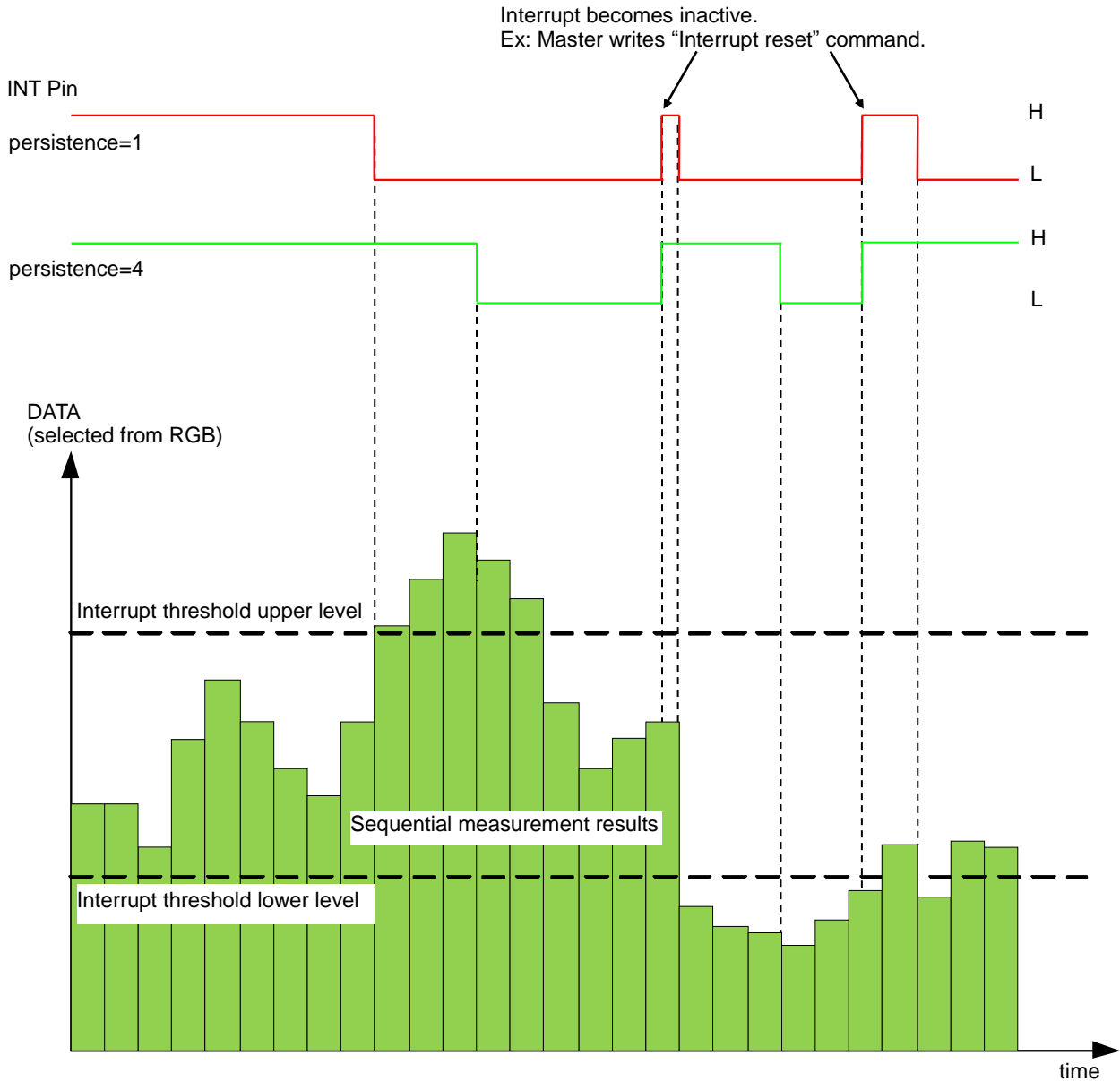
Interrupt function compares the measurement result selected from RGB data by INT SOURCE register to preset interrupt threshold level. If measurement result is outside of two threshold level, it outputs 'L'. This IC uses two threshold level (upper and lower). Interrupt threshold is defined at TH\_HIGH register and TH\_LOW register.

The INT pin is inactive (High impedance) when VCC is supplied.

