GP2AP002S00F

Proximity Sensor

■Description

GP2AP002S00F provide a digital detection system integrated into one package the light emitting element and a light receiving element.
So small package size, it is easy to mount on the equipment.

■Agency approvals/Compliance

1. Compliant with RoHS directive (2002/95/EC)

■Applications

1. Mobile phone
2. Smartphone, Tablet
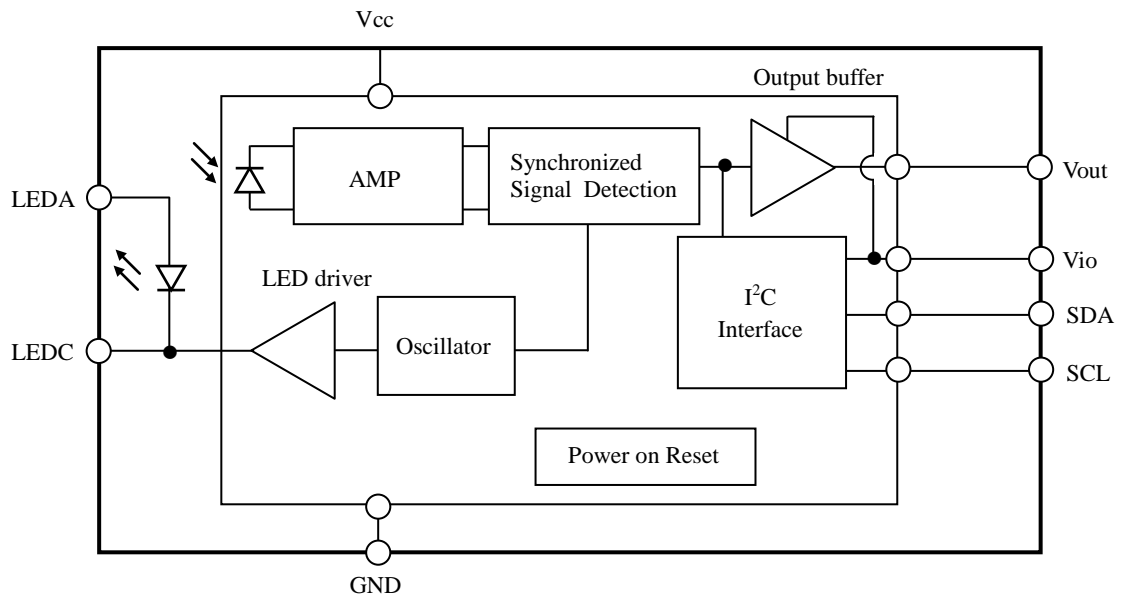3. Digital single-lens reflex camera

■Features

1. Disparities in detecting distance results are greatly reduced using a built-in circuit for reduction of light-detecting sensitivity disparities
2. Compact size($4.0 \times 2.0 \times 1.25t$ mm)
3. Built-in LED for simple optical design
4. I^2C output type

■ Schematic Internal Block Diagram

Vcc

Output buffer

LEDA

LED driver

LEDC

AMP

Synchronized Signal Detection

Oscillator

I²C Interface

Power on Reset

Vout

Vio

SDA

SCL

GND

■Outline Dimensions

IR Detector

IR Emitter

4

2 2

1.275 1.375

0.05 0.05

2

R0.45 R0.45

1.25±0.1

This laser marking means

○ : Model No.

▽ : Direction discrimination

(1.8)

(1)

Pin assignment (Top View)

