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SHARP

OPTO-ELECTRONIC DEVICES DIVISION
ELECTRONIC COMPONENTS GROUP
SHARP CORPORATION

SPECIFICATION

DEVICE SPECIFICATION FOR
PHOTOCOUPLER

MODEL No.

PC412S

(Business dealing name : PC412S0NIP0F)

Specified for

Enclosed please find copies of the Specifications which consists of 13 pages including cover.
After confirmation of the contents, please be sure to send back copies of the Specifications
with approving signature on each.

CUSTOMER'S APPROVAL

DATE

BY

PRESENTED

DATE

June 28, 2004

BY

H. Imanaka,
Department General Manager of
Engineering Dept.,II
Opto-Electronic Devices Div.
ELECOM Group
SHARP CORPORATION

Product name : PHOTOCOUPLER

Model No. : PC412S

| Business dealing name | Business dealing name |
|-----------------------|-----------------------|
| PC412S0NIP0F | PC412S0YIP0F |

1. These specification sheets include materials protected under copyright of Sharp Corporation ("Sharp"). Please do not reproduce or cause anyone to reproduce them without Sharp's consent.
2. When using this product, please observe the absolute maximum ratings and the instructions for use outlined in these specification sheets, as well as the precautions mentioned below. Sharp assumes no responsibility for any damage resulting from use of the product which does not comply with the absolute maximum ratings and the instructions included in these specification sheets, and the precautions mentioned below.

(Precautions)

- (1) This product is designed for use in the following application areas ;

| | | |
|--|--------------------------|-------------------|
| · OA equipment | · Audio visual equipment | · Home appliances |
| · Telecommunication equipment (Terminal) | · Measuring equipment | |
| · Tooling machines | · Computers | |

If the use of the product in the above application areas is for equipment listed in paragraphs (2) or (3), please be sure to observe the precautions given in those respective paragraphs.

- (2) Appropriate measures, such as fail-safe design and redundant design considering the safety design of the overall system and equipment, should be taken to ensure reliability and safety when this product is used for equipment which demands high reliability and safety in function and precision, such as ;

| | |
|--|---------------------------------|
| · Transportation control and safety equipment (aircraft, train, automobile etc.) | |
| · Traffic signals | · Gas leakage sensor breakers |
| · Other safety equipment | · Rescue and security equipment |

- (3) Please do not use this product for equipment which require extremely high reliability and safety in function and precision, such as ;

| | |
|-----------------------------------|---|
| · Space equipment | · Telecommunication equipment (for trunk lines) |
| · Nuclear power control equipment | · Medical equipment |

- (4) Please contact and consult with a Sharp sales representative if there are any questions regarding interpretation of the above three paragraphs. etc.

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

1. Application

This specification applies to the outline and characteristics of OPIC photocoupler Model No. PC412S.

2. Outline Refer to the attached sheet, page 3.

3. Ratings and characteristics Refer to the attached sheet, page 4 to 6.

4. Reliability Refer to the attached sheet, page 7.

5. Outgoing inspection Refer to the attached sheet, page 8.

6. Supplement

6.1 Isolation voltage shall be measured in the following method.

- (1) Short between pins 1 and 4 on the primary side and between pins 5 and 8 on the secondary side.
- (2) The dielectric withstanding tester with zero-cross circuit shall be used.
- (3) The wave form of applied voltage shall be a sine wave.

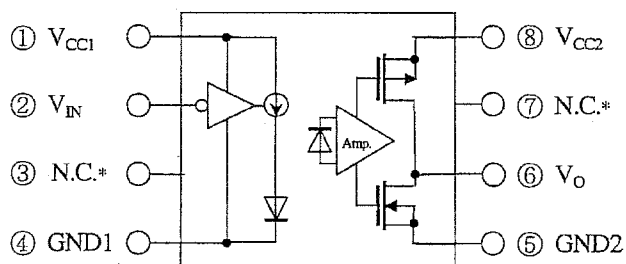
6.2 Business dealing name

("○" mark indicates business dealing name of ordered product)

| Product | Business dealing name | Remark |
|---------|-----------------------|--|
| ○ | PC412S0NIP0F | |
| | PC412S0YIP0F | Applied to product as a option (Attachment-2-1 to 2-3.) |

6.3 Package specification Refer to the attached sheet, page 9, 10.

6.4 The block diagram, Truth table



*③,⑦ N.C. terminal is not allowed external connection.