To clear interrupt

- 1) Writing INT reset command
- 2) Reading INTERRUPT register
- 3) Writing to the registers (0x41, 0x42, 0x60, 0x61, 0x62, 0x63, 0x64, 0x65)
- 4) Writing software reset command

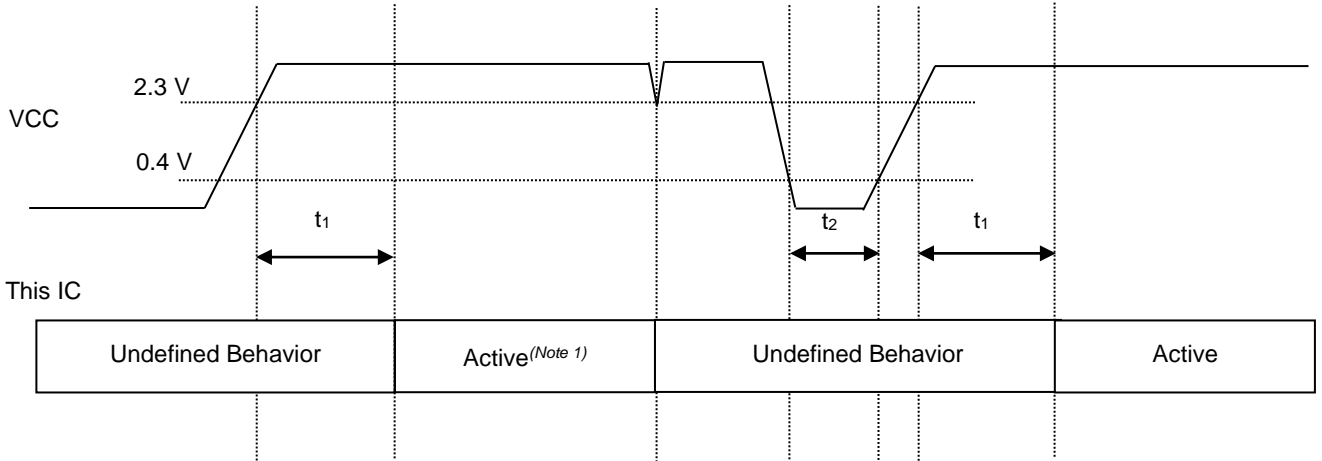
Ex: Interrupt behavior example



**Power Supply Sequence**

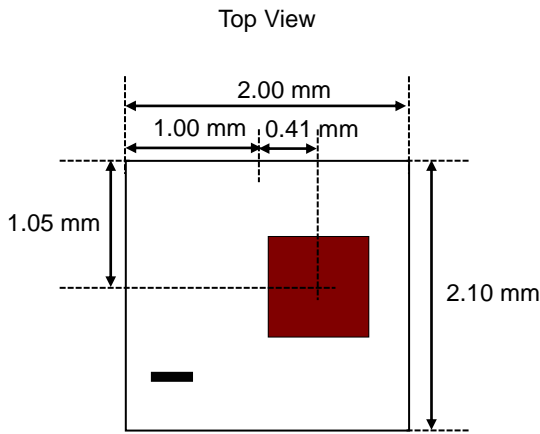
ALL register of this IC is reset when supplying VCC.  
 There are some notes about power up and down sequence as shown below.

- (1) Power ON Time:  $t_1$   
 2 ms period is necessary to activate this IC after VCC becomes more than or equal to 2.3 V from less than or equal to 0.4 V.
- (2) Power OFF time:  $t_2$   
 The period when VCC is less than or equal to 0.4 V is necessary for more than or equal to 1 ms before supplying power to this IC.



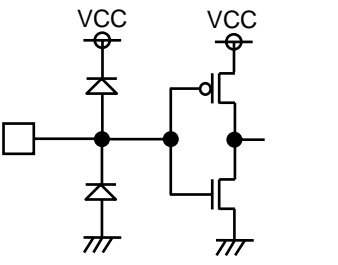
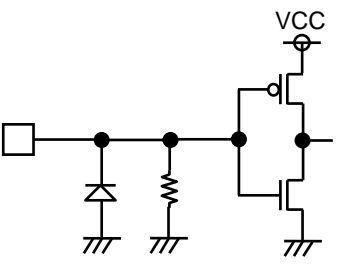
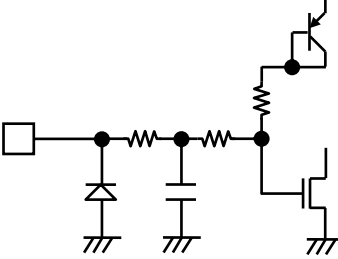
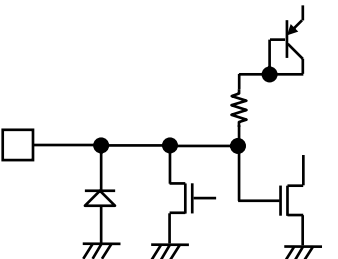
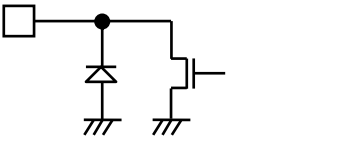
(Note 1) "Active" state is that this IC works and accepts I<sup>2</sup>C bus access correctly.

