

Ambient Light Sensor IC Series

Digital 16bit Serial Output Type Color Sensor IC

BH1749NUC

General Description

BH1749NUC is a digital color sensor IC with I²C 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
- I²C Bus Interface (f/s mode support)
- It is possible to select 2 type of I²C 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

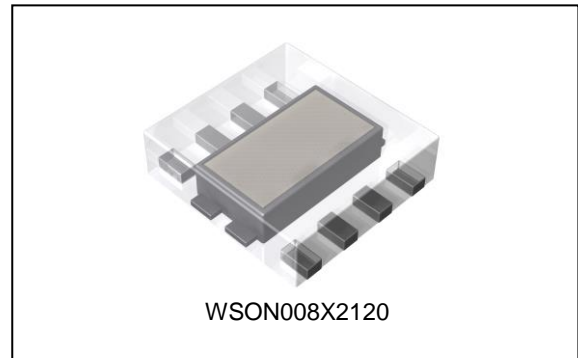
- VCC Voltage Range: 2.3 V to 3.6 V
- Illuminance Detection Range^(Note 1): 80 lx (Typ)
- Current Consumption: 190 μA (Typ)
- Power Down Current: 0.8 μA (Typ)
- Operating Temperature Range: -40 °C to +85 °C
(Note 1) White LED is used.

Package(s)

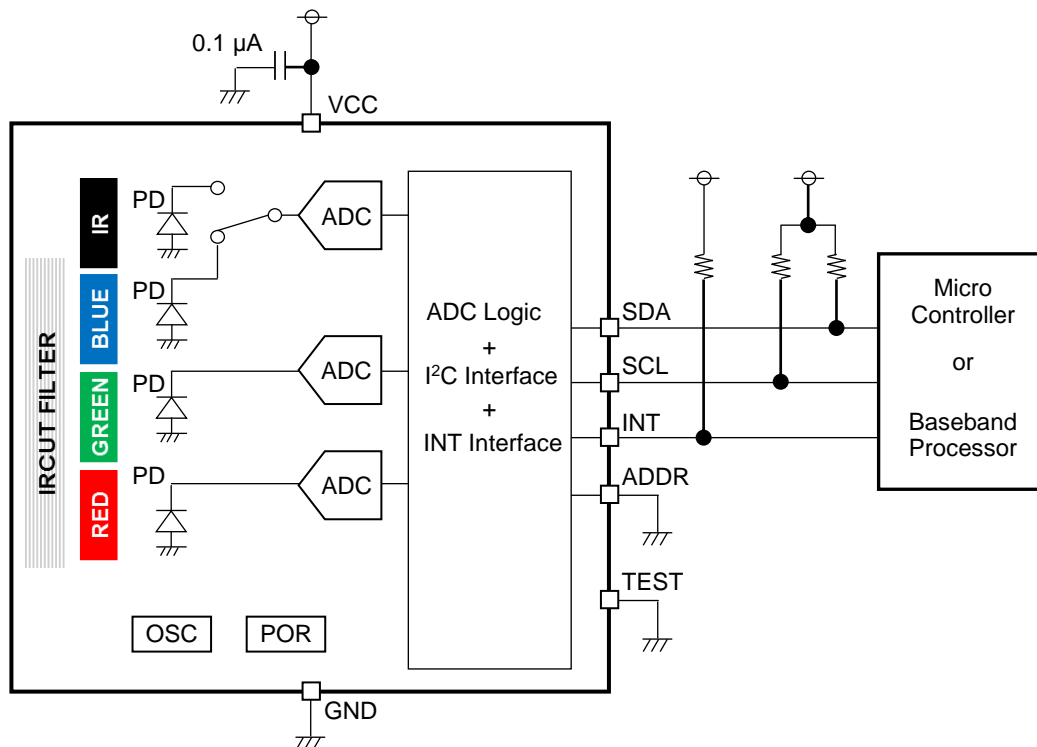
WSON008X2120

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.