Truth table

| Input | LED | Output |
|-------|-----|--------|
| H | OFF | H |
| L | ON | L |

H : Logic (1)

L : Logic (0)

6.5 This Model is approved by UL(under preparation).

Approved Model No. : PC412S

UL file No. : E64380

6.6 This product is not designed against irradiation.

This product is assembled with electrical input and output.

This product incorporates non-coherent light emitting diode.

6.7 ODS materials

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 (Methyl chloroform)

6.8 Brominated flame retardants

Specific brominated flame retardants such as the PBBOs and PBBs are not used in this device at all.

7. Notes

Precautions for photocouplers : Attachment-1

PC412S Outline Dimensions
(Business dealing name : PC412S0NIP0F)

3. Ratings and characteristics

3.1 Absolute maximum ratings

Ta=25°C

| Parameter | | Symbol | Rating | Unit |
|--------------------------|---------------------------|-----------------------|-------------------------------|------|
| Input | Supply voltage | V _{CC1} | 0 to 5.5 | V |
| | Input voltage | V _{IN} | -0.5 to V _{CC1} +0.5 | V |
| Output | Supply voltage | V _{CC2} | 0 to 5.5 | V |
| | High level output voltage | V _O | -0.5 to V _{CC2} +0.5 | V |
| | Low level output current | I _O | 10 | mA |
| *1 Isolation voltage | | V _{iso(rms)} | 2.5 | kV |
| Operating temperature | | T _{opr} | -40 to +85 | °C |
| Storage temperature | | T _{stg} | -55 to +125 | °C |
| *2 Soldering temperature | | T _{sol} | 270 | °C |

*1 AC for 1 min, 40 to 60%RH

*2 For 10 s

3.2 Electro-optical characteristics *3

(Unspecified : Ta=Topr, VCC1=VCC2=5V, TYP. ; Ta=25°C)

| Parameter | | Symbol | MIN. | TYP. | MAX. | Unit | Conditions | |
|--------------------------|---|--|------------------|--------------------|------------------|------|--|---|
| Input | Low level input supply current | I _{CC1L} | - | 6.0 | 10.0 | mA | V _{IN} =0 | |
| | High level input supply current | I _{CC1H} | - | 0.8 | 3.0 | mA | V _{IN} =V _{CC1} | |
| | Input current | I _{IN} | -10 | - | 10 | μ A | V _{CC1} =5V | |
| Output | High level output supply current | I _{CC2H} | - | 2.5 | 9.0 | mA | V _{CC1} =V _{CC2} =5V,V _{IN} =5V | |
| | Low level output supply current | I _{CC2L} | - | 2.0 | 9.0 | mA | V _{CC1} =V _{CC2} =5V,V _{IN} =0 | |
| | High level output voltage | V _{OH} | 4.4 | 5.0 | - | V | I _O =20 μ A,V _{IN} =5V | |
| | | | 4.0 | 4.8 | - | V | I _O =4 mA,V _{IN} =5V | |
| | Low level output voltage | V _{OL} | - | 0 | 0.1 | V | I _O =20 μ A,V _{IN} =0 | |
| | | | - | - | 0.1 | V | I _O =400 μ A,V _{IN} =0 | |
| | | | - | 0.2 | 1.0 | V | I _O =4mA,V _{IN} =0 | |
| Transfer characteristics | Isolation resistance | | R _{ISO} | 5×10 ¹⁰ | 10 ¹¹ | - | Ω | DC=500V, 40 to 60%RH |
| | Response time *4 | "H→L" propagation delay time | t _{PHL} | - | 23 | 40 | ns | V _{CC1} =V _{CC2} =5V C _L =15pF CMOS Logic level Vin=0→5V tr=tf<1ns Pulse width 40ns Duty 50% |
| | | "L→H" propagation delay time | t _{PLH} | - | 22 | 40 | ns | |
| | | Distortion of pulse width t _{PHL} -t _{PLH} | | - | - | 6 | ns | |
| | | Propagation delay skew | T _{PSK} | - | - | 20 | ns | |
| | | Data rate | T | - | - | 25 | Mb/s | |
| | | Rise time | tr | - | 4 | - | ns | |
| | | Fall time | t _f | - | 3 | - | ns | |
| | Instantaneous common mode rejection voltage (High level output) *5 | | CM _H | 10 | 20 | - | kV/μ s | V _{IN} =V _{CC1} ,V _O >0.8×V _{CC2} V _{CM} =1kV |
| | Instantaneous common mode rejection voltage (Low level output) *5 | | CM _L | -10 | -20 | - | kV/μ s | V _{IN} =0,V _O <0.8 V _{CM} =1kV |