**Optical Design for the Device**



PD area;(0.60 mm x 0.60 mm)

I/O Equivalence Circuit

Pin Name	Equivalence Circuit
ADDR	
TEST	
SCL	
SDA	
INT	

## Operational Notes

### 1. Reverse Connection of Power Supply

Connecting the power supply in reverse polarity can damage the IC. Take precautions against reverse polarity when connecting the power supply, such as mounting an external diode between the power supply and the IC's power supply pins.

### 2. Power Supply Lines

Design the PCB layout pattern to provide low impedance supply lines. Furthermore, connect a capacitor to ground at all power supply pins. Consider the effect of temperature and aging on the capacitance value when using electrolytic capacitors.

### 3. Ground Voltage

Ensure that no pins are at a voltage below that of the ground pin at any time, even during transient condition.

### 4. Ground Wiring Pattern

When using both small-signal and large-current ground traces, the two ground traces should be routed separately but connected to a single ground at the reference point of the application board to avoid fluctuations in the small-signal ground caused by large currents. Also ensure that the ground traces of external components do not cause variations on the ground voltage. The ground lines must be as short and thick as possible to reduce line impedance.

### 5. Recommended Operating Conditions

The function and operation of the IC are guaranteed within the range specified by the recommended operating conditions. The characteristic values are guaranteed only under the conditions of each item specified by the electrical characteristics.

### 6. Inrush Current

When power is first supplied to the IC, it is possible that the internal logic may be unstable and inrush current may flow instantaneously due to the internal powering sequence and delays, especially if the IC has more than one power supply. Therefore, give special consideration to power coupling capacitance, power wiring, width of ground wiring, and routing of connections.

### 7. Operation Under Strong Electromagnetic Field

Operating the IC in the presence of a strong electromagnetic field may cause the IC to malfunction.

### 8. Testing on Application Boards

When testing the IC on an application board, connecting a capacitor directly to a low-impedance output pin may subject the IC to stress. Always discharge capacitors completely after each process or step. The IC's power supply should always be turned off completely before connecting or removing it from the test setup during the inspection process. To prevent damage from static discharge, ground the IC during assembly and use similar precautions during transport and storage.

### 9. Inter-pin Short and Mounting Errors

Ensure that the direction and position are correct when mounting the IC on the PCB. Incorrect mounting may result in damaging the IC. Avoid nearby pins being shorted to each other especially to ground, power supply and output pin. Inter-pin shorts could be due to many reasons such as metal particles, water droplets (in very humid environment) and unintentional solder bridge deposited in between pins during assembly to name a few.

### 10. Unused Input Pins

Input pins of an IC are often connected to the gate of a MOS transistor. The gate has extremely high impedance and extremely low capacitance. If left unconnected, the electric field from the outside can easily charge it. The small charge acquired in this way is enough to produce a significant effect on the conduction through the transistor and cause unexpected operation of the IC. So unless otherwise specified, unused input pins should be connected to the power supply or ground line.

## Operational Notes – continued

## 11. Regarding the Input Pin of the IC

This monolithic IC contains P+ isolation and P substrate layers between adjacent elements in order to keep them isolated. P-N junctions are formed at the intersection of the P layers with the N layers of other elements, creating a parasitic diode or transistor. For example (refer to figure below):

When  $GND > Pin A$  and  $GND > Pin B$ , the P-N junction operates as a parasitic diode.

When  $GND > Pin B$ , the P-N junction operates as a parasitic transistor.

Parasitic diodes inevitably occur in the structure of the IC. The operation of parasitic diodes can result in mutual interference among circuits, operational faults, or physical damage. Therefore, conditions that cause these diodes to operate, such as applying a voltage lower than the GND voltage to an input pin (and thus to the P substrate) should be avoided.

