

● General Description

RPR-0521RS is a module which integrates optical proximity, digital ambient light sensor IC, and infrared LED (IrLED). Proximity sensor (PS) part detects the human or object approaching by the reflection of IrLED light. Ambient light sensor (ALS) part detects the wide range of illumination; from the dark environment to the direct sun light. The illuminant intensity of LCD display and keypad can be adjusted by using RPR-0521RS. It enables lowering current consumption and/or improving the visibility under the bright environment.

● Features

- 1) Compatible to I²C bus interface (f/s mode support)
- 2) Compatible to 1.8V logic interface
- 3) Low Current consumption by power down function/mode
- 4) There are two ALS outputs; peaks of spectrum responses are in visible light (Data0) and in infrared light (Data1) for calculating illuminance.
- 5) Correspond to very wide range of light intensity
- 6) Rejecting 50Hz/60Hz light noise (ALS function)
- 7) Detection range of proximity sensor is around 1 - 100mm (adjustable by I²C)
- 8) Built-in current configurable IrLED driver

● Application

Smart phone, Mobile phone, Digital Still Camera, Portable game, Camcorder, PDA, LCD display etc.

● Absolute maximum ratings (Ta = 25°C)

| Parameter | Symbol | Limits | Units |
|---------------------------------|----------------------------|--------|-------|
| VDD Supply Voltage | Vddmax | 4.5 | V |
| SDA, SCL Terminal Voltage | Vsdamax, Vsclmax | 4.5 | V |
| LEDA, LDR, INT Terminal Voltage | Vledamax, Vldrmax, Vintmax | 7 | V |
| Operating Temperature | Topr | -25~85 | °C |
| Storage Temperature | Tstg | -30~85 | °C |
| INT, SDA Sink Current | I _{max} | 7 | mA |

● Operating conditions

| Parameter | Symbol | Min. | Typ. | Max. | Units |
|----------------------|--------|------|------|------|-------|
| VDD Supply Voltage | Vdd | 2.5 | 3.0 | 3.6 | V |
| VLEDA Voltage | Vleda | 2.8 | 3.0 | 5.5 | V |
| INT Terminal Voltage | Vint | — | — | 5.5 | V |

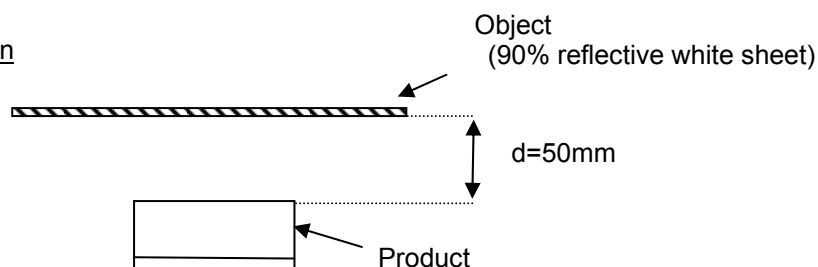
●Electrical characteristics

(VDD= 3.0V, Ta = 25°C, and all registers are default unless otherwise noted.)

| Parameter | Symbol | Min. | Typ. | Max. | Units | Conditions |
|--|----------|------|------|------|-------|---|
| Supply current for ALS | Icc1 | 10 | 90 | 300 | uA | EV = 10 lx*1 MODE_CONTROL(41h) =89h |
| Supply current for PS | Icc2 | 10 | 90 | 200 | uA | MODE_CONTROL(41h) =49h |
| Standby mode current | Icc3 | 0.1 | 1.0 | 2.0 | uA | MODE_CONTROL(41h)=00h, No input light |
| Calculated Lx | Lx | 6 | 10 | 14 | lx | EV = 10 lx*1 MODE_CONTROL(41h)=89h ALS_PS_CONTROL(42h)=02h |
| Dark (0 lx) Sensor out in TYPE0 | SO_0 | — | — | 5 | count | No input light MODE_CONTROL(41h)=89h ALS_PS_CONTROL(42h)=02h |
| Dark (0 lx) Sensor out in TYPE1 | SO_1 | — | — | 5 | count | No input light MODE_CONTROL(41h)= 89h ALS_PS_CONTROL(42h)=02h |
| PS sensor out (d=50mm ²) | PS50 | 48 | 80 | 112 | count | MODE_CONTROL(41h)=49h LED current =100mA |
| PS sensor out (No proximity object) | PS0 | — | — | 10 | count | Ambient irradiance = 0uW/cm ² MODE_CONTROL(41h)=49h LED current =100mA |
| ILED pulse duration 1 | twILED 1 | 80 | 200 | 300 | us | MODE_CONTROL(41h)=49h |
| ILED pulse duration 2 | twILED 2 | 110 | 330 | 500 | us | MODE_CONTROL(41h)=69h |
| LDR terminal sink current at LDR terminal voltage = 1.3V | ILED | 22 | 25 | 28 | mA | ALS_PS_CONTROL (42h) <1:0> = "00" |
| INT output 'L' Voltage | VINTL | 0 | | 0.4 | V | lint = 3mA |
| SCL SDA input 'H' Voltage | VIH | 1.26 | — | — | V | |
| SCL SDA input 'L' Voltage | VIL | — | — | 0.54 | V | |
| SCL SDA input 'H'/'L'Current | IIHL | -10 | — | 10 | uA | |
| I ² C SDA Output 'L' Voltage | VOL | 0 | — | 0.4 | V | Iol = 3mA |

*1 White LED is used as optical source. "Lx" is calculated from ADC count valus.

*2 Measuring Condition



Object: 90% reflective white sheet (50×50mm Kodak Gray Card Plus)

Distance between the object and the product is 50mm. No glass or apertures is above the product.

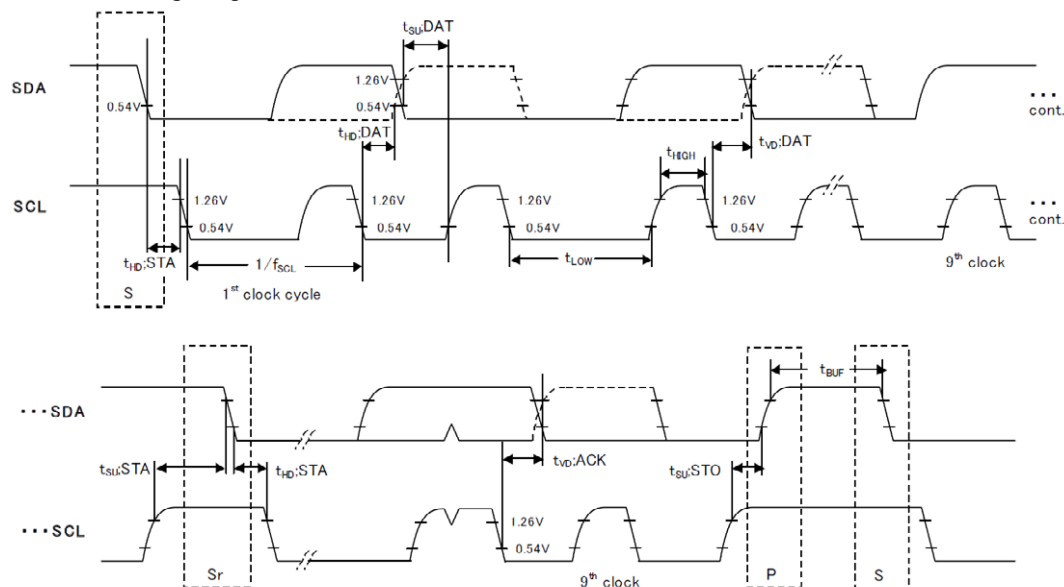
● Transmitter Electrical characteristics (Ta = 25°C, unless otherwise noted.)

| Parameter | Symbol | Min. | Typ. | Max. | Units | Conditions |
|------------------------------|-------------|------|------|------|-------|--------------------|
| LED Forward Voltage | VF | — | 1.6 | 1.95 | V | LED current =100mA |
| LED Peak Emission Wavelength | λ_p | — | 940 | — | nm | |

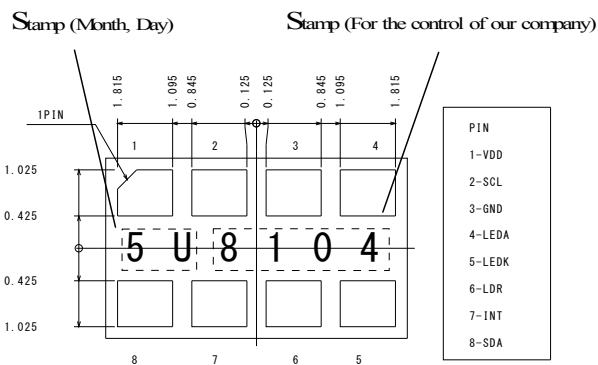
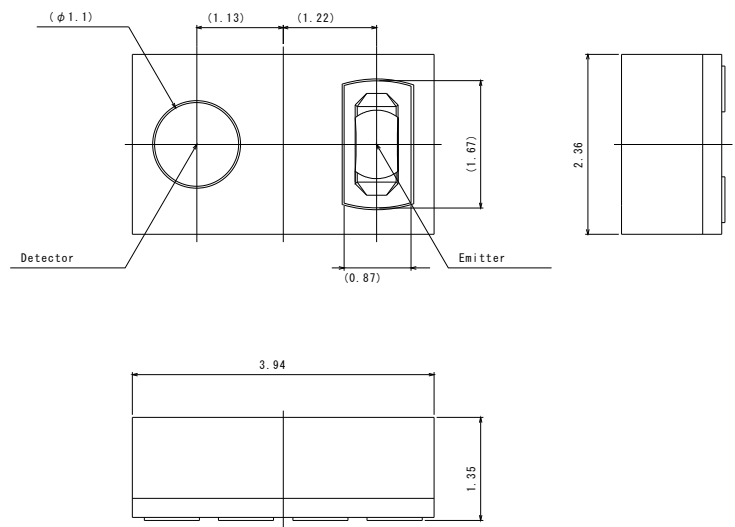
● I²C bus timing characteristics (VDD= 3.0V, Ta = 25°C, unless otherwise noted.)