*3 It shall connect a by-pass capacitor of 0.01 μF or more between V_{CC1} (Pin No.1) and GND(Pin No.4) and between between V_{CC2} (Pin No.8) and GND(Pin No.5) near the device, when it measures the transfer characteristics and the output side characteristics.

*4 Propagation delay time : Refer to Fig.1

*5 Instantaneous common mode rejection voltage : Refer to Fig.2

Fig.1 t_{PHL} , t_{PLH} , t_r , t_f test circuit

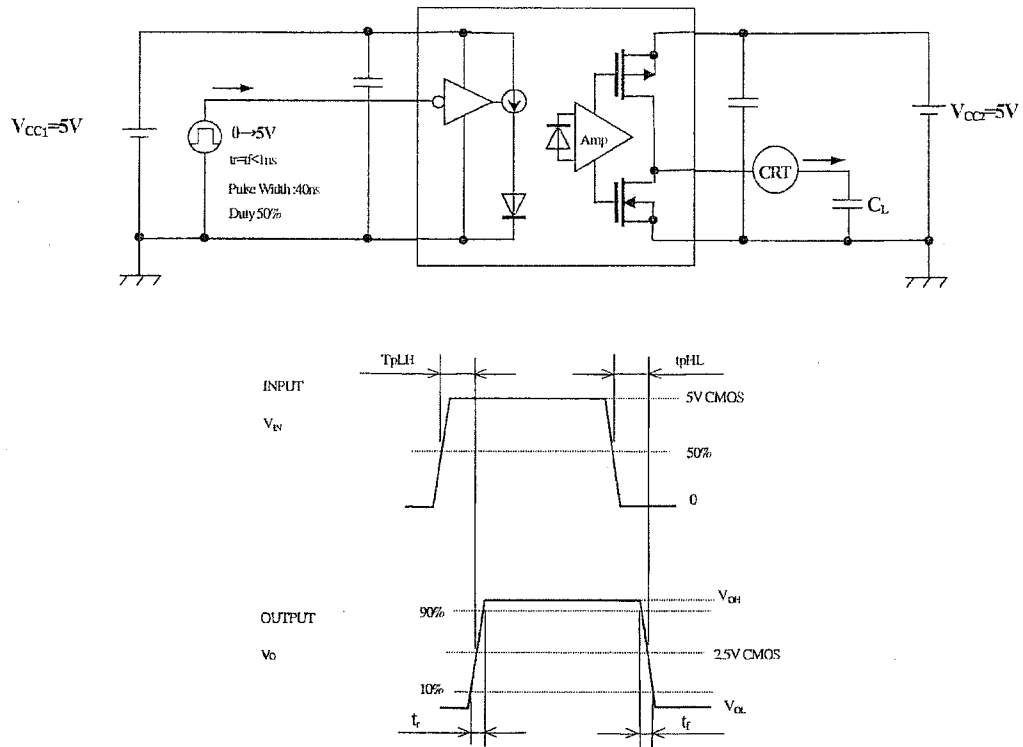
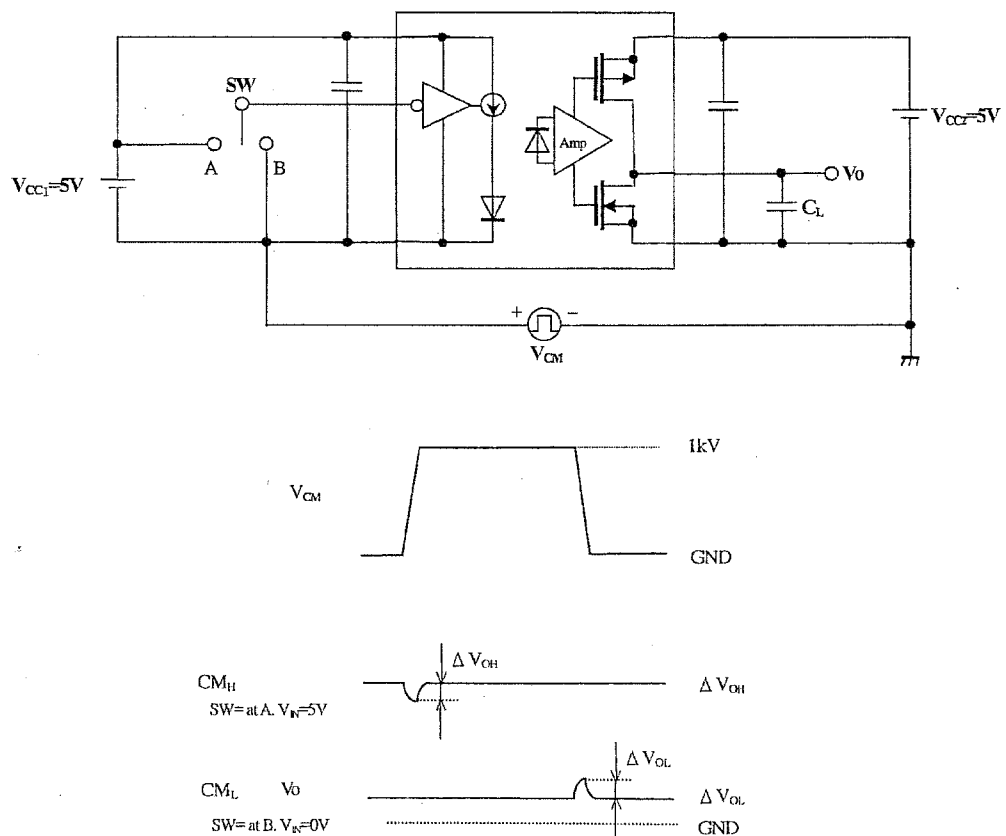