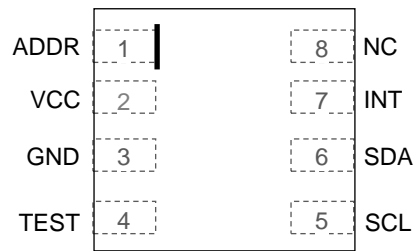
○This product includes Photo detector, (Photo Diode) inside of it.

○This product has no designed protection against radioactive rays.

○This product does not include optical load.

Pin Configuration

TOP VIEW

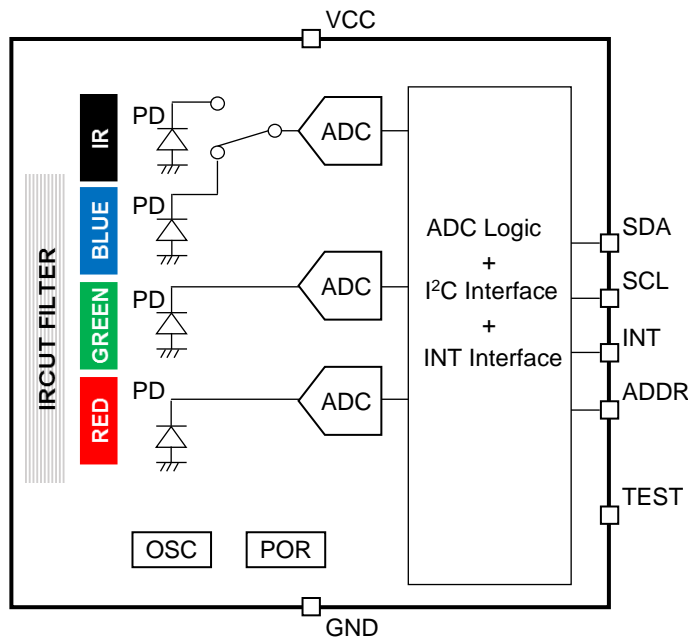


Pin Description

| Pin No. | Pin Name | Function |
|---------|----------|---|
| 1 | ADDR | I ² C bus slave address selector |
| 2 | VCC | Power supply ^(Note 1) |
| 3 | GND | Ground |
| 4 | TEST | Test pin (Connect to GND) |
| 5 | SCL | I ² C bus serial clock |
| 6 | SDA | I ² 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 + I²C 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 _{CC_MR} | 4.5 | V |
| Input Voltage 1 [INT,SCL,SDA] | V _{IN1_MR} | -0.3 to +4.5 | V |
| Input Voltage 2 [ADDR] | V _{IN2_MR} | -0.3 to (V _{CC} +0.3) or +4.5 whichever is less | V |
| Storage Temperature Range | T _{stg} | -40 to +100 | °C |
| Maximum Junction Temperature | T _{jmax} | 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^(Note 1)

| Parameter | Symbol | Thermal Resistance (Typ) | | Unit |
|--|-----------------|--------------------------|--------------------------|------|
| | | 1s ^(Note 3) | 2s2p ^(Note 4) | |
| WSON008X2120 | | | | |
| Junction to Ambient | θ _{JA} | 384.2 | 54.2 | °C/W |
| Junction to Top Characterization Parameter ^(Note 2) | Ψ _{JT} | 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 ^(Note 5) | |
|-----------------------------------|----------|------------------------------|---------------------------------|----------|
| | | | 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 _{opr} | -40 | +25 | +85 | °C |
| Supply Voltage | V _{CC} | 2.3 | 2.5 | 3.6 | V |
| Input Voltage [INT,SCL,SDA] | V _{IN} | 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 _{CC1} | - | 190 | 295 | μA | Ev=100 lx ^(Note 1) |
| Power Down Current | I _{CC2} | - | 0.8 | 1.5 | μA | Power down mode No input light |
| Red Data Count Value | D _{RED} | 60 | 71 | 82 | count | Ev=20 μW/cm ² ^(Note 2) |
| Green Data Count Value | D _{GREEN} | 84 | 99 | 114 | count | Ev=20 μW/cm ² ^(Note 3) |
| Blue Data Count Value | D _{BLUE} | 59 | 70 | 81 | count | Ev=20 μW/cm ² ^(Note 4) |
| Ir Data Count Value | D _{IR} | 18 | 25 | 32 | count | Ev=20 μW/cm ² ^(Note 5) |
| Dark Count Value | S _{0_0} | - | - | 3 | count | No input light |
| Measurement Time | t _{MT} | - | 35 | 50 | ms | |
| INT Output 'L' Voltage | V _{INTL} | 0 | - | 0.4 | V | I _{OL} =3 mA |
| SCL SDA Input 'H' Voltage | V _{IH} | 1.26 | - | - | V | |
| SCL SDA Input 'L' Voltage | V _{IL} | - | - | 0.54 | V | |
| SDA Output 'L' Voltage | V _{OL} | 0 | - | 0.4 | V | I _{OL} =3 mA |
| ADDR Input 'H' Voltage | V _{ADDRH} | 0.7*V _{CC} | - | - | V | |
| ADDR Input 'L' Voltage | V _{ADDRL} | - | - | 0.3*V _{CC} | 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.

