# PS9001

HIGH CMR, 10 Mbps OPEN COLLECTOR OUTPUT TYPE,
5-PIN SOP (LSO5 WITH 8mm CREEPAGE DISTANCE) PHOTOCOUPLER

R08DS0130EJ0101
Rev.1.01
Oct 29, 2018

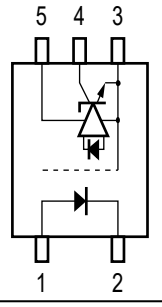
## DESCRIPTION

The PS9001 is an optically coupled high-speed, active low type isolator containing an AlGaAs LED on the input side and a photodiode and a signal processing circuit on the output side on one chip.

## FEATURES

- Long creepage distance (8 mm MIN)
- High common mode transient immunity ($CM_H$, $CM_L$ = ±50 kV/$\mu$s MIN.)
- Operating Ambient Temperature (125 °C MAX.)
- High-speed response ($t_{PHL}$ = 100 ns MAX., $t_{PLH}$ = 100 ns MAX.)
- Embossed tape product : PS9001-F3: 3000 pcs/reel
- Pb-Free product
- Safety standards
  - UL approved: UL1577, Double protection
  - CSA approved: CAN/CSA-C22.2 No. 62368-1, Reinforced insulation
  - VDE approved: DIN EN 60747-5-5 (Option)