| Parameter | Symbol | Min. | Typ. | Max. | Units | Conditions |
|--|---------------------|------|------|------|-------|------------|
| I ² C SCL Clock Frequency | f _{SCL} | 0 | — | 400 | kHz | |
| I ² C START Condition Hold Time | t _{HD;STA} | 0.6 | — | — | us | |
| I ² C 'L' Period of the SCL Clock | t _{LOW} | 1.3 | — | — | us | |
| I ² C 'H' Period of the SCL Clock | t _{HIGH} | 0.6 | — | — | us | |
| I ² C S START Condition Set up time | t _{SU;STA} | 0.6 | — | — | us | |
| I ² C Data Hold Time | t _{HD;DAT} | 0 | — | — | us | |
| I ² C Data Setup Time | t _{SU;DAT} | 100 | — | — | ns | |
| I ² C STOP Condition Set up Time | t _{SU;STO} | 0.6 | — | — | us | |
| I ² C Bus Free Time | t _{BUF} | 1.3 | — | — | us | |
| I ² C Data Vaild Time | t _{VD;DAT} | — | — | 0.9 | us | |
| I ² C Data Vaild Acknowledge Time | t _{VD;ACK} | — | — | 0.9 | us | |

I²C bus F/S-mode timing diagram



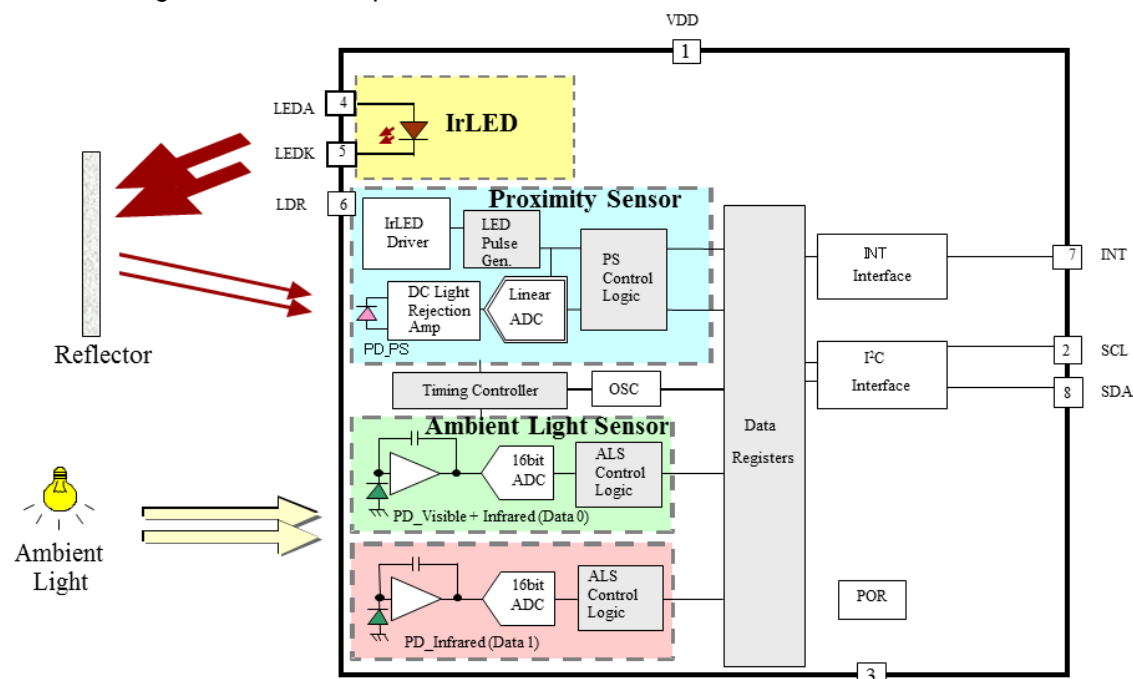
● Package outlines



- 1) Unit: mm
2) Tolerance shall be ± 0.2 mm unless otherwise noted.

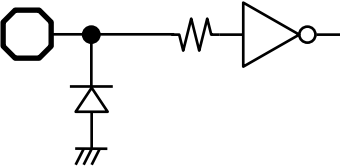
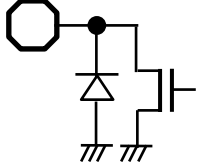
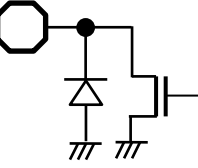
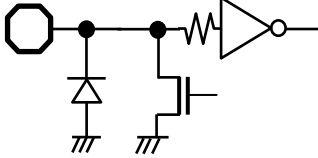
| PIN Number | Symbol | Description |
|------------|--------|--|
| 1 | VDD | Supply Voltage |
| 2 | SCL | I ² C Clock, Input |
| 3 | GND | Ground |
| 4 | LEDA | LED Supply Voltage |
| 5 | LEDK | LED Cathode |
| 6 | LDR | LED Driver |
| 7 | INT | PS or ALS Interrupt Pin, Open Drain |
| 8 | SDA | I ² C Serial Data, Input/Output |

● Block diagram and block explanation

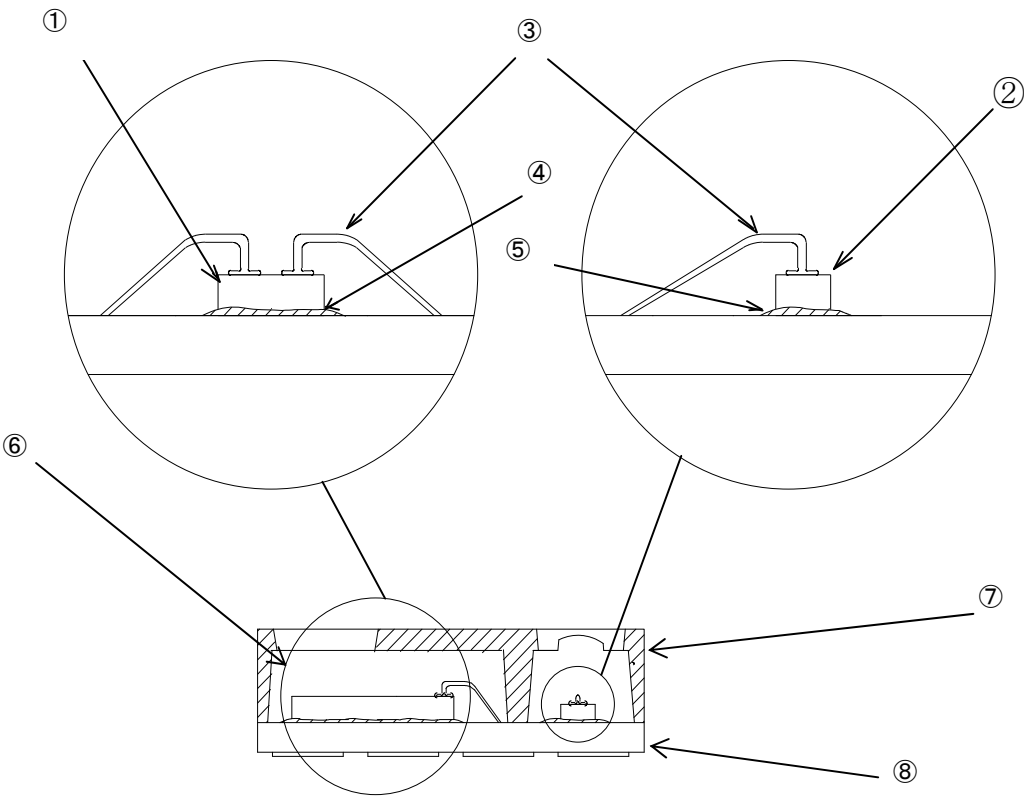


- I²C Interface
I2C bus interface. f/s mode. 1.8V interface.
- POR
Power on reset function.
- OSC
Internal oscillator.
- Timing Controller
Internal management block for proximity sensor and ambient light sensor.
- PS Control Logic
This block controls proximity sensor ADC.
- LED Pulse Gen
LED current generator. LED current can be adjusted by ALS_PS_CONTROL (42h) register.
- IrLED Driver.
IrLED driver block.
- PD_Visible + Infrared, PD_Infrared
Photo diodes for ambient light sensor.
- 16bit ADC
AD converter for ALS.
- ALS Control Logic
This block controls ambient light sensor ADC.
- PD_PS
Photo diode for proximity sensor.
- DC Light Rejection Amp
DC light is rejected in this block.
- Linear ADC
AD converter for proximity sensor.

