

TO ; \_\_\_\_\_

# S P E C I F I C A T I O N S

Product Name Time of Flight Sensor

Model No. GP2AP02VT20F

These specifications contain 19 pages including the cover and appendix.  
This specification sheets and attached sheets shall be both side copy.  
After confirmation of the contents, please be sure to send back      copy of the Specifications with approving signature on each.  
If you have any objections, please contact us before issuing purchasing order.

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# SHARP

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  - Other safety equipment
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  - Nuclear power control equipment • Medical equipment
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- (3) equipment which Sharp products are connected to or mounted in.
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- (5) installation problem.
- (6) act of God or other disaster (natural disaster, fire, flood, etc.)
- (7) external factors (abnormal voltage, abnormal electromagnetic wave, fire, etc.)
- (8) special environment (factory, coastal areas, hot spring area, etc.)
- (9) phenomenon which cannot be foreseen based on the practical technologies at the time of shipment.
- (10) the factors not included in the product specification sheet.

4. Please contact and consult with a Sharp sales representative for any questions about Sharp product.

1. Application  
This technical sheets applies to the outline and characteristics of time of flight sensor Model No. GP2AP02VT20F
2. Outline Refer to page 7.
3. Ratings and characteristics Refer to Page 8 to 9.
4. Reliability Refer to Page 10.
5. Outgoing inspection Refer to Page 11.
6. Supplement
  - 6.1 This product is built-in SPAD (single photon avalanche diode).
  - 6.2 Brominated flame retardants  
Specific brominated flame retardants such as the PBB and PBDE are not used in this device at all.
  - 6.3 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)
  - 6.4 Compliance with each regulation
    - (1) This product complies with EU RoHS Directive (2011/65/EU) and Commission Delegated Directive (EU)2015/863
    - (2) Content of six substances specified in Management Methods for Control of Pollution Caused by Electronic Information Products Regulation (Chinese : 电子信息产品污染控制管理办法).

Marking Styles for the Names and Contents of the Hazardous Substances

Category	Hazardous Substances					
	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent chromium (Cr <sup>6+</sup> )	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
Time of flight sensor	○	○	○	○	○	○

This table is prepared in accordance with the provisions of SJ/T 11364.

○ : Indicates that said hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement of GB/T 26572

- 6.5 Country of origin : China
- 6.6 Product mass: Approx. 0.028g
- 6.7 The moisture absorption level of this product is MSL.3.
- 6.8 Taping specifications: Refer to Page 13 to 15.
- 6.9 Taping moisture-proof packing: Refer to Page 16 to 18.
- 6.10 Eye Safety Considerations  
GP2AP02VT20F contains a laser emitter and corresponding drive circuitry. The laser output is Class 1 laser safety under all reasonably foreseeable including single faults in compliance with IEC 60825-1:2014. The laser output will remain within Class 1 limits as long as the Sharp recommended device settings are used and the operating conditions specified in this datasheet are respected. The laser output power must not be increased by any means and no optics should be used with the intention of focusing the laser beam. List of controls, adjustments and procedures for operation and maintenance, including the warning "Caution - Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure" (or alternatively, equivalent appropriate warnings).



## 7. Notes

## 7.1 Notes concerning receiver surface

Please note enough that it is likely to malfunction when a surface is dirty with garbage and dust, etc. Moreover, please do not touch a surface.

## 7.2 Please take proper methods to prevent ESD. The IC built in GP2AP02VT20F is ESD-sensitive because it is fabricated by sub-micron CMOS process. For example, in handling GP2AP02VT20F, human body and soldering iron etc. should be grounded.

## 7.3 Before the circuit design

In circuit designing, make allowance for the degradation of the laser output that results from long continuous operation.

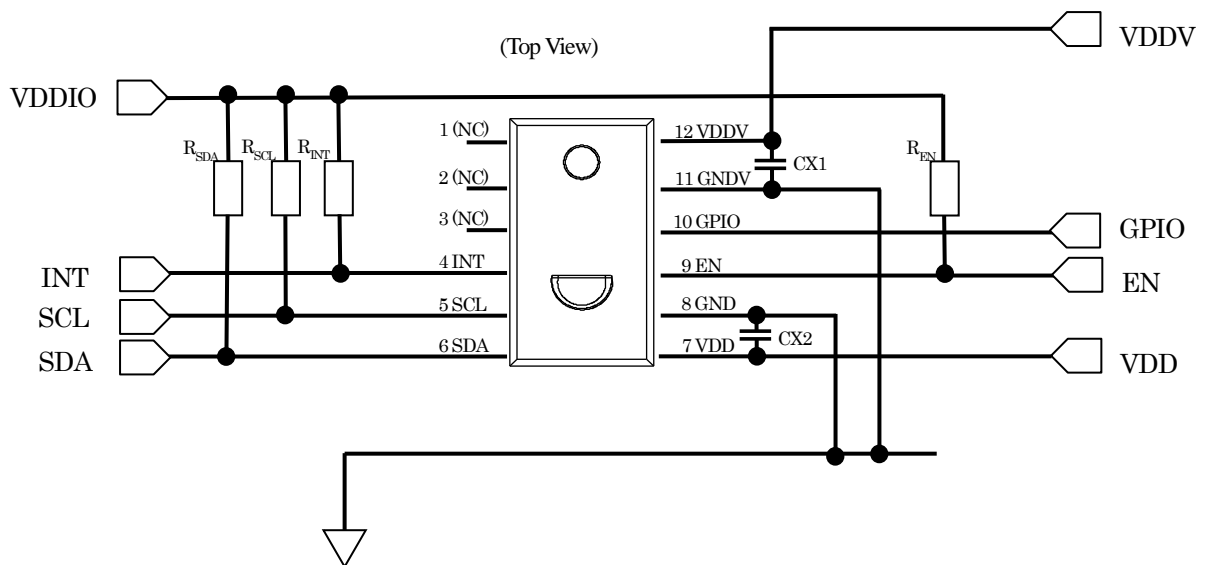
## 7.4 Notes ambient light

When set to avoid malfunctions due to a strong disturbance light, such an arrangement to receive ambient light directly on the detector, please be avoided. Also by placing this product in close to other components, it may be a malfunction with the light reflected from their product, structural arrangement to reduce the amount of light receiving surface of the outer, please consider.