**PIN CONNECTION**
(Top View)



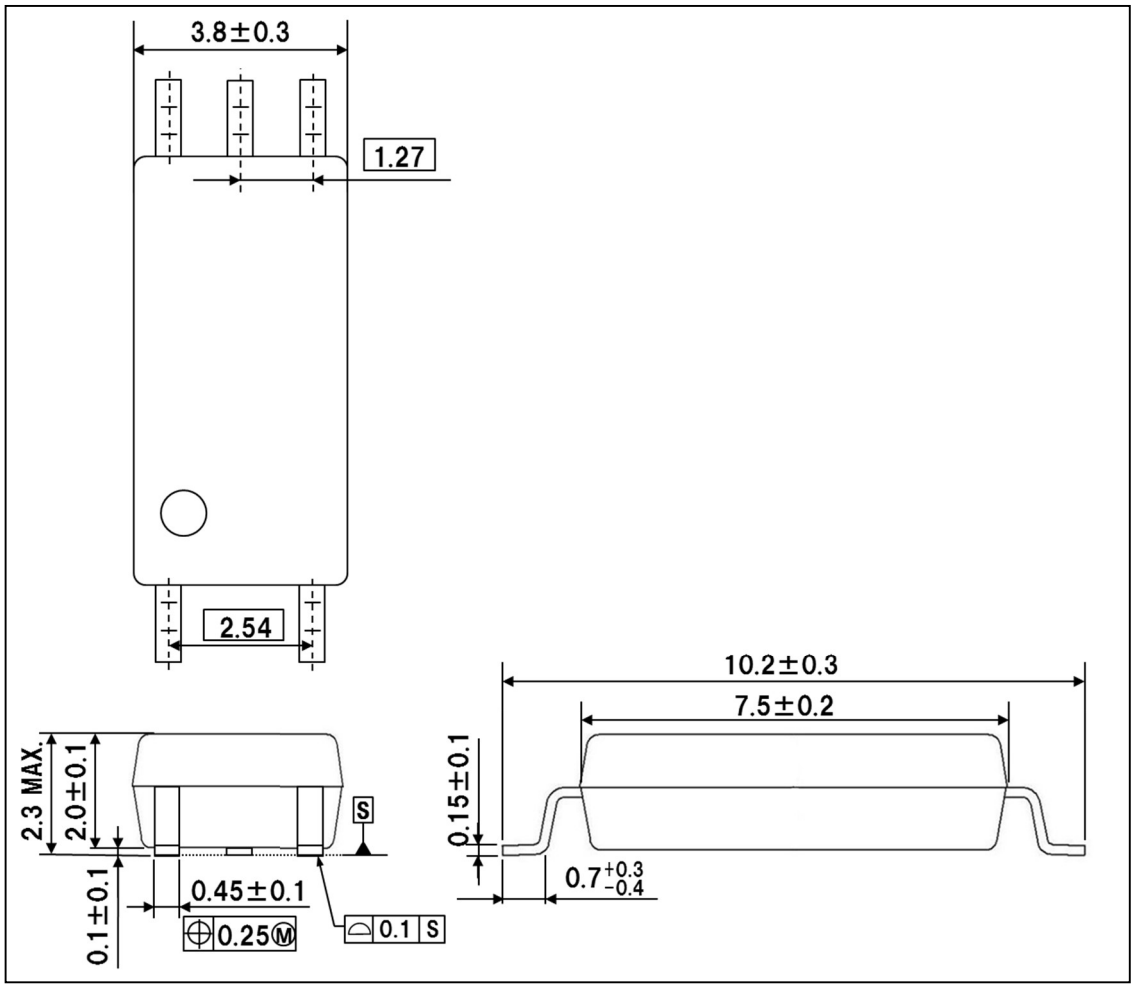

1. Anode
2. Cathode
3. GND
4. $V_O$
5. $V_{CC}$

## APPLICATIONS

- Measurement equipment
- FA Network

Start of mass production
Oct.2015

## PACKAGE DIMENSIONS (UNIT: mm)

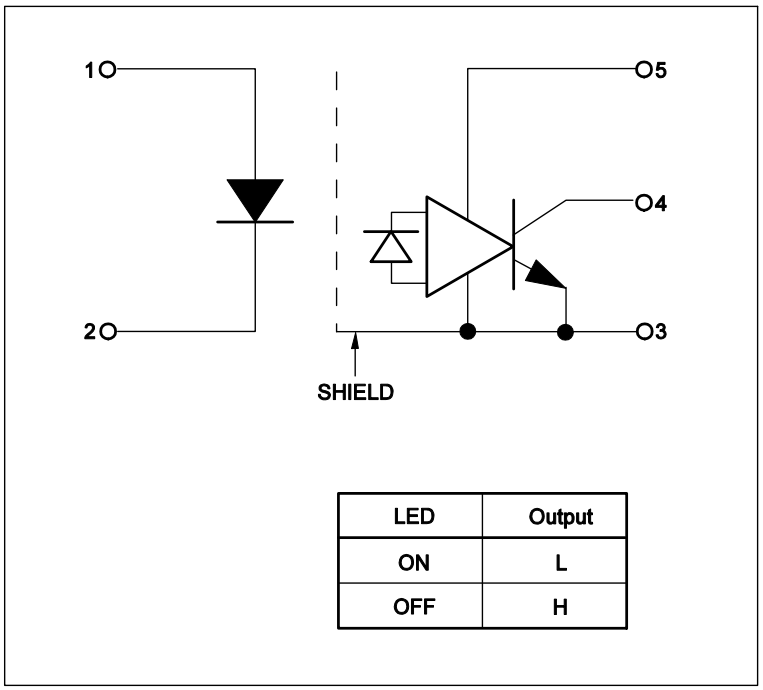



Weight : 0.119g (typ.)

## PHOTOCOUPLER CONSTRUCTION

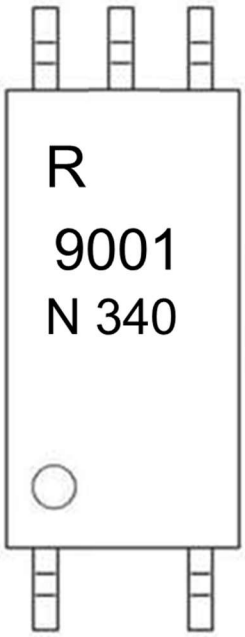
| Parameter | MIN. |
|---|---|
| Air Distance | 8.0 mm |
| Creepage Distance | 8.0 mm |
| Isolation Distance | 0.15 mm |

## BLOCK DIAGRAM (Unit: mm)




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

## MARKING EXAMPLE




| | | | |
|---|---|---|---|
| R | | An initial of “Renesas” | |
| 9001 | | Product Part Number | |
| ○ | | No.1 pin Mark, Anode Mark | |
| N340 | N | Rank Code | |
| | 340 | Assembly Lot | |
| | | 3 | Last one-digit of Assembly Year |
| | | 40 | Weekly Serial Code |

## ORDERING INFORMATION

| Part Number | Order Number | Solder Plating Specification | Packing Style | Safety Standard Approval | Application Part Number*1 |
|---|---|---|---|---|---|
| PS9001 | PS9001-Y-AX | Pb-Free and Halogen Free (Ni/Pd/Au) | 20 pcs (Tape 20 pcs cut) | Standard products (UL, CSA approved) | PS9001 |
| PS9001-F3 | PS9001-Y-F3-AX | | Embossed Tape 3 000 pcs/reel | | |
| PS9001-V | PS9001-Y-V-AX | | 20 pcs (Tape 20 pcs cut) | UL, CSA, DIN EN 60747-5-5 approved | |
| PS9001-V-F3 | PS9001-Y-V-F3-AX | | Embossed Tape 3 000 pcs/reel | | |

Note: *1. For the application of the Safety Standard, following part number should be used.

## ABSOLUTE MAXIMUM RATINGS ($T_A$ = 25°C, unless otherwise specified)

| Parameter | | Symbol | Ratings | Unit |
|---|---|---|---|---|
| Diode | Forward Current *1 | $I_F$ | 25 | mA |
| | Reverse Voltage | $V_R$ | 5 | V |
| Detector | Supply Voltage | $V_{CC}$ | -0.5 to 7 | V |
| | Output Voltage | $V_O$ | -0.5 to 7 | V |
| | Output Current | $I_O$ | 20 | mA |
| | Power Dissipation | $P_C$ | 100 | mW |
| Isolation Voltage *2 | | BV | 5000 | Vr.m.s. |
| Operating Ambient Temperature | | $T_A$ | –40 to +125 | °C |
| Storage Temperature | | $T_{stg}$ | –55 to +150 | °C |

Notes: *1. Reduced to 0.325 mA/°C at $T_A$ = 85°C or more.

*2. AC voltage for 1 minute at $T_A$ = 25°C, RH = 60% between input and output.
Pins 1-2 shorted together, 3-5 shorted together.

## RECOMMENDED OPERATING CONDITIONS

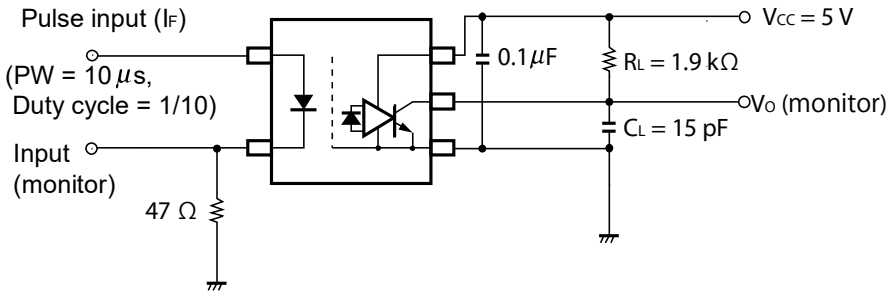
| Parameter | Symbol | MIN. | TYP. | MAX. | Unit |
|---|---|---|---|---|---|
| High Level Input Voltage | $V_F$ | –2 | – | 0.8 | V |
| Low Level Input Current | $I_F$ | 8 | 10 | 12 | mA |
| Supply Voltage | $V_{CC}$ | 4.5 | 5.0 | 5.5 | V |
| Operating Ambient Temperature | $T_A$ | -40 | – | 125 | °C |