0.4

0.45

1

1

0.45

P=1.075

0.675

⑤ ⑥ ⑦ ⑧

④ ③ ② ①

④ ③ ② ①

⑤ ⑥ ⑦ ⑧
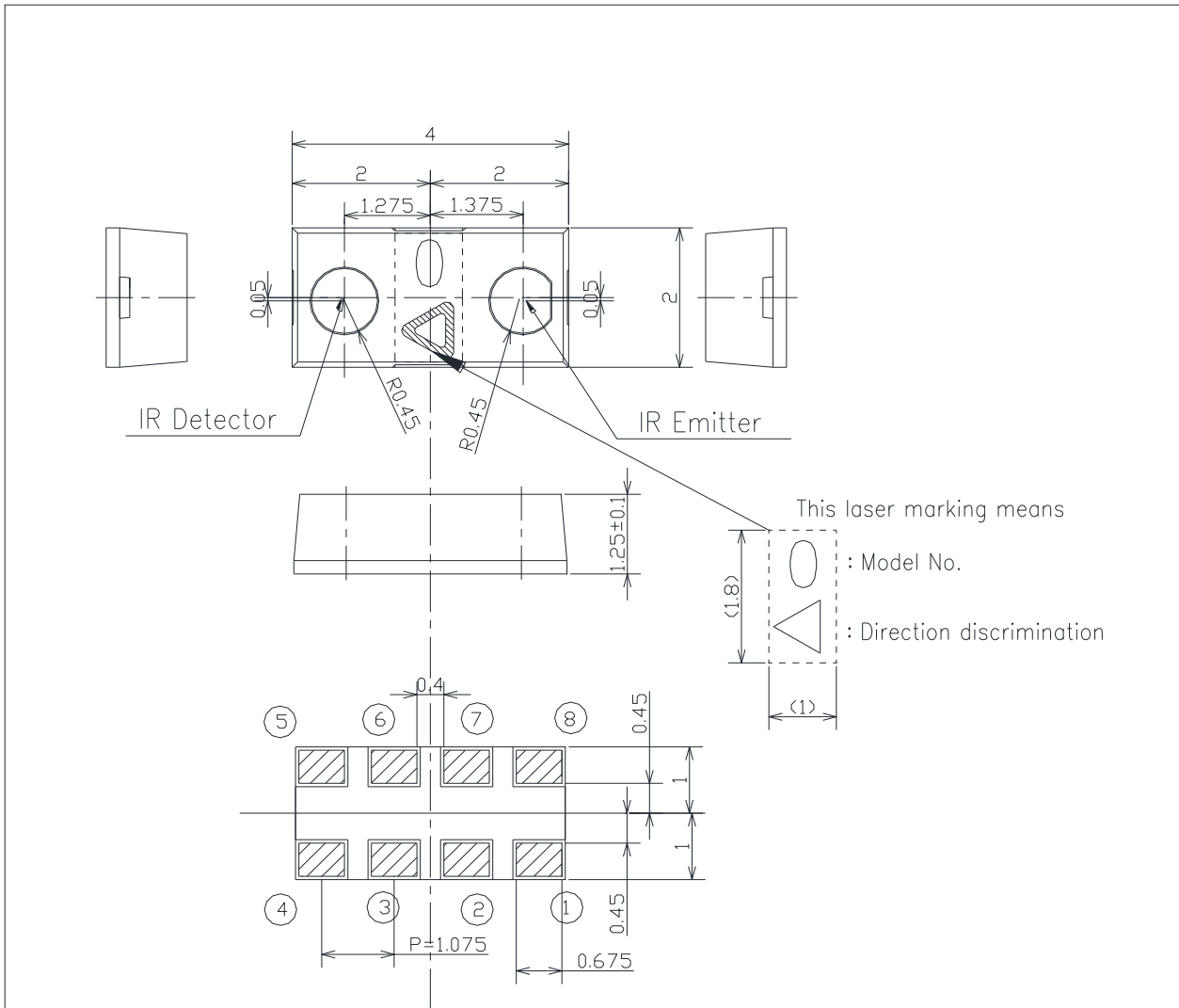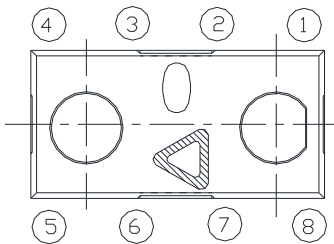
Pin	Pin name	Symbol
①	LED Anode	LEDA
②	LED Cathode	LEDC
③	Supply Voltage	Vcc
④	Output	Vout
⑤	Ground	GND
⑥	Logic I/O Supply Voltage	Vio
⑦	I2C DATA BUS	SDA
⑧	I2C CLOCK	SCL

1) ▨▨▨ area: Au plating
2) Unspecified tolerance shall be ±0.2.
3) Adhesion of resin to the terminal area shall be allowed Max. 0.2mm.

SCALE	MATERIAL	FINISH	Name	GP2AP002S00F
10/1	Terminal : Cu	Terminal : Ni(≧3μm) , Au(≧0.1μm)		Outline dimension
UNIT	Package:Epoxy resin			
1 = 1/1 mm			DRAWING No.	C Y 1 4 4 6 6 i 0 2

■Absolute Maximum Ratings

Ta=25°C (unless otherwise specified)

Parameter	Symbol	Rating	Unit	Remarks
Supply voltage	Vcc	-0.3 to 3.8	V	
LED supply voltage	V_{LED}	-0.3 to 3.8	V	
LED peak forward current	I_{LED}	300	mA	
Logic I/O supply voltage	Vio	-0.3 to Vcc+0.3 and 3.8V or less	V	Cf: Refer to the page 7, Directions for power-line connection
SDA/SCL pull-up voltage	-	Vio-0.3 to Vio+0.3 and 3.8V or less	V	Cf: Refer to the page 7, Directions for power-line connection
Operating temperature	Topr	-25 to +85	°C	
Storage temperature	Tstg	-40 to +85	°C	
Soldering temperature	Tsol	260	°C	peak temperature duration:10sec

■Recommended Operating Conditions

Ta=25°C (unless otherwise specified)