## 7.5 After being mounted and soldered, if GP2AP02VT20F 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.

## 7.6 For soldering: Refer to Page 12.

## 7.7 Recommended external circuit



Components	Recommended values
CX1	4.7 $\mu$ F
CX2	100nF
R <sub>SDA</sub> *1	1~10k $\Omega$
R <sub>SCL</sub> *1	1~10k $\Omega$
R <sub>INT</sub>	47k $\Omega$
R <sub>EN</sub>	47k $\Omega$

There are cases to generate a noise because VCSEL driving current flows VDDV terminal, and to distort a waveform of VCSEL driving current.

To reduce these influences, please arrange CX1 within 5mm from VDDV terminal, and wire between VDDV terminal, CX1 and GND terminal as close as possible. Also, the wiring of VDDV is separated from VDD and VDDIO terminals, and the power source of VDDV is separated from VDD is recommended.

And in order to reduce the influence of the power supply noise, please arrange CX2 within 5mm from VDD terminal.

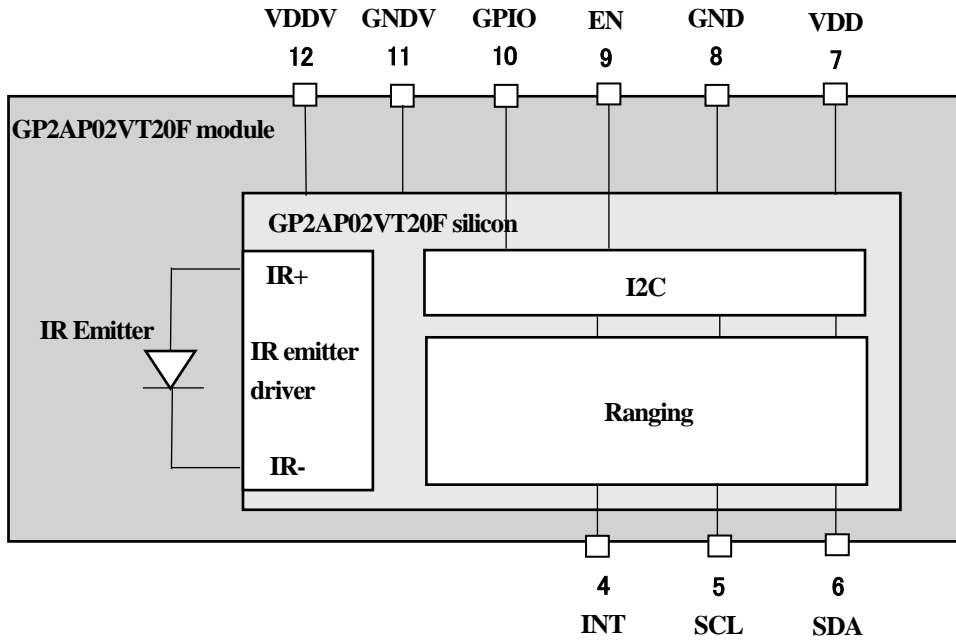
Please evaluate with the actual electrical implementation, and carefully make sure that there is no problem.

SDA and GPIO terminal is NMOS open-drain output and digital input. EN and SCL terminals are digital input.

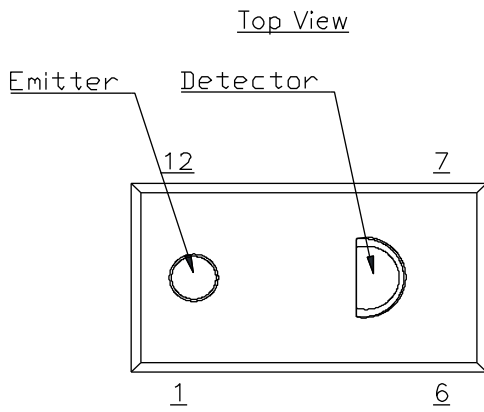
INT terminal is NMOS open-drain output.

\*1 The pull-up resistor needs to be adjusted by communication speed, board capacitance, power supply voltage.

7.8 Block diagram

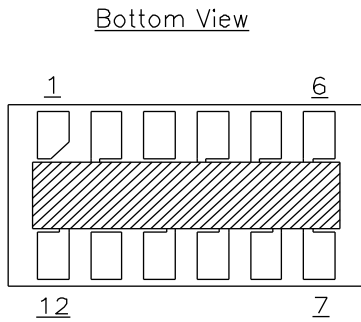


7.9 Foot pattern of PCB

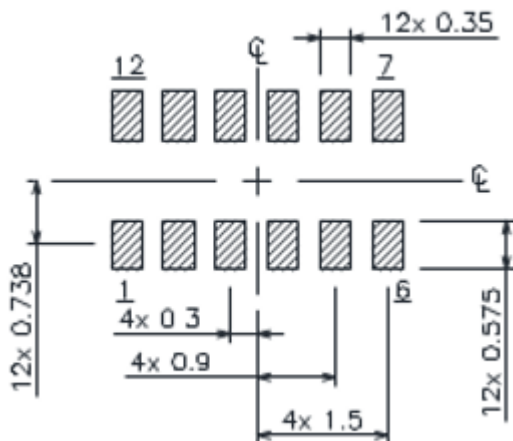


Pin Description

Pin No.	Pin Name
<u>1</u>	(NC)
<u>2</u>	(NC)
<u>3</u>	(NC)
<u>4</u>	INT
<u>5</u>	SCL
<u>6</u>	SDA
<u>7</u>	VDD
<u>8</u>	GND
<u>9</u>	EN
<u>10</u>	GPIO
<u>11</u>	GND V
<u>12</u>	VDD V