● Terminal description

| PIN No. | Terminal Name | Equivalent Circuit | Function |
|---------|---------------|---|--|
| 1 | VDD | | Power supply terminal |
| 2 | SCL |  | I ² C bus Interface SCL terminal |
| 3 | GND | | GND terminal |
| 4 | LEDV | | LED supply voltage |
| 5 | LEDK | | LED Cathode, Please connect to LDR PIN when using internal LED driver circuit. |
| 6 | LDR |  | Nch open drain LED terminal. LED current and emitting pulse width can be defined by internal register. |
| 7 | INT |  | Nch open drain output. Interrupt setting is defined by internal register. |
| 8 | SDA |  | C bus Interface SDA terminal |

●Structure figure

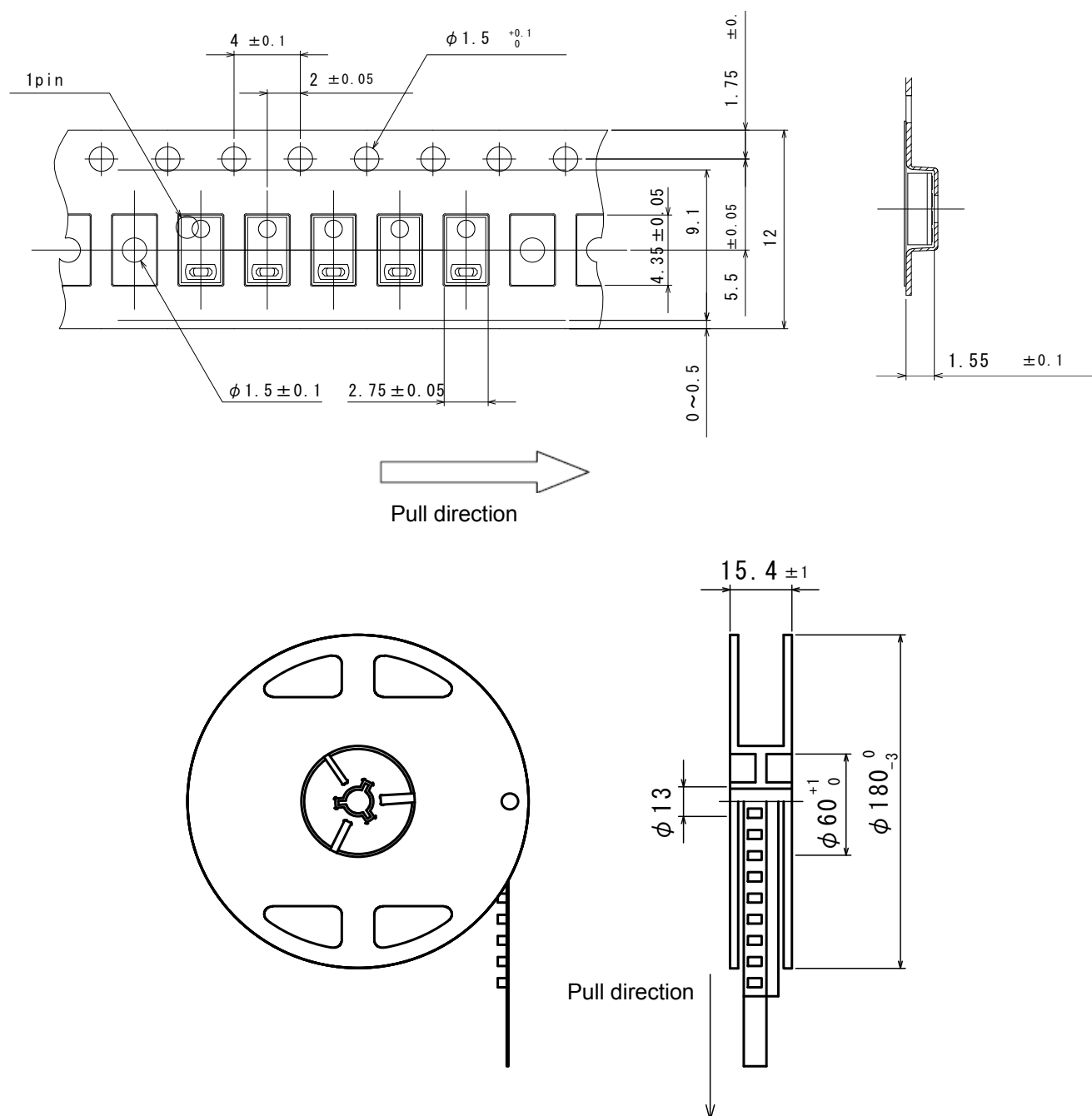


| NO. | Name | Material |
|-----|----------------------------|------------------------------------|
| ① | LSI | Si |
| ② | Ir LED | GaAlAs |
| ③ | Au wire | Au |
| ④ | Insulating bonding paste | Epoxy resin |
| ⑤ | Conductive bonding paste | Ag + Epoxy resin |
| ⑥ | Transparent mold resin | Epoxy resin |
| ⑦ | Light-resistant mold resin | Epoxy resin |
| ⑧ | PCB | Epoxy resin Cu,Ni,Au(Electrode) |

Unit:mm

- Taping standard

Note) 1.Unspecified tolerance shall be ± 0.2 .
2.Dimensions and marking of reels are in accordance with JEITA's standard ET-7103A.

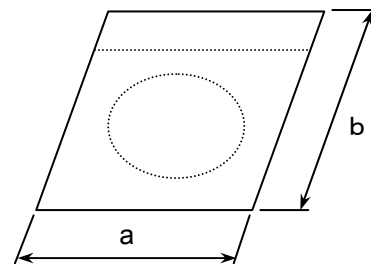


Packaging quantity: 2,500 pcs/reel

● Packaging requirements

1. Packaging

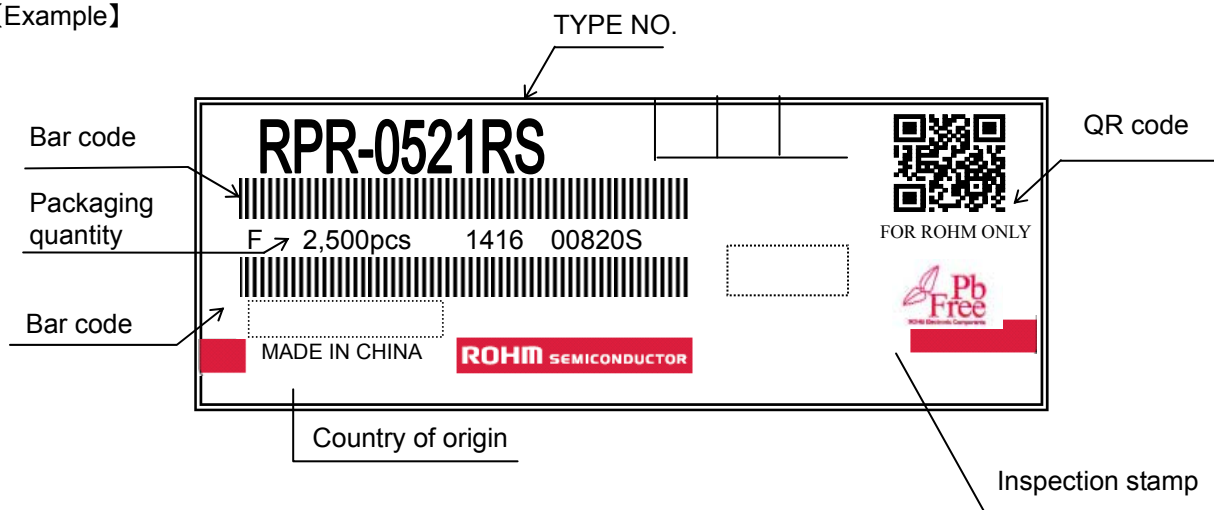
- (1) Quantity per reel is 2,500pcs
- (2) Each reel are packed in aluminum bag.
The size of aluminum bag is 240(a)×240(b)mm.
- (3) Aluminum bag is pressure sealed on all four directions.



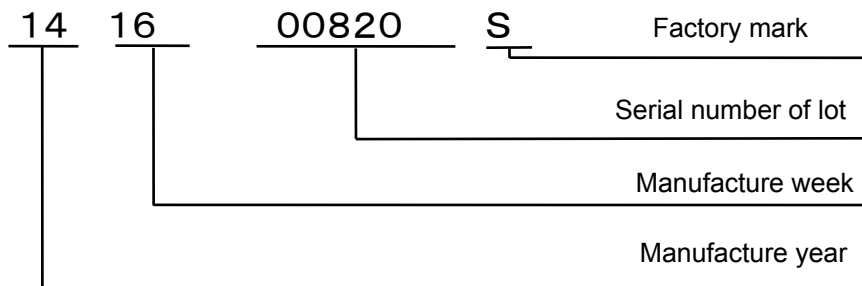
2. Label indication

The following information shall be described on a aluminum bag label; ROHM type number, packaging quantity, and lot number

【Example】



【Example of lot number marking】



3. Factory (Country of origin)

- ROHM ELECTRONICS DALIAN CO., LTD. (CHINA)

Attention points in handling

This product is developed as an optical proximity sensor and ambient light sensor with IrLED; suitable for reflow soldering. Please take care of following points when using this device.