## ELECTRICAL CHARACTERISTICS ($T_A$ = –40 to +125°C, Vcc=5V unless otherwise specified)

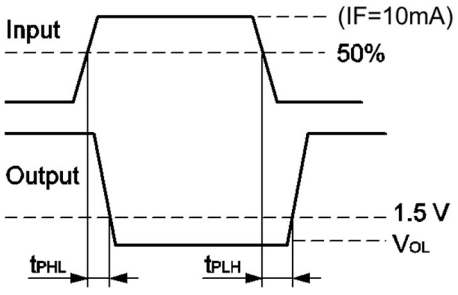
| Parameter | | Symbol | Conditions | MIN. | TYP. *1 | MAX. | Unit |
|---|---|---|---|---|---|---|---|
| Diode | Forward Voltage | $V_F$ | $I_F$ = 10 mA, $T_A$ = 25°C | 1.35 | 1.56 | 1.75 | V |
| | Reverse Current | $I_R$ | $V_R$ = 3 V, $T_A$ = 25°C | | | 10 | μA |
| | Terminal Capacitance | $C_t$ | f = 1 MHz, $V_F$ = 0 V, $T_A$ = 25°C | | 30 | | pF |
| Detector | High Level Output Current | $I_{OH}$ | $V_{CC}$ = $V_O$ = 5.5 V, $V_F$ = 0.8 V | | | 50 | μA |
| | Low Level Output Voltage | $V_{OL}$ | $I_F$ = 4 mA, $I_{OL}$ = 5 mA | | 0.1 | 0.6 | V |
| | High Level Supply Current | $I_{CCH}$ | $V_{CC}$ = 5.5 V, $I_F$ = 0 mA, $V_O$ = open | | 1.4 | 2.0 | mA |
| | Low Level Supply Current | $I_{CCL}$ | $V_{CC}$ = 5.5 V, $I_F$ = 10mA, $V_O$ = open | | 1.4 | 2.0 | mA |
| Coupled | Threshold Input Voltage (H → L) | $I_{FHL}$ | $V_O$ = 0.6V,$I_O$ = 5mA | | 1.2 | 4.0 | mA |
| | Propagation Delay Time (H → L) *2 | $t_{PHL}$ | $I_F$ = 10 mA, $R_L$ = 1.9 k Ω, $C_L$ = 15 pF, $V_{THHL}$ = 1.5 V, $V_{THLH}$ = 1.5 V | | 35 | 100 | ns |
| | Propagation Delay Time (L → H) *2 | $t_{PLH}$ | | | 65 | 100 | ns |
| | Pulse Width Distortion (PWD) | $\lvert t_{PHL}-t_{PLH} \rvert$ | | | 30 | 50 | ns |
| | Propagation Delay Skew | $t_{psk}$ | | | | 60 | ns |
| | Common Mode Transient Immunity at High Level Output *3 | $CM_H$ | $T_A$ = 25°C, $I_F$ = 0 mA, $V_O$ > 1.5 V, $R_L$ = 1.9 kΩ, $V_{CM}$ = 1.5 kV, $C_L$ = 15 pF | 50 | | | kV/μs |
| | Common Mode Transient Immunity at Low Level Output *3 | $CM_L$ | $T_A$ = 25°C, $I_F$ = 10 mA, $V_O$ < 1.5 V, $R_L$ = 1.9 kΩ, $V_{CM}$ = 1.5 kV, $C_L$ = 15 pF | 50 | | | kV/μs |

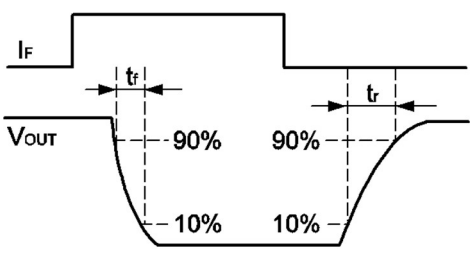
Notes: *1. Typical values at $T_A$ = 25°C

*2. Test circuit for $t_{PHL}$ and $t_{PLH}$

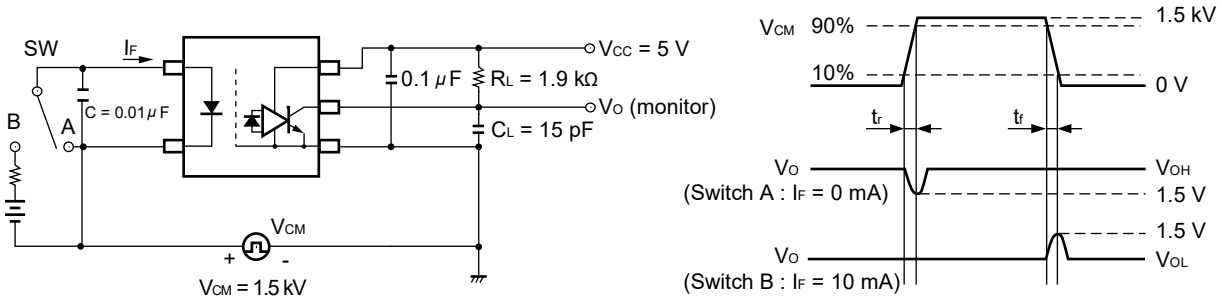



**Remark** $C_L$ includes probe and stray wiring capacitance.



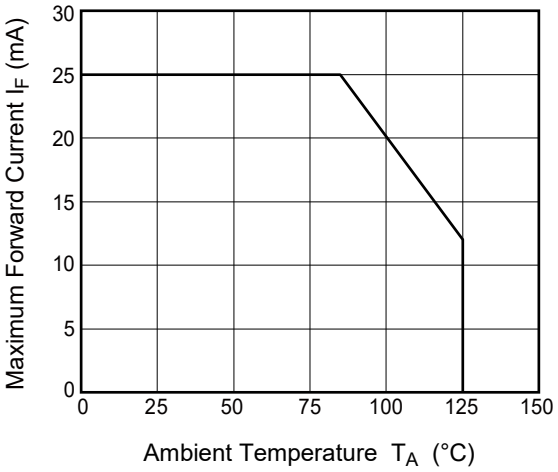
*3. Test circuit for common mode transient immunity