Recommended PCB PAD Layout

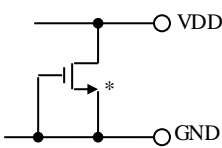
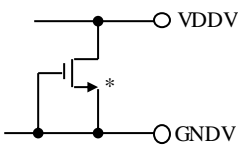
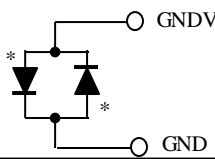
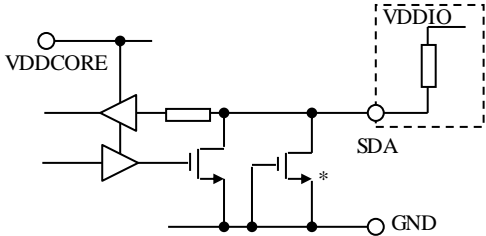
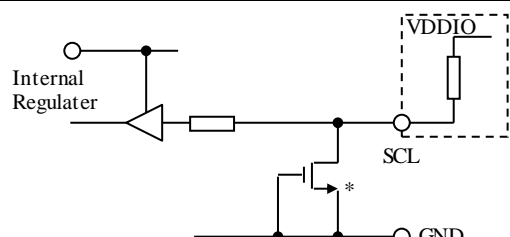
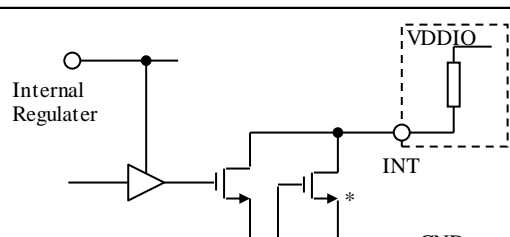
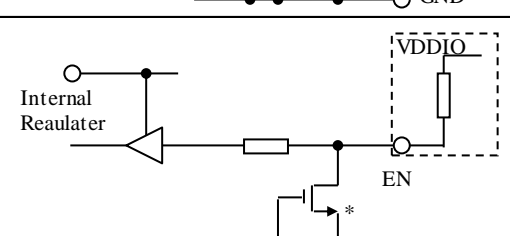
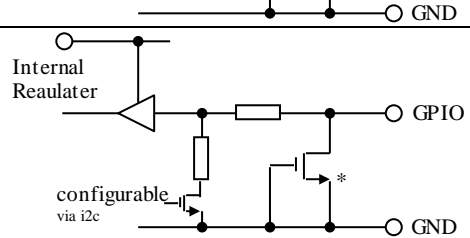


Unit : mm

\* Unit : mm

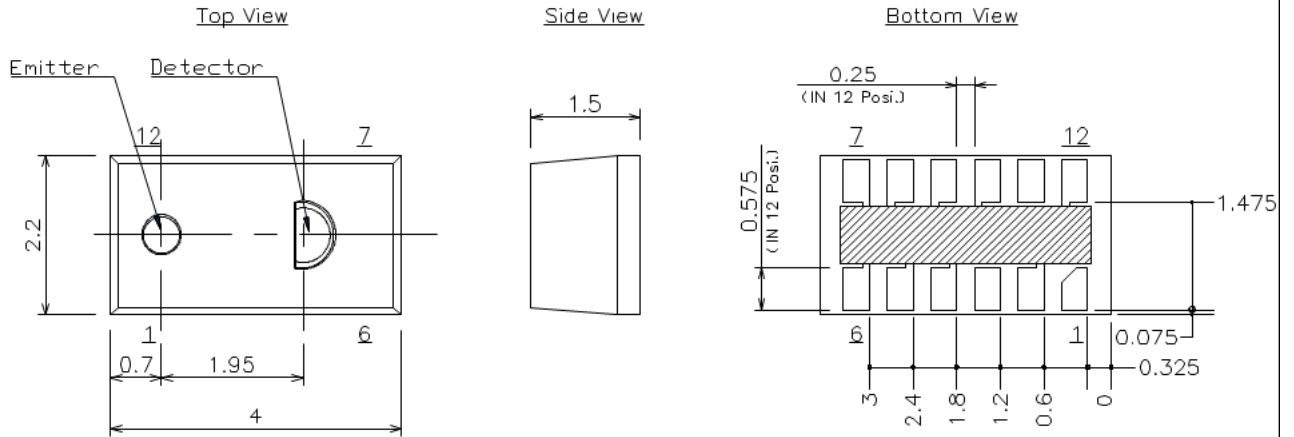
\*\* area Au plating

7.10 Pin Description

Pin Name	Functional description	Equivalent Internal Circuit
VDD	Power Supply	
VDDV	VCSEL Power Supply	
GND GNDV	Ground VCSEL Ground	
SDA	I2C serial data line The terminal is pulled-up to VDDIO	
SCL	I2C serial clock line The terminal is pulled-up to VDDIO	
INT	Interrupt pin The terminal is pulled-up to VDDIO Open drain output terminal	
EN	Enable pin The terminal is pulled-up to VDDIO	
GPIO	GPIO pin	

\*ESD protection device  
External circuit

2. Outline Dimensions



Unit : mm

(Note)

- (1) area : Au plating
- (2) Unspecified tolerance shall be ±0.1mm

Pin Description

Pin No	Pin Name
1	(NC)
2	(NC)
3	(NC)
4	INT
5	SCL
6	SDA
7	VDD
8	GND
9	EN
10	GPIO
11	GND V
12	VDD V

: Model Number  
GP2AP02VT20F = 22

: Year  
\* it repeats the cycle during 21 years except G , I , O , Q , Y

Year	Mark
2021	N
2022	P
2023	R
2024	S
...	...
2032	B
2033	C

: Month ( 1 to 9 , X to Z )  
\* X to Z = 10 to 12

: Day ( 1 to 9 , A to Z ) \* A to Z = 10 to 31  
 : Day Lot Number ( 1 to 9 , A to Z ) \* A to Z = 10 to 31