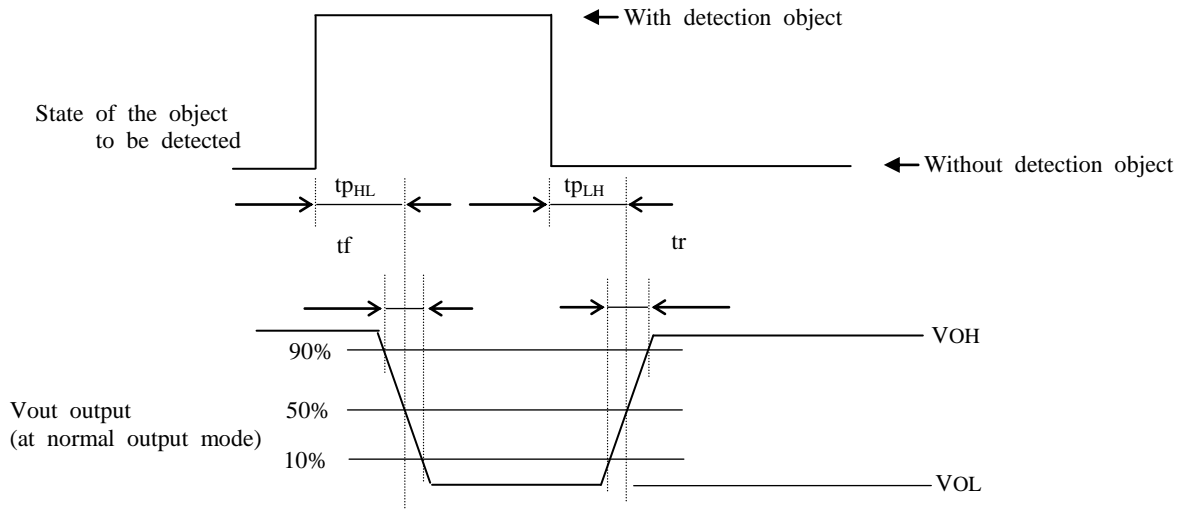| Parameter	Symbol	Operating condition	Unit	Remarks
Supply voltage	Vcc	2.4 to 3.6	V	
LED supply voltage	V_{LED}	2.4 to 3.6	V	
Operating temperature	T_{opr}	-25 to 85	°C	
Logic I/O supply voltage	Vio	1.65 to Vcc	V	
SCL, SDA input low level	VIL	-0.3 to 0.2×Vio	V	
SCL, SDA input high level	VIH	0.8×Vio to Vio+0.3	V	

■Electrical and Optical Characteristics

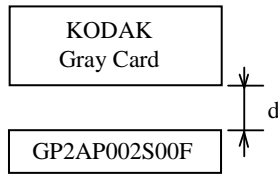Ta=25°C ,Vcc=3.3V, V_{LED}=3.3V R_{LED}=6.8Ω (unless otherwise specified)

Parameter		Symbol	Min.	Typ.	Max.	Unit	Remarks
Current consumption	operating mode	I_{CC}	-	240	600	uA	No detection object, Ev=0 lx. *1, except for LED and driver
	shutdown mode	I_{CC-S}	-	-	1.0		No input signal. *1, except for LED and driver
LED peak current		I_{LED}	-	170	-	mA	
Peak emission wavelength		λ_p	-	940	-	nm	
Vout terminal High level output voltage		V_{OH}	Vio-0.5	Vio-0.3	Vio+0.3	V	I_{OH}=0.3mA,*2
Vout terminal Low level output voltage		V_{OL}	-	-	0.5	V	I_{OL}=1mA, *2
Response time (H→L)		tp_{HL}	-	-	50	ms	*2
Response time (L→H)		tp_{LH}	-	-	50	ms	
Rise time		tr	-	1	-	μs	*2, CL=15pF
Fall time		tf	-	1	-	μs	
Maximum detection distance		Lon	25	65	-	mm	*3, Detection object: KODAK Gray Card (r = 0.18) Operation mode B1
Minimum no detection distance		Loff	-	78	150	mm	
Wake up time		t_{sdw}	-	-	100	ms	*4
Maximum acceptable illuminance		Ev	3000	-	-	lx	*5
SCL clock frequency		SCL	4	-	400	kHz	