Fig.2 CM_H , CM_L test circuit



4. Reliability

The reliability of products shall satisfy items listed below.

Confidence level : 90%

LTPD : 10 or 20

| Test Items | Test Conditions *1 | Failure Judgement Criteria | Samples (n) Defective (C) |
|--------------------------------------|---|--|------------------------------|
| Solderability *2 | 245±2°C, 3 s | ————— | n=11, C=0 |
| Soldering heat | 270 °C, 10 s | $I_{CC1L} > U \times 1.2$ $I_{CC1H} > U \times 1.2$ $I_{CC2L} > U \times 1.2$ $I_{CC2H} > U \times 1.2$ $V_{OL} > U \times 1.2$ $V_{OH} < L \times 2$ U: Upper specification limit L: Lower specification limit | n=11, C=0 |
| Mechanical shock | 15km/s ² , 0.5ms 3 times/±X, ±Y, ±Z direction | | n=11, C=0 |
| Variable frequency vibration | 100 to 2000 to 100Hz/4 min 200m/s ² 4 times/X, Y, Z direction | | n=11, C=0 |
| Temperature cycling | 1 cycle -55 °C to +125 °C (30 min) (30 min) 20 cycles test | | n=22, C=0 |
| High temp. and high humidity storage | +85°C, 85%RH, 1000h | | n=22, C=0 |
| High temp. storage | +125 °C, 1000h | | n=22, C=0 |
| Low temp. storage | - 55 °C, 1000h | | n=22, C=0 |
| Operation life | V _{CC1} =V _{CC2} =5V Ta=25 °C, 1000h | | n=22, C=0 |

*1 Test method, conforms to EIAJ ED 4701.

*2 Solder shall adhere at the area of 95% or more of immersed portion of lead,
and pin hole or other holes shall not be concentrated on one portion.

5. Outgoing inspection

5.1 Inspection items

(1) Electrical characteristics

I_{CC1L} , I_{CC1H} , I_{CC2L} , I_{CC2H} , V_{OL} , V_{OH} , R_{ISO} , V_{iso}

(2) Appearance

5.2 Sampling method and Inspection level

A single sampling plan, normal inspection level II based on ISO 2859 is applied.