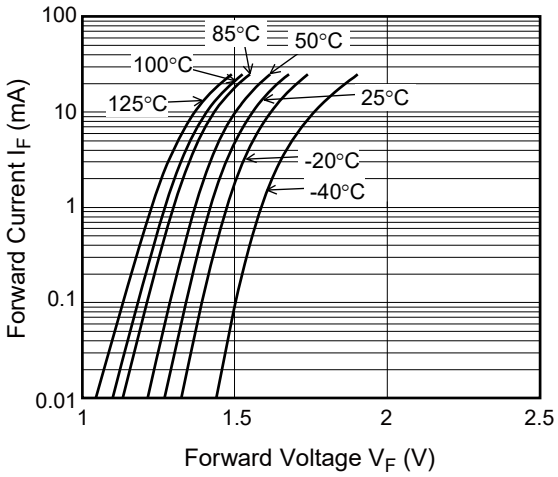

**Remark** $C_L$ includes probe and stray wiring capacitance.

## TYPICAL CHARACTERISTICS ($T_A$ = 25°C, unless otherwise specified)

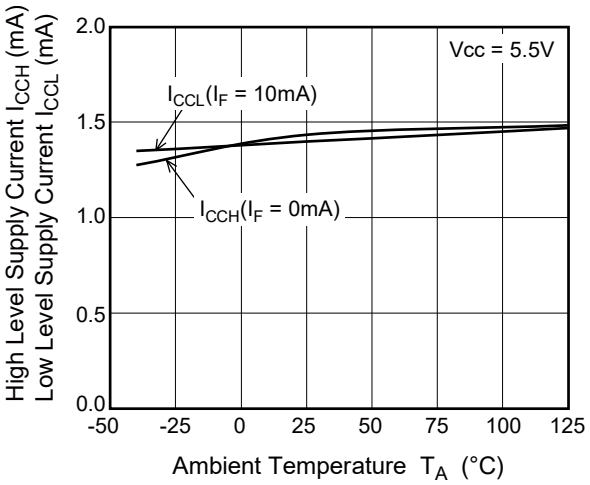
MAXIMUM FORWARD CURRENT vs. AMBIENT TEMPERATURE