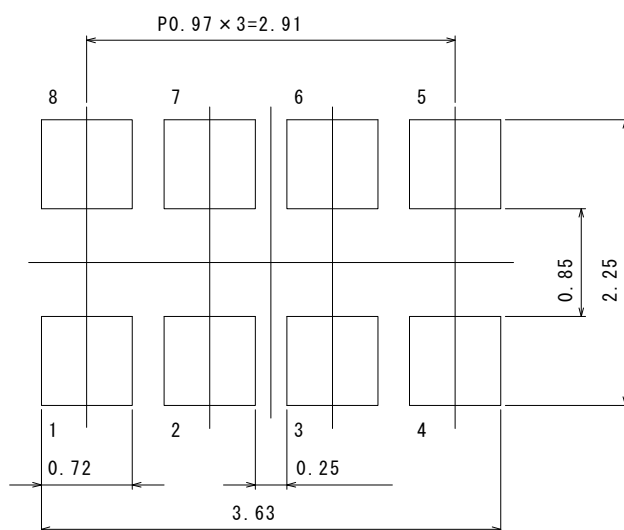
1. Storage

There will be the possibility that the moisture influences the reliability of this product during the reflow soldering process. Hence, the product is packed in the anti-moisture bag. When using the product, please keep following conditions.

- | | | | |
|---|-------------------------------|-------|--|
| ① | Storage condition | ▪ ▪ ▪ | ▪ Storage Temperature : 5 ~ 30°C Storage Humidity : less than 70%RH |
| ② | Process after opening the bag | ▪ | ▪ Please storage the product at the temperature between 5 ~ 30°C and the moisture less than 70% RH within 168 hours. |
| ③ | Baking (dry) process | ▪ ▪ | ▪ If the above conditions aren't kept, please apply the baking process. The baking process should be executed under the reel condition at 60°C±5°C for 12~24 hours. During the baking process, the reel and emboss tape should be handled with care. |

2. Designing of PCB

The figure below is the recommended solder pattern. This pattern may need to be adjusted to mounting conditions and solder paste.



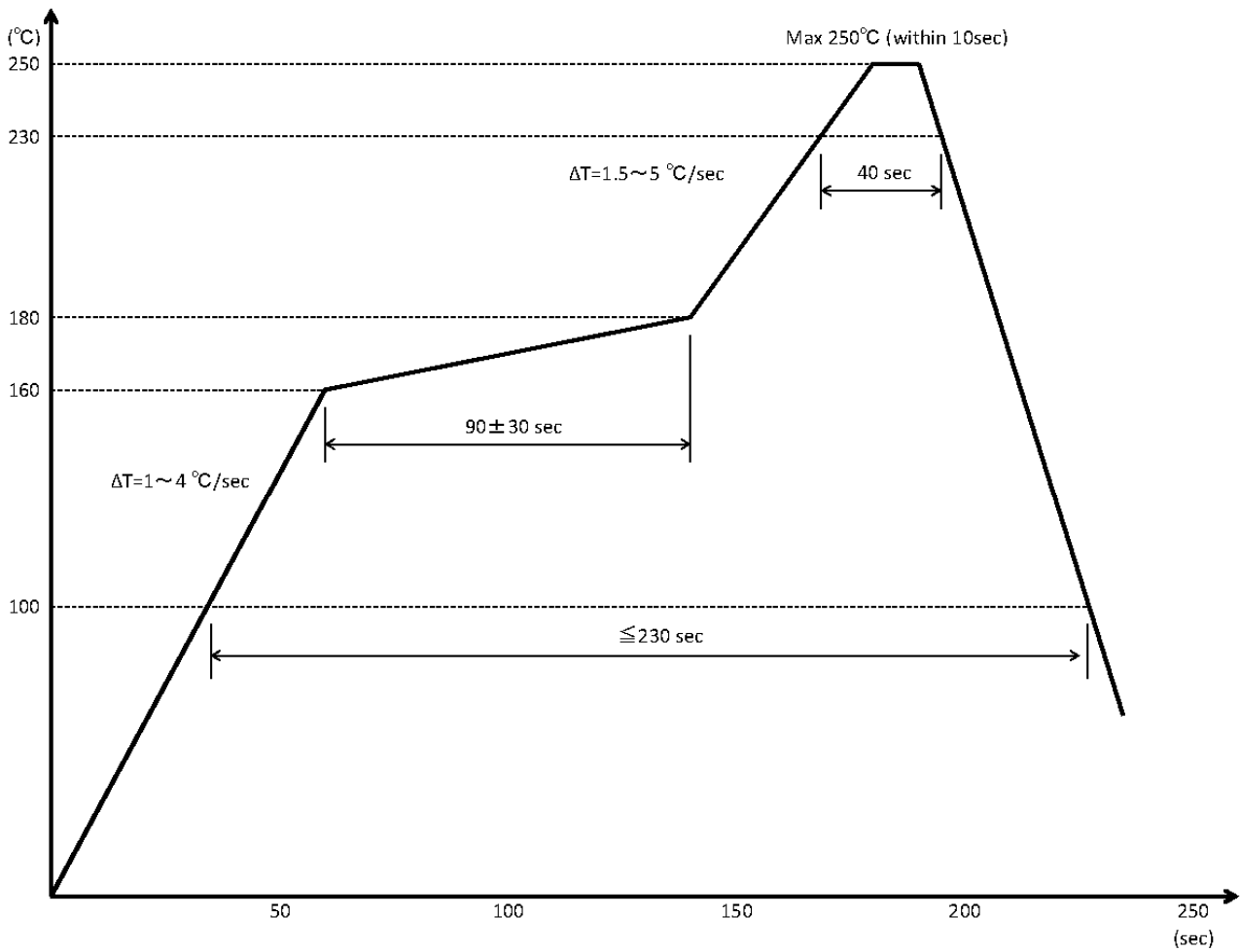
3. Reflow soldering

Number of reflow process shall be less than 2 times. When the second reflow process is performed, the interval between the first and the second reflow process shall be as short as possible to prevent absorption of moisture into the resin of the product. Cooling process to the room temperature shall be required between the first and the second reflow process.

The following temperature condition is recommended for the reflow soldering. We would like you to evaluate your reflow condition because the condition is affected by the PCB size, the product heat-resistivity or the mount density

4. Reflow temperature profile

Package surface temperature (°C)



● Command set

| Address | TYPE | default | Register name | Register function |
|---------|------|---------|-------------------|-------------------------------------|
| 40h | RW | 0Ah | SYSTEM_CONTROL | System control |
| 41h | RW | 00h | MODE_CONTROL | ALS, PS function setting |
| 42h | RW | 02h | ALS_PS_CONTROL | ALS Gain, PS LED Driver |
| 43h | RW | 01h | PS_CONTROL | PS Gain, PS interrupt persistence |
| 44h | R | 00h | PS_DATA_LSBs | PS data low byte |
| 45h | R | 00h | PS_DATA_MSBs | PS data high byte |
| 46h | R | 00h | ALS_DATA0_LSBs | ALS DATA0 low byte |
| 47h | R | 00h | ALS_DATA0_MSBs | ALS DATA0 high byte |
| 48h | R | 00h | ALS_DATA1_LSBs | ALS DATA1 low byte |
| 49h | R | 00h | ALS_DATA1_MSBs | ALS DATA1 high byte |
| 4Ah | RW | 00h | INTERRUPT | Interrupt control |
| 4Bh | RW | FFh | PS_TH_LSBs | PS upper threshold low byte |
| 4Ch | RW | 0Fh | PS_TH_MSBs | PS upper threshold high byte |
| 4Dh | RW | 00h | PS_TL_LSBs | PS lower threshold low byte |
| 4Eh | RW | 00h | PS_TL_MSBs | PS lower threshold high byte |
| 4Fh | RW | FFh | ALS_DATA0_TH_LSBs | ALS DATA0 upper threshold low byte |
| 50h | RW | FFh | ALS_DATA0_TH_MSBs | ALS DATA0 upper threshold high byte |
| 51h | RW | 00h | ALS_DATA0_TL_LSBs | ALS DATA0 lower threshold low byte |
| 52h | RW | 00h | ALS_DATA0_TL_MSBs | ALS DATA0 lower threshold high byte |
| 53h | RW | 00h | PS_OFFSET_LSBs | PS offset low byte |
| 54h | RW | 00h | PS_OFFSET_MSBs | PS offset high byte |
| 92h | R | E0h | MANUFACT_ID | MANUFACT ID |

● SYSTEM_CONTROL (40h)

| Field | Bit | TYPE | Description |
|-----------|-------|------|---|
| SW reset | 7 | RW | 0 : initial reset is not started 1 : initial reset is started |
| INT reset | 6 | RW | 0 : INT pin status is not initialized 1 : INT pin become inactive (high impedance) |
| Part ID | 5 : 0 | R | 001010 |

default value 0Ah

● MODE_CONTROL (41h)

| Field | Bit | TYPE | Description |
|-------------------|-------|------|---|
| ALS_EN | 7 | RW | 0 : ALS Standby 1 : ALS Enable |
| PS_EN | 6 | RW | 0 : PS Standby 1 : PS Enable |
| PS_PULSE | 5 | RW | 0 : PS LED pulse width is typ 200us 1 : PS LED pulse width is typ 330us (PS sensor out is doubled) |
| PS Operating mode | 4 | RW | 0 : normal mode 1 : twice measurement mode |
| Measurement time | 3 : 0 | RW | Shown in table below |

default value 00h

| Value | ALS | PS | Value | ALS | PS |
|-------|---------|---------|-------|---------------------|---------|
| 0000 | standby | standby | 1000 | 400ms ^{*1} | 50ms |
| 0001 | standby | 10ms | 1001 | 400ms ^{*1} | 100ms |
| 0010 | standby | 40ms | 1010 | 400ms ^{*2} | standby |
| 0011 | standby | 100ms | 1011 | 400ms ^{*2} | 400ms |
| 0100 | standby | 400ms | 1100 | 50ms ^{*3} | 50ms |
| 0101 | 100ms | 50ms | 1101 | Forbidden | |
| 0110 | 100ms | 100ms | 1110 | Forbidden | |
| 0111 | 100ms | 400ms | 1111 | Forbidden | |