*1. Current consumption through VLED terminal (including LED and its driver output) depends on actual environment and situations. (See attached document 【1】 1-1)
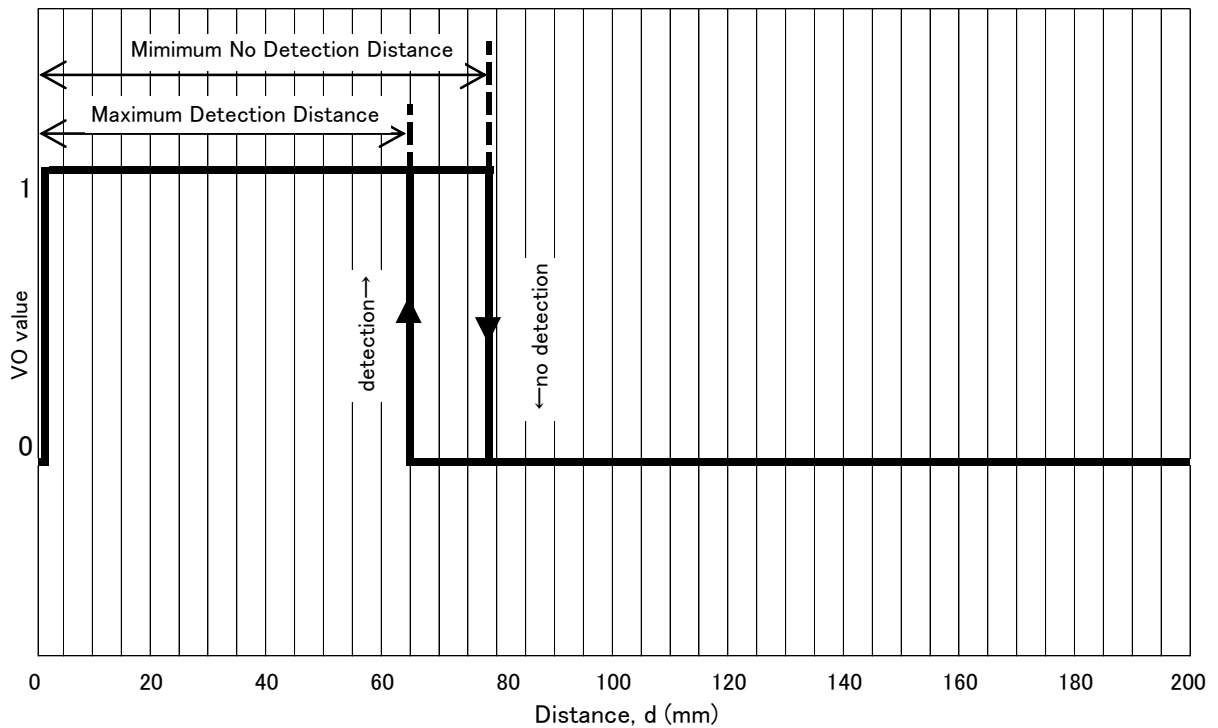
*2. Parameters defined for Vout output waveform specifications

State of the object to be detected

← With detection object

← Without detection object

tp_{HL}

tp_{LH}

tf

tr

Vout output (at normal output mode)

90%

50%

10%

VOH

VOL

*3. Detection distance

KODAK Gray Card

d

GP2AP002S00F

GP2AP002S00F output example vs. distance characteristics (operation mode B1)

Mimimum No Detection Distance

Maximum Detection Distance

1

0

VO value

detection →

← no detection

Distance, d (mm)

0   20   40   60   80   100   120   140   160   180   200

*4. Wake up time, tsdw, is defined as a delay of the 1st LED emission after issuing the I^2C write command to release GP2AP002S00F from the shutdown mode. Note that there should be no external light noise sources in this particular examination. Also, by definition, it does not matter where reflective object is, but it is recommended that the object should be placed at d << Lon because VO is initialized to 0 and the next expected change is 0 to 1.

*5. Test set-up for "Maximum Acceptable Illuminance" measurement

Light source A

GP2AP002S00F

Emitter/Detector surface
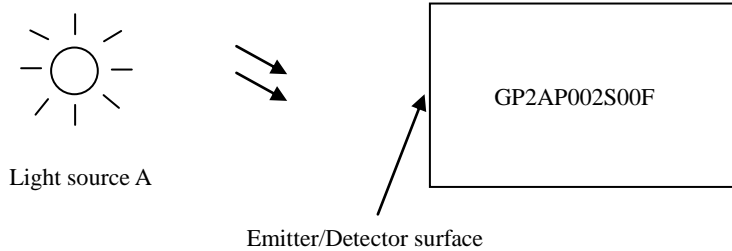
Illuminance should be measured and evaluated at Emitter/Detector surface of GP2AP002S00F.
The maximum acceptable illuminance, Ev, is a maximum level of illuminance at which GP2AP002S00F should keep its sensing result, VO, as "0" (no detection) as long as no reflective objects exist. However, GP2AP002S00F may start to exhibit false detection with external light noise beyond this level.
See attached document 【1】 1-10 for more details.

■Supplement

●This product is built-in photodiode.
●Compliance with each regulation
　　1) The RoHS directive(2002/95/EC)
　　　This product complies with the RoHS directive(2002/95/EC) .
　　　Object substances: mercury, lead, cadmium, hexavalent chromium, polybrominated biphenyls(PBB)
　　　and polybrominated diphenyl ethers(PBDE)
　　2) Content of six substances specified in Management Methods for Control of Pollution Caused by Electronic
　　　Information Electronic Information Products Regulation (Chinese：电子信息产品污染控制管理办法).