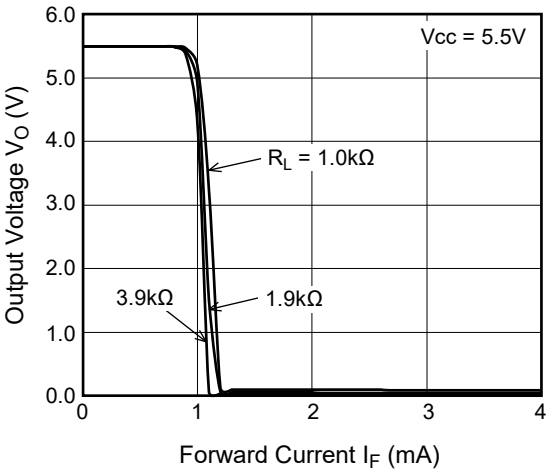

FORWARD CURRENT vs. FORWARD VOLTAGE



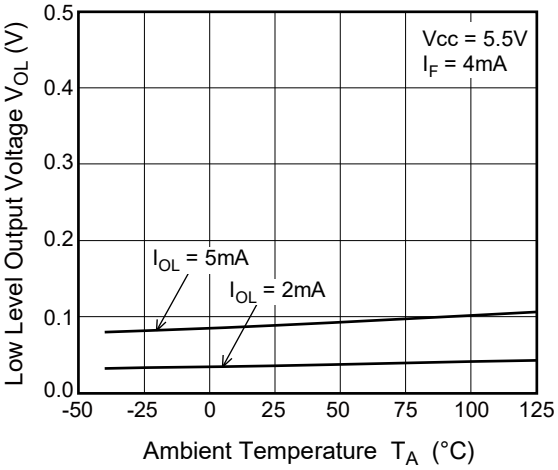

SUPPLY CURRENT vs. AMBIENT TEMPERATURE



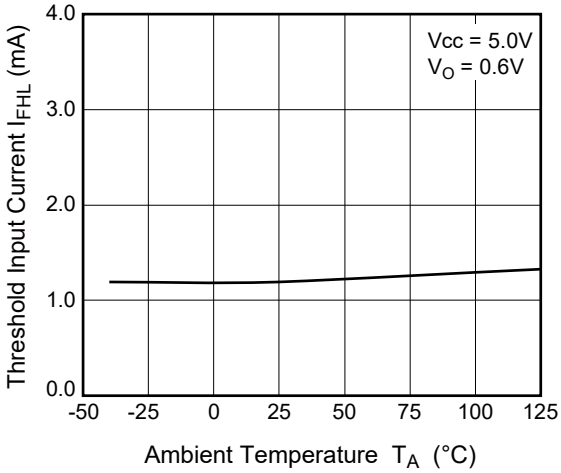

OUTPUT VOLTAGE vs. FORWARD CURRENT




LOW LEVEL OUTPUT VOLTAGE vs. AMBIENT TEMPERATURE

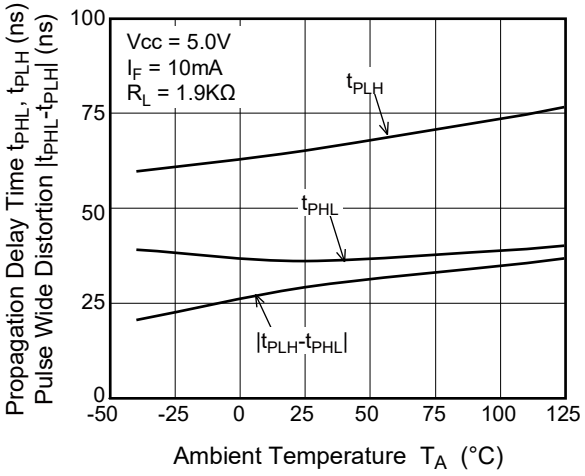



THRESHOLD INPUT CURRENT vs. AMBIENT TEMPERATURE

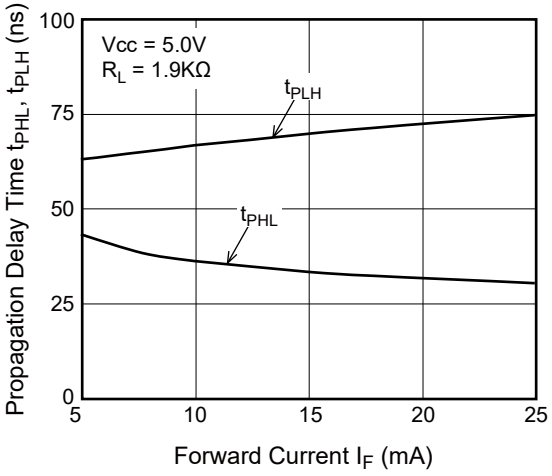



**Remark** The graphs indicate nominal characteristics.

PROPAGATION DELAY TIME,
PULSE WIDE DISTORTION
vs. AMBIENT TEMPERATURE

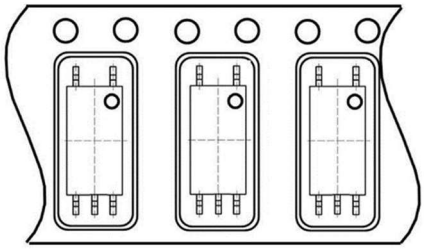



PROPAGATION DELAY TIME
vs. FORWARD CURRENT



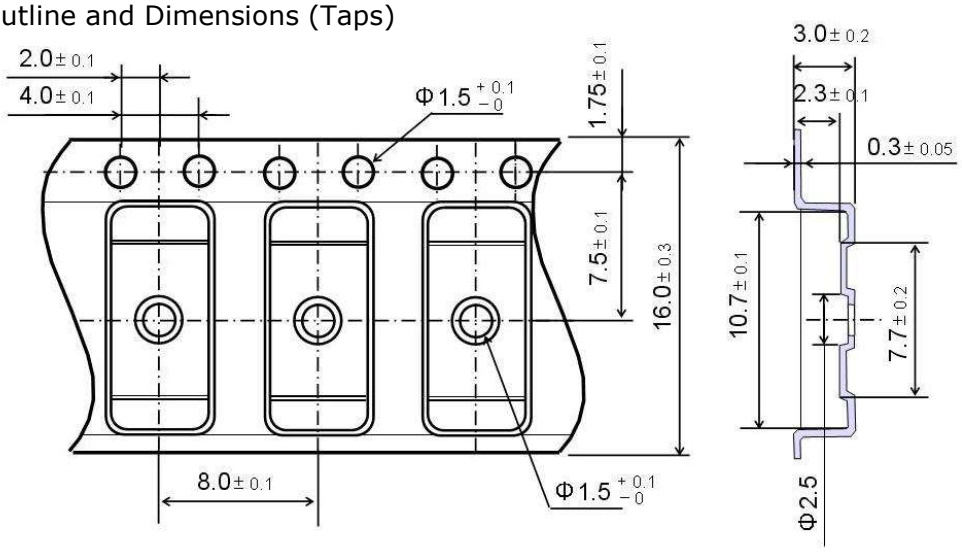

**Remark** The graphs indicate nominal characteristics.

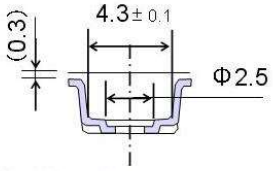
## TAPING SPECIFICATIONS (UNIT: mm)



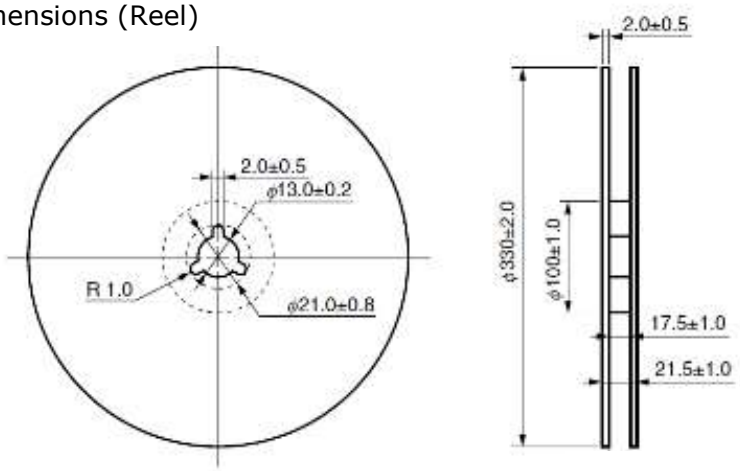
Tape Direction

Outline and Dimensions (Taps)