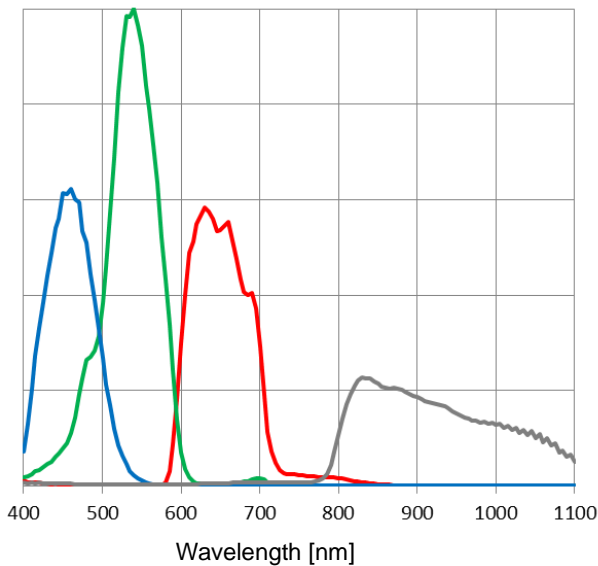
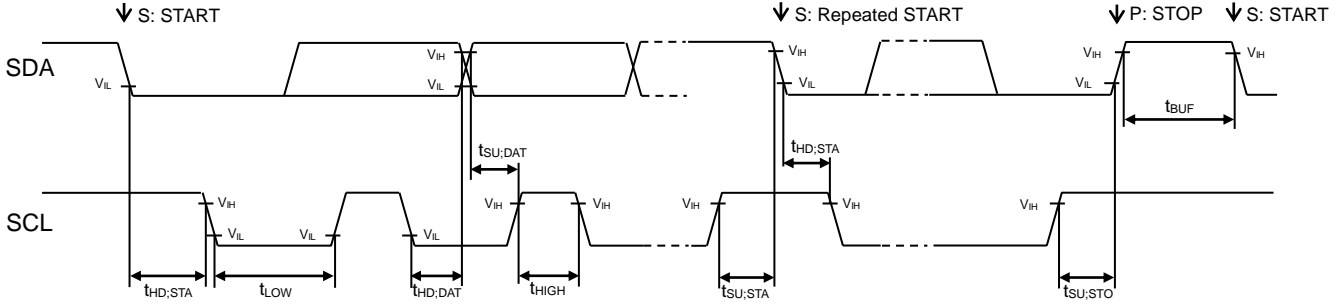
Typical Performance Curves

Figure 1. Ratio vs Wavelength
(Spectral Response)

I²C Bus Timing Characteristics (Unless otherwise specified VCC=2.5 V, Ta=25 °C)