Charts of the Days / Daily Lot Numbers

10	11	12	13	14	15
A	B	C	D	E	F
16	17	18	19	20	21
G	H	J	K	L	N
22	23	24	25	26	27
P	Q	R	S	T	U
28	29	30	31		
V	X	Y	Z		

Except I , M , O , W

SCALE	MATERIAL	FINISH	Name
10/1	Terminal: Cu	Terminal: Ni, Au	GP2AP02VT20F
UNIT	Package : Epoxy		Outline Dimension
1 = 1/1 mm			DRAWING No. CY15551i02



## 3. Ratings and Characteristics

## 3.1 Absolute Maximum Ratings

Ta=25°C

Parameter	Symbol	Rating	Unit	Remarks
Power supply voltage	VDD	-0.5 to 3.6	V	
VCSEL voltage	VDDV	-0.5 to 3.6	V	
I2C voltage	VDDIO	-0.5 to 3.6	V	
Operating temperature	Topr	-20 to 70	°C	
Storage temperature	Tstg	-40 to 85	°C	
Soldering temperature	Tsol	250	°C	peak temperature duration:10s

## 3.2 Recommended Operating Conditions

Ta=25°C

Parameter	Symbol	Operating condition	Unit	Remarks
Power supply voltage	VDD	2.6 to 3.5	V	
VCSEL voltage	VDDV	2.6 to 3.5	V	
I2C voltage	VDDIO	1.7 to 3.5	V	
Optimum operating temperature	Topr	-20 to 70	°C	
Functional operating temperature	Tfunc	-20 to 70	°C	
SCL, SDA input low level	VIL	-0.25 to 0.5	V	
SCL, SDA input high level	VIH	1.3 to VDDIO+0.15	V	
GPIO, EN input low level	VILIO	-0.25 to 0.5	V	
GPIO, EN input high level	VIHIO	1.3 to VDDIO+0.15	V	

## 3.3 Electrical and Optical Characteristics

## (1) Electrical Characteristics

Ta=25°C, VDD=VDDV=VDDIO=3.3V

(Unless otherwise specified, the external circuit constants follow the recommended external circuit of page 3.)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Current consumption (Short mode)	I <sub>CC-ps</sub>	—	1.7	—	mA	80 ms cycle
Current consumption (Long mode)	I <sub>CC-dis</sub>	—	10	—	mA	33 ms cycle
Current consumption (Power Down)	I <sub>CC-s</sub>	—	—	10	μA	
I2C clock frequency	f	1	—	1000	kHz	
SDA output low level voltage	V <sub>OL_SDA</sub>	0	—	0.4	V	I <sub>OL_SDA</sub> =3mA
INT output low level voltage	V <sub>OL_INT</sub>	0	—	0.4	V	I <sub>OL_INT</sub> =3mA

## (2) VCSEL Characteristics

Ta=25°C, VDD= VDDV=VDDIO =3.3V

(Unless otherwise specified, the external circuit constants follow the recommended external circuit of page 3.)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
VCSEL peak wavelength	λ <sub>p-ps</sub>	—	940	—	nm	
VCSEL peak current	I <sub>vcselep</sub>	—	31	—	mA	Short mode
VCSEL peak current	I <sub>vcseld</sub>	—	64	—	mA	Long mode
VCSEL FOV	Fov	—	25	—	°	

## (3) Ranging Characteristics

Ta=25°C, VDD=VDDV=VDDIO=3.3V

(Unless otherwise specified, the external circuit constants follow the recommended external circuit of page 3.)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Range distance (Short mode : 100mm)	Rinw1	-10	—	+10	mm	IF=31mA, White 88%
Repeatability (Short mode : 100mm)	Rinrepw1	0	—	+10	mm	Indoor : no infrared
Range distance (Long mode : 100mm)	Rinw1	-10	—	+10	mm	IF=64mA, White 88%
Repeatability (Long mode : 100mm)	Rinrepw1	0	—	+10	mm	Indoor : no infrared
Range distance (Long mode : 1200mm)	Ring2	-4	—	+4	%	IF=64mA, White 88%
Repeatability (Long mode : 1200mm)	Rinrep2	0	—	+25	mm	Indoor : no infrared
Range distance (Long mode : 700mm)	Ring3	-5	—	+5	%	IF=64mA, Gray 17%
Repeatability (Long mode : 700mm)	Rinrep3	0	—	+25	mm	Indoor : no infrared
Range distance (Outdoor, Long mode : 700mm)	Routw	-10	—	+10	%	White 88%
Repeatability (Outdoor, Long mode : 700mm)	Routw	0	—	+25	mm	Equivalent to 50kLux daylight
Ranging speed	Trange	—	33	—	msec	400kHz, Normal mode
Min ranging distance (Short mode)	Rinsmin			50	mm	IF=31mA, White 88% Indoor : no infrared
Min ranging distance (Long mode)	Rinlmin			100	mm	IF=64mA, White 88% Indoor : no infrared
Max ranging distance (Long mode, gray card)	Ringmax	120	—	—	cm	IF=64mA, Gray 17% Indoor : no infrared
Mode changing to Short mode	Shorth	—	80	—	mm	
Mode changing to Long mode	Longh	—	100	—	mm	

※ Repeatability : max – min (10 times evaluation)

## (4) Ranging offset error

(Unless otherwise specified, the external circuit constants follow the recommended external circuit of page 3.)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Voltage drift	Vdrift	—	—	10	mm	Ta=25°C, VDD=VDDV=VDDIO =3.2~3.4V
Temperature drift (Range Average)	Tdrift	—	—	15	mm	Ta=-10°C~+60°C, VDD=VDDV=VDDIO=3.3V

## 3.4 Reliability

The reliability of products shall satisfy items listed below.