Category	Toxic and hazardous substances					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent chromium (Cr^{6+})	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
Proximity sensor	✓	✓	✓	✓	✓	✓

　　✓ : indicates that the content of the toxic and hazardous substance in all the homogeneous materials of the part is
　　　　below the concentration limit requirement as described in SJ/T 11363-2006 standard .
●This product shall not contain the following materials.
　　Also, the following materials shall not be used in the production process for this product.
　　Materials for ODS : CFCs, Halon, Carbon tetrachloride, 1,1,1-Trichloroethane (Methylchloroform)
●Brominated flame retardants
　　Specific brominated flame retardants such as the PBB and PBDE are not used in this device at all.
●Product mass : Approx . 0.017 g
●Country of origin : China
●Packing : Refer to the attached sheet, Page 11.
●Moisture level: MSL3

■Notes

● Before the circuit design
In circuit designing, make allowance for the degradation of the light emitting diode output that results from long continuous operation. (50% degradation/5 years)

● Please take proper methods to prevent ESD. The IC built in GP2AP002S00F is ESD-sensitive because it is fabricated by sub-micron CMOS process. For example, in handling GP2AP002S00F, human body and soldering iron etc. should be grounded.

● As it takes at most 100ms to let GP2AP002S00F go to active operation from shut-down mode, please take this delay into system design consideration. Also, if the host system relies on the actual value of this delay, e.g. to do frequent software shutdown, please thoroughly make sure that the operation be successful in any realistic situation.

● Regarding to prevention of malfunction
To prevent GP2AP002S00F from faulty operation due to external light noise sources, do not set the detection surface to these sources directly. Under very unlikely situation, GP2AP002S00F output may fall into malfunction (See attached document 【1】 1-10 for more detail). It can be reset by letting GP2AP002S00F go shutdown once, and then activating GP2AP002S00F again. In case of this, take it into consideration, in software implementation, to prepare a method to reset GP2AP002S00F. Also, if some other electronic components are placed close to this device, faulty operation may occur. (The light reflection caused by the other components may slip into the photo-detecting portion of the device and may cause faulty operation.)

● Directions for power-line connection
Avoid that GP2AP002S00F's SDA/SCL terminals are pulled-up to the other power line than GP2AP002S00F's Vio terminal even if they are in the same operating voltage. See also 10) Recommended external circuit. For example, when you shut down GP2AP002S00F by letting Vcc and Vio terminals go to GND level (instead of using software shutdown function), and if GP2AP002S00F's SDA/SCL terminals are still pulled-up to another active power line, these terminals will draw significant currents from a pull-up resister through internal ESD devices and the SCL and SDA lines are pulled-down, which causes system error (I^2C bus error).
Also, when you consider reducing total current consumption of the I^2C devices by turning off the power line(s), avoid that one of the Vcc and Vio terminals of GP2AP002S00F is turned off and the other is kept on. It never shuts down GP2AP002S00F's current consumption, but possibly yields excessive current between these power lines.
Please consider making use of "software shutdown" function. However, when you do have to turn off one of these power lines (Vcc, Vio, SDA/SCL pull-up level), all of them in GP2AP002S00F should be turned off for the purpose of choking GP2AP002S00F's current consumption regardless of the register setting for the software shutdown function.

● Directions for I^2C-bus interface
GP2AP002S00F is equipped with a 7-bit address as a slave device on the I^2C bus interface. Through the SDA and SCL terminals, GP2AP002S00F's registers can be set up, and also GP2AP002S00F's sensing result can be read out. However, the read format specified for GP2AP002S00F is a proprietary one that differs from the normal read format (immediately after the first byte) or the combined format shown in the I^2C-bus specification version 2.1, January 2000. For more details to let GP2AP002S00F operate properly, see attached document 【1】 1-2, I^2C-bus interface, and 【2】 recommended operation mode / register setting procedure.

● After being mounted and soldered, if GP2AP002S00F is deformed by external force or impact, e.g. something falls onto the device, it may result in defective implementation such as lift-off of the terminals. Careful handling should be taken.

● For soldering
Refer to the page 10

● For cleaning
Cleaning shall carry out as the below items to avoid keeping solvent, solder and flux on the device
    (1)   Solvent cleaning : Solvent temperature 45°C or less, Immersion for 3 min or less
    (2)   Ultrasonic cleaning : Please don't carry out ultrasonic cleaning.
    (3)   The cleaning shall be carried out with solvent below.
        Solvent : Ethyl alcohol, Methyl alcohol, Isopropyl alcohol