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

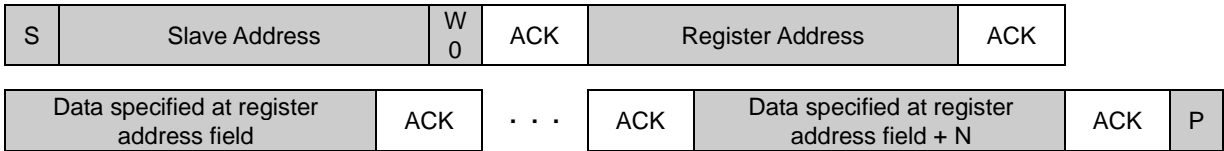
I²C Bus Communication

1. Write Format

(1) Indicate register address

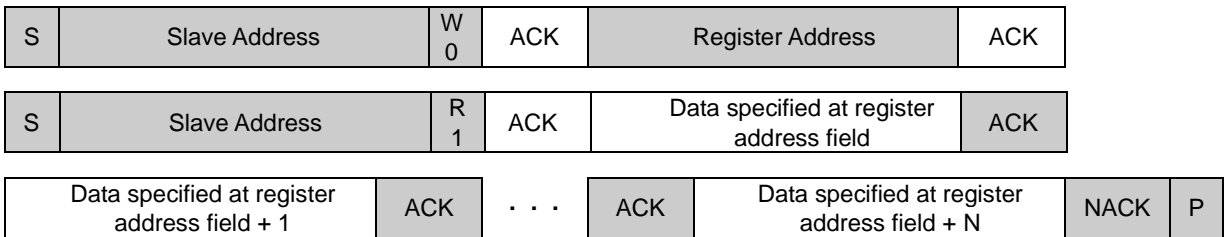


(2) Write data after indicating register address

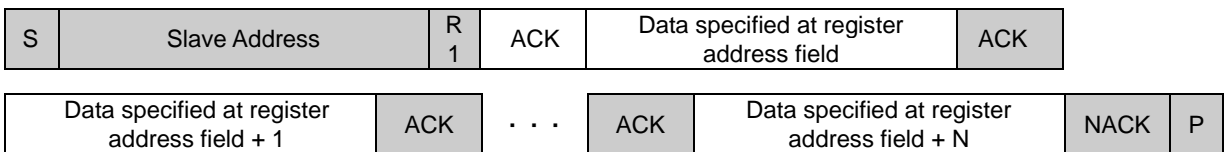


2. Read Format

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



(2) Read data from the specified register