Confidence level: 90%  
LTPD: 10 or 20

Test Items	Test Condition	Failure Judgment Criteria	Samples (n) Defective (C)
* Temperature cycling	1 cycle -40°C (30min) to +85°C (30min) 20 cycles test	$I_{CC\_VDD} > U_p \times 1.2$  Up: Upper specification limit  Range accuracy <-10% Range accuracy >+10%  Condition: VDD=VDDV=VDDIO =3.3V, Gray Card 17%, Indoor at 1200mm	n=22, c=0
* High temp. and high humidity storage	+60°C, 90%RH, 240h		n=22, c=0
* High temp. storage	+85°C, 240h		n=22, c=0
* Low temp. storage	-40°C, 240h		n=22, c=0
Operation life	+25°C, VDD=VDDV=VDDIO=3.6V, 240h		n=11, c=0
Mechanical shock	1000m/s <sup>2</sup> , 6ms 3 times / ±X, ±Y, ±Z direction		n=22, c=0
Variable frequency vibration	200m/s <sup>2</sup> 100 to 2000 to 100Hz/ Approx. for 4min 48 min/ X, Y, Z direction		n=22, c=0
Reflow solder heat	250°C, 10s, three times. Temperature profile as shown in page 12.		n=22, c=0

In the test \*mark above, the sample to be tested shall be left at normal temperature and humidity for 2h after it is taken out of the chamber. (No dew point)

These test results are sampling examples from a specific lot for reference purpose only, and do not constitute any warranty or assurance in connection with the products.

## 4. Outgoing inspection

## 4.1 Inspection lot

Inspection shall be carried out each delivery lot.

## 4.2 Inspection method

A single sampling plan, normal inspection level II based on ISO 2859 shall be adopted.

Parameter	Inspection items and test method		AQL (%)
Major defect	1. Disconnection, short		0.1
	2. Electrical characteristics defect in section 3.3		
Minor defect	1. Appearance defect		0.25
	Parameter	Judgment criteria	
	Cracks, Chipping, Scratches, Stains, Burrs	One which affects the characteristics of Parameter in section 3.3 shall be defect.	

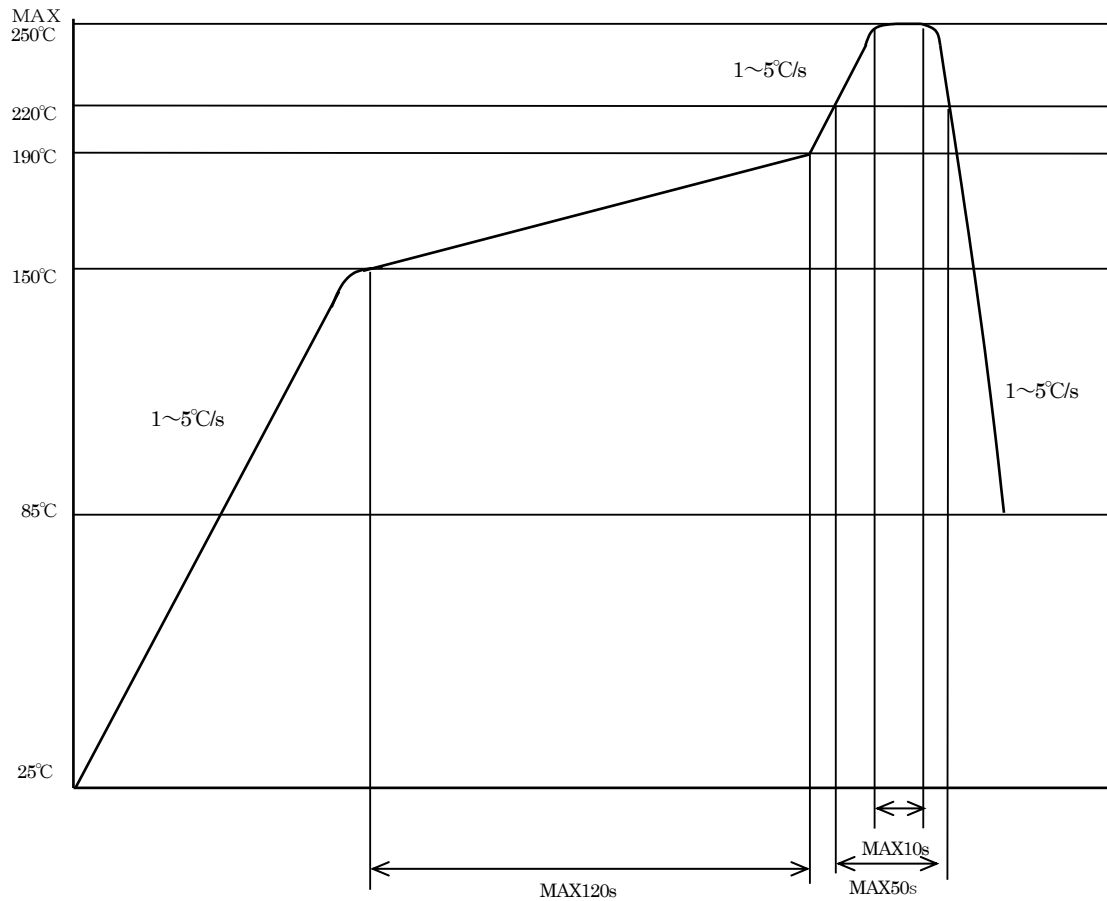
Precautions for Soldering

## 1. In the case of solder reflow

Reflow is allowed only three times at the temperature and the time within the temperature profile as shown in the figure below.

This Profile temperature is the sensor surface package temperature.

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 of package inside. Even if within the temperature profile above, there is the possibility that the gold wire in package is broken. Please use after confirmation the conditions fully actual solder reflow machine.

Taping Specifications

## 1. Application

This packing specification sheets specify the taping specifications for GP2AP02VT20F.

## 2. Taping method

## 2.1 Tape structure and Dimensions (Refer to page 14.)

The tape shall have a structure in which a cover tape is sealed pressed on the carrier tape of conductive Polycarbonate.