●Recommended external circuit

(Top View)
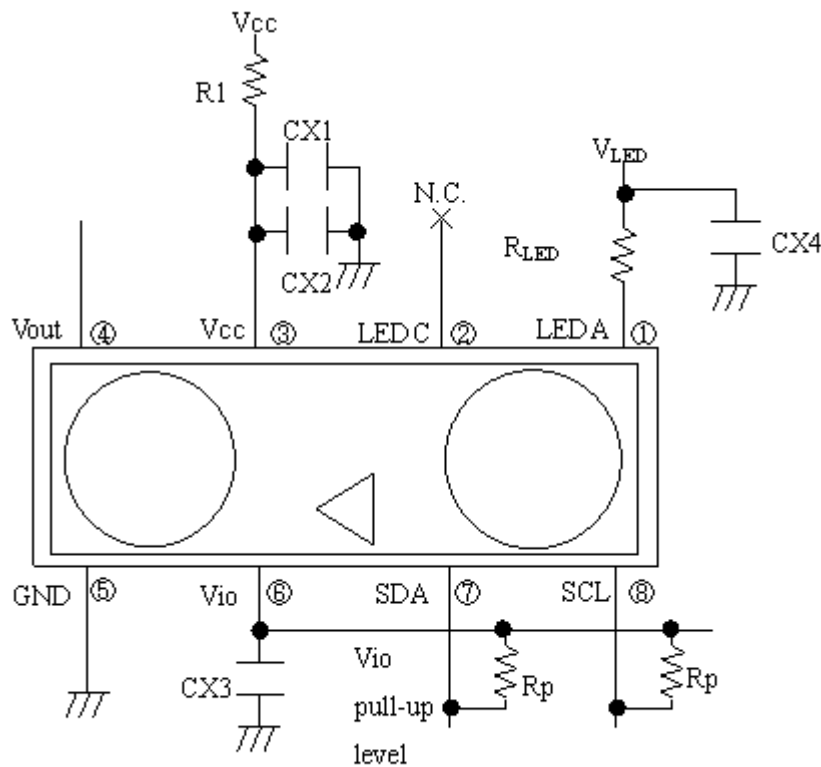
| Components		Recommended values
CX1		4.7uF (Ceramic)
CX2		0.1uF (Ceramic)
CX3		1.0uF (Ceramic)
CX4		10uF (Ceramic)
R1	1/20W	10 Ω
R_{LED}	1/20W	6.8Ω±1% (V_{CC}=V_{LED}=3.3V)
Rp	1/20W	10k Ω (*)

Notes:

Place the capacitors CX1～CX4 as close as possible to the corresponding terminals. For CX1~CX3, at most
5mm or less is preferable. Depending on the level and/or frequency component(s) of the power supply
noise, CX's and R1 listed above may not completely eliminate its influence. Therefore, to avoid
GP2AP002S00F's false detection which can be greatly influenced by the supply noises, please carefully
make sure that there is no problem with the actual electrical implementation.
Whenever considering to change V_{LED} voltage, choose proper value for R_{LED} so that the desired I_{LED} is obtained.
SDA terminal (as output) and LEDA terminal are NMOS open-drain output. On the other hand, Vout terminal
is CMOS output, but it has no high-impedance state.

(*) To determine the appropriate value for Rp's, see section 16 of The I^{2}C-Bus Specification.

● Foot pattern of PCB
  Dimensions are shown for reference.

Top View

Mount center
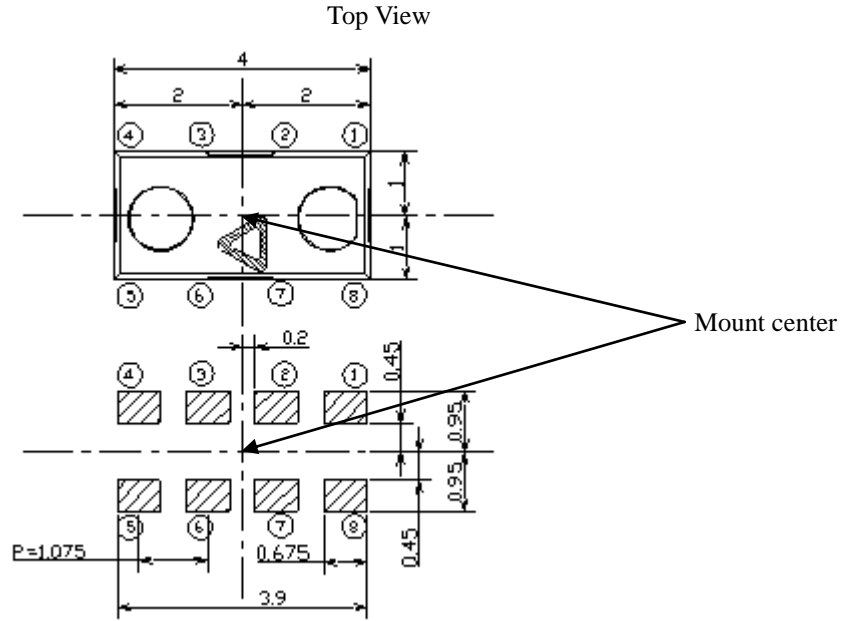
1. Dimension in parenthesis are shown for reference.
2. Unit : mm

Pin	Pin name	Symbol
①	LED Anode	LEDA
②	LED Cathode	LEDC
③	Vcc	Vcc
④	Output	Vout
⑤	Ground	GND
⑥	Logic I/O Supply Voltage	Vio
⑦	I^2C DATA BUS	SDA
⑧	I^2C CLOCK	SCL