The AQL according to the inspection items are shown below.

| Defect | Inspection item | AQL (%) |
|--------------|--|---------|
| Major defect | Electrical characteristics Unreadable marking | 0.065 |
| Minor defect | Appearance defect except the above mentioned. | 0.25 |

6.3 Package specifications

6.3.1 Taping conditions

- (1) Tape structure and Dimensions (Refer to the attached sheet, Page 9)
The carrier tape has the heat pressed structure of A-PET material carries tape of protect against static electricity and three layers cover tape (PET material base).
- (2) Reel structure and Dimensions (Refer to the attached sheet, Page 10)
The taping reel shall be of plastic (PS material) with its dimensions as shown in the attached drawing.
- (3) Direction of product insertion (Refer to the attached sheet, Page 10)
Product direction in carrier tape shall direct to the anode mark at the hole side on the tape.
- (4) Joint of tape
The cover tape and carrier tape in one reel shall be jointless.
- (5) The way to repair taped failure devices
Cutting a bottom of carrier tape with a cutter, and after replacing to good devices, the cut portion shall be sealed with adhesive tape.

6.3.2 Adhesiveness of cover tape

- The exfoliation force between carrier tape and cover tape shall be 0.2N to 0.7N for the angle 160° to 180°.

6.3.3 Rolling method and quantity

- Wind the tape back on the reel so that the cover tape will be outside the tape.
- Attach more than 20cm of blank tape to the trailer and the leader of the tape and fix the both ends with adhesive tape.
One reel shall contain 1500pcs.

6.3.4 Outer packing appearance (Refer to attached sheet, Page 10)

6.3.5 Marking

- The outer packaging case shall be marked with following information.
* Model No. * Number of pieces delivered * Production date

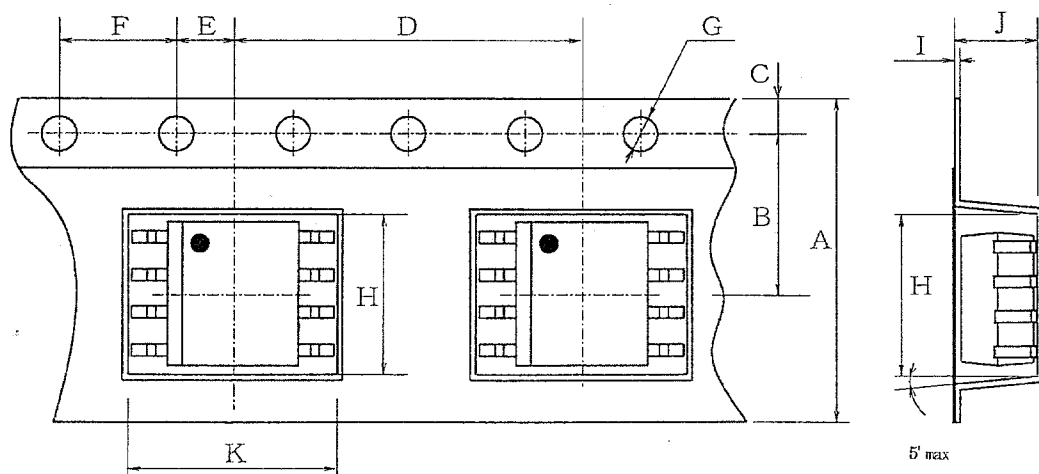
6.3.6 Storage condition

- Taped products shall be stored at the temperature 5 to 30°C and the humidity lower than 70%RH.

6.3.7 Safety protection during shipping

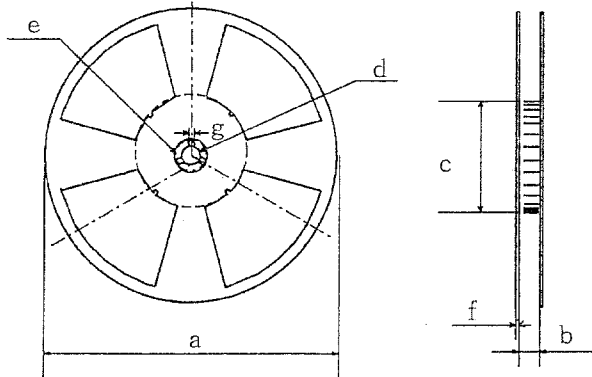
- There shall be no deformation of component or degradation of electrical characteristics due to shipping.