^{*1} Measurement time is 100ms, sleep time is 300ms.^{*2} High sensitivity mode, measurement time is 400ms.^{*3} Additional software process is necessary. Please refer to P.18

● ALS_PS_CONTROL (42h)

| Field | Bit | TYPE | Description |
|----------------|-------|------|---|
| Reserved | 7 : 6 | RW | Write 00 |
| ALS DATA0 GAIN | 5 : 4 | RW | Gain control of ALS DATA 0 00 : x1 Gain mode 01 : x2 Gain mode 10 : x64 Gain mode 11 : x128 Gain mode |
| ALS DATA1 GAIN | 3 : 2 | RW | Gain control of ALS DATA 1 00 : x1 Gain mode 01 : x2 Gain mode 10 : x64 Gain mode 11 : x128 Gain mode |
| LED CURRENT | 1 : 0 | RW | 00 : 25mA 01 : 50mA 10 : 100mA 11 : 200mA |

default value 02h

● PS_CONTROL (43h)

| Field | Bit | TYPE | Description |
|-----------------|-------|------|--|
| Ambient_Ir_Flag | 7 : 6 | R | 00: Ambient infrared level is low 01: Ambient infrared level is high 11: Ambient infrared level is too high |
| PS_GAIN | 5 : 4 | RW | 00: PS GAIN ×1 01: PS GAIN ×2 10: PS GAIN ×4 11: Forbidden |
| PERSISTENCE | 3 : 0 | RW | PS interrupt persistence setting 0000: Interrupt becomes active at each measurement end 0001: Interrupt status is updated at each measurement end 0010: Interrupt status is updated if two consecutive threshold judgments are the same 0011 or more: Interrupt status is updated if threshold judgments are the same over consecutive set times |

default value 01h

● PS_DATA_LSBs (44h)

| Register | TYPE | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------------|------|-------|-------|-------|-------|-------|-------|-------|-------|
| PS_DATA_LSBs | R | 2^7 | 2^6 | 2^5 | 2^4 | 2^3 | 2^2 | 2^1 | 2^0 |

default value 00h

● PS_DATA_MSBs (45h)

| Register | TYPE | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|--------------|------|---|---|---|---|----------|----------|-------|-------|
| PS_DATA_MSBs | R | 0 | 0 | 0 | 0 | 2^{11} | 2^{10} | 2^9 | 2^8 |

default value 00h

● ALS_DATA0_LSBs(46h)

| Register | TYPE | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|----------------|------|-------|-------|-------|-------|-------|-------|-------|-------|
| ALS_DATA0_LSBs | R | 2^7 | 2^6 | 2^5 | 2^4 | 2^3 | 2^2 | 2^1 | 2^0 |

default value 00h

● ALS_DATA0_MSBs(47h)

| Register | TYPE | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|----------------|------|----------|----------|----------|----------|----------|----------|-------|-------|
| ALS_DATA0_MSBs | R | 2^{15} | 2^{14} | 2^{13} | 2^{12} | 2^{11} | 2^{10} | 2^9 | 2^8 |

default value 00h

● ALS_DATA1_LSBs(48h)

| Register | TYPE | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|----------------|------|-------|-------|-------|-------|-------|-------|-------|-------|
| ALS_DATA1_LSBs | R | 2^7 | 2^6 | 2^5 | 2^4 | 2^3 | 2^2 | 2^1 | 2^0 |

default value 00h

● ALS_DATA1_MSBs(49h)

| Register | TYPE | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|----------------|------|----------|----------|----------|----------|----------|----------|-------|-------|
| ALS_DATA1_MSBs | R | 2^{15} | 2^{14} | 2^{13} | 2^{12} | 2^{11} | 2^{10} | 2^9 | 2^8 |

default value 00h

● INTERRUPT (4Ah)

| Field | Bit | TYPE | Description |
|----------------|-------|------|---|
| PS INT STAUTS | 7 | R | 0 : PS interrupt signal inactive 1 : PS interrupt signal active |
| ALS INT STATUS | 6 | R | 0 : ALS interrupt signal inactive 1 : ALS interrupt signal active |
| INT MODE | 5 : 4 | RW | 00 : Only PS_TH_H is effective 01 : PS_TH_H and PS_TH_L are effective as hysteresis 10 : PS_TH_H and PS_TH_L are effective as outside detection 11 : Forbidden |
| INT ASSERT | 3 | RW | 0 : Interrupt output 'L' is stable if newer measurement result is also interrupt active 1 : Interrupt output 'L' is de-assert and re-assert if newer measurement result is also interrupt active |
| INT LATCH | 2 | RW | 0 : INT pin is latched until INTERRUPT register is read or initialized 1 : INT pin is updated after each measurement |
| INT TRIG | 1 : 0 | RW | 00 : INT pin is inactive 01 : Triggered by only PS measurement 10 : Triggered by only ALS measurement 11 : Triggered by PS and ALS measurement |

default value 00h

1. In case of PS/ALS outside detection mode, interrupt signal inactive means that measurement result is within registered threshold level; interrupt signal active means measurement result is out of registered threshold level.
2. In case of PS hysteresis mode, once interrupt signal becomes active, INT status is kept until measurement result becomes less than PS_TH_L register value.
3. Persistence is for PS only.
4. INT Pin become inactive (high impedance) if INTERRUPT register is read, initialized, or SW reset is started.

● PS_TH_LSBs (4Bh)

| Register | TYPE | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|------------|------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| PS_TH_LSBs | RW | 2 ⁷ | 2 ⁶ | 2 ⁵ | 2 ⁴ | 2 ³ | 2 ² | 2 ¹ | 2 ⁰ |

default value FFh

● PS_TH_MSBs (4Ch)

| Register | TYPE | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|------------|------|---|---|---|---|-----------------|-----------------|----------------|----------------|
| PS_TH_MSBs | RW | 0 | 0 | 0 | 0 | 2 ¹¹ | 2 ¹⁰ | 2 ⁹ | 2 ⁸ |

default value 0Fh

● PS_TL_LSBs (4Dh)

| Register | TYPE | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|------------|------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| PS_TL_LSBs | RW | 2 ⁷ | 2 ⁶ | 2 ⁵ | 2 ⁴ | 2 ³ | 2 ² | 2 ¹ | 2 ⁰ |

default value 00h

● PS_TL_MSBs (4Eh)

| Register | TYPE | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|------------|------|---|---|---|---|-----------------|-----------------|----------------|----------------|
| PS_TL_MSBs | RW | 0 | 0 | 0 | 0 | 2 ¹¹ | 2 ¹⁰ | 2 ⁹ | 2 ⁸ |

default value 00h

● ALS_DATA0_TH_LSBs (4Fh)

| Register | TYPE | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|-------------------|------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| ALS_DATA0_TH_LSBs | RW | 2 ⁷ | 2 ⁶ | 2 ⁵ | 2 ⁴ | 2 ³ | 2 ² | 2 ¹ | 2 ⁰ |

default value FFh

● ALS_DATA0_TH_MSBs (50h)

| Register | TYPE | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|-------------------|------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------------|----------------|
| ALS_DATA0_TH_MSBs | RW | 2 ¹⁵ | 2 ¹⁴ | 2 ¹³ | 2 ¹² | 2 ¹¹ | 2 ¹⁰ | 2 ⁹ | 2 ⁸ |

default value FFh

● ALS_DATA0_TL_LSBs (51h)

| Register | TYPE | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|-------------------|------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| ALS_DATA0_TL_LSBs | RW | 2 ⁷ | 2 ⁶ | 2 ⁵ | 2 ⁴ | 2 ³ | 2 ² | 2 ¹ | 2 ⁰ |

default value 00h

● ALS_DATA0_TL_MSBs (52h)

| Register | TYPE | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|-------------------|------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------------|----------------|
| ALS_DATA0_TL_MSBs | RW | 2 ¹⁵ | 2 ¹⁴ | 2 ¹³ | 2 ¹² | 2 ¹¹ | 2 ¹⁰ | 2 ⁹ | 2 ⁸ |

default value 00h

● PS_OFFSET_LSBs (53h)

| Register | TYPE | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|----------------|------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| PS_OFFSET_LSBs | RW | 2 ⁷ | 2 ⁶ | 2 ⁵ | 2 ⁴ | 2 ³ | 2 ² | 2 ¹ | 2 ⁰ |

default value 00h

● PS_OFFSET_MSBs (54h)

| Field | Bit | TYPE | Description |
|----------------|-------|------|-------------|
| Resereved | 7 : 2 | R | Ignored |
| PS_OFFSET_MSBs | 1 : 0 | RW | Shown below |

default value 00h

| Register | TYPE | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|----------------|------|---|---|---|---|---|---|----------------|----------------|
| PS_OFFSET_MSBs | RW | - | - | - | - | - | - | 2 ⁹ | 2 ⁸ |

default value 00h

When changed these registers, PS_DATA (44h,45h) becomes
 ([PS measured value]- ([PS offset value]) offset value)]