● Recommendable size of solder creamed paste (Reference)
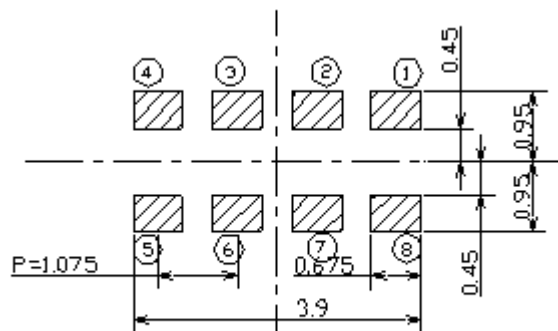
⌗⌗⌗ : Soldering paste area
* Dimension in parenthesis are shown for reference.
  Unit : mm

■Precautions for Soldering
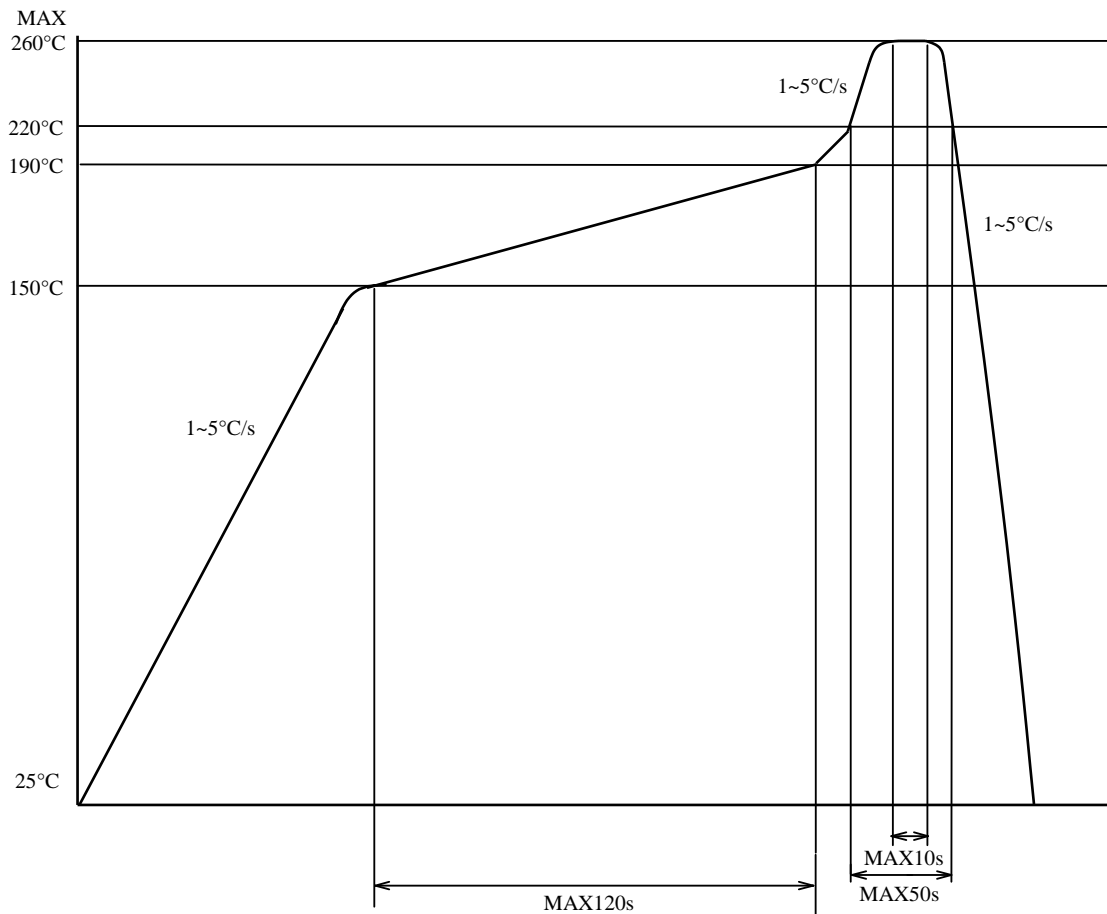
1. In case of solder reflow

Reflow is allowed only twice at the temperature and the time
within the temperature profile as shown in the figure below.
Reflow interval shall be within 7days under conditions, 10 to 30°C, 70%RH or less.