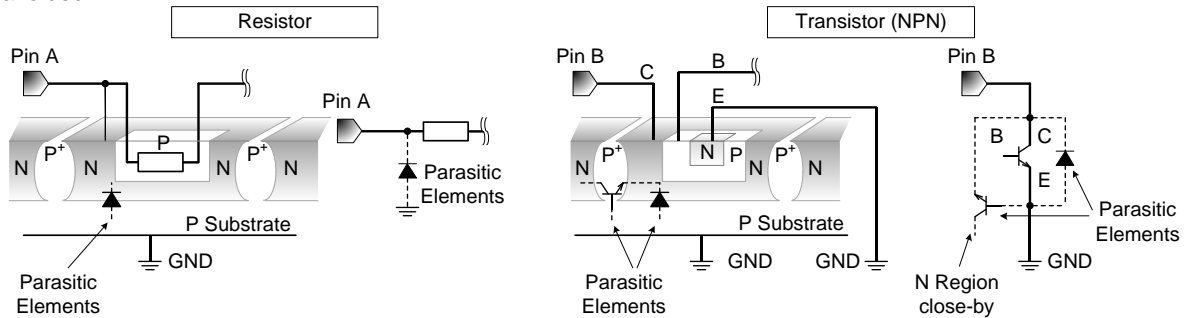


Figure 2. Example of monolithic IC structure

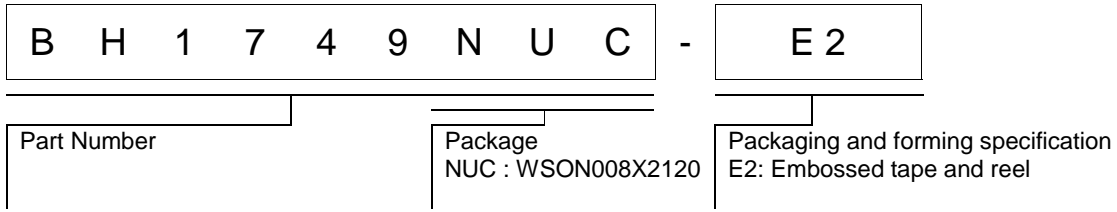
## 12. Ceramic Capacitor

When using a ceramic capacitor, determine the dielectric constant considering the change of capacitance with temperature and the decrease in nominal capacitance due to DC bias and others.

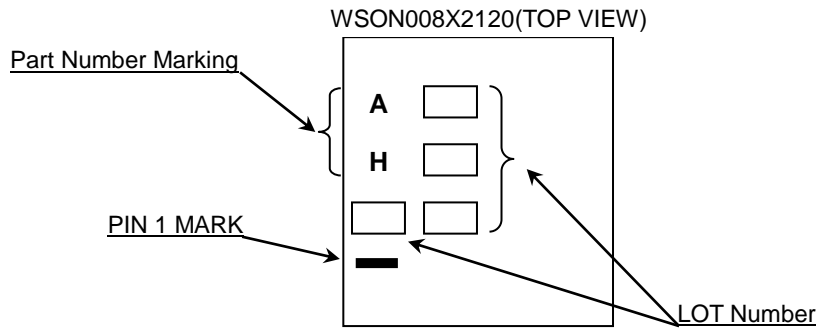
## 13. Area of Safe Operation (ASO)

Operate the IC such that the output voltage, output current, and power dissipation are all within the Area of Safe Operation (ASO).

Ordering Information

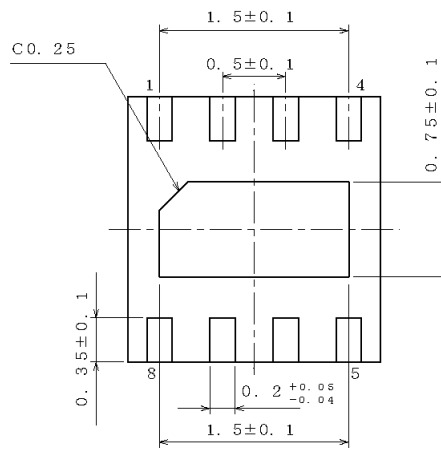
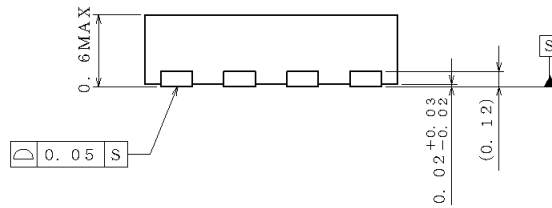
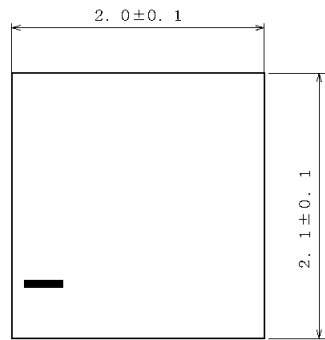