## 2.2 Reel structure and Dimensions (Refer to page 15.)

The taping reel shall be conductive plastic with its dimensions as shown in the attached drawing.

## 2.3 Direction of product insertion (Refer to page 15.)

The sensor direction in carrier tape shall be; the detector of the sensor locates to the feeding hole side of the carrier tape and the sensor window faces to the top of the pocket of the carrier tape.

## 2.4 The way to repair taped failure devices

The way to repair taped failure devices cut a bottom of carrier tape with a cutter, and after replacing to good devices, the cutting portion shall be sealed with adhesive tape.

## 3. Adhesiveness of cover tape

The exfoliation force between carrier tape cover tape shall be 0.2N to 1.2N for the angle from 160 degrees to 180 degrees.

## 4. Rolling method and quantity

- Wind the tape back on the reel so that the cover tape will be outside the tape.
- Attach 16cm or more of blank tape to the trailer and 40cm or more of blank tape to the leader and fix the both ends with adhesive tape.
- One reel shall contain 2,000pcs. Except for the case that device is removed.
- There must not be continuously two or more Stock-Outs.

## 5. Safety protection during shipping

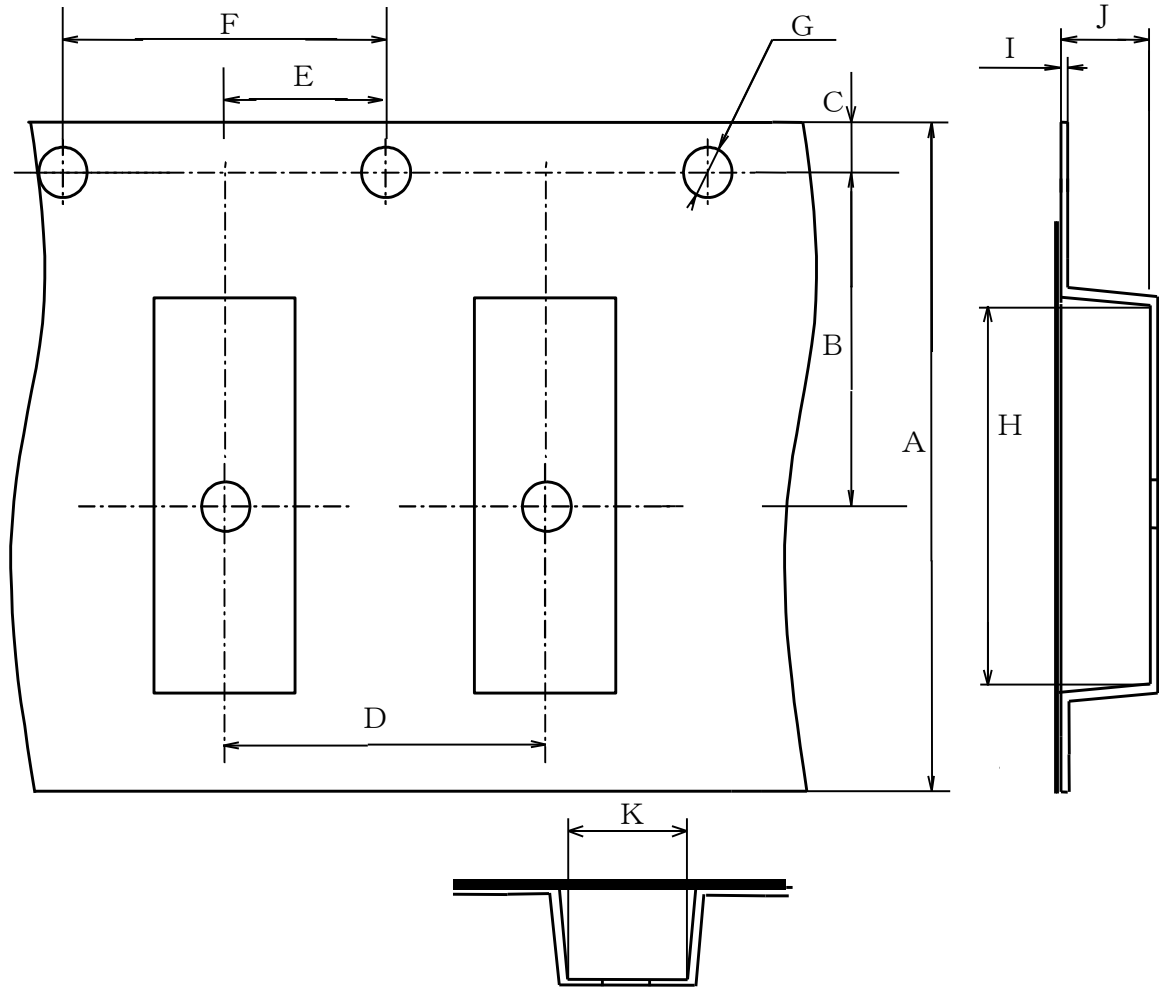
There shall be no deformation of component or degradation of electrical characteristics due to shipping.