● MANUFACT_ID (92h)

| Field | Bit | TYPE | Description |
|-------------|-------|------|-------------|
| MANUFACT_ID | 7 : 0 | R | 11100000 |

default value E0h

● I²C bus communication

1) Slave address "0111000" (38h)

2) Main write format

1. Case of "Indicating register address"

| | | | | | | |
|----|--------------------------|--------|-----|---------------------------------------|-----|----|
| ST | Slave Address 0111000 | W 0 | ACK | Indicate register address 010XXXXX | ACK | SP |
|----|--------------------------|--------|-----|---------------------------------------|-----|----|

2. Case of "writing data register after indicating register address"

| | | | | | |
|----|--------------------------|--------|-----|---------------------------------------|-----|
| ST | Slave Address 0111000 | W 0 | ACK | Indicate register address 010XXXXX | ACK |
|----|--------------------------|--------|-----|---------------------------------------|-----|

| | | | | | |
|---|-----|-----|--|-----|----|
| Data specified at register address field | ACK | ACK | Data specified at register address field + N | ACK | SP |
|---|-----|-----|--|-----|----|

RPR-0521RS continues to write data with address increments until master issues stop condition.
Write cycle is 40h - 41h - 42h - 43h - 44h - 45h - 46h 53h - 54h - 40h

Ex) If register address field is 42h, then RPR-0521RS writes data like below.

42h - 43h - 44h - 45h - 46h 53h - 54h - 40h.....

Register writing continues until master issues stop condition.

3) Main read format

1. Case of "Reading data after indicating register address" (Master issues restart condition)

| | | | | | |
|----|--------------------------|--------|-----|---------------------------------------|-----|
| ST | Slave Address 0111000 | W 0 | ACK | Indicate register address 010XXXXX | ACK |
|----|--------------------------|--------|-----|---------------------------------------|-----|

| | | | | | |
|----|--------------------------|--------|-----|---|-----|
| ST | Slave Address 0111000 | R 1 | ACK | Data specified at register address field | ACK |
|----|--------------------------|--------|-----|---|-----|

| | | | | | |
|---|-----|-----|---|------|----|
| Data specified at register address field + 1 | ACK | ACK | Data specified at register address field + N | NACK | SP |
|---|-----|-----|---|------|----|

2. Case of "Reading data from specified register address"

| | | | | | |
|----|--------------------------|--------|-----|---|-----|
| ST | Slave Address 0111000 | R 1 | ACK | Data specified at register address field | ACK |
|----|--------------------------|--------|-----|---|-----|

| | | | | | |
|---|-----|-----|---|------|----|
| Data specified at register address field + 1 | ACK | ACK | Data specified at register address field + N | NACK | SP |
|---|-----|-----|---|------|----|

RPR-0521RS continues to read data from specified address field until master issues stop condition.

Read cycle is 40h - 41h - 42h - 43h - 44h - 45h - 46h 53h - 54h - 40h

Ex) If register address field is 53h, then RPR-0521RS reads data like below.

53h - 54h - 40h

Register reading continues until master issues stop condition.



from master to slave



from slave to master

※ RPR-0521RS operates as I2C bus slave device.

※ Please refer formality I2C bus specification of NXP semiconductors.

● Notice in case of using ALS 50ms measurement mode

At 50msec mode (MODE_CONTROL (41h) <3:0>:"1100"), full scale count of ALS_DATA0 (46h, 47h) and ALS_DATA1 (48h, 49h) become half of other modes.

ALS_DATA0<15> or ALS_DATA1<15> is a flag indicating the data overflow.

Consequently, additional function as follows is necessary in software at 50msec mode.

<Necessary software function>

if (DATA0<15>==1){DATA0<15:0>=7FFFh}

if (DATA1<15>==1){DATA1<15:0>=7FFFh}

*This function is necessary at 50msec mode only.

*This function must be executed before Lux calculation given

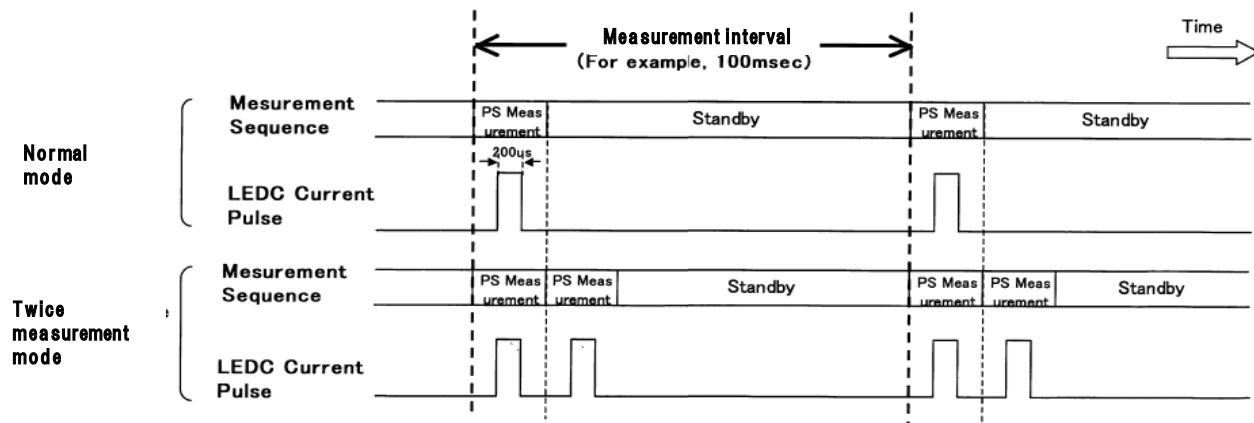
● PS twice measurement mode

RPR-0521RS has two PS operating modes that can be selected by MODE_CONTROL(41h).

At normal mode, PS measurement is done only once in each measurement period.

At twice measurement mode, PS measurement is done twice in each measurement period.

By using twice measurement mode, quicker response of interrupt is available than normal mode when persistence function is active.



● Notice in case of changing register value

When master changes a value of ALS_PS_CONTROL(42h) (For example, ALS gain), it is necessary to stop the ALS/PS measurement in progress and re-start the measurement from the beginning ("Interrupt & Re-start" sequence). The way to "Interrupt & Re-start" is to write some data to MODE CONTROL(41h). By writing both MODE_CONTROL(41h) and ALS_PS_CONTROL(42h) with address increments access, it is possible to change the register setting and "Interrupt & Re-start" the measurement at the same time.

● Power on reset function

RPR-0521RS series have power on reset function. By operating this function, all of registers are reset when the power is supplied.

Please note followings and design the application.

① Power on time : t_1

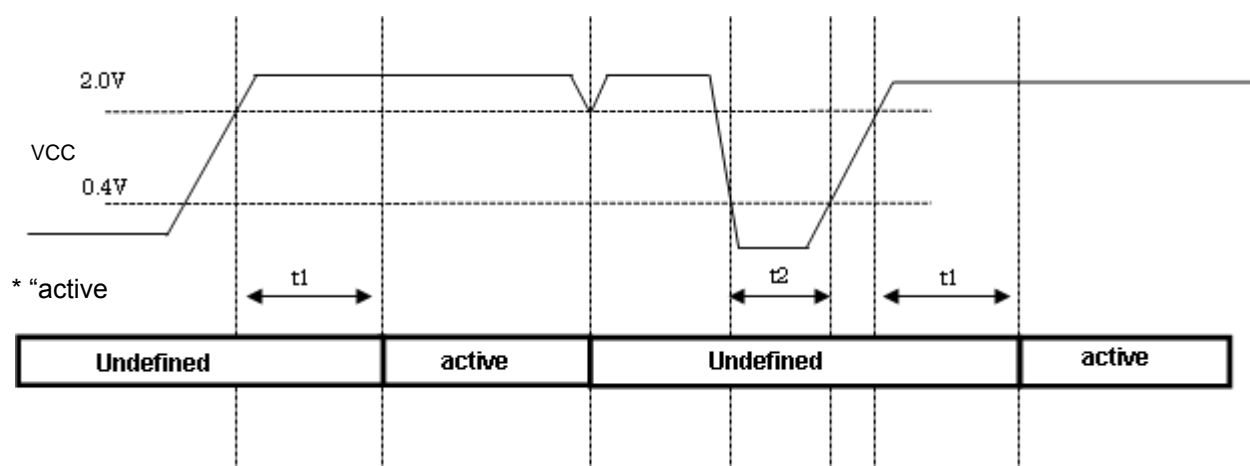
$t_1 > 2\text{ms}$

RPR-0521RS series become operational after 2ms since VDD voltage crosses 2.0V from being less than 0.4V.

② Power off time : t_2

$t_2 > 1\text{ms}$

Before the power is supplied, VDD voltage should be less than 0.4V at least for 1ms.



"active" means that RPR-0521RS series are correctly operational.