I²C 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

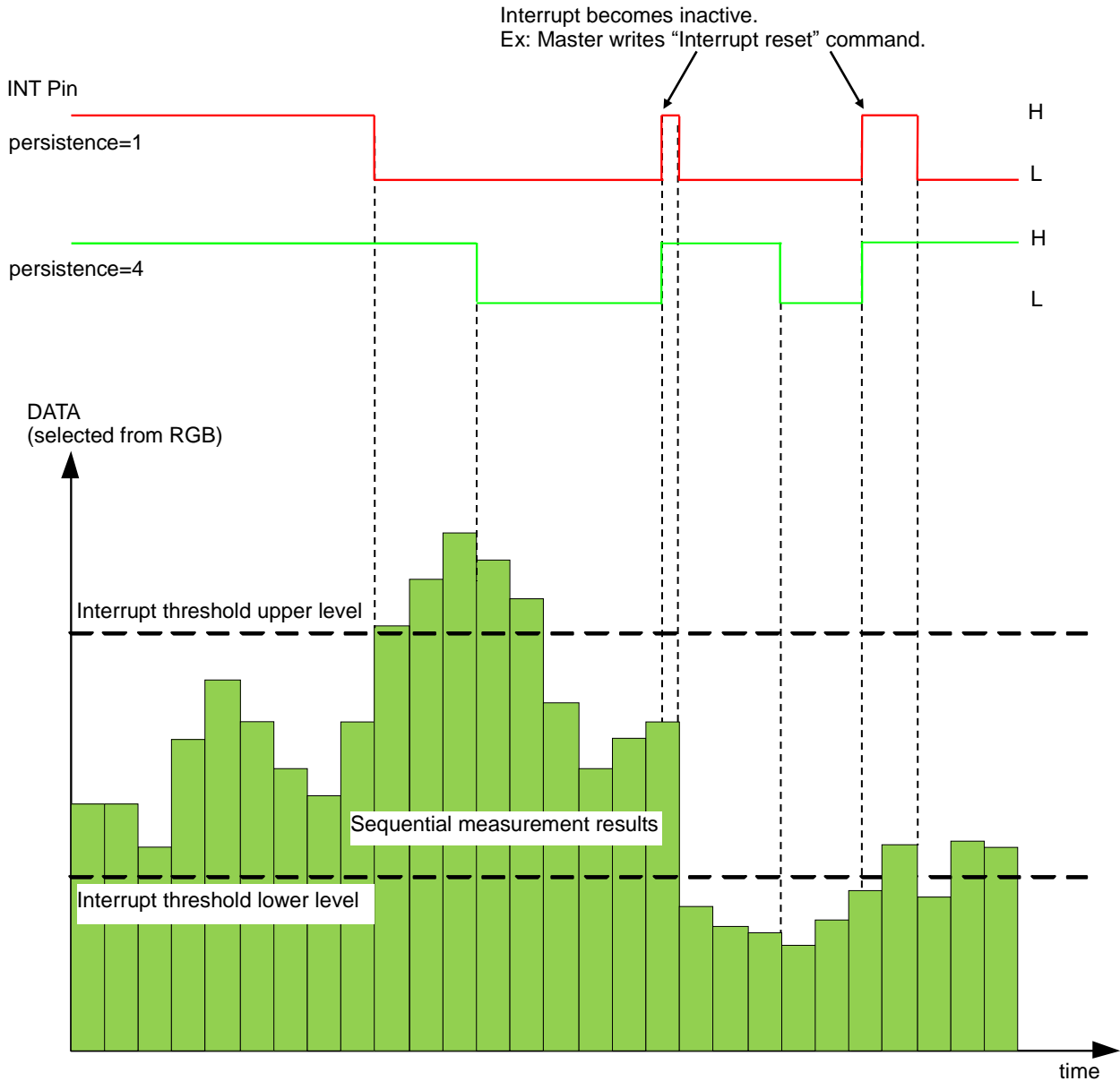
Interrupt function compares the measurement result selected from RGB data by INT SOURCE register to preset interrupt threshold level. If measurement result is outside of two threshold level, it outputs 'L'. This IC uses two threshold level (upper and lower). Interrupt threshold is defined at TH_HIGH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