## 6. Surface resistivity

Name	Surface resistivity ( $\Omega/\square$ )	Material
Carrier tape	$1 \times 10^4$ to $1 \times 10^8$	Electroconductive polycarbonate
Cover tape	$1 \times 10^4$ to $1 \times 10^7$	Poly ethylene terephthalate
Reel	Less than $1 \times 10^9$	Poly phenylene ether

7. Tape and Real structures  
 7.1 Tape structure and Dimensions

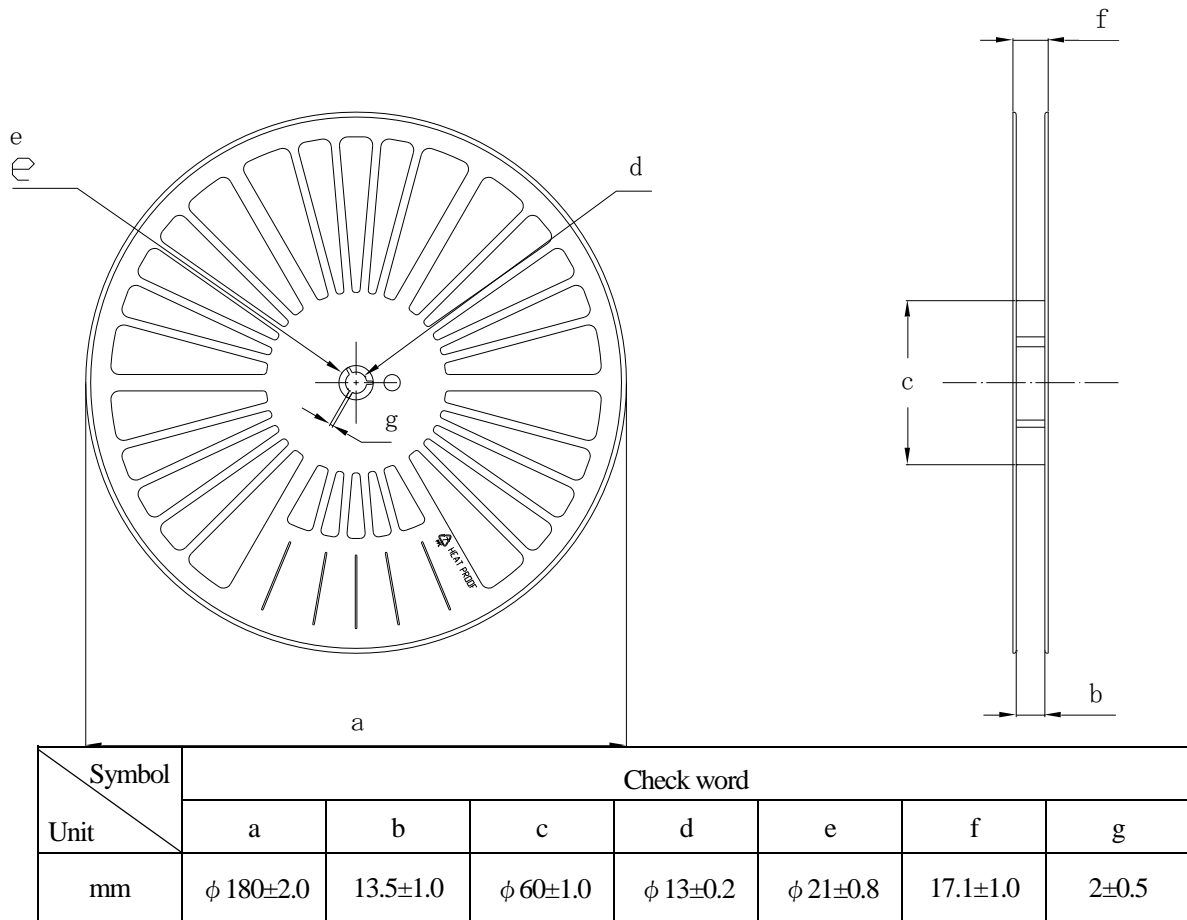
Tape outline drawing



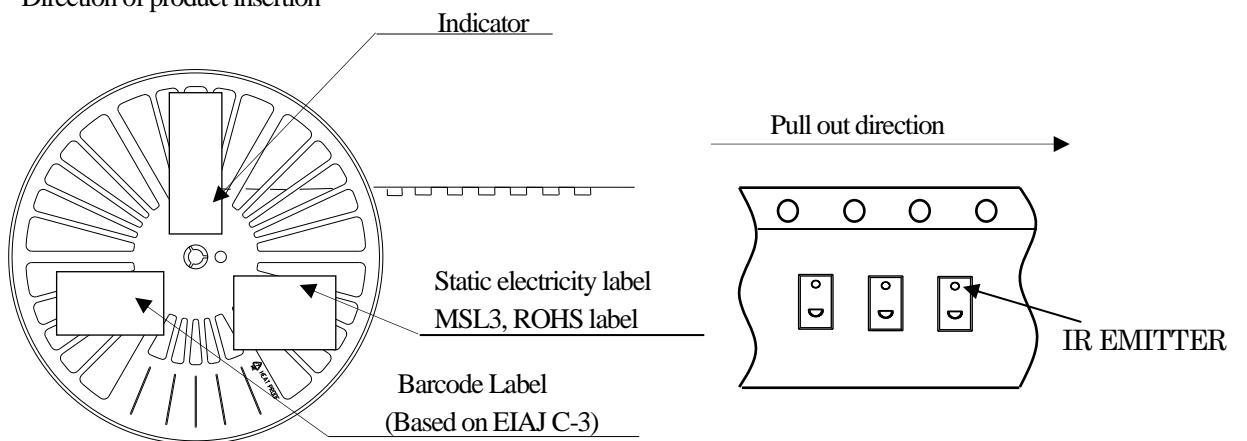
Symbol	A	B	C	D	E	F
Unit						
mm	±0.1 12.0	±0.05 5.5	±0.1 1.75	±0.1 4.0	±0.05 2.0	±0.1 4.0

Symbol	G	H	I	J	K
Unit					
mm	+0.1 -0 Φ 1.5	±0.1 4.25	±0.05 0.28	±0.1 1.75	±0.1 2.45

7.2 Tape and Reel structures Reel structure and Dimensions



7.3 Direction of product insertion





Taping Moisture-proof packing

## 1. Application

This packing specification sheets apply to the moist-proof packing for the GP2AP02VT20F in the taping package.