Carrier tape structure and Dimensions



| A | B | C | D | E | F | G | H |
|----------|----------|----------|---------|----------|---------|-----------|---------|
| 12.0±0.3 | 5.5±0.05 | 1.75±0.1 | 8.0±0.1 | 2.0±0.05 | 4.0±0.1 | 1.55±0.05 | 5.4±0.1 |
| I | J | K | | | | | |
| 0.3±0.05 | 3.7±0.1 | 6.3±0.1 | | | | | |

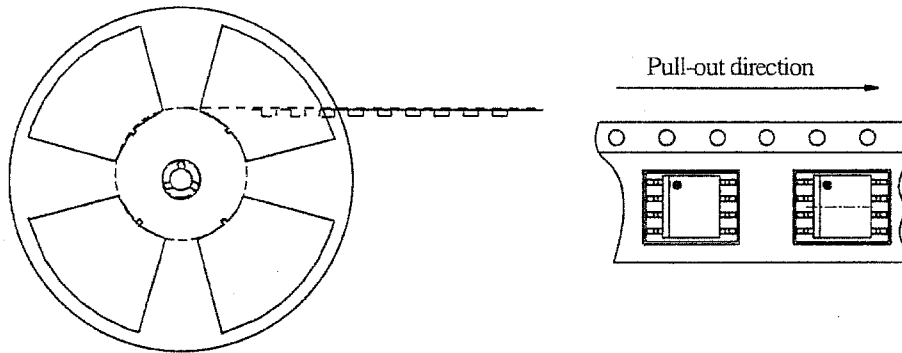
Reel structure and Dimensions



Dimensions list (Unit : mm)

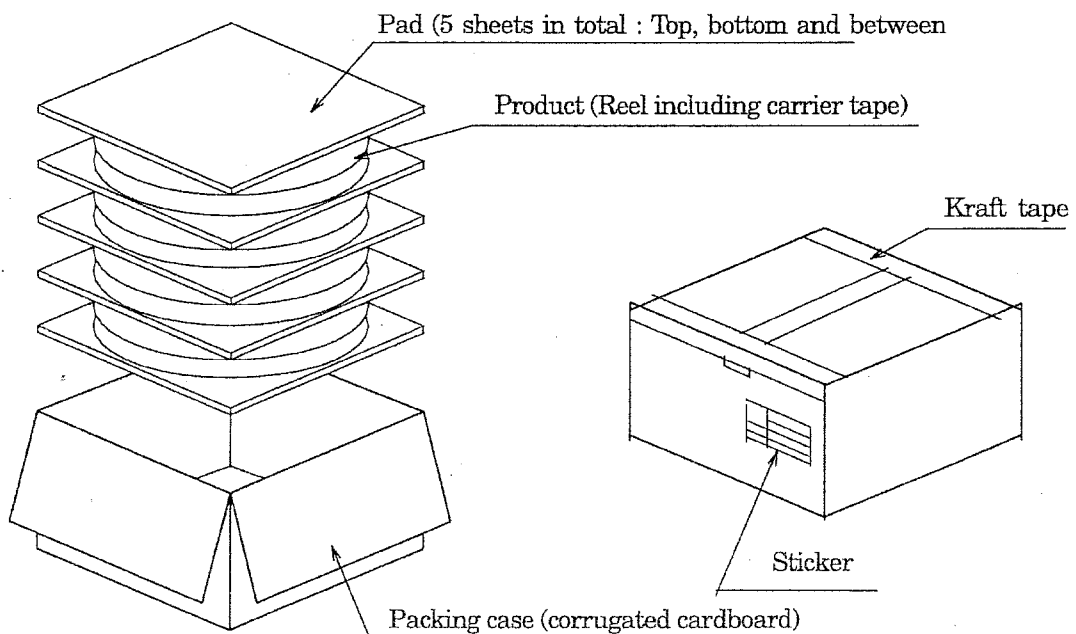
| a | b | c | d |
|--------------|----------------|---------------|--------------|
| 330 | 13.5 ± 1.5 | 100 ± 1.0 | 13 ± 0.2 |
| e | f | g | |
| 21 ± 0.8 | 0.75 ± 2.0 | 2.0 ± 0.5 | |

Direction of product insertion



Outer packing appearance

- (1) Carrier tape with 1,500pcs. of the devices (reeled) are packed in packing case.
 - (2) The packing case is sealed by kraft tape & the label is placed on it.
- (Max. 4 reels are packed in one carton. (Max. 6,000pcs. of devices are in one carton.))