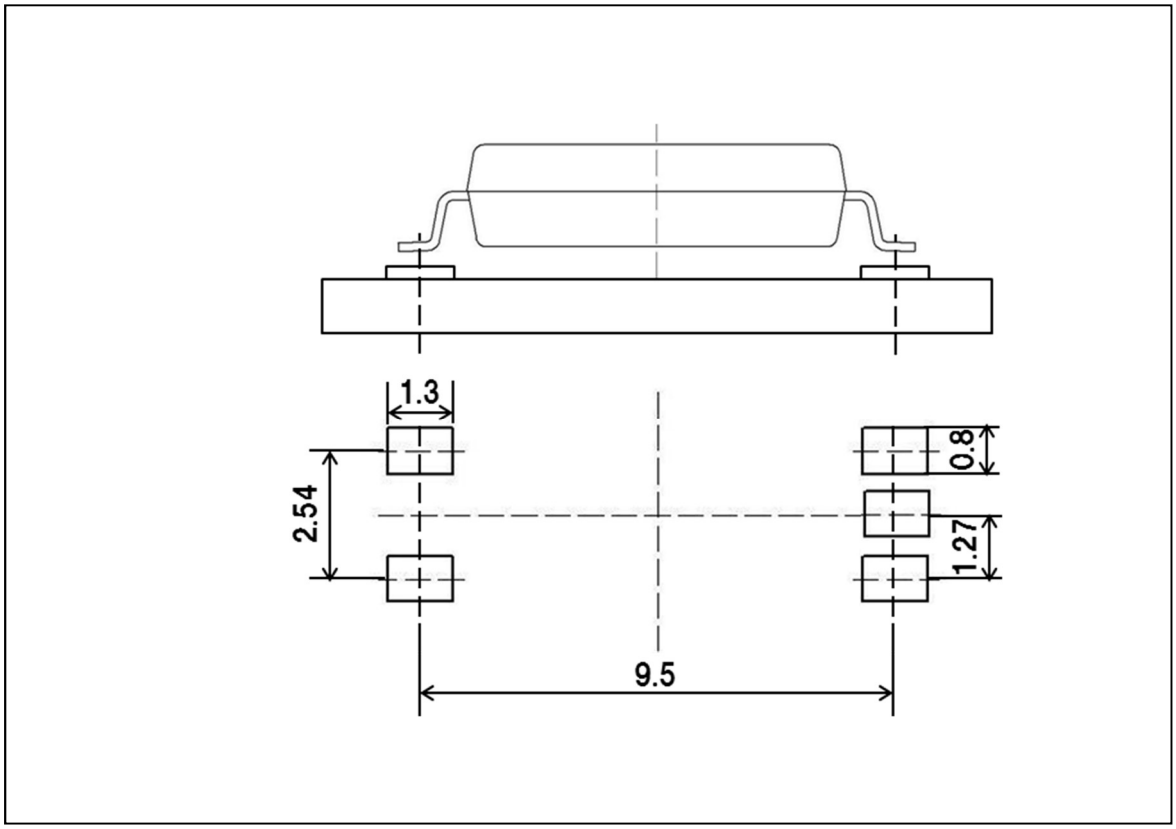




Outline and Dimensions (Reel)




Packing:3000 pcs/reel

## RECOMMENDED MOUNT PAD DIMENSIONS (UNIT: mm)




**Remark** All dimensions in this figure must be evaluated before use.

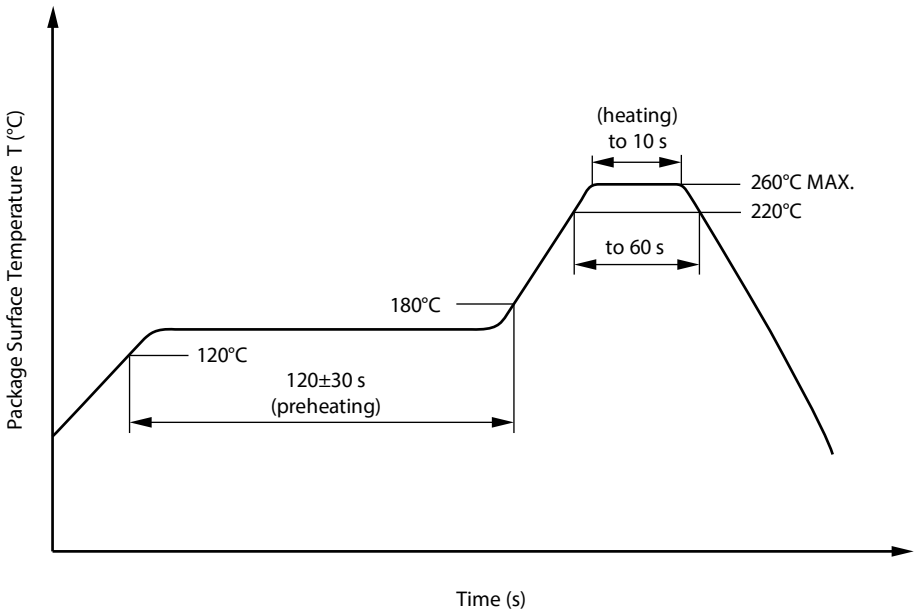
## NOTES ON HANDLING

1. Recommended soldering conditions

(1) Infrared reflow soldering

| | |
|---|---|
| • Peak reflow temperature | 260°C or below (package surface temperature) |
| • Time of peak reflow temperature | 10 seconds or less |
| • Time of temperature higher than 220°C | 60 seconds or less |
| • Time to preheat temperature from 120 to 180°C | 120±30 s |
| • Number of reflows | Three |
| • Flux | Rosin flux containing small amount of chlorine (The flux with a maximum chlorine content of 0.2 Wt% is recommended.) |

Recommended Temperature Profile of Infrared Reflow




(2) Wave soldering

| | |
|---|---|
| • Temperature | 260°C or below (molten solder temperature) |
| • Time | 10 seconds or less |
| • Preheating conditions | 120°C or below (package surface temperature) |
| • Number of times | One (Allowed to be dipped in solder including plastic mold portion.) |
| • Flux | Rosin flux containing small amount of chlorine (The flux with a maximum chlorine content of 0.2 Wt% is recommended.) |

(3) Soldering by Soldering Iron

| | |
|---|---|
| • Peak Temperature (lead part temperature) | 350°C or below |
| • Time (each pins) | 3 seconds or less |
| • Flux | Rosin flux containing small amount of chlorine (The flux with a maximum chlorine content of 0.2 Wt% is recommended.) |

(a) Soldering of leads should be made at the point 1.5 to 2.0 mm from the root of the lead

(4) Cautions

- Fluxes Avoid removing the residual flux with freon-based and halogens-based (chlorine-based) cleaning solvent .