INT terminal is high impedance when VDD is supplied.

When VDD voltage become less than 2.0V, the power should be supplied again in accordance with the above sequence.

● Interrupt function

Interrupt function compares ALS and PS measurement result to preset interrupt threshold level. Interrupt status can be monitored by INT pin. Interrupt function is able to be controlled by INTTERRUPT register (4Ah).

Interrupt persistence is defined at PERSIST register (43h). Persistence function is for PS only. There are two output modes about interrupt function (latched mode and unlatched mode).

INT pin is Nch open drain terminal, so this terminal should be pull-up to some kind of voltage source by an external resistance. INT terminal is high impedance when VCC is supplied.

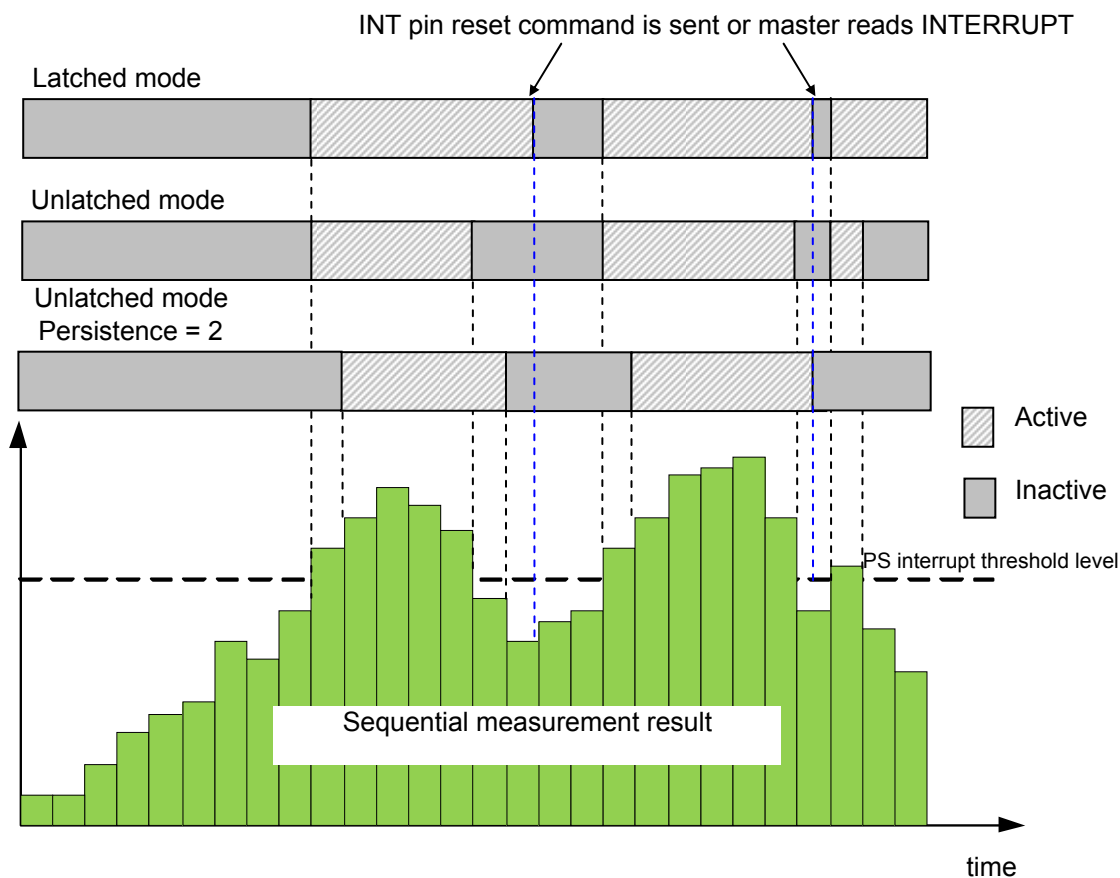
INT terminal keeps previous state when power down command is sent. So it is recommended to set INT terminal to high impedance before sending power down command. VDD current (approximately 25uA at VDD=2.5V) is consumed during INT terminal is active. INT terminal can be changed to high impedance by writing INT reset command, reading INTERRUPT register (4Ah), or resetting software.

ex1) In case of using PS 'H' threshold (INTERRUPT register 4Ah<5:4> : "00")

In case of unlatched mode, if the measurement value exceeds the PS interrupt threshold 'H' value, the interrupt becomes active. And if the measurement value is below the threshold 'H' value, the interrupt becomes inactive.

In case of latched mode, once the interrupt becomes active, it keeps the status until INT reset command is sent or interrupt register is read.

In case of persistence function is set to active, if the INT is inactive, it keeps inactive status until the measurement value exceeds the threshold 'H' value continuously. If the interrupt is active, it keeps active status until INT reset command is sent, interrupt register is read, or the measurement value is below threshold 'H' value continuously (case of unlatched mode).

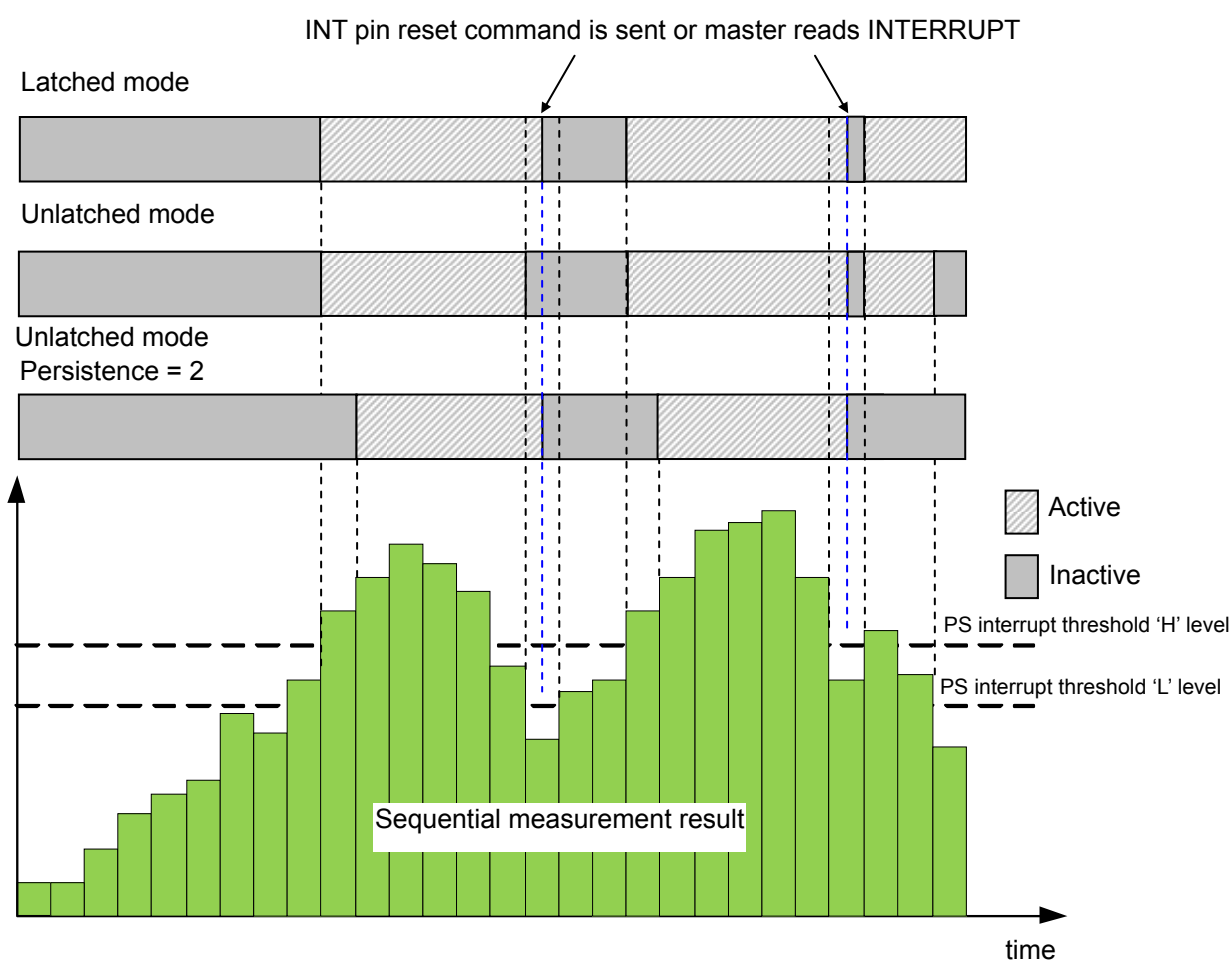


ex2) In case of using PS hysteresis mode (INTERRUPT register 4Ah<5:4> : " 01")

In case of unlatched mode, if the measurement value exceeds the PS interrupt threshold 'H' value, the interrupt becomes active. And if the measurement value is below the threshold 'L' value, the interrupt becomes inactive.

In case of latched mode, once the interrupt becomes active, it keeps the status until INT reset command is sent or interrupt register is read.