## 2. Packaging specifications

## 2.1 Packaging material

Name	Material	Counter measure for ESD	Quantity
Aluminum laminate bag	Aluminum polyethylene	Conductive type	Refer to the following number in section 2.2
Label	Paper(-made)	Non	
Siccative	-	Non	
Packing case	Paper	Non	
Cushioning material	Urethane	Non	
Indicator	Paper	Non	

## 2.2 Packaging method

- (1) Paste one of the barcode labels and a moisture indicator to a tape reel (contains 2,000 devices per reel).
- (2) Seal the aluminum laminated bag that contains the tape reel and siccative, and paste one of the barcode labels.
- (3) Pack 5 aluminum laminated bags (contains 1 reel each) into the designated packing case, where Urethane cushioning material are placed on the top of the packing case.

Package shape	Product	Quantity	Moisture-proof sack Quantity
Tape reel (φ 180mm)	1 model	2,000pcs. / reel *	1 reel / laminated bag

## (4) Packaging material

The packing case would be then sealed with the craft tape, with barcode label (based on EIAJ C-3).  
(Total of 10,000pcs. per carton) \* Except for the case that device is removed.

## 3. Storage and Treatment after Unsealed

## 3.1 Storage conditions

The delivered product should be stored with the conditions shown below;

Storage temperature: 10 to 30°C

Humidity: below 70%RH

The warranty term for the shipped product shall be for 1 year after shipping to the designated place by the ordered customer.

## 3.2 Treatment after open

- (1) After unsealed, devices should be mounted under the temperature condition of 10 to 30°C, at the humidity condition of below 70%RH, within 7days.
- (2) In case that long term storage is needed, devices should either be stored in dry box, or re-sealed to moist-proof bag with siccative and leave them in the environment where the temperature is 10 to 30°C, at the humidity condition of below 70%RH. Devices must be mounted within 2 weeks.

## 3.3 Baking before mounting

In the event that the devices are not maintained in the storage conditions described above, or the enclosed siccative indicator already turned its color to light-green, baking must be applied before devices are to be mounted.

In the case that Devices were not mounted under the temperature condition of 10 to 30°C at the humidity condition of below 70%RH or lower within 7days, Baking process must be applied before devices are to be mounted.:

Please also note that baking should only be applied twice.

Recommended condition: ①100 to 110°C, 12 to 24 hours ②125°C, 6 to 24hours

※ Baking will not properly done in packing condition.

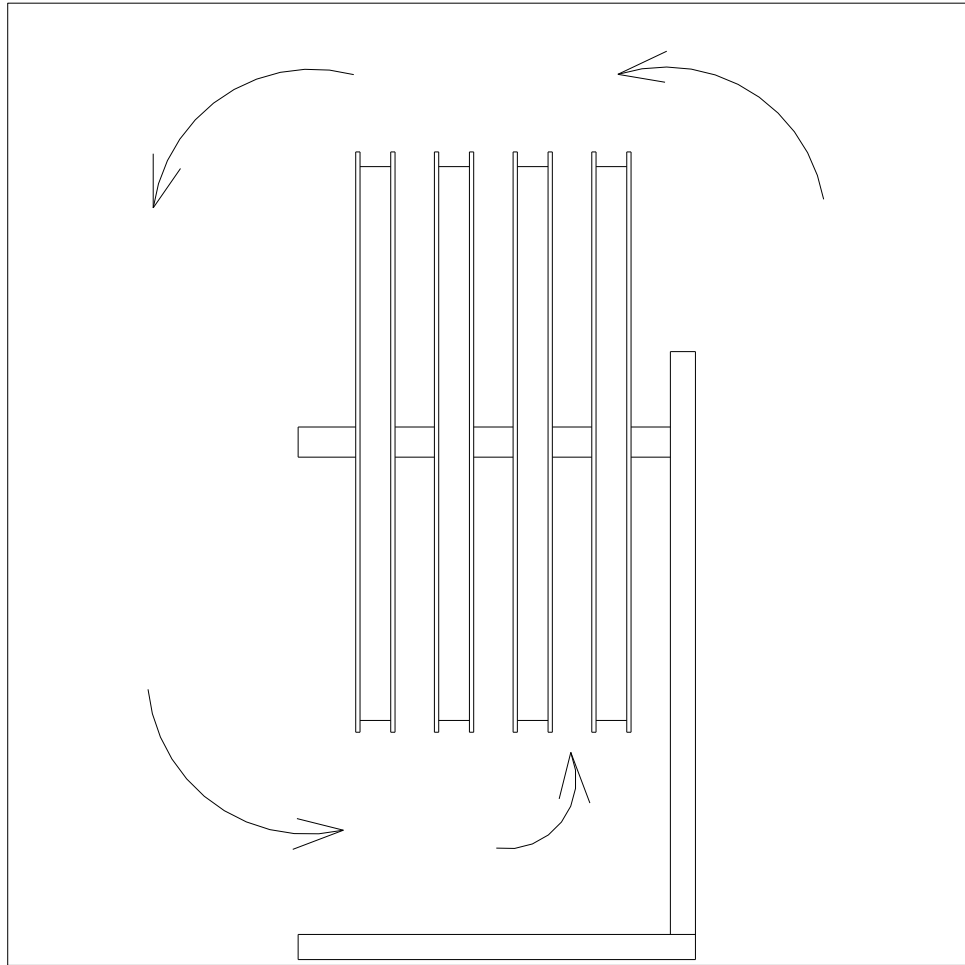
To complete the baking properly, devices should be placed to the metal tray.

Recommended condition of reel baking: 125°C, 6 to 24hours

※ In the case of reel baking, hung the reel in the oven by passing the shaft in the center hole of reel.

Please avoid laying the reel.

## 3.4 Placement of reels in an oven



- (1) Please hang reels by using a center hole for fixing the reel.  
Please keep some space between reels for better air rotation in the oven.  
Please do not lay a reel down in the oven to avoid any damages for the tape edge and the flange of reel.
- (2) Please make sure the carrier tape does not have any slack in a reel before baking to avoid peeling the cover tape off.  
Since the tape using for fixing carrier tape is not heatproof, there is a case to remain glue.  
So if necessary, please change the tape to a heatproof one.