2. Cautions regarding noise

Be aware that when voltage is applied suddenly between the photocoupler's input and output at startup, the output transistor may enter the on state, even if the voltage is within the absolute maximum ratings.

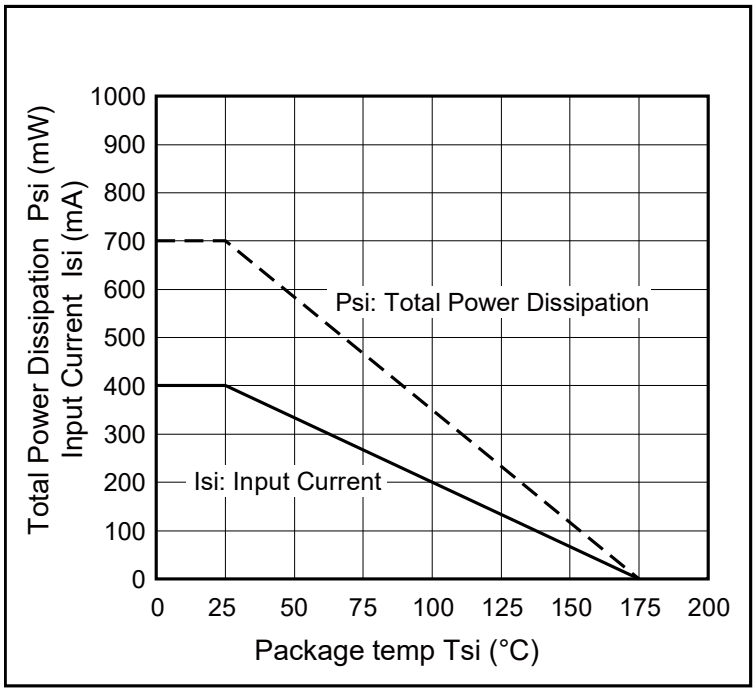
## USAGE CAUTIONS

1. This product is weak for static electricity by designed with high-speed integrated circuit so protect against static electricity when handling.
2. By-pass capacitor of more than 0.1 $\mu$F is used between $V_{CC}$ and GND near device. Also, ensure that the distance between the leads of the photocoupler and capacitor is no more than 10 mm.
3. Avoid storage at a high temperature and high humidity.
4. Do not use adhesives or coating materials including halogens to fix this device.