Marking Diagram



Physical Dimension and Packing Information

Package Name	WS0N008X2120
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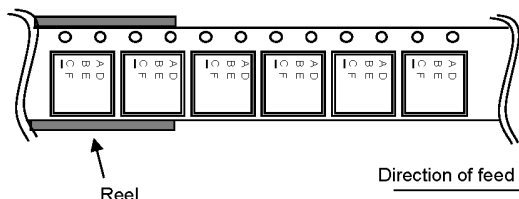
(UNIT : mm)

< Tape and Reel information >

Tape	Embossed carrier tape(with dry pack)
Quantity	4000pcs
Direction of feed	E2 (The direction is 1pin product is at the upper left when you hold reel on the hand and you pull out the tape on the right hand)

PKG:WS0N008X2120

Drawing No. EX071-5001



\*Order quantity needs to be multiple of the minimum quantity.

**Revision History**

Date	Revision	Changes
12.Sep.2017	001	New Release
20.Dec.2017	002	VALID function addition.



# Notice

## Precaution on using ROHM Products

- Our Products are designed and manufactured for application in ordinary electronic equipment (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 <sup>(Note 1)</sup>, 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
CLASS III	CLASS III	CLASS II b	CLASS III
CLASS IV		CLASS III	

- 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:
  - Installation of protection circuits or other protective devices to improve system safety
  - Installation of redundant circuits to reduce the impact of single or multiple circuit failure
- 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:
  - Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
  - Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
  - Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, and NO<sub>2</sub>
  - Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
  - Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
  - Sealing or coating our Products with resin or other coating materials
  - 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
  - Use of the Products in places subject to dew condensation
- The Products are not subject to radiation-proof design.
- Please verify and confirm characteristics of the final or mounted products in using the Products.
- 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.
- De-rate Power Dissipation depending on ambient temperature. When used in sealed area, confirm that it is the use in the range that does not exceed the maximum junction temperature.
- Confirm that operation temperature is within the specified range described in the product specification.
- 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

- When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.
- In principle, the reflow soldering method must be used on a surface-mount products, the flow soldering method must be used on a through hole mount products. If the flow soldering method is preferred on a surface-mount products, 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.
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 Cl<sub>2</sub>, H<sub>2</sub>S, NH<sub>3</sub>, SO<sub>2</sub>, and NO<sub>2</sub>
  - [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

A two-dimensional barcode 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 concerned goods might be fallen under listed items of export control prescribed by Foreign exchange and Foreign trade act, please consult with ROHM in case of export.

### Precaution Regarding Intellectual Property Rights

1. All information and data including but not limited to application example contained in this document is for reference only. ROHM does not warrant that foregoing information or data will not infringe any intellectual property rights or any other rights of any third party regarding such information or data.
2. ROHM shall not have any obligations where the claims, actions or demands arising from the combination of the Products with other articles such as components, circuits, systems or external equipment (including software).
3. No license, expressly or implied, is granted hereby under any intellectual property rights or other rights of ROHM or any third parties with respect to the Products or the information contained in this document. Provided, however, that ROHM will not assert its intellectual property rights or other rights against you or your customers to the extent necessary to manufacture or sell products containing the Products, subject to the terms and conditions herein.

### Other Precaution

1. This document may not be reprinted or reproduced, in whole or in part, without prior written consent of ROHM.
2. The Products may not be disassembled, converted, modified, reproduced or otherwise changed without prior written consent of ROHM.
3. In no event shall you use in any way whatsoever the Products and the related technical information contained in the Products or this document for any military purposes, including but not limited to, the development of mass-destruction weapons.
4. The proper names of companies or products described in this document are trademarks or registered trademarks of ROHM, its affiliated companies or third parties.

**General Precaution**

1. Before you use our Products, you are requested to carefully read this document and fully understand its contents. ROHM shall not be in any way responsible or liable for failure, malfunction or accident arising from the use of any ROHM's Products against warning, caution or note contained in this document.
2. All information contained in this document is current as of the issuing date and subject to change without any prior notice. Before purchasing or using ROHM's Products, please confirm the latest information with a ROHM sales representative.
3. The information contained in this document is provided on an "as is" basis and ROHM does not warrant that all information contained in this document is accurate and/or error-free. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties resulting from inaccuracy or errors of or concerning such information.