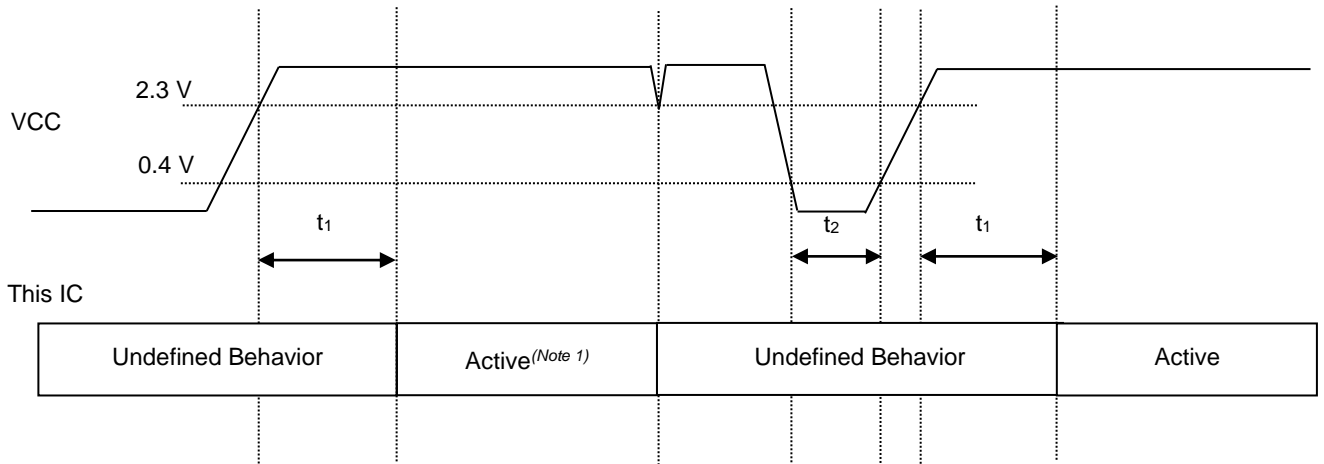
Ex: Interrupt behavior example



Power Supply Sequence

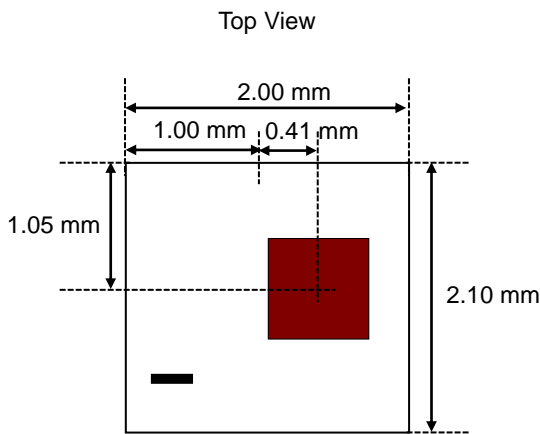
ALL register of this IC is reset when supplying VCC.
 There are some notes about power up and down sequence as shown below.

- (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.



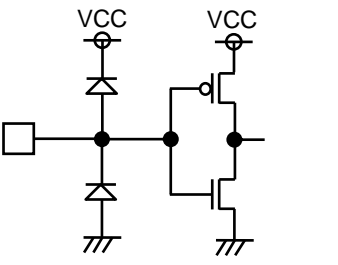
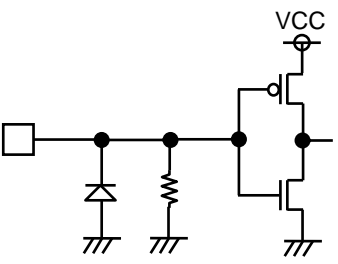
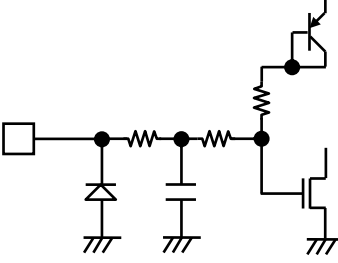
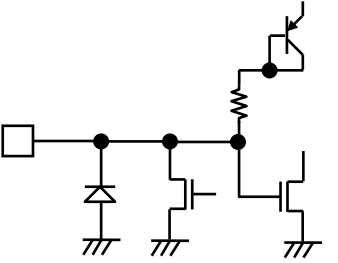
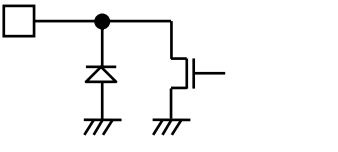
(Note 1) "Active" state is that this IC works and accepts I²C bus access correctly.

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.