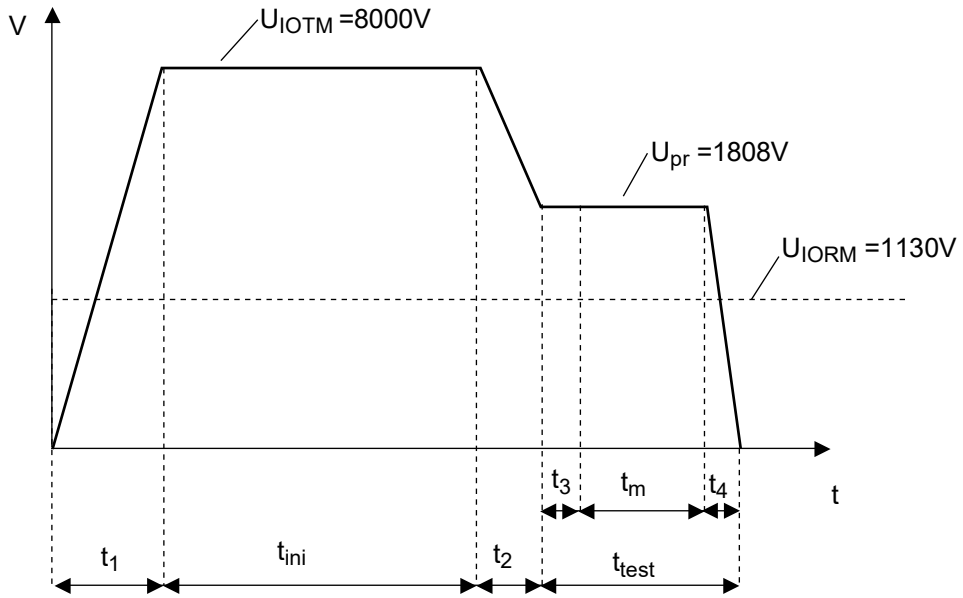
## SPECIFICATION OF VDE MARKS LICENSE DOCUMENT

| Parameter | Symbol | Rating | Unit |
|---|---|---|---|
| Climatic test class (IEC 60068-1/DIN EN 60068-1) | | 40/125/21 | |
| Dielectric strength<br>maximum operating isolation voltage<br>Test voltage (partial discharge test, procedure a for type test and random test)<br>$U_{pr}$ = 1.6 × $U_{IORM.}$, $P_d$ < 5 pC | <br>$U_{IORM}$<br>$U_{pr}$ | <br>1 130<br>1 808 | <br>$V_{peak}$<br>$V_{peak}$ |
| Test voltage (partial discharge test, procedure b for all devices)<br>$U_{pr}$ = 1.875 × $U_{IORM.}$, $P_d$ < 5 pC | $U_{pr}$ | 2 119 | $V_{peak}$ |
| Highest permissible overvoltage | $U_{TR}$ | 8 000 | $V_{peak}$ |
| Degree of pollution (DIN EN 60664-1 VDE0110 Part 1) | | 2 | |
| Comparative tracking index (IEC 60112/DIN EN 60112 (VDE 0303 Part 11)) | CTI | 400 | |
| Material group (DIN EN 60664-1 VDE0110 Part 1) | | II | |
| Storage temperature range | $T_{stg}$ | –55 to +150 | °C |
| Operating temperature range | $T_A$ | –40 to +125 | °C |
| Isolation resistance, minimum value<br>$V_{IO}$ = 500 V dc at $T_A$ = 25°C<br>$V_{IO}$ = 500 V dc at $T_A$ MAX. at least 100°C | <br>Ris MIN.<br>Ris MIN. | <br>$10^{12}$<br>$10^{11}$ | <br>Ω<br>Ω |
| Safety maximum ratings (maximum permissible in case of fault, see thermal derating curve)<br>Package temperature<br>Current (input current $I_F$, Psi = 0)<br>Power (output or total power dissipation)<br>Isolation resistance<br>$V_{IO}$ = 500 V dc at $T_A$ = Tsi | <br>Tsi<br>Isi<br>Psi<br><br>Ris MIN. | <br>175<br>400<br>700<br><br>$10^9$ | <br>°C<br>mA<br>mW<br><br>Ω |

### Dependence of maximum safety ratings with package temperature

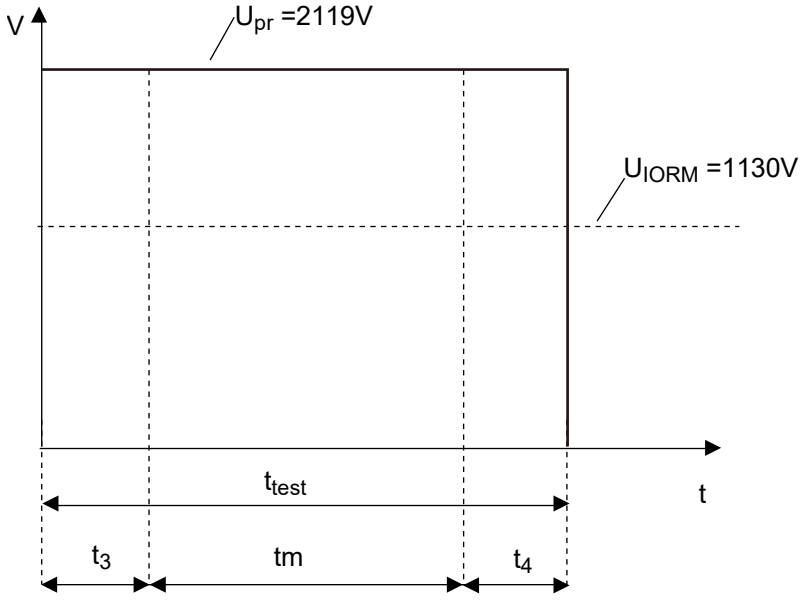


### Method a) Destructive Test, Type and Sample Test




$t_1$,$t_2$ = 1 to 10 sec
$t_3$,$t_4$ = 1 sec
$t_{m(PARTIAL\ DISCHARGE)}$= 10 sec
$t_{test}$ = 12 sec
$t_{ini}$ = 60 sec

### Method b) Non-destructive Test, 100% Production Test




$t_3$,$t_4$ = 0.1 sec
$t_{m(PARTIAL\ DISCHARGE)}$= 1.0 sec
$t_{test}$ = 1.2 sec

| | |
|---|---|
| **Caution** GaAs Products | This product uses gallium arsenide (GaAs).<br>GaAs vapor and powder are hazardous to human health if inhaled or ingested, so please observe the following points.<br>• Follow related laws and ordinances when disposing of the product. If there are no applicable laws and/or ordinances, dispose of the product as recommended below.<br>1. Commission a disposal company able to (with a license to) collect, transport and dispose of materials that contain arsenic and other such industrial waste materials.<br>2. Exclude the product from general industrial waste and household garbage, and ensure that the product is controlled (as industrial waste subject to special control) up until final disposal.<br>• Do not burn, destroy, cut, crush, or chemically dissolve the product.<br>• Do not lick the product or in any way allow it to enter the mouth. |

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4590 Patrick Henry Drive, Santa Clara, California 95054-1817, U.S.A.
Tel: +1-408-919-2500, Fax: +1-408-988-0279

**Renesas Electronics Europe Limited**
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K
Tel: +44-1628-651-700, Fax: +44-1628-651-804

**Renesas Electronics Europe GmbH**
Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

**Renesas Electronics (China) Co., Ltd.**
Room 1709 Quantum Plaza, No.27 ZhichunLu, Haidian District, Beijing, 100191 P. R. China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

**Renesas Electronics (Shanghai) Co., Ltd.**
Unit 301, Tower A, Central Towers, 555 Langao Road, Putuo District, Shanghai, 200333 P. R. China
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

**Renesas Electronics Hong Kong Limited**
Unit 1601-1611, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2265-6688, Fax: +852 2886-9022

**Renesas Electronics Taiwan Co., Ltd.**
13F, No. 363, Fu Shing North Road, Taipei 10543, Taiwan
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

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Tel: +65-6213-0200, Fax: +65-6213-0300

**Renesas Electronics Malaysia Sdn.Bhd.**
Unit 1207, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

**Renesas Electronics India Pvt. Ltd.**
No.777C, 100 Feet Road, HAL 2nd Stage, Indiranagar, Bangalore 560 038, India
Tel: +91-80-67208700, Fax: +91-80-67208777

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