2. Other precautions

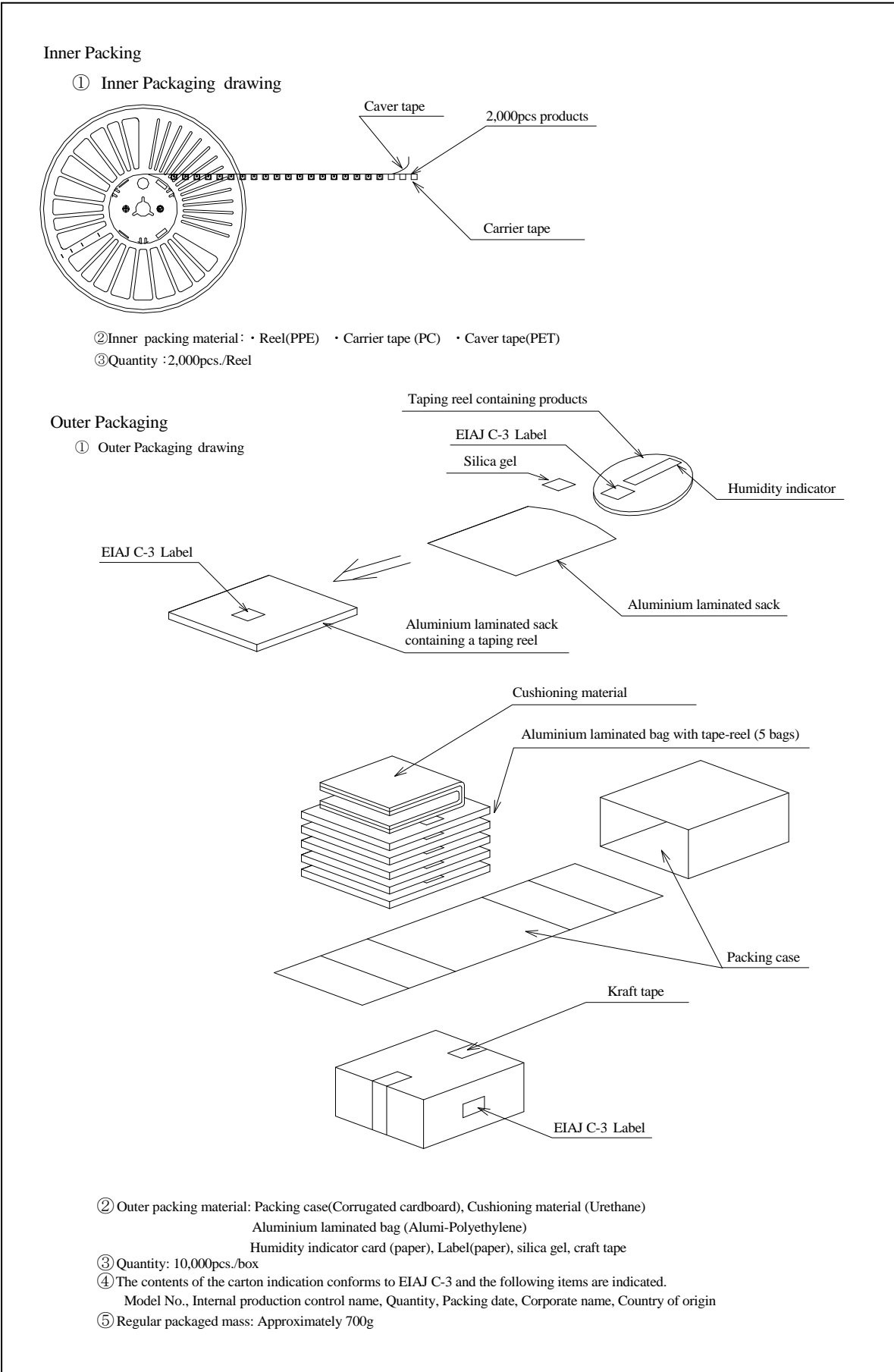An infrared lamp used to heat up for soldering may cause a localized temperature rise in the resin.
Also avoid immersing the resin part in the soldering.
Even if within the temperature profile above, there is the possibility that the gold wire in package is broken
in case that the deformation of PCB gives the affection to lead pins.
Please use after confirmation the conditions fully actual solder reflow machine.

■Packing

Inner Packing

① Inner Packaging drawing

Caver tape   2,000pcs products

Carrier tape

②Inner packing material： ・Reel(PPE)　・Carrier tape (PC)　・Caver tape(PET)

③Quantity：2,000pcs./Reel

Outer Packaging

① Outer Packaging drawing

Taping reel containing products

EIAJ C-3 Label

Silica gel

Humidity indicator

EIAJ C-3 Label

Aluminium laminated sack

Aluminium laminated sack
containing a taping reel

Cushioning material

Aluminium laminated bag with tape-reel (5 bags)

Packing case

Kraft tape

EIAJ C-3 Label

②Outer packing material: Packing case(Corrugated cardboard), Cushioning material (Urethane)

Aluminium laminated bag (Alumi-Polyethylene)

Humidity indicator card (paper), Label(paper), silica gel, craft tape

③ Quantity: 10,000pcs./box

④The contents of the carton indication conforms to EIAJ C-3 and the following items are indicated.

Model No., Internal production control name, Quantity, Packing date, Corporate name, Country of origin

⑤Regular packaged mass: Approximately 700g

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