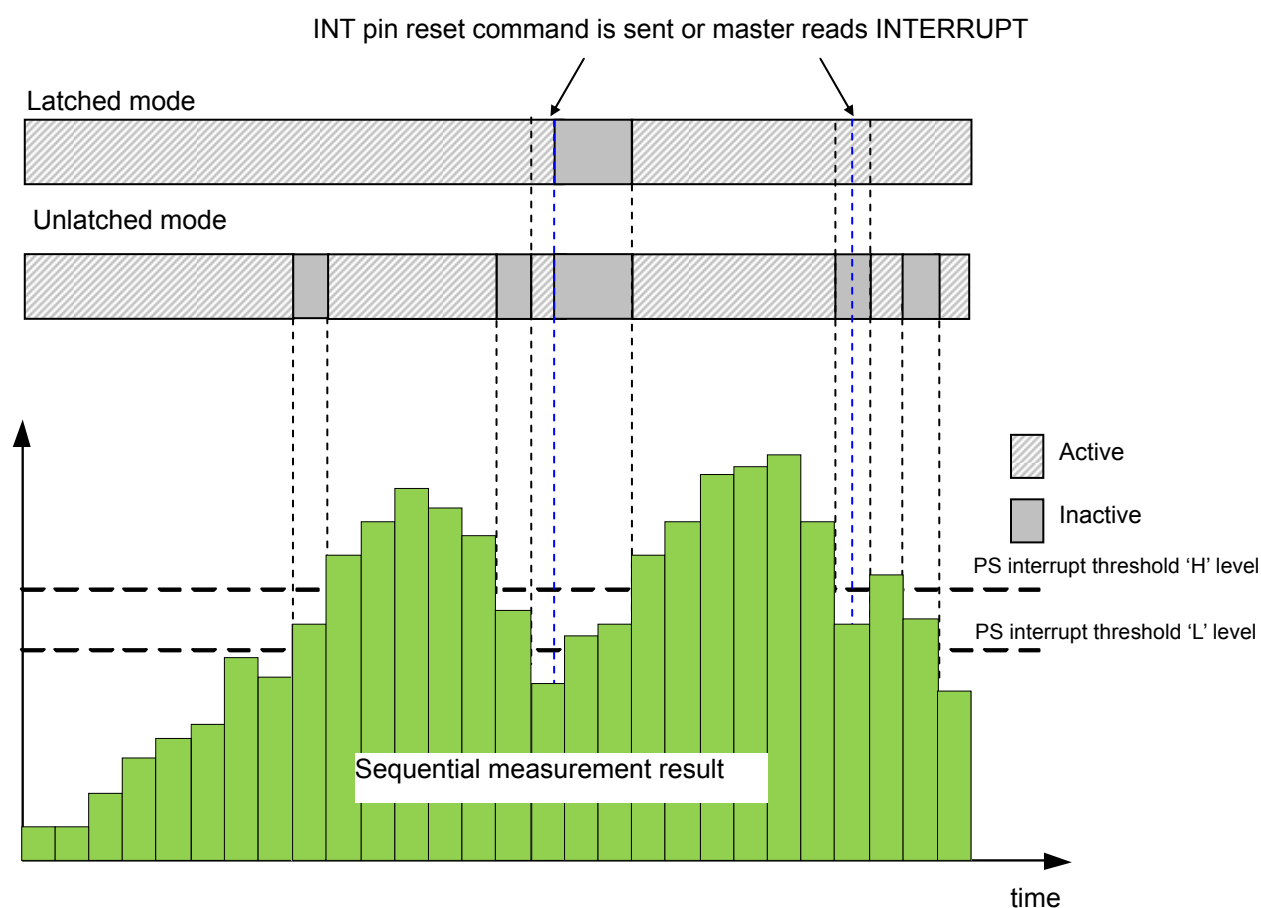
In case of persistence function is set to active, if the INT is inactive, it keeps inactive status until the measurement value exceeds the threshold 'H' value continuously. If the interrupt is active, it keeps active status until INT reset command is sent, interrupt register is read, or the measurement value is below threshold 'L' value continuously.



ex3) In case of using PS outside threshold mode (INTERRUPT register 4Ah<5:4> : " 10")

In case of unlatched mode, if the measurement value is within the range set by PS interrupt threshold 'H' and 'L' value, the interrupt becomes inactive. And if the measurement value is out of the range set by threshold 'H' and 'L' value, the interrupt becomes active.

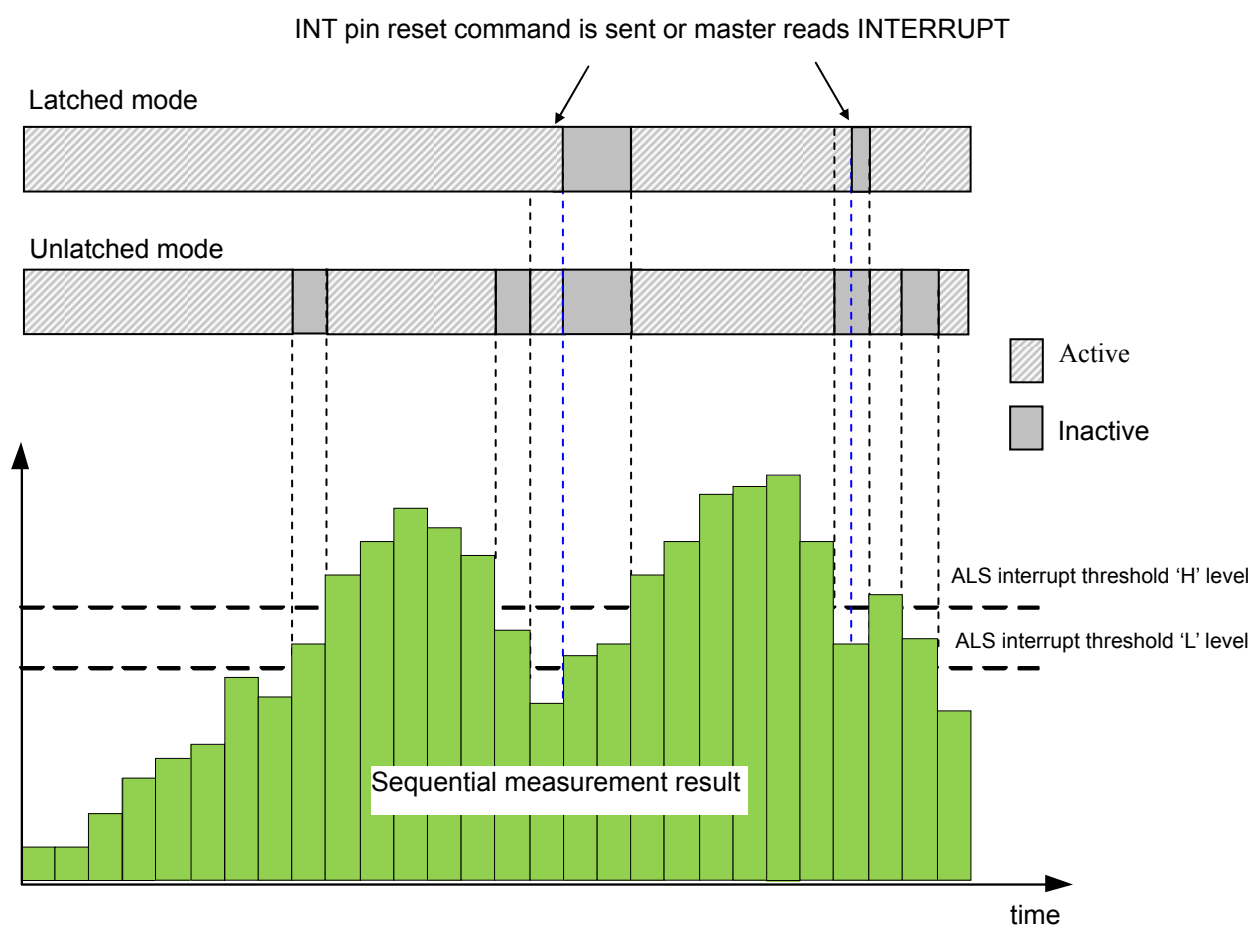
In case of latched mode, once the interrupt becomes active, it keeps active status until INT reset command is sent, or interrupt register is read.



ex4) Ambient light sensor interrupt function

In case of unlatched mode, if the measurement value (ALS_DATA0) is within the range set by ALS interrupt threshold 'H' and 'L' value, the interrupt becomes inactive. And if the measurement value (ALS_DATA0) is out of the range set by threshold 'H' and 'L' value, the interrupt becomes active.

In case of latched mode, once the interrupt becomes active, it keeps active status until INT reset command is sent, or interrupt register is read.



- Cautions for using this product

- 1) Absolute Maximum Ratings

An excess in the absolute maximum ratings, such as supply voltage, temperature range of operating conditions (T_{opr}), etc., can break down devices, and make impossible to identify breaking mode such as short circuit or 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.

- 2) GND voltage

It is necessary to keep the potential of the GND terminal at the minimum potential of all terminals at any time.

- 3) Short circuit between terminals and erroneous mounting

In order to mount products on the set PCB, pay thorough attention to the direction and offset of the products. Erroneous mounting can break down the products. 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 products can break down.

- 4) Operation in strong electromagnetic field

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

- 5) Inspection with set PCB

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. In addition, pay attention to protection against static electricity.

- 6) Dust or scratch

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

- 7) Rush current

When power is supplied to the product, it is possible that the internal logic may be unstable and rush current may flow instantaneously. Therefore, give special consideration to power coupling capacitance, power supply, and circuit design.

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