Precautions for Photocouplers

1. Recommended operating conditions

| Parameter | Symbol | MIN. | MAX. | Unit |
|--------------------------|-----------|------|-----------|------|
| Supply voltage | V_{CC1} | 4.5 | 5.5 | V |
| Supply voltage | V_{CC2} | 4.5 | 5.5 | V |
| High level input Voltage | V_{IH} | 2.0 | V_{CC1} | V |
| Low level input Voltage | V_{IL} | 0 | 0.8 | V |
| Operating temperature | T_{opr} | -40 | +85 | °C |

Sharp recommends usage of the device under the above conditions to secure reliability and allowance for over time degradation of light emitting diode.

2. For cleaning

- 2.1 Solvent cleaning : Solvent temperature 45°C or less, Immersion for 3 min or less
- 2.2 Ultrasonic cleaning : The effect to device by ultrasonic cleaning differs by cleaning bath size, ultrasonic power output, cleaning time, PCB size or device mounting condition etc.
Please test it in actual using condition and confirm that doesn't occur any defect before starting the ultrasonic cleaning.
- 2.3 Applicable solvent : Ethyl alcohol, Methyl alcohol, Isopropyl alcohol
When the other solvent is used, there are cases that the packaging resin is eroded.
Please use the other solvent after thorough confirmation is performed in actual using condition.

3. Precaution for use

This product is transistor of detector side in bipolar and CMOS type device and is susceptible to static electricity due to its minute design.

When handling them, general countermeasure against static electricity should be taken to avoid breakdown of devices or degradation of characteristics.

4. Circuit design

- 4.1 In order to stabilize power supply line, we should certainly recommend to connect two by-pass capacitor of 0.01 μ F or more.
One capacitor should connect between V_{CC1} and GND1, another should connect between V_{CC2} and GND2.
- 4.2 When steep voltage noise is applied between the primary side and the secondary side of the photocoupler, current flows or changes in the light emitting diode through a parasitic capacitance between the primary side and the secondary side of the photocoupler, then there is a case that miss operation occurs depending upon the applied noise level.
We should certainly recommend to use a by-pass capacitor between both terminals of the light emitting diode where used in a noisy environment.
- 4.3 The detector which is used in this device, has parasitic diode between each pins and GND.
There are cases that miss operation or destruction possibly may be occurred if electric potential of any pin becomes below GND level even for instant.
Therefore it shall be recommended to design the circuit that electric potential of any pin does not become below GND level.
- 4.4 ③,⑦ N.C. terminal is not allowed external connection.

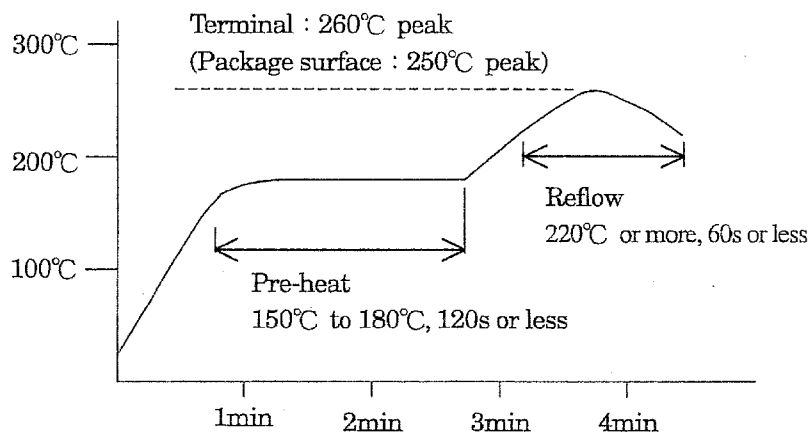
5. Precautions for Soldering Photocouplers

5.1 In the case of flow soldering (Whole device dipping)

It is recommended that flow solder be carried out at 270°C and within 10 s (Pre-heating : 100 to 150°C, 30 to 80s).
(2 times or less)

5.2 If solder reflow :

It is recommended that only one soldering be done at the temperature and the time within the temperature profile as shown in the figure below. (2 times or less)



Since, influence to the device is different according to reflow equipment and its condition, please use the device after confirming no damage in the actual using condition.

5.3 In the case of hand soldering

What is done on the following condition is recommended. (2 times or less)

Soldering iron temperature : 400°C

Time : 3s or less

5.4 Other precautions

An infrared lamp used to heat up for soldering may cause a localized temperature rise in the resin.

So keep the package temperature within that specified in Item (2).