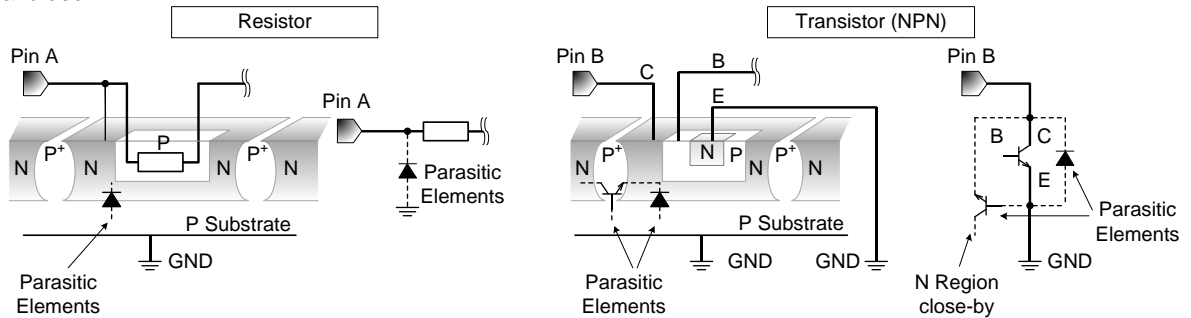


Figure 2. Example of monolithic IC structure

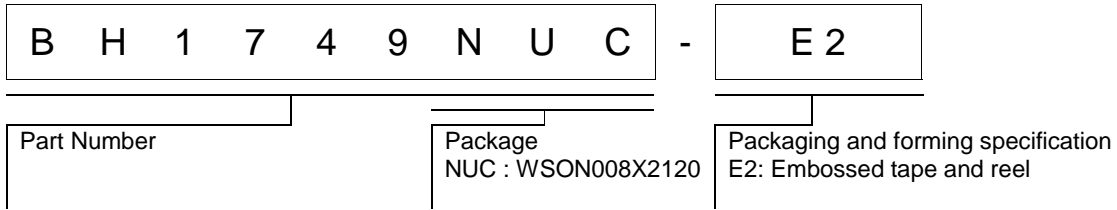
12. Ceramic Capacitor

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.

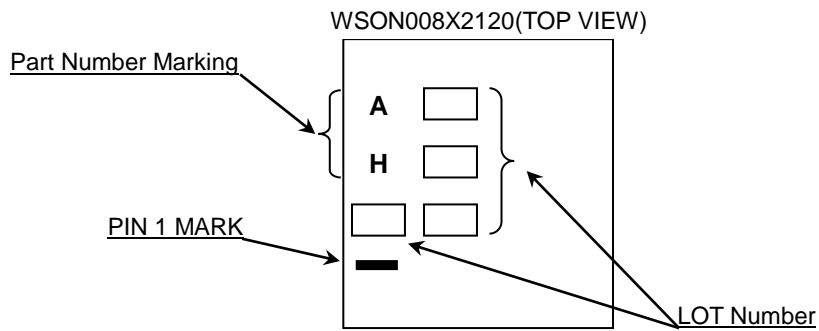
13. Area of Safe Operation (ASO)

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

Ordering Information

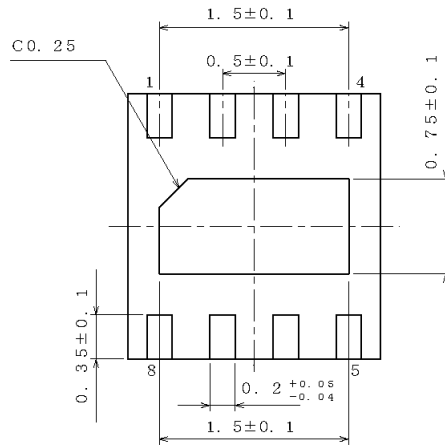
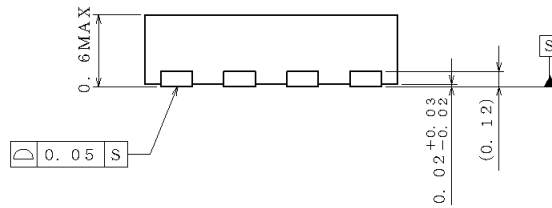
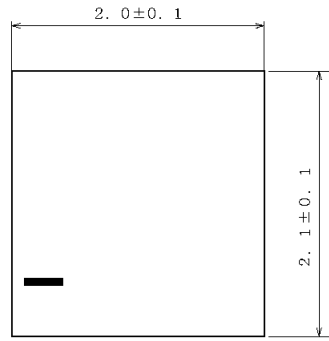


Marking Diagram



Physical Dimension and Packing Information

| | |
|--------------|--------------|
| Package Name | WS0N008X2120 |
|--------------|--------------|



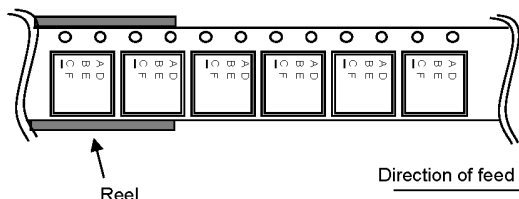
(UNIT : mm)

< 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 ^(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 |
|-----------|-----------|------------|-----------|
| 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 Cl₂, H₂S, NH₃, SO₂, and NO₂
 - 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